Quaid-e-Azam Thermal Power (Pvt.) Ltd.

To

The Registrar
National Electric Power Regulatory Authority
2nd Floor, OPF Building
Sector G-5/2,
Islamabad

Subject: APPLICATION FOR A GENERATION LICENSE

I, Ahad Khan Cheema, being the duly authorized representative of Quaid-e-Azam Thermal Power (Pvt.) Ltd. by virtue of Board Resolution dated 07.07.15, hereby apply to the National Electric Power Regulatory Authority (NEPRA) for the grant of a generation license to the Quaid-e-Azam Thermal Power (Pvt.) Ltd. Pursuant to section 15 of the Regulation of Generation, Transmission and Distribution of Electric Power Act, 1997.

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

A Demand Draft bearing No. 3236937, dated 15/07/2015, in the sum of Rs. 400,000/- (Rupees four hundred thousand only) being the non-refundable license application fee calculated in accordance with Schedule II to NEPRA Licensing (Application and Modification Procedure) Regulations 1999, is also attached herewith.

Date: July 15, 2015.

Ahad Khan Cheema
Chief Executive Officer

3rd Floor, 83A/E-1, Main Boulevard, Gulberg III, Lahore,
Phone: (+92 42) 35790363-5, Fax: +92 42 35790366

No. 3236937

A/C PAYEE ONLY

BOP

THE BANK OF PUNJAB MAIN BR, EGERTON

DEMAND DRAFT

0003236897

D.D No. : 2015/05802/0206-0002

Issued on: 15/07/2015

Not Over Rs.**********400,000.00

Passion Reborn

On Demand pay to: NATIONAL ELECTRIC POWER REGULATORY AUTHORITY :or order

The sum of Rupees: Four Hundred Thousand Only

for value received.

PKR : **********400,000.00

Authorized Signature

Authorized Signature

TO: The Bank of Punjab

237- ISLAMABAD (BLUE AREA)

Valid for 6 months from the date of issuance, thereafter requires revalidation.

⑈3236937⑈083000 2⑆0000000000⑈020⑈

A009018

SECP

SECURITIES AND EXCHANGE COMMISSION OF PAKISTAN

COMPANY REGISTRATION OFFICE, LAHORE

CERTIFICATE OF INCORPORATION

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

Corporate Universal Identification No.0092611

I hereby certify that **QUAID-E-AZAM THERMAL POWER (PRIVATE) LIMITED** is this day incorporated under the Companies Ordinance, 1984 (XLVII of 1984) and that the company is **Limited by Shares**.

Given under my hand at **Lahore** this **Twenty Fifth** day of **March,** Two **Thousand** and **Fifteen**.

Fee Rs.104,000/-

Company Registration Office Lahore

Securities & Exchange Commission of Pakistan

(LIAQAT ALI DOLLA)
Additional Registrar

No.ARL/ 2542 DATED: 25/03/15

Quaid-e-Azam Thermal Power (Pvt) Ltd

CERTIFIED TO BE TRUE COPY

10/4/15

ASSISTANT REGISTRAR OF COMPANIES
COMPANY REGISTRATION OFFICE
LAHORE.

The Companies Ordinance, 1984

(PRIVATE COMPANY LIMITED BY SHARES)

Memorandum of Association Of

I. The name of the Company is Quaid e Azam Thermal Power (Private) Ltd.

II. The registered office of the Company will be situated in the Province of Punjab, Pakistan.

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

A. THE MAIN OBJECTS FOR WHICH THE COMPANY IS ESTABLISHED ARE:

1. To carry on all or any of the businesses of generating, purchasing, importing, transforming, converting, distributing, supplying, exporting and dealing in electricity and all other forms of energy including thermal power and products or services associated therewith and of promoting the conservation and efficient use of electricity and to perform all other acts which are necessary or incidental to the business of electricity generation, transmission, distribution and supply.

2. To locate, establish, construct, equip, operate, use, manage and maintain thermal power plants, power grid station, transforming, switching, conversion, and transmission facilities, grid stations, cables, overhead lines, sub-stations, switching stations, tunnels, cable bridges, link boxes, heat pumps, plant and equipment for combined heat and power schemes, offices, computer centres, shops, dispensing machines for pre-payment cards and other devices, showrooms, depots, factories, workshops, plants, printing facilities, warehouses and other storage facilities.

3. To carry on all or any of the businesses of wholesalers, retailers traders, importers, exporters, suppliers, distributors, designation, developers, manufacturers, installer, filters, testers, repairers, maintainers, contractors, constructors, operators, LPG, RFO, natural gas including LNG, users, inspectors, reconditions, improvers, alterers, protectors, removers, hirers, replacers, importers, and exporters, of and dealers in, electrical, appliances, System, Product and services used for energy conversation, equipment's, machinery, material and installation including but not limited to cables, wires, maters,

Registrar of Companies Registration Office Lahore

Quaid-e-Azam Thermal Power (Pvt) Ltd

Quaid-e-Azam Thermal Power (Pvt) Ltd

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pylons, tracks, reils, pipelines and any other plant, apparatus equipment, systems and things incidental to the efficient generations, procurement, transformation supply and distribution of electricity.

4. To carry on or expand the facilities and to take over or assume any or all of the belongings, funds, assets, rights, privileges, obligations, and contractors related to or in respect of such facilities.

5. To do anything which a public electricity is empowered or required to do by virtue of or under a license or other authorization granted according to law and its implementing rules and regulations or any statutory instrument made here under or any statutory notification or re-enactment thereof, and to plan, survey, design and supply equipment, and carry out the electrification of cities, cantonments, towns, villages, housing, colonies, industrial status, complexes gas and oil refineries, workshops, building, highways, bridges, ports, air terminals, and other pry within its area of supply.

6. To act as agents or representatives of foreign and local manufacturers, consultants of plants, machinery, material or other articles for sale to any Government, local authorities, firms, companies, association of persons or individual and also to import and export such (except managing agency).

7. To carry on the business of general order supplies including Government, semi-Government Agencies, Armed Forces , Army Military or Defences and commission agents, indenters , traders and as general merchants, wholesalers, retailers, dealers, distributors, stockiest agents, sub-agents in any goods or products within the scope of the object of the Company, subject to any permission required under the law.

8. To prepare feasibilities and to conduct studies for engineering, electrical, mechanical and allied projects.

9. To ascertain the tariff for supply of power that will secure recovery of operating cost, interest charges and depreciation of assets redemption at due times of loan other than those covered by depreciation expansion projects, payment of taxes, and a reasonable return on investment, obtain any approval thereof as may be required by law or license for the time being in force, to quote the tariff to purchasers of electric power.

10. To pay all costs, charges and preliminary expenses, if any, incidental to the promotion, formation, registration and establishment of the company.

11. To borrow or raise money by means of loans or by obtaining lease facility from directors, banks, government or other financial institution, leasing companies,

investment companies and other lending institution for the purpose of business of the company in such manners as the company may think fit and particular by issue of debentures, perpetual or otherwise convertible into shares or non-convertible perpetual annuities and as security for any such money so borrowed; and mortgage pledge, or charge whole or any part of the property, assets or revenue of the company, by special assignment or otherwise to transfer or convey the same absolutely or in trust as may seem expedient and to purchase, redeem or pay of any such securities.

12. To invest the surplus funds of the Company upon such securities and in such manner as shall from time to time be thought necessary or for the benefit of the Company.

13. To remunerate any person or Company and pay commission or brokerage in cash or otherwise howsoever for services rendered or to be rendered in placing or assisting to place or guaranteeing the placing if any shares in the Company's capital or any debentures or other securities or the Company and to adopt become bound by and carry into effect any agreement or arrangement which may have been entered into for that purpose with any person or Company on behalf of the company.

14. To advance, lease or deposit money to any person with or without taking any security therefore and upon such other terms as may be thought fit by the Company but only in furtherance of objects of the company.

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

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

17. To set up a countywide network for power generation systems, procure equipment, purchase material and allied items and arrange its management/ operations and maintenance to serve the needs of the subscribers.

18. To sell, lease and in any other manner, deal with or dispose of the undertaking or Property of the Company or any part thereof for such consideration as the company may think fit.

19. To open bank account of the Company and draw, accept, make endorse, discount, Execute and issue cheques, promissory notes, bills of exchange, bills of ladings or other negotiable or transferable instruments related to the business of the Company.

20. To amalgamate with any company having objects altogether or in part similar to those of this company, and to enter into partnership or any arrangement for sharing profits, union of interest, co-operating, joint venture, reciprocal, concession, or otherwise with any person or company carrying on or engaged in, or about carry on or engaged in business or transaction which this company is authorized to carry on or engage in or any business or transaction capable of being conduct so as directly or indirectly to benefit this comp[any.

21. To purchase, take on lease, or in exchange, hire, apply for or otherwise acquire and hold for any interest, any rights, privileges, lands, buildings, easements, trademarks, patents, patent rights, copyrights, licences, machinery, plants, stock-in-trade and any movable and immovable property of any kind, necessary or convenient for the purposes of or in connection with the Company's business or any branch or department thereof and to use, exercise, develop, and grant licences in respect of or otherwise turn to account any property, rights and information so acquired, subject to any permission required under the law. To purchase or otherwise acquire any patents, brevets, inventions, trademarks, licenses, concessions and the like conferring any exclusive or non-exclusive or limited right to use any invention which may seem capable of being used for any of the purposes of the Company or the acquisition of which may seem calculated directly or indirectly to benefit the Company, and to use, exercise, develop or grant licenses in respect of or otherwise turn to account, the property and rights so acquired. To act as representatives, for any person, firm or company and to undertake and perform sub-contracts, and also act in the business of the Company through or by means of agents, sub-contractors or otherwise, to do all or any of the things mentioned herein in any part of the world and either alone or in collaboration with others and by or through agents, sub-contractors or otherwise, to invest in subsidiaries to buy, export, transfer, supply or otherwise, and to deal in matters, applications and accessories, ancillary and related to the business, object or objects of the Company or otherwise as permitted by law.

22. To acquire and carry on all or any part of the business or property and to undertake any liabilities of any person, firm, association or company's possession of property suitable for any of the purposes of the Company or carrying on any

business which this Company is authorised to carry on and in consideration for the same, to pay cash or to issue shares of the Company.

23. To establish, promote or assist in establishing or promoting, and subscribe to or become a member of any other company, association or club whose objects are similar or in part similar to the objects of this Company or the establishment or promotion of which may be beneficial to the Company as permissible under law.

24. To open accounts with any bank or banks and to draw, make, accept, endorse, execute, issue, negotiate and discount cheques, promissory notes, bills of exchange, bills of lading, warrants, deposit notes, debentures, letters of credit and other negotiable instruments and securities.

25. To borrow or raise money by means of loans or other legal arrangements from local and foreign banks, or other financial institutions, or in such manner as the Company may think fit and in particular by issue of debentures, debenture stock, perpetual or otherwise convertible into shares and to mortgage, or charge the whole or any part of the property or assets of the Company, present or future, by special assignment or to transfer or convey the same absolutely or in trust as may seem expedient, and to purchase, redeem or payoff any such securities.

26. To purchase or otherwise acquire and to sell, change, surrender, lease, mortgage, charge, convert, turn to account, dispose of and to deal with property and rights of all kinds and in particular, mortgages, charges, hypothecations, debentures, concessions, options, contracts, patents, licences, shares, bonds, policies, book debts, business concerns, undertakings and actions of all kinds.

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

28. To invest the capital of the Company from time to time as may be determined by the Company and subject to any permission as required under the law.

29. To act as representatives, for any person, firm or company and to undertake and perform sub-contracts, and also act in the business of the Company through or by means of agents, sub-contractors or otherwise, to do all or any of the things mentioned herein in any part of the world and either alone or in collaboration with others and by or through agents, sub-contractors or otherwise, to invest in subsidiaries to buy, export, transfer, supply or otherwise, and to deal in matters, applications and accessories, ancillary and related to the business, object or objects of the Company or otherwise as permitted by law.

30. To pay all costs, charges, and expenses preliminary or incidental, incurred in the formation or about the promotion and establishment of the Company and to remunerate any person, firm or company for services rendered or to be rendered

in or about the formation or promotion of the Company or the conduct of its business.

31. To employ contractors, managers, consultants and other skilled persons for the Company.

32. To give any employee of the Company commission in the profits of the Company's business or any branch thereof and for the purpose, to enter into any agreement or scheme of arrangement as the Company may deem fit.

33. To establish and support or aid in the establishment and support of associations, institutions, funds and conveniences calculated to benefit persons who are or have been directors of, or who have been employed by or who are serving or have served the Company or any other company which is a subsidiary or associate of the Company or the dependents of such persons and to grant pensions, gratuities, allowances, relief and payments in any other manner calculated to benefit the persons described herein.

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

35. To guarantee the performance of contracts and obligations of the Company in relation to the payment of any loan, debenture-stock, bonds, obligations or securities issued by or in favour of the Company and to guarantee the payment or return on such investments.

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

37. To take out any insurances that the Company deems necessary or appropriate and to pay the premium thereof.

38. To constitute and regulate separate branches or departments of the Company's business and to appropriate thereto respectively any of the assets of the Company and any of the capital, issued or to be issued, of the Company and from time to time to vary the constitution or regulations of any such branches or departments or any such appropriations and if thought fit to amalgamate all or any of the said branches or departments.

39. To procure the Company to be registered or recognized in any country or place outside Pakistan and to keep branch registers.

40. To institute and defend in any forum legal proceedings of every kind or description whatsoever, enter into arbitration agreements and refer disputes to arbitration, pay, satisfy or receive payments in respect thereof, or compound or

compromise any claim, demand, action, suit or proceeding of any nature whatsoever made or brought by or against the Company.

41. To carry on any other business or activity of any nature whatsoever which may seem to the Company to be capable of conveniently or advantageously carried on in connection or conjunction with any business of the Company hereinabove or hereinafter authorized or to be expedient.

42. To apply for and obtain necessary consents, permissions and licences from any government, provincial, local and other authorities for enabling the Company to carry on any of its objects into effect as and when required by law.

43. To invest and deal with any moneys of the Company in bonds, stocks or any other securities or such other investments and in such manner as may from time to time be determined by the Company and to hold, sell or otherwise deal with such investments, but in any event not to act as an investment company.

44. To act as representatives, for any person, firm or company and to undertake and perform sub-contracts, and also act in the business of the Company through or by means of agents, sub-contractors or otherwise, to do all or any of the things mentioned herein in any part of the world and either alone or in collaboration with others and by or through agents, sub-contractors or otherwise, to invest in subsidiaries to buy, export, transfer, supply or otherwise, and to deal in matters, applications and accessories, ancillary and related to the business, object or objects of the Company or otherwise as permitted by law.

45. To subscribe or guarantee money for any purpose which may be considered likely, directly or indirectly, to further the objects of the Company or for any national, charitable, benevolent, public, general or useful object or for any exhibition.

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

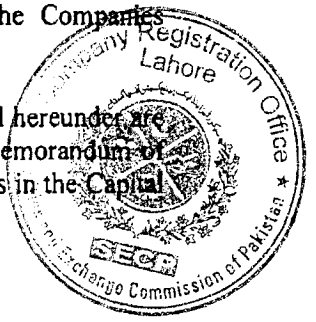
47. Notwithstanding anything stated in any object clause, the company shall obtain such other approval or licence from the competent authority as may be required under any law for the time being in force, to undertake a particular business.

48. The company shall not engage in banking business or business of investment company or any unlawful business and that nothing in object clauses shall be construed to entitle it to engage in such business or undertaking business of banking company, investment, leasing, payment sales receipt scheme and insurance business directly or indirectly. The company shall not launch multilevel marketing, pyramid and Ponzi scheme.

IV. The Liability of the members of the Company is limited.

V. The Authorized Share Capital of the Company is Rs.10,000,000/- (Rupees ten million Only) divided into 100,000 (Hundred Thousand) Equity Shares of Rs.100/- (Rupees Hundred Only) each with power to increase, reduce, consolidate or otherwise re-organise the share capital and to divide the shares of the company into different classes in accordance with the provisions of the Companies Ordinance. 1984.

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



S. No.	Name and Surname (present & former) in full (in Block Letters)	CNIC No. (in case of foreigner Passport No.)	Father's/ Husband's Name in full	Nationality (ies) with any former Nationality	Occupation	Residential address in full	Number of shares taken by each subscriber	Signatures
1	Government of Punjab, Energy Department through Mr. Mohammad Jehanzeb Khan	-	-	-	-	8th Floor, EFU House Building, 6-D jail road, Main Gulberg , Lahore	99,996	ACS
2	Mr. Mohammad Jehanzeb Khan	173018-276764-5	Mr. Muhammad Aurangzeb Khan	Pakistani	Additional Chief Secretary Energy Department	16-Golf Road, GOR-I Lahore City,District, Lahore, Pakistan	1	ACS
3	Mr.Yusuf Khan	14101-9473520-1	Mr.Abu Kalaam Khan	Pakistani	Secretary Finance Department	1-B, Broomhead Road, GOR-I, Lahore City,District, Lahore, Pakistan	1	FS

4	~~Mr.~~ Dr. Aamer Ahmed.	36201-1022823-1	Mr. Bashir Ahmed (late)	Pakistani	Secretary Planning and Development Department	4-Tollinton Lane, GOR-I Lahore.	1	
5	~~Mr.~~ Dr. Arshad Mahmood	35202-7783745-3	Mr. Izzat Ali	Pakistani	Secretary Mines and Minerals	18-Club Road GOR-I, Lahore.	1	

Company Registration Office Lahore
Securities and Exchange Commission of Pakistan
SECP

Total number of shares taken 100,000
[One Hundred Thousand]

Dated the 5th day of **March 2015**

Witness to ~~above~~ signatures.

CERTIFIED TO BE TRUE COPY
10/4/15
ASSISTANT REGISTRAR OF COMPANIES
COMPANY REGISTRATION OFFICE
LAHORE.

Signatures

Full Name: Muhammad Najeeb Ullah

NIC Number: 35202-8315608-9

Father's/Husband's Name: Muhammad Abdullah

Full Address: Housne No. 78 Yousaf Street Ichhra, Lahore

Occupation: Office Assistant

THE COMPANIES ORDINANCE, 1984

(COMPANY LIMITED BY SHARES)

ARTICLES OF ASSOCIATION

OF
QUAID E AZAM THERMAL POWER (PRIVATE) LIMITED

1. The regulations contained in Table "A" in the First Schedule to The Companies Ordinance, 1984 shall not apply to the Company except in so far as the same are expressly made applicable by the said Ordinance, or these Articles. The regulation for management of the Company, and for the observance thereof by the members of the Company, and their representatives shall, subject as aforesaid and to any exercise of the statutory power of the Company in reference to the repeal or alteration of or addition to its regulations by Special Resolution as prescribed by the said Ordinance; be such as are contained in these Articles.

INTERPRETATION

2. In the interpretation of these Articles the following expressions shall have the following meanings, unless repugnant to or inconsistent with the subject Articles.

2.1: "The Ordinance" means the Companies Ordinance, 1984, or any statutory modification or re-enactment thereof for time being in force in Pakistan;

2.2: "Board" means a Board of the Directors, elected by the shareholders, to act on their behalf in the management of the Company affairs;

2.3: "The Company" or "This Company" means **Quaid E Azam Thermal Power (Private) Limited;**

2.4: "The Directors" means the Directors and Alternate Directors for the time being of the Company, or as the case may be, the Directors and Alternate Directors assembled at a Board;

2.5: "Dividend" includes bonus shares;

2.6: "Month" means a calendar month;

2.7: "The Office" means the Registered Office for the time being of the Company;

2.8: "Persons" includes corporation as well as individuals;

2.9: "The Register" means the Register of members to be kept pursuant to the Ordinance;

2.10: "In Writing" means written or printed or partly written and partly printed or lithographed or typewritten or other substitute for writing;

Company Registration Office Lahore

Quaid-e-Azam Thermal Power (Pvt) Ltd

Quaid-e-Azam Thermal Power (Pvt) Ltd

2.11: Words importing singular number include the plural number and vice versa;

2.12: Words importing masculine gender include the feminine gender;

2.13: Subject as aforesaid any words or expressions defined in the Ordinance; shall except where the subject or context forbids bear the same meaning in these Articles.

PRIVATE COMPANY

3. The Company is "Private Company" within the meaning of sub section 2(1) (28) of the Ordinance and accordingly:

(1) No invitation shall be issued to the public to subscribe for any share of the Company.

(2) The numbers of the members of the Company (exclusive of persons in the employment of the Company), shall be limited to fifty, provided that for the purpose of this provision, where two or more persons hold one or more shares in the company jointly, they shall be treated as single member; and

(3) The right to transfer shares of the Company is restricted in manner and to the extent herein appearing.

BUSINESS

4. The company is entitled to commence business from the date of its incorporation. The business of the company shall include all or any of the objects enumerated in the Memorandum of Association. The business of the company shall be carried out at such place or places anywhere in Pakistan or elsewhere as the directors may deem proper or advisable from time to time.

SHARES AND CAPITAL

5. The Authorized share capital of the Company is Rs.10,000,000/- (Rupees ten million Only) divided into 100,000 (Hundred Thousand) ordinary shares of Rs.100/- (Rupees Hundred Only) each with powers of the Company to increase or reduce the same and to divide the shares into several classes.

6. The shares shall be under the control of the Board of Directors who may allot or otherwise dispose off the same to such persons, on such terms and conditions and at such times, as the Board of Directors think fit. Shares may also be allotted in consideration other than cash.

7. Fully paid shares shall be allotted to all subscribers in the first instance and the Company shall not be bound to recognize any equitable, contingent, future or partial claim to or interest in a share on the part of any person other than the registered share holder, save as herein provided or saves as ordered by some Court of competent jurisdiction.

8. The certificate of title to shares shall be issued under the seal of the Company.

9. Every member shall be entitled to one certificate for the shares registered in his name, or at the discretion of the directors to several certificates, each for one or more of such shares.

TRANSFER AND TRANSMISSION OF SHARES

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

11. The directors may decline to register any transfer of shares to transferee of whom they do not approve and shall be bound to show any reasons for exercising their discretion subject to the provisions of Section 77 and 78 of the Ordinance.

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

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

BORROWING POWERS

14. Subject to the provision of the Ordinance, the Directors may from time to time at their absolute discretion raise or borrow any sum, or sums of money for the purpose of the company from banks, firms or companies, particularly a person holding the office of the director, and may secure the payment of money in such manner and upon such terms, and conditions in all respects as they think fit particularly by the issue of debentures of the company or by making, drawing, accepting or endorsing on behalf of the company any promissory note or bills of exchange or giving or issuing any other security of the Company.

15. Debentures and other securities may be made assignable free from any equities between the Company and the persons to whom the same may be issued.

16. Any debentures or other security may be issued at a discount, premium or otherwise and with any special privilege as to redemption, surrender, drawing, allotment of shares, attending and voting at general meeting of the Company or subject to compliance of the provisions of the Ordinance.

RESERVES

17. The directors may from time to time before recommending any dividend set aside out of the profit of the company such sums as they think fit as a reserve for redemption of debentures or to meet contingencies for equalization of or for special dividends or for rebuilding, repairing, restoring replacing, improving, maintaining or altering any of the property of the Company or for such other purpose as the directors may in their absolute discretion think conducive to the interest of the Company.

GENERAL MEETINGS

18. A General meeting, to be called annual general meeting shall be held, in accordance with the provisions of section 158, within eighteen months from the date of incorporation of the Company and thereafter once at least in every year within a period of four months following the close of its financial year and not more than fifteen months after the holding of its last preceding annual general meeting as may be determined by the directors.

19. The directors 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 requisitionists, as is provided by section 159 of the Ordinance.

NOTICE AND PROCEEDINGS OF GENERAL MEETING

20. 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 the hour of meeting and, in case of special business, the general nature of that business shall be given in manner provided by the Ordinance for the general meeting, to such persons as are, under the Ordinance or the regulation of the Company, entitled to receive such notice from the Company, but the accidental omission to give notice to, or the non-receipt or notice by, any member shall not invalidate the proceedings at any general meeting.

21. All business shall be deemed special that is transacted at an extraordinary general meeting, and also all that is transacted at annual general meeting with the exception of declaring dividend, the consideration of the accounts, balance sheet and the reports of the directors and auditors, the election of the directors, the appointment of and the fixing of the remuneration of, the auditors.

QUORUM

22. 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; save as herein otherwise provided, members having twenty-five percent of the voting power present in person or through proxy and two members personally present will be quorum of the Company's meeting.

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

24. The Chairman of the Board of Directors, if any, shall preside as Chairman at every 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 the Directors present may be elected to be Chairman, and if none of the directors is present, or willing to act as Chairman, the members present shall choose one of their number to be Chairman.

25. The Chairman may, with the consent of any meeting at 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 unfinished at the meeting from which the adjournment took place. When the meeting is adjourned for ten days or more, notice of the adjourned meeting shall be given as in the case of an original meeting. Save as aforesaid, it shall not be necessary to give any notice of an adjournment of the business to be transacted at an adjourned meeting.

26. At any general meeting a resolution put to the vote of the meeting shall be decided on a show of hands unless a poll is (before or on the declaration of the show of hands) demanded. Unless a poll is so demanded, a declaration by the Chairman that a resolution has, on a show of hands, being carried, or carried unanimously, or by particular majority, or lost an entry to that effect in the book of the proceedings of the company shall be conclusive evidence of the fact, without proof of the number or proportion of the votes recorded in favour of, or against that resolution.

27. A poll may be demanded only in accordance with the provisions of section 167 of the Ordinance.

28. If a poll is duly demanded, it shall be taken in accordance with the manner laid down in section 168 of the Ordinance and the result of the poll shall be deemed to be the resolution of the meeting at which the poll was demanded.

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

30. In the case of an equality of votes, whether on a show of hand or on a poll, the Chairman of the meeting at which the show of hands take place, or at which the poll is demanded, shall have and exercise a second or casting vote.

VOTES OF MEMBERS

31. Subject to any rights or restrictions for the time being attached to any class 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 provisions of section 178 of the Ordinance shall apply. On a poll every member shall have voting rights as laid down in section 160 of the Ordinance.

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

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

34. (1) The instrument appointing a proxy shall be in writing under the hand of the appointer or of his attorney duly authorized in writing. A proxy must be a member.

(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 that power or authority, shall be deposited at the registered office of the company not less than forty-eight hours before the time for holding the meeting at which the person named in the instrument proposes to vote and in default the instrument of proxy shall not be treated as valid.

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

Quaid E Azam Thermal Power (Pvt) Ltd

I .....Son of .....in the district of..... being a member of the Quaid E **Azam Thermal Power (Pvt) Ltd** hereby appoint ..... of ..... as my proxy to vote for me and on may behalf at the (annual, extraordinary, as the case may be) general meeting of the company, to be held on the ..... day of ..... and at any adjournment thereof.

DIRECTORS

36. The number of directors shall not be less than two. The Board of Directors shall comprise of up to Thirteen (13) Directors which will be nominated by the Government of Punjab. However the following persons shall be the first directors of the Company:

1. Additional Chief Secretary (Energy).	Mr. Mohammad Jehanzeb Khan
2. The Secretary, Finance Department.	Mr. Yusuf Khan
3. The Secretary, P&D Department.	Dr. Aamer Ahmed
4. The Secretary, Mines & Minerals.	Dr. Arshad Mahmood

37. 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.

38. Save as provided in Section 187 of the Ordinance, no person shall be appointed as a director unless he is a member of the Company.

39. **QUORUM OF DIRECTORS:** A Meeting of the Board for the time being at which a quorum is present shall be competent to exercise all or any of the authorities, powers and discretion by or under the Articles vested in or exercisable by the Board generally. Two Directors personally present shall constitute a quorum.

POWERS AND DUTIES OF DIRECTORS

40. 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 but no regulations made by the company in general meeting shall invalidate any prior act of the directors which would have been valid if that regulation had not been made. The directors shall appoint a chief executive in accordance with the provisions of sections 198 and 199 of the Ordinance.

41. The amount, for the time being remaining undischarged, of moneys borrowed or raised by the directors for the purposes of the company (other wise 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.

42. The directors shall cause minutes to be made in books provided for the purpose:-

(a) of all appointments of officers made by the directors;

(b) of the names of the directors present at each meeting of the directors and of any committee of the directors;

(c) of all resolutions and proceedings at all meetings of the company and of the directors and of committees of directors.

DISQUALIFICATION OF DIRECTORS

43. No person shall become the director of a company if he suffers from any of the disabilities or disqualifications mentioned in section 187 of the Ordinance 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 had 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

44. The directors may meet together for the dispatch of business, adjourn and otherwise regulate their meetings, as they think fit. Questions arising at any meeting shall be decided by a majority of votes. In case of an equality of votes, the chairman shall have and exercise a second or casting vote. A director may, and the secretary on the requisition of a director shall, at any time, summon a meeting of directors. It shall not be necessary to give notice of a meeting of directors to any director for the time being absent from Pakistan.

45. The directors may elect the 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 the 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.

46. 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

47. 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 178 of the Ordinance for a term of three years.

48. A retiring director shall be eligible for re-election.

49. The directors shall comply with the provisions of sections 174 to 178 and sections 180 and 184 of the Ordinance relating to the election of directors and matters ancillary thereto.

50. 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.

51. The company may remove a director but only in accordance with the provisions of the Ordinance.

DIVIDENDS AND RESERVE

52. The company in general meeting may declare dividends but no dividend shall exceed the amount recommended by the directors. No dividends shall be paid otherwise than out of the profits of the Company.

THE SEAL

53. 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 the presence of at least two directors; and those two directors shall sign every instrument to which the seal of the company is so affixed in their presence.

ACCOUNTS

54. The directors shall cause to be kept proper books of account as required under section 230 of the Ordinance.

55. 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.

56. The directors shall be required by sections 233 and 236 of the Ordinance, cause to be prepared and to be laid before the company in general meeting such profit and loss accounts or income and expenditure accounts and balance sheets duly audited and reports as are referred to in those sections.

AUDIT

57. Once at least in every year the accounts of the Company shall be audited and the correctness of profit and loss accounts or income and expenditure accounts and balance sheet ascertained by an auditor or auditors and the provisions of the Ordinance in regard to audit and the appointment and qualification of auditors shall be observed.

58. Auditors shall be appointed and their duties regulated in accordance with sections 252 to 255 of the Ordinance.

WINDING UP

59. If the company is wound up, whether voluntarily or otherwise the liquidator may, with the sanction of a special resolution, divide amongst the contributories in specie or kind, the whole or any part of the assets and liabilities of the company, subject to the section 421 and other provisions of the Ordinance as may be applicable.

INDEMNITY

60. Every director and other officer or servant of the company shall be indemnified by the company against, and it shall be the duty of the directors to pay out of the funds of the company, all costs, losses and expenses which any such officer or servant may incur or become liable to by reason of any contract entered into or thing done by such officer or servant as such in any way in the discharge of the duties of such officer or servant including traveling expenses.

61. No director or other officer of the company shall be liable for the acts, receipts, neglect or default of any other director or officer or for joining in any receipt or other act for conformity or for any loss or expenses happening to the company through the insufficiency or deficiency of title to any property acquired by order of the directors for or on behalf of the company or for the insufficiency or deficiency of any security or investment in or upon which any of the money of the company shall be invested or for any loss or damage arising from bankruptcy, insolvency or tortuous act of any person with whom any money, securities or effects shall be deposited or for any loss occasioned by any error of judgment or oversight on his part or for any other loss, damage or misfortune whatever which shall happen in the execution of his office or in relation thereto unless the same happens through his dishonesty.

NOTICES

62. (1) A notice may be given by the company to any member either personally or by sending it by post to him to his registered address or (if he has no registered address in Pakistan) to the address, if any, within Pakistan supplied by him to the company for the giving of notices to him.

(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 letters would be delivered in the ordinary course of post.

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

ARBITRATION

64. Whenever any difference arises between the company on the one hand and any of the members, their executors, administrators or assignees on the other hand touching the intent or construction or the incidence or consequences of these presents, or of the statute or touching any thing then or thereafter done, executed, omitted, or suffered in pursuance of these presents or of the statute or touching breach or alleged breach or otherwise relating to the premises, or to any statute effecting the company, or to any of the affairs of the company, including the fixing of the fair value of the shares of the company, every such difference shall be referred to the decision of an arbitrator to be appointed by the parties in difference or if they cannot agree upon a single arbitrator to the decision of two arbitrators of whom one shall be appointed by each of the parties in difference or any umpire to be appointed by the two arbitrators.

SECRECY CLAUSE

65. Every director, manager, member of the committee, officer, servant, accountant or other person employed in the business of the Company shall if so require by the directors before entering upon his duties, sign a declaration pledging to observe a strict secrecy respecting all transactions of the company with the customers and the state of accounts with individuals, matters relating thereto and shall by such declaration pledge himself not to reveal any of the matters which come to his knowledge in the discharge of his duties except when required to do so by the directors or by a Court of Law and except so far as may be necessary in order to comply with any of the provisions in these presents contained.

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

S. No.	Name and Surname (present & former) in full (in Block Letters)	CNIC No. (in case of foreigner Passport No.)	Father's/ Husband's Name in full	Nationality (ies) with any former Nationality	Occupation	Residential address in full	Number of shares taken by each subscriber	Signatures
1	Government of Punjab, Energy Department through Mr. Mohammad Jehanzeb Khan	-	-	-	-	8th Floor, EFU House Building, 6-D jail road, Main Gulberg , Lahore	99996	
2	Mr.Mohammad Jehanzeb Khan	173018-276764-5	Muhammad Aurangzeb Khan	Pakistani	Additional Chief Secretary Energy	16-Golf Road, GOR-I, Lahore, Pakistan	1	

					Department			
3	Mr.Yusuf Khan	14101-9473520-1	Mr.Abu Kalaam Khan	Pakistani	Secretary Finance Department	1-B, Broomhead Road, GOR-1,Lahore.	1	
4	Dr.Aamer Ahmed	36201-1022823-1	Mr. Bashir Ahmed (late)	Pakistani	Secretary Planning and Development Department	4-Tollinton Lane GOR 1, Lahore.		
5	Dr.Arshad Mahmood	~~44400-4830878-9~~ 35202-7783745-3	Mr.Izzat Ali	Pakistani	Secretary Mines and Minerals	18-Club Road GOR-1, Lahore.	1	

Total number of shares taken 100,000
[One Hundred Thousand]

Dated the 5th day of **March 2015**

Witness to above signatures.

Signatures

Full Name: Muhammad Najeeb Ullah

NIC Number: 35202-8315608-9

Father's/Husband's Name: Muhammad Abdullah

Full Address: Housne No. 78 Yousaf Street Ichhra, Lahore

Occupation: Office Assistant

CERTIFIED TO BE TRUE COPY
10/3/15
ASSISTANT REGISTRAR OF COMPANIES
COMPANY REGISTRATION OFFICE
LAHORE

"THIRD SCHEDULE

(See section 156)

FORM A- ANNUAL RETURN OF COMPANY HAVING SHARE CAPITAL

1	Registration No.	**0092611**
2	Name of the Company	**QUAID-E-AZAM THERMAL POWER (PVT.) LTD.**

3	Form A made upto (Day/Month/Year)	**15**	**07**	**2015**
4	Date of AGM (Day/Month/Year)	-	-	-

PART-A

5	Registered office address:	**Energy Department, 8th Floor, EFU House, 6D Main Gulberg, Jail Road, Lahore.**
6	Email Address:	**compsec@qathermal.com**
7	Office Tel. No.:	**042-35790364, 35790365**
8	Office Fax No.:	**042-35790366**
9	Nature of Business:	**Power Generation**

10 **Authorized Share Capital**

Type of Shares	No. of Shares	Amount	Face Value
Ordinary Shares	**100,000**	**10,000,000**	**100 each**

11 **Paid up Share Capital**

Type of Shares	No. of Shares	Amount	Issue Price
Ordinary Shares	**100,000**	**10,000,000**	**100 each**

12 Amount of indebtedness on the date upto which form A is made in respect of all Mortgages/Charges: **NIL**

13 **Particulars of the holding company**

Name	**N/A**		
Registration No.	-	% Shares Held	-

14 **Chief Executive**

Name	**Mr. Ahad Khan Cheema**	NIC	**35202-0449427-1**
Address	**House No. 3A, GOR-II, Mozang, Lahore**		

15 **Chief Accountant**

Name	**Mr. Shams ul Aziz**	NIC	**61101-4709295-5**
Address	**Shamim Ahmed Siddiqi**		

16 **Company Secretary**

Name	**Syed Salman Hassan**	NIC	**35200-1513320-7**
Address	**87-Karim Block, Allama Iqbal Town, Lahore**		

17 **Legal Adviser**

Name	-
Address	-

Company Secretary
Quaid-e-Azam Thermal Power (Pvt.) Ltd.

18 **Auditors**

Name	-
Address	-

19 **List of Directors on the date of Form-A**

Name of Director	Address	Nationality	NIC (Passport No. if foreigner)
1. **Mohammad Jehanzeb Khan**	16- Golf Road, GOR-I, Lahore	**Pakistani**	1 7 3 0 1 8 2 7 6 7 6 4 5
2. **Yusuf Khan**	1-B, Broom head Road, GOR-I, Lahore	**Pakistani**	1 4 1 0 1 9 4 7 3 5 2 0 1
3. **Muhammad Irfan Elahi**	Lower Mall, Civil Lines, Lahore	**Pakistani**	3 5 2 0 1 1 4 5 0 6 5 1 5
4. **Abdul Basit**	23-Aikman Road, GOR-I, Lahore	**Pakistani**	3 5 2 0 2 9 5 6 8 7 7 9 7
5. **Mohammad Afzaal Bhatti**	1-Club Road, GOR-I, Lahore	**Pakistani**	3 5 2 0 2 2 5 7 6 0 5 0 3
6. **Arif Saeed**	2-Main Gulberg, Lahore	**Pakistani**	3 5 2 0 2 2 8 3 5 7 2 5 9
7. **Najam Ahmed Shah**	83 A/E-1, Main Boulevard, Gulberg III, Lahore	**Pakistani**	4 2 1 0 1 9 7 7 9 2 9 2 5
8. **Asad Ali Khan**	4- Noon Avenue, Main Canal, Lahore	**Pakistani**	3 5 2 0 0 1 4 8 2 3 4 6 9
9. **Nauman Ahmed Khan**	2-D1 Gulberg III, Lahore	**Pakistani**	3 5 2 0 0 2 9 2 3 7 8 0 9
10. **Syed Maratib Ali**	Aziz Avenue, Gulberg, Canal Bank, Lahore	**Pakistani**	3 5 2 0 0 1 5 0 1 3 6 7 9

PART-B

20. List of members & debenture holders on the date upto which this Form A is made

Folio	Name	Address	Nationality	No. of shares	NIC (Passport No. if foreigner)
	Members				
1	**Government of the Punjab, Energy Department through Mr. Mohammad Jehanzeb Khan**	8th Floor, EFU House, 6D1-Main Gulberg, Jail Road, Lahore	**Pakistani**	**99,996**	N / A
2	**Mr. Mohammad Jehanzeb Khan**	16- Golf Road, GOR-I, Lahore	**Pakistani**	1	1 7 3 0 1 8 2 7 6 7 6 4 5
3	**Mr. Yusuf Khan**	1-B, Broom head Road, GOR-I, Lahore	**Pakistani**	1	1 4 1 0 1 9 4 7 3 5 2 0 1

Company Secretary
Quaid-e-Azam Thermal Power (Pvt.) Ltd.

4	**Dr. Aamer Ahmed**	**4- Tollinton Lane, GOR-I, Lahore**	**Pakistani**	**1**	**3**	**6**	**2**	**0**	**1**	**1**	**0**	**2**	**2**	**8**	**2**	**3**	**1**
5	**Dr. Arshad Mahmood**	**18- Club Road, GOR-I, Lahore**	**Pakistani**	**1**	**3**	**5**	**2**	**0**	**2**	**7**	**7**	**8**	**3**	**7**	**4**	**5**	**3**
			Total	**100,000**													

21. Transfer of shares (debentures) since last Form A was made

	Name of Transferor	Name of Transferee	Number of shares transferred	Date of registration of transfer
	Members			

22. I certify that this return and the accompanying statements state the facts correctly and completely as on the date upto which this Form-A is made

Date	15	07	2015			Signature	
					Designation		Company Secretary

Company Secretary
Quaid-e-Azam Thermal Power (Pvt.) Ltd.

INSTRUCTIONS FOR FILLING FORM-A

1. The Form shall be made upto the date of last AGM of the Company or the last date of the year where no AGM is held during the year.
2. Under nature of business, please give precisely the specific nature of business in which the company is engaged.
3. Under S. No.20 above, the aggregate number of shares held by each member should be stated, and the aggregates must be added up so as to agree with the number of shares stated against NO. 11.
4. When the shares are of different classes the columns should be subdivided so that the number of each class held, or transferred, is shown separately against S. Nos. 10,11,20 and 21.
5. If the space provided in the Form is insufficient, the required particulars should be listed in a separate statement attached to this return which should be similarly certified and signed.
6. The return and any statement attached hereto shall be signed by the chief executive or the secretary.
7. In case a body corporate is a member, NIC number may be omitted to be given.
8. In case of foreign nationals, indicate "passport number" in the space provided for "NIC No." Pakistani nationals will only indicate "NIC NO."
9. This form is to be filed within 30 days (45 days in case of listed company) of the date indicated in S.No.3 above.

ARIF SAEED

Director – Service Industries Limited
Servis House, 2- Main Gulberg Lahore
ARIF@SERVIS.COM / (+92) 300 8450451
NATIONALITY – PAKISTAN
PLACE OF BIRTH – LAHORE
DATE OF BIRTH – NOVEMBER 16, 1967

EDUCATION

UNIVERSITY OF OXFORD — *1987 - 1990*
B.A. Honors (Philosophy, Politics & Economics)

CURRENT BOARDS

SERVICE INDUSTRIES LIMITED
Director – Pakistan's leading footwear & tyre company — *January 2007 – Present*

SAIF TEXTILE MILLS LIMITED
Director — *January 2011 – Present*

PUNJAB DAANISH SCHOOLS & CENTERS OF EXCELLENCE
Member — *May 2010 – Present*

PUNJAB SOCIAL SECURITY & HEALTH MANAGEMENT COMPANY
Director — *August 2004 – Present*

PUNJAB INDUSTRIAL ESTATES DEVELOPMENT & MANAGEMENT COMPANY
Director — *January 2007 –Present*

QUAID-E-AZAM SOLAR POWER (PVT.) LIMITED
Chairman — ***November 2013 – Present***

PUNJAB POWER DEVELOPMENT COMPANY LIMITED
Chairman — ***December 2013 – Present***

Privatisation Commission
Member — ***September 2013 - Present***

Punjab Land Development Company Limited
Director — ***June 2014 – Present***

Institute of Development and Economic Alternatives (IDEAS)
Director — ***September 2014 – Present***

Quaid-e-Azam Thermal Power (Private) Limited
Chairman — ***March 2015 - Present***

National Power Parks Management Company (Private) Limited
Chairman — ***April 2015 - Present***

PREVIOUS POSITIONS

TECHNICAL EDUCATION & VOCATIONAL TRAINING AUTHORITY (TEVTA)
Chairman — *2010 – 2013*

LAHORE STOCK EXCHANGE
Chairman — *2008, 2009, 2010*

LAHORE STOCK EXCHANGE (GUARANTEE) LIMITED
Director — *2006 – 2008*

SUI NORTHERN GAS PIPELINES LIMITED
Director — *2005 – 2010*
Member Finance Committee
Member Audit Committee
Member & Chairman HR Committee

DAR ES SALAAM TEXTILE MILLS LIMITED
Chief Executive — *1991 – 2006*

Profiles of the Chief Executive Officer and Senior Management of Quaid-e-Azam Thermal Power (Pvt.) Limited

1. **Mr. Ahad Khan Cheema**
   Chief Executive Officer

Mr. Ahad Khan Cheema is a Civil Servant belonging to Pakistan Administrative Service (PAS). He earned the degree in MSc. Social Policy and Planning from London School of Economics and Political Science. He has more than 14 years of experience of working in different leading positions including Secretary to Government of the Punjab, District Coordination Officer (DCO) Lahore and Director General, Lahore Development Authority (LDA).

During his service career, he has accomplished high level assignments. Under his leadership, many engineering masterpieces were constructed in Lahore including Lahore Metro Bus Project, Kalma Underpass, Azadi Chowk and Qainchi Flyovers.

Lahore Metro Bus Project is first of its kind in Pakistan which was completed in mere eight months.

Mr. Ahad Khan Cheema has been bestowed with Tamgha-e-Imtiaz by the Government of Pakistan in recognition of his public service.

2. **Mr. Shamsul Aziz**
   Chief Financial Officer

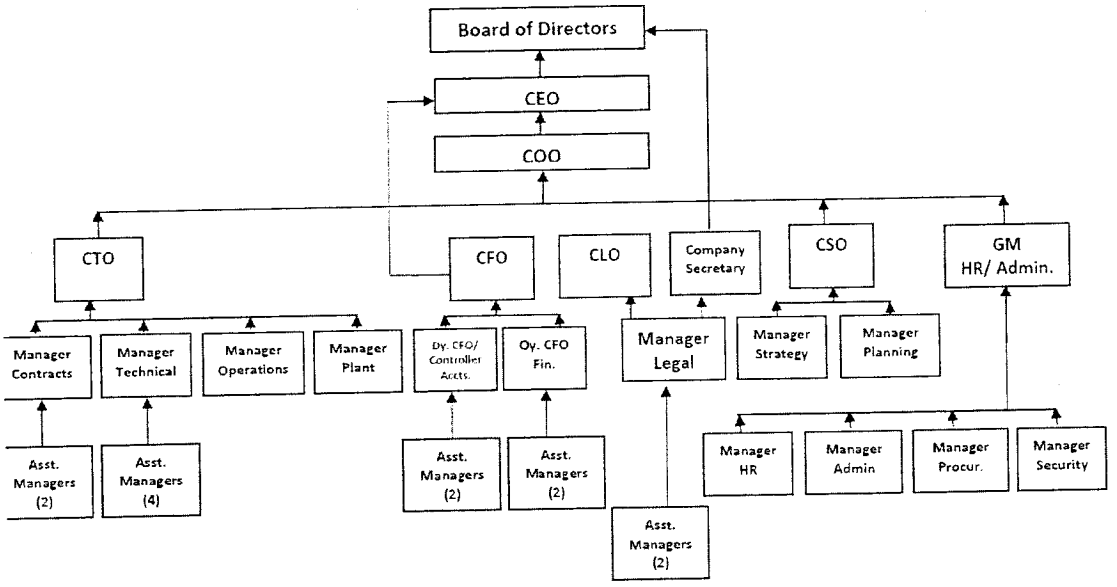
Mr. Shamsul Aziz is a seasoned professional with proven success in financial and operations management to achieve the organizational mission. He developed leadership qualities with a solid record of contributions leading to improved financial and technical performance and enhanced internal controls.

He has successful track record and in-depth experience of independently planning and handling projects from planning, development of feasibility studies to execution including dealing with project lenders, regulators and other Government agencies for their successful execution.

He has solid background and expertise in managing the financial and operational affairs of a corporate entity of substantial size.

He is well versed with the dynamics of energy sector of Pakistan. He has worked in Siemens for 8 years, in PPIB for one and a half years, and in Southern Electric Power Company Limited on top position for 15 years.

ORGANOGRAM


Board of Directors
CEO
COO
CTO
CFO
CLO
Company Secretary
CSO
GM HR/ Admin.
Manager Contracts
Manager Technical
Manager Operations
Manager Plant
Dy. CFO/ Controller Accts.
Dy. CFO Fin.
Manager Legal
Manager Strategy
Manager Planning
Asst. Managers (2)
Asst. Managers (4)
Asst. Managers (2)
Asst. Managers (2)
Asst. Managers (2)
Manager HR
Manager Admin
Manager Procur.
Manager Security

THE BANK OF PUNJAB

Passion Reborn

Main Branch,
7-Egerton Road, Lahore.
Tel: +92-42-99200421-5
Fax: +92-42-99200351
Email: bop0002@bop.com.pk

July 15, 2015

MB/LHR/01/233

TO WHOM IT MAY CONCERN

This is to certify that Quaid-e-Azam Thermal Power (Pvt.) Ltd. are maintaining CPA Account # 129280019 since April 28, 2015 with us and Account Balance as on July 15, 2015 is PKR-135,144,775/- (Rupees One Hundred Thirty Five Million and One Hundred Forty Four Thousands and Seven Hundred and Seventy Five Only). Furthermore Quaid-e-Azam Thermal Power (Pvt.) Ltd is maintaining Fixed Deposit with us as on July 15, 2015 of RS. 7500, 000,000/-(Rupees Seven Billion and Five Hundred Million Only).

This certificate is being issued at the specific request of the customer without any prejudice, risk and responsibility on the part of the bank and this information should not be considered as guarantee or indemnity.

Regards,

SOHAIL TANVIR
CHIEF MANAGER OPERATIONS

AlliedBank

Celebrating 70 Years

Allied Bank Ltd.
Gulberg Main Market, LHR. (0216)

Main Market Gulberg (0216), Lahore

Dated: 15th July 2015

TO WHOM IT MAY CONCERN

It is to certify that an **APPA SPECIAL SAVING** account is being maintained with a/c # **0010033797000010**, titled as **"QUAID-E-AZAM THERMAL POWER PRIVATE LTD"** with us since **29th MAY 2015** in a satisfactory manner.

The balance of the said account as of today is **Rs. 1,370,315/20**; furthermore, the said company is maintaining **fixed deposit / TDR** with us amounting to **Rs. 5,000,000,000.**

This certificate is issued on particular request of customer without any responsibility on bank and any of its officials.

Allied Bank Ltd.
Gulberg Main Market, LHR. (0216)

BANKING SERVICES MANAGER

OFFICER

United Bank Limited
1301-Amin Chamber Main Market Gulberg Lahore

DATE: 15-JUL-2015

TO WHOM IT MAY CONCERN

This is to certify that *M/S QUAID E AZAM THERMAL POWER PVT LTD* is maintaining it's Account # 222234696 with our branch since 07-MAY-2015.

The available balance in account no 222234696 as on 15-JUL-2015 is

PKR 565,823.38

The UTTIP booked in our branch of this customer is as follows

UTTIP A/C		AMOUNT IN PKR
223121984	PKR	500,000,000.00
223122185	PKR	500,000,000.00
223122338	PKR	500,000,000.00
223122482	PKR	500,000,000.00
223122789	PKR	500,000,000.00
223318344	PKR	500,000,000.00
223318511	PKR	500,000,000.00
223318603	PKR	500,000,000.00
223318726	PKR	500,000,000.00
223318832	PKR	500,000,000.00

The total balance of *M/S QUAID E AZAM THERMAL POWER PVT LTD* including all available investments is PKR 5,000,565,823.00

This certificate is issued on the specific request of the customer without any risk and responsibility on the part of the bank or its Officers.

RUMINA FARHAN KHAN
VP / Branch Manager
UNITED BANK LIMITED
Amin Chamber Br. Main Market Gulberg LHR.

Authorized Signature

Risk	Recommended Mitigants
Continuous supply of RLNG to power plant.	Fuel Supply should be the responsibility of Government of Pakistan (GoP) and as such a GoP Guarantee is proposed to be obtained which backstops the RLNG Supply Agreement and covers QATL's revenue shortfalls in case the quantity and quality of gas required for the project is not received.
Cost overruns may escalate the cost of the project.	Sponsor's commitments will need to be appropriately negotiated for meeting cost overruns resulting from any eventuality/situation during the construction phase will be negotiated once the lenders have greater clarity of the project contracts and the exact terms of the NEPRA policy. This Sponsor's support commitment may be through the contemplated GoPb's Energy Fund.
Delay in payment from NTDC to this power plant.	Like other IPPs, GoP Guarantee will be provided under the Implementation Agreement to guarantee the payables of NTDC. Additionally, to enable QATL to continue to operate smoothly, the GoPb through its Energy Fund may be required to fund any working capital needs that may not be covered through the working capital facilities due to delay in payments by NTDC;

We look forward to a positive response on the above proposal. In the next week NBP and HBL shall be circulating a draft detailed term sheet to the QATL management for its consideration so that we can move forward in the transaction.

Thank you.

Yours sincerely,

Syed Iqbal Ashraf
President
National Bank of Pakistan

Nauman Dar
President
Habib Bank Limited

May 14th, 2015

H.E. Mr. Muhammad Shahbaz Sharif
Chief Minister Punjab,
Lahore.

Subject: **Financing Arrangement for the 1200 MW Power Project sponsored by the Government of Punjab**

Dear Sir,

We write with reference to various meetings and discussions among major local banks and other stakeholders from Government of Punjab (GoPb) related to the setting up a single fuel RLNG based 1200 MW combined cycle gas fired power plant in Bhikki, Sheikhupura District, Punjab (referred to as Quaid-e-Azam Thermal Limited (QATL)) under the 2015 Power Policy especially with regards to arranging financing for the project.

Recognizing the national importance of this project, National Bank of Pakistan (NBP) and Habib Bank Limited (HBL) jointly and equally offer to underwrite PKR 82 billion of the required debt for the project and arrange the balance amount from the market. In order to expedite the debt arrangement and to enable the achievement of early financial closure, our teams will work closely with QATL management to ensure the transaction's bankability. You would appreciate that the above is indicative of the commitment of Pakistan's two largest financial institutions to this large scale project of national importance and the necessity for it to achieve its financial close on the aggressive timelines.

As per our understanding, QATL is expected to be setup as an IPP through the establishment of a Government of Punjab (GoPb) wholly owned subsidiary for which 50 acres of land has been allocated in Bhikki. Given the significant prevailing energy crisis in Pakistan, the project is being fast tracked and the GoPb is targeting COD for end of 2017.The project cost is estimated at US$1,073 million and require working capital facilities of approximately US$250 million which will be financed in the debt to equity ratio of 75:25.

	US$ mill	**PKR billion** (PKR 102/$)
Estimated Project Cost		
Estimated Base Equity	268.25	27.36
Estimated Long Term Loan/Facility	804.75	82.08
Total	**1,073**	**109.446**
Working Capital		
Equity Needed for Working Capital	62.5	6.375
Estimated Working Capital Facilities	187.5	19.125
Total	**250**	**25.5**

Our commitment is being provided based on the understanding that various conditions detailed in an indicative term sheet to be provided to the QATL will be met prior to financial close. Some of the salient features are given below:

1. GoPb will inject the required base equity (presently estimated at PKR 27.5 billion) for the project by August 2015 and the requisite funds are also available in the Government of Punjab's proposed Energy Fund.
2. GoPb has to finalize the following at the earliest:
    a. The project size
    b. The total project cost/budget including the budgeting for contingencies.
    c. The drafts of the various project agreements are made available to us for due diligence (EPC contract(s), the Implementation Agreement, Power Purchase Agreement, etc).
3. The facilities will be structured as Islamic and/or conventional and made available after financial close of the transaction. To clarify, financial close refers to:
    a. Completion of the due diligence process by the various Lenders advisors,
    b. Signing of Facility Agreements for the full required debt amount,
    c. Signing of all project agreements,
    d. Security creation along with completion of all conditions precedents to drawdown.
    e. Finalization of the sponsor supports required for the project by the lenders directly from the GoPB or through its proposed Energy Fund.
    f. Issuance of required licenses, approvals, guarantees as required by the Lenders syndicate/Consortium for a project of this nature.
4. To achieve full financial close, NBP and HBL would request your continued support for any regulatory approvals that may be needed (including the State Bank of Pakistan) to enable the consortium/syndicate members to participate in this transaction.
5. NBP and HBL would require GoPb commitment that any time after achievement of Commercial Operation Date, these two (2) banks will have the option that they may acquire upto 9.99% each of the equity/paid-up capital of QATL at a price of PKR 10 per share.
6. If there is any ECA financing available, its participation in debt will be used to reduce exposure/commitment of NBP and HBL.

It is clarified that any requirements of QATL prior to the achievement of financial close would be met through its own resources or that of the Energy Fund that the GoPb is structuring.

Please note that during initial discussions, certain key risks (given below) had been identified and presented in various meetings on which we require the GoPb's support to build mitigations for the benefit of the project itself and in order to make the transaction bankable:

Consultant

Regarding the preparation of tender documentation and negotiation process of EPC contract, the government of Punjab is supported by Consulting team which consists NESPAK and Lahmeyer International as Technical Advisor.

NESPAK is National Engineering Services Pakistan (Pvt) Limited is Pakistan's leading engineering consultancy organization. It was established in 1973 as a private limited company by the Government ofPakistan. NESPAK is registered with a number of international funding agencies such as IBRD, ADB,IDB, etc. NESPAK has undertaken more than 3500 projects located in Afghanistan, Azerbaijan, Bahrain,Bangladesh, Benin, Cameroon, Chad, Comoros Island, Dominica, Ethiopia, Gambia, Ghana,Guinea, Iran, Iraq, Kazakhstan, Kyrgyzstan, Libya, Nepal, Nigeria, Oman, Pakistan, Qatar, Saudi Arabia,Senegal, Sierra Leone, Somalia, Sudan, Syria, Tajikistan, Tanzania, Thailand, Turkey, Turkmenistan,U.A.E, Uzbekistan, Yemen.

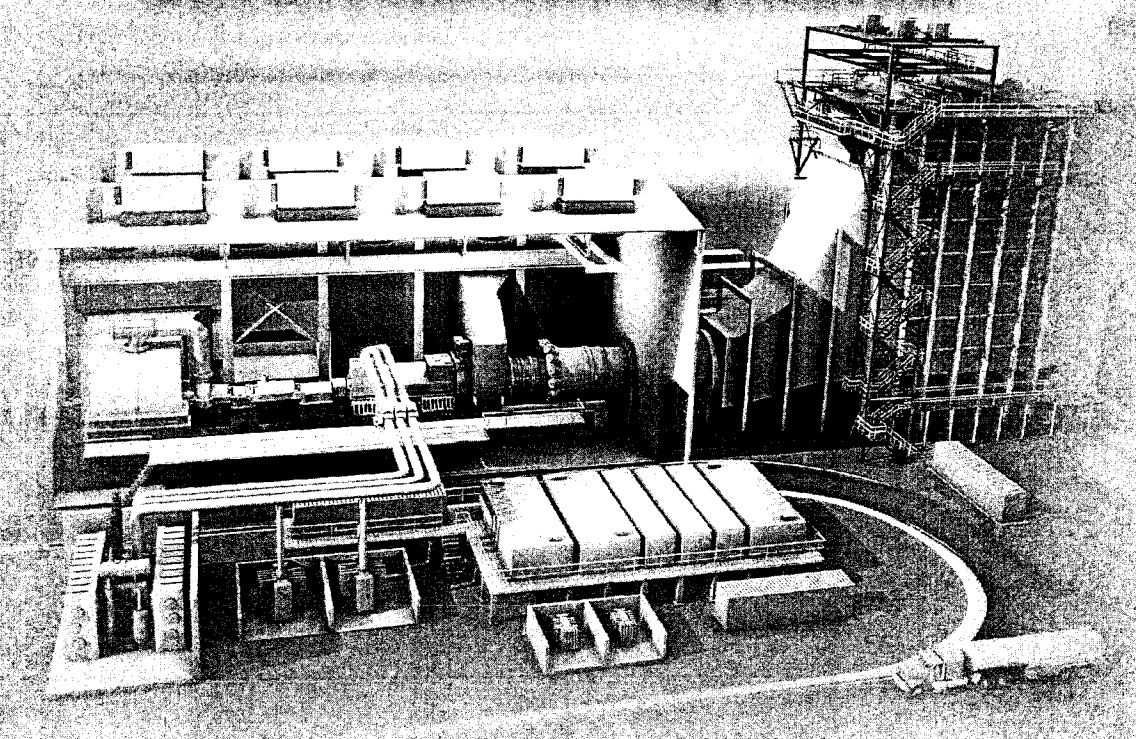
Lahmeyer International from Germany was established in 1890 in Frankfurt am Main and from the beginning of 2015 is a part of GDF SUEZ Group as a daughter company of Tractebel Engineering (Belgium). Tractebel Engineering ranks as one of the major international engineering companies operating in the energy and infrastructures sectors. Lahmeyer also offers a wide range of planning and

engineering services for complex infrastructure projects in the fields of energy and water, as well as building and transportation. Lahmeyer, a trusted brand name, is continuing as an independent business unit of Tractebel Engineering. With well over 4,400 employees and an annual turnover of more than 600 Million Euro, joint company is one of the most significant energy, water, and infrastructures engineering companies worldwide.

The all consulting team comprising National Engineering Services Pakistan (NESPAK), Lahmeyer International (technical advisor), Haidermota & Co. and Bhandari, Naqvi & Riaz (legal advisor) and Ernst & Young (financial advisor)

QUAID-E-AZAM THERMAL POWER COMPANY (PVT.) LIMITED
GOVERNMENT OF THE PUNJAB

1000-1500 MW (GROSS) RE-GASIFIED LIQUEFIED NATURAL GAS (RLNG) BASED COMBINED CYCLE POWER PLANT AT BHIKKI, DISTRICT SHEIKHUPURA, PAKISTAN



ENVIRONMENTAL IMPACT ASSESSMENT (EIA) REPORT

JUNE 2015

NATIONAL ENGINEERING SERVICES PAKISTAN (PVT.) LIMITED
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SA-307/023/M/08(15)

1,000-1,500 MW (GROSS) RLNG BASED COMBINED CYCLE POWER PLANT AT BHIKKI, SHEIKHUPURA

Environmental Impact Assessment (EIA) Report

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LIST OF ABBREVIATIONS

ADM	Air Dispersion Modeling
AIS	Air Insulated Switchgear
AMSL	Above Mean Sea Level
AP	Affected Person
BCP	Building Code of Pakistan
BCFD	Billion Cubic Feet/Day
BHU	Basic Health Unit
BoP	Balance of Plant
BOD	Biological Oxygen Demand
BS	Balloki Sulemanki
CAD	Computer Aided Design
CAS	Compulsory Acquisition Surcharge
CBD	Conventional Biological Diversity
CCPP	Combined Cycle Power Plant
CCT	Clean Coal Technologies
CCR	Central Control Room
CEMS	Continuous Emission Monitoring System
CNIC	Computerized National Identity Card
CO	Carbon Monoxide
CO_2	Carbon Dioxide
COD	Chemical Oxygen Demand
COD	Commercial Operation Date
CMP	Change Management Plan
CBM	Confidence Building Measure
C&W	Communication and Works
DCR	District Census Report
DCS	Distributed Control System
DLP	Defect Liability Period
DG	Director General
DO	Dissolved Oxygen
E&RT	Environment and Resettlement Team
ECO	Economic Cooperation Organization
EHS	Environmental, Health and Safety
EIA	Environmental Impact Assessment
EMC	Environmental Monitoring Cell
EMP	Environmental Management Plan
EPA	Environmental Protection Agency
EPC	Engineering, Procurement and Construction
EPD	Environmental Protection Department
EPRF	Emergency Preparedness and Response Framework
EUAD	Environment and Urban Affairs Division
FBC	Fluidized Bed Combustion
GDP	Gross Domestic Product
GM	General Manager
GoP	Government of Pakistan
GoPb	Government of the Punjab
GT	Gas Turbine
HC	Hydro Carbons
HFO	Heavy Furnace Oil

HP	High Pressure
HSE	Health Safety and Environment
HRSG	Heat Recovery Steam Generator
HSD	High Speed Diesel
I&C	Instrumentation and Control
IEE	Initial Environmental Examination
IEC	International Electrotechnical Commission
IP	Intermediate Pressure
IPP	Independent Power Producer
IUCN	International Union for the Conservation of Nature
KV	Kilovolt
LAA	Land Acquisition Act
LAC	Land Acquisition Committee
LES	Livestock Experiment Station
LHV	Lower Heating Value
LNG	Liquefied Natural Gas
LP	Low Pressure
LPG	Liquefied Petroleum Gas
LTSA	Long Term Service Agreement
MMM	Mitigation Management Matrix
MMCFD	Million Cubic Feet per Day
MBTU	Million British Thermal Units
MSDS	Material Safety Data Sheet
MW	Mega Watt
NCS	National Conservation Strategy
NEQS	National Environmental Quality Standards
NEPRA	National Electric Power Regulatory Authority
NESPAK	National Engineering Services Pakistan
NFPA	National Fire Protection Association
NGO	Non-Governmental Organization
NH_3	Ammonia
NHA	National Highway Authority
NO_x	Oxides of Nitrogen
NOC	No Objection Certificate
NPO	No Project Option
NPV	Net Present Value
NTDC	National Transmission and Despatch Company
OEM	Original Equipment Manufacturer
O&M	Operation and Maintenance
OIC	Organization of the Islamic Conference
P&D	Planning and Development
Pak-EPA	Pakistan Environmental Protection Agency
PAP	Project Affected Person
PCAP	Pakistan Clean Air Program
PEPCO	Pakistan Electric Power Company
PGA	Peak Ground Acceleration
PIDA	Punjab Irrigation and Drainage Authority
PM	Particulate Matter
PPDB	Punjab Power Development Board
PPDCL	Punjab Power Development Company Limited
PPE	Personal Protective Equipment

PSHA	Pakistan Seismic Hazard Assessment
QB	Qadirabad Balloki
RLNG	Regasified Liquefied Natural Gas
RSC	Reference Site Conditions
RTR	Reliability Test Run
SAS	Substation Automation System
SAARC	South Asian Association for Regional Cooperation
SC	Supervisory Consultant
SCFD	Standard Cubic Feet/Day
SCADA	Supervisory Control and Data Acquisition
SNGPL	Sui Northern Gas Pipeline Company Limited
SOP	Standard Operating Procedure
SO_x	Oxides of Sulphur
SPSS	Statistical Package for Social Sciences
ST	Steam Turbine
T&P	Tools and Plants
TDS	Total Dissolved Solid
TG	Turbine Generator
TMA	Tehsil Municipal Administration
TSP	Total Suspended Particles
TSS	Total Suspended Solid
UBC	Uniform Building Code
UNO	United Nations Organization
VOC	Volatile Organic Compound
WMF	Waste Management Framework
WAPDA	Water and Power Development Authority

1,000-1,500 MW (GROSS) RLNG BASED COMBINED CYCLE POWER PLANT AT BHIKKI, SHEIKHUPURA

ENVIRONMENTAL IMPACT ASSESSMENT REPORT

EXECUTIVE SUMMARY

A. INTRODUCTION

Pakistan is facing acute power shortages. It has been reported that the shortfall in power generation has tremendously increased to about 4,000 – 6,000 megawatt (MW) and power shortage is estimated to cost the economy 2% of Gross Domestic Product (GDP) each year[1]. Government of Punjab (GoPb) has initiated a fast track Project to install a 1,000 - 1,500 MW Regasified Liquefied Natural Gas (RLNG) based Power Plant near Bhikki, Sheikhupura to reduce the ongoing acute power crisis. Government of Punjab (GoPb) has engaged M/s National Engineering Services Pakistan (NESPAK) Pvt. Limited for providing the consultancy services to conduct the Environmental Impact Assessment (EIA) study. The proponent for this Project will be Quaid-e-Azam Thermal Power Company (Pvt.) Limited, GoPb.

An EIA team from NESPAK comprised experienced experts including: Environmental Engineers, Ecologist, Environmental Scientist, Thermal Power Plant Experts and Sociologists. The scoping and TOR of the EIA is attached with EIA report.

B. LEGISLATIVE REQUIREMENTS AND FRAMEWORK

18th Amendment in the Constitution of Pakistan has fundamentally altered the division of legislative powers between National and the Provincial Assemblies, resulting in a significant increase in the extent of Provincial autonomy. For the subject project, Environment Protection Department (EPD), Punjab is the concerned authority. The EIA report has been prepared keeping in view the following national policies, laws, regulations and guidelines:

- National Conservation Strategy, 1992;
- National Environmental Policy, 2005;
- Pakistan Labour Policy, 2010;
- Punjab Environmental Protection Act, 1997 (Amended 2012);
- Pakistan Environmental Protection Agency (PAK-EPA) (Review of IEE and EIA Regulations, 2000);
- Pakistan Environmental Impact Assessment (EIA) Procedures;
- National Environmental Quality Standards (NEQS);
- Land Acquisition Act (LAA), 1894;
- Punjab Irrigation and Drainage Authority (PIDA) Act, 1997; and
- Other relevant acts and ordinances.

The major guidelines considered included Pakistan Clean Air Program (PCAP); Guidelines for Public Consultation; and Sectoral Guidelines for Environmental Reports, Major Thermal Power Plants, October 1997.

C. PROJECT ALTERNATIVES

Different alternatives considered for the project include the No Project Option (NPO), other power generation options, site alternatives, fuel alternatives, technology alternatives, pollution control alternatives, alternatives considered for the cooling system and wastewater discharge alternatives.

[1] Annual Plan 2013-14, Ministry of Planning, Development and Reforms, Government of Pakistan

D. PROJECT DESCRIPTION

The proposed Project is essentially a RLNG based Combined Cycle Power Plant (CCPP). The Power Plant has a capacity of producing 1,000-1,500 MW (Gross) of electricity. The Power Plant will operate on imported RLNG to be transported from Karachi through pipelines. The gas for the Project will be supplied by Sui Northern Gas Pipeline Company Limited (SNGPL). The Project Site is adjacent to Qadirabad-Balloki (QB) Link Canal (about 100m) and Shorkot-Pir Mahal-Jaranwala-Sheikhupura single railway track (approx. 200 km from Shorkot). The main access road to the Power Plant will be Sheikhupura-Faisalabad Road which passes approximately 1 km from the Project Site.

The power plant will be installed to operate first in open cycle mode and then it will be converted into combined cycle. The open cycle operation of the power plant generates the electricity by using gas turbine only without the recovery to waste heat to generate additional electricity by running a steam turbine.

To increase the overall efficiency of thermal power plants, multiple processes can be combined to recover and utilize the residual heat energy in hot exhaust gases. The term "combined cycle" refers to the combining of multiple thermodynamic cycles to generate power. Combined cycle operation employs a heat recovery steam generator (HRSG) that captures heat from high temperature exhaust gases to produce steam, which is then supplied to a steam turbine to generate additional electric power. The combined cycle operation of the power plant increase the efficiency as compared to the single cycle operation.

i. Components of the Power Plant

The Project includes the complete engineering design, procurement, construction, commissioning, and operation of the plant including: (a) Civil Works (b) Equipment and Machinery and (c) Other Physical Facilities. The Major equipment and structures include:

- Gas Turbines and Auxiliaries;
- Heat Recovery Steam Generators (HRSGs);
- Condensate System;
- Feed Water and Steam System;
- Steam Turbine (ST) and Condenser;
- EHV Switchyard/Equipment;
- Electrical Systems;
- 500 kV High Voltage Switchyard;
- Generators;
- Power Transformers;
- Electrical Auxiliary System;
- Electric Control and Protection Systems;
- Lightning System;
- Instrumentation & Control (I&C) and Communication Systems;
- State-of-the-Art Distributed Control System (DCS); and
- Other Plant Components.

ii. Fuel System

Main fuel for Power Plant will be RLNG. The planned supply for the Project is up to 200 Million Cubic Feet/Day (MMCFD). The fuel gas supply system will be designed for flow of sufficient fuel gas according to all requirements of the two (2) Gas Turbines up to peak load operation as well as safe supplies during rapid changes of gas flow due to changing load requirements. As a back-up fuel, High Speed Diesel (HSD) will be used. The letter from SNGPL commitment for supply of RLNG has been attached as Annex to EIA report. The RLNG supplied to the project will be imported from Qatar as mentioned in the Letter from SNGPL. There will be no storage facility of RLNG at the power plant site.

iii. Transmission and Distribution System

The power will be evacuated by connection to the existing 500 kV high voltage line which is located 2.2 km from the Project Site. Step-up transformers 450 – 650 MVA size is required. Air-insulated switchgear (AIS) in 1 ½ breaker type is included in EPC scope. 500 kV Substation will be built by the EPC Contractor within the boundary wall of the Project.

iv. Water Requirement and Cooling System

The water during the plant operation will be used for sanitary, plant uses and cooling purposes. Cooling water for main cooling cycle will be taken from canal next to project site The flow of the canal is sufficient to use 'once through' cooling as the main cooling system technology. The volume extracted from the canal will be less than 5% of the total water volume. During approx. one to two months per year, water from the canal will be unavailable and water will be taken from underground wells. In this period, mechanical draft cell-type cooling will serve as the heating sink. Both main cooling systems have to be connected in a manner to allow smooth switch over from once through to mechanical draft cell-type cooling system Sufficient volume of water may be provided by using water quality of filtered water, permeate water, potable/service water. The Contractor may provide the continuous available volume either via a permanent dedicated fire water tank or one sufficiently sized storage tank. Fire water system shall be provided with 2 x 100% electric pumps and one diesel driven pump.

The water extracted for use will be treated with the help of water demineralization, chlorination and potable and service water treatment plants installed at the power plant.

v. Implementation Schedule

Considering implementation of the project through Engineering, Procurement and Construction (EPC) contract, the Project will require approximately 27 months to start for commercial operation in Combined Cycle Mode.

vi. Project Cost

The total project cost has been estimated around 600 – 700 Million US$ (±100 MUS$), depends on configuration and implemented machines and specific investment conditions. The yearly operation costs (OPEX) is estimated approx. 27.0 – 36.5 Million US$.

E. DESCRIPTION OF THE ENVIRONMENT

A team of experts carried out field visits to the proposed Power Plant site (Project and Study Area), adjoining areas like Thatha Miana, Therian, Chah Waris and Bhikki from February 23 to 25, 2015 for baseline data collection on physical, ecological and socio-economic aspects. For the collection of baseline information, checklists, proformas, satellite imagery (Google Earth), and general topographic sheets were used. The relevant collected data was computerized and analyzed using software such as Microsoft Office (Word, Excel and Access), Statistical Package for Social Sciences (SPSS), Computer Aided Design (CAD), etc.

i. Physical Environment:

The topography of the proposed Project Site is relatively flat as the area is located in plain terrain of Punjab. The major land use pattern of the project area is agricultural land. Few tube wells and katcha tracks also exist inside the boundary. The total area demarcated for the proposed project is distributed in mainly two categories i.e. permanent area and temporary Area. The area is mostly agriculture land and the featured quantification of land use at project site is shown is in Figure 5.2.

	A	B	C	D	E	F
1	**GENERATION,New generation facilities(thermal),SCHEDULE III**					
2	1.0	Location(location maps,site map),land	##########	EIA report,June 2015 attached. The technical data provided herein is based on the feasibility/EIA report,and exact data will be provided once the bids from EPC are opened.		
3	2.0	Technology,size of plant,number of units	Gas based Combined Cycle Power Plant(CCPP),1000-1500 MW ISO.One block consisting of 2GT+2HRSG+1ST.			
4	3.0	Fuel: type,imported/indigeneous,supplier,logistics,pipe line etc	##########			
5	4.0	Emission values	As per the EIA report.Guranteed values from the EPC will be available,after opening of the bids.Please refer EIA report,section 7.5.5 for the details of the expected emissions.	EIA report,June 2015 attached. The technical data provided herein is based on the feasibility/EIA report,and exact data will be provided once the bids from EPC are opened.		
6	5.0	Cooling water source:tube wells,sea/river/canal,distance from source	##########	PI refer EIA report for further details.		
	6.0	Interconnection with national grid company,distance and name of nearest grid,voltage level(single line diagram)	The power will be evacuated by connection to the existing 500 KV HV line,which is located 2.2 km from project site.500 kv substation will be built by the EPC in the plant boundary.	PI refer grid interconnection study(March2015)for further details.		
8	7.0	Infrastructure:road,rail,staff colony,amenities	The project site is adjacent to Qadirabad-Balloki(QB) link canal(about 100 m).The main acces to the plant will be Sheikhupura-Faisalabad road which passes approximately 1 km from project site.			
9	8.0	Project Cost,information regarding sources and amount of equity and debt	00000?? MUSD, 25:75			
10	9.0	Project commencement and completion schedule with milestones.	36 months	Tentative Implementation schedule attached.		
11	10.0	ESSA(Environmental and Social Soundness Assessment)	Environmental Impact Assesment report,June2015 is attached.			
12	11.0	Safety plans,emegency plans	These data will be provided once EPC bids are open.			

	A	B	C	D	E	F
13	12.0	Sytem studies:load flow,short circuit,stability,reliability	Grid interconnection study report March2015,carried out by NTDC is attached.	Grid interconnection study report March2015, is attached.		
14	13.0	Plant characteristics:generation voltage,frequency ,power factor,automatic generation control,,ramping rate,alternate fuel,auxiliary consumption,time(s) required to synchronize to grid	############################	The technical data provided herein is based on the feasibility report,and exact data will be provided once the bids from EPC are opened.		
15	14.0	Control, metering, instrumentation and protection	These data will be provided once EPC bids are open.			
16	15.0	Training and development	These data will be provided once EPC bids are open.			
17	16.0	Feasibility report	Technical feasibility report,July2015 is attached.	Technical feasibility report is attached.		

The project area lies in the Upper Indus Basin and is drained by the Jhelum, Indus, Sutlej, Ravi and Chenab rivers, which join at Punjnad to form lower Indus Basin. The project area consists of recent sediments brought by spill channel from Chenab River. The exposed alluvial complex of Pleistocene and recent age represents the latest phase of sedimentation. Nearly all the deposits underlying the Sheikhupura city and its surrounding are the products of the events that evolved during the Pleistocene and recent geological time. On the basis of preliminary soil investigation, subsoil strata is identified as silty clay/clayey silt from 0-3 m, silty sand from 3-7 m and sand with concretions from 7 m onwards. The proposed Power Plant Project as per Building Code of Pakistan (BCP), 2007 (Seismic Provisions) falls entirely in the zone 2A which is the region of moderate seismic risk. The climate of the area is semi-arid, hot subtropical with foggy winter, pleasant spring, summer with dust and heat wave periods, rainy monsoon, and dry autumn. June is the hottest month with the mean minimum temperature of 27.6°C and the mean maximum temperature as 40.25°C. The maximum rainfall occurs during the monsoon season in the months of July and August.

The major water sources in the Study Area are the QB-Link canal and the natural sewerage and storm water drain that falls into the QB-Link canal near Al-Rahim Textile Industry. The groundwater in the study area is extracted through tube wells and hand pumps installed in nearby villages and along the banks of the QB-Link canal. Groundwater is main mainly use to meet the irrigation and drinking water demands of the area.

No conventional solid waste management system exists in the Study Area. Most of the solid waste was found to be stored in the forms of heaps at various locations near the villages. Similarly, there is no proper sewerage system in the Study Area, only some open drains are constructed in the vicinity for the discharge of wastewater. In general, each village drains its sewage through small open drains into the depression area found near to each village.

Ambient air quality for CO_2, NO, NO_2, SO_2, PM_{10} and $PM_{2.5}$ was monitored at four (04) points in the Study Area. All the parameters are within the NEQS applicable limiting values. The background noise level monitoring was carried out in the Study Area at eight locations. The overall monitoring points from NL-01 to NL-08 fall into category A (Residential Area) and category C (Industrial Area) as few industries such as Nimar Chemicals, Sabir Hatchery and Al-Rahim Textile exist near these locations. All the points are in compliance with the NEQS Noise Level Category A & C except NL-01 and NL-05 that marginally exceeds the limiting value of Category A as mentioned in NEQS due to close proximity to above mentioned industries and with the main road where daily traffic movement and commercial activity causes higher noise levels. The surface water sampling was done from QB-Link Canal. All the samples were collected as grab samples. These were labeled and preserved before transportation to the laboratory for testing. Ground water samples were collected from hand pumps and tube wells from five locations. Based on the analysis, all the tested parameters are in compliance with the NEQS for drinking water except turbidity that marginally exceeds at Point GW 05. Wastewater samples were collected from the surrounding villages and from the natural storm water drain. The results were compared with the NEQS limiting values for the inland discharge. Based on the analysis, all the samples are exceeding the limits of BOD_5, COD, temperature. One sample taken from drain exceeds the limits of pH, barium exceeds at point WW 02 and WW 03 while manganese and arsenic exceed at point WW 01 the limit as defined by the NEQS for inland discharge

ii. Ecological Environment

No compact plantation or woodlots exist in the Project Area, but scattered trees are growing in the farmlands in linear pattern consisting of eucalyptus, kikar, shisham, and simal with irregular spacing. A total of 58 trees of various sizes with girth ranging from 8" to 40" are present in Project Area (Permanent and Temporary Acquisition and Access Road) Among grasses Khabbal (*Cynodon dactylon*), Dhaman (*Cenebrus ciliaris*) and Khawi (*Cymbopogan jawarancusa*) are mainly present.

The Study Area being agricultural land, is not very rich in wildlife Mammals. However, common mammals are Jackal (*Canis aurecus)*, Fox (*Vulpus bengalensis*), Hare (*Lepus*), Porcupine (*Hystrix indica)*. Common reptiles found in the Study Area include Lizards, Geko *(Gekkonidae)*, Goh *(monitor),* snakes *(Serpentes*), Rats *(Rattus*) and common frog *(Rana temporaria*). Not many birds were observed in the Project Area during site visit, probably due to scattered vegetation and other anthropogenic interventions. However, avifauna population seemed to be on increase in Study Area, probably due to small size orchards, agricultural crops and linear plantations. No Fishery was found in the Study Area, as the major land use is agriculture due to the high fertility of land. It was reported that local level fishing is carried out in the surrounding canals but it was not sighted during site visit.

Main crops grown in the area consist of Wheat, Rice, Maize, Sugarcane, Potatoes, Onion, Capsicum, Tomato, Peas and Okra. Raising of orchards are not common in the area, as vegetables are preferred due to high rate of return. Fodder crops are grown for use by the domestic livestock kept by the farmers mainly for milk purpose as well as for their own requirements.

iii. Socio-Economic Environment

Social assessment of the people of the Study Area was carried out through socio-economic baseline surveys; village profile survey and public/stakeholders consultations/focus group discussions in the Study Area. During the socio-economic survey, 80 respondents from the Project as well as Study Area villages were sampled.

The overall population of 80 households was calculated as 480. Average household size was concluded as about 6. The sex ratio (males per 100 females) for the Study Area is found to be 101.6. Punjabi is the predominant language being spoken in the Study Area, however, Urdu is also understood. In general, a wide range of castes were identified among respondents which mainly include: Arain; Bhatti; Rajpoot; Syed; Khokar; Malik; Jutt; Sheikh; and Gujjar. In three of the villages in the study area, namely Thatha Miana, Chah Waris and Therian, primary schools for boys and girls were present. The literacy level of the respondents, identified during the survey, depicts that the majority of the respondents interviewed in the Study Area were illiterate and their weightage is 53.8% followed by 18.8% and 23.8% having an education level upto middle and matric respectively. Only 3.6% of the respondents had education up to intermediate and bachelor level.

Joint family system is dominant in the Study Area. The average monthly income of most of the respondents who are involved in agriculture was found to be Rs. 20,000/- or above i.e. 6.4%. However, respondents who use to earn through labour works, reported to earn under Rs. 20,000/- i.e. 93.6%. Agricultural labor in the study area is primarily done by men but women and children are also involved in farming activities. Large land owners employ tenants for agricultural activities or give their land for cultivation on contract basis whereas small land owners cultivate their land by themselves with the help of their family members.

During the survey, respondents reported that they were suffering from different diseases. On the contrary, the dispensary or Basic Health Units (BHU) were not reported in the surveyed villages except in Bhikki Town. Even in Bhikki Town, there are no proper arrangements to deal with emergency cases and people use to rush to Sheikhupura city in the hour of need. Seasonal fever, cough, cold and flu are the common diseases. Natural (Sui) gas and landline telephone network also partially exist in the area, however, most of the mobile phone networks are being used. The whole area is deficient in terms of civic facilities such as metalled roads network, playgrounds, recreational activities, street lights, drainage system, postal services etc. Crime and conflict resolution system mostly relied on the Wadera system. The Wadera (head) or Lumberdar of the village is the most influential person to resolve the conflicts.

Women in the Study Area were suffering through economical and social poverty and were mainly dependent on male members of their family for economic reasons. They could not take decisions regarding their own lives.

There were no sensitive, religious or archaeological sites within the project boundary. However, one graveyard exists near each village in the Study Area. One shrine of a saint was also identified in Thatha Miana village. It was reported during socio-economic surveys that there is no active Non-Governmental Organization (NGO) in the entire Study Area.

F. STAKEHOLDER CONSULTATIONS

Stakeholder were identified, categorized and consulted at provincial and district levels (Departments like Environmental Protection, Irrigation, Agriculture, Wildlife etc.) and at village level (Direct and Indirect Affectees and Locals). Consultation with the provincial and district level departments were carried out through meetings and presentations while consultations with locals, village people, directly affected people, local NGOs etc. were undertaken during the baseline survey of the Study Area.

i. Provincial Level Consultations

The major issues/concerns by provincial Stakeholder are described below:

It is emphasized that waste management plan should be prepared for the Project to protect the environment as much as possible. The power plant is being set up on agricultural lands, and affectees are sacrificing their land for a national cause. The loss of agriculture will be compensated to a large extent by increasing yield per acre of the area and by bringing barren land under cultivation. It was suggested that the used water should be discharged into the canal, only after proper purification/treatment. These concerns are reported in detail in the EIA along with their addressal.

ii. District Level Consultations

The major issues/concerns raised during district level Stakeholder are described below:

It was emphasized that in view of the power shortage in the country such projects are the need of the time. The project should be executed ensuring that it will not cause any significant negative impact on the flora of the area or the wildlife. Every effort shall be made by the irrigation department to supply the requisite water for the power plant. These concerns are reported in detail in the EIA along with their addressal.

iii. Village Level Consultations

A series of public consultations (4 Nos.) were conducted to get the feedback/concerns. The main issued/concerns discussed were:

- There is no government water supply scheme laid in the area due to which people use to drink water from hand pumps and ultimately it leads to several diseases, despite of good apparent quality of water;
- Drainage and sewerage systems are a big issue and people use domestic draining channels which leads to a pond and become a severe source of pollution;
- The proposed power plant should also take measures for establishing health, education and recreational facilities in the study area;
- No NGO or any welfare organization is present in the area. Even, the relevant MNA/MPA do not take any necessary or productive measure towards the improvement of life quality of the villagers; and
- Locals should also get benefit from this project as the villagers lack the natural gas for their domestic house use.

- The project land belongs to us after our migration from India and we only know agriculture as main skill.

G. IMPACTS AND MITIGATION MEASURES

The project impacts have been assessed for the design/pre-construction, construction and operation phases. The impacts have been categorized as positive and negative as discussed below:

i. Potential Positive Impacts

The power plant is expected to generate a maximum of 1,500 MW of electricity. Given that Pakistan currently faces a shortfall of about 4,000 to 6,000 MW per day, the power generation by the project will help to reduce this shortfall. The generation of maximum of 1,500 MW electricity which will be added to the national grid, will help in reducing the current crisis of the electricity. It is estimated that about 2,500 and 150-200 workers will be employed during the construction and operation phases respectively which will be a positive impact.

With the influx of laborers for the proposed project, there will be more opportunities for small scale businesses such as grocery shops, small cafes (khokas), vehicle tuning and tyre-repair shops etc. The access road from Shiekhupura-Faisalabad road to the project area will be upgraded and rehabilitated which will improve accessibility of the area. It is envisaged that basic amenities such as schools for children, hospital/health clinics, local shops etc. will be improved due to establishment of power plant in the vicinity.

ii. Impacts and Mitigation during Design/Pre-Construction Phase

The project will be constructed over a land area of 315,964.34 sq.m for permanent area and access road area only) and 137,710.65 sq.m for temporary area. Temporary area will be used for establishment of construction camp and other construction related activities. Govt. will acquire the private land per provisions of LAA, 1894 ensuring the assessment and payment of compensation for the loss of private land and assets. For the loss of livelihood, other compensation should be provided to the adversely affected population who may have usufruct or customary rights to the land or other resources taken for the project. The proponent should provide livelihood assistance to the affectees like loans, job assistance etc.

The implementation of the Project will affect the built up area, crops, water courses, katcha track, transmission line and 3 No. of tube wells that will come under permanent, temporary and access road area. The loss of private built up area and crops will be compensated according to the provisions of the LAA, 1894. Other government infrastructure should be relocated by the concerned departments in consultation with the project proponent.

Due to the acquisition of the private land, some families may have direct impact and lose their livelihood. Other compensation should be provided to the adversely affected population who may have usufruct or customary rights to the land or other resources taken for the project. The proponent should provide livelihood assistance to the affectees like loans, job assistances, trainings etc.

It is expected that the requirement of water during pre-construction stage will be fulfilled from groundwater through tube wells. The water requirements for construction may affect the quantity of groundwater. This impact on groundwater through tube wells needs to be addressed carefully by the concerned Department. Contractor should consult with department and obtain permit for extraction of water.

iii. Impacts and Mitigations during Construction Phase

Soil erosion may occur during the construction phase in the Project Area as a result of improper runoff drawn from the equipment washing-yards. Discarded construction materials may also contaminate soil. Good engineering practices will help in controlling soil erosion at the construction site. Compaction and phasing the removal of vegetation will also help to reduce soil erosion. Soil contamination may occur due to oil leakages and other spills. Oil leakages, chemicals and other liquids spills should be avoided/minimized by providing appropriate storage places depending on the type of material for storage. Contractor should consult with the proponent and the Tehsil Municipal Administration (TMA) for disposal of solid waste.

Water will be required for the construction purposes. The groundwater supplies, which need to be tapped to meet campsite and construction requirements may affect the groundwater table. Hydrogeological studies including resistivity survey should be conducted to assess the groundwater potential for construction purposes. It will be the responsibility of the Contractor to ensure safe supply of water for construction purposes.

To avoid sewage, untreated wastewater, and chemicals & oil spillage from draining into the irrigation channels during construction activities, measures should be taken by the Contractor to contain the chemicals and treat sewage and other wastewater. Sewage from construction camps should be disposed of by development of on-site sanitation systems i.e. septic tanks along with soakage pits. Similarly utmost care should be taken to avoid any spills of oils and hazardous chemicals by best management practices and good house-keeping and following the Material Safety Data Sheet (MSDS).

Air quality is likely to be adversely affected by the construction of the Power Plant. Several types of emissions are expected, including gaseous emissions due to movement of construction machinery; fugitive dust emissions due to movement of machinery on dirt tracks, construction of roads and excavation of borrow areas; and particulate matter emissions during the operation of concrete batching plants and asphalt mixing plants. Noise from the construction activities (such as batching plant, vehicular movement etc.) will be significant and may cross the NEQS limit for noise. Water will be sprinkled on the dirt tracks to control fugitive dust emission. Tuning of vehicles should be made mandatory to reduce the emissions. Emissions points from batching plants should be controlled efficiently by the installation of cyclone.

It is estimated that about 58 large and medium size trees will be removed before the start of construction. Loss of vegetative cover in the form of removal of these trees will occur, while clearing land for plant installation (temporary for construction camp and permanent for plant) and access road, which will cause a low negative impact. A total of 600 trees will be planted in accordance with the tree plantation plan specified in EMP. The trees on the boundaries of the Project Area should be planted in linear form as Tree Belts / Strips of 1-2 rows in multi-storey pattern (trees with varying height) to control any noise pollution

The construction machines will generate pollutants and particulate matter which will affect flora and fauna. The impact on reptiles, rodents and birds will also remain to a negligible level on account of proportionately small area for Project installation and can, however, be avoided with vigilant movement of heavy machinery and equipment during construction.

Trees should be raised all along the roads and paths in the Project Area after the construction of the proposed power plant. A number of grassy lawns must also be established, spreading uniformly in the Project area to promote good environment friendly practices.

The project construction will also result in the loss of agriculture land which should be compensated by promoting modern agriculture practices in the area by agriculture department. The increase in availability of electricity will also improve agriculture yield. The traffic congestions and accidents may occur during the construction stage. Efforts should also be made to discuss traffic conditions with the National Highway Authority (NHA) and

Communication and Works (C&W) Department so that regular traffic is not disturbed. Transporters engaged by the plant should be forced to adhere to the load specifications of the access road. Induction of outside workers in the Contractor's labor force may cause cultural issues with the local community as the local community is very sensitive about their cultural values. Good relations with the local communities will be promoted by encouraging Contractor to provide opportunities for skilled and unskilled employment to the locals, as well as on-the-job training in construction for young people. Contractor will restrict his permanent staff to mix with the locals to avoid any social problems. During the construction phase, the general mobility of the local residents and their livestock in and around the Study Area is likely to be hindered. Contractor will have to take care as much as possible that the construction activities should not affect the privacy particularly with reference to women.

iv. Impacts and Mitigations during Operation Phase

During operation stage, fire poses a major risk. Fire protection and detection systems shall be provided to protect life, property, equipment, and operation of the Plant. The systems shall be complete with all necessary piping, pumps, safety valves, mobile equipment, vehicles etc.

The soil can be contaminated during the operation phase due to the many chemicals used in the Power Plant processes. If proper care is not taken for handling, storing and transportation of these toxic substances, they may cause damage to the health of the workers as well as their spills which will not only contaminate the soil and may also impact the workers. Even solid waste generated from the plant can contaminate the soil. SOPs should be followed to avoid spilling of oil and other waste to prevent soil contamination. Floors with impervious top-surface should be designated to avoid the contamination of soils. However, in case soil contamination due to spillage of oil occurs, the contaminated soil should be removed to avoid further contamination of soils. To manage the waste generated from the power plant, provisions should be made for proper solid waste management per guidelines of the Waste Management Framework (WMF) in Chapter 8 of this report.

Cooling water for main cooling cycle will be taken from QB-Link irrigation canal for open cycle cooling system. During a yearly period of canal closure (6-8 weeks) water will be taken from underground wells for cooling towers that have to be developed as part of the EPC Contract. The volume extracted from the canal will be less than 5% of the total water volume, therefore, the impact is not expected to be significant. According to preliminary findings of Groundwater Availability Study, the existing wells show sufficient quantity and suitable quality of well water to provide for the needs of the cooling tower as well as other water needs. However, the main source of recharge of the underground aquifer is judged to be vertical penetration of canal water flowing parallel to the site. This is crucial, since the expected times of high well water extraction is during the period when the canal is empty. It has to be determined if and how the extraction of the needed quantities of raw water from the aquifer will be possible during unavailability of the main recharge source (canal water). Special attention shall be paid to the stability of buildings and foundations of heavy equipment such as gas turbines and the cooling tower structure.

The plant operation will generate Industrial as well as sanitary wastewater. It is estimated that about a maximum of 2 m^3/h of sanitary, 4 m^3/h of industrial wastewater will be generated along with cooling tower blow down (expected concentration factor:4-5) in canal closure period. Only hypochlorite (NaClO) is used in the cooling water, the level will be closely monitored to keep it at the specified value which is evaluated as acceptable for the environment. The industrial wastewater treatment plant shall be constructed to treat all wastewater in compliance with NEQS. It is highly recommended that a separate water quality modeling study be conducted to monitor water quality along a stretch of the QB- Link Canal from the point of discharge of hot water into canal. The Contractor shall investigate the possibility of discharge into the canal during the annual canal closure period. In case treated water discharge is not permitted during this time by the canal authorities, a sufficiently sized seepage pit for all cleaned effluents shall be provided. The location of seepage pit will be finalized by EPC Contractor during the design.

Air quality can be impacted from SO_2, NO_x, PM_{10} and $PM_{2.5}$ emissions which are typical air pollutants. The plant will utilize the RLNG as main and HSD as a backup fuel. The impact on air quality is not expected to be significant for RLNG (main fuel) which is a clean fuel with less air emissions. The stack emission estimates provided by the designer for the RLNG[2] and HSD are within the thresholds of NEQS 2000. The Air Dispersion Modeling (ADM) software ISC-AERMOD View was used for predicting ground level concentrations of the pollutants (SO_2, NO_x, PM_{10} and $PM_{2.5}$) in order to check the compliance with the standards and assess the impacts on receptors. The baseline values of NO_x, SO_2, PM_{10} and $PM_{2.5}$ were measured for 24 hours averaging period. The values are expected to be lower if measured for average annual periods. The 24 hours averaging measurements for SO_2, NO_x and PM_{10} are also lower than average annual thresholds specified by NEQS 2010. However, 24 hours averaging measurement for $PM_{2.5}$ is slightly above the average annual threshold specified by NEQS 2010.

The maximum ground level concentrations as determined by ADM are within limits of NEQS 2000 and 2010 both for RLNG and HSD for 24 hours averaging period. For annual averaging, the results of SO_2, NO_x, and PM_{10} are within thresholds of NEQS 2000 and 2010. The long term baseline monitoring for $PM_{2.5}$ spreading atleast over a period of one year before commissioning of power plant or start of power plant construction should be done to determine the average annual concentration to assess compliance during plant operation. The maximum annual average contribution of $PM_{2.5}$ from the power plant will be 0.036 $\mu g/m^3$ which is quite low.

The stacks of the power plant will be kept high i.e. at minimum 45 m and 60 m above ground level for bypass stack and the main HRSG stack. Low NOx burners will be used in GT to control emissions and the water will be injected during the use of HSD to control the NO_x emissions.
A continuous emission monitoring system (CEMS) will be installed, including flue gas analysers at each HRSG stack. The designer should comply with the standards for CEMS i.e. ISO 10396: Stationary Source Emissions – Sampling for the Automated Determination of Gas Concentrations (2007) and ISO 10849: Stationary Source Emissions – Determination of the Mass Concentration of Nitrogen Oxides – Performance Characteristics of Automated Measuring Systems (04/1996).

Noise and vibration during the operation phase are likely to affect the health of local residents and animals. Some of the noise sources from the proposed Power Plant during the operation phase include noise from the operation of the boilers (steam blowing and purging) as well as combustion. It is already recommended to provide and adjust the height of boundary wall as per distribution of living structures outside the project area. Noise during Plant Operation would be significantly blocked by trees to be planted all along the periphery of the Project Area. Tree plantation should be started during the construction phase. Equipment noise will be controlled using conventional noise control measures, such as insulation, lagging, ear protection, and enclosures as needed to comply with the Pakistan NEQS. Each Gas Turbine (GT) shall be located in a compartment, which shall reduce the dissipated noise. The noise reduction shall achieve a noise level of 85 dB(A) measured one meter away at 1.5 meter height from the floor level. An ambient noise measurement program will be instituted upon executions of the Project which will cover the construction and operation of the project

In order to offset the negative impacts on agriculture crops and other vegetation in the Study Area, the mitigation technologies prescribed for air and wastewater treatment must be implemented at the desired level as discussed in earlier sections concerning mitigation of impacts on air and water resources. Strict control must be exercised for stoppage of killing/poaching of available wildlife species by enhancing protection practices and deploying effective watch and ward system. Large scale planting with suitable indigenous trees, shrubs and ornamental plants in the form of Tree Groves, and Linear plantation will be carried out in accordance with the Tree Plantation Plan to improve aesthetic value and offset the effect of removal of vegetation.

[2] Data provided by the designer to the best of their knowledge. NO_x values have been based on limits, which can be achieved and guaranteed, while the PM values are taken from similar projects on diesel fuel with a typical split between PM2.5 and PM10.

Plantations so raised must be maintained according to the Silvicultural practices which include proper Irrigation, Cleaning, Pruning, Thinning at prescribed intensity, silt clearance and trench-opening, etc. in accordance with the approved practices of Punjab Forest Department.

At operational stage the induction of outside labor may create social and gender issues due to the unawareness of local customs and norms. It will also cause hindrance to the mobility of the local women. Power Plant staff should respect the local community's sensitivity towards their customs and traditions and should obey the local norms and cultural restrictions particularly with reference to women.

H. ENVIRONMENTAL MANAGEMENT PLAN

The EMP of this project is structured into several sections as Regulatory Requirements and Applicable Standards; Mitigation Management Matrix (MMM); Planning for the Implementation of EMP; Institutional Arrangements for the Implementation of EMP and Roles and Responsibilities; Environmental Monitoring Plan; Waste Management Framework (WMF); Emergency Preparedness and Response Framework (EPRF); Evacuation Framework; Health and Safety Management Framework (HSMF); Site Restoration; Change Management Plan (CMP); Construction Material Transportation; Traffic Management Plan (TMP); Training Program; Communication and Documentation; Plantation Plan and Environmental Cost.

MMM has been developed for this project which identifies the impacts and required mitigation measures recommended in EIA; the person/organization directly responsible for adhering to or executing the required mitigation measures.

The immediate institutional requirements considering the existing institutional setup of proponent is the establishment of Environmental Monitoring Cell (EMC). The EMC will have a competent Environment & Resettlement Team (E&RT) that will render its duties in close coordination with the EPC Contractor. This E&RT will remain on-board throughout the construction time and will finally be merged into the proposed Health, Safety and Environment (HSE) Section during operation stage of the project.

The monitoring during the construction phase will be carried out by EPC Contractor and afterwards HSE Section of the Proponent will take the responsibility of all environmental monitoring activities. Before the commissioning of the Power Plant, EPC Contractor will run a Reliability Test Run (RTR) of the Power Plant at various loads to check the reliability of the Power Plant.

One kick off meeting will take place between the Proponent/EMC, EPC Contractor before the start of construction. Monthly meetings will be held during the construction phase at construction camp office. The minutes of meeting will be recorded in the form of a Monthly Environmental Report (MER) to be prepared by EPC Contractor and reviewed by EMC and will be submitted to the Proponent for final approval.

An estimated cost for instrumental monitoring for all the three phases of the Project is calculated as Rs. 1,000,000/- (one time only) for pre-construction phase; Rs. 18,000,000/- (annually) for construction phase; and Rs. 5,000,000/- (annually) for O&M phase of the project. The plantation cost is calculated to be Rs. 350,000/-. Initial cost for establishment of EMC has been calculated as Rs. 28,000,000 for setting up EMC during construction phase (2 years & 3 months) and Rs. 15,000,000/- (annually) by HSE Section during operation phase.

I. CONCLUSION AND RECOMMENDATIONS

It is also recommended that EMP will be made a part of all bidding/tender document. EPC Contractor will be bound to completely implement relevant mitigation measures set out in the EMP for environmental sustainability. EPC Contractor shall prepare an Evacuation; Emergency Preparedness and Response; Waste Management and Health and Safety Plan based on the

frameworks provided in EMP.

Govt. will acquire the private land per provisions of LAA, 1894 ensuring the assessment and payment of compensation for the loss of private land, assets and crops. Proper measures need to be taken to safeguard the livelihoods of the affectees apart from the compensation. Proponent should consult more with the local community of the study area for their need assessment before the commencement of the project to satisfy their concerns. Some Confidence Building Measures (CBMs) in the form of general improvement of the social infrastructure in the villages should be planned and implemented by the proponent to lessen the loss of the local community and to build trust and confidence.

The loss of agriculture due to conversion of agriculture land in to built-up area will be compensated (apart from the compensation as per LAA, 1894) by adopting and promoting modern and scientific irrigation techniques and agricultural practices to be promoted in consultation with the agriculture and irrigation departments like improved variety of seeds, fertilizers and machinery on subsidized rates that will increase the yield and soil fertility.

The impact on air quality is not expected to be significant considering the RLNG which is a clean fuel having less air emissions. The stack air emission will be well within the applicable NEQS limits. The maximum ground level concentrations as determined by ADM are within limits of NEQS 2000 and 2010 both for RLNG and HSD for 24 hours averaging period. For annual averaging, the results of SO_2, NO_x, and PM_{10} are within thresholds of NEQS 2000 and 2010. The long term baseline monitoring for $PM_{2.5}$ spreading atleast over a period of one year before commissioning of power plant or start of power plant construction should be done to determine the average annual concentration to assess compliance during plant operation. The maximum annual average contribution of $PM_{2.5}$ from the power plant will be 0.036 $\mu g/m^3$ which is quite low.

The stacks of the power plant will be kept high i.e. at minimum 45 m and 60 m above ground level for bypass stack and the main HRSG stack respectively. Low NOx burners will be used in GT to control emissions and the water will be injected during the use of HSD to control the NO_x emissions.

If there are any changes in Plant layout, or any other changes in project description then change should be carried out through CMP included in EMP of this report.

CHAPTER–1

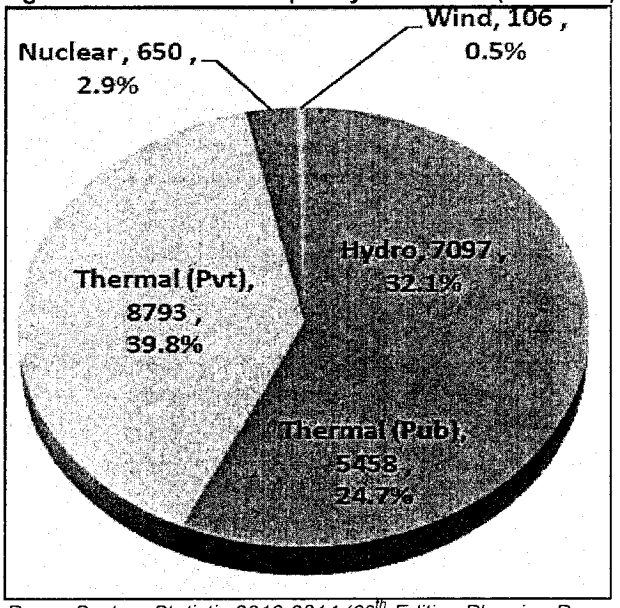
INTRODUCTION

1.1 GENERAL

Power is a lifeline for the economic development of any country. Pakistan is facing acute power shortages. It has been reported that the shortfall in power generation has increased to about 4,000 – 6,000 megawatt (MW) and power shortage is estimated to cost the economy 2% of Gross Domestic Product (GDP) each year[1].

Pakistan is facing immense challenges in power sector. The ever increasing demand of electricity with only marginal addition of generation capacity in the recent past has resulted in long load shedding hours causing resentment in the public in general and has hampered the economic growth of the country. The main issues confronting the power sector include expensive generation mix, inefficient operation of the aging thermal power generating units, high power losses of distribution companies and seasonal reductions in hydropower generation. Another important factor is the rapidly depleting gas reserves that have compelled the supply of gas to be cut down for power generation. This has resulted in greater reliance on alternate expensive fuels such as Heavy Furnace Oil (HFO) and High Speed Diesel (HSD). The cumulative installed capacity including the public and private sector of Pakistan for the year 2013-2014 is shown in Figure 1.1.

Figure 1.1: Installed Capacity- Pakistan (MW & %)



Source: Power System Statistic 2013-2014 (39th Edition Planning Power, NTDC

The substantial increase in the electricity price during the past can be mainly attributed to increase in oil prices in the international market and greater utilization of fuel oil instead of natural gas. It is, therefore, vital to bridge this gap and the Government of Pakistan (GoP) is looking for fast track options to fill this gap on urgent basis with due consideration for the generation mix for rationalizing providing electricity to the masses at affordable price. Installation of new Regasified Liquefied Natural Gas (RLNG) based Power Plants is a step in this direction.

The power shortages, in addition to other impacts, have environmental and social implications as well. Other than complaints of distress by the citizens, there have been

[1] Annual Plan 2013-14, Ministry of Planning, Development and Reforms, Government of Pakistan

Table 4.1: Plant Power Production Efficiency

Sr. No	Data	CC Operation Once Through Cooling	CC Operation Wet Cooling Tower	OC Operation
1.	Net Power (MsW)	1,329	1,320	897
2.	Net Efficiency (%) Lower Heating Value (HV) Based	58.75	58.38	39.51

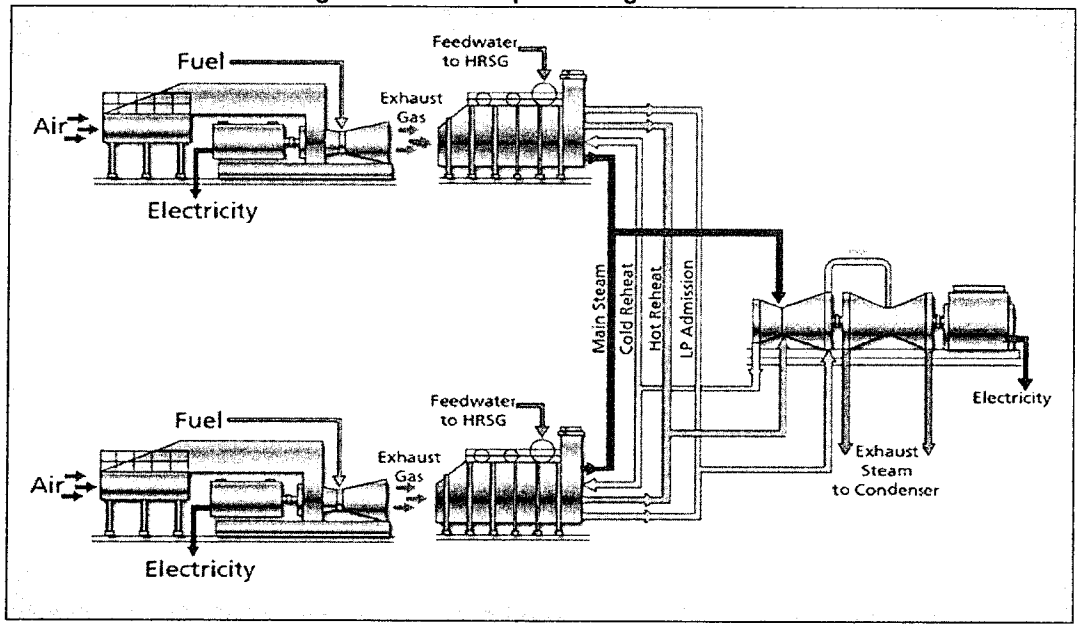
Source: Input Provided by Lahmeyer International

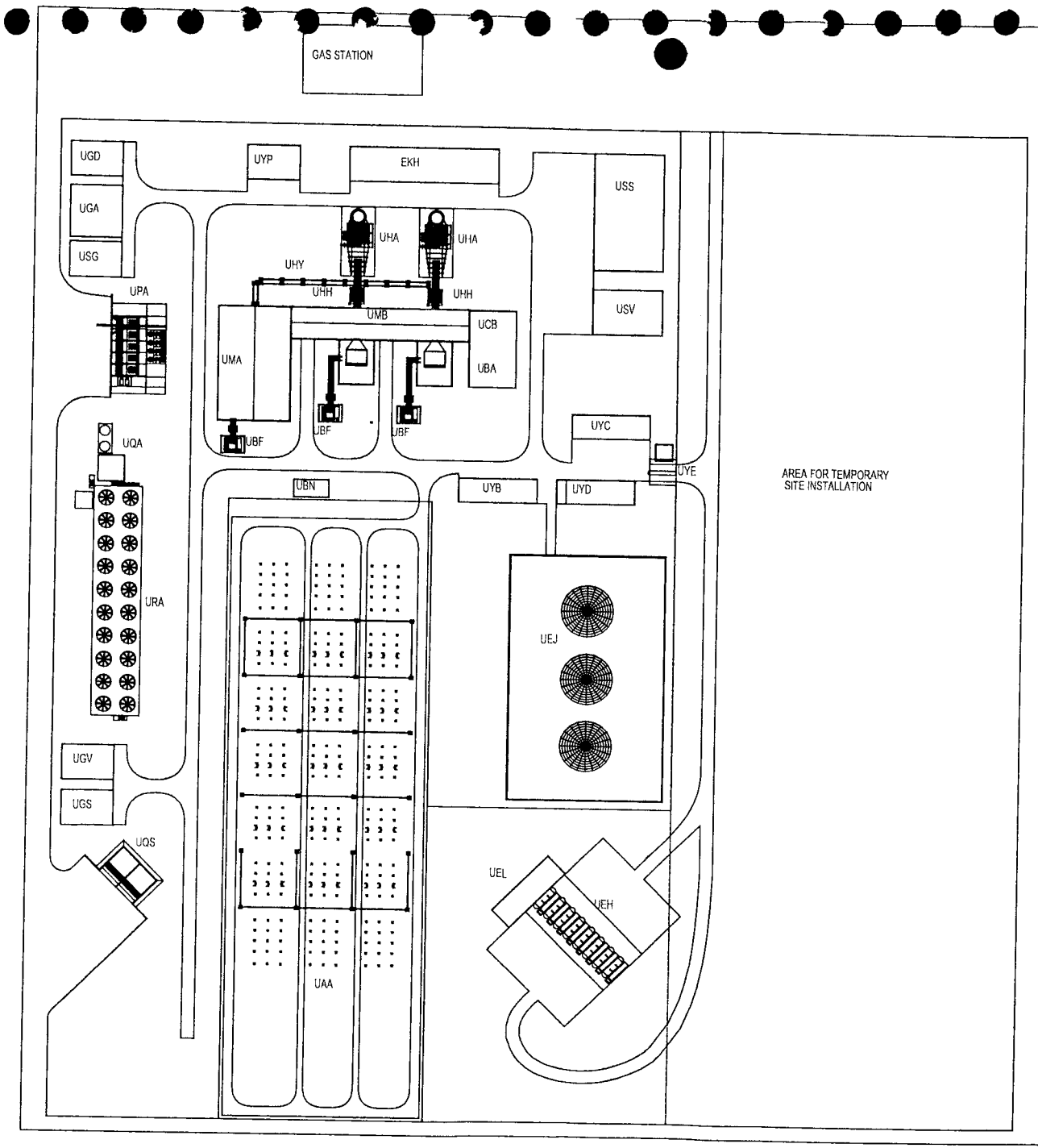
The power plant will be installed to operate first in open cycle mode and then it will be converted into combined cycle. The open cycle operation of the power plant generates the electricity by using gas turbine only without the recovery to waste heat to generate additional electricity by running a steam turbine.

To increase the overall efficiency of thermal power plants, multiple processes can be combined to recover and utilize the residual heat energy in hot exhaust gases. The term "combined cycle" refers to the combining of multiple thermodynamic cycles to generate power. Combined cycle operation employs a heat recovery steam generator (HRSG) that captures heat from high temperature exhaust gases to produce steam, which is then supplied to a steam turbine to generate additional electric power. The combined cycle operation of the power plant increases the efficiency as compared to the single cycle operation.

The design shall provide maximum levels of reliability and availability, convenience of operation and maintenance, neat and orderly arrangement, which shall take into account the functional requirements of various systems and pleasing physical appearance of the completed power station. The CCPP shall be designed for base load operation. A Simplified Conceptual Diagram of a CCPP is shown in Figure 4.1 and the layout plan is shown in Figure 4.2.

Figure 4.1: Conceptual Diagram of CCPP





KKS	IDENTIFICATION
EKH	Main pressure boosting system.
UAA	Structure for switchyard area.
UBA	Central electrical and control building.
UBF	Structure for transformer area.
UBN	Structure for emergency generator set.
UCB	Central control room
UEH	Truck unloading station
UEJ	Diesel storage tanks
UEL	Diesel forwarding pump station
UGA	Structures for raw water supply, cleaning and treatment.
UGD	Structure for water demineralization system.
UGS	Structure for operational / chemical waste water treatment incl. pumping station.
UGV	Structure for sanitary waste water treatment incl. pumping station.
UHA	Structure for HRSG
UHH	Structure for bypass stack
UHY	Bridge structure
UMA	Steam turbine building
UMB	Gas turbine building
UPA	Circulating main cooling water intake structure.
UQA	Circulating main cooling water pump station
UQS	Circulating main cooling water discharge structure.
URA	Cooling tower structure for circulating main cooling water.
USG	Fire extinguishing water pumping station.
USS	Combined workshop and storage building.
USV	Laboratory building.
UYB	Staff amenities building.
UYC	Administration building.
UYD	Canteen.
UYE	Gate house.
UYP	Fire station.

LAYOUT PLAN

1,000-1,500 MW (Gross) RLNG based Combined Cycle Power Plant at Bhikki, Sheikhupura

Figure 4.2

4.5.1 Civil Works

The complete scope of the civil works for the Bhikki power plant project shall provide all buildings and structure for the entire plant to accommodate all necessary work stations for the operation and maintenance of the plant and to accommodate the complete mechanical, electrical and I&C equipment necessary for the operation of the plant. Furthermore the complete infrastructure for the power plant and all temporary facilities needed for the erection of the plant shall be provided within the scope of the civil works.

The major civil works for the Project includes:

- The complete site installation for the Engineering Procurement Construction (EPC) Contractor's use;
- Field laboratory;
- Site offices for Owner/Owners Engineer (supply & erection, fully furnished and handed over to the Owner/Owners Engineer);
- Site preparation works including demolishing old reinforced concrete structures, grading, levelling of the site;
- Access to the site connected to the public road;
- Complete civil engineering and planning for the complete project;
- Multifunction building;
- Security building and necessary infrastructure;
- Main gate house;
- Workshop / central store;
- Turbine hall;
- HRSG foundations;
- Step-up transformers foundations,
- Switchgear building;
- Circulating cooling water pump house;
- Cooling towers and foundations;
- HV-switchgear building;
- Open switch yard;
- Demineralised water plant building;
- Diesel oil tank and facilities (if necessary);
- Industrial waste water treatment plant building;
- Raw water pump house;
- Road grid system, parking areas, hard stands;
- Appurtenant structures, landscaping and gardening;
- Pipe and cable bridges;
- Pipe and cable trenches and ducts, and
- Complete subsoil piping systems for raw water supply from the river, industrial waste water, sewage water, storm water, potable water and firefighting.

4.5.2 Major Equipment's and Structures

a) GT and Auxiliaries

Only the most advanced, reliable heavy duty gas turbine with single fuel firing system shall be taken into account. Finally, Lahmeyer recommended below listed GT series with proven commercial operation record:

- Siemens – SGT5-8000H;
- Alstom – GT26;
- Mitsubishi Hitachi Power Systems - M701F4, M701J;
- GE Water & Power - 9F.05, 9HA.01.

The proposed gas turbine model (50 and 60 Hz model of the same design) shall have:

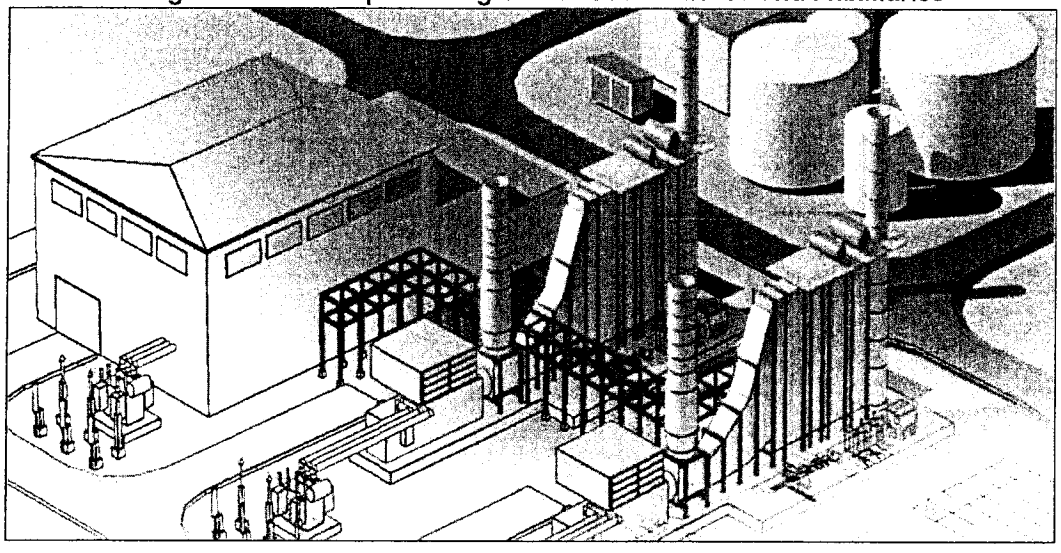
- At least four (4) units in commercial operation since at least one (1) year, or
- At least eight (8) units as firm orders, of which three (3) units shall be shipped in 2016 or earlier.
- For GTs falling under category b) above, an additional two (2) years warranty period is required (above the standard two (2) years Defect Liability Period (DLP)).

Power augmentation via evaporation cooling shall be considered too. In principle, 1 block - a multi shaft configuration with a 2-2-1 configuration with a two heavy duty gas turbines (F/H class), could achieve 1,000 – 1,500 MW net – ISO at high efficiency. 2 blocks with single shaft configuration (2 x 1-1-1) and 1 block with multi shaft (3-3-1) can be concerned too, but final decision depends on economics of submitted proposal.
A combined gas distribution piping system including insulation valves and instrumentation for each the GT units shall be provided. This system shall include but not be limited to:

- Final gas filters in front of each GT unit dual type;
- Piping interconnections of all equipment;
- Sample points;
- Gas detection system;
- Dry low NO_X combustion system for RLNG;
- Gas flow metering separate for each GT-unit.

The conceptual Diagram of GT and Auxiliaries is shown in Figure 4.3.

Figure 4.3: Conceptual Diagram of Gas Turbines and Auxiliaries



b) Heat Recovery Steam Generators (HRSGs)

Heat Recovery Steam Generators (HRSG) shall be designed as an "indoor". Gas turbine and HRSG shall be started up commonly. The gas turbine exhaust gas at start-up is directly led to the HRSG. The HRSG shall be shut down in accordance with the normal gas turbine shutdown. The HRSG shall be provided as once through boiler and/or with adequately dimensioned steam drums to ensure stable operation under all load conditions.

The individual major items are as follows:

- HRSG pressure parts (drums, economizers, evaporators, superheaters, reheaters etc);
- Steam and feed water piping system;
- High Pressure (HP) circulating pumps (in case forced circulation system is offered);
- Intermediate Pressure (IP) circulating pumps (in case forced circulation system is offered);
- Low Pressure (LP) circulating pumps (in case forced circulation system is offered);
- Safety valves and silencers;
- HRSG and external piping ;
- Steam and feedwater valves;
- Drains and vents;
- Blow down equipment;
- HRSG steel structure, platforms, galleries, stairs and lift;
- Heat exchanger chamber;
- Exhaust system (ducts, expansion joints, silencer, chimney);
- Thermal insulation and cladding; and
- Control and monitoring equipment.

The HRSG shall be based on a package concept. This means the supply shall contain prefabricated packages as far as possible.

c) Condensate System

The condensate system shall be designed for the supply of condensate from the ST condenser to the feed water system. The condensate system shall be complete in any respect for safe and reliable operation and shall include, but not be limited to the following main components:

- 2 x 100% condensate pumps complete with motors, couplings, coupling protection;
- Pneumatic or motorised control valve as minimum flow device leading back to condenser;
- Non-return valves and motorised isolating valves at each pump suction and discharge line;
- Sealing water system for valves without bellows normally operating under vacuum, all necessary supporting steel structure, frames, cooling and lubrication system including local instrumentation, drains and vents, control system, switches, etc.,
- Spray water system supplying main condensate from the main condensate pump discharge to the by-pass desuperheating stations, if desuperheated by condensate pumps, ST exhaust hood spray, etc.

Make-up water shall be used for the condensate feed water system (water losses) and for drain condensate cooling. In case the feed water level in the feed water tank drops, make-up water shall be fed to the condenser via a control station. To minimise the O_2 content in the condensate system make-up water shall be sprayed into the condenser by means of spray nozzles. The quantity of make-up water shall be monitored continuously.

d) Feed Water and Steam System

The feed water system shall include, but not be limited to the following main components:

- A combined feed water storage tank for the HRSG or a separate feed water storage tank for the HRSG including steam heating device, and all necessary equipment;
- a spray or degassing type deaerator system which may be combined with the feed water tank(s);
- LP steam and or ST bleed steam supply system for each feed-water tank heating to

required temperatures including steam pressure reducing stations, all necessary nozzles, flanges, local instrumentation, vent and drain system, control system, warming up facilities, etc.;
- Feed water pumps with variable speed drives in sufficient redundancy;
- Automatically operated minimum flow devices with integrated non-return flow function, separate for each individual pump;
- All necessary connecting pipes, including hangers, supports, vent and drain systems, valves, motor valves, non-return valve, strainers, traps; and
- Components of the feed water system piping system, if not specified elsewhere.

The steam systems shall be complete in every respect for safe and reliable operation and shall include, but not be limited to the following main components:

- Steam piping from each HRSG outlet to steam headers near to ST;
- HRSG start up piping with control and motor isolation valves and silencer;
- Steam piping to ST, steam piping connection to by-pass station(s), including stop valves and isolation valves;
- Appropriate steam supply for gland steam, start-up and heating requirements of the plant;
- Spray water pipelines to individual desuperheating stations including spray water flow control stations with individual flow measurement;
- All required draining and venting systems;
- All required warm-up lines for all steam lines including the lines from and to the steam bypass stations;
- Drains and condensate collection system with drain pumps, including start-up atmospheric drains flash tank with necessary silencer, including all necessary equipment.

All drain valves shall be of an approved throttle controlling type and shall have cast or forged steel bodies with covers and glands of approved design.

e) Steam turbine and Condenser

The steam turbine shall be of the condensing type without steam extraction for feedwater heating or other heating purposes. The steam is produced in the HRSGs at three pressure levels, including a reheat after the HP part of the turbine. The amount of produced steam is transferred to the steam turbine to generate power for export to the grid and to cover the auxiliary electricity demand of the auxiliaries.

For the considered configuration of two gas turbines with HRSG producing steam to one common header and feeding one steam turbine, there are restrictions of the turbine manufacturers with regard to the capacity and design. Therefore, the final decision to select one or two steam turbines as well as the selection of live steam parameters should be left to the contractor for competitive reasons.

The LP exhaust steam is condensed in a surface condenser cooled by water of the channel. Depending on ST-manufacturer, the LP exhaust can be of single or double flow design.

The following general requirements shall be considered:

- HRSG with 3 pressure with reheat, condensing type; and
- Modified sliding pressure operation (fixed pressure at low ST loads and sliding pressure at higher ST loads).

Steam turbine generator package shall be completed in every respect for reliable, efficient

and safe operation for achieving high service life time whether mentioned or not in this Employer's Requirements. The following major design features shall be considered:

- Steam admission valves consisting of stop- and control-valve for HP and LP steam;
- Complete oil system;
- Turbine and generator bearing with 2-plane proximity vibration system (monitor, record, trend); and
- Hydrogen-cooled electrical generator.

For condenser, the following general requirements shall be considered:

- Manufacturing, assembling and testing in the workshop to the highest extend possible for improved quality and short erection time on site as applicable;
- Satisfactory performance up to highest cooling water temperature; and
- The condenser shall be complete in every respect for reliable, efficient, and safe operation for a high service lifetime including 100 % bypass operation of steam turbine.

f) EHV Switchyard/Equipment

500 kV outdoor Switchyard and auxiliary systems, mainly:

- Switchyard bus bar protection,
- Control and interlocking bay control units to DCS,
- Control/alarm and protection data communication link to National LDC,
- MWh and kvarh metering facilities,
- Earthing grid,
- Lightning protection,
- Switchyard lighting,
- Fencing of switchyard area,
- Connection tower to 2 x 500 kV power lines for grid interconnection,
- 500 kV interconnecting HV cables to Step-up transformers.

g) Electrical Systems CCPP

- 2 x GT and 1 x ST generator(s) – case 2-2-1;
- Generator connection(s) (IPB), generator circuit breaker(s);
- Step-up transformers, unit auxiliary transformers, aux. transformers;
- MV power distributions (Draw-out type, vacuum type);
- LV power distributions (MCC);
- DC/UPS systems & Emergency diesel generators;
- Electrical control & protection system;
- MV/LV/DC motors;
- Earthing / lightning & cathodic corrosion protection system;
- Plant lighting; and
- Cable and support systems.

h) 500 kV High Voltage Switchyard

The interconnection of the CCPP with the 500 kV substation (double busbar scheme) will be accomplished through 500 kV HV cables from the relevant step-up transformers to correspondingq three breaker bays. Connections among various equipment shall be through Aluminium Conductors Steel Reinforced (ACSR) conductors, All Aluminium Conductors (AAC) conductors, or tubular conductors as deemed most economical. All support structures and gantries shall be of galvanised steel.

i) Generators

Two turbo generators for the GT-units and one turbo generator for the ST-unit with all required auxiliaries shall be supplied, installed and commissioned.

j) Power Transformers

Following transformers shall be supplied, installed and commissioned:

- 2 x Generator transformers BAT, one for each GT-unit, ratio: 525/ U_{Gen} kV, three-phase;
- 3-limb, oil immersed, outdoor type step-up transformer, Cooling ONAN/ ONAF, Tap changer: on-load, motor operated (MR), manually controlled;
- 1 x Generator transformer BAT, for the ST-unit, ratio: 525/ U_{Gen} kV, three-phase, 3-limb, oil immersed, outdoor type step-up transformer, Cooling ONAN/ ONAF, Tap changer: on-load, motor operated (MR), manually controlled;
- 2 x Unit transformers BBT, one for each GT-unit, ratio: U_{Gen} /11 kV for MV-Unit-switchgear, 3-winding, three phase, oil immersed, outdoor type transformer, connected to the GT generator busbars, Cooling: ONAN/ONAF, Tap changer: on-load, motor operated (MR), manually controlled;
- 1 x Unit transformers BBT, for ST-unit, ratio: U_{Gen} /11 kV for MV-Unit-switchgear, 2-winding, three phase, oil immersed, outdoor type transformer, connected to the GT generator busbars, Cooling: ONAN/ONAF, Tap changer: on-load, motor operated (MR), manually controlled;
- Auxiliary MV/LV (oil filled or dry type) station transformers as required at rated voltage, indoor or outdoor type transformers, Cooling: AN, Tap changer: off load, number and rating are depending on number of LV-distributions;
- Neutral earthing transformers for each generator; and
- Multifunctional digital protection equipment shall be provided for transformer protection.

The indicated numbers and ratings of transformers are preliminary only and have to be defined/ verified finally by the EPC Contractor to match with the turbine outputs and further electrical requirements of the envisaged plant.

k) Electrical Auxiliary System

- MV Power Distribution;
- LV Power distribution;
- Safe AC- and DC systems; and
- Emergency Diesel Generator.

l) Electric Control and Protection Systems

Automatic and/or manual control of electrical equipment of the plant shall be co-ordinated and designed accordingly as following:

- Electrical control system;
- Synchronisation devices;
- Electrical metering system;
- Electrical protection system.

m) Lightning System

The lighting system shall include the internal building lighting, emergency and escape lighting and external lighting. The system shall be designed to be fully in accordance with the latest edition of the international electro technical commission (IEC).

n) Instrumentation & Control (I&C) and Communication Systems

The Instrumentation & Control (I&C) system will support an efficient and reliable operation, control, and supervision of the whole plant by a minimal operational staff. Start-up, synchronisation and loading of the GT units, the HRSGs and the ST unit from the Central Control Room will be possible fully automatic through pressing one pushbutton by the operator. Plant operation, control, and supervision will be based on a Distributed Control System (DCS).

4.5.3 Other Physical Facilities

- Supervisory Control and Data Acquisition (SCADA) System;
- Telecommunication system including fiber optic cable and satellite links;
- Security system for all installations;
- Fire and gas detection and alarm system;
- Central Control Room (CCR);
- Control equipment room(s);
- Relay room;
- Battery room;
- Interconnection arrangements;
- Labs;
- Warehouse; and
- Transportation.

4.6 TECHNICAL DATA

Technical parameters of the CCPP are as under:

Table 4.2: Key Technical Data

Sr. No	Action	Data
1.	Combined Cycle Power Plant at Bhikki site	1,000 -1,500 MW – ISO
2.	Heavy-duty gas turbines	330 - 380 MW - ISO
3.	Configuration - 1 x 2xGT-2xHRSG-1xST configuration	-
4.	Basic fuel	natural gas (RLNG)
5.	Back-up fuel	High Speed Diesel
6.	Minimum Net efficiency (LHV) in Combined cycle operation	58% - ISO
7.	Staged construction for early operation in SC mode (from EDOC): SC – first unit CC	 after 18 – 20 months after 28 – 30 months
8.	Indoor installation	-
9.	Once-through cooling system with water from adjacent canal plus wet/dry cooling tower for 1 month (January/February) outage period of canal per year	-
10.	The plant shall be complete in all respect with auxiliaries and balance of plant (BoP) and all other facilities required	-
11.	Potentially, evaporative cooling for GT air intakes	-
12.	Spare parts for 2 years operation	-
13.	Operating modes (OP):	-
	OP1 - with once-through cooling	-
	OP2 - with cooling towers	-
	OP3 - with once-through cooling and evaporating cooling	-
14.	AIS switch yard in 1 ½ breaker type	-
15.	Max weight	550 t
16.	Discount factor	10%
17.	Fuel price (2015) - US$/MMBTU-HHV	10.0

Sr. No	Action	Data
18.	Fuel price escalation	1%

Source: Pre-feasibility Report April, 2015

4.7 FUEL GAS SYSTEM

The gas supply terminal is situated within the power plant's boundaries. There the gas pressure will have a pressure of 20.7 to 27.6 bar (g). The planned supply for the Project is up to 200 Million Cubic Feet/Day (MMCFD). The fuel gas supply system will be designed for flow of sufficient fuel gas according to all requirements of the two (2) Gas Turbines up to peak load operation as well as safe supplies during rapid changes of gas flow due to changing load requirements. The pre-treated gas shall be supplied via one (1) 16" pipeline levels to the power station. The letter from SNGPL commitment for supply of RLNG has been attached as Annex-3.

The reference composition of gas, which is resulting from imported RLNG is given in Table 4.3.

Table 4.3: Composition of Natural Gas

Component	Composition [mole-%]
Methane (C1)	88.852
Ethane (C2)	5.148
Propane (C3)	0.257
Butane and heavier (C4+)	0.183
Nitrogen (N2)	4.815
Carbon Dioxide (CO2)	0.745

Source: Pre-feasibility Report April, 2015

In order to ensure the required gas quality appropriate filters shall be provided for each line as required. For safety reasons emergency shut-off valves shall be supplied downstream yet in proximity to the terminal points. Special attention shall be paid to ensure increased safety against fire hazard due to gas handling. There will be no storage facility of RLNG at the power plant site.

The scope of supply shall include but not be limited to the following main equipment / installations:

- Isolation valve with flange connection at terminal point, connection by Contractor;
- One emergency shut-off valve for the gas supply line in proximity to the terminal points;
- One Check meter with accuracy of ±0.5% and adequate measuring range (online gas chromatograph);
- One single vertical separator scrubber (100% DFR);
- One dual dust filter.

The check – meter shall measure the current as well as accumulated gas flow at an accuracy of 0.5%. The possibility of continuous monitoring and recording of measurements via DCS shall be provided.

4.8 BACK-UP FUEL SYSTEM

As a back-up fuel, high sulphur diesel (HSD) could be used. The composition for HSD is shown in the Table 4.4.

Table 4.4: Fuel Composition of Back-up Fuel (HSD)

Component	Composition (%)
Ash, %wt.	Max. 0.01
Water, %Vol.	Max. 0.10 (import)
Calorific value Btu/lb	Typical 19000
Sulphur content, %wt.	Max. 1.0

Source: Input Provided by Lahmeyer International

The fuel oil system will be optimized and have sufficient redundancy to ensure the maximum availability of the GTs including the phase during a changeover between fuel types. The fuel oil system will include facilities for road tanker unloading, fuel oil storage tanks, and all related equipment. The fuel oil system will be designed to be operable under the coldest specified ambient conditions.

4.9 TRANSMISSION AND DISTRIBUTION SYSTEM

The power will be evacuated by connection to the existing 500 kV high voltage line which is located 2.2 km from the Project Site. Step-up transformers 450 – 650 MVA size is required. Air-insulated switchgear (AIS) in 1 ½ breaker type is included in EPC scope. 500 kV Substation will be built by the EPC Contractor within the boundary wall of the Project.

4.10 WATER REQUIREMENT AND COOLING SYSTEM

The water during the plant operation will be used for sanitary, plant uses and cooling purposes. During ten to eleven months per year, main cooling water will be taken from a canal adjacent to the site of Bhikki PP. The flow of the canal is sufficient then to use 'once through' cooling as the main cooling system technology (called '**System A**' in the following) then. During approx. one to two months per year, water from the canal will be unavailable. In this period, mechanical draft cell-type cooling (called '**System B**' in the following) will serve as the heating sink.

Both main cooling systems, System A – Once-through cooling - and System B - mechanical draft cell-type cooling towers - have to be connected in a manner to allow smooth switch over from System A to System B operation. Interconnection points shall be upstream and downstream of the condenser (after the closed cooling cooler connection). They shall share the cooling water piping through the condenser as well as bypass cooling connection for closed cooling water coolers.

All necessary equipment in order to enable switch over from one main cooling water source to the other (System A to B and vice versa), shall be provided, such but not limited to save isolation of both main cooling water sources (canal water and closed cooling tower water), flushing facilities, etc. Different water quality of main water cooling systems A and B shall be considered for common equipment and interconnection points.

The cooling water requirements are given in Table 4.5 below:

Table 4.5: Cooling Water Requirements

Sr. No	Component	Once through	Wet Cooling Tower
1.	Cooling Water Intake Flow Rate (kg/s)	21,357	--
2.	Cooling Water Outfall Flow Rate (kg/s)	21,357	--
3.	Cooling Water Temperature Rise (K)	8	8
4.	Cooling Water Intake	25	--

impacts on the industrial educational, health and other sectors. The shortage of power results in the use of firewood, kerosene and biomass resulting in deforestation and deterioration of air quality. The power outages also result in the use of small generators in cities and surrounding areas and their emissions of Oxides of Nitrogen (NO_x), Oxides of Sulphur (SO_x), Particulate Matter (PM), other pollutants and noise have negative impacts on environment.

The gap between the cost of producing power and revenue desired from its sale has also widened. Compounding the problem is the cumulative effect of the inter-corporate circular debt in the energy supply chain. The problem of circular debt has to be resolved on war footings. Several options which have lower generation costs include hydropower, coal, RLNG etc. Although, GoP is actively pursuing hydropower, but it entails a longer implementation period. Import of RLNG across the globe will help to bridge the gap between supply and demand which is being faced by Pakistan. GoP has decided to transport the imported RLNG from Karachi through pipeline.

The reserves of natural gas in Pakistan are depleting rapidly; therefore, the present focus is on the imported RLNG. Considering the above situation, use of RLNG is a virtuous option which can lead to power production in a cleaner manner as compared to other fuels. This will require the installation of new power plants. The GoP has planned to use RLNG to lessen its heavy reliance on furnace oil.

Considering the above context, the Government of the Punjab (GoPb) via newly established company. Quaid-e-Azam Thermal Power Company (Pvt.) Limited, has initiated a fast track Project to install a 1,000-1,500 MW (Gross) RLNG based Power Plant at Bhikki, near Sheikhupura to reduce the ongoing acute power crisis.

M/s National Engineering Services Pakistan (NESPAK) Pvt. Limited has been engaged for providing the consultancy services to conduct the Environmental Impact Assessment (EIA) study of "1,000-1,500 MW RLNG based Power Plant at Bhikki."

1.2 PURPOSE AND SCOPE OF THE STUDY

The EIA report has been prepared in accordance with the Terms of Reference (TOR) and scoping attached as Annex-I and keeping in view the following regulations and guidelines:

a) Punjab Environmental Protection Act, 1997 (Amended 2012);
b) Pakistan Environmental Protection Agency (Pak-EPA) Regulations, 2000 for review of Initial Environmental Examination (IEE) and EIA;
c) Pakistan EIA procedures; and
d) Sectoral guidelines for environmental reports: Major Thermal Power Stations, October 1997, EIA Package by Pak-EPA.

The purpose of the EIA study is to identify the possible beneficial and adverse environmental impacts as presently envisaged and propose the practicable mitigation measures to be implemented during construction and operational phases of the Project to minimize the negative impacts of the RLNG based Power Plant only.

The specific stages of EIA Study are:

- Review of available documents;
- Overview of different Project Alternatives;
- Collection of baseline data related to physical, ecological and social domains of environment;
- Evaluation of Project impacts on environment and social settings;
- Conducting, recording and reporting public consultation with stakeholders;
- Suggesting mitigation measures for adverse impacts;

- Preparation of Environmental Management Plan (EMP); and
- Preparation of EIA Report.

Considering the prime importance of the Project and its urgency, the present EIA study has been prepared in parallel to the pre-feasibility study on a very fast track in a very short period of time to meet the targets.

1.3 PROJECT PROPONENT

The proponent for the project is Quaid-e-Azam Thermal Power Company (Pvt.) Limited established by the Government of the Punjab (GoPb).

1.4 EIA TEAM

NESPAK EIA team comprised the following experienced experts:

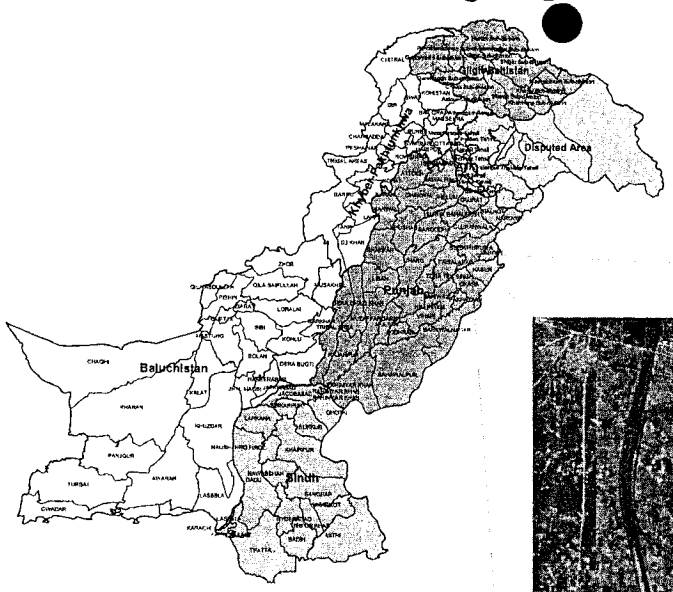
▪ Irfan-ul-Haq	General Manager and Head (E&R)
▪ Imran-ul-Haq	Principal Engineer – Team Leader
▪ Dr. Jahangir Ghauri	Ecologist
▪ Makhdum Ali Sheikh	Ecologist
▪ Saqib Rehman	Environmental Scientist
▪ Hafiz Muhammad Abid Saleem	Environmental Engineer
▪ Waqar Saleem	Sociologist
▪ Shahzad Hasan Rizvi	Sociologist

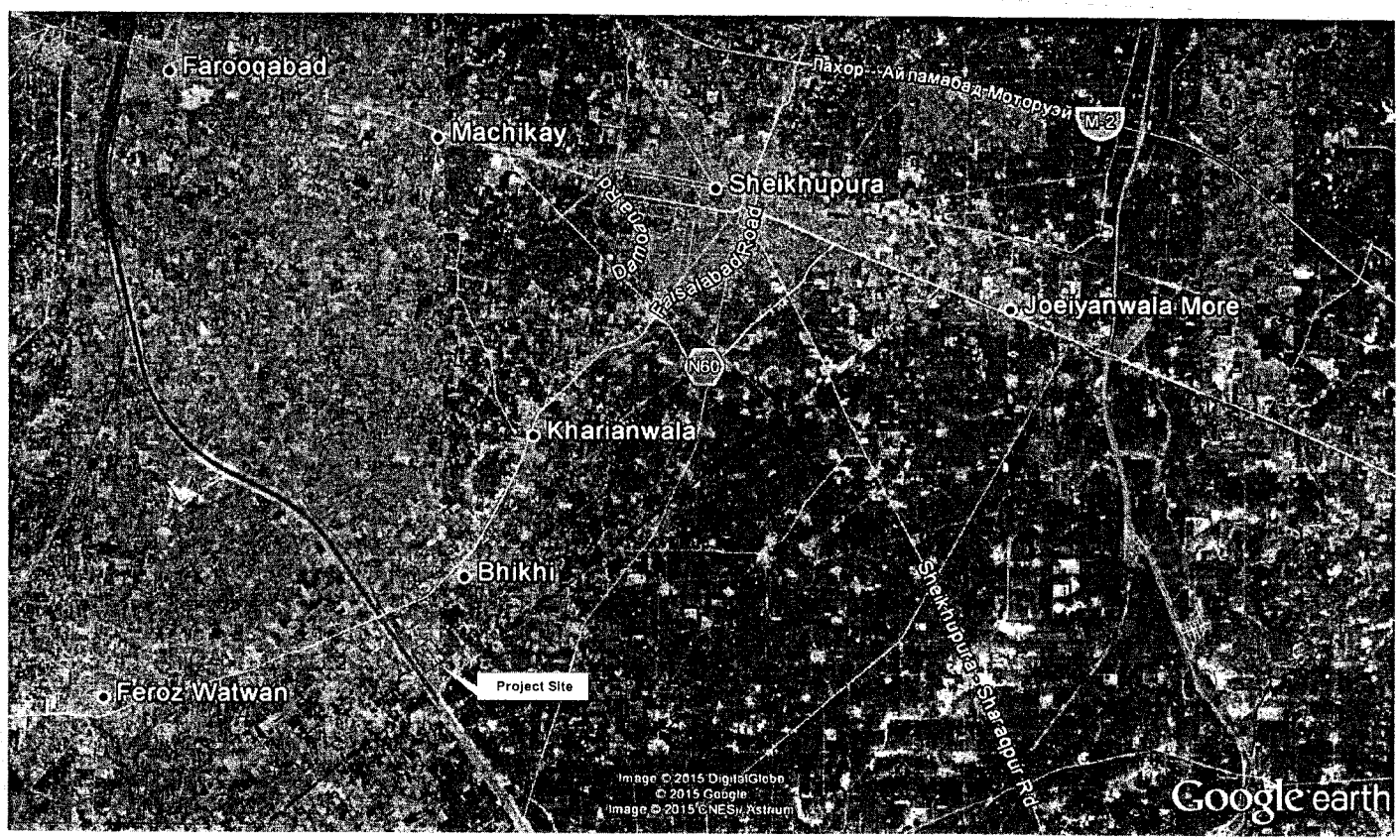
1.5 NATURE, SIZE AND LOCATION OF THE PROJECT

The proposed Project is essentially a RLNG based Combined Cycle Power Plant (CCPP). The Power Plant has a capacity of producing 1,000-1,500 MW (Gross) of electricity. The Power Plant will operate on imported RLNG to be transported from Karachi through pipelines. This power plant site is located at Bhikki near Sheikhupura. The overall location of the Project is shown in Figure 1.2.

1.6 STRUCTURE OF THE REPORT

The EIA report is divided into nine chapters. **Chapter-1** covers introduction to the proposed Project, **Chapter-2** provides the country's environmental legislative requirements and framework applicable to the proposed Project together with the guidelines, **Chapter-3** provides the analysis of project alternatives, **Chapter-4** presents the description of the Project including project components and activities, design parameters, detail of infrastructure facilities etc., **Chapter-5** describes in detail the existing environmental baseline conditions of the Study Area related to the physical, ecological and social domains of environment, **Chapter-6** explains the public consultation mechanism and findings, **Chapter-7** exhibits the impacts assessment at construction and operational phases of the proposed Project along with their mitigation measures, **Chapter-8** outlines EMP along with proposed institutional framework required for effective implementation and monitoring and **Chapter-9** gives the conclusions and recommendations.





OVERALL LOCATION MAP

1,000-1,500 MW (Gross) RLNG based Combined Cycle Power Plant at Bhikki, Sheikhupura

Figure 1.2

CHAPTER – 2

ENVIRONMENT LEGISLATIVE REQUIREMENTS AND FRAMEWORK

2.1 GENERAL

This section deals with the current environmental policy as well as administrative and legal framework and provides an overview of the regulations and guidelines of Pakistan related to the EIA of Thermal Power Plants and specifically Punjab Environmental Protection Act, 1997 (Amended 2012). This is because the 18th Amendment in the constitution of Pakistan has fundamentally altered the division of legislative powers between National and the Provincial Assemblies, resulting in a significant increase in the extent of Provincial autonomy.

After the approval of 18th amendment, powers have been delegated to the provincial Environmental Protection Agencies/Departments (EPAs/EPDs). For the subject Project EPD, GoPb is the concerned authority.

The requirement for an EIA or an IEE is laid out in Punjab Environmental Protection Act, 1997 (Amended 2012). Under this act, no project involving construction activities or any change in the physical environment can be undertaken unless an EIA or IEE study is conducted, followed by an approval from the provincial EPA.

2.2 NATIONAL/PROVINCIAL POLICIES, LAWS, REGULATIONS AND GUIDELINES

2.2.1 National Conservation Strategy, 1992

Pakistan National Conservation Strategy (NCS), which was approved by the federal cabinet in March 1992, is the principal policy document on environmental issues in the Country (Environment and Urban Affairs Division (EUAD)/World Conservation Union (IUCN, 1992)).

The NCS outlines the Country's primary approach towards encouraging sustainable development, conserving natural resources and improving efficiency in the use and management of resources. The NCS has 68 specific programs in 14 core areas in which policy intervention is considered crucial for the preservation of Pakistan's natural and physical environment. The core areas that are relevant in the context of the proposed Project are pollution prevention and abatement, restoration of rangelands, increasing energy efficiency, conserving biodiversity, supporting forestry and plantation and the preservation of the cultural heritage.

2.2.2 National Environment Policy, 2005

In March, 2005 GoP launched its National Environmental Policy, which provides a framework for addressing the environmental issues. Section 5 of the policy commits for integration of environment into development planning as instrument for achieving the objectives of National Environmental Policy. It further states in clause (b) of sub-section 5.1 that EIA related provisions of Environmental Protection Act, 1997, will be diligently enforced for all developmental Projects. It also provides broad guidelines to the Federal Government, Provincial Governments, Federally Administered Territories and Local Governments to address their environmental concerns and to ensure effective management of their environmental resources.

2.2.3 Pakistan Labour Policy, 2010

The main objective of the Labour Policy, 2010 is the social and economic well-being of the labour of Pakistan. The Labour Policy, 2010 has following 4 parts:

i) Legal Framework;
ii) Advocacy: rights of workers and employers;
iii) Skill development and employment; and
iv) Manpower export.

2.2.4 Punjab Environmental Protection Act, 1997 (Amended, 2012)

The Punjab Environmental Protection Act, 1997 (Amended, 2012) is a fairly comprehensive legislation and provides legislative framework for protection, conservation, rehabilitation and improvement of the environment. It contains provisions for the prevention of pollution and promotes sustainable development. The 'environment' has been defined in the Act as: (a) air, water and land; (b) all layers of the atmosphere; (c) all organic and inorganic matter and living organisms; (d) the ecosystem and ecological relationships; (e) buildings, structures, roads, facilities and works; (f) all social and economic conditions affecting community life; and (g) the interrelationships between any of the factors specified in sub-clauses 'a' to 'f'.

The salient features of the law are:

- No proponent of a Project shall commence construction or operation unless he has filed with the Provincial Agency designated by the Provincial EPAs an EIA, and has obtained an approval;
- Establishment and Formation of the Punjab Environmental Protection Council;
- Prohibition of certain discharges or emissions;
- National Environmental Quality Standards (NEQS) for wastewater, air emissions and noise; and
- Law also empowers Provincial Government to issue notices and to enforce them for the protection of the environment.

The Act was amended in 2012 under the 18th amendment which gives legislatives power related to environment and ecology to provincial governments from the Federal government. The provinces are required to enact their own legislation for environmental protection. Other minor amendments include increasing the penalty cost for violations.

The capability of regulatory institutions for environmental management largely ensures the success of environmental assessment to ensuring that development projects are environmentally sound and sustainable.

2.2.5 Pakistan Environmental Protection Agency (Pak-EPA) Review of IEE and EIA Regulations, 2000

This document sets out the key policy and procedural requirements. It contains a brief policy statement on the purpose of environmental assessment and the goal of sustainable development, and requires that environmental assessment be integrated with feasibility studies. It defines the jurisdiction of the Federal and Provincial EPA's and Planning & Development (P&D) Departments. The document lists the responsibilities of proponents, and duties of responsible authorities, and provides schedules of proposals that the Project requires either IEE or an EIA.

This document also provides the environmental screening of the projects under schedule I, II and III as well as laying down the procedure for the environmental approval for filing the case with the concerned EPA for the grant of the No Objection Certificate (NOC).

2.2.6 Pakistan Environmental Impact Assessment Procedures

These guidelines are descriptive documents describing the format and content of IEE/EIA reports to be submitted to Provincial EPA/EPD for obtaining NOC. Following are the major

areas, which are covered by these guidelines:

- The Environmental Assessment report formation (scoping, type and category of Project, description of Project, alternatives, site selection, baseline data);
- Assessing impacts (identification, analysis and significance);
- Mitigation and impact management and preparing an environmental management plan;
- Reporting (drafting style, main features, shortcomings, other forms of presentation);
- Review and decision making (role, steps, remedial options, checks and balances);
- Monitoring and auditing (systematic follow up, effective data management); and
- Project Management (inter-disciplinary teams, programming and budgeting).

2.2.7 National Environmental Quality Standards (NEQS)

The NEQS were first promulgated in 1993 and have been amended in 1995 and 2000, 2009 and 2010. In 2009 the NEQS were amended to include standards for Motor Vehicles Exhaust and Noise, while in 2010 the amendments included standards for Ambient Air, Drinking Water and Noise. NEQS are attached as Annex-2. The following standards are specified therein:

- NEQS for Municipal and Liquid Industrial Effluents;
- NEQS for Industrial Gaseous Emission;
- NEQS for Motor Vehicle Exhaust and Noise;
- National Drinking Water Quality Standards; and
- Ambient Air and Noise Standards.

2.2.8 Land Acquisition Act, 1894

The Pakistani law governing land acquisition is the Land Acquisition Act (LAA) of 1894 and successive amendments. The LAA regulates the land acquisition process and enables the provincial government to acquire private land for public purposes. Land acquisition is a provincial responsibility and provinces have also their own province specific implementation rules like Punjab and Sindh Land Acquisition Rules, 1983. The LAA and its Implementation Rules require that, following an impact identification and valuation exercise, land and crops are compensated in cash at the current market rate to titled landowners. The LAA mandates that land valuation is to be based on the last 3 to 5 years average registered land-sale rates. However, in several recent cases, the median rate over the past one (01) year, or even the current rates, have been applied with an added 15% Compulsory Acquisition Surcharge (CAS) according to the provision of the law. The Affected Persons (APs), if not satisfied, can go to the Court of Law to contest the compensation.

2.2.9 Punjab Katchi Abadis Act, 1992

Amendment Ordinance No. XVIII of 2007 updated the Punjab Katchi Abadis Act, 1986. It made provisions for the regularization of Katchi Abadis and outlined the provision for giving assistance. The ordinance stated that the Director General (DG) shall be appointed by the Government and will be responsible to implement the Act. Subject to the provisions of sub-sections (2), (3), (4) and (5) and the directions, if any, of the government the DG can regularize any settlement of more than 40 dwelling units that was occupied before March 23, 2010. This Act is applicable in combination with LAA to provide compensation to Katchi Abadis.

2.2.10 Cutting of Trees Act, 1975

This Act prohibits cutting or chopping of trees without permission of the Forest Department. The act presents fine or imprisonment or both, for illegal cutting of tree but has not

mentioned any compensatory afforestation. However, it's a common practice to plant 7-10 trees for compensation of 1 tree to be rooted up.

2.2.11 Punjab Wildlife Act, 1974

This Act was enacted in 1974 for the regulation of activities relating to protection, conservation and management of Wildlife in the province. Enabling rules were notified in the same year to enforce the Act.

2.2.12 Punjab Plantation and Maintenance of Trees Act, 1974

The provincial government enacted this law in 1974 to regulate tree plantation and enforce measures for the protection of tree plantations in the province.

2.2.13 Antiquities Act, 1975

The Antiquities Act of 1975 ensures the protection of cultural resources in Pakistan and aims to protect 'antiquities' from destruction, theft, negligence, unlawful excavation, trade and export. Antiquities have been defined as ancient products of human activity, historical sites, or sites of anthropological or cultural interest, and national monuments. The law prohibits new construction in the proximity of a protected antiquity and empowers the GoP to prohibit excavation in any area that may contain articles of archeological significance.

2.2.14 Pakistan Penal Code, 1860

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

2.2.15 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 Operation and Maintenance (O&M) works to be carried out during the proposed Project.

2.2.16 Punjab Irrigation and Drainage Authority Act, 1997

This Act aims to implement the strategy of the GoPb for streamlining the Irrigation and Drainage System; to replace the existing administrative setup and procedures with more responsive, efficient and transparent arrangements; to achieve economical and effective O&M of the irrigation, drainage and flood control system in the Province; and to make the irrigation and drainage network sustainable on a long-term basis and introduce participation of beneficiaries in the operation and management.

2.2.17 Pakistan Clean Air Program

The Pakistan Clean Air Program (PCAP) is an initiative of the Pak-EPA to comprehensively address the air quality issue in the country. Key elements of the PCAP include an Air Quality Monitoring Program, Air Quality Indicators, Research Program, Air Quality Resource Center, Regulatory Measures, Economic Instruments, Emissions Inventory, Air Dispersion Models and Air Quality Abatement Technology Clearing House.

The objectives of the program are to:

- Protect and enhance the quality of the country's air resources;

- Protect public health and welfare against any actual or potential adverse effects that may reasonably be anticipated to accrue from air pollution;
- Preserve, protect, and enhance the air quality in urban areas and the countryside and in areas of natural, recreational, scenic, cultural, or historic value, in particular, the protected areas of the country, i.e. national parks, wildlife sanctuaries, game reserves, and national monuments;
- Ensure that economic growth will occur in a manner consistent with the preservation of existing clean air resources;
- Assure that emissions from any source in any province do not interfere with pollution prevention programs in any other province; and
- Assure that Pakistan's international obligations regarding the trans-boundary effects of air pollution are met.

2.2.18 Guidelines for Public Consultation

These guidelines deal with possible approaches to public consultation and techniques for designing an effective program of consultation that reaches out to all major stakeholders and ensures the incorporation of their concerns in any impact assessment study. These guidelines cover:

- Consultation, involvement and participation of stakeholders;
- Effective public consultation (planning, stages of EIA where consultation is appropriate); and
- Facilitation involvement (including the poor, women and Non-Governmental Organizations (NGOs).

2.2.19 Sectoral Guidelines for Environmental Reports, Major Thermal Power Plants, October 1997

These guidelines deal with major thermal Power Plants, which will be defined as those producing electrical energy from fossil fuels (coal, oil or gas). These guidelines identify the key environmental issues that need to be assessed as well as mitigation measures and Project alternatives to be considered in the actual EIA. These guidelines include:

- A sector overview of the industry and the processes;
- Potential impacts on the environment;
- Mitigation measures (abatement technologies);
- Monitoring and reporting;
- Management and training; and
- Checklist of likely environmental impacts and mitigation measure.

2.3 INTERNATIONAL GUIDELINES, PROTOCOLS AND AGREEMENTS

As Pakistan is a member of a number of international organizations like United Nations Organization (UNO), Organization of the Islamic Conference (OIC), South Asian Association for Regional Cooperation (SAARC), Economic Cooperation Organization (ECO) etc., so it has to follow the international protocols and obligations related to the environment. The protocols and obligations related to the proposed Project are as under:

2.3.1 Convention on Biological Diversity, 1994

The Convention on Biological Diversity (CBD), known informally as the Biodiversity Convention, is an international legally binding treaty. The Convention has three main goals:

- Conservation of biological diversity (or biodiversity);
- Sustainable use of its components; and
- Fair and equitable sharing of benefits arising from genetic resources.

In other words, its objective is to develop national strategies for the conservation and sustainable use of biological diversity. It is often seen as the key document related to sustainable development.

2.3.2 The Rio Declaration, 1992

The Rio Declaration comprises 27 principles which address important issues such as; sustainable development to integrate environmental protection into the development process; common but differentiated responsibilities to conserve, protect and restore the earth's ecosystems; public participation and information access at the national level, reduce and eliminate unsustainable patterns of production and consumption.

Table 3.1: Power Generation by Natural Gas in Various Countries

Sr. No	Country	Power Share Produced by NG (%)
1	Netherlands	54.3
2	Mexico	52.2
3	Ireland	49.7
4	Italy	46.1
5	Turkey	43.6
6	Japan	41.5
7	USA	29.8
8	UK	27.7
9	Belgium	26.6

Source: Electricity production from natural gas sources (2010-2014), The World Bank

Natural gas is likely to remain a key component of the fuel mix for power generation to meet electricity demand, especially the growing demand in developing countries. According to the GoP and the World Bank, in 2013 Pakistan produced 29% of energy from natural gas. Bearing in mind the country's depleting natural gas resources and drastically increasing energy demands, it is need of the hour to import Liquefied Natural Gas (LNG) for the purpose of regasification and power generation.

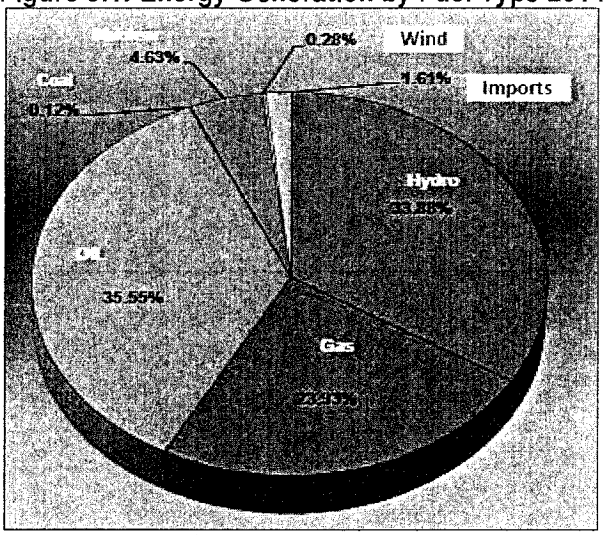
1,500 MW of electricity to be produced by the proposed project makes up 30% of the present gap between demand and supply. Therefore, the project can play an effective role to bridge up the widening gap between demand and supply. Considering the above scenario, if the 1,500 MW power plant is not installed on RLNG, then Pakistan will be deprived of this electricity generated which can help to fill in the demand and supply gap. In view of above scenario and justification, the NPO is not viable for this project.

3.3 POWER GENERATION OPTIONS

Two major potential power generation options available in Pakistan are hydel power and thermal power generation by use of natural gas, coal and oil.

In Pakistan, energy generation by various fuels is shown in Figure 3.1. The figure clearly indicates that major chunks of energy are produced by hydro, gas and oil.

Figure 3.1: Energy Generation by Fuel Type 2014



Source: Power System Statistics 2013-2014 - NTDC

As a first option, Hydel power was considered being friendlier to natural environment during operational phase. Various feasibilities are available or in progress for various hydel power generation projects in Pakistan like Basha Diamer Dam and other small Hydel projects. Dasu Hydropower Project has already been initiated. As per Water and Power Development Authority (WAPDA) Vision 2025 program, these projects are required to be implemented as soon as possible but will take long time to be completed.

In view of the long-lead-time required to bring large hydel projects online, GoP's intention is to solicit bids for thermal projects, for which feasibility studies are already available or can be prepared on a very fast track basis. The immediate solution to the power shortage in Pakistan is the implementation of thermal power projects based on fossil fuels.

In this regard, GoPb also took an initiative to generate electricity in order to reduce load shedding. Therefore, 1,000-1,500 MW RLNG based CCPP initiated by Quaid-e-Azam Thermal Power Company (Pvt.) Limited based on imported LNG and its regasification near Bhikki was considered as a feasible option as it will reduce the overall power shortages in Pakistan. The Project will be connected with national grid and will reduce the power shortages in national grid.

3.4 SITE ALTERNATIVES

Three alternative sites were identified initially for the proposed RLNG based Thermal Power Plant as shown in Figure 3.2. These sites were limited to the province Punjab. A brief technical evaluation is given below:

3.4.1 Site A: Land near Qadirabad Balloki (QB) Link Canal near Bhikki, Sheikhupura

This site is located about 2 km off Sheikhupura-Faisalabad Road. The site is adjacent to QB-Link Canal and Shorkot-Pir Mahal-Jaranwala-Sheikhupura single railway track. Gatti-Lahore double circuit 500 kV transmission line traverses about 2 km from the site.

3.4.2 Site B: Land near Balloki Sulemanki (BS) Link Canal near Changa Manga, Kasur

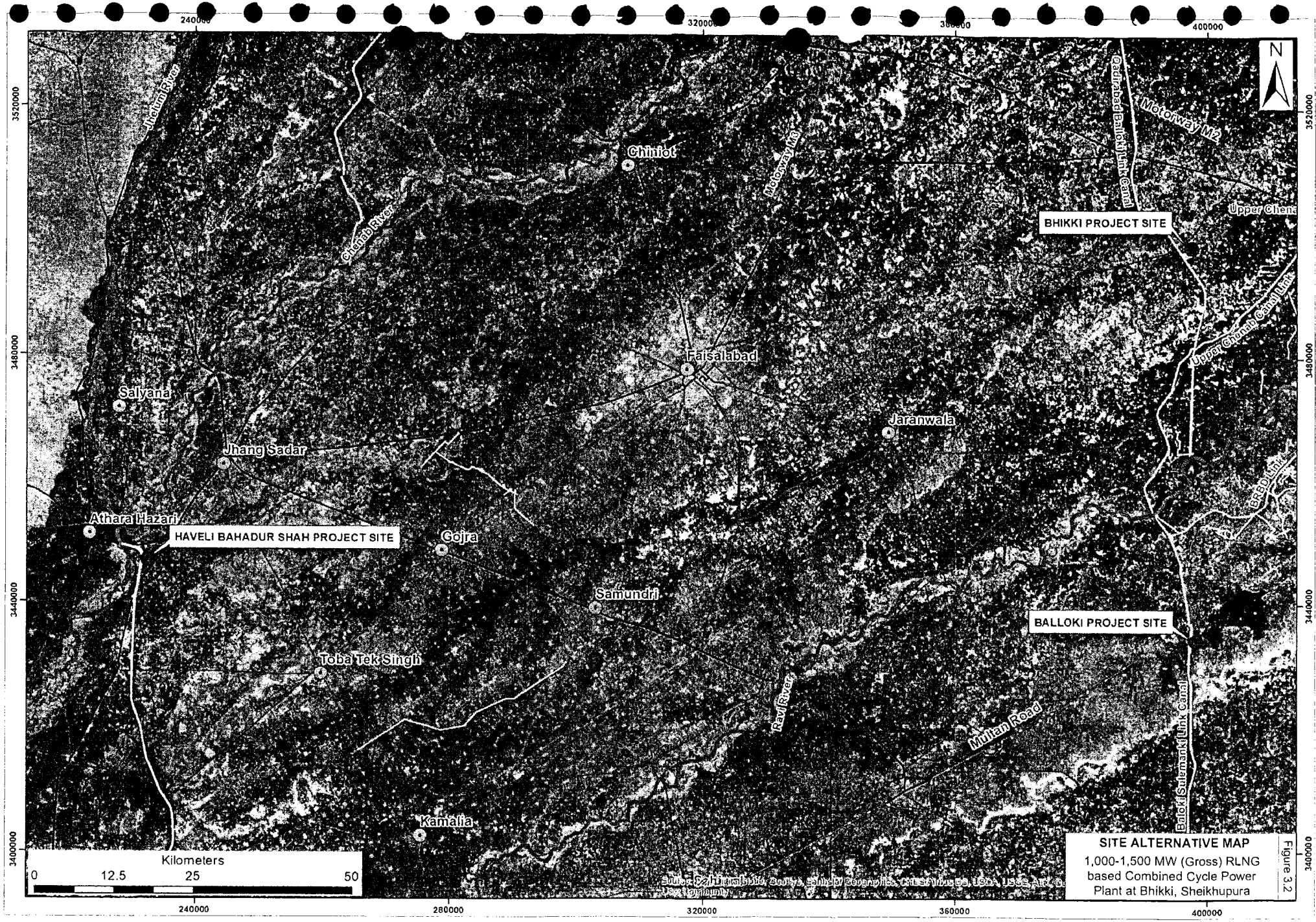
This site falls within the area of Changa Manga and is located near the BS-Link Canal. Nearest Railway Station is Changa Manga which is approximately 05 km from the site. Nearest main road is Multan road (N5) which passes 6.5 km from the site. A 500 kV Transmission Line of approximately 40 km length from Proposed Site to Lahore South is envisaged.

3.4.3 Site C: Land near Trimmu Sidnai (TS) Link Canal near Haveli Bahadur Shah, Jhang

This site is located near Jhang-Shorkot Road at about 47 km from Toba Tek Singh. The Proposed Site is adjacent to TS-Link Canal. Railway line is approximately 5.5 km from the site. Nearest main road is Multan road (N5) which passes 80 km from the site. Two 500 kV lines are passing near to the proposed site. i) Muzaffargarh Gatti passes approx. 3 km and ii) Multan Gatti passes approx. 25 km.

3.4.4 Suitability to Proposed Project

All the three evaluated sites have the essentials for a thermal power plant, such as, proximity to major roads and railway track, proximity to canals for cooling water and proximity to 500 kV transmission lines for power evacuation.


240000
320000
360000
400000
3520000
3480000
3440000
3400000
N
Jhelum River
Chenab River
Chiniot
Motorway M3
Sadiqabad Balloki Link Canal
Motorway M2
BHIKKI PROJECT SITE
Upper Chenab Canal Link
Faisalabad
Salyana
Jaranwala
Jhang Sadar
Athara Hazari
HAVELI BAHADUR SHAH PROJECT SITE
Gojra
Samundri
BALLOKI PROJECT SITE
Toba Tek Singh
Ravi River
Multan Road
Balloki Suleman Ki Link Canal
Kamalia
Kilometers
0
12.5
25
50
SITE ALTERNATIVE MAP
1,000-1,500 MW (Gross) RLNG based Combined Cycle Power Plant at Bhikki, Sheikhupura
Figure 3.2

3.5 FUEL ALTERNATIVES

Main fuels which are considered in Pakistan for power generation include the local Natural Gas, HFO, HSD (mostly as a stand by fuel) and Coal.

However HFO is are mostly used for thermal power generation. The main issues with this fuel include high SO_2, NO_2 and PM emissions. Imported HFO is expensive and cost of the power generation with this fuels is higher as compared to any other indigenous fuel in Pakistan.

There are technologies available to burn coal but coal combustion through any technology may result in toxic emissions. Some of the coal combustion technologies are pulverized fuel combustion, Fluidized Bed Combustion (FBC) and coal gasification. All the processes involve coal burning and air pollutant emissions. In order to control air and wastewater emissions from the burning coal, Clean Coal Technologies (CCT) are used. However, use of these technologies involves higher capital and operation & maintenance cost which might not be sustainable for a developing country like Pakistan.

Therefore, considering the above mentioned limitations in the supply of local natural gas, coal combustion and high price of the imported HFO, imported LNG has been selected as the most feasible source.

3.6 TECHNOLOGY ALTERNATIVES

Different alternatives were considered for the gas turbines. The major advantages and disadvantages of these technologies are described below:

3.6.1 Aero-Derivative Gas Turbines

a) Advantages

- Core part, multi-shaft design, of such industrial application of airborne gas turbines are built in huge quantities;
- Power turbine section built as modular system, easy installation/ removal-exchange for maintenance purposes, hence very short outage time, say 2-3 days for exchange of module or GT complete;
- GT lead time 6-9 months (confirmed by manufacturers);
- Relatively high efficiency for single cycle operation;
- Short starting time up to full load, typically 10 minutes;
- Best choice for peaking operation, black-start and grid stabilization/reactive power;
- Typical schedule for execution EPC project is estimated 8-12 months.

b) Disadvantages

- Relatively high price per installed kW;
- Relative low efficiency for combined cycle operation;
- Special lubrication required for ball and roller bearings, different to generator on journal bearings;
- Gearbox required between power turbine and generator;
- Unit size limited to 60 MW (100 MW with compressor intercooling-not recommended), twin unit 120 MW

3.6.2 Heavy-Duty Gas Turbines

a) Advantages

- Built on demand in small quantities; about 12 months+ lead time for GT only;
- Simple design for long-term trouble free operation (single shaft, journal bearings);
- Bigger units have a good efficiency for single cycle operation ~40%;
- Biggest units have highest efficiency around 60% in CC mode;
- Unit size up to 420 MW; step-up to 500+ kV required;
- Bigger size have lowest capital cost per kW;
- Best choice for base load operation and load following operation;
- Lowest possible cost per kWh on Net Present Value (NPV) basis for 25 year life-time.

b) Disadvantages

- Maintenance takes up to 6 weeks for major overhaul at site;
- Big units are very heavy, ~400 t, a transport issue;
- Typical EPC schedule: 18-21 months-SC, 24-30 months-CC; fast track- can be a bit quicker.

Based on above, discussion with major representatives of GoPb, the Combined Cycle mode with high efficient heavy-duty gas turbines was recommended.

3.7 POLLUTION CONTROL ALTERNATIVES

There are two primary control techniques considered for the control of NO_x: (1) combustion modifications to suppress the formation of NO_x, and (2) add-on controls to reduce NO_x to molecular nitrogen.

a) Combustion Modifications

Most of these techniques involve a reduction in the peak gas temperatures, a reduction in the oxygen concentrations in the high temperature areas of the burner flames, and/or a reduction in the residence time of combustion products in the high temperature areas of the burner flame. A partial list of the combustion modifications to reduce NO_x formation is provided below:

- Low excess air operation;
- Off-stoichiometric combustion (Low NO_x Burners, Overfire Air and Burners out of Service); and
- Flue gas recirculation.

b) Post Combustion Control

Due to the limitations of combustion modifications, add-on control systems are being developed to decrease NO_x emissions below the levels possible by means of combustion modifications alone. There are two categories of add-on control systems that are applicable to boilers and other combustion processes.

- Selective Non Catalytic Reduction (SNCR); and
- Selective Catalytic Reduction (SCR).

Both types of systems inject ammonia or urea into the gas stream to reduce nitrogen oxides to molecular nitrogen and water.

For this Project, low NOx burners has been selected as the most easily adoptable option in Gas Turbines which can result of about 50% of NOx. However, control of NOx during the use of HSD, water will be injected to control the NO_x emissions.

3.8 ALTERNATIVES FOR THE SELECTION OF COOLING SYSTEM

Water use and conservation at electric Power Plants have been an important siting issue in Pakistan and anywhere else. The requirement of water for condensing exhaust steam from steam turbines (ST), generally known as Power Plant cooling, is the largest use of water at the most of the plants. For Power Plant thermal discharge, there are different cooling methods which include once-through cooling water system, recirculation water cooling system and air cooling. For this project, once through and mechanical draft cell-type (with cooling towers) systems were considered.

During ten to eleven months per year, main cooling water will be taken from QB Link Canal adjacent to the Project Site. The flow of the canal is sufficient to use 'once through' cooling as the main cooling system technology. During approx. one to two months per year, water from the canal will be unavailable. In this period, mechanical draft cell-type cooling towers will serve as the heating sink for which ground water will be used. All necessary equipment in order to enable switch over from one main cooling water source to the other shall be provided.

3.9 WASTEWATER DISCHARGE ALTERNATIVES

Different alternatives considered for the disposal of plant wastewater after the treatment include the following:

Option-1: Discharge of Treated Wastewater in Qadirabad-Balloki (QB) Link Canal

The treated wastewater can be discharged into QB-Link Canal. However, following are the major consideration while selecting this alternative:

- Approval from Irrigation Department will be required for discharge of treated effluent into main canal;
- The treatment should be decided carefully to prevent health hazard as canal water is also being used for recreation purpose such as bathing by locals; and
- It may also affect the livestock and animals which consume the canal water for drinking purpose.

Option-2: Recycling and Reuse of Treated Wastewater

Recycling and reuse of the treated wastewater was also considered in which wastewater after treatment can be used in-house for the plantation within the plant boundary and in the surrounding agricultural areas. Mainly three types of wastewater will be generated from the proposed Power Plant. The sewage wastewater can be used for watering vegetation within the colony and the surroundings of the Power Plant. However, 100% water cannot be recycled.

Option-3: Construction of Seepage Pit

The Contractor shall investigate the possibility of discharge into the canal during the annual canal closure period. In case treated water discharge is not permitted during this time by the canal authorities, a sufficiently sized seepage pit for all cleaned effluents shall be provided.

All the above options will be adopted for the disposal of the treated wastewater from the Power Plant.

CHAPTER – 4

PROJECT DESCRIPTION

4.1 GENERAL

This chapter describes the Project, site features, impetus and components of the project, technical data, fuel gas system, backup fuel system, transmission and distribution arrangements, water requirements and cooling system, raw water intake and outfall, wastewater generation and treatment, air emission controls, maintenance facilities, main phases of EPC, project implementation schedule and project cost.

4.2 THE PROJECT

The proposed Project is essentially a RLNG based CCPP. The Power Plant shall be of producing 1,000-1,500 MW electricity. The Power Plant will operate on imported RLNG to be transported from Karachi through pipelines. However, HSD will be used as backup fuel.

4.3 SITE FEATURES

The Project Site is adjacent to Qadirabad-Balloki (about 100m) and Shorkot-Pir Mahal-Jaranwala-Sheikhupura single railway track (approx. 200 km from Shorkot). Gatti-Lahore double circuit 500 kV transmission line traverses about 2 km from the site. The main access road to the Power Plant will be Sheikhupura Faisalabad Road which passes approx. 1 km from the Project Site.

4.4 IMPETUS OF THE PROJECT

The project is aimed to provide additional power to the National Grid by using RLNG Based CCPP in view of the higher price of other resources like RFO, HFO etc. for production of affordable electric power and to help narrowing the gap in the supply and demand. The main objectives of the Project are as follow:

- To provide adequate power generation capacity at the least cost;
- To encourage and ensure exploitation of imported LNG for development of Thermal Power Generation projects in the country;
- To encourage the local engineering industry to form joint ventures with foreign companies for participation in the development of the Power Generation projects.
- To protect the environment;
- To achieve energy generation self-sufficiency in order to support economic growth and reduce poverty;
- To provide affordable electricity to the main load centers through National Grid;
- To reduce the load shedding in the country; and
- To provide energy security to the country.

4.5 COMPONENTS OF THE PROJECT

The combined cycle power plants utilizing large sized heavy duty Gas Turbines (GT) have several advantages and are known for their reliable long term trouble free operation, high thermal efficiency and are the best choice for base load operation. The application of large GT in CCPPs results in lowest possible cost per kWh on Net Present Value (NPV) basis for 25 year life-time. Plant power production efficiency at Reference Site Conditions (RSC) is given in Table 4.1 below:

Sr. No	Component	Once through	Wet Cooling Tower
	Temperature (°C)		
6.	Cooling Water Intake Salinity		
7.	Cooling Water Intake pH		
8.	Discharged Cooling Water Temperature (°C)	33	--
9.	Discharged Cooling Water Salinity		
10.	Discharged Cooling Water pH	6 - 9 according to specification*	6 - 9 according to specification*
11.	Air Into Cooling Tower	--	24 °C / 70 % rH / 12,469 kg/s
12.	Air leaving Cooling Tower	--	33 °C / 100 % rH / 12,715 kg/s
13.	Makeup Water Flow Rate (incl. Blowdown) (kg/s)	--	308.20

Source: Input Provided by Lahmeyer International
(* In case of out of range values, discharge valve to be closed and neutralisation to be carried out)

Water for firefighting shall be available according to the Codes and Standards of NFPA (National Fire Protection Association, USA) regulations. Sufficient volume of water may be provided by using water quality of filtered water, permeate water, potable/service water. The Contractor may provide the continuous available volume either via a permanent dedicated fire water tank or one sufficiently sized storage tank. Fire water system shall be provided with 2 x 100% electric pumps and one diesel driven pump.

4.11 WATER TREATMENT

The water extracted for use will be treated with the help of water demineralization, chlorination and potable and service water treatment plants installed at the power plant.

4.12 RAW WATER INTAKE / OUTFALL

Canal water for cooling and other purposes of the CCPP shall be extracted from the existing canal by means of intake water pumps mounted on a floating pontoon. Location of the pontoon will be at the southern part of the sedimentation pond adjacent to the northern fence of the CCPP site. Interface point will be at the intake pipe inlet screening facility below the pontoon structure.

The cooling water system blow down water, collected storm water, and all other treated plant effluents shall be discharged through an outfall pipeline into the existing sewerage canal system and from there to the canal. Interface point will be at the outlet of the outfall pipeline to the existing sewerage canal system.

Sanitary sewage of the buildings of the CCPP site will be treated in a dedicated biological sewage treatment plant and the treated effluent will be discharged into the existing sewerage canal system and from there to the canal. Interface point will be at the outlet of the outfall pipeline to the existing sewerage canal system.

4.13 WASTEWATER GENERATION AND TREATMENT SYSTEM

The plant operation will generate Industrial as well as sanitary wastewater. It is estimated that about a maximum of 2m³/h (max 200 staff, 250l/d/person) of sanitary, 4m³/h of industrial

wastewater will be generated along with cooling tower blow down (expected concentration factor: 4 - 5) in canal closure period.

Treated waste waters from sanitary and industrial WWT; WWT plants will be designed to meet NEQS.

4.13.1 Industrial Wastewater Treatment and Disposal

The industrial waste water treatment plant shall be constructed to treat all waste water occurring during operation and maintenance of the power plant. The facilities have to be capable to achieve discharge limits for discharge into surface waters, stipulated in the most recent issue of the Pakistan National Environmental Quality Standards (NEQS).

Industrial wastewater will be treated by oily water treatment, clarifier, filter, sludge thickening. The treated wastewater will be monitored and disposed to outfall.

4.13.2 Sanitary Wastewater Treatment and Disposal

Sanitary WWT will be treated by screening, aeration, clarifier, chlorination, and sludge thickening. The treated wastewater will be monitored and disposed of in the outfall. The waste after treatment can also be used for fertilizing purposes.

The Contractor shall investigate the possibility of discharge into the canal during the annual canal closure period. In case treated water discharge is not permitted during this time by the canal authorities, a sufficiently sized seepage pit for all cleaned effluents shall be provided.

4.14 AIR EMISSIONS CONTROL

The plant is not expected to generate high concentrations of air pollutants. The internal combustion temperature will be greater than 1,300 °C and low NOx burners will be used for control of oxides of Nitrogen. Flue gas cleaning is not required due to the low Sulphur content of the fuel. A maximum content of total Sulphur of 20 grains/100 SCF will lead to 28.46 mg/Nm³ SO_2 emissions at 15% O_2. For backup fuel, the concentration emissions of SO_2 will be of 546 mg/Nm^3 for combined and open cycle.

4.15 MAINTENANCE FACILITIES

The Contractor shall develop an in house facility for scheduled maintenance, forced outages and emergency maintenance. Mechanical, electrical, Instrumentation and Control (I&C) workshops, chemical and industrial labs shall be developed too. The tools & plants required for chemical laboratory, electrical & electronic instruments for electrical laboratory and the workshop equipment and accessories as required will be identified and will be supplied to the plant by EPC Contractor.

4.16 FIREFIGHTING SYSTEM

Fire protection and detection systems shall be provided to protect life, property, equipment, and operation of the Plant. The detection and fire alarm, fire protection and fire-fighting systems shall include, but not be limited to the following:

- Fire fighting water storage, may be combined with raw water tank, depending on local regulations;
- Fire fighting pumps;
- Fire water ring main system, including hydrants;
- Fire protection systems; and
- Fire alarm and detection system.

All systems shall be subject to the approval of the insurance company. The systems shall be complete with all necessary piping, pumps, safety valves, mobile equipment, vehicles etc.

4.17 MAIN PHASES OF EPC PROJECT

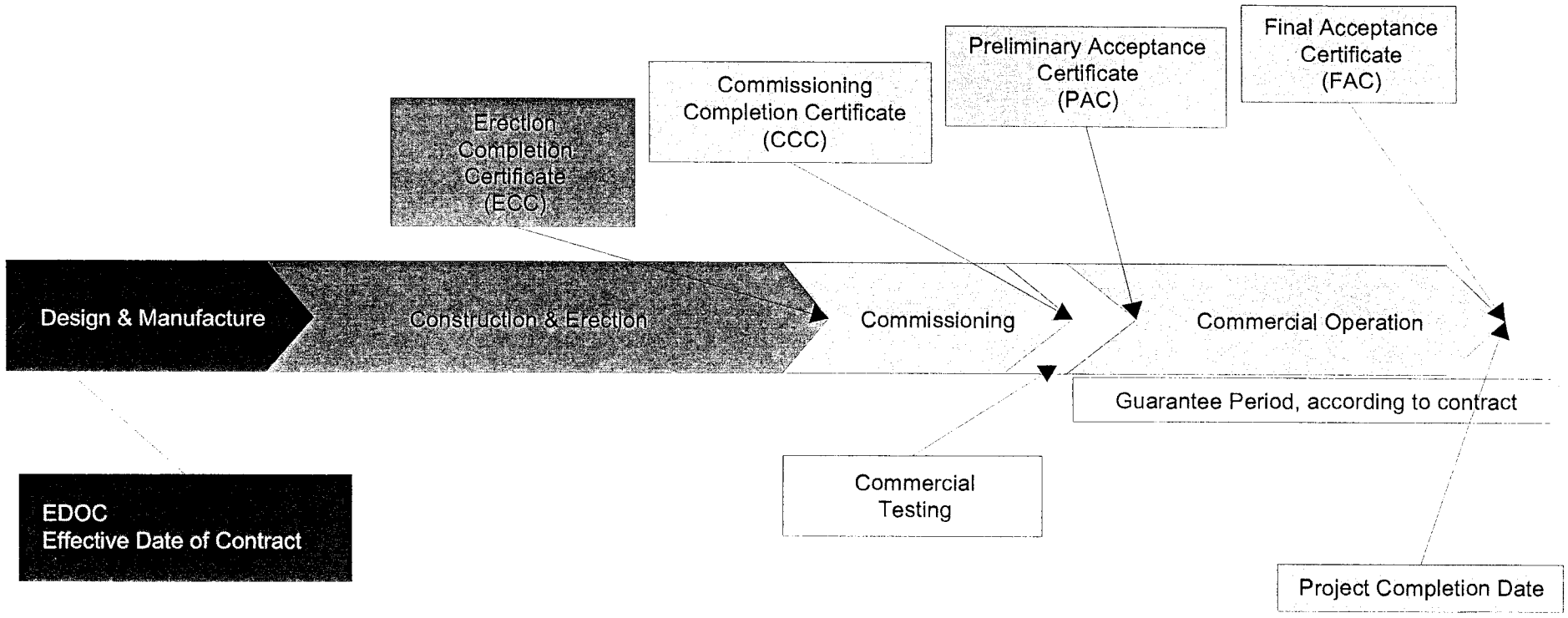
The EPC is engaged on site start-up of site investigation and beginning of construction works. Any power plant project, subsequent to the EPC Contract becoming effective, would typically be implemented in phases as shown in Figure 4.4.

4.18 IMPLEMENTATION SCHEDULE

Considering implementation of the project through Engineering, Procurement and Construction (EPC) contract, the Project will require 27 months to start for commercial operation in combined cycle mode. The Project Implementation Schedule is attached as Figure 4.5.

4.19 PROJECT COST

The total project cost has been estimated around 600 – 700 Million US$ (±100 MUS$), depends on configuration and implemented machines and specific investment conditions. The yearly operation costs (OPEX) is estimated approx. 27.0 – 36.5 Million US$.

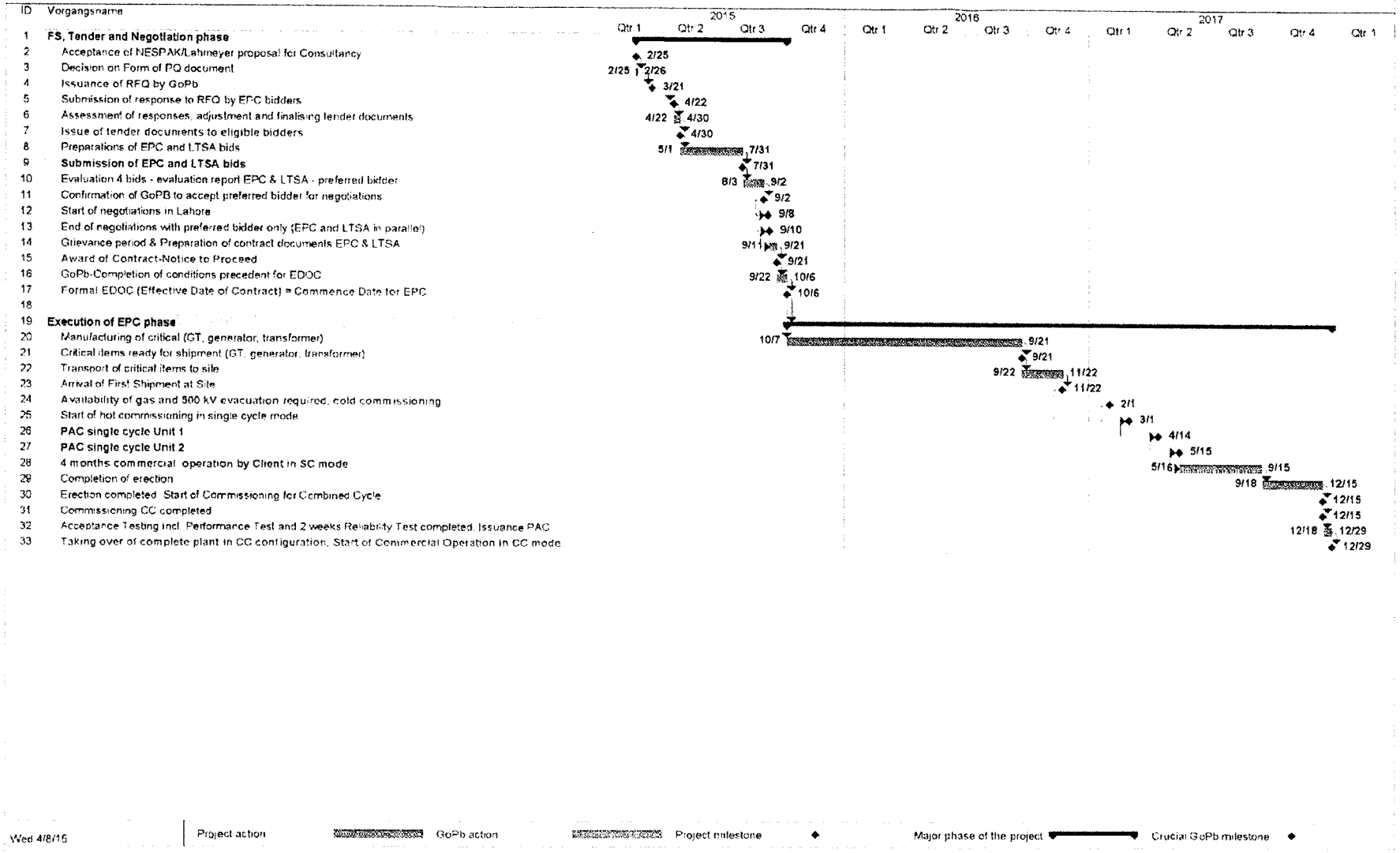


MAIN PHASES OF EPC PROJECT
1,000-1,500 MW (Gross) RLNG based Combined Cycle Power Plant at Bhikki, Sheikhupura

Figure 4.4

1,000 - 1,500 MW CCGT - Bhikki project - Punjab, Pakistan

LAHMEYER INTERNATIONAL



PROJECT IMPLIMENTATION SCHEDULE

1,000-1,500 MW (Gross) RLNG based Combined Cycle Power Plant at Bhikki, Sheikhupura

Figure 4.5

CHAPTER – 5

DESCRIPTION OF THE ENVIRONMENT

5.1 INTRODUCTION

This section provides the description of baseline conditions of the Project as well as the Study Area. The existing environmental conditions of the proposed Study Area will also be a benchmark to be used for a comparison of before and after construction phases of the Project. This baseline will also provide the datum for assessing the impacts and suggesting the mitigation measures, which will be implemented effectively at various phases of the Project activities.

5.2 APPROACH ADOPTED

A consultant's team of experts was constituted to establish the baseline conditions of the Study Area. The team comprised experienced experts including: Environmental Engineers, Ecologist, Environmentalist, Thermal Power Plant Experts and Sociologists.

For the collection of baseline information checklists/proformas, Satellite Imagery (Google Earth), and General Topographic (GT) sheets were used. Study Area was delineated based on expert judgment, field reconnaissance, Consultant's experience, study of available maps and data collected through the secondary sources and results of the consultation with the relevant departments,.

Each expert prepared his checklist/proformas for the collection of baseline data of the important parameters of physical, ecological and socio-economic environment.

Meetings and scoping sessions with all the concerned Project stakeholders were held for the collection of primary information, disclosure of Project interventions, provide information and to clear queries and misconceptions of the Project. Government offices were contacted and visited for the verification of baseline data collected during the field visit and to obtain relevant published documents.

The relevant collected data was computerized and analyzed using software such as Microsoft Office (Word, Excel and Access etc.), Statistical Package for Social Sciences (SPSS), Computer Aided Design (CAD) etc.

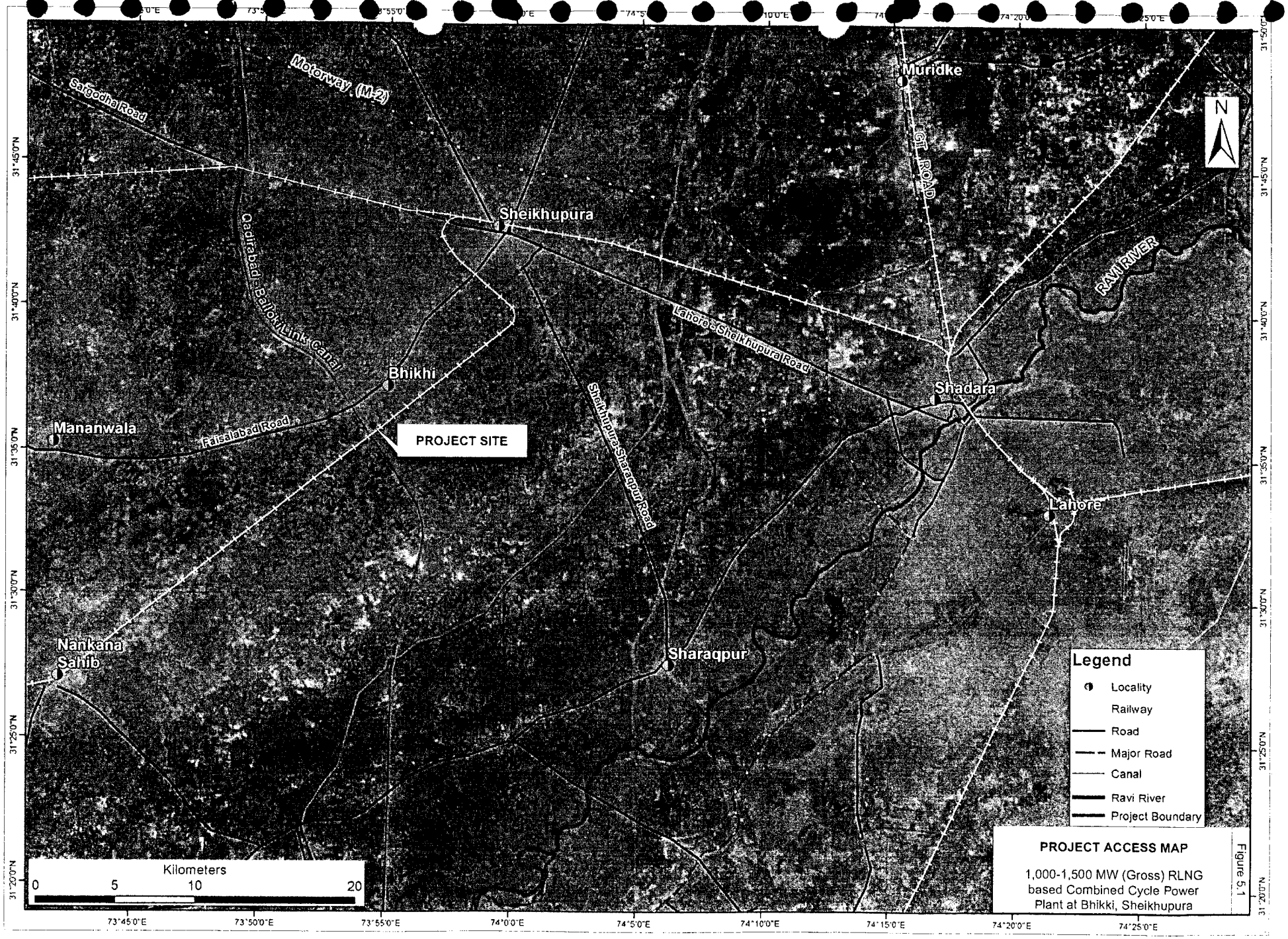
5.3 PROJECT AREA

The site primarily falls within the area of Bhikki near Sheikhupura and is located adjacent to QB Link Canal. The proposed site is accessible through Sheikhupura-Faislabad Road. The specific location and access to the Project Site is shown in Figure 5.1. There is also a single Line railway track adjacent to the Project Area. The Study Area considered for the EIA is described in the next section.

5.4 STUDY AREA

For an EIA study, it is imperative to delineate the area where the potential significant impacts of the proposed Project are envisaged. The Study Area is the area within which the potentially significant adverse environmental and social impacts of the proposed intervention are envisaged. In the light of this, potential impacts on the existing environment have to be considered in a larger geographical area than the proposed "Project Area" depending upon the extent of direct/indirect impacts.

Based on the experience of the Consultant, the available secondary information of the proposed Project Area, and technical details of the Power Plant, criteria was developed to delineate the Study Area for the proposed Project. In the criteria, critical parameters of


Motorway (M-2)
Safoodha Road
Muridke
G.T. Road
Sheikhupura
Qadirabad - Balloki Link Canal
RAVI RIVER
Lahore - Sheikhupura Road
Bhikhi
Shadara
Mananwala
Faisalabad Road
PROJECT SITE
Sheikhupura-Sharaqpur Road
Lahore
Nankana Sahib
Sharaqpur
N
Legend
Locality
Railway
Road
Major Road
Canal
Ravi River
Project Boundary
Kilometers
0 5 10 20
PROJECT ACCESS MAP
1,000-1,500 MW (Gross) RLNG based Combined Cycle Power Plant at Bhikki, Sheikhupura
Figure 5.1
73°45'0"E
73°50'0"E
73°55'0"E
74°0'0"E
74°5'0"E
74°10'0"E
74°15'0"E
74°20'0"E
74°25'0"E
31°45'0"N
31°40'0"N
31°35'0"N
31°30'0"N
31°25'0"N
31°20'0"N

physical (wind direction and speed, topography), ecological and social (location of settlements, other receptors and existing land use resources) domains of the environment for the RLNG-Based Power Plant have been considered. The Study Area was marked using the GT sheets and Google Earth Image during desk studies which was later finalized during the field visit.

Study Area includes the actual proposed Project boundary or the area which is considered to be acquired for the Project, as well as the area in the surroundings in which potential adverse impacts may be foreseen due to the implementation of the proposed Project like location of construction camp, residential and non-residential buildings, workshops etc.

So the "Study Area" includes the Project Area, nearby land having settlements, agriculture fields, canal and other infrastructure as shown in the photolog on which the proposed Power Plant is likely to have any impact.

5.5 SITE VISITS

A team of experts carried out field visits to the proposed Power Plant site (Project and Study Area), adjoining areas like Thatha Miana, Therian, Chah Waris and Bhikki from February 23 to 25, 2015 in order to collect the baseline data on physical, ecological and socio-economic aspects.

Primary data was collected from various sources. The people living around the proposed Power Plant area were interviewed to have their views about the plant installation and the perceived impacts on the natural environment around the Proposed Plant. This included information on land, surface water, groundwater, air, vegetation, animals and human. Photographs of the various environmental aspects both inside and outside the proposed plant area were also taken and are included as Photologs in this report. Stakeholder consultations were undertaken, details for which are provided in Chapter – 6 of this report.

Following is the description of baseline conditions of the Study Area.

5.6 PHYSICAL ENVIRONMENT

5.6.1 Topography

Land allocated for the proposed Power Plant is located near Qadrabad-Balloki Link Canal. The topography of the proposed Project Site is relatively flat as the area is located in plain terrain of Punjab. The existing site is surrounded by cultivated land and industries. Average elevation of the site is 201 m Above Mean Sea Level (AMSL). The Project area requires little land leveling as the area around the project site is under agriculture practice.

5.6.2 Land-Use

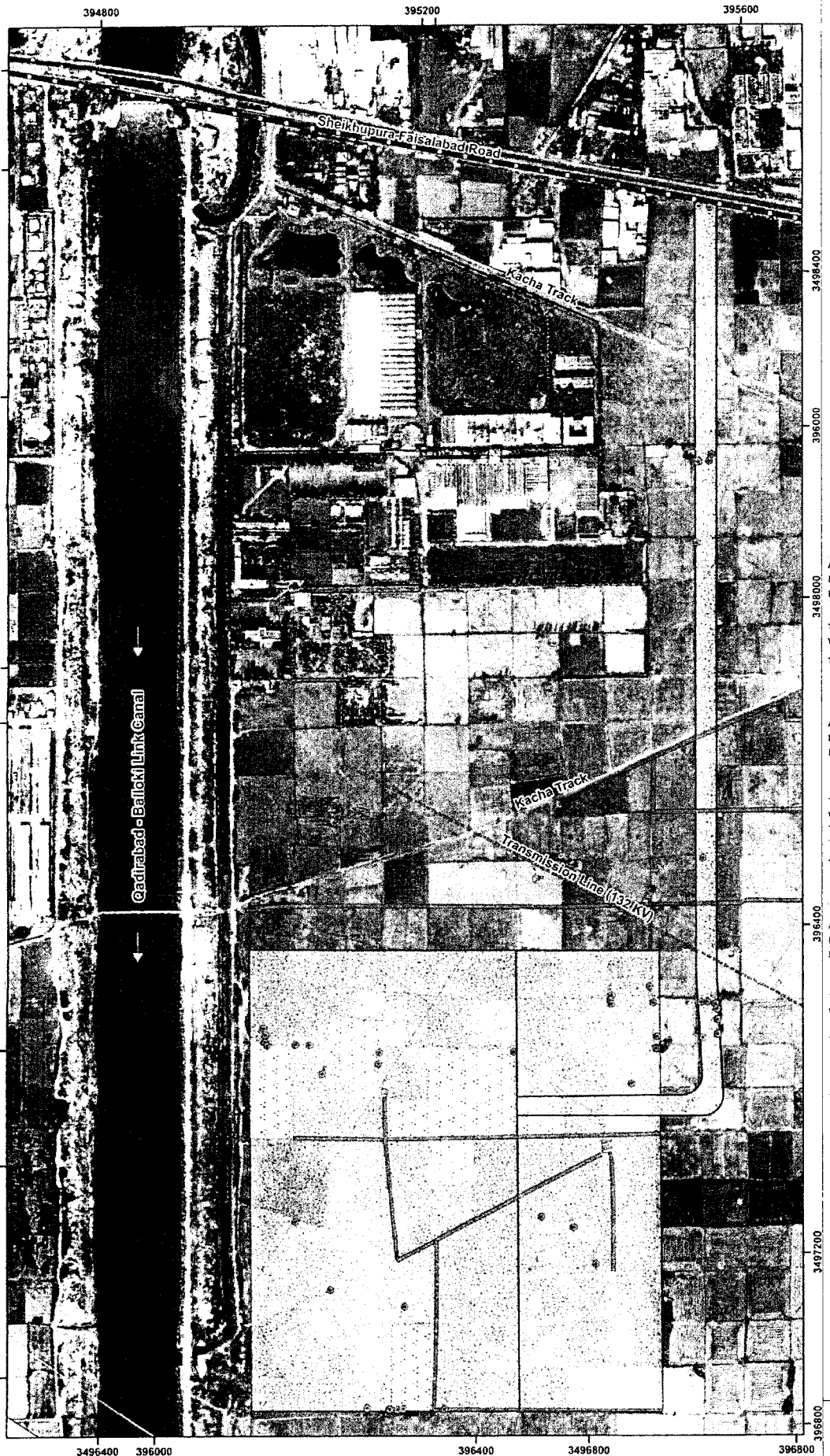
The total area demarcated for the proposed project is distributed in mainly two categories i.e. permanent area and temporary Area. The total permanent area is 315,964.34 sq.m (70.27 acres)[1] that includes the area for the plant i.e. 267,266.26 sq.m (59.44 acres) and the area required for the access road i.e. 48,698.08 sq.m (10.83 acres) while the temporary area demarcated for the temporary activaties is 137,710.65 sq.m (30.629 acres). The featured quantification of land use at project site is shown is in Figure 5.2.

5.6.3 Geology

The project area lies within the Upper Indus Basin and is drained by the Jhelum, Indus, Sutlej, Ravi and Chenab rivers, which joins at Punjnad to form lower Indus Basin. The

[1] Using a conversion of 1 Acre= 220 ft x 220 ft

Figure 5.2



Legend

- Tree
- Sheikhupura - Faisalabad Road
- Transmission Line (132 KV)
- Water Course
- Access Road
- Barren Area
- Builtup Area
- Permanent Area
- Temporary Area
- Agricultural Area

Permanent Area Quantification

Description	Unit	Quantity
Agricultural Area	sq. m	214572.70
Barren Area	sq. m	52608.86
Builtup Area	sq. m	84.70
Total Area	sq. m	267266.26
Tubewell	No.	1
Water Course	meters	1421
Tree	No	13

Access Road Quantification

Description	Unit	Quantity
Agricultural Area	sq. m	44721.03
Barren Area	sq. m	3848.95
Builtup Area	sq. m	128.10
Total Area	sq. m	48698.08
Total Length	meters	1592.00
Tubewell	No.	1
Water Course	meters	108
Track	meters	71
Transmission Line	meters	34
Tree	No.	25

Temporary Area Quantification

Description	Unit	Quantity
Agricultural Area	sq. m	135417.81
Barren Area	sq. m	2016.92
Builtup Area	sq. m	275.92
Total Area	sq. m	137710.65
Tubewell	No.	2
Water Course	meters	524
Tree	No.	20

Description	Unit	Quantity
Total Permanent Area	sq. m	315964.34
Total Temporary Area	sq. m	137710.65

Note

1. One tubewell is under tree cover and not visible in map.
2. Tubewell and tree count is based on satellite imagery and field verification carried out by EIA Team.

Meters

0 75 150 300

LANDUSE MAP OF THE PROJECT AREA

1,000-1,500 MW (Gross) RLNG based Combined Cycle Power Plant at Bhikki, Sheikhupura

project area consists of recent sediments brought by spill channel from Chenab River. The exposed alluvial complex of Pleistocene and recent age represents the latest phase of sedimentation. Nearly all the deposits underlying the Sheikhupura city and its surrounding are the products of the events that evolved during the Pleistocene and recent geological time. The alluvial deposit consists principally of fine to medium Sand, Silt and Clay. Associated with the fine grained strata are the concretionary zones of nodules of Kankars and Silty Clay, occasionally containing beds of reddish and ferromagnesian material.

5.6.4 Soils

Total nine (09) points were selected for soil investigation. On the basis of preliminary soil investigation, subsoil strata is identified as silty clay/clay silt from 0-3 m, silty sand from 3-7 m and sand with concretions from 7 m onwards.

5.6.5 Seismology

Earthquake is generated by tectonic process in the upper part of the earth called lithosphere, which is divided into several rigid parts called "Plates". Due to the movements of these plates, stress build up takes place and result in the deformation of the crustal mass.
On the basis of Peak Ground Acceleration (PGA) values obtained through Probabilistic Seismic Hazard Assessment (PSHA), Pakistan is divided into 5 seismic zones in line with the Uniform Building Code (UBC) 1997. The boundaries of these zones are defined on the basis as shown in Table 5.1.

Table 5.1: Peak Ground Acceleration (PGA) Values of Seismic Zones of Pakistan

Zone	PGA (g)
1	0.05 to 0.08
2A	0.08 to 0.16
2B	0.16 to 0.24
3	0.24 to 0.32
4	> 0.32

Source: Building Code of Pakistan Seismic Provisions, 2007

The proposed Power Plant Project per Building Code of Pakistan (BCP), 2007 (Seismic Provisions) falls entirely in the zone 2A which is the regions of moderate seismic risk (Figure 5.3). Hence all the applicable provisions, related to Soil and Foundations, Structural Design Requirements and with the Structural Concrete of BCP should be considered in the design of the structures[2].

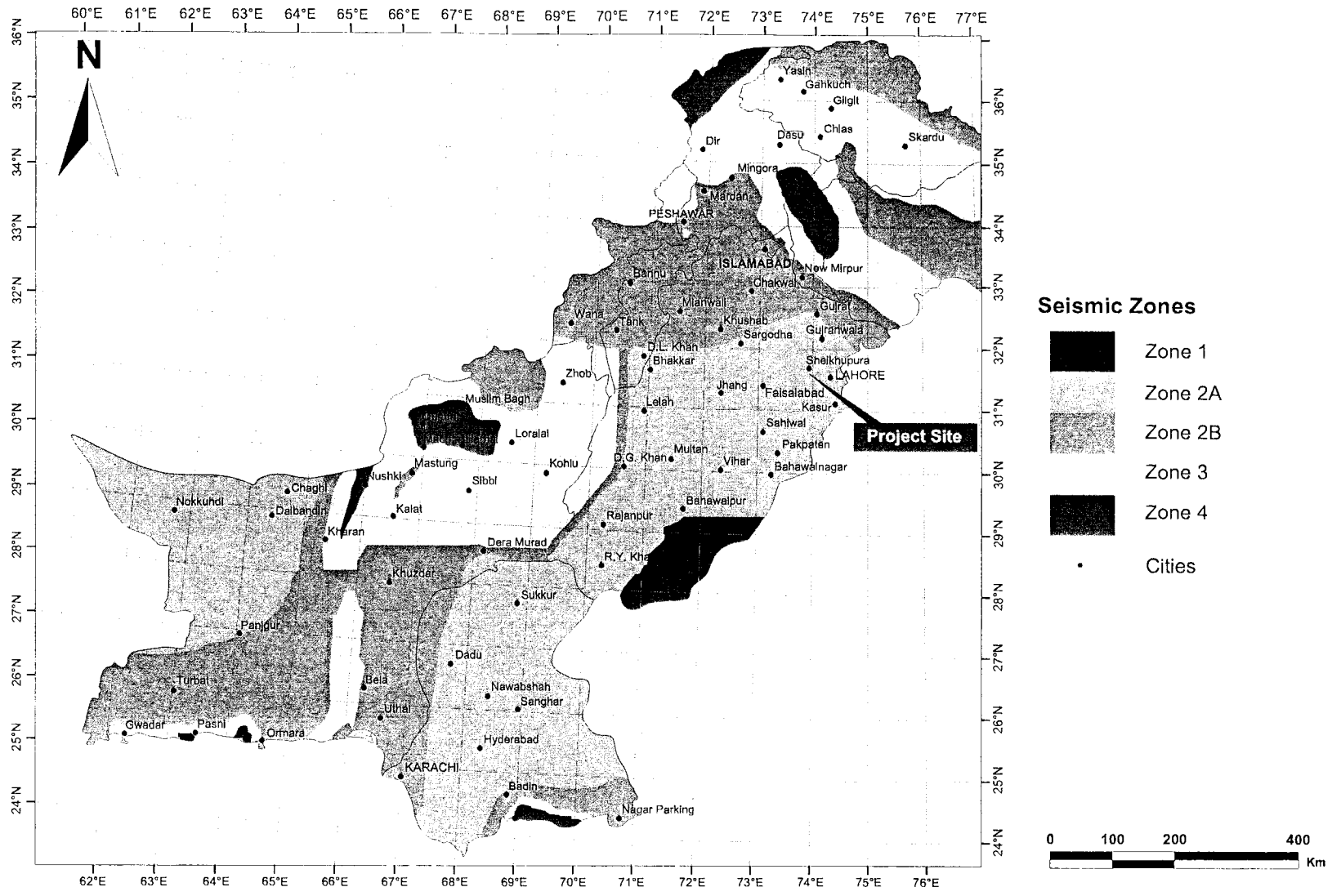
5.6.6 Climate

The climatic data has been obtained from Pakistan Meteorological Department. Lahore Weather Station is the nearest station from the Project Site. The climate of the area is semi-arid, hot subtropical with foggy winter, pleasant spring, summer with dust and heat wave periods, rainy monsoon, and dry autumn. The data for the various climatic parameters of Lahore such as temperature, rainfall, relative humidity, wind speed and wind direction is available for the years 2012 and 2013 (2 years). The different climatic parameters are discussed below:

a) Temperature

The coldest month is January in which the mean minimum temperature is 6.5°C and the mean maximum temperature is 17.45°C. June is the hottest month with the mean minimum

[2] Building Code of Pakistan (Seismic Provisions – 2007), Ministry of Housing and Works



SEISMIC ZONING MAP OF PAKISTAN

1,000-1,500 MW (Gross) RLNG based Combined Cycle Power Plant at Bhikki, Sheikhupura

Figure 5.3

Source: *Building Code of Pakistan, Seismic Provisions, 2007*

temperature of 27.6°C and the mean maximum temperature as 40.25°C. Mean monthly temperature data of the region for the years 2012-13 is presented in Table 5.2:

Table 5.2: Monthly Mean of Daily Temperatures

Month	Minimum Temperature °C			Maximum Temperature °C		
	2012	2013	Mean	2012	2013	Mean
January	7.4	5.6	6.5	18	16.9	17.45
February	8.3	9.9	9.1	20.3	20.5	20.40
March	14.4	14.9	14.65	27.4	28.1	27.75
April	20.1	19.8	19.95	33.3	34	33.65
May	25.4	25.1	25.25	39.3	40.3	39.80
June	28.7	26.5	27.6	41.8	38.7	40.25
July	27.7	25.2	26.45	38.5	35.3	36.90
August	26.1	24.8	25.45	34.4	32	33.20
September	24.5	24.4	24.45	33.5	35.1	34.30
October	18.4	20.5	19.45	31.3	32.1	31.70
November	12.8	11.3	12.05	26.6	26.5	26.55
December	7.5	7.3	7.4	19.7	20.9	20.30
Annual	18.44	17.94	18.19	30.34	30.03	30.19

Source: Meteorological Department, Lahore

b) Rainfall

The maximum rainfall occurs during the monsoon season in the months of July and August. The variation of monthly rainfall for the two years 2012 & 2013 is given in Table 5.3:

Table 5.3: Mean Monthly Rainfall

Month	Mean Monthly Rainfall (mm)		
	2012	2013	Mean
January	18.6	13.2	15.90
February	6.8	71	38.90
March	10	19	14.50
April	49.9	7.3	28.60
May	0.2	1.2	0.70
June	13.2	136	74.60
July	37.7	242.2	139.95
August	197.1	352.3	274.70
September	199.4	30.7	115.05
October	28.8	18.4	23.60
November	0.2	4.5	2.35
December	21	7	14.00
Annual	48.58	75.23	61.90

Source: Meteorological Department, Lahore

c) Relative Humidity

The data for relative humidity is being recorded on daily basis for 0000 GMT, 0300 GMT and 1200 GMT. The monthly mean, which is calculated for these timings for the years 2012 & 2013, is presented in Table 5.4:

Table 5.4: Relative Humidity

Month	Mean Monthly Relative Humidity (%)		Annual Mean
	2012	2013	

January	71.33	75.33	73.33
February	59.67	75.67	67.67
March	53.33	65.00	59.17
April	52.67	46.33	49.50
May	33.00	34.00	33.50
June	38.33	58.67	48.50
July	64.67	77.00	70.83
August	78.00	83.33	80.67
September	74.67	73.33	74.00
October	64.33	72.67	68.50
November	68.33	68.33	68.33
December	76.67	77.00	76.83
Annual	61.25	67.22	64.24

Source: Meteorological Department, Lahore

d) Wind Speed and Wind Direction

The wind data is being recorded on daily basis for 000GMT, 0300GMT and 1200GMT. The monthly mean for the wind speed is calculated and mentioned in Table 5.5 below for the years 2012 and 2013 in knots. It is observed that the wind speed is low in winter season, while in summer season, winds are blowing at a relatively higher speed than winter.

Table 5.5: Mean Wind at Synoptic Hours (Knots)

Months	Mean Monthly Wind Speed 2012						Mean Monthly Wind Speed 2013					
	0000 GMT	Wind Direction	0300 GMT	Wind Direction	1200 GMT	Wind Direction	0000 GMT	Wind Direction	0300 GMT	Wind Direction	1200 GMT	Wind Direction
January	0.6	N52W	0.2	N22W	2.6	N37W	0.9	N43W	0.5	N28W	1.9	N60W
February	1.4	N08W	1.3	N74W	3.4	N42W	1.4	N67E	1.1	S74E	3.7	N45W
March	2.0	N22W	1.6	N32W	4.8	N53W	1.2	N27W	1.2	N52W	3.7	N78W
April	2.1	N13E	1.6	N18E	3.3	N81W	1.7	N52W	1.1	N	3.7	N59W
May	3.1	N45W	2.2	N19W	3.3	N67W	1.7	N45W	2.7	N53W	4.3	N73W
June	1.3	S68W	2.1	S68W	4.1	S81W	2.1	S64E	3.7	N88E	3.7	S28W
July	2.2	S38E	2.9	S64E	2.1	S34E	2.9	S63E	2.6	S76E	2.6	N56E
August	1.0	S54E	1.5	S40E	1.3	S71E	0.5	S10E	1.0	S39E	2.5	N18E
September	0.4	S39E	0.4	N67W	2.0	N63W	1.0	N54E	1.3	S35E	2.9	N25E
October	0.1	N68W	0.4	N27E	1.0	N82W	0.5	N70W	0.8	N22W	2.1	N50W
November	0.4	N45W	0.1	N	0.5	N45W	1.5	N30W	0.2	N38W	1.7	N55W
December	0.8	N68W	0.5	N	1.2	N60W	0.8	N42W	0.4	W	1.0	N71W
Annual	1.2	---	1.2	---	2.4	---	1.3	---	1.3	---	2.8	---

Source: Meteorological Department, Lahore

5.6.7 Water Resources

The major water sources in the Study Area are the QB-Link Canal and the natural sewerage and storm water drain that falls into the QB-Link canal near Al-Rahim Textile Industry. The Ground water sources in the study area include tube wells and hand pumps installed in nearby villages and along the banks of the QB-Link Canal.

a) Surface Water

The QB-Link canal was designed and built in 1967 to feed water from the Chenab River to Ravi River. The Qadirabad barrage on the Chenab River is 32 kilometers below the Khanki

Headwork's. The other benefit of that Link Canal is to enhance drainage of the area by intercepting a number of drains and conveying their discharge to the Ravi River. The average flow of canal is given in Table 5.6.

Table 5.6: Average Monthly Flow of QB-Link Canal

Month	QB-Link Canal (m3/h)	
	Max	Min
Jan-12	1,529,100	-
Feb-12	1,732,980	1,529,100
Mar-12	1,834,920	428,148
Apr-12	2,242,680	1,325,220
May-12	2,242,680	1,529,100
Jun-12	2,242,680	1,019,400
Jul-12	2,242,680	1,478,130
Aug-12	2,242,680	1,162,116
Sep-12	2,242,680	611,640
Oct-12	2,242,680	1,631,040
Nov-12	1,936,860	1,427,160
Dec-12	1,885,890	-

Source: Pre-feasibility Report April, 2015

A natural wastewater drain also exists near Al-Rahim Textile in the study area that connects with the QB-Link canal on its left bank after 200 m stretch from the main Sheikhupura-Faisalabad Road. All the sewerage including the wastewater from Bhikki village falls in the drain and ultimately it runoffs into the canal.

b) Groundwater

The groundwater table was encountered at shallow depths of about 3 m (9.8 feet) during the soil investigations. It was reported by the local residents that tube wells are installed in the project area with an approximate depth of 100-150 m (400-600 feet). The water is mostly used to meet the agriculture and drinking water demands of the area.

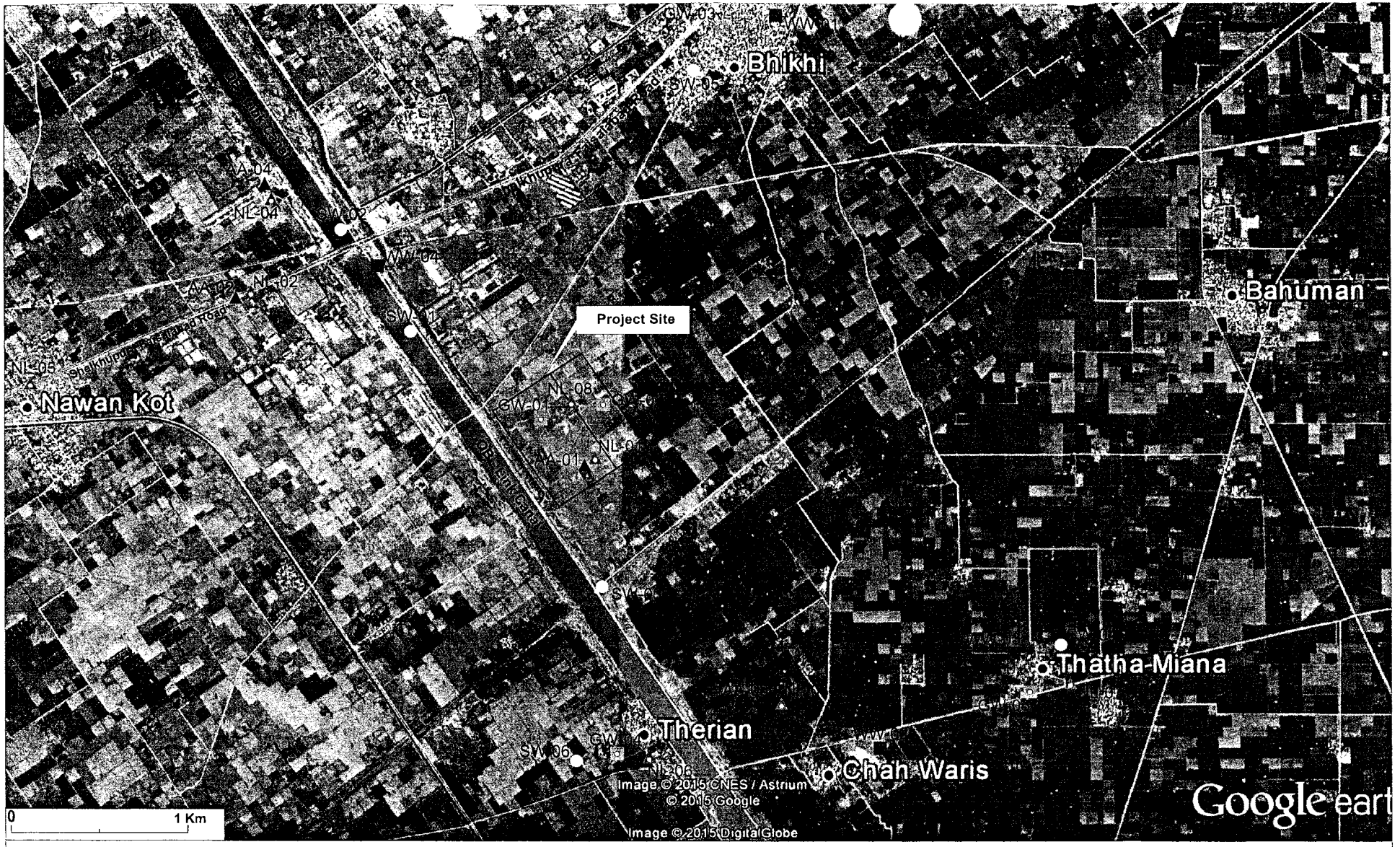
5.6.8 Solid Waste and Wastewater Drainage

In the Study Area, no conventional solid waste management system exists. Most of the solid waste was found to be stored in the forms of heaps at various locations near the villages. Similarly, there is no proper sewerage system in the Study Area, only some open drains are constructed in the vicinity for the discharge of wastewater. In general, each village drains its sewage through small open drains which discharge the sewage into the depression area near each village. This depression area/pond is called village chappar in local language. One natural drain exists in the Study Area, which ultimately falls in QB-Link Canal.

5.6.9 One Time Environmental Monitoring and Testing

Purpose of environmental monitoring is to collect baseline instrumental data of ambient air, background noise levels and water (groundwater, surface water and wastewater) quality in the Study Area. Based on the available information, a base map was prepared on which the points for the monitoring of ambient air, noise levels and water sampling were marked. Map showing the monitoring and sampling points is attached as Figure 5.4.

Apex/Ectech Environmental Laboratory (an EPA approved lab), was awarded the contract for the environmental monitoring, sampling and testing of ambient air, background noise levels, and water (groundwater and surface water/wastewater) on the basis of competitive bidding. The field work continued from February 26 to 27, 2015 for the direct instrumental monitoring for the ambient air and background noise levels while samples of the water



LEGEND:

- SW - Surface Water
- WW - Waste Water
- AA - Ambient Air
- GW - Ground Water
- NL - Noise Level

ENVIRONMENTAL MONITORING & SAMPLING LOCATION MAP

1,000-1,500 MW (Gross) RLNG based Combined Cycle Power Plant at Bhikki, Sheikhupura

Figure 5.4

(groundwater and surface water/wastewater) were collected/preserved per standard procedures and transported to the lab for testing.

Detail of the monitoring, sampling and testing parameters are given in the Table 5.7 below:

Table 5.7: Environmental Monitoring, Sampling and Testing Parameters Details

Sr. No	Parameter	No. of Points	Details of Critical Parameters Tested
1	Ambient Air	04	SO_x, NO_x, PM_{10}, $PM_{2.5}$, Volatile Organic Compound (VOC), CO_2
2	Noise Levels	08	In dB Scale (A)
3	Ground Water Samples	05	pH, Temperature (at site), Color, Total Dissolved Solids (TDS), Total Suspended Solids (TSS), Taste , Odor, Total Hardness, Nitrate as NOs ,Ammonia, Arsenic, Turbidity, Chlorides as Cl^-, Fluoride as F^-, Sulphate as SO_4^{2-}, Iron as Fe^{3+}, Sodium, Iodine, Zinc as Zn^{2+}, Total Coliform, E-Coli
4	Surface Water/ Wastewater Samples	10	pH, Temperature (at site), Biochemical Oxygen Demand (BOD_5), Chemical Oxygen Demand (COD), TSS, TDS Grease & Oil, Phenolic Compound as Phenols, Chloride as Cl^-, Fluoride as F^-, Cyanide total as CN-, An-Iconic Detergents as MBAs, Sulphate as SO_4^{2-}, Sulphide as S-, Ammonia Pesticides, Cadmium, Chromium trivalent and hexavalent, Copper, Lead, Mercury, Selenium, Nickel, Silver, Total toxic metals, Zinc, Arsenic, Barium, Iron, Manganese, Boron and Chlorine, Nutrients, Dissolved Oxygen, Turbidity

The monitoring and testing results are given in Annex-4. Based on the analysis, results and discussions for the ambient air, background noise levels, surface water, groundwater and wastewater are given below:

a. Ambient Air

Ambient air quality for CO_2, NO, NO_2, SO_2, PM_{10} and $PM_{2.5}$ was monitored at four (04) points located in the Study Area as shown in Figure 5.4. These results were compared with the NEQS for ambient air 2010 (i.e., effective from January 01, 2013), limiting values of the corresponding parameters. All the parameters are within the applicable NEQS limiting values. The details of ambient air monitoring points i.e., AA01 to AA04 along with averaging periods and monitoring location are provided in Annex-4.

b. Background Noise Levels

The background noise level monitoring was carried out in the Study Area at eight locations as shown in the Figure 5.4. The results of Noise levels were compared with the NEQS for noise 2010 (i.e., effective from July 01, 2012). The NEQS has defined four categories of areas for noise level i.e., residential area (A), Commercial area (B), Industrial area (C) and Silence zone (D), with limiting values of 55 dB, 65 dB, 75 dB and 50 dB, respectively. The overall monitoring points from NL-01 to NL-08 fall into category A (Residential Area) and category C (Industrial Area) as few industries such as Nimar Chemicals, Sabir Hatchery and Al-Rahim Textile exist near these locations. All the points are in compliance with the NEQS Noise Level Category A & C except NL-01 and NL-05 that marginally exceeds the limiting value of Category A as mentioned in NEQS due to close proximity to above mentioned industries and with the main road where daily traffic movement and commercial activity causes higher noise levels. The points with their average corresponding readings are given in Annex-4.

c. Surface Water

The only surface water body in the Study Area is QB-Link Canal. All the samples were collected as grab samples and after being labeled and preserved were transported to the laboratory in Lahore for testing. Location of all the sampling points is given in Figure 5.4. Results of these samples are attached as Environmental Monitoring Report in Annex-4.

d. Groundwater

In order to document the existing groundwater quality five samples were collected. Groundwater in the Study Area and near Bhikki is mostly being used as a main source of drinking water through hand pumps. All the samples were collected as grab samples and after being labeled and preserved they were transported to the laboratory in Lahore for testing. These samples were tested against the twenty one parameters as given in Table 5.8. Location of all the sampling points are given in Figure 5.4.

Results of these samples are attached as Environmental Monitoring Report in Annex-4. Results were compared with the NEQS values. Based on the analysis, all the tested parameters are in compliance with the NEQS for drinking water except turbidity that marginally exceeds at Point GW 05.

e. Wastewater

In order to document the existing quality of wastewater being generated in the Study Area, four grab samples of wastewater were collected from the surrounded villages and from the natural storm water drain as shown in Figure 5.4.

These collected samples were labeled and transported to the lab for testing. Wastewater samples were tested for parameters specified in NEQS and additional parameters namely Nutrients, DO and Turbidity were also tested. Results (Annex-4) were compared with the NEQS limiting values for the inland discharge. Based on the analysis, all the samples are exceeding the limits of BOD_5, COD, temperature, one sample taken from drain exceed the limits of pH, barium exceeds at point WW 02 and WW 03 while manganese and arsenic exceed at point WW 01 the limit defined by the NEQS for inland discharge.

5.7 ECOLOGICAL ENVIRONMENT

Ecological study of the area has been conducted using standard ecological assessment technique based on primary and secondary information and inclusion of additional information collected during site visit, discussion with Government departments and meetings with groups of communities/public living in and around Project Area coupled with expert visual observations. Following is the description of the baseline ecological environment of the area.

5.7.1 Flora

Sheikhupura District has a hot semi-arid climate intermediating between Desert climate and Humid climate in ecological characteristics and agriculture potential. The climate tends to have hot and sometimes extremely hot summers and mild warm winters. The soils are very fertile, therefore, climate supports variety of agricultural crops and vegetables, with scare growth of indigenous flora and grasses.

a) Trees, Bushes and Shrubs

No compact plantation or woodlots exist in the Project Area, but scattered trees are growing in the farmlands in linear pattern consisting of eucalyptus, kikar, shisham, and simal with irregular spacing. A total of 58 trees of various sizes with girth ranging from 8" to 40" are present in Project Area comprising of Permanent (Plant and Access Road) and Temporary

Acquisition. Among grasses Khabbal (*Cynodon dactylon*), Dhaman (*Cenebrus ciliaris*) and Khawi (Cymbopogan jawarancusa). The detail of vegetative species found in the Study area are given in Table 5.8:

Table 5.8: Names of Trees and Shrubs in the Study Area

Sr. No.	Common Name	Scientific Name
1.	Kikar	*Acacia nilotica*
2.	Shisham	*Dalbergia sisso*
3.	Simal	*Bombax ceiba,*
4.	Sufeda	*Eucalyptus species*
5.	Frash	*Tamarix articulata*
6.	Neem	*Azedarachta indica*
7.	Pipal	*Ficus reigiosa*
8.	Bakain	*Melia azedarach*
9.	Ber	*Zyziphus numelaria*
10.	Mesquite	*Prosopis juliflora*

b) Agriculture

i) Crops

The Project area consists of fertile agricultural land of high productivity. The major source of irrigation to the crops is groundwater (about 90%) augmented with canal water (about 10%). Main crops grown in the area consist of Wheat, Rice, Maize and Sugarcane while vegetable crops include Potatoes, Onion, Capsicum, Tomato, Peas and Okra. Raising of orchards is not common in the area, as vegetables are preferred due to high rate of return. Fodder crops are grown for use by the domestic livestock kept by the farmers mainly for milk purpose as well as for to meet their own requirements.

ii) Cropping Pattern

Rabi crop, mainly is sown during November and December which becomes ready for harvest during May and June. Kharif crops consisting of Sugarcane, Cotton, Rice and Fodder crops are sown during June and July and harvesting is done during October and November except sugarcane which requires longer rotation to ripe. Vegetables are grown throughout the year according to specific seasonal requirement for each kind. Farmers also adopt modern technologies line tunnel farming for growing vegetables ahead of the actual season to fetch maximum return on account of nearness of area to city markets of Sheikhupura and Lahore.

iii) Yield and Income

As per local information as well as secondary information obtained from office of District Officer, Agriculture, Sheikhupura, the average yield and annual income of crops and vegetables in Study Area are given in Table 5.9.

Table 5.9: Average Yield and Income of Crops and Vegetables

Sr. No	Crop	Yield/acre	Income/acre (Rs.)
1	Wheat	1,400-1,600 kg	44,000 to 50,000
2	Rice	1,200 kg	45,000
3	Sugarcane	16,000-20,000 kg	70,000 to 90,000
4	Cotton	700-800 kg	80,000 to 90,000
5	Vegetables	----	150,000 to 300,000

5.7.2 Fauna

a) Wildlife Mammals

The Study Area being agricultural land and devoid of trees and bushes, is not very rich in wildlife Mammals. However, common mammals are Jackal (*Canis aurecus*, Fox (*Vulpus bengalensis*), Hare (*Lepus*), Porcupine (*Hystrix indica).*

b) Reptiles, Insects, Amphibians

Common reptiles found in the Study Area include Lizards, Geko *(Gekkonidae),* Goh *(monitor),* Snakes *(Serpentes*), Rats *(Rattus*) and Common Frog *(Rana temporaria*). Mammals and Reptiles are indicated in Table 5.10.

Table 5.10: Names of Mammals and Reptiles in the Study Area

Sr. No.	Mammals	IUCN Status	Reptiles	IUCN Status
1.	Jackal (*Canis* sp.)	----	Snakes (*Vipera /Elapidae* sp.)	----
2.	Fox (*Canis vulpes)*	----	Lizards (*Sauria* sp.)	----
3.	Rabbit (*Rodentia* sp.)	----	Rats/Mouse (*Rodentia* sp.)	----
4.	Pig *(Artiodactyla* sp.)	----	Frog (*Rana temporaria)*	----

A number of insects pests of agricultural crops include Bugs, Leaf Rollers, Tela, Rice Borer, Caterpilars and Moths. Livestock dungs provide flourishing platform for Flies and Mosquitoes which act as disease vectors for Malaria, Diarrhea, Dysentry and Gastro disorder.

c) Birds - Avifauna

Not many birds were observed in the Project Area during site visit, probably due to scattered vegetation and other anthropogenic interventions. However, avifauna population seemed to be on increase in Study Area, probably due to small size orchards, agricultural crops and linear plantations. The common birds observed and reported in the Study area are given in Table 5.11.

Table 5.11: Name of Common Birds

Sr. No	Common Name	Scientific Name	IUCN Status
1.	Ring Dove	*Zenaida* sp.	Least Concern
2.	Myna	*Acridotheres tristis*	Least Concern
3.	Crow	*Corvus corone*	Least Concern
4.	Paddy bird/ Pond Heron	*Ardeola grayii*	Least Concern
5.	Quail	*Coturnix coturnix*	Least Concern
6.	Hoopoe	*Upupa epops*	Least Concern
7.	Koel	*Eudynamys scolopacea*	Least Concern
8.	Common Bulbul	*Pycnonotus barbatus*	Least Concern
9.	Sparrow	*Spizella* sp.	----

d) Fisheries

No Fishery was found in the Study Area, as the major land use is agriculture due to the high fertility of land. It was reported that local level fishing is carried out in the surrounding canals but it was not sighted during site visit.

5.8 SOCIO-ECONOMIC AND CULTURAL ENVIRONMENT

5.8.1 General

The basic objectives of the social surveys were to:

- Observe and document the existing socio-economic settings of the Project and Study Area;
- Identify the potential impacts associated with the implementation of the proposed Project;
- Get feedback from community about existing and potential social issues; and
- Evaluate the possibilities of addressing them in the report.

Baseline information was collected from direct and indirect affectees during the field visit. The people whose land and houses or any other structure will be directly affected are called direct Project Affected Persons (PAPs) while indirectly affected are those people who will have to face impacts of proposed Project indirectly.

5.8.2 Methodology Used for Data Collection

Socio-economic survey of the selected households of the Project and Study Area villages (as listed in Table 5.12) was carried out. During the socio-economic survey, 96 respondents from the Project as well as Study Area villages were selected as sample size by calculation with 95% confidence level and 10% confidence interval. Population of those villages was about 41,004 calculated by stimulating with 2.7% growth rate on the population in the year 1998 as per District Census Report (DCR), 1998 and during the field survey conducted on February 23, 2015 to February 24, 2015. However, due to the unavailability of some local residents in peak working time, the sample size was contained to 80 respondents.

These respondents were selected by using systematic random sampling technique. Questionnaires were developed to collect the baseline data, based on the demographic and socio-economic indicators. Interviewing technique was used as a tool for data collection. In order to quantify the existing baseline conditions of the Study Area, collected data was analyzed digitally by using SPSS software.

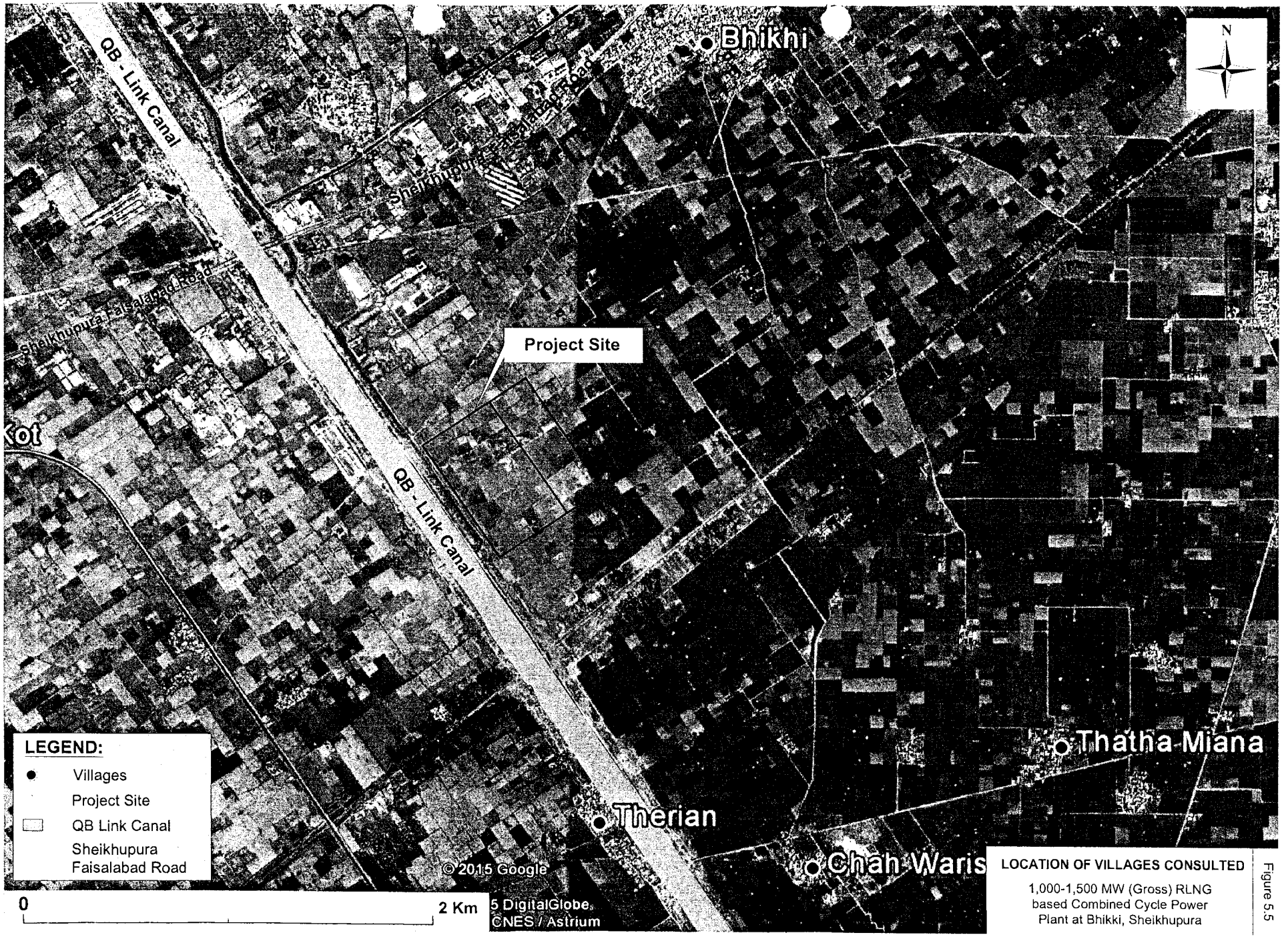
During the socio-economic survey, people were informed about the objective and purpose of the Proposed Project. In particular, apprehensions of the locals regarding the proposed Project were discussed. Focus Group Discussions (FGDs) were held in the villages located in the study area as well as within project boundary, to clarify the Project related works and activities in detail and also to record the concerns and suggestions of the people. The total number of houses in each village was identified either through observatory analysis or the figure quoted by the residents during the questionnaire survey.

Sample proformas used during the survey are attached as Annex-5.

Table 5.12: Details of Villages Surveyed during Socio-economic Survey in the Study Area

Sr. No.	Name of Village	Number of Houses
1	Thatha Miana	122
2	Chah Waris	38
3	Therian	97
4	Bhikki Town	5,000
Total (A)		**5,257**
Average Household size as per DCR, 1998 **(B)**		7.8
Estimated Population in all villages surveyed **(C=A x B)**		41,004

The villages consulted during the socio economic survey are shown in Figure 5.5.



LOCATION OF VILLAGES CONSULTED

1,000-1,500 MW (Gross) RLNG based Combined Cycle Power Plant at Bhikki, Sheikhupura

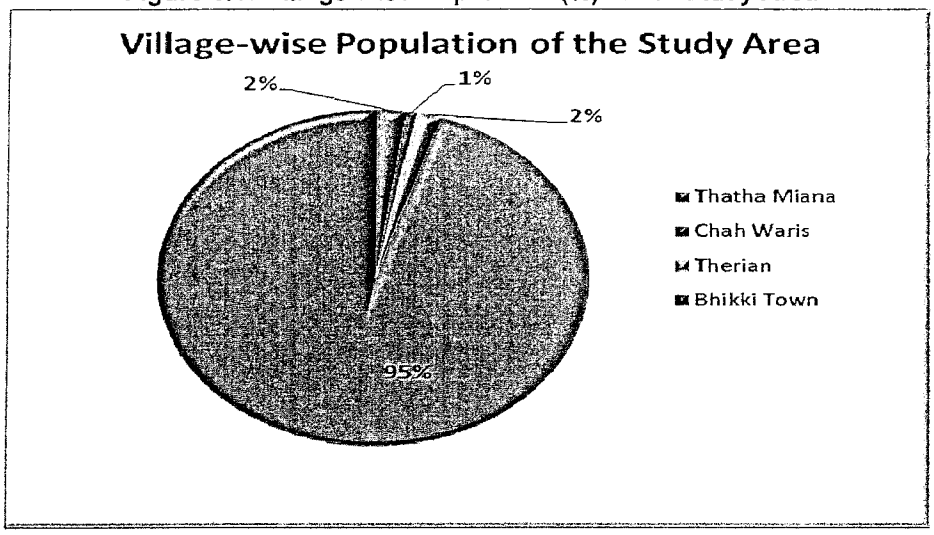
Figure 5.5

5.8.3 Statistics of Affected Villages

All villages in the Study Area fall outside the Project boundary. The direct affectees of this project are those whose land and/or other assets fall inside the project area. The socio-economic survey also includes the consultation with the direct and indirect affectees.

The village wise population of the Study Area is shown in Figure 5.6

Figure 5.6: Village-wise Population (%) of the Study Area



It was identified during the survey that the demographic and socio-economic details of all the villages were similar within and outside the Project Area.

5.8.4 Political and Administrative Settings

The district is managed by the Deputy Commissioner who is District Magistrate as well as district Collector. As District Magistrate, he is responsible for law & order and other allied matters of whole of the district. In this capacity he is assisted by Additional District Magistrate (Additional Deputy Commissioner), three (03) Sub-Divisional Magistrates and 10 Ilaqa Magistrates.

Sheikhupura district is divided into five (05) following tehsils:

1. Sheikhupura
2. Ferozwala
3. Muridke
4. Sharaqpur
5. Safdarabad

5.8.5 Characteristics of the Study Area

a) Sample Population and Family Size

Based on the socio-economic survey of the selected households of the Study Area, the overall population of 80 households was calculated as 480. Average household size was concluded as about 6. The sex ratio (males per 100 females) for the Study Area is found to be 101.6. Detail is given in Table 5.13.

Table 5.13: Village-wise Sample Population and Family Size

Villages	Sample Size	Indicator	Sex		Total
			Male	Female	
Thatha Miana	15	Number	45	44	89
		%	50.5	49.5	100
		Sex Ratio	102.3		
		Family Size	5.9		
Chah Waris	20	Number	65	62	127
		%	51.2	48.8	100
		Sex Ratio	104.9		
		Family Size	6.3		
Therian	20	Number	57	57	114
		%	50	50	
		Sex Ratio	100		
		Family Size	5.7		
Bhikki Town	25	Number	75	75	150
		%	50	50	100
		Sex Ratio	100		
		Family Size	6		
Total Number			242	238	480
%			50.4	49.6	100
Sex Ratio*			101.6		
Family size as per socio-economic survey			6		

* Men per 100 women.

b) Age and Marital Status

As per the respondents interviewed during the socio-economic survey, it was identified that all of them were married and were falling in the age group of 36 years and above (Table 5.14), therefore all of them were identified as key informant of the area.

Table 5.14: Age Distribution of Respondents in the Study Area

Sr. No.	Age Group (in years) / Village	36-50	51-65	66 or above	Total
1	Thatha Miana	4	7	4	15
2	Chah Waris	4	11	5	20
3	Therian	9	7	4	20
4	Bhikki Town	11	8	6	25
Total		28	33	19	80
Percentage		35	41.25	23.75	

c) Languages Spoken

Punjabi is the predominant local language being spoken in the Study Area. However, Urdu is also understood.

d) Ethnicity and Minority Groups

In general, a wide range of castes were identified among respondents of the study area which mainly include:

1. Arain;
2. Bhatti;
3. Rajpoot;
4. Syed;
5. Khokar;
6. Malik;
7. Jutt;
8. Sheikh; and

9. Gujjar.

However, minority group comprising Christian community was also identified in some parts of the study area.

e) Education Level and Facilities

In three of the villages in the study area, namely Thatha Miana, Chah Waris and Therian, primary schools for boys and girls were present. However, the adequate availability of teachers was not reported. While in Bhikki Town, the education facilities were present up to the college level for both boys and girls.

The literacy level of the respondents, identified during the survey, depicts that the majority of the respondents interviewed in the Study Area were illiterate and their weightage is 53.8% followed by 23.7% matric and 18.7% middle. Only 3.7% of the respondents had education up to intermediate and bachelor level. Details are given in Table 5.15 below.

Table 5.15: Level of Education in the Study Area

Sr. No.	Education Level / Village	Illiterate	Primary	Middle	Matric	Total
1	Thatha Miana	12	1	2	0	15
2	Chah Waris	10	5	3	2	20
3	Therian	9	6	4	1	20
4	Bhikki Town	12	7	6	0	25
	Total	43	19	15	3	80
	Percentage	53.8	23.7	18.75	3.75	100

f) Family System

Joint family system is the dominant culture in the Study Area. Few people were found who have two or more than two wives. It was observed that the family structure in the area was very strong and members played a pivot role in solving their social and cultural problems.

g) Occupations

The dominant source of income in the whole Study Area is found as agriculture which is 67.5% (Table 5.16). The second major source of income identified in the study area was labour. Only few people were found who are employed in government sector.

Table 5.16: Occupation Distribution of Respondents in the Study Area

Sr. No	Occupation / Village	Agriculture	Labour	Total
1	Thatha Miana	13	2	15
2	Chah Waris	11	9	20
3	Therian	12	8	20
4	Bhikki Town	18	7	15
	Total	54	26	80
	Percentage	67.5	32.5	

h) Income Sources and Expenditure

The major source of income in the entire Study Area is Agriculture. During the interviews, it was found that some households had nine (09) dependents. Now with this salary and necessary expenditures, it was reported that the living was just from hand to mouth. Therefore, they often exceed their income level in expending for their domestic purposes, however, no respondent was found who had ever borrowed money. Moreover, despite of

living hand to mouth in financial term, the respondents were found quite satisfied with their lifestyle in natural environment and organic food.

Only a small percentage of 6.4% has an income level of Rs. 20,000/- or above whereas a major percentage of 93.6% has an income of less than Rs. 20,000./- per month.

Table 5.17: Income Level of Respondents in the Study Area

Sr. No.	Monthly Income Level (Rs.) / Village	5,001/- to 10,000/-	10,001 to 15,000/-	15,001/- to 20,000/-	20,001/- to 25,000/-	Total
1	Thatha Miana	6	6	3	0	15
2	Chah Waris	1	3	12	4	20
3	Therian	5	6	8	1	20
4	Bhikki Town	11	14	0	0	25
	Total	23	29	23	5	80
	Percentage	28.7	36.2	28.7	6.4	

i) Housing Characteristics

Housing characteristics is one of the major indicators for the assessment of the living standard of the population. All of the houses found in the villages of Study Area are of pucca nature.

j) Ownership and Tenure System

Agricultural labor in the study area is primarily done by men but women and children are also involved in farming activities. Big land owners employ tenants for agricultural activities or give their land for cultivation on contract basis whereas small land owners cultivate their land by themselves with the help of their family members. The big land owners hire labour on a permanent basis. Every farmer and landowner adopts a system according to his own will and resources. Generally landowners hire tenants on equal-share of crop basis. The laborers work throughout the season and after harvest, the crop is distributed equally between laborers and land owner. Some landowners hire the services of laborers on cash payment.

l) Livestock

A significant percentage of the workforce and households in the area are engaged in livestock rearing in addition to agricultural farming. The livestock is a pillar of economy growth through improvement of breeds, feeding and health facilities; dairy development; commercializing management of range dependent livestock for beef and meat; value addition of livestock products; and taking advantage of Lahore proximity to supply livestock products and develop a livestock market. The importance of livestock as a major source of livelihood has decreased due to growing of agriculture and vegetable cropping with tube wells and canal irrigation. The livestock farming is a traditional activity in the area; it comprises rearing of Cattle, Sheep and Goat. Cattle constitute major portion of the livestock population within the area.

5.8.6 Amenities in Study Area

a) Water Supply

The drinking water through hand pumps is sufficiently available in the area. Any planned government water supply scheme was not identified in the entire study area.

b) Health Facilities

Most of the respondents reported that they were suffering from different diseases. On the

contrary, the dispensary or Basic Health Units (BHU) were not found in the entire villages of the study area except Bhikki Town. Even in Bhikki Town, there are no proper arrangements for emergency cases and people use to rush towards Sheikhupura city in the hour of need. Domestic child birth attendant were reported in all the villages of the study area.

c) Sewerage & Solid Waste Disposal

No public sewerage system was observed. Lined drainage channels were found in each village which lead to a larger pond and sometimes drop into the nearby major drain passing near the project area. Solid waste disposal is one of the major problems being faced by the residents of the area. People threw solid waste within the vicinity of villages or burnt it in a large pit.

d) Common Diseases

Seasonal fever, cough, cold and flu are the common diseases amongst the people of the Study Area. However, some people were found who reported that they had been suffering from Hepatitis-C.

e) Civic and Institutional Amenities

The whole area is deficient in having civic facilities such as metaled roads network, playgrounds, recreational activities, street lights, drainage system, postal services etc. Similarly, natural (Sui) gas and land line telephone network also partially exist in the area, however, most of the mobile phone networks are being used in the area depending on the signals availability.

5.8.7 Commercial/Industrial Activities

Any noticeable commercial activity was not observed in the entire study area. However, in Bhikki Town, the commercial activities including shops, godowns, workshops, markets etc. There are few industries exist in the vicinity of the project area namely, Nimir Group of Industries, Sabir Hatcheries and Al-Rahim Textiles. Details of the consultation with the industries are included in Chapter-6 of this report.

5.8.8 Crime & Conflict Resolution System

Crime and conflict resolution system mostly relied on the Wadera system. The Wadera (head) or Lumberdar of the village is the most influential person to resolve the conflict issues of people as and when occurred. The crime situation in the area is observed as under-control, however, some serious criminal activities were reported by Nimir Industry during the consultation.

5.8.9 Women Emancipation/Empowerment

Due to cultural constraints, it was not possible to conduct questionnaire interview survey with the women respondents in the Study Area. However, as per observatory analysis and secondary information provided by the local key informants, women in the Study Area are suffering through economic and social poverty. Economic poverty is due to the lack of assets and low endowment of human capital. Social poverty derives from the inability of the society to accept women's equality and their economic, political and cultural rights.

In the rural set-up women are kept under-educated or uneducated, so is the case in the Study Area. However, there are some households who are pro-education and use to send their girls to the available educational facilities in the Area.

Women in the Study Area are mainly dependent on male members of their family for economic reasons and cannot take decisions regarding their own lives. They have no

opinion in the family matters and are not asked about their preference for marriage. Yet for the paucity of rights, women play a vital part in the society.

5.8.10 Culture

The cultural aspects of the area are found to be very hospitable; however, Wadera system is exercised throughout the area. Decisions are mostly taken by head of the village but people also use to resolve their issues on their own first. Gender sensitivity was found in all the villages. In general people were found humble in consultation except few hardliners.

Religious sites including mosques, shrines and graveyards are socially sensitive areas to deal with. Shrines and graveyards are regarded as sacred heritage and receive devoted attention from the people. The survey exposed that the people of the Study Area were attached to their religion and culture. As per information provided by the residents, one graveyard exists near each village in the Study Area. One shrine of a saint was also identified in Thatha Miana village.

5.8.11 NGOs or CBOs

NGOs and Community Based Organizations (CBOs) play a vital role in the socio-economic development of the area. In many cases NGOs/CBOs are involved in these development activities which are normally the responsibility of the government. No NGO was identified in the entire Study Area.

CHAPTER – 6

STAKEHOLDER CONSULTATIONS

6.1 GENERAL

Stakeholders', involvement especially the local population and key concerned stakeholders, is an important feature of the environmental assessment and can lead to a better and more acceptable decision-making regarding the project design and implementation. Public involvement, undertaken in a positive manner and supported by a real desire to use the information gained to improve the Project design, will lead to better outcomes and lay the basis for on-going positive relationships between the stakeholders. It gives the feeling of an ownership to the local population. Public involvement is necessary for smooth implementation of the project and especially the local community whose support is also required for the success of the project.

RLNG power plant project management and implementation authorities are committed for undertaking public consultation at Provincial and local levels as a part of project planning/design for getting necessary environmental permissions.

6.2 OBJECTIVES

The objectives of stakeholder consultation were to contribute to the openness, transparency and dialogue. Special efforts were made to ensure that the communication with the public should be efficient and well balanced. The concerned stakeholder groups were identified to participate in the assessment process.

The objectives of public involvement include:

- Informing the stakeholders about the proposed project;
- Providing an opportunity to those who remained unable to present their views and values, therefore allowing more sensitive consideration of mitigation measures and trade-offs;
- Providing those involved with planning the proposal with an opportunity to ensure that the benefits of the proposal are maximized and that no major impacts have been overlooked;
- Providing an opportunity for the public to influence the project design in a positive manner;
- Increasing public confidence in front of proponent, reviewers and decision makers;
- Providing better transparency and accountability in decision making;
- Reducing conflict through the early identification of contentious issues, and working through these to find acceptable solutions;
- Creating a sense of ownership of the proposal in the minds of the stakeholders; and
- Developing proposals which are truly sustainable.

6.3 STAKEHOLDER IDENTIFICATION

Considering the urgency and importance of the project, consultations were carried out at all possible levels i.e. provincial, district and village level. The process of consultation is an on-going process which continues during the project life cycle and even after the submission of this report and so on. Therefore, three-tier approach was adopted. Stakeholders were identified, categorized and consulted at provincial level EPD, Punjab, Irrigation Department, Agriculture Department, Wildlife Department etc.), district level (EPD, Agriculture Department, Fisheries Department, Wildlife Department, Forest Department etc.) and at village level (Direct and Indirect Affectees and Locals).

Consultation with the provincial and district level departments were carried out through meetings and presentations while consultations with locals, village people, directly affected people, local NGOs etc. were undertaken during the baseline survey of the Study Area. Consultations were held with the following;

6.3.1 Provincial Level Stakeholders

1. Environmental Protection Department, Punjab
2. Agriculture Department, Punjab
3. Forest Department, Punjab
4. Wildlife Department, Punjab
5. Irrigation Department, Punjab

6.3.2 District Level Stakeholders

1. Environment Protection Department, Sheikhupura
2. Agriculture Department, Sheikhupura;
3. Forest Department, Sheikhupura;
4. Wild life Department, Sheikhupura;
5. Irrigation Department, U.C.C. Division Sheikhupura; and
6. Fisheries Department Sheikhupura

6.3.3 Village Level Consultations

1. PAPs and local communities;
2. Thatha Miana
3. Chah Waris
4. Therian
5. Bhikki Town

6.4 CONSULTATIONS

A series of public consultations were required to get the feedback/concerns of the different category of stakeholders including provincial departments, district level departments, potential PAPs, local community and other general public residing in the Study Area.

6.4.1 Concerns/Feedback

Feedback received during public consultation includes both project related concerns and other/general concerns.

Project related concerns and suggestions are related to the willingness of people to accept project loss of land, issues related to livelihood, electricity and compensation/relocation/ resettlement drinking water supply and sewerage, health facilities, road infrastructures, education, women issues, agriculture and security. Brief Introduction about the proposed project, its various components, positive and negative impacts and other technical details related to environment, social and economic considerations are provided before the consultation to stakeholders.

Details of Provincial and District Level officials contacted are given in Table 6.1:

Table 6.1: List of Government Officials Consulted

Sr. No.	Name of Person	Designation	Name of Department/ Office	Level
1	Dr. Mohammad Anjum Ali	Director General	Agriculture Extension	Provincial
2	Mr. Nasim Shah	Director Environment	EPD Punjab, Lahore	Provincial
3	Mr. Rana Shabbir Ahmed	Chief Conservator	Forest, M&E	Provincial
4	Mr. Naeem Bhatti	Deputy Director	Wildlife Department	Provincial
5	Mr. Imtiaz Ahmad	Superintendent Engineer	Irrigation Department, DCC	Provincial
6	Mr. Mohammad Khan Maqsood	District Agriculture Officer	Agriculture Department, Sheikhupura	District
7	Mr. Shoaib Akhtar	Sub Divisional Forest Officer	Forest Department, Sheikhupura	District
8	Mr. Amjad Farooq	District Wildlife Officer (DWO)	Wild life Department, Sheikhupura	District
9	Ms. Pakeeza Bukhari	Deputy District Officer Environment	Environment Protection Department, Sheikhupura	District
10	Mr. Rashid Minhas	Executive Engineer	Irrigation Department, U.C.C. Division Sheikhupura	District
11	Mr. Shaukat Jamil	Assistant Warden Fisheries	Fisheries Department Sheikhupura	District

6.4.2 Provincial Departments Consultations

The following is the details of issues/points raised/discussed during the consultation:

Table 6.2: Details of Issues/Points Raised/Discussed during Provincial Level Consultation

Sr. No.	Departments	Stakeholder Observations/ Concerns	Response
1	Director Environment Protection Department, Lahore	The difference between RLNG and Liquefied Petroleum Gas (LPG) was discussed during the consultation.	NESPAK, during meeting discussed the difference between RLNG and LPG.
		Moreover, it was emphasized that waste management plan should be prepared for the Project to protect the environment as much as possible	The comment has been incorporated in the EMP.
2	Director General, Agriculture Department Lahore	It is good to know about efforts being made to overcome the electricity shortage. On knowing that these plants are being set up on agricultural lands, some sacrifice has to be given to gain a bigger purpose. Further, this loss shall be compensated to a large extent by increasing yield per acre of the area and by bringing barren land under cultivation due to increased power for irrigation through tube wells.	Agriculture department should take practical measures to compensate loss of agriculture by increasing yield per acre of the area and by bringing barren land under cultivation due to availability of more electricity.

Sr. No.	Departments	Stakeholder Observations/ Concerns	Response
3	Chief Conservator Forests, M&E, Punjab, Central Zone Lahore	The project is appreciable in view of the prevailing electricity shortage. However, the emissions from the plant may have harmful impacts on the plantations. It is suggested that the gaseous emissions from the plant should be treated, before their release into the atmosphere.	The project will operate on RLNG which is a clean fuel and will have insignificant air emissions. HSD will be occasionally used as backup fuel. Emissions from backup fuel are also within NEQS Limits for stack emissions.
4	Deputy Director Wildlife Department, Lahore	These projects are in national interest and any negative impact on wildlife can be properly dealt with by adopting mitigation measures.	The impacts have been assessed and mitigations have been devised in the impacts and mitigation section of the report.
5	Superintendent Engineer, Irrigation Department, DCCC	The canal water required for cooling effects and other purposes shall be made available, however NOC from Secretary, Irrigation, shall have to be obtained in this respect. It is however suggested that the used water should be discharged into the canal, only after proper purification/treatment.	The proponent will obtain the NOC from the irrigation department for extraction of cooling water from the Canal. The wastewater treatment plant has been included in the project design to treat the generated wastewater before its discharge.

6.4.3 District Level Consultations

The following points were raised/discussed during the consultation meeting:

Table 6.3: Details of Issues/Points Raised/Discussed during District level Consultations

Sr. No.	Departments	Stakeholder Observations/Concerns	Response
1	District Agriculture Officer, Sheikhupura	The proposed project is appreciable and the land where project is to setup consists of highly fertile and productive soil. A loss of fertile land is expected due to the land acquisition for the Project but the bigger cause of producing energy for the nation is favourable.	It is just a comment that project will help in production of electricity but will result in loss of fertile land also.
2	SDFO and District Wildlife Officer, Sheikhupura.	The project should be executed while ensuring that the Project will not cause any significant negative impact on the flora of the area or the wildlife.	The relevant mitigation measures have been designed in the report after assessing the impacts.
3	Deputy District.Officer Environment Protection Department, Sheikhupura	In view of the power shortage in the country such projects are the need of the time. As this project is LNG based, there will be possibly no difficulty in its approval.	Agreed.
4	XEN, Irrigation Department, U.C.C. Division Sheikhupura	New power plants are necessary in view of current power shortage. Every effort shall be made by the irrigation department to supply the requisite	Irrigation department is providing water for power plant operation.

Sr. No.	Departments	Stakeholder Observations/Concerns	Response
		water for the power plant.	
5	District Officer Fisheries, Sheikhupura	There are 400 fish farms in this district with varying extent ranging from 2 to 5 acres. There will be no negative impacts on fishery as no fish farm exists in the proposed Project area.	Agreed.

6.4.4 Village Level Consultations with PAPs

A series of public consultations were conducted to get the feedback/concerns of the different category of stakeholders including potential PAPs, local community and other general public residing in the Study Area. Four (4) consultative meetings were held with more than 80 participants in the study area. The major categories participated in these meetings were local population, community groups, landowners, tenants and potential PAPs. Majority of the people who participated in these consultations are mature/elderly persons because as per the local culture, elders have the right regarding any decision. However, young people participated in the consultations.

These consultations were carried out from February 23 to 24, 2015 with the direct and indirect affectees. Major consultation with the PAPs/local community and general public were carried out in Thatha Miana, Chah Waris, Therian and Bhikki Town. The detail of the participants is given in Table 6.4 below:

Table 6.4: Participants during Village Level Consultation

Sr. No.	Village	Name	Father's Name
1	Bhikki Town	Ch. Hakim Ali	Faqir Muhammad
2		Abdul Sattar	Saraj Din
3		Muhammad Iqbal	Hakim Ali
4		Meher Karamat Ali	Abdullah
5		Ali Sher	Noor Muhammad
6		Nazir Ahmed	Gulsher Muhammad
7		Muhammad Rafiq	Chajji Khan
8		Muhammad Arshad	Ghulam Muhammad
9		Muhammad Aslam	Said Muhammad
10		Haji Ejaz Ahmed	Muhammad Iqbal
11		Muhammad Ashiq	Muhammad Hussain
12		Amjad Ali	Muhammad Aslam
13		Akhtar Hussain	Allah Ditta
14		Akram Mughal	Muhammad Siddiq
15		Muhammad Arif	Muhammad Shafiq
16		Ejaz Ahmed	Abdul Razzaq
17		Shah Muhammad	Ahmed Din
18		Nazir Hussain	Shokat Ali
19		Muhammad Boota	Muhamamd Shafi
20		Arshad	Rehmat Ali
21		Muhammad Ashraf	Allah Ditta

Sr. No.	Village	Name	Father's Name
22		Muhammad Ashiq	Muhammad Ali
23		Arshad	Bashir
24		Muhammad Asif	Nazar Hussain
25		Ghulam Asghar	Din Muhammad
1	Thatha Miana	Karamat Ali	Faqir Hussain
2		Basharat Ali	Sakhi Muhammad
3		Irfan	Asgher
4		Rashid	Muhammad Mansha
5		Muazzam Ali	Habib Ullah
6		Muhammad Zahid	Muhammad Mansha
7		Fayyaz Ahmed	Muhammad Riaz
8		Ghulam Haider	Muhammad Yousuf
9		Muhammad Aslam	Amir
10		Muhammad Riaz	Imdad Hussain
11		Muhammad Arif	Allah Ditta
12		Muhammad Yousuf	Abbas Ali
13		Ahsan Ullah	Liaqat Ali
14		Khalil Ahmed	Hussain Ali
15		Aurangzeb	Allah Ditta
1	Chah Waris	Muhammad Nawaz	Muhamamd Ismail
2		Muhammad Ashraf	Nazir Ahmed
3		Muhammad Qasim	Noor Ahmed
4		Liaqat	Ghulam Nabi
5		Sabir	Noor Muhammad
6		Abdul Ghafoor	Muhammad Hussain
7		Muhammad Farhan	Muhammad Aslam
8		Muhammad Ishaq	Hussain
9		Waqar	Ghulam Sabir
10		Shabbir Ahmed	Noor Ahmed
11		Muhammad Ahzal	Shah Muhammad
12		Muhammad Imran	Muhammad Anwar
13		Muhammad Akram	Bashir Ahmed
14		Muhammad Jawaid	Ismail
15		Waqas	Ghulam Sabir
16		Arshad	Bashir Ahmed
17		Kalu	Nazir Ahmed
18		Anwar Maseeh	Channa Maseeh
19		Ishaq Maseeh	Haru Maseeh
20		Bhola Maseeh	Barkat Maseeh
1	Therian	Muhammad Aslam	Nazir Ahmed
2		Muhammad Akram	Nazir Ahmed
3		Muhammad Tufail	Barkat Ali
4		Nazir Ahmed	Barkat Ali

Sr. No.	Village	Name	Father's Name
5		Mudassar	Allah Yar
6		Muhammad Ashraf	Faqeer
7		Muhammad Javaid	Abdul Hameed
8		Muhammad Ashraf	Ismail
9		Muhammad Irfan	Abdul Sattar
10		Maqsood	Haji Abdul Ali
11		Muhammad Bashir	Barkat Ali
12		Shabbir Ahmed	Sher Muhammad
13		Ghulam Mustafa	Wali Muhammad
14		Muhammad Yunis	Jan Muhammad
15		Alayar	Nazir Ahmed
16		Abdul Sattar	Allah Rakha
17		Zulfiqar	Niaz Ahmed
18		Muhammad Yunis	Muhammad Sadiq
19		Muhammad Arshad	Nazir Ahmed
20		Khizar Hayat	Abdul Aziz

The following points were raised/discussed during the consultation:

Table 6.5: Details of Issues/Points Raised/Discussed during Village Level Consultations

Sr. No.	Stakeholder Observations / Concerns	Response
1	There is no government water supply scheme laid in the area due to which people use to drink water from hand pumps and ultimately it leads to several diseases, despite of good apparent quality of water.	The comment is not directly related to the project scope. The Govt. should consider this to provide safe drinking water to the area.
2	Drainage and sewerage system are totally nowhere and people use to use domestic draining channels which leads to a pond and become a sever source of pollution.	The comment is not directly related to the project scope. The Govt. should consider this for social uplift of the area.
3	Mega projects usually execute multiple projects of public welfare for nearby community. So, this proposed power plant should also take measures for establishing health, education and recreational facilities in the study area.	The comment has been incorporated in the report and it has been recommended that project should share its facilities like dispensaries with the locals. It is also recommended that proponent should take some Confidence Building Measures (CBMs).
4	The residents of this area are mostly migrated from India during partition. If our land is again acquired, then what will be the prospect for our future generation in our possible next migrated area?	The Govt./proponent should do more consultation with the PAPs and proper compensation should be given and their concerns should be addressed.
5	Road quality in the entire area is at sparse. No NGO or any welfare organization is present in the area. Even, the relevant MPA and MNA do not take any necessary or productive measure towards the improvement of life	The comment is not directly related to the project scope. The Govt. should consider this to improve infrastructure facilities

Sr. No.	Stakeholder Observations / Concerns	Response
	quality of the villagers.	in the area.
6	The proposed power plant is supposed to be based on RLNG. But this is totally in-just that the local population, especially villagers are lacking the natural gas for their domestic house use and on the other hand, in the vicinity, the power plant is running on gas. We should also be benefited with the gas.	The Govt. should share its policy of imported RLNG for awareness raising of the locals.
10	The land owners or even the tenants of the proposed project area are mostly based on the agricultural activities. If they are compensated with money, then up to when the money will benefit them.	The Govt./proponent should do more consultation with the PAPs and proper compensation should be given and their concerns should be addressed. The govt. should provide livelihood assistance to the PAPS like loan, job assistance, training etc. This has been recommended in EIA Report.

6.4.5 Stakeholder Consultations Framework for Construction and Operation Phases

Key stakeholders of the Project include provincial and district level government department such as Environmental Protection Department, Agriculture Department, Forest Department, Wildlife Department, Irrigation Department, Fisheries Department and Project directly affected people, land owners and local people. The community members will be compensated by project proponent and they will be encouraged to participate in project activities during construction and operation phases. The consultations will be made in future to facilitate the community at the local level.

The consultations will be carried out during the construction and operation phases of project. Efforts will be made to maximize the consultations during the project implementation. The consultations will be carried out with the objectives to develop and maintain communication linkages between the project promoters and stakeholders, provide key project information to the stakeholders, and to solicit their views on the project and its potential or perceived impacts, and ensure that views and concerns of the stakeholders are incorporated during the implementation with the objectives of reducing or offsetting negative impacts and enhancing benefits of the proposed project. The framework for the future consultations is elaborated in Table 6.6 below:

Table 6.6: Future Consultations Framework

Sr. No.	Stakeholders	Project Phase	Frequency of Consultation
1	Provincial Government Departments	▪ Pre-Implementation ▪ During the Project Implementation	▪ One round of consultation before start of implementation of project. ▪ Monthly during construction stage and bi-annually during operation phase of the project.
2	District Level Government Officials	▪ Pre-Implementation ▪ During Project Implementation	▪ One round of consultations before start of implementation of project. ▪ Monthly during construction stage and bi-annually during operation phase of the project.
3	Project Affected Peoples	▪ Pre-Implementation ▪ During the Project Implementation	▪ One rounds of consultations before start of implementation. ▪ Fortnightly during construction stage and bi-annually during operation phase

Sr. No.	Stakeholders	Project Phase	Frequency of Consultation
			of the project.
4	Surrounding Villages	▪ Pre-Implementation ▪ During Project Implementation	▪ One round of consultation before start of implementation. ▪ Quarterly during construction stage and bi-annually during operation phase of the project.
5	Local Elders	▪ Pre-Implementation During Project Implementation	▪ One round of consultations before start of implementation of project. ▪ Monthly during construction stage and bi-annually during operation phase of the project.
6	Women	▪ Pre-Implementation ▪ During Project Implementation	▪ One rounds of consultations before start of implementation. ▪ Fortnightly during construction stage and bi-annually during operation phase of the project.
7	NGOs, Local CBOs or other Civil Society Groups	▪ Pre-Implementation ▪ During Project Implementation	▪ One round of consultations before start of implementation of project. ▪ Fortnightly during construction stage and bi-annually during operation phase of the project.

CHAPTER – 7

IMPACTS AND MITIGATION MEASURES

7.1 IMPACT EVALUATION

This chapter identifies the potentially significant beneficial as well as adverse environmental and social impacts of the design/pre-construction, construction and operational phases of the proposed Power Plant project on the physical, ecological and socio-economic domains of the environment. A project impact evaluation matrix has been developed to evaluate the potential impacts of the proposed project.

7.1.1 Methodology for Impact Evaluation

The methodology adopted for the evaluation of the impacts includes the following assessment tools, (i) project impact evaluation matrix and (ii) overlays. These tools have been used to identify the significance and magnitude of the impact as well as the nature, reversibility, extent etc.

a) Project Impact Evaluation Matrix

The Impact Evaluation Matrix was developed by placing project activities along one axis (i.e. Y-axis), and on the other axis (i.e. X-axis) the different environmental parameters likely to be affected by the proposed project actions grouped into categories i.e. physical, ecological and socio-economic environment. For the impact assessment, project impact evaluation matrix is used by dividing the project action into different phases (design/pre-construction, construction and operational phases). A Project Impact Evaluation Matrix is attached as Annex- 6.

b) Overlays

In order to identify spatial based impacts, overlays were used. An overlay is based on a set of transparent maps, each of which represents the spatial distribution of an environmental characteristic (for example, land acquisition). Information for an array of variables such as land use, infrastructure, vegetation etc. is collected for the standard geographical units within the Study Area are recorded on a series of maps, typically one for each variable. These maps are overlaid to produce a composite map. The resulting composite maps characterize the area's physical, social, ecological, land use and other relevant parameters related to the location of the proposed intervention. An overlay map of the Project Area is attached as Figure 5.2.

7.2 POTENTIAL POSITIVE IMPACTS

The Project is envisaged to have the following major positive impacts.

7.2.1 Electricity Generation

The power plant is expected to generate 1,000-1,500 MW of electricity. Given that Pakistan currently faces a shortfall of about 4,000 to 6,000 MW per day, the generation capacity of this power plant will help towards meeting a portion of the shortfall, thus providing some measure of relief to the people of Pakistan. The generation of electricity will not only help the industrial sector and its outputs but will also help to raise the standard of living as it will reduce load shedding.

7.2.2 Employment Opportunities

Electricity generation will help industry in producing more output and in being more efficient, which in turn will have a ripple effect of increasing local employment. Even during the construction phase of the project, the requirement of engineers, workers, laborers, technicians, para-professionals etc. will generate employment opportunities. Locals will also have the opportunity to diversify their incomes by being employed during the construction period of the project. It is estimated that about 2,500 during the construction phase and about 150-200 during the operation phase will be employed. Hence, there will be large number of employment opportunities mainly for the local people, during the construction phase of the project.

7.2.3 Increase in Business

With the influx of laborers for the proposed project, there will be more opportunities for small scale business such as small grocery shops, small cafes (khokas), and vehicle tuning, tyre-repair shops etc. Additionally the generation of electricity will reduce load shedding and contribute towards more business in the country.

7.2.4 Increased Accessibility

Construction of the access road for the construction of Power Plant and up gradation of existing tracks to the project area will result in improved accessibility.

7.2.5 Indirect Benefits

In addition to the power production and other benefits described above, there will be other economic benefits associated with the project implementation. These are known as secondary or indirect benefits, which are as follows:

- The generation of 1,000 - 1,500 MW of electricity which will be added to the national grid, will help in reducing the current crisis of the electricity. The availability of electricity will boost the industrial sector of Pakistan. This will have a huge impact on the economy of the country;
- The proposed Project will have positive impacts on the areas due to the development of quarry sites. In this regard, construction of new roads to the quarry sites will also benefit the local population apart from job opportunities;
- The construction and operation of the proposed Project will stimulate business and employment opportunities for the labor in the form of handling, transportation, business etc.;
- The prices of Study Area lands will be appreciated considerably due to this proposed power plant as a result of commercial activities; and
- In addition to all these benefits, the project will result in the general economic and social uplift of the people particularly in areas of the Punjab Province and will provide basic infrastructure and raw material for other projects in the region.

7.3 POTENTIALLY SIGNIFICANT ADVERSE IMPACTS AND MITIGATION DURING DESIGN/PRE-CONSTRUCTION PHASE

This section identifies the potentially significant adverse environmental and social impacts anticipated during the pre-construction phase of the project. Mitigation measures, where applicable have also been suggested.

7.3.1 Land Acquisition

a) Impact

The project will be constructed over a land area of 315,964.34 sq.m (including permanent plant and access road area only). Temporary area requirement will be 137,710.65 sq.m for construction camp and other construction related activities. Govt. will acquire the private land per provision of LAA, 1894. The section 4 is also attached as Annex-7. The revenue map is shown in Figure 7.1 and the details of land are provided in Table 7.1.

b) Mitigation of Land Acquisition

The plant construction mostly involves the private land. The land will be acquired according to the provision of the LAA, 1894. The LAA is broadly grouped into eight (8) parts comprising 55 Sections dealing with the details of land acquisition and compensation. The main relevant Sections of LAA,, 1894 are shown in Figure 7.2. Apart from other relevant sections, the sections describing the aspects to be considered and not to be included during the determination of compensation are as summarized below:

Section-23 (Matters to be considered in Determining Compensation): Section-23 testifies that in determining the amount of compensation to be paid for land acquired under this Act, the Collector shall take into account the followings:

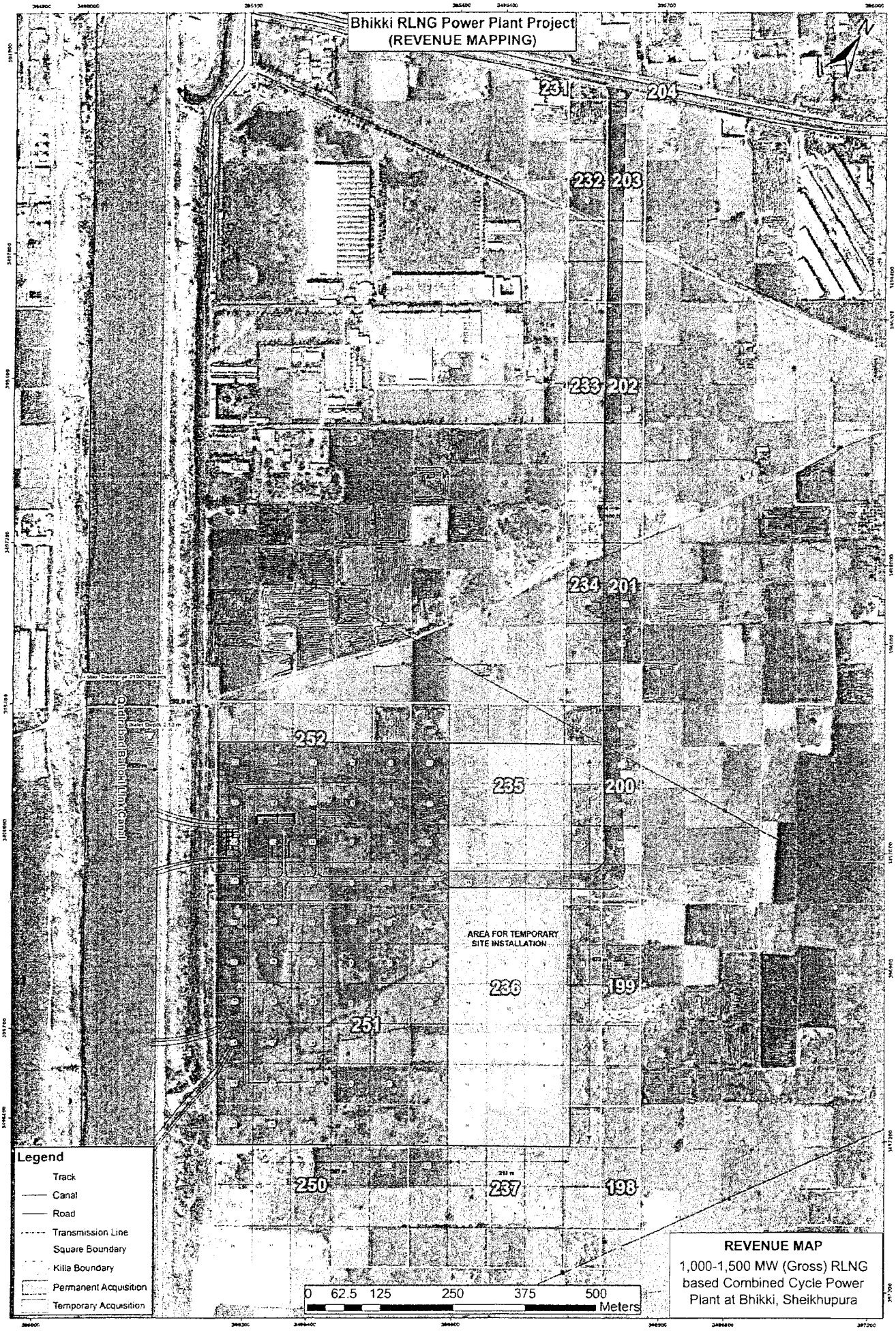
- Market value of land at the date of publication of notification under Section-4;
- Damage sustained, by reason of the taking of any standing crops or trees at the time of the Collector's taking possession thereof;
- Damage (if any) sustained, at the time of taking possession of the land, by reason of severing such land from his other land;
- Damage (if any) sustained, at the time of taking possession of the land, by reason of the acquisition injuriously affecting his other property or his earnings;
- If in consequence of the acquisition of the land, the person interested is compelled to change his residence or place of business, the reasonable expenses (if any) incidental to such change;
- The damage sustained by diminution of the profits of the land between the time of the publication of the declaration under Section-6 and the time of taking possession of the land; and
- 15% over and above the cost of the land determined by the Collector as charges for acquisition.

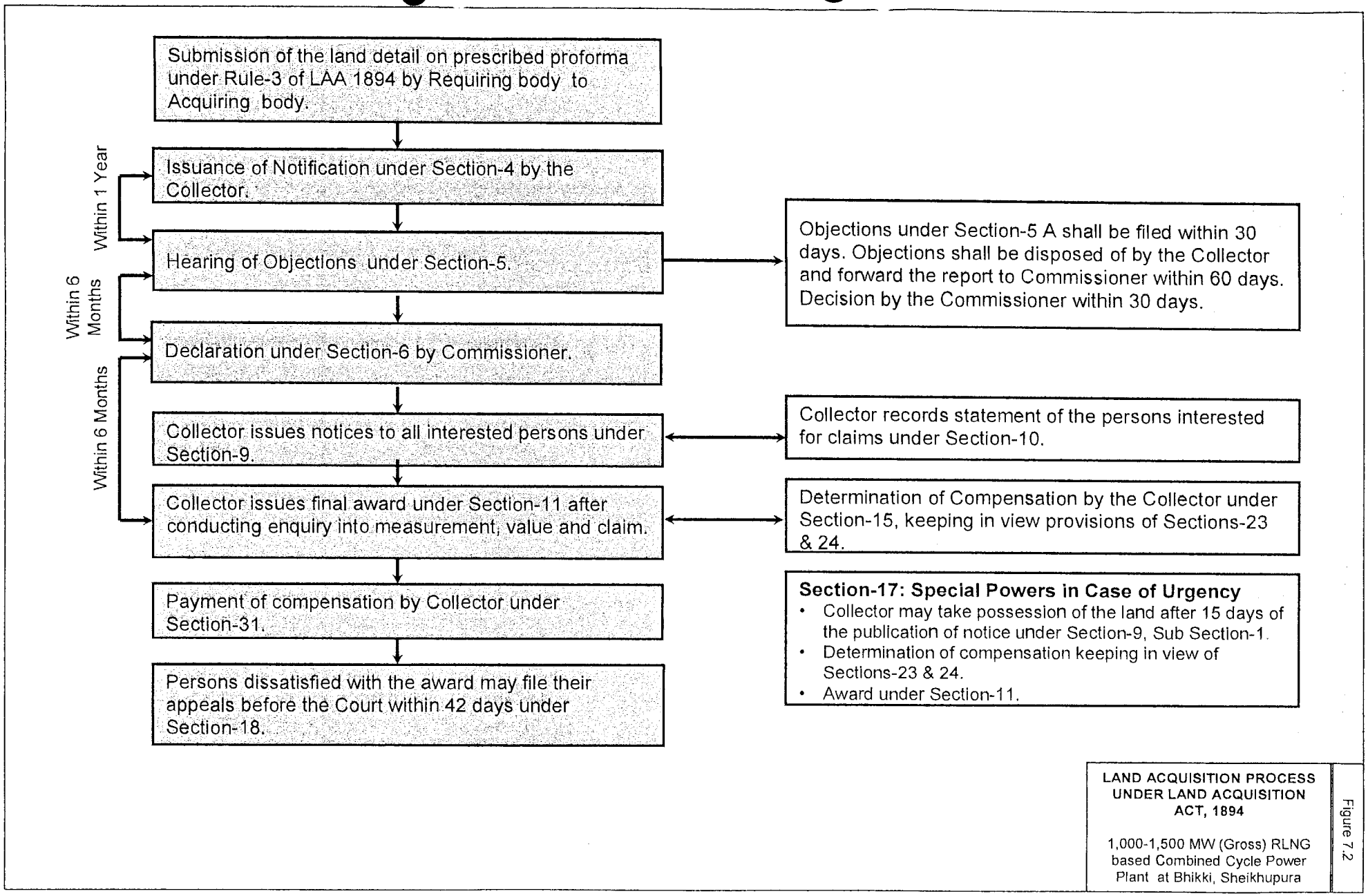
Section-24 (Matters to be neglected in Determining Compensation): In accordance with Section-24, following matters shall not be taken into consideration in determining:

- The degree of urgency which has led to the acquisition;
- Any disinclination of the person interested to part with land acquired;
- Any damage sustained by him which, if caused by a private person, would not render such person liable to a suit;
- Any damage which is likely to be caused to the land acquired after the date of publication under Section 6, by or in consequence of the use to which it will be put;
- Any increase to the value of the land acquired likely to accrue from the use to which it will be put when acquired;
- Any increase to the value of the other land of the person interested likely to accrue from the use to which the land will be put; and
- Any outlay or improvements made without the sanction of the Collector after the date of the publication of the notification under Section-4.

The above provision will be strictly complied with during the determination and payment of compensation. Proper measures need to be taken to safeguard the livelihoods of the

Figure 7.1


Bhikki RLNG Power Plant Project
(REVENUE MAPPING)
N
231
204
232
203
233
202
234
201
252
235
200
AREA FOR TEMPORARY
SITE INSTALLATION
236
199
251
250
237
198
Upper Jhelum Link Canal
Legend
Track
Canal
Road
Transmission Line
Square Boundary
Killa Boundary
Permanent Acquisition
Temporary Acquisition
0 62.5 125 250 375 500
Meters
REVENUE MAP
1,000-1,500 MW (Gross) RLNG
based Combined Cycle Power
Plant at Bhikki, Sheikhupura



LAND ACQUISITION PROCESS UNDER LAND ACQUISITION ACT, 1894

1,000-1,500 MW (Gross) RLNG based Combined Cycle Power Plant at Bhikki, Sheikhupura

Figure 7.2

affectees apart from the compensation.

7.3.2 Loss of Agriculture Land

a) Impact

The proposed project will result in the conversion of agriculture land in to built-up area that will decrease the agriculture produce of the area.

b) Mitigation

The proponent should consult with the locals and take guidance from the agriculture department and promote such practices and techniques that will increase the yield and soil fertility. Following steps are recommended for yield increase in the nearby surrounding area.

- Promote and adopt new irrigation techniques like drip irrigation, sprinkle irrigation, etc. and other prevailing modern scientific methods that will improve the crop yield;
- Use of Effective Microorganisms (EM) technology for crop yield enhancement;
- Agricultural inputs should be offered on subsidized prices to farmers of small land holdings relating to electricity tariff, supply of seeds, fertilizers, machinery and other agricultural tools so as to attract the farmers zeal to work hard in increasing the crop yield;
- Soil microbial inoculants as an alternative biological approach should be used to improve the soil quality;
- Integrated use of green manure, farmland manure and inorganic fertilizers may be promoted;
- Improving agronomic performance of crops, particularly wheat and rice, by controlling insect pests;
- Use of modern machines for cultivation and harvesting will increase yield of the crops;
- Government may evolve a system to offer credit facilities to farmers of small holdings to purchase certified seeds, pesticides, fertilizers, etc. and
- Lack of guidance to small farmers about new agricultural techniques and allied sciences may be overcome by means of communication through Radio and TV in rural areas to air the programmes in regional and local languages for better understanding and field adoption.

7.3.3 Water Quality & Quantity

a) Impact

It is expected that the requirement of water during pre-construction stage will be fulfilled from groundwater through tube wells. The preconstruction activities include construction of new access tracks and improvement of existing track, clearing and leveling of project areas etc. Water extraction from groundwater will negatively affect the existing water quantity.

b) Mitigation

This impact on water through tube wells needs to be addressed carefully adopting the recommendations of Hydrogeological Study and Electrical Resistivity Survey (ERS). Contractor should consult with department and obtain permit for extraction of water.

7.3.4 Loss of Livelihood

a) Impact

Due to the acquisition of the private land, some families may have direct impact and lose

their livelihood. The bread and butter of these families are dependent on the agriculture of these lands. With the acquisition of these lands livelihood of these families will be lost. As per the LAA these families will get the compensation of these lands however, loss of livelihood is a significant adverse social impact of the proposed Project which is required to be addressed.

b) Mitigation

As per LAA, no provisions for the loss of livelihoods exist. Other compensation should be provided to the adversely affected population who may have usufruct or customary rights to the land or other resources taken for the project. It is strongly recommended that the proponent should provide livelihood assistance to the affectees like loans, job assistances, trainings etc.

7.3.5 Impacts on Built Up Areas, Infrastructure and Crops

a) Impact

The implementation of the Project will affect the tube wells, crops, water courses, katcha track, transmission line that will come under permanent, temporary and access road area. The detailed quantification is shown in Table 7.1.

Table 7.1: Details of Built-up Area and Land Classification

Land Classification	Quantity
Permanent Area Quantification	
Agriculture Land (sq.m)	214572.70
Barren Area (sq.m)	52608.86
Builtup Area (sq.m)	84.70
Total Area	**2672266.26**
Water Course (m)	1421
No of Tube well (No.)	1
No of Trees	13
Access Road Quantification	
Agriculture Land (sq.m)	44721.03
Barren Area (sq.m)	3848.95
Builtup Area (sq.m)	128.10
Total Area	**48698.08**
Water Course (m)	108
Track (m)	71
Transmission Line (m)	34
No of Tube well	1
No of Trees	25
Temporary Area Quantification	
Agriculture Land (sq.m)	135417.81
Barren Area (sq.m)	2016.92
Builtup Area (sq.m)	275.92
Total Area	**137710.65**
Water Course (m)	524
No of Tube well	2
No of Trees	20
Total Permanent Area including Access Road (sq.m)	**315964.34**
Total Temporary Area (sq.m)	**137710.65**

b) Mitigation

The loss of private built up area, infrastructure and crops should be compensated according to the provisions of the LAA,1894. Other government infrastructure should be relocated by

the concerned department in consultation with the project proponent.

7.4 IMPACTS AND MITIGATIONS DURING CONSTRUCTION PHASE

7.4.1 Impacts on Land Resources

a) Soil Erosion

Soil erosion may occur during the construction phase in the Project Area as a result of improper runoff drawn from the equipment washing-yards and improper management of construction activities. Soil erosion may also occur at quarry area if unmanaged material extraction is carried out.

Construction works may temporarily change the grading of the natural ground surfaces and due to instability of top soil surface, soil erosion may occur.

b) Soil Contamination

All the carbon based compounds are toxic to varying degrees. Hydro Carbons (HCs), petrol, diesel etc. are toxic in nature. The insulation on electric wires and cables are made from hydrocarbon compounds, which are toxic. Paints and varnishes are also toxic in nature, which are used during construction. If proper care is not taken for handling, storing and transportation of these toxic substances these may cause damage to the health of the workers as well as their spills will contaminate the soil. The other waste generated is mostly composed of rubbish, ashes and residues, demolition materials and hazardous wastes. These wastes will be generated due to the construction activities and materials used for construction. Indiscriminate disposal of solid waste will contaminate the soil.

Another source of soil contamination is the discarded construction materials that include chemicals, wires, plastics, cut pieces of pipes, pieces of empty fuel and lubricants tins and cardboard packing and other discarded materials. All these wastes are part of solid waste.

One of the most important aspects is the generation of solid waste during construction activities. During the construction activities the generation rate for solid waste will increase considerably. The major components of the workers camp waste are garbage, putrescible wastes. The construction camp will be located over reasonable area, and therefore there is significant area that is potentially susceptible to soil contamination. Immediate attention is required for such type of wastes as these are degradable and those that produce odor. It is expected that approximately 0.5 kg/capita/day[1] waste will be generated from the camps. The total expected labour force will vary during the course of the construction phase of the project. The table 7.2 below shows an average estimate of the number of workers during the construction phase and estimated solid waste generated.

Table 7.2: Estimated Solid Waste Generated by Workers

No. of Workers	Estimated Solid Waste Generated per day
2,500	1,200 kg/day

c) Water Ponding

The excavated material will be generated from the excavations of trenches for foundations, laying of water supply pipeline and other structures. This excavated materials will be used for filling works as much as possible. However, a bulk of the excavated material will not be reused. If this material is left at places of excavation, it will remain there in loose form and

[1] Source: The World Bank Report 2012 – What a Waste: A global review of solid waste management. Based on UNEP estimates for waste generation in the Asia Pacific. Average is 0.45 kg/capita/day.

may promote development of temporary water ponding within the Project Area and its nearby vicinity.

7.4.2 Proposed Mitigation of Impacts on Land Resources

a) Soil Erosion

Good engineering practices will help in controlling soil erosion at the construction site areas. Controlled excavations at quarry areas will also help to reduce the soil erosion. Contractor should make proper arrangements for drainage of water in the washing yards and quarry areas such as drainage channels. It is recommended that a properly developed quarry management plan should be prepared for each quarry site. The Waste Management Framework (WMF) described in Chapter 8 of this report should also be adhered to by the contractor.

b) Soil Contamination

Oil leakages, chemicals and other liquids spills should be avoided/minimized by providing appropriate storage places depending on the type of material for storage. Oil and other lubrication material should be stored in water proof tanks especially built for oil storage. These tanks should be built away from the main road and residential areas or safety purposes. Access to these tanks should only be allowed to the authorized personnel. Safety equipment like fire extinguishers should be placed near these places along with signs for danger and fire.

Workers must be familiar with the Material Safety Data Sheets (MSDS) of each chemical used at site. MSDS are provided with each chemical drum. Chemicals will be stored as per the instructions of MSDS. Utmost care should be taken during the handling of these chemicals. Precautions should be taken to prevent spills and all workers should be trained in proper handling, storage and disposal of hazardous or toxic materials.

Solid waste Contractor should consult with the proponent and the Tehsil Municipal Administration (TMA), for final disposal. Adequate number of solid waste containers should be placed at various locations within the Project Site and shall not in any case dispose of waste indiscriminately outside the boundary of the Project Area.

Separate primary collection of organic and in-organic waste arrangements need to be provided. In this regard, workers should be made well aware of the solid waste management system being adopted at the site. Hazardous, Non-hazardous, Inert and municipal wasted such as garbage, refuse, etc. produced during the construction, pre-commissioning and commissioning stages shall be disposed in compliance with the National guidelines and government ordinances. All hazardous wastes shall be clearly labeled. Other waste shall be placed in designated containers.

Regular clean-up of scrap material, saw dust, rags, oil, paint, grease, flammable solvents and other residue of construction operation shall not only remove or reduce the fire hazard, but shall promote general safety at the same time.

Contractor will arrange to obtain at each of work areas adequate waste disposal and toilet facilities, potable water for use of its employees. In addition, Contractor shall comply with all laws, standards, codes and regulations relating to sanitation at the work-site, including company's requirements as to waste disposal and toilet facilities and Potable Water.

All the above measures should be implemented as part of a Waste Management Plan to be prepared by the contractor under the guidelines presented in the WMF in Chapter 8 of this report.

c) Water Ponding

Proper storage place for each type of material to be used during the construction should be built to avoid the development of water ponds. Left over material should be disposed of immediately at designated places.

7.4.3 Impact on Water Resources

a) Water Utilization for Construction

Water will be required for the construction purposes. Groundwater will be used for this purpose that may have negative effect on the available water quantity and water required for construction may result in competition with original use of water. It is also expected that groundwater supplies, which need to be tapped to meet campsite and construction requirements will lower the water table in the Study Area.

b) Contamination of Canal Water

Sewage and wastewater will be generated at the construction camps and from construction activities. If the generated sewage is not properly treated or disposed of, this may contaminate the water quality of the Canal and might affect the groundwater resources apart from soil contamination. Water from dewatering activities (during rainy season) has the potential to contain suspended solids and oil and grease and if disposed of untreated may affect the quality of surface water bodies. Furthermore, spills of oils and hazardous chemicals if in large quantities can drain into the nearby water channels that are a source of irrigation water to the agricultural fields. This is a potentially significantly adverse impact as the wastewater can drain from the Project Area into the Canal. Such contamination of canal water can have adverse impacts on the water quality. The Table 7.3 below shows an estimate of the wastewater to be generated during the course of the construction phase of the project assuming that on average the water demand per person is 100 litres per day and that 80% of the water demand will become wastewater.

Table 7.3: Estimated Wastewater Generated by Workers in Construction Camps

No. Of Workers*	Estimated Total Water Demand (litres/day)	Estimated Wastewater Generated (litres/day)
2500	250,000	200,000

c) Contamination of Groundwater Resources

The groundwater can also be contaminated by sewage from the septic tanks. The deep wells will also be installed at the Site. These deep wells will be used for the supply of makeup water during the Canal closure period.

7.4.4 Mitigation of Impacts on Water Resources

a) Water Utilization for Construction

Efforts should be made to draw water from deep aquifer which do not influence the top unconfined aquifer which is being exploited by the local community. However, this should be done by carefully adopting the recommendations of Hydrogeological Study and ERS. It will be the responsibility of the contractor to ensure safe supply of water for construction purposes.

b) Contamination of Canal Water

To avoid sewage, untreated wastewater, and chemicals and oil spillage from draining into the canal nearby during construction activities, measures should be taken to contain the chemicals, sewage and untreated wastewater. Contractor should not in any case dispose of above chemicals into the nearby Canal.

Similarly utmost care should be taken to avoid any spills of oils and hazardous chemicals by best management practices and good house-keeping and following the MSDS. In case of emergency spills, Standard Operating Procedures (SOPs) should be developed and strictly followed by contractor. The chemicals and other oils shall be disposed of at designated places or supplied to other industries as raw material to avoid contamination. Measures should also be taken to remove settle-able solids prior to discharging water from the site include the use of sediment sumps. Any visible oil and grease can be skimmed off the surface using absorbent pads.

For Sanitary drainage, installation of proper temporary sanitary sewage disposal facilities for the entire site should be considered. These include provisions for the construction offices and living area. The number of comfort rooms/portables shall correspond to the number of workers, as required by law, and the sanitary sewage facilities should be adequately sized.

c) Contamination of Groundwater Resources

Sewage from construction camps should be disposed of by development of on-site sanitation systems i.e. septic tanks along with soakage pits. On-site sanitation system can be operated well as long as the difference from the bottom of the soakage pit is two (02) m (6.56 ft) from the groundwater. Therefore, this system will minimize the negative effect on groundwater quality.

7.4.5 Impacts on Ambient Air and Noise

a) Air Quality

Air quality is likely to be adversely affected by the construction of the Power Plant. Several types of emissions are expected, including:

- Gaseous emissions due to movement of construction machinery;
- Fugitive dust emissions due to movement of machinery on dirt tracks, construction of roads and excavation of borrow areas; and
- PM emissions during the operation of concrete batching plants and asphalt mixing plants.

These emissions are described in the following sections.

i) Gaseous and Fugitive Dust Emissions

For the construction work, various types of machinery will be required. Machinery will consist of gantry cranes, tower cranes, crawler cranes, loaders, trailer pumps, mixers, excavators, dumpers, concrete rollers etc. Since most of the machinery will use diesel as fuel, emissions will mainly consist of carbon monoxide (CO), SO_2 PM, NO_x and HC. Most of the above machinery (excluding the batching plants) will move around during the construction period.

Fugitive dust will be produced by earth moving activities, excavation, haulage, heavy machinery movement and construction of roads within the power plant area. Fugitive dust emissions are a function of silt content of dirt tracks, vehicle speed and the mean annual number of days with 0.01 inches (0.254 mm) or more of rainfall.

Gaseous and fugitive dust emissions will result in an impact of medium significance, due to their moderate magnitude, relatively small duration (less than five years), and localized geographic impact area. Gaseous and fugitive dust emissions will affect the people living in the nearby settlements. Moderate levels of vehicular emissions tend to cause lung irritation, shortness of breath and increase a person's susceptibility to asthma. This impact is classified as moderately significant.

ii) Particulate Matter Emissions from Concrete Batching

Concrete batching plants will be a major source of PM emissions. These emissions accumulate in the respiratory system and can lead to decreased lung function, and respiratory disease. Direct impacts will be encountered by the construction workers working in close proximity to the batching plants as well as those residents in nearby settlements.

b) Noise

Noise from the construction activities (such as batching plant, vehicular movement etc.), vibration and movement of heavy traffic might be significant and may cross the NEQS limit as detailed in Table 7.4 below:

Table 7.4: Noise Levels for Different Zones

Sr. No.	Zone	Noise Levels (dBA)	
		Day Time	Night Time
1	Residential (A)	55	45
2	Commercial (B)	65	55
3	Industrial (C)	75	65
4	Silence (D)	50	45

7.4.6 Mitigations of Impacts on Ambient Air and Noise

- Tuning of vehicles should be made mandatory to reduce the emissions of NO_x, SO_2, CO, HC and Total Suspended Particles (TSP) to ensure that these emissions do not exceed NEQS limits of Motor Vehicle Exhaust and Noise. All vehicles will be required to carry a fitness certificate;
- Emissions points from batching plants can be controlled efficiently by the installation of cyclone. It is also recommended that during the operations of the machines labor shall wear Personal Protective Equipment (PPEs) in order to save their health. Diesel operated equipment and vehicles should be well maintained to minimize particulate emissions. Maintenance will include changing the lubricating oil, changing the air and fuel filter, cleaning the fuel system, draining the water separators and proper tuning;
- Haul-trucks carrying, soil, sand, aggregate and other materials will be kept covered with tarpaulin to contain the construction materials being transported within the body of each carrier. Moreover, slightly wet material controls air pollution;
- Dust emissions will be reduced by regular sprinkling of water. Sprinkling will take place every three hours during daylight hours and every six hours during night time throughout the construction period in the summer and during the winter the frequency can be reduced. Sprinkling will be done on access roads, tracks frequently used by vehicles, construction zones and material storage area;
- Noisy construction activities will be avoided during the night times and silencers should be provided in all vehicles. Noise complaints should be logged and kept onsite by the construction contractor. Noise producing machinery should be properly examined to reduce noise;
- All the provisions of NEQS, 2010 based on the zone classification should be strictly enforced;
- The proposed Project Area site should be fenced and noise barriers to be installed.

7.4.7 Impacts on Ecological Environment

It is estimated that about 58 small, medium and large size trees will be removed before the start of construction. Loss of vegetative cover in the form of removal of these trees will occur while clearing land.

Presence of snakes, scorpions and insect vectors like mosquitoes and flies may be hazardous to the health of workers, who may get bit and acquire malaria, stomach diseases like cholera, diarrhea, hepatitis etc.

The construction machines will generate pollutants and particulate matter which will affect flora and fauna at a non-significant level in the area. This impact is expected which will be mitigated by the biological practices given in the relevant section of mitigation.

Due to noise and vibration during construction phase, reptiles, rodents and birds will migrate and may settle in the adjoining area.

7.4.8 Mitigation of Impacts on Ecological Environment

- Only trees coming within the various structures to be constructed on the site, shall be removed and every possible effort shall be made to save the remaining trees, which fall in open spaces or those which can be adjusted in the future landscape of the power plant;
- Ten (10) trees will be planted as a replacement of each of the tree affected and a total of 600 trees will be planted in accordance with the tree plantation plan specified in EMP;
- Trees on the boundaries of the Project Area should be planted in linear form as Tree Belts/Strips of 1-2 rows in multi-storey pattern (trees with varying height) to control any noise pollution. Tall trees like Shisham, Neem, Siris, Amaltas, Kachnar and Kikar, (scientific names are provided in Chapter-5) etc. will be used for upper storey. Alstonia, Bottle Brush, Pilkan, Bakain, Siver Oak, etc. for mid storey and ornamental bushes, like Hibiscus, Gul chin, Lagerstroemia, etc. for lower storey to provide suitable habitat for birds and other fauna, in addition to acting as shelter belts against noise;
- Trees should be raised all along the roads and paths in the Project Area after the construction of the proposed power plant. A number of grassy lawns must also be established, spreading uniformly in the Project area to promote good environment friendly practices;
- Campsites and asphalt plants will be established on vacant land rather than on green areas. However, if such type of land is not available, it will be ensured that minimum clearing of the vegetation is carried out and minimum damage is caused to trees and undergrowth;
- Construction vehicles, machinery and equipment will remain confined within their designated areas of movement;
- The Contractor's staff and labor will be strictly directed not to damage any vegetation such as trees or bushes;
- Contractor will provide gas cylinders at the camps for cooking purposes and cutting of trees/bushes for fuel will not be allowed;
- Prophylactic measures against snakes and scorpions must be taken for the health and safety of workers. Malaria and stomach ailment measures be adopted by establishing adequate number of Health Care Units/Centers in the residential area and in nearby population;
- The impact on reptiles, rodents and birds will also remain to a negligible level on account of proportionately small area for Project installation and can, however, be avoided with vigilant movement of heavy machinery and equipment during construction; and
- Hunting, poaching and harassing of wild animals and birds will be strictly prohibited and contractor shall be held responsible for any such act of his men.

7.4.9 Impacts on Socio-economic Environment

During the construction period, the movement of construction vehicles from the main highway into the proposed plant boundary may affect traffic on Sheikhupura-Faisalabad Road and may create minor annoyances to the residents and traffic on the road. Transportation of heavy construction equipment and material is likely to damage the road.

Induction of outside workers in the Contractor's labor force may cause cultural issues with the local community as the local community is very sensitive about their cultural values. Also theft problems to the local community may arise by the labor force and vice versa.
Unmonitored construction activities may create an accident risk for the local residents particularly the children and labor force.

Disturbance may happen to the privacy of the local women residing in the Study Area when workers will work at height.

The community belonging to the villages of project areas can be affected during the construction phase as follows:

- During the construction phase, the general mobility of the local residents and their livestock in and around the Study Area is likely to be hindered;
- Unmonitored construction activities;
- Usage of community common resources like potable water, fuel wood etc. by Contractor workforce may create conflicts between the community and the Contractor; and
- Community will have to face the noise and dust problems during the construction activities.

7.4.10 Mitigation Measures of Impacts on Socio-economic Environment

- Efforts should also be made to discuss traffic conditions with the National Highway Authority (NHA) and Communication and Works (C&W) Department so that regular traffic is not disturbed. Transporters engaged by the plant would be forced to adhere to the load specifications of the access road. No overloading would be allowed in any case;
- Good relations with the local communities will be promoted by encouraging Contractor to provide opportunities for skilled and unskilled employment to the locals, as well as on-the-job training in construction for young people. Contractor will restrict his permanent staff to mix with the locals to avoid any social problems;
- The Contractor should prefer local labor from nearby villages. The Contractor will keep the copies of Computerized National Identity Card (CNIC) of his employees and will warn the workers not to involve in any theft activities and if anyone would involve, he will have to pay heavy penalty. Similarly, at the time of employment, Contractor has to take care that the workers should be of good repute. The Contractor camp will be properly fenced and main gate will be locked at night with a security guard to check the theft issues;
- Contractor should arrange first aid kits along with medical officer in the field. Routine medical check-ups of all the field staff including unskilled labor need to be conducted by a qualified doctor;
- Training of workers in construction safety procedures, environmental awareness, equipping all construction workers with PPEs, safety boots, helmets, gloves, and protective masks, and monitoring their proper and sustained usage will be carried out. In case of accidents contractor will provide free medical treatment to the community;
- Contractor will have to take care as much as possible that the construction activities should not affect the privacy particularly with reference to women;
- Large noise generating activity will be carried out during the fixed hours (preferably during the mid-day). The timing will be made known to all the people within 500 m (1640 ft) radius of the site;
- Construction camp will be located at least 500 m (1,640 ft) away from the local settlements to prevent the contamination of community-owned water resources;

- Approval from the locals (elders and leaders of nearby population) will be obtained before using the local water resources;
- The Contractor will be responsible for the sensitivity towards the local customs and traditions;
- The Contractor will be required to maintain close liaison with the local communities to ensure that any potential conflicts related to the common resource utilization for the project purposes are resolved quickly;
- Mitigation suggested to control air and noise pollution should be enforced by the Contractor;
- Effective construction controls by the Contractor to avoid inconvenience to the locals due to noise, smoke and fugitive dust should be provided;
- Haul-trucks carrying concrete, aggregate and sand fill materials will be kept covered with tarpaulin to help contain construction materials being transported between the sites, thus preventing environmental pollution; and
- Local vendors will be preferred for purchase of camp site goods and services.
- Some Confidence Building Measures (CBMs) in the form of general improvement of the social infrastructure in the villages should be planned and implemented by the proponent to lessen the loss of the local community and to build trust and confidence.

7.5 IMPACTS DURING THE OPERATION PHASE

7.5.1 Impacts on Land Resources

a) Fire Breaking

For the proposed power plant there is also a risk of fire breaking out that may become a serious risk for residents living in allied facilities and/or nearby in the vicinity of the proposed Power Plant.

b) Solid Waste from Office Building and Other allied facilities

The project operation will result into generation of organic as well as in-organic waste from the Power Plant. This waste may have significant impact on soil, ambient air, residents living in proximity to the Power Plant, as well as on the aesthetic values if improper systems are adopted. In order to assess the impacts and proper designing of collection, transportation and disposal system, it is imperative to quantify the solid waste generation and assess its characterization.

It is estimated that about 150-200 persons will be employed during operation phase. In case of solid waste generation from office building and other facilities, the following range has been worked out as shown in the Table 7.5 below. Given that there will be 200 personnel, and using a rate of about 0.8 kg/day (1.7 lb/day), about 160 kg/day (353 lb/day) of solid waste will be generated.

Table 7.5: Typical Solid Waste Generation Rate of Industries

Sr.	Source	Range
1	Office Buildings	0.5 – 1.1 kg/employee/day (1.1-2.4 lb/employee/day)
2	Residential Colony(ies)	0.2 – 0.8 kg/employee/day (0.4-1.7 lb/employee/day)

c) Soil Contamination

The soil can be contaminated during the operation phase due to the many chemicals used in the Power Plant processes. If proper care is not taken for handling, storing and transportation of these toxic substances, they may cause damage to the health of the workers as well as their spills which will not only contaminate the soil and may also impact the workers. Even solid waste generated from the plant and from the office building and

other allied facilities can contaminate the soil.

7.5.2 Mitigations of Impacts on Land Resources

a) Fire Breaking

Fire protection and detection systems shall be provided to protect life, property, equipment, and operation of the Plant. The detection and fire alarm, fire protection and fire-fighting systems shall include, but not be limited to the following:

- Firefighting water storage, may be combined with raw water tank, depending on local regulations;
- Firefighting pumps;
- Fire water ring main system, including hydrants;
- Fire protection systems; and
- Fire alarm and detection system.

All systems shall be subject to the approval of the insurance company. The systems shall be complete with all necessary piping, pumps, safety valves, mobile equipment, vehicles etc.

All three documents are to be submitted to the local statutory authorities and the purchaser for review, comment and approval.

b) Solid Waste from Office Building and Other Allied Facilities

Provisions should be made for proper solid waste management as per the guidelines of the WMF in Chapter 8 of this report, which will involve the following major operations:

- Storage at Source;
- Component Separation at Source;
- Collection of Waste;
- Storage;
- Transportation;
- Resource Recovery for recycle and reuse items; and
- Disposal of Waste (sanitary landfill).

Proponent should make final disposal arrangements in consultation with the concerned government department and should take approvals for final disposal of the waste at the designated disposal site.

A separate solid waste management system for waste from the office building and other allied facilities will be required. During the collection of solid waste, recyclable and reusable waste will be separated for resource recovery and reuse of the generated material.

c) Soil Contamination

SOPs should be followed to avoid spilling of oil and other waste to prevent soil contamination. Floors with impervious top-surface should be designated to avoid the contamination of soils. However, in case soil contamination due to spillage of oil occurs, the contaminated soil should be removed to avoid further contamination of soils.

7.5.3 Impacts on Water Resources

a) Impact on Water Requirements

Cooling water for main cooling cycle will be taken from QB Link irrigation canal next to project site which has been agreed by the Irrigation Department. During a yearly period of

canal closure (6-8 weeks) the cooling demands of the power plant will be met using cooling towers. During this period, water will be taken from underground wells that have to be developed as part of the EPC Contract. The impact of the extraction of the water on the aquifer can be determined on the basis of recommendations of Hydrogeological survey. and Electical Resistiviy survey.

b) Wastewater Produced from Plant Operations

The plant operation will generate Industrial as well as sanitary wastewater. It is estimated that about a maximum of $2m^3/h$ of sanitary, $4m^3/h$ of industrial wastewater will be generated along with cooling tower blow down (expected concentration factor: 4 - 5) in canal closure period.

c) Raw Water Reservoir

If raw water reservoir will be constructed during the canal closure to store ground water, the water quality of this reservoir (if uncovered) can be impacted by solid waste, sewage. Furthermore, there is risk of vector borne diseases like malaria or dengue if the reservoir is uncovered or not properly monitored.

7.5.4 Mitigations of Impacts on Water Resources

a) Impact on Water Requirements

The volume extracted from the canal will be less than 5% of the total water volume, therefore, the impact is not expected to be significant. According to preliminary findings of Groundwater Availability Study, the existing wells show sufficient quantity and suitable quality of well water to provide for the needs of the cooling tower as well as other water needs. However, the main source of recharge of the underground aquifer is judged to be vertical penetration of canal water flowing parallel to the site. This is crucial, since the expected times of high well water extraction is during the period when the canal is empty. It has to be determined if and how the extraction of the needed quantities of raw water from the aquifer will be possible during unavailability of the main recharge source (canal water). Special attention shall be paid to the stability of buildings and foundations of heavy equipment such as gas turbines and the cooling tower structure.

b) Treatment and Disposal of Wastewater Produced from Plant Operations

Wastewater treatment system needs to be selected carefully considering the characteristics of wastewater generated from the power plant. The Contractor shall investigate the possibility of discharge into the canal during the annual canal closure period. In case treated water discharge is not permitted during this time by the canal authorities, a sufficiently sized seepage pit for all cleaned effluents shall be provided. The location of seepage pit will be finalized by EPC Contractor during the design.

It is highly recommended that a separate water quality modeling study be conducted to monitor water quality along a stretch of the QB- Link Canal from the point of discharge of hot water into canal.

Sanitary waste water from the plant area shall be treated in biological treatment plant where all sanitary effluents will be reduced from organic matter to stable sediment. The water discharged from this plant shall be conveyed to the cooling water outfall. Separated sludge shall be collected in a sludge collector pond and suitably disposed of. The system shall have a sufficient treatment capacity and will be divided into several pits each performing a phase of the treatment (retention basin, aeration basin, clarifier, sludge pit). The separated clear water phase shall be chlorinated before discharge. The chlorination shall be performed by

hypochlorite solution generated in the chlorination plant. The plant shall be designed to meet the following discharge limits (table 7.6):

Table 7.6: Characteristics of Treated Effluent

Sr. No	COMPONENT	VALUE
1.	BOD_5	25 mg/l
2.	COD	125 mg/l
3.	TSS	35 mg/l
4.	Total Nitrogen Compounds (as N)	15 mg/l

The treated effluent from the sanitary wastewater treatment plant shall be transferred through piping to the treated water monitoring basin by gravity or dedicated pump station. The industrial waste water treatment plant shall be constructed to treat all wastewater occurring during O&M of the power plant. The facilities have to be capable to achieve discharge limits for discharge into surface waters, stipulated in the most recent issue of the NEQS, Pakistan.

In industrial wastewater treatment plant, all oil contaminated drains and wash waters from the plant area shall be collected and treated by oil separators. The oil separators shall have two stages and shall be designed to meet the applicable wastewater discharge standards for residual oil and grease.

In case of accidents, large amounts of oil may lead to a blocking of the oil separators. Therefore, the de-watering of transformer areas shall be equipped with a retention basin with sufficient capacity to hold up the maximum possible oil discharge plus the firefighting water used in case of fire.

The oil free water from the oil separators and all other industrial drains shall be directed to the wastewater retention basin. The wastewater will be treated by the following steps: clarifier, secondary oily cleaning stage, and mechanical filters. The effluent from the mechanical filters and the boiler blow down shall also be directed to the treated wastewater basin for regular sampling and analyses in the plant chemical laboratory. From there, all plant effluents shall be finally discharged through the cooling water outfall pipes to the canal.

Only hypochlorite (NaClO) is used in the cooling water, the level will be closely monitored to keep it at the specified value which is evaluated as acceptable for the environment. Chemical drains from the water demineralisation plant, electrochlorination plant, battery room, etc. shall be collected in a separate drainage system, stored in a chemical waste water pit and treated on demand in a waste water treatment tank by means of precipitation and neutralisation chemicals. The treated effluent from the chemical waste water treatment tank shall be discharged treated waste water monitoring basin and from there to the cooling water outfall.

Separated sludge from waste water and oily water treatment, as well as effluents from boiler acid cleaning and GT compressor washing shall be disposed of externally by a certified waste disposal contractor.

The GT wash waters and effluents boiler acid cleaning shall be collected during the washing procedure in dedicated tanks (to be provided) and disposed of externally by a certified waste disposal contractor.

c) Raw Water Reservoir

The raw water reservoir must be managed properly by the Project proponent with a plan to ensure that it is not contaminated. Preferably, it should be covered.

7.5.5 Air Pollution

Air quality can be impacted from SO_x, NO_x, CO, and PM emissions which are typical air pollutants. Oxides of Nitrogen are formed when combustion temperatures exceed 1,300 degree Celsius. Oxides of Sulphur, and PM are emitted depending upon the fuel characteristics.

The plant will utilize the RLNG as main fuel and HSD as a backup fuel. The impact on air quality is not expected to be significant for RLNG (main fuel) which is a clean fuel with very less air emissions. The emission estimate provided by the designer for the RLNG[2] and HSD are given in Table 7.7 below:

Table 7.7: Pollutant Concentrations and Compliance Status with NEQS

Parameter	Units	Combined Cycle	Open Cycle	NEQS
MAIN FUEL - RLNG				
NO_x Concentrations	mg/Nm^3	50*	50*	400
PM concentration total @ 15% O_2	mg/Nm^3	5	5	-
PM concentrations (PM_{10})	mg/Nm^3	3	3	-
PM concentrations ($PM_{2.5}$)	mg/Nm^3	2.5	2.5	-
SO_2 concentrations	mg/Nm^3	28.46	28.46	1700
BACKUP FUEL - HSD				
NO_x Concentrations	mg/Nm^3	100*	100*	600
PM concentration total @ 15% O_2	mg/Nm^3	5	5	300
PM concentrations (PM_{10})	mg/Nm^3	3	3	-
PM concentrations ($PM_{2.5}$)	mg/Nm^3	2.5	2.5	-
SO_2 concentrations	mg/Nm^3	546	546	1700

As shown in the Table above, the concentration being emitted from power plant are within the thresholds of NEQS.

NEQS also lays down the compliance criteria for maximum allowable ground level increment to ambient and maximum SO_2 emissions in tons/day/plant. These criteria are required to be met on the basis of classification of the airshed as unpolluted, moderately polluted and very polluted based on the measurement of SO_2 as annual average and maximum 24 hrs interval as shown in Table 7.8.

[2] Data provided by the designer to the best of their knowledge. NO_x values have been based on limits, which can be achieved and guaranteed, while the PM values are taken from similar projects on diesel fuel with a typical split between $PM_{2.5}$ and PM_{10}.

Table 7.8: SO_2 Ambient Air Criteria

Background Air Quality (SO_2 Basis)	Annual Average ($\mu g/m^3$)	Max. 24 hrs Interval ($\mu g/m^3$)	Standards	
			Max. SO_2 Emission (tons/day/plant)	Max. Allowable ground level increment to ambient ($\mu g/m^3$) (One year average)
Unpolluted	< 50	< 200	500	50
Moderately Polluted*				
Low	50	200	500	50
High	100	400	100	10
Very Polluted**	> 100	> 400	100	10

* For intermediate values between 50 and 100 ug/m^3 linear interpolations should be used.
** No project with sulphur dioxide emissions will be recommended.

The above criteria cannot be precisely adopted as the annual average interval measured values of SO_2 are not available. The data can only be obtained once the EPA starts continuous monitoring under national program. However, 24-hour monitoring was done at the proposed project site and indicated a maximum of 24-hour concentration of about 33.61$\mu g/m^3$ of SO_2. Considering this concentration, it is likely that the airshed would be classified as Unpolluted. Furthermore, the SO_2 emissions in tons/day/plant is calculated as 163.5 tons/day for a maximum capacity of 1,500 MW for single cycle operation on HSD which is less than value of 500 tons/day/plant specified in NEQS, therefore the plant meets the maximum SO_2 emission requirements laid down in NEQS.

b) Air Dispersion Modeling

Air dispersion modeling is an important tool used to predict ambient air quality concentrations based on air pollutant emissions from stacks of power plant. It utilizes the mathematical formulation to describe the atmospheric process that disperse the pollutant and determine the ground level concentrations to assess the impacts on different receptors. In impact assessment studies, the models are typically used to determine whether proposed facilities will be in compliance with national ambient air quality standards and offer the advantage of bringing about necessary changes in the proposed industrial facilities so that plans can be fine-tuned to minimize environmental impacts.

Air dispersion modeling was done for this project with an objective to determine the ground level concentrations of SO_2, NO_x, and PM in order to check the compliance with the standards and assess the impacts on receptors.

i) ISC-AERMOD

The Lakes air dispersion modeling software ISC-AERMOD View, a replacement of ISC models (Industrial Source Complex) for predicting ground level concentrations of the pollutants and estimating the air quality impacts of sources, was used in this study. It also includes necessary user-friendly options such as complete AERMET meteorological data pre-processing and multiple pollutant utilities for modeling multiple pollutants in an AERMOD run.

ISC-AERMOD is Gaussian steady-state plume dispersion model. It can be successfully applied for air quality assessments of inert pollutants that are directly emitted from a variety of sources.

The model assumes that the plume disperses in the horizontal and vertical direction, resulting in Gaussian (bell-shaped) concentration distributions. For the steady-state assumption, emission rates are assumed to be constant and continuous. The model is

typically used to assess ambient concentrations of various pollutants in regulatory applications for a near-field modeling analysis.

This model uses the hourly sequential meteorological data to take account of complex turbulence and atmospheric stability effects and incorporate terrain affects. The model allows pollutant concentrations to be calculated at specific receptors or gridded locations for both long and short term averaging periods for emissions from a number of specified sources.

ii) Working of ISC-AERMOD View Software

The ISC-AERMOD View interface uses six pathways that compose the run stream file as the basis for its functional organization. These pathways include:

- **Control Pathway (CO)**: Where the modeling scenario is specified, and control the overall modeling run.
- **Source Pathway (SO):** It is used to define the sources of pollutant emissions. The model is capable of handling multiple sources, including point, volume, and area source types.
- **Receptor Pathway (RE):** This pathway is used to specify and define the location, type and the number of receptors.
- **Meteorological Pathway (ME):** Here the atmospheric conditions of the area being modeled are defined; which will be useful while determining the distribution of air pollution impacts for the area.
- **Terrain Grid Pathway (TGP):** Here the terrain type to be used for modeling is specified. The option of complex terrain is also available in addition to simple terrain.
- **Output Pathway (OP):** The types of output required are specified in this pathway.

iii) ADM Setup

The modeling setup based on the data provided by the designer is given in Table 7.9 below:

Table 7.9: Air Dispersion Modeling Setup

Description	Units	Value	
		Combined Cycle	Single Cycle
Source (Stacks)	No.	3	3
Stack Height	m	60	45
Stack Diameter	m	7	6.1
MAIN FUEL-RLNG			
Flue gas flow rate (each stack)	(m^3/sec)	766.66	1773.33
Flue gas temperature	K	366	872
Velocity of flue gas	m/s	19.7	62.2
Emission rate SO_2	g/s	18.56	18.63
Emission rate NO_x	g/s	28.60	27.76
Emission rate total PM	g/s	2.86	2.76
Emission rate PM (PM_{10})	g/s	1.7	1.66
Emission rate PM ($PM_{2.5}$)	g/s	1.43	1.4
Anemometer Height	m	10.24	10.24
Terrain	Simple and Flat		
Meteorology	Two years meteorological data used for ADM (2013-2014)		
Pollutant Averaging Periods	Annual and 24 Hours		
BACKUP FUEL – HIGH SPEED DIESEL			
Flue gas flow rate (each stack)	(m^3/sec)	912	1810.66
Flue gas temperature	^{0}K	423	866
Velocity of flue gas	m/s	23.4	63.7
Emission rate SO_2	g/s	397.33	366

Description	Units	Value	
		Combined Cycle	Single Cycle
Emission rate NO_x	g/s	58.86	57.06
Emission rate total PM	g/s	2.93	2.86
Emission rate PM (PM_{10})	g/s	1.76	1.7
Emission rate PM ($PM_{2.5}$)	g/s	1.46	1.43
Terrain	Simple and Flat		
Meteorology	Two years meteorological data used for ADM (2013-2014)		
Pollutant Averaging Periods	Annual and 24 Hours		

iv) Modeling Scenarios

Based on the plant main and backup fuels and operation modes, following four scenarios were selected for the ADM:

1. **Plant Operation on RLNG in a Single Cycle Mode (RLNG+SC)**
2. **Plant Operation on RLNG in a Combined Cycle Mode (RLNG+CC)**
3. **Plant Operation on HSD in a Single Cycle Mode (HSD+SC)**
4. **Plant Operation on HSD in a Combined Cycle Mode (HSD+CC)**

The ADM was done for SO_2, NO_x and PM for all the above scenarios for average annual and 24 hours averaging periods. Pollutant wise results and analysis of scenarios are given below:

v) Oxides of Sulphur (SO_2)

The dispersion isopleths for SO_2 for all four scenarios for annual as well as 24 hours averaging periods are shown in Figure 7.3 to 7.10.

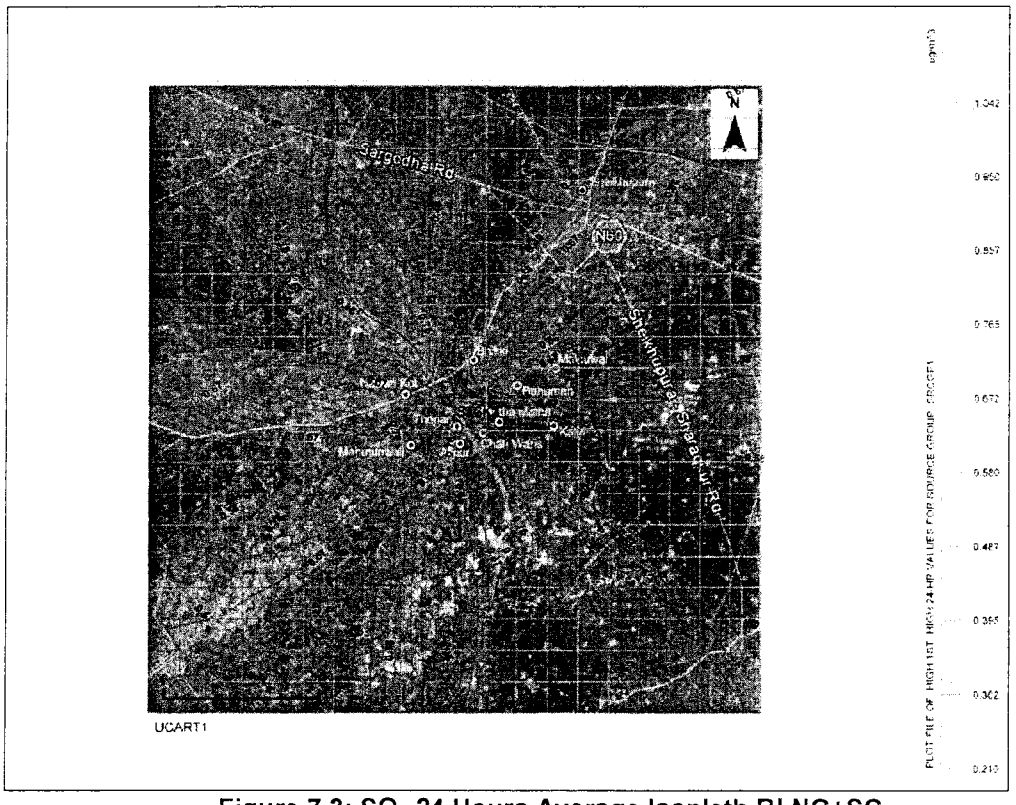


Figure 7.3: SO_2 24 Hours Average Isopleth RLNG+SC

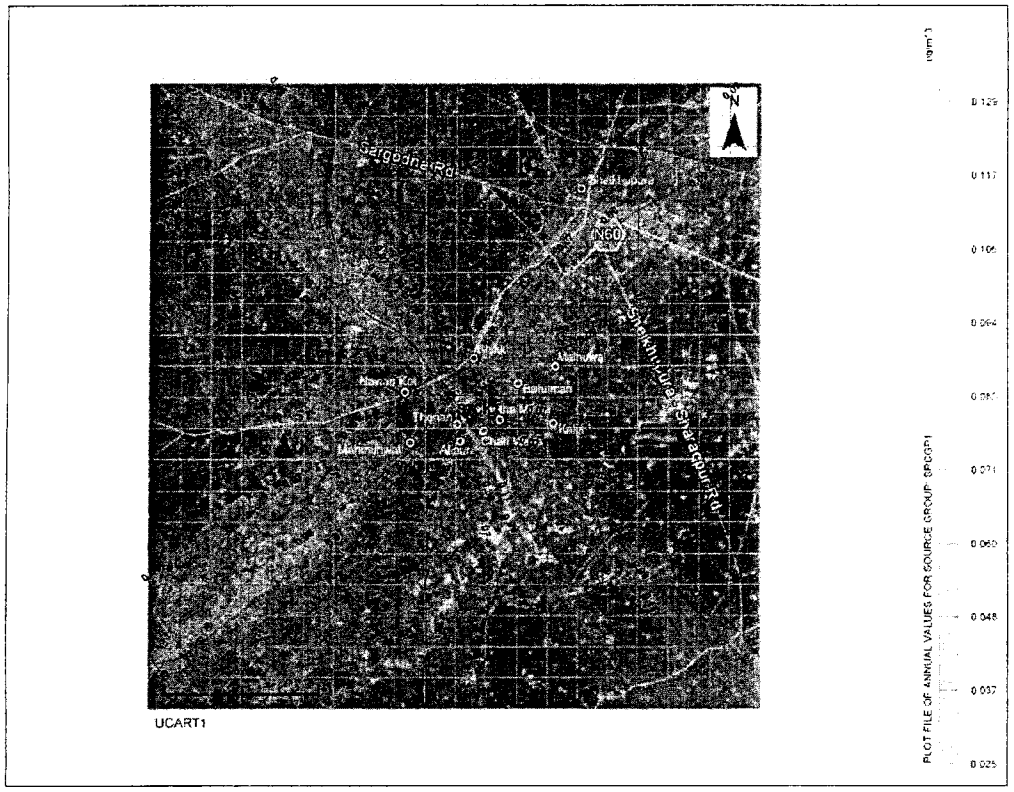


Figure 7.4: SO_2 Average Annual isopleth RLNG+SC

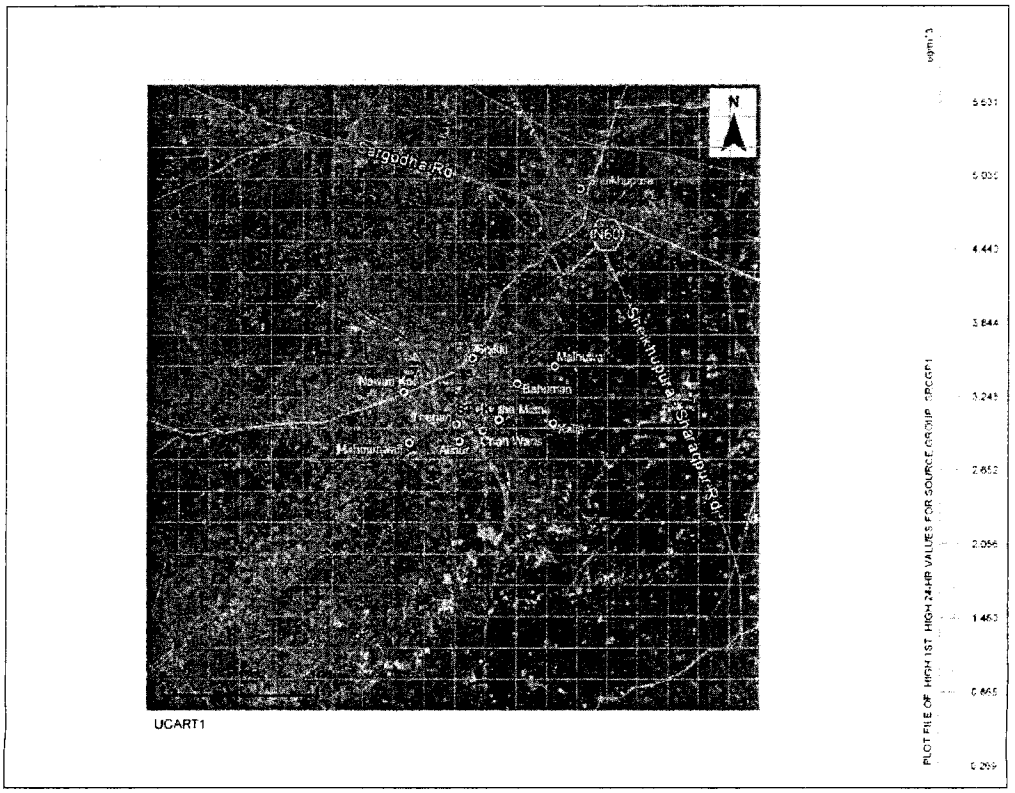


Figure 7.5: SO_2 24 Hours Average Isopleth RLNG+CC

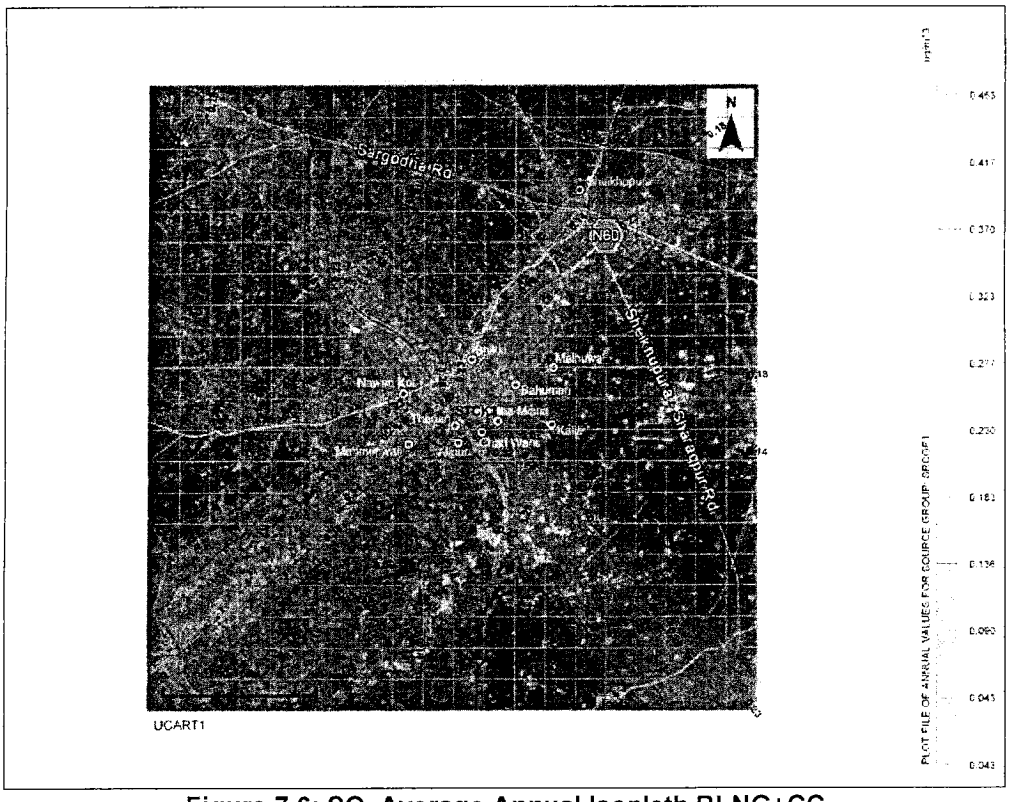


Figure 7.6: SO_2 Average Annual Isopleth RLNG+CC

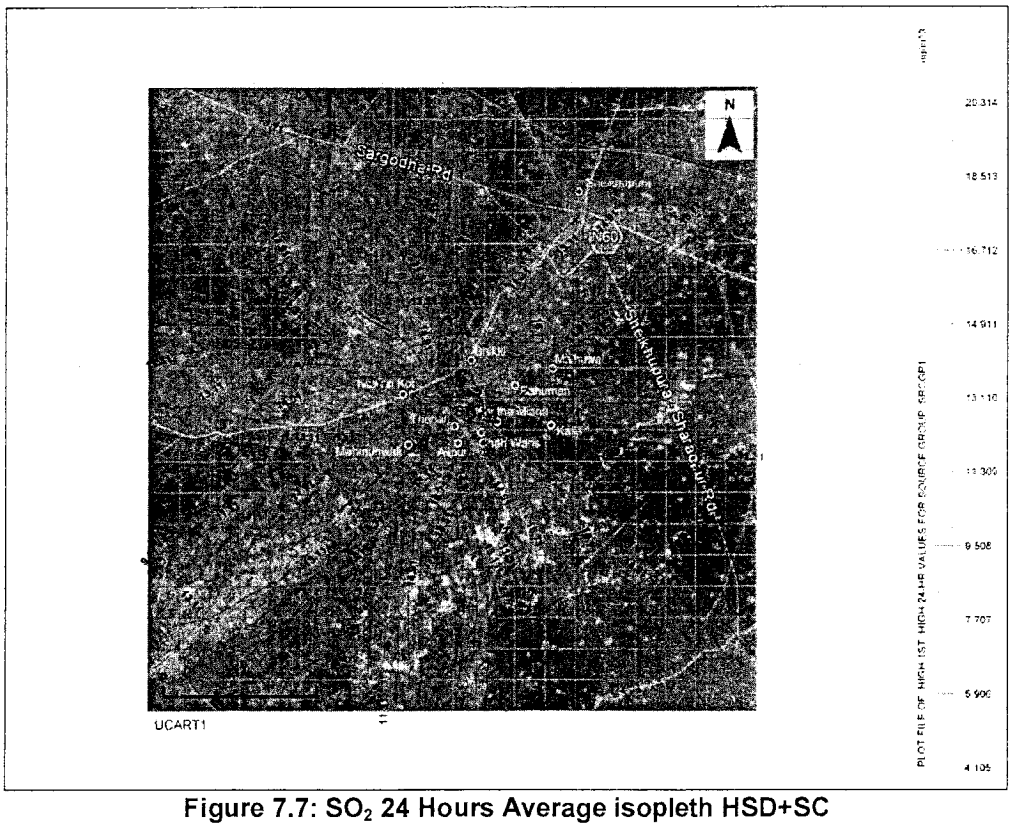


Figure 7.7: SO_2 24 Hours Average isopleth HSD+SC

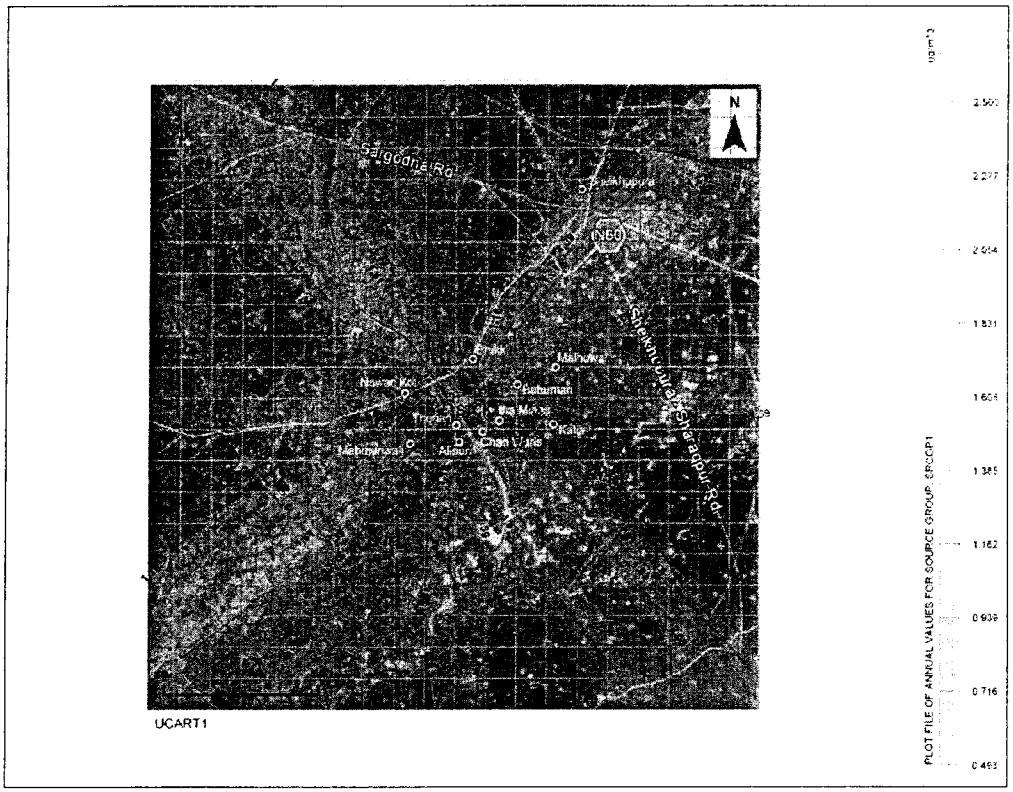


Figure 7.8: SO_2 Average Annual Isopleth HSD+SC

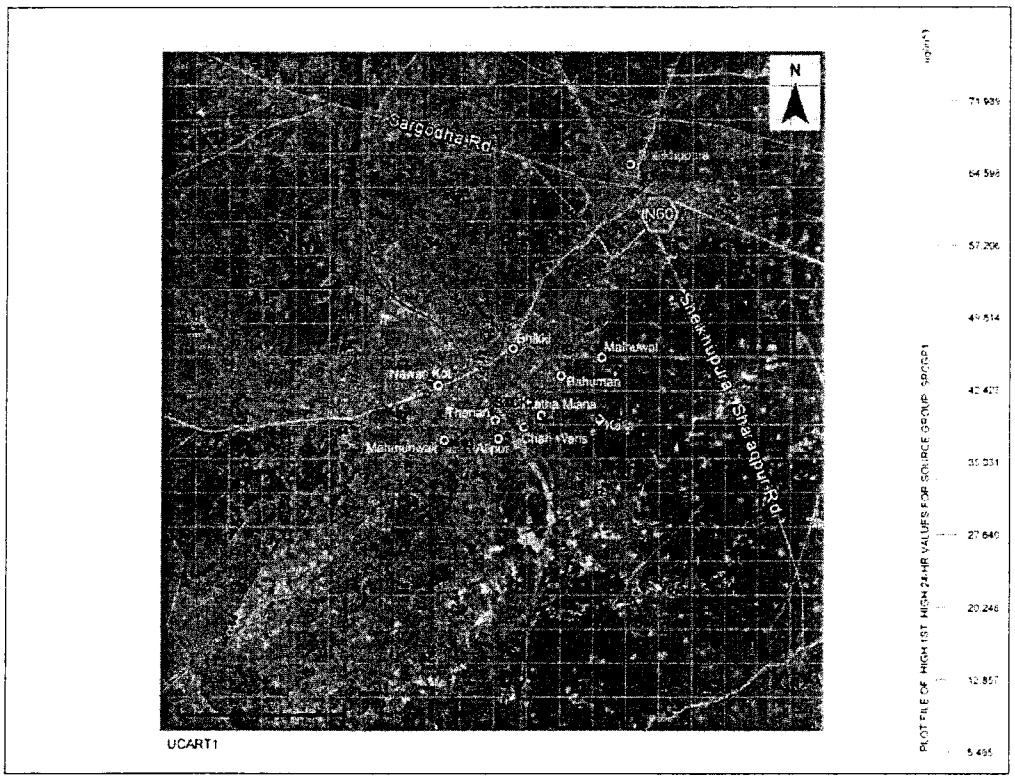


Figure 7.9: SO_2 24 Hours Average Isopleth HSD+CC

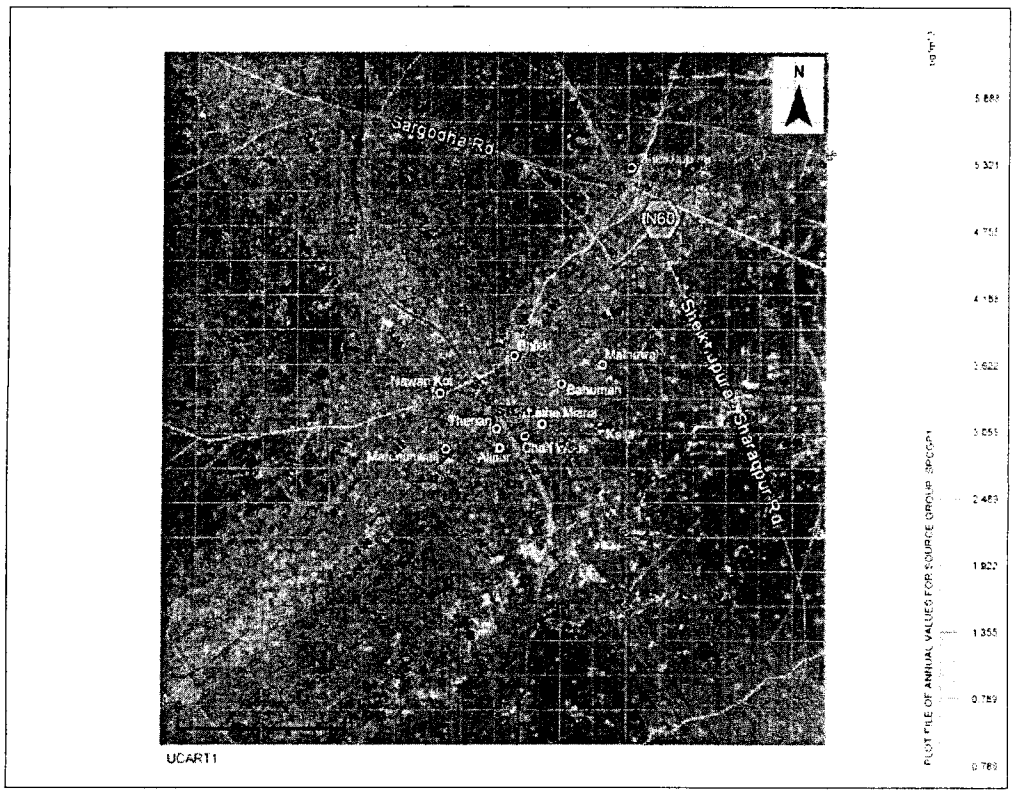


Figure 7.10: SO_2 Average Annual Isopleth HSD+CC

The Table 7.10 below shows the maximum concentration of SO_2 for all the our scenarios. Among the four scenarios, ADM has shown the maximum concentration for SO_2 for Plant Operation on HSD in a Combined Cycle Mode for 24 hours as well as annual averaging periods. The resulting maximum concentrations for 24 hours and annual average by utilizing HSD are 71.989 $\mu g/m^3$ and 5.888 $\mu g/m^3$ respectively.

Table 7.10: Maximum SO_2 concentrations for 24 hours and annual averaging periods

Sr. No	Scenarios	Maximum SO_2 Concentration	
		24 Hours	Annual
1	RLNG +SC	1.042	0.129
2	RLNG+CC	5.631	0.463
3	HSD+SC	20.314	2.500
4	HSD+CC	71.989	5.888

The maximum value of background SO_2 measured at site is 33.61 $\mu g/m^3$ for 24 hours averaging period. The values if were measured for the annual averaging periods would be much lower than these concentrations. However, due to unavailability of average annual concentrations, the 24 hours averaging values are taken as baseline concentrations. The maximum concentration of SO_2 for 24 hours averaging period is less than the thresholds of 120 $\mu g/m^3$ and 80 $\mu g/m^3$ for 24 hours and average annual periods respectively as specified by the NEQS, Pakistan (2010).

The above table shows that the maximum contribution of SO_2 from the power plant will be 71.989 $\mu g/m^3$ for 24 hours averaging and 5.888 $\mu g/m^3$ for average annual period. The plant contribution for 24 hours averaging when added in maximum baseline concentration would result in a total value of 105.599 $\mu g/m^3$ for 24 hours averaging which is less than 24 hours average ambient air quality threshold of 120 $\mu g/m^3$ as specified by NEQS, Pakistan (2010). The plant contribution when added in maximum baseline concentration would result in a total value of 39.498 $\mu g/m^3$ for annual averaging which is less than annual average ambient air

quality threshold of 80 $\mu g/m^3$as specified by NEQS, Pakistan (2010). The maximum average annual plant contribution of SO_2 is also less than the maximum allowable increment of 50 $\mu g/m^3$ as specified by NEQS, Pakistan (2000).

vi) Oxides of Nitrogen

The dispersion isopleths for NO_x for all four scenarios for annual as well as 24 hours averaging periods are shown in Figure 7.11 to 7.18:

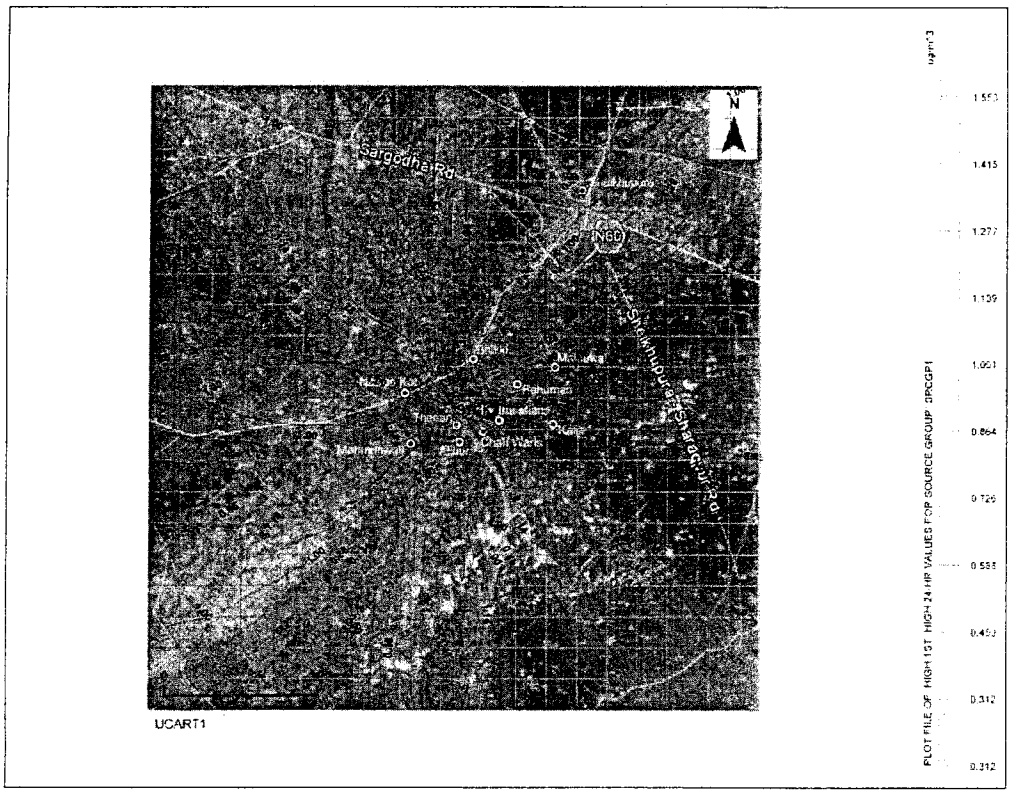


Figure 7.11: NO_x 24 Hours Average Isopleth RLNG+SC

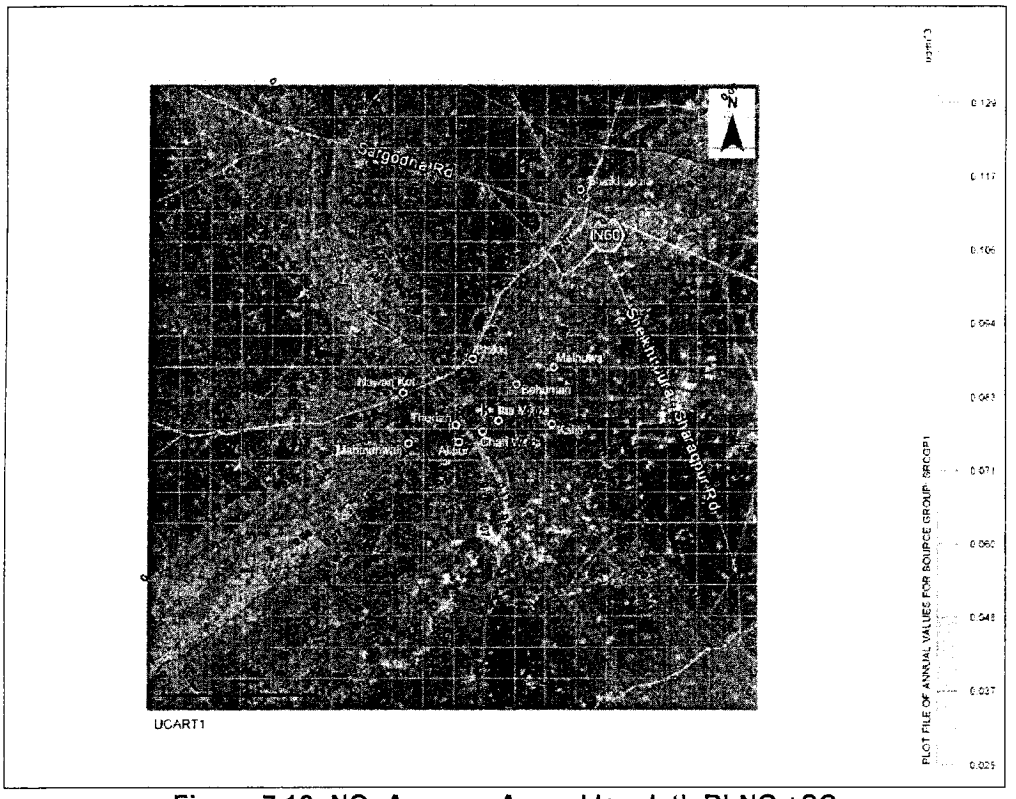


Figure 7.12: NO_x Average Annual Isopleth RLNG +SC

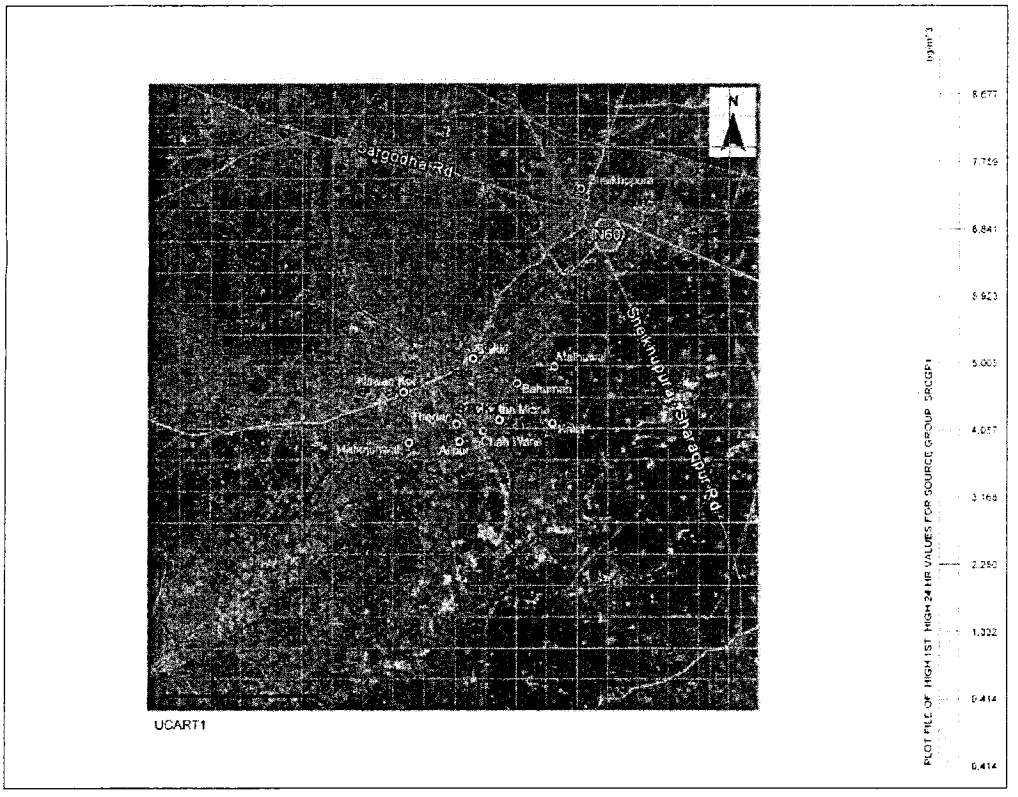


Figure 7.13: NO_x 24 Hours Average Isopleth RLNG+CC

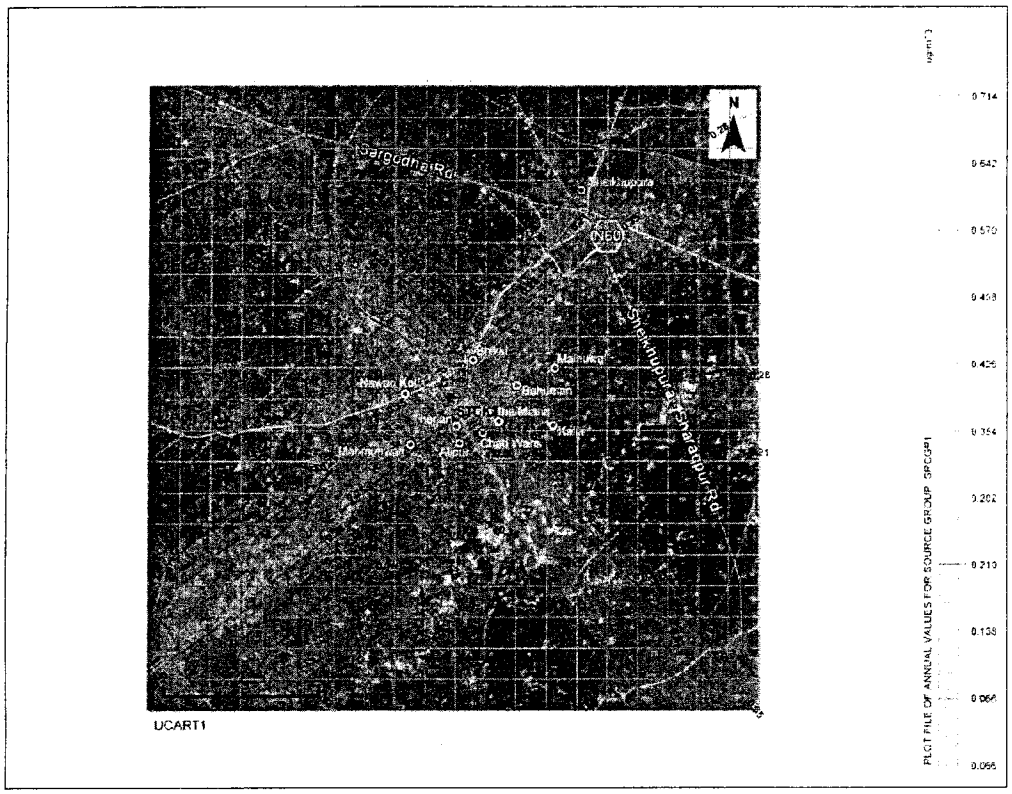


Figure 7.14: NO_x Average Annual Isopleth RLNG+CC

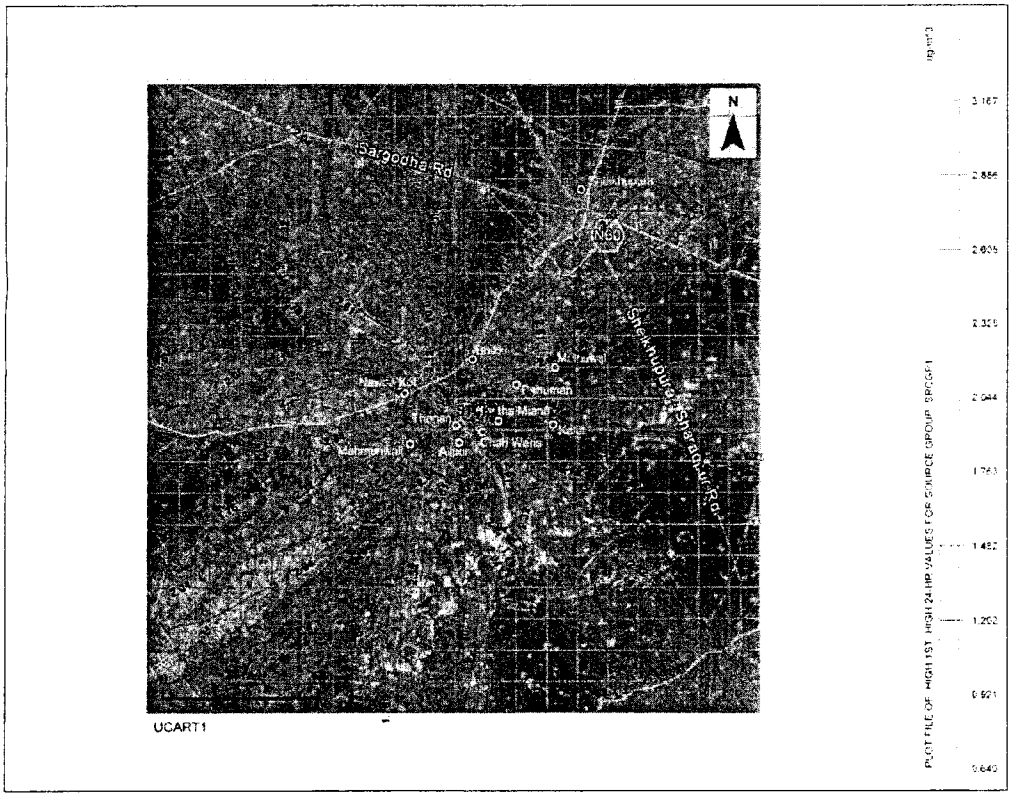


Figure 7.15: NO_x 24 Hours Average Isopleth HSD+SC

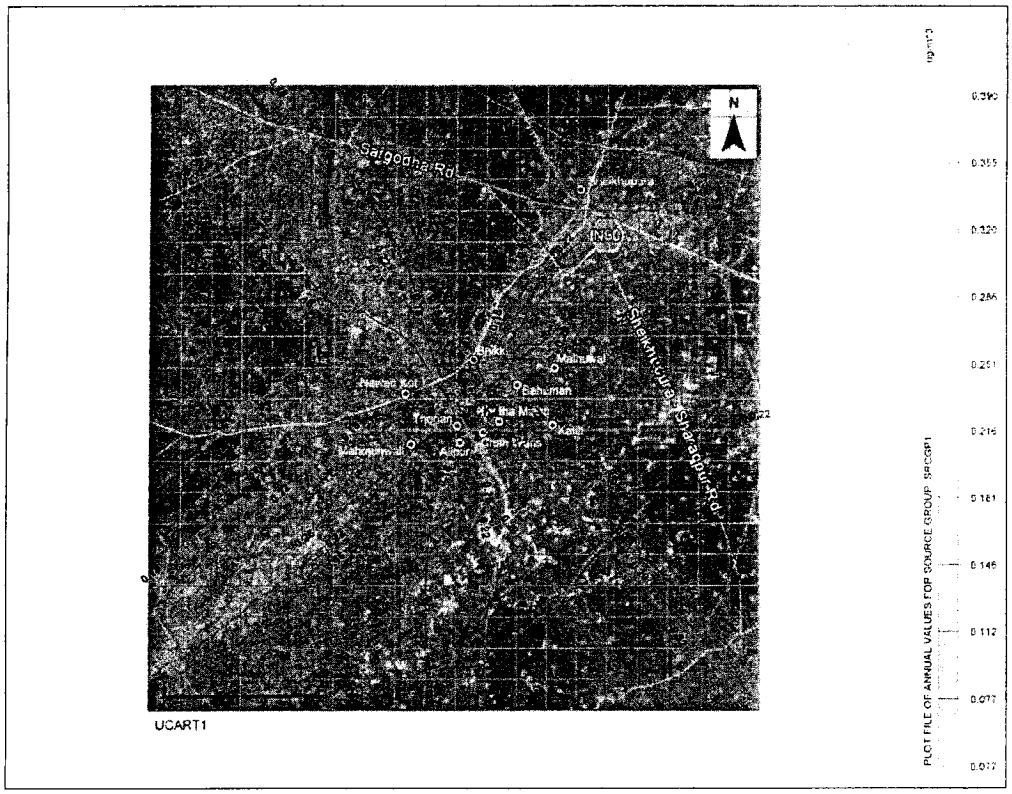


Figure 7.16: NO_x Average Annual Isopleth HSD+SC

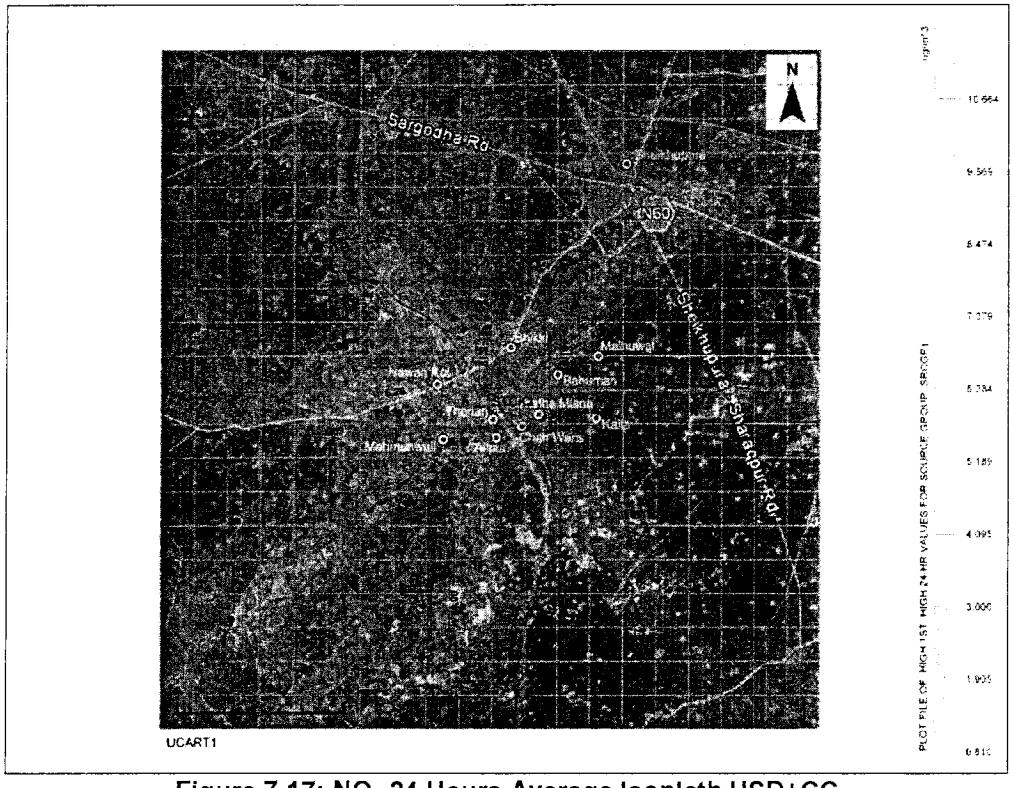


Figure 7.17: NO_x 24 Hours Average Isopleth HSD+CC

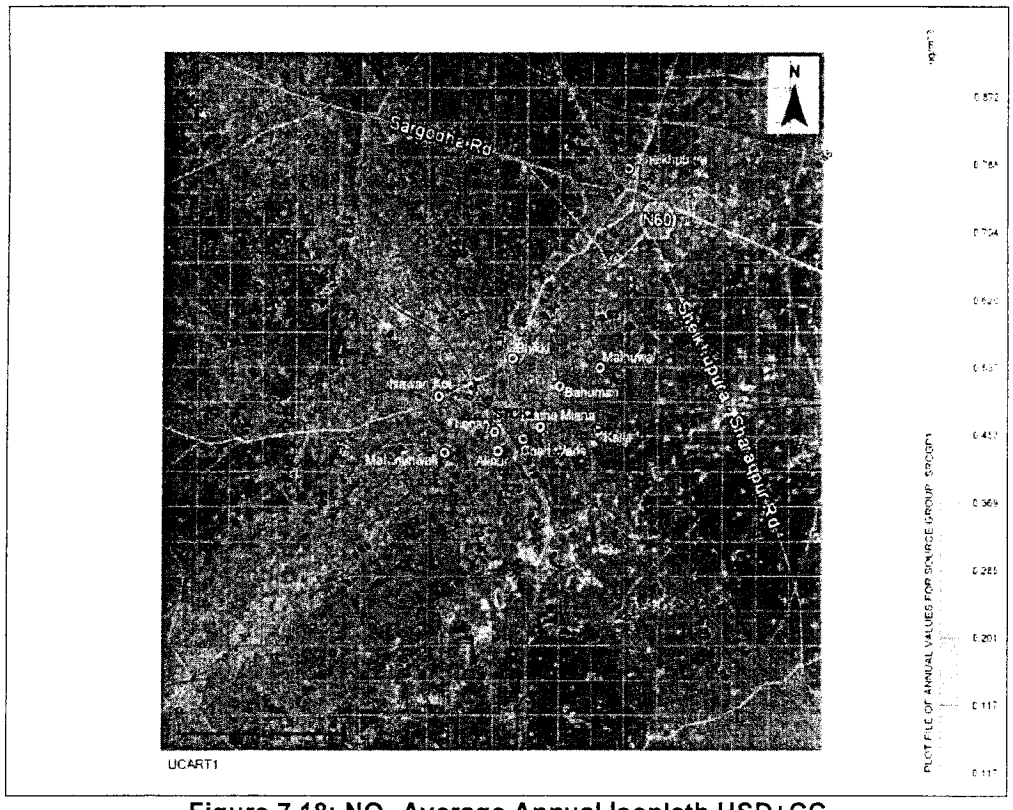


Figure 7.18: NO_x Average Annual Isopleth HSD+CC

The Table 7.11 below shows the maximum concentration of NO_x for all the four scenarios. Among the four scenarios, ADM has shown the maximum concentration for NO_x for Plant Operation on HSD in a Combined Cycle Mode for 24 hours as well as annual averaging periods. The resulting maximum concentrations for24 hours and annual average by utilizing HSD are 10.664 $\mu g/m^3$ and 0.872 $\mu g/m^3$ respectively.

Table 7.11: Maximum NO_x concentrations for 24 hours and annual averaging periods

Sr. No	Scenarios	Maximum NO_x Concentration	
		24 Hours	Annual
1	RLNG +SC	1.553	0.129
2	RLNG+CC	8.677	0.714
3	HSD+SC	3.167	0.390
4	HSD+CC	10.664	0.872

The maximum value of baseline NO_x measured at site is 29.55 $\mu g/m^3$ for 24 hours averaging period. The values if were measured for the annual averaging periods would be much lower than these concentrations. However, due to unavailability of average annual concentrations, the 24 hours averaging values are taken as baseline concentrations. The maximum concentration of NO_X for 24 hours averaging period is much less than the threshold of 40 $\mu g/m^3$ for average annual and 80 $\mu g/m^3$ for 24 hours averaging period for NO_2 specified by the NEQS, Pakistan (2010)[3].

The above isopleth shows that the maximum contribution of NO_x from the power plant will be 10.664 $\mu g/m^3$ for 24 hours averaging and 0.872 $\mu g/m^3$ for annual averaging periods. The maximum 24 hours and annual average plant contributions when added to the maximum baseline concentration results in a total ground level NO_x concentration values of 40.214

[3]The average concentration of NO_X for 24 hours and annual average is compared with the threshold values of NO_2 as specified in the NEQs, 2010, because NO_X in ambient air exist mostly in the form of NO_2.

$\mu g/m^3$ and 30.422 $\mu g/m^3$ for 24 hours and average annual periods, which are lower than ambient air quality standard of 80 $\mu g/m^3$ and 40 $\mu g/m^3$ for NO_2 specified by NEQS, Pakistan (2010) for 24 hours and average annual periods. The maximum annual concentration of NO_X in ambient air during plant operation is 30.422 $\mu g/m^3$ which is less than the standard of 100 $\mu g/m^3$ NO_x specified by NEQS, Pakistan (2000).

vii) Particulate Matter (PM_{10})

The dispersion isopleths for PM_{10} for all four scenarios for annual as well as 24 hours averaging periods are shown in Figure 7.19 to 7.26.

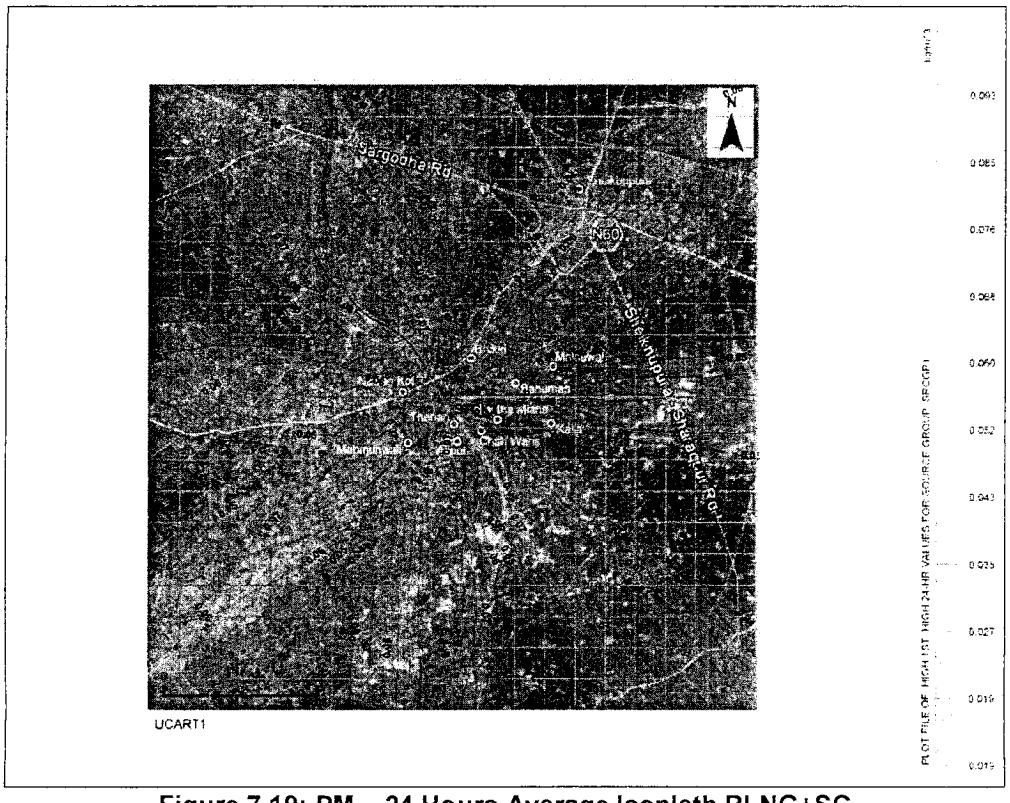


Figure 7.19: PM $_{10}$ 24 Hours Average Isopleth RLNG+SC

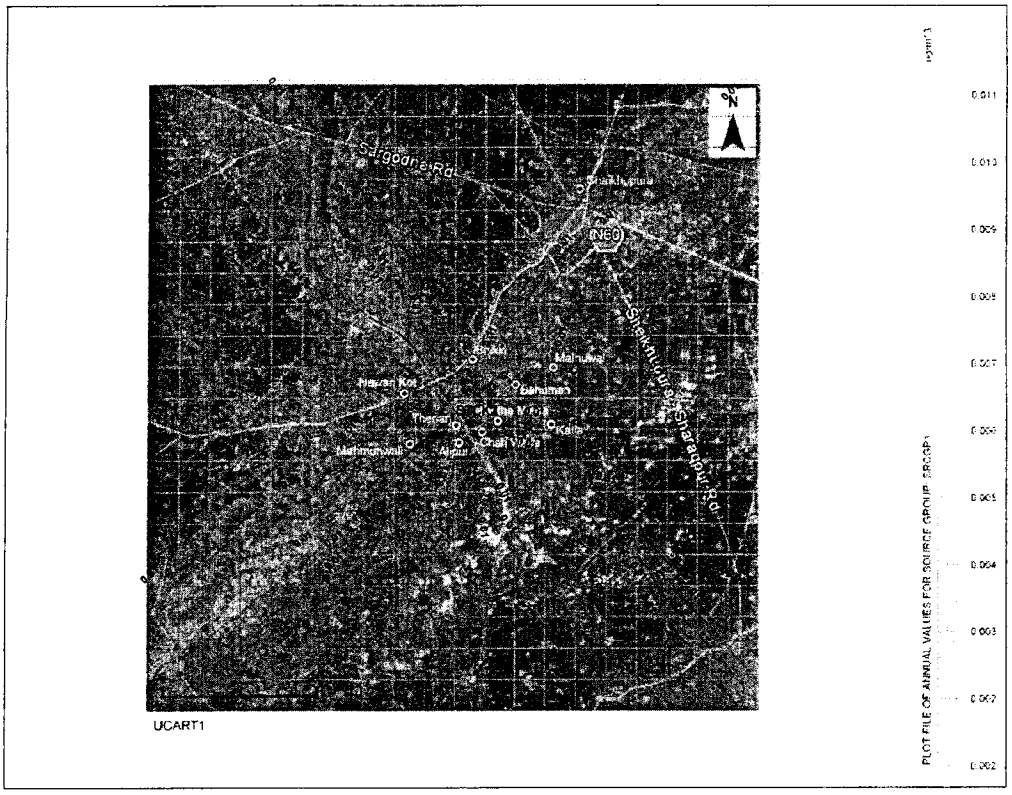


Figure 7.20: PM $_{10}$ Average Annual Isopleth RLNG+SC

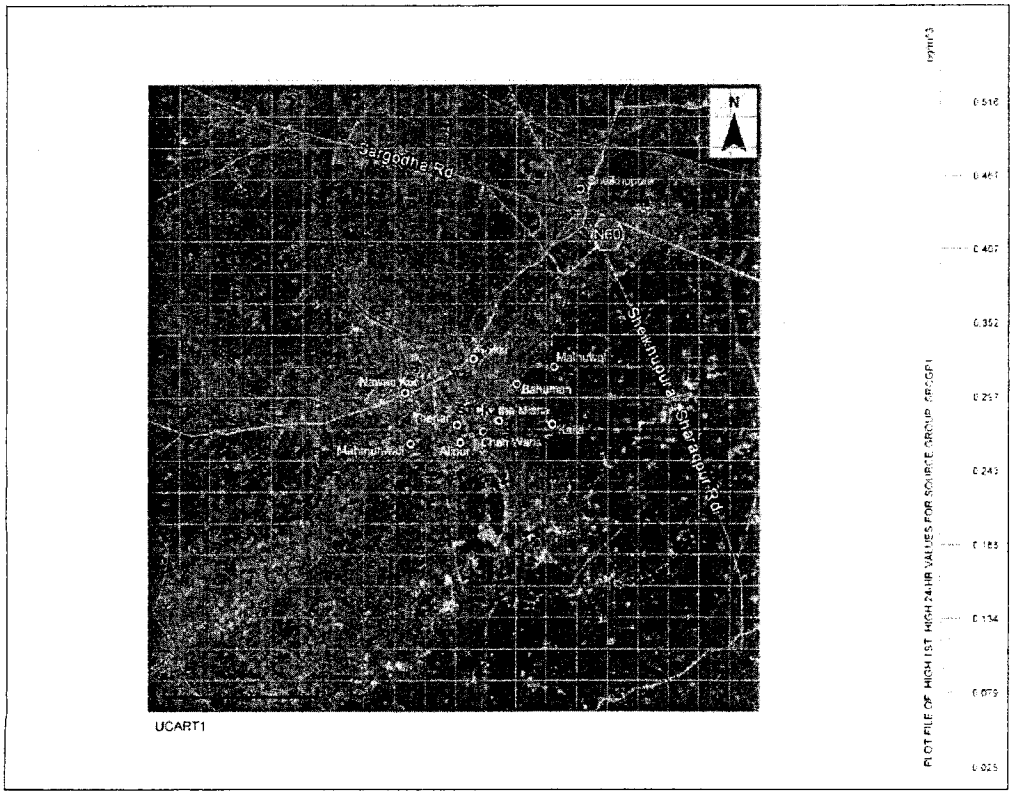


Figure 7.21: PM $_{10}$ 24 Hours Average Isopleth RLNG+CC

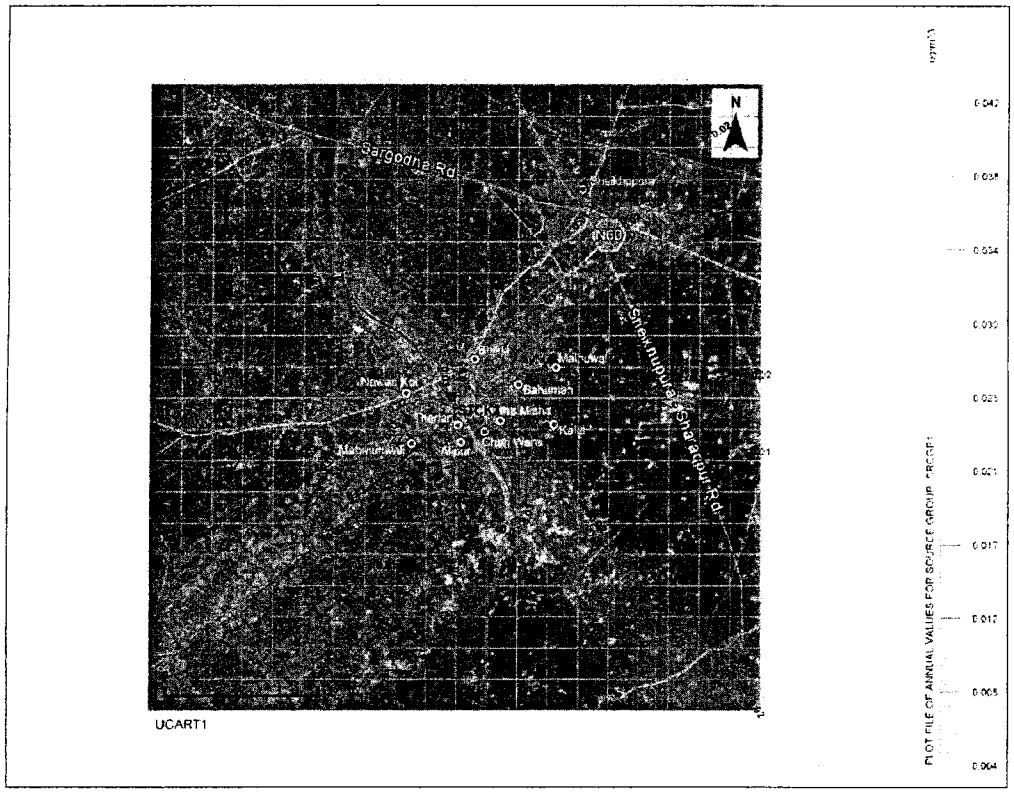


Figure 7.22: PM $_{10}$ Average Annual Isopleth RLNG+CC

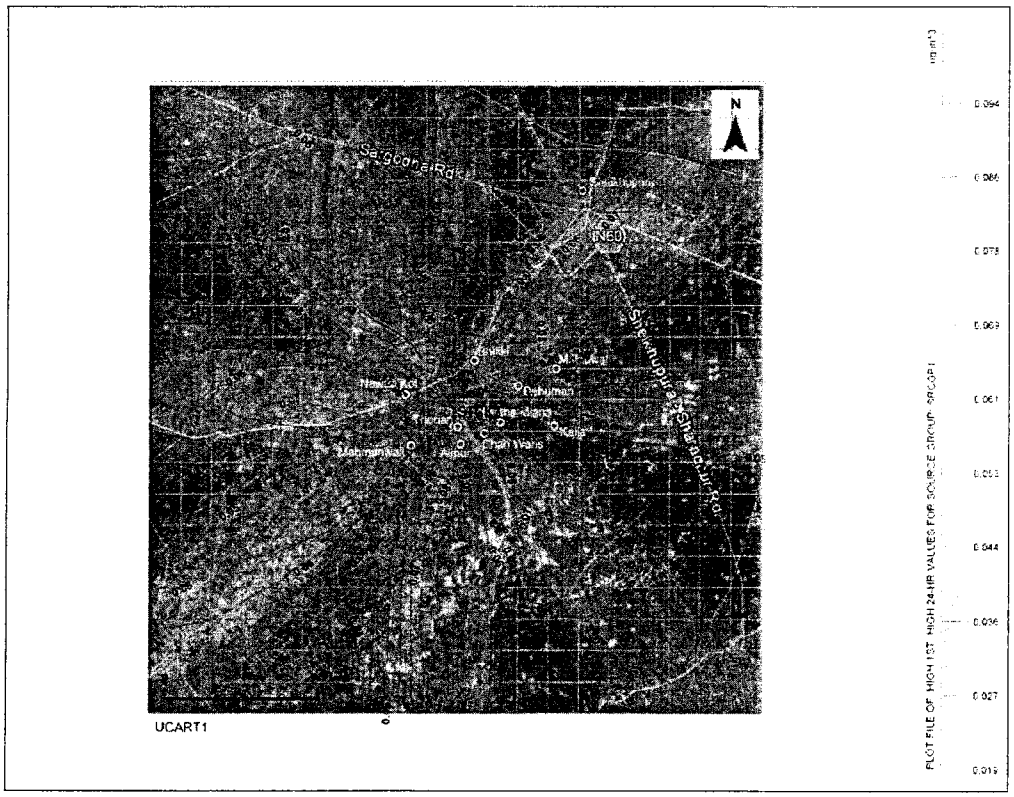


Figure 7.23: PM $_{10}$ 24 Hours Average Isopleth HSD+SC

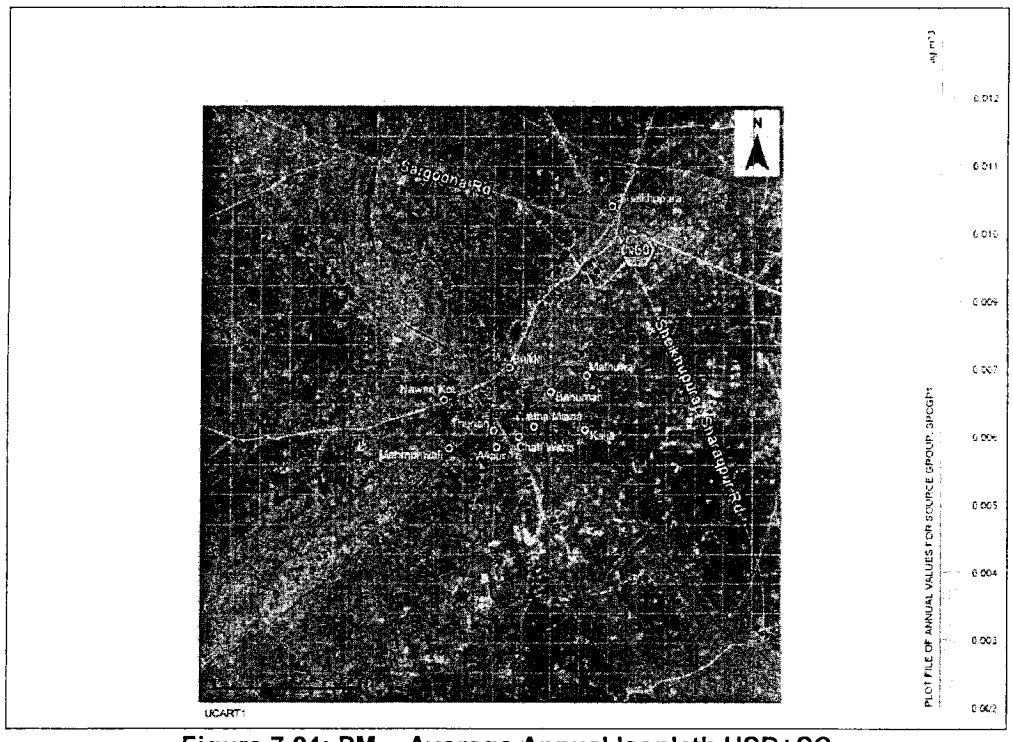


Figure 7.24: PM $_{10}$ Average Annual Isopleth HSD+SC

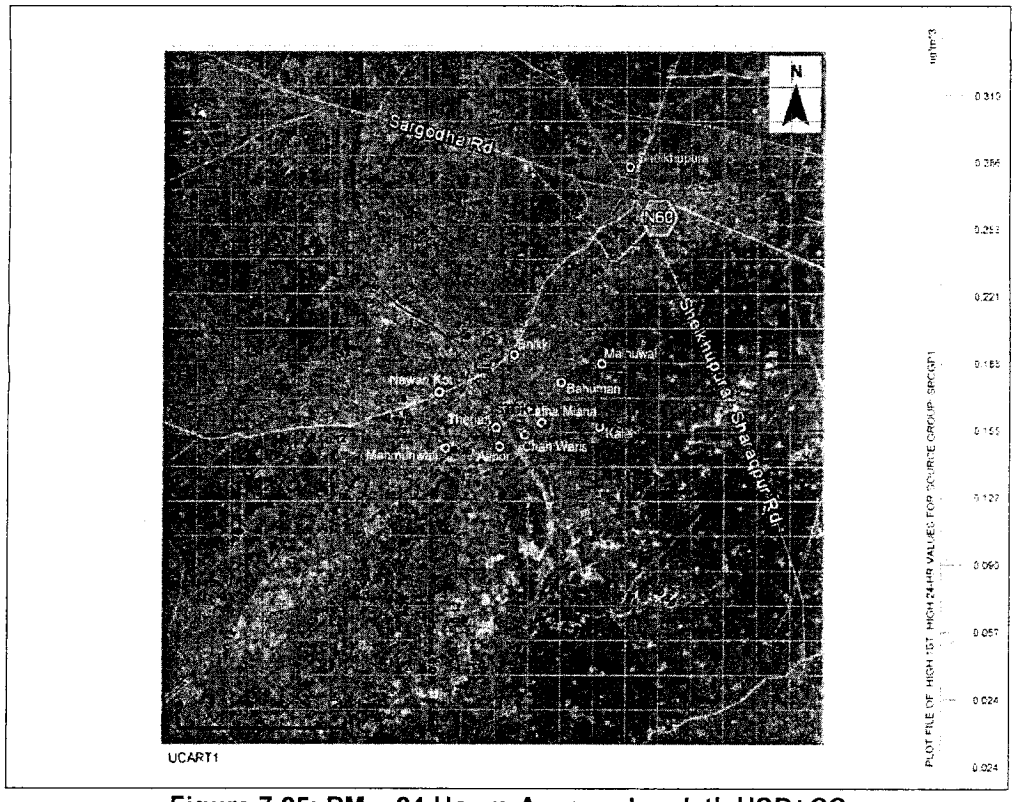


Figure 7.25: PM $_{10}$ 24 Hours Average Isopleth HSD+CC

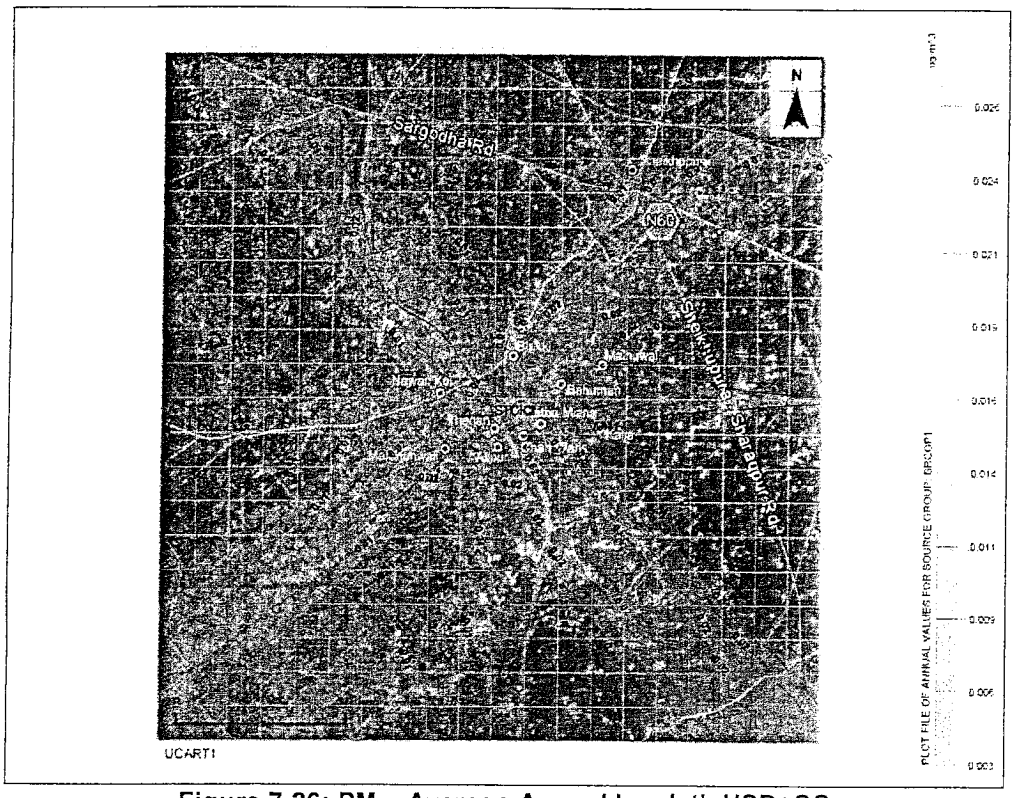


Figure 7.26: PM $_{10}$ Average Annual Isopleth HSD+CC

The Table 7.12 below shows the maximum concentration of PM_{10} for all the four scenarios. Among the four scenarios, ADM has shown the maximum concentration for PM_{10} for Plant Operation on RLNG in a Combined Cycle Mode for 24 hours as well as annual averaging periods. The resulting maximum concentrations for 24 hours and annual average by utilizing RLNG are 0.516 $\mu g/m^3$ and 0.042 $\mu g/m^3$ respectively.

Table 7.12: Maximum PM_{10} concentrations for 24 hours and annual averaging periods

Sr. No	Scenarios	Maximum PM $_{10}$ Concentration	
		24 Hours	Annual
1	RLNG +SC	0.093	0.011
2	RLNG+CC	0.516	0.042
3	HSD+SC	0.094	0.012
4	HSD+CC	0.319	0.026

The maximum baseline value for PM_{10} is 98.40 $\mu g/m^3$ for 24 hours averaging period. The values if were measured for the annual averaging periods would be much lower than these concentrations. However, due to unavailability of average annual concentrations, the 24 hours maximum values are taken as baseline concentrations. The maximum concentration of PM_{10} for 24 hours averaging period is much less than the threshold of 120 $\mu g/m^3$ for average annual and 150 $\mu g/m^3$ for 24 hours averaging period specified by NEQS, Pakistan (2010).

The above isopleths show that the maximum 24 hours average contribution of PM_{10} from the power plant will be 0.516 $\mu g/m^3$. The plant contribution when added in maximum baseline concentration would result in a total value of 98.916 $\mu g/m^3$ which is much lower than 24 hours average ambient air quality threshold of 150 $\mu g/m^3$ as specified by NEQS (2010). The maximum annual average contribution of PM_{10} from the power plant will be 0.042 $\mu g/m^3$. The plant contribution when added in maximum baseline concentration would result in a total value of 94.442 $\mu g/m^3$ which is much lower than average annual ambient air quality threshold of 120 $\mu g/m^3$ as specified by NEQS (2010).

viii) Particulate Matter ($PM_{2.5}$)

The dispersion isopleths for $PM_{2.5}$ for all four scenarios for annual as well as 24 hours averaging periods are shown in Figure 7.27 to 7.34.

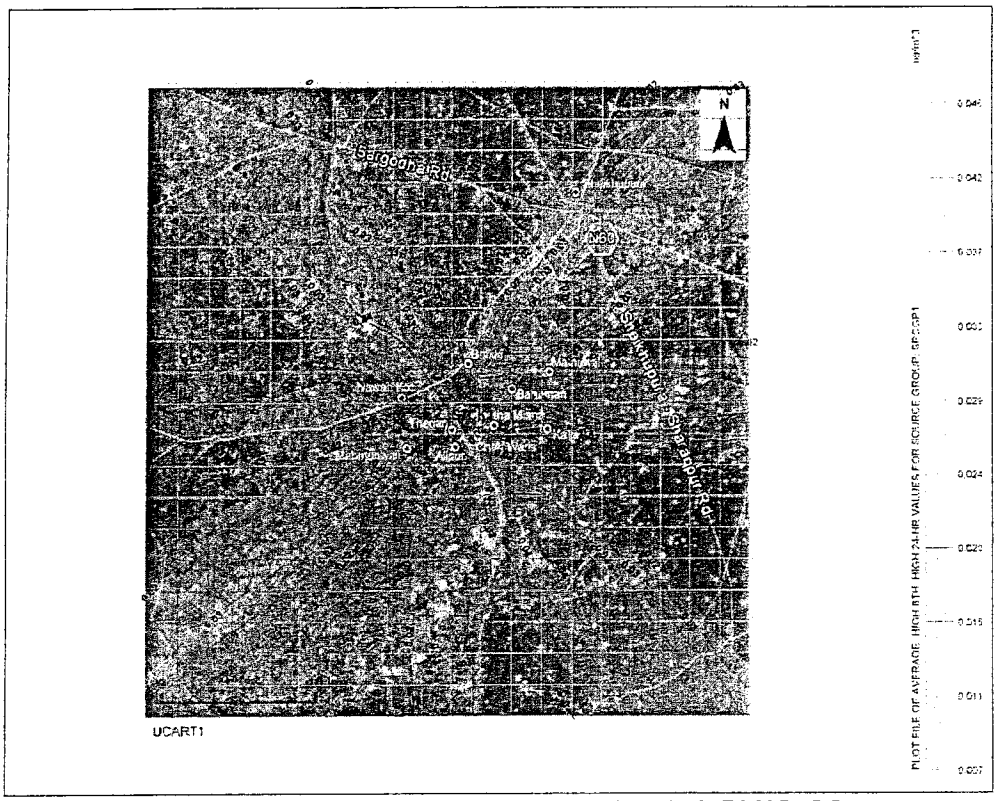


Figure 7.27: $PM_{2.5}$ 24 Hours Average Isopleth RLNG+SC

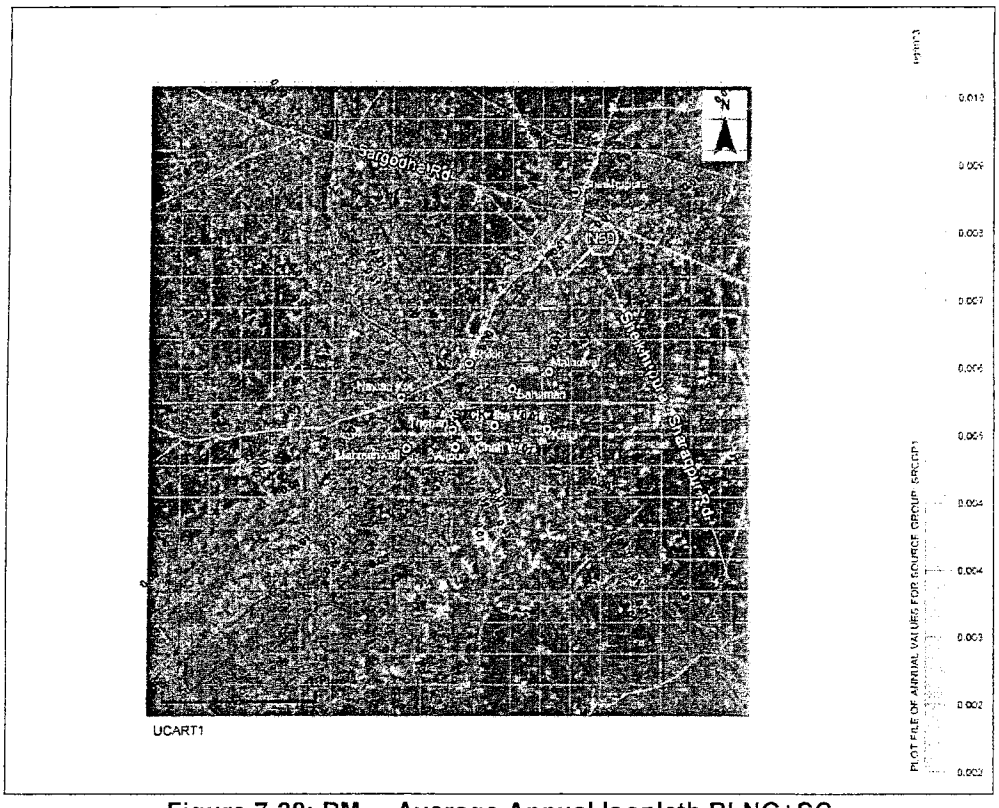


Figure 7.28: PM $_{2.5}$ Average Annual Isopleth RLNG+SC

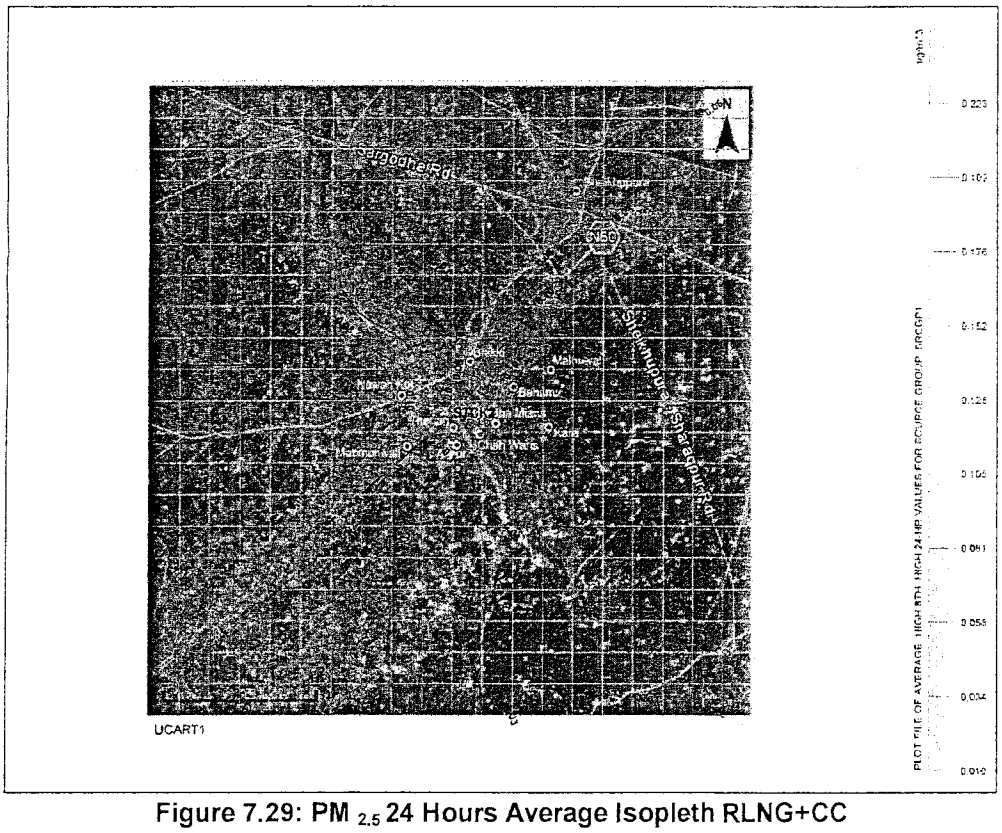


Figure 7.29: PM $_{2.5}$ 24 Hours Average Isopleth RLNG+CC

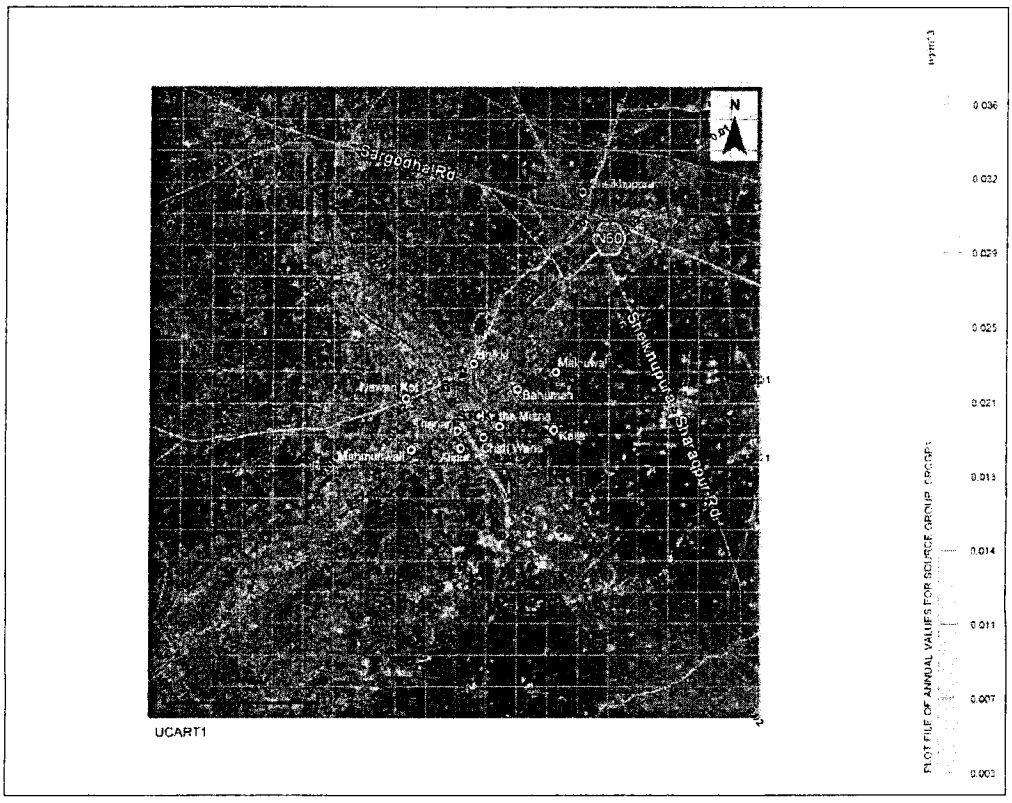


Figure 7.30: PM $_{2.5}$ Average Annual Isopleth RLNG+CC

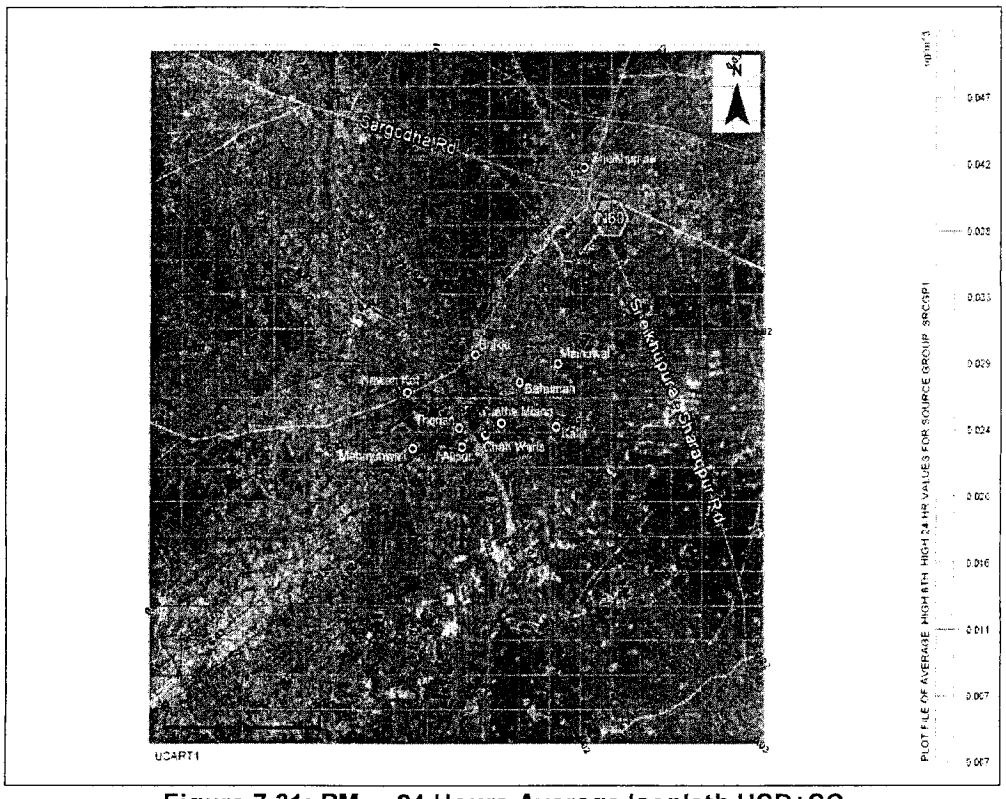


Figure 7.31: PM $_{2.5}$ 24 Hours Average Isopleth HSD+SC

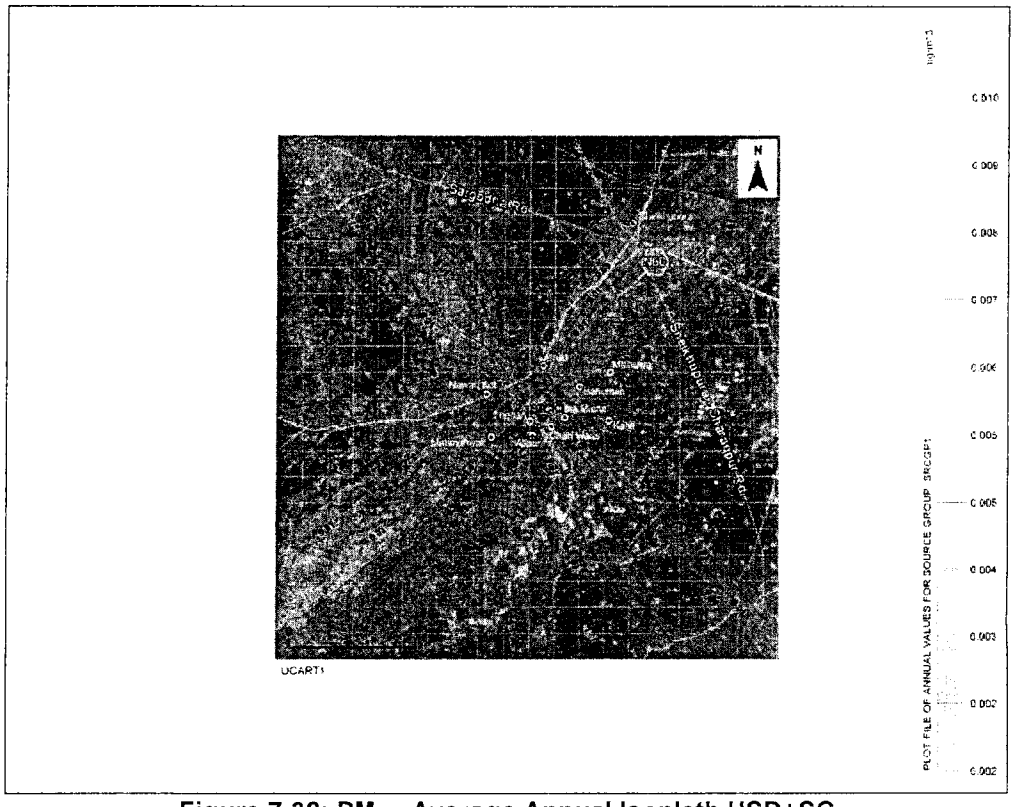


Figure 7.32: $PM_{2.5}$ Average Annual Isopleth HSD+SC

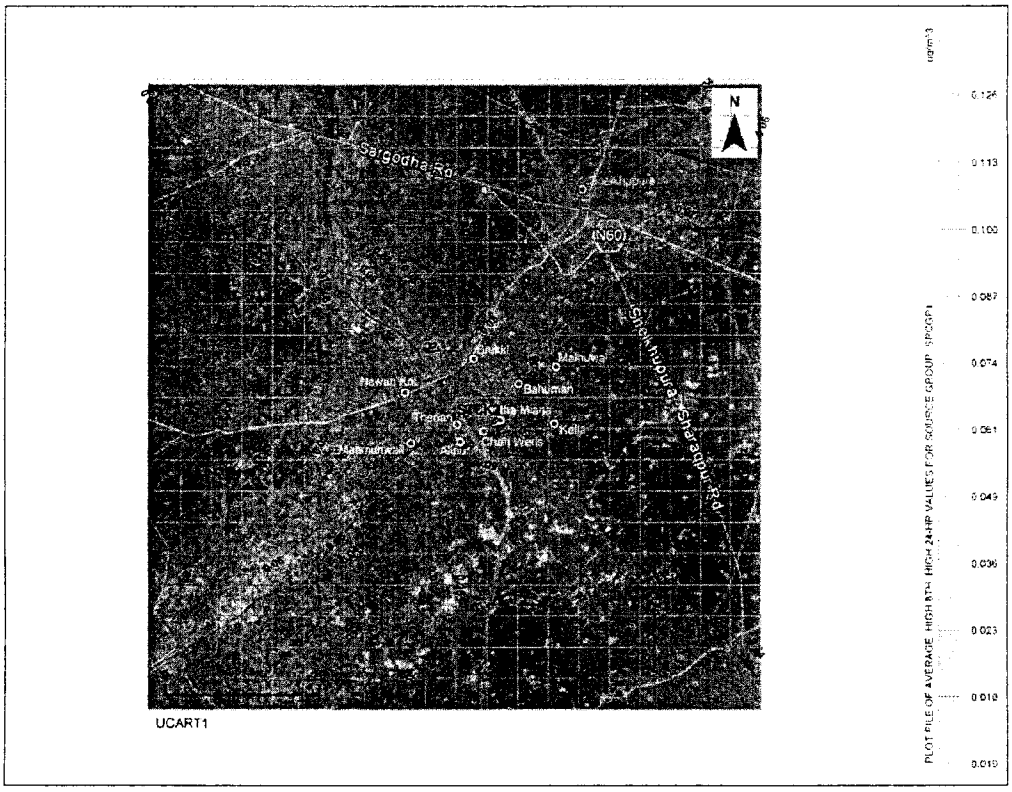


Figure 7.33: $PM_{2.5}$ 24 Hours Average Isopleth HSD+CC

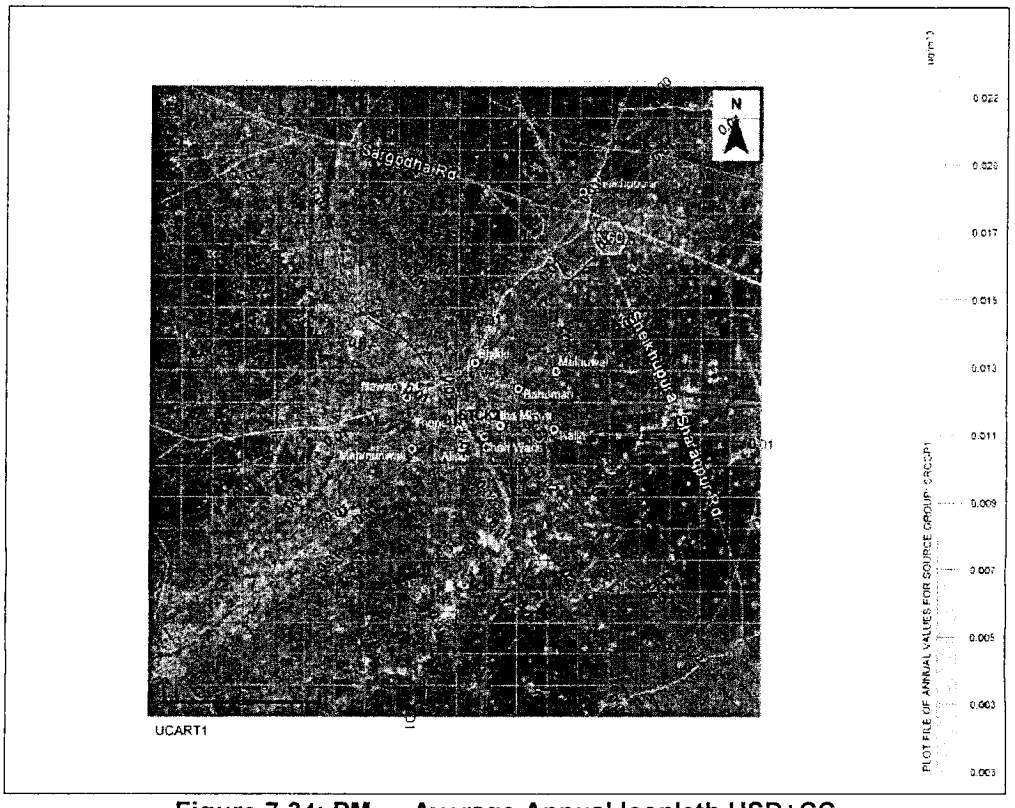


Figure 7.34: PM $_{2.5}$ Average Annual Isopleth HSD+CC

The Table 7.13 below shows the maximum concentration of $PM_{2.5}$ for all the four scenarios. Among the four scenarios, ADM has shown the maximum concentration for $PM_{2.5}$ for Plant Operation on RLNG in a Combined Cycle Mode for 24 hours as well as annual averaging periods. The resulting maximum concentrations for 24 hours and annual average by utilizing RLNG are 0.223 $\mu g/m^3$ and 0.036 $\mu g/m^3$ respectively.

Table 7.13: Maximum $PM_{2.5}$ concentrations for 24 hours and annual averaging periods

Sr. No	Scenarios	Maximum PM $_{2.5}$ Concentration	
		24 Hours	Annual
1	RLNG +SC	0.046	0.010
2	RLNG+CC	0.223	0.036
3	HSD+SC	0.047	0.010
4	HSD+CC	0.126	0.022

The maximum baseline value of $PM_{2.5}$ is 18.70 $\mu g/m^3$ for 24 hours averaging period which is less than the threshold of 35 $\mu g/m^3$ for 24 hours averaging period and is slightly higher than the limit of 15 $\mu g/m^3$ for average annual period as specified by NEQS, Pakistan (2010). The baselines values of $PM_{2.5}$ if were measured for the annual averaging periods would be much lower than the concentrations of 24 hours averaging period. However, due to unavailability of average annual concentrations, the 24 hours maximum values are taken as baseline concentrations. The long term baseline monitoring for $PM_{2.5}$ spreading atleast over a period of one year before commissioning of power plant or start of power plant construction should be done to determine the annual average concentration of $PM_{2.5}$ to assess compliance.

The above isopleths show that the maximum 24 hours average contribution of $PM_{2.5}$ from the power plant will be 0.223 $\mu g/m^3$. The plant contribution when added in maximum baseline concentration would result in a total value of 18.923 $\mu g/m^3$ which is lower than 24 hours average ambient air quality threshold of 35 $\mu g/m^3$ as specified by NEQS. The maximum

annual average contribution of $PM_{2.5}$ from the power plant will be 0.036 $\mu g/m^3$ which is quite low.

7.5.6 Mitigations of Impacts on Air Resources

a) Air Pollution

The long term baseline monitoring for $PM_{2.5}$ spreading atleast over a period of one year before commissioning of power plant or start of power plant construction should be done to determine the annual average concentration of $PM_{2.5}$ to assess compliance.

The stacks of the power plant will be kept high i.e. at minimum 45 m and 60 m above ground level for bypass stack and the main HRSG stack. Low NO_x burners will be used in GT to control emissions and the water will be injected during the use of HSD to control the NO_x emissions.

A continuous emission monitoring system (CEMS) will be installed, including flue gas analysers at each HRSG stack for NO_x, SO_2, Particulate Matter, CO, Volatile Organic Carbon (VOC, only at Aux. Boilers) and the reference parameters O_2, flue gas pressure and flue gas temperature, sample conditioning equipment, calibration gases, analysers for temperature, data acquisition module, data evaluation and visualisation equipment for the measured emission data with connection to the DCS. During the monitoring of the power plant during its operation, it will be determined if the occasional use of HSD fuel requires a flue gas desulphurisation system to be installed.

The designer should comply with the standards for CEMS i.e. ISO 10396: Stationary Source Emissions – Sampling for the Automated Determination of Gas Concentrations (2007) and ISO 10849: Stationary Source Emissions – Determination of the Mass Concentration of Nitrogen Oxides – Performance Characteristics of Automated Measuring Systems (04/1996).

7.5.7 Impacts on Noise

There are various villages adjacent to the Project Area.

Noise and vibration during the operation phase are likely to affect the health of local residents and animals. Some of the noise sources from the proposed Power Plant during the operation phase include noise from the operation of the turbines, boilers (steam blowing and purging) as well as combustion.

7.5.8 Mitigation of Impacts on Noise

The plant will be designed to control the noise generated to meet National regulations within the plant and at the fence line. It is already recommended to provide and adjust the height of boundary wall as per distribution of living structures outside the project area.

Noise during Plant Operation would be significantly blocked by trees to be planted all along the periphery of the Project Area. Tree plantation should be started during the construction phase

Equipment noise will be controlled using conventional noise control measures, such as insulation, lagging, ear protection, and enclosures as needed to comply with the Pakistan NEQS. Each GT shall be located in a compartment, which shall reduce the dissipated noise. The noise reduction shall achieve a noise level of 85 dB(A) measured one meter away at 1.5 meter height from the floor level. Additional efforts will include the declaration of a "no horn zone" and construction of a wall around the project site. An ambient noise measurement program will be instituted upon executions of the Project which will cover the construction and operation of the project. The monitoring program will consider the noise limits during

day-time and night-time at the closest point of public contact

7.5.9 Impacts on Aesthetics

Aesthetics plays an important role in improving the working environment of an area. Similarly the design provision can improve the aesthetics of an area and thereby improve the working efficiency of labor. In this regard greenery and plantation play an important role.

7.5.10 Mitigation of Impacts on Aesthetics

In order to improve the working environment, good house-keeping, cleaning, efficient solid waste management system should be implemented. Moreover, it is suggested that use of flower pots and other techniques should be used inside the buildings to improve the working environment of the area.

As already suggested that tree plantation and vegetation will be carried out within the plant area, this activity will also add to the aesthetics to the natural outlook of the area.

7.5.11 Impacts on Ecological Environment

RLNG based Power Plant will not release any considerable emissions to be detrimental to Fauna (Avi-fauna as well as Terrestrial) and Flora including trees and agricultural crops. However, such emissions if any, will be lowered by control technologies.

Raising of Livestock is one of the primary sources of livelihood of local economy. No damage to Livestock in the area is expected through release of wastewater, noise and vibration from the plant, thus will have no effect on Livestock productivity.

All the same way, negative effect on the productivity and vigor of agriculture crops mainly comprising of Rice, Wheat, Cotton, Maize, Sugarcane, Potatoes and other fodder crops and vegetables will be very minimal / negligible.

7.5.12 Mitigation of Impacts on Ecological Environment

- In order to offset the negative impacts on agriculture crops and other vegetation in the Study Area, the mitigation technologies prescribed for air and wastewater treatment must be implemented at the desired level as discussed in earlier sections concerning mitigation of impacts on air and water resources.
- Strict control must be exercised for stoppage of killing/poaching of available wildlife species by enhancing protection practices and deploying effective watch and ward system.
- Large scale planting with suitable indigenous trees, shrubs and ornamental plants in the form of Tree Groves, and Linear plantation will be carried out in accordance with the Tree Plantation Plan to improve aesthetic value and offset the effect of removal of vegetation.

Plantations so raised must be maintained according to the Silvicultural practices which include proper irrigation, cleaning, pruning, thinning at prescribed intensity, silt clearance and trench-opening, etc. in accordance with the approved practices of Punjab Forest Department.

7.5.13 Impacts on Socio-economic Environment

a) Gender Issues

At operational stage the induction of outside labor may create social and gender issues due to the unawareness of local customs and norms. It will also cause hindrance to the mobility of the local women. Disturbance may occur to the privacy of the local women residing in the nearby villages.

b) Noise

Due to the operation of plant noise and vibration will be produced which will have impact in the adjoining chak/villages, poultry industry etc. this will be an impact on the local population.

c) Wastewater

With the operation of this power plant, wastewater will be generated. The disposal of wastewater without proper treatment will have impact on the local community. If the wastewater is discharged into the QB-Link Canal, it is likely to cause damage to the livestock as it is used for their drinking purposes. Similarly some villagers use this water for washing purposes of their clothes and other domestic uses.

7.5.14 Mitigation of Impacts on Socio-economic Environment

a) Gender Issues

Power plant staff should respect the local community's sensitivity towards their customs and traditions. The staff must not involve any un-ethical activities and should obey the local norms and cultural restrictions particularly with reference to women.

b) Noise

To minimize the noise of the proposed power plant pollution barriers should be placed around the boundary of the power plant and continuous monitoring should be done to determine noise levels and ensure that they are within the NEQS limits.

c) Wastewater

As discussed in the mitigation of impacts on water resources due to wastewater, the wastewater should be treated to prevent any impacts.

CHAPTER – 8

ENVIRONMENTAL MANAGEMENT PLAN

8.1 GENERAL

EMP provides an overall approach for managing and monitoring the environmental issues of the proposed project, and describes the institutional framework and reporting mechanism to implement EMP for the Project. The EMP has been prepared with the following objectives:

- Provide project impacts along with the proposed mitigation measures, and a corresponding implementation phase;
- Define the roles and responsibilities of the project proponent, contractor and Environmental Monitoring Cell (EMC) in the existing setup of proponent in order to effectively communicate environmental issues among them;
- Frame a monitoring mechanism, reporting frequency, auditing mechanism and identifying monitoring parameters to ensure that all the mitigation measures are completely and effectively implemented;
- Define the requirements necessary for documenting compliance with EMP and communicating it to all the concerned regulatory agencies; and
- Provide other plans considering the project specific requirements.

8.2 STRUCTURE OF EMP

EMP is structured into several sections as listed below:

1. Regulatory Requirements and Applicable Standards;
2. Mitigation Management Matrix (MMM);
3. Planning for the Implementation of EMP;
4. Institutional Arrangements for the Implementation of EMP and Roles and Responsibilities;
5. Environmental Monitoring Plan;
6. Waste Management Framework;
7. Emergency Preparedness and Response Framework (EPRF);
8. Evacuation Framework;
9. Health and Safety Management Framework (HSMF);
10. Site Restoration;
11. Change Management Plan (CMP);
12. Construction Material Transportation;
13. Traffic Management;
14. Training Program;
15. Communication and Documentation;
16. Plantation Plan; and
17. Environmental Cost.

8.3 REGULATORY REQUIREMENTS AND APPLICABLE STANDARDS

The Punjab Environmental Protection Act, 1997 (amended 2012) is a fairly comprehensive legislation which provides legislative framework for protection, conservation, rehabilitation and improvement of the environment. It contains provisions for the prevention of pollution and promotes sustainable development. The 'environment' has been defined in the Act as: (a) air, water and land; (b) all layers of the atmosphere; (c) all organic and inorganic matter and living organisms; (d) the ecosystem and ecological relationships; (e) buildings, structures, roads, facilities and works; (f) all social and economic conditions affecting community life; and (g) the interrelationships between any of the factors specified in sub-clauses 'a' to 'f'.

The salient features of the law are:

- No proponent of a project shall commence construction or operation unless he has filed with the Provincial Agency designated by the Provincial EPAs an EIA, and has obtained an approval;
- Establishment and formation of the Punjab Environmental Protection Council;
- Prohibition of certain discharges or emissions;
- NEQS for wastewater, air emissions and noise; and
- Law also empowers Provincial Government to issue notices and to enforce them for the protection of the environment.

The Act was amended in 2012 under the 18th amendment which gives legislatives power related to environment and ecology to the Provincial government from the Federal government. The provinces are required to enact their own legislation for environmental protection. Other minor amendments including increasing the penalty cost for violations.

The capability of regulatory institutions for environmental management largely ensures the success of environmental assessment for ensuring that the development projects are environmentally sound and sustainable.

Other project related national environmental laws, regulations, policies and guidelines are as follows:

- National Conservation Strategy (NCS), 1992;
- National Environment Policy, 2005;
- Pakistan Labor Policy, 2010;
- Punjab Environmental Protection Act, 1997 (Amended 2012);
- Pak-EPA (Review of IEE and EIA Regulations, 2000);
- Pakistan EIA Procedures;
- National Environmental Quality Standards (NEQS);
- Land Acquisition Act (LAA), 1894;
- Punjab Katchi Abadis Act, 1992;
- Cutting of Trees (Prohibition) Act, 1975;
- Punjab Wildlife (Protection, Preservation, Conservation and Management) Act, 1974;
- Punjab Plantation and Maintenance of Trees Act, 1974;
- Antiquities Act, 1975;
- Pakistan Penal Code, 1860;
- Canal and Drainage Act, 1873;
- Punjab Irrigation and Drainage Authority (PIDA) Act, 1997;
- Pakistan Clean Air Program (PCAP);
- Guidelines for Public Consultation; and
- Sectoral Guidelines for Environmental Reports, Major Thermal Power Plants, October 1997.

8.4 MITIGATION MANAGEMENT MATRIX (MMM)

Environmental protection and enhancement is achieved in various ways. These approaches should begin right at the grass root level and should continue through each phase of the Project, i.e., (i) Design/Pre-construction (ii) Construction and (iii) Operation and Maintenance (O&M) phases. Appropriate environmental management measures are required to be exercised in a cascade order by the Proponent, Engineering, Procurement and Construction (EPC) Contractor at each phase of the project.

In this way, it is envisaged that the Project will achieve maximum ongoing cost-effectiveness, environmental sustainability and social soundness, far beyond if it's implemented at the end of the Project. All phases of the Project have to be managed by adopting the proposed

environmental mitigation measures, which, besides the engineering aspects, are given due importance which make a perfect blend with the surrounding ecosystem.

MMM is provided in Table 8.1 and it identifies the following:

- The impacts and required mitigation measures recommended in EIA;
- The person/organization directly responsible for adhering to or executing the required mitigation measures;
- The person/organization responsible for ensuring and monitoring adherence to mitigation measures;
- The parameters which will be monitored to ensure compliance with the mitigation measures; and,
- The timing at which the mitigation or monitoring has to be carried out.

8.5 PLANNING FOR THE IMPLEMENTATION OF EMP

Planning is the most important phase for the implementation of EMP. Good planning results in timely implementation of EMP in the most effective manner. EMC will be established by the Proponent to supervise all the construction activities by EPC Contractor. However, during the operation phase of the project, Proponent's proposed Health Safety and Environment (HSE) Section will take up the responsibilities of implementing the mitigation measures or may be EPC Contractor will remain on board for first year of operation. Following are the major components of planning for the implementation of EMP.

8.5.1 NOC and other Approvals

Obtaining approval from Environment Protection Department (EPD), Punjab will not relieve the proponent from other legal obligations. In-fact issuance of NOC will start the implementation of suggested mitigation measures given in the EIA report. Apart from NOC, proponent will obtain all other relevant clearances and necessary approvals as per other relevant laws and requirements, prior to commencing respective operations. Apart from NOC, proponent will obtain all other relevant clearances and necessary approvals as per other relevant laws and requirements, prior to commencing respective operations. List of references is attached as Annex-8.

8.5.2 Contractual Provisions

EPC Contractor will be legally bound for the execution and implementation of EMP.

8.5.3 Coordination with Stakeholders

Proponent will ensure that coordination with the project primary stakeholders including PAPs and residents of the Study Area, EPD-Punjab, Irrigation Department, Wildlife department, NHA, C&W Department and other district level departments and EPC Contractor on environmental and social matters as required by the EMP is maintained throughout the implementation period (construction and O&M phase) of the project.

8.5.4 Monitoring

Proponent, in coordination with EPD-Punjab, will ensure that the monitoring of the project activities is carried out according to the monitoring program as stipulated in the EMP at Construction Phase.

8.5.5 Health and Safety Management Framework, Emergency Preparedness and Response Framework (EPRF) and Evacuation Framework

EMP of EIA report includes the HSMF, EPRF and Evacuation Framework. During the construction phase, EPC Contractor will prepare these complete plans based on the guidelines and structure provided in EMP. EMC will check if these plans are in place and effective in addressing the issues.

8.5.6 Approvals

EPC Contractor will be responsible for obtaining all relevant approvals from proponent through EMC such as approvals for final solid waste, disposal of used oil/lubricants, a utilizing ground or surface water sources and others as specified in the MMM. Whereas, approvals of above matters from concerned government department will be the responsibility of proponent.

8.5.7 Communication and Documentation

EPC Contractor and EMC will ensure that the communication and documentation requirements specified in the EMP are fulfilled during the construction phase of the project.

Table 8.1: Mitigation Management Matrix

Responsible Agency/ies:
PP = Project Proponent
EPD = Environmental Protection Department
EPC = Engineering, Procurement and Construction Contractor
HSE = Health Safety & Environment (HSE) Section
EMC = Environmental Monitoring Cell

Project Phases:
Design /Pre-construction Phase
Construction Phase
O&M Phase

Potential Positive Impacts		
1	**Electricity Generation**	The power plant is expected to generate maximum of 1,000-1,500 MW of electricity. Given that Pakistan currently faces a shortfall of about 4,000 to 6,000 MW per day, the generation capacity of this power plant will help towards meeting a portion of the shortfall, thus providing some measure of relief to the people of Pakistan. The generation of electricity will not only help the industrial sector and its outputs but will also help to raise the standard of living as it will reduce load shedding.
2	**Employment Opportunities**	Electricity generation will help industry in producing more output and in being more efficient, which in turn will have a ripple effect of increasing local employment. Even during the construction phase of the project, the requirement of engineers, workers, laborers, technicians, para-professionals etc. will generate employment opportunities. Locals will also have the opportunity to diversify their incomes by getting employment during the construction period of the project. It is estimated that about 2,500 during the construction phase and about 150-200 during the operation phase will be employed. Hence, there will be large number of employment opportunities mainly for the local people, during the construction phase of the project.
3	**Increase in Business**	With the influx of laborers for the proposed project, there will be more opportunities for small scale business such as small grocery shops, small cafes (khokas), and vehicle tuning, tyre-repair shops etc. Additionally the generation of electricity will reduce load shedding and contribute towards more business in the country.
4	**Increased Accessibility**	Construction of the access road for the construction of Power Plant and up gradation of existing tracks to the project area will result in improved accessibility.

5	**Indirect Benefits**	In addition to the power production and other benefits described above, there will be other economic benefits associated with the project implementation. These are known as secondary or indirect benefits, which are as follows: ▪ The generation of 1,000 - 1,500 MW of electricity which will be added to the national grid, will help in reducing the current crisis of the electricity. The availability of electricity will boost the industrial sector of Pakistan. This will have a huge positive impact on the economy of the country; ▪ The proposed Project will have positive impacts on the areas due to the development of quarry sites. In this regard, construction of new roads to the quarry sites will also benefit the local population apart from job opportunities; ▪ The construction and operation of the proposed Project will stimulate business and employment opportunities for the labor in the form of handling, transportation, business etc.; ▪ The prices of Study Area lands will be appreciated considerably due to this proposed power plant as a result of commercial activities; and ▪ In addition to all these benefits, the project will result in the general economic and social uplift of the people particularly in areas of the Punjab Province and will provide basic infrastructure and raw material for other projects in the region.		
Sr. No	**Impacts**	**Mitigation Measure**	**Responsibility**	
			Implementation	**Monitoring**
		Design /Pre-construction Phase		
a.	**Land Acquisition for the Proposed Project**			
1	The project will be constructed over a land area of 315,964.34 sq.m (including permanent plant and access road area only). Temporary area requirement will be 137,710.65 sq.m. Govt. will acquire the private land per provision of LAA,1894.	The plant construction mostly involves the private land. The land will be acquired according to the provision of the LAA 1894. The LAA is broadly grouped into eight (8) parts comprising 55 Sections dealing with the details of land acquisition and compensation. The main relevant Sections of LAA, 1894 are shown in Figure 7.1. Apart from other relevant sections, the sections describing the aspects to be considered and not to be included during the determination of compensation are as summarized below: **Section-23 (Matters to be considered in Determining Compensation):** Section-23 testifies that in determining the amount of compensation to be paid for land acquired under this Act, the Collector shall take into account the followings: ▪ Market value of land at the date of publication of	District Government Sheikhupura	Proponent/EMC

		notification under Section-4; ▪ Damage sustained, by reason of the taking of any standing crops or trees at the time of the Collector's taking possession thereof; ▪ Damage (if any) sustained, at the time of taking possession of the land, by reason of severing such land from his other land; ▪ Damage (if any) sustained, at the time of taking possession of the land, by reason of the acquisition injuriously affecting his other property or his earnings; ▪ If in consequence of the acquisition of the land, the person interested is compelled to change his residence or place of business, the reasonable expenses (if any) incidental to such change; ▪ The damage sustained by diminution of the profits of the land between the time of the publication of the declaration under Section-6 and the time of taking possession of the land; and ▪ 15% over and above the cost of the land determined by the Collector as charges for acquisition. **Section-24 (Matters to be neglected in Determining Compensation)**: In accordance with Section-24, following matters shall not be taken into consideration in determining: ▪ The degree of urgency which has led to the acquisition; ▪ Any disinclination of the person interested to part with land acquired; ▪ Any damage sustained by him which, if caused by a private person, would not render such person liable to a suit; ▪ Any damage which is likely to be caused to the land acquired after the date of publication under Section 6, by or in consequence of the use to which it will be put; ▪ Any increase to the value of the land acquired likely to accrue from the use to which it will be put when acquired; ▪ Any increase to the value of the other land of the		

		person interested likely to accrue from the use to which the land will be put; and ▪ Any outlay or improvements made without the sanction of the Collector after the date of the publication of the notification under Section-4. The above provision will be strictly complied with during the determination and payment of compensation. Proper measures need to be taken to safeguard the livelihoods of the affectees apart from the compensation.		
b.	**Loss of Agriculture Land**			
1	The proposed project will result in the conversion of agriculture land in to built-up area that will decrease the agriculture produce of the area.	The proponent should consult with the locals and take guidance from the agriculture department and promote such practices and techniques that will increase the yield and soil fertility. Following steps are recommended for yield increase in the nearby surrounding area. • Promote and adopt new irrigation techniques like drip irrigation, sprinkle irrigation, etc. and other prevailing modern scientific methods that will improve the crop yield; • Use of Effective Microorganisms (EM) technology for crop yield enhancement; • Agricultural inputs should be offered on subsidized prices to farmers of small land holdings relating to electricity tariff, supply of seeds, fertilizers, machinery and other agricultural tools so as to attract the farmers zeal to work hard in increasing the crop yield; • Soil microbial inoculants as an alternative biological approach should be used to improve the soil quality; • Integrated use of green manure, farmland manure and inorganic fertilizers may be promoted; • Improving agronomic performance of crops, particularly wheat and rice, by controlling insect pests; • Use of modern machines for cultivation and harvesting will increase yield of the crops; • Government may evolve a system to offer credit facilities to farmers of small holdings to purchase		

		certified seeds, pesticides, fertilizers, etc. and • Lack of guidance to small farmers about new agricultural techniques and allied sciences may be overcome by means of communication through Radio and TV in rural areas to air the programmes in regional and local languages for better understanding and field adoption.		
c.	**Water Quality & Quantity**			
1	It is expected that the requirement of water during pre-construction stage will be fulfilled from ground Water through tube wells. The preconstruction activities include construction of new access tracks and improvement of existing track, clearing and leveling of project areas etc. Water extraction from groundwater negatively affect the existing water quantity.	This impact on water through tube wells needs to be addressed carefully adopting the recommendations of Hydrogeological Study and ERS. Contractor should consult with department and obtain permit for extraction of water.	Irrigation Department Sheikhupura	Proponent/EMC
d.	**Loss of Livelihood**			
1	Due to the acquisition of the private land, some families may have direct impact and lose their livelihood. The bread and butter of these families are dependent on the agriculture of these lands. With the acquisition of these lands livelihood of these families will be lost. As per the LAA these families will get the compensation of these lands however, loss of livelihood is a significant adverse social impact of the proposed Project which is required to be addressed.	As per LAA, no provisions for the loss of livelihoods exist. Other compensation should be provided to the adversely affected population who may have usufruct or customary rights to the land or other resources taken for the project. It is strongly recommended that the proponent should provide livelihood assistance to the affectees like loans, job assistances, trainings etc.	Proponent/District Government Sheikhupura	Proponent/EMC

e.	**Impacts on Built Up Areas, Infrastructure and Crops**			
1	The implementation of the Project will affect the built up area, crops, water courses, katcha track, transmission line and 3 No. of tube wells that will come under permanent, temporary and access road area.	The loss of private built up area, infrastructure and crops should be compensated according to the provisions of the LAA 1894. Other government infrastructure should be relocated by the concerned department in consultation with the project proponent.	Proponent/ District Government Sheikhupura	Proponent/EMC
		Construction Phase		
a. Impacts on Land Resources				
1	**Soil Erosion:** Soil erosion may occur during the construction phase in the Project Area as a result of improper runoff drawn from the equipment washing-yards and improper management of construction activities. Soil erosion may also occur at quarry area if unmanaged material extraction is carried out. Construction works may temporary change the grading of the natural ground surfaces and due to instability of top soil surface, soil erosion may occur.	Good engineering practices will help in controlling soil erosion at the construction site areas. Controlled excavations at quarry areas will also help to reduce the soil erosion. Contractor should make proper arrangements for drainage of water in the washing yards and quarry areas such as drainage channels. It is recommended that a properly developed quarry management plan should be prepared for each quarry site. The WMF described in Chapter 8 of this report should also be adhered to by the contractor. .	EPC Contractor	Proponent/EMC
2	**Soil Contamination:** All the carbon based compounds are toxic to varying degrees. HCs, petrol, diesel etc. are toxic in nature. The insulation on electric wires and cables are made from HCs compounds, which are toxic. Paints and varnishes are also toxic in nature, which are used during construction. If proper care is not taken for handling, storing and transportation of these toxic substances these may cause damage to the health of the workers as well as their spills will contaminate the soil. The other waste generated is mostly composed of rubbish, ashes and residues, demolition	Oil leakages, chemicals and other liquids spills should be avoided/minimized by providing appropriate storage places depending on the type of material for storage. Oil and other lubrication material should be stored in water proof tanks especially built for oil storage. These tanks should be built away from the main road and residential areas or safety purposes. Access to these tanks should only be allowed to the authorized personnel. Safety equipment like fire extinguishers should be placed near these places along with signs for danger and fire. Workers must be familiar with the MSDS of each chemical used at site. MSDS are provided with each chemical drum. Chemicals will be stored as per the instructions of MSDS. Utmost care should be taken during the handling of these	EPC Contractor	Proponent/EMC

	materials and hazardous wastes. These wastes will be generated due to the construction activities and materials used for construction. Indiscriminate disposal of solid waste will contaminate the soil. Another source of soil contamination is the discarded construction materials that include chemicals, wires, plastics, cut pieces of pipes, pieces of empty fuel and lubricants tins and cardboard packing and other discarded materials. All these wastes are part of solid waste. One of the most important aspects is the generation of solid waste during construction activities. During the construction activities the generation rate for solid waste will increase considerably. The major components of the workers camp waste are garbage, putrescible wastes. The construction camp will be located over reasonable area, and therefore there is significant area that is potentially susceptible to soil contamination. Immediate attention is required for such type of wastes as these are degradable and those that produce odor. It is expected that approximately 0.5 kg/capita/day[1] waste will be generated from the camps.	chemicals. Precautions should be taken to prevent spills and all workers should be trained in proper handling, storage and disposal of hazardous or toxic materials. Solid waste Contractor should consult with the proponent and the Tehsil Municipal Administration, for final disposal. Adequate number of solid waste containers should be placed at various locations within the Project Site and shall not in any case dispose of waste indiscriminately outside the boundary of the Project Area. Separate primary collection of organic and in-organic waste arrangements need to be provided. In this regard, workers should be made well aware of the solid waste management system being adopted at the site. Hazardous, Non-hazardous, Inert and municipal wasted such as garbage, refuse, etc. produced during the construction, pre-commissioning and commissioning stages shall be disposed in compliance with the National guidelines and government ordinances. All hazardous wastes shall be clearly labeled. Other waste shall be placed in designated containers. Regular clean-up of scrap material, saw dust, rags, oil, paint, grease, flammable solvents and other residue of construction operation shall not only remove or reduce the fire hazard, but shall promote general safety at the same time. Contractor will arrange to obtain at each of work areas adequate waste disposal and toilet facilities, potable water for use of its employees. In addition, Contractor shall comply with all laws, standards, codes and regulations		

[1] Source: The World Bank Report 2012 – What a Waste: A global review of solid waste management. Based on UNEP estimates for waste generation in the Asia Pacific. Average is 0.45 kg/capita/day.

		relating to sanitation at the work-site, including company's requirements as to waste disposal and toilet facilities and Potable Water. All the above measures should be implemented as part of a Waste Management Plan to be prepared by the contractor under the guidelines presented in the WMF in Chapter 8 of this report.		
3	**Water Ponding:** The excavated material will be generated from the excavations of trenches for foundations, laying of water supply pipeline and other structures. This excavated materials will be used for filling works as much as possible. However, a bulk of the excavated material will not be reused. If this material is left at places of excavation, it will remain there in loose form and may promote development of temporary water ponding within the Project Area and its nearby vicinity.	Proper storage place for each type of material to be used during the construction should be built to avoid the development of water ponds. Left over material should be disposed of immediately at designated places.	EPC Contractor	Proponent/EMC
b. Impacts on Water Resources				
1	**Water Utilization for Construction:** Water will be required for the construction purposes. Groundwater will be used for this purpose that may have negative effect on the available water quantity and water required for construction may result in competition with original use of water. It is also expected that groundwater supplies, which need to be tapped to meet campsite and construction requirements will lower the water table in the Study Area.	Efforts should be made to draw water from deep aquifer which do not influence the top unconfined aquifer which is being exploited by the local community. However, this should be done by carefully adopting the recommendations of Hydrogeological Study and Electrical Resistivity Surve.. It will be the responsibility of the contractor to ensure safe supply of water for construction purposes.	EPC Contractor	EPD/Proponent/EMC
2	**Contamination of Canal Water:** Sewage and wastewater will be generated at the construction camps and from construction activities. If the generated sewage is not properly treated	To avoid sewage, untreated wastewater, and chemicals and oil spillage from draining into the canal during construction activities, measures should be taken to contain the chemicals, sewage and untreated wastewater. Contractor should not in any case dispose of above chemicals into the	EPC Contractor	EPD/Proponent/EMC

	or disposed of, this may contaminate the water quality of the Canal and might affect the groundwater resources apart from soil contamination. Water from dewatering activities (during rainy season) has the potential to contain suspended solids and oil and grease and if disposed of untreated may affect the quality of surface water bodies. Furthermore, spills of oils and hazardous chemicals if in large quantities can drain into the nearby water channels that are a source of irrigation water to the agricultural fields. This is a potentially significantly adverse impact as the wastewater can drain from the Project Area into the Canal. Such contamination of canal water can have adverse impacts on the water quality. The project assuming that on average the water demand per person is 100 litres per day and that 80% of the water demand will become wastewater.	nearby Canal. Similarly utmost care should be taken to avoid any spills of oils and hazardous chemicals by best management practices and good house-keeping and following the MSDS. In case of emergency spills, SOPs should be developed and strictly followed by contractor. The chemicals and other oils shall be disposed of at designated places or supplied to other industries as raw material to avoid contamination. Measures should also be taken to remove settle-able solids prior to discharging water from the site include the use of sediment sumps. Any visible oil and grease can be skimmed off the surface using absorbent pads. For Sanitary drainage, installation of proper temporary sanitary sewage disposal facilities for the entire site should be considered. These include provisions for the construction offices and living area. The number of comfort rooms/portables shall correspond to the number of workers, as required by law, and the sanitary sewage facilities should be adequately sized.		
2	**Contamination of Groundwater Resources:** The groundwater can also be contaminated by sewage from the septic tanks. The deep wells will also be installed at the Site. These deep wells will be used for the supply of makeup water during the Canal closure period.	Sewage from construction camps should be disposed of by development of on-site sanitation systems i.e. septic tanks along with soakage pits. On-site sanitation system can be operated well as long as the difference from the bottom of the soakage pit is 2 m (6.56 ft) from the groundwater. Therefore, this system will minimize the negative effect on groundwater quality.	EPC Contractor	EPD/Proponent/EMC
c. Impacts on Ambient Air and Noise				
	Air quality is likely to be adversely affected by the construction of the Power Plant. Several types of emissions are expected, including: ▪ Gaseous emissions due to	▪ Tuning of vehicles should be made mandatory to reduce the emissions of NO_x, SO_2 CO, HC and TSP to ensure that these emissions do not exceed NEQS limits of Motor Vehicle Exhaust and Noise. All vehicles will be required to carry a fitness certificate; ▪ Emissions points from batching plants can be controlled	EPC Contractor	EPD/Proponent/EMC

	movement of construction machinery; ▪ Fugitive dust emissions due to movement of machinery on dirt tracks, construction of roads and excavation of borrow areas; and ▪ PM emissions during the operation of concrete batching plants and asphalt mixing plants. These emissions are described in the following sections.	efficiently by the installation of cyclone. It is also recommended that during the operations of the machines labor shall wear Personal Protective Equipment (PPEs) in order to save their health. Diesel operated equipment and vehicles should be well maintained to minimize particulate emissions. Maintenance will include changing the lubricating oil, changing the air and fuel filter, cleaning the fuel system, draining the water separators and proper tuning; ▪ Haul-trucks carrying, soil, sand, aggregate and other materials will be kept covered with tarpaulin to contain the construction materials being transported within the body of each carrier. Moreover, slightly wet material controls air pollution; ▪ Dust emissions will be reduced by regular sprinkling of water. Sprinkling will take place every three hours during daylight hours and every six hours during night time throughout the construction period in the summer and during the winter the frequency can be reduced. Sprinkling will be done on access roads, tracks frequently used by vehicles, construction zones and material storage area; ▪ Construction activity shall be avoided during the night times and silencers should be provided in all vehicles to minimize the emissions of noise. Noise complaints should be logged and kept onsite by the construction contractor. Noise producing machinery should be properly examined to reduce noise; ▪ All the provisions of NEQS, 2010 based on the zone classification should be strictly enforced; ▪ The proposed Project Area site should be fenced and noise barriers to be installed.		
1	**Gaseous and Fugitive Dust Emissions:** For the construction work, various types of machinery will be required. Machinery will consist of gantry cranes, tower cranes, crawler cranes, loaders, trailer pumps, mixers, excavators, dumpers, concrete rollers etc. Since most of the machinery will use diesel as fuel, emissions will mainly consist of CO, SO_2 PM, NO_x and HC. Most of the above machinery (excluding the batching plants) will move around during the construction period. Fugitive dust will be produced by earth moving activities, excavation, haulage, heavy machinery movement and construction of roads within the power plant area. Fugitive dust emissions are a function of silt content of dirt tracks, vehicle speed and the mean annual number of days with 0.01 inches (0.254 mm) or more of rainfall. Gaseous and fugitive dust emissions will result in an impact of medium significance, due to their moderate magnitude, relatively small duration (less		EPC Contractor	EPD/Proponent/EMC

	than five years), and localized geographic impact area. Gaseous and fugitive dust emissions will affect the people living in the nearby settlements. Moderate levels of vehicular emissions tend to cause lung irritation, shortness of breath and increase a person's susceptibility to asthma. This impact is classified as moderately significant.			
2	**Particulate Matter Emissions from Concrete Batching:** Concrete batching plants will be a major source of PM emissions. These emissions accumulate in the respiratory system and can lead to decreased lung function, and respiratory disease. Direct impacts will be encountered by the construction workers working in close proximity to the batching plants as well as those residents in nearby settlements.		EPC Contractor	EPD/Proponent/EMC
3	**Noise:** Noise from the construction activities (such as batching plant, vehicular movement etc.), vibration and movement of heavy traffic will be significant and may cross the NEQS limits.			
d. Impacts on Ecological Environment				
1	It is estimated that about 58 large and medium size trees will be removed before the start of construction. Loss of vegetative cover in the form of removal of these trees will occur while clearing land. Presence of snakes, scorpions and insect vectors like mosquitoes and flies may be hazardous to the health of workers, who may get bit and acquire malaria, stomach diseases like cholera, diarrhea, hepatitis	Only trees coming within the various structures to be constructed on the site, shall be removed and every possible effort shall be made to save the remaining trees, which fall in open spaces or those which can be adjusted in the future landscape of the power plant. Ten (10) trees will be planted as a replacement of each of the tree affected and a total of 600 trees will be planted in accordance with the tree plantation plan specified in EMP. Trees on the boundaries of the Project Area should be planted in linear form as Tree Belts / Strips of 1-2 rows in	EPC Contractor	EPD/Proponent/EMC

	etc. The construction machines will generate pollutants and particulate matter which will affect flora and fauna at a non-significant level in the area. This impact is expected which will be mitigated by the biological practices given in the relevant section of mitigation. Due to noise and vibration during construction phase, reptiles, rodents and birds will migrate and may settle in the adjoining area.	multi-storey pattern (trees with varying height) to control any noise pollution. Tall trees like Shisham, Neem, Siris, Amaltas, Kachnar and Kikar, (scientific names are provided in Chapter-5) etc. will be used for upper storey. Alstonia, Bottle Brush, Pilkan, Bakain, Siver Oak, etc. for mid storey and ornamental bushes, like Hibiscus, Gul chin, Lagerstroemia, etc. for lower storey to provide suitable habitat for birds and other fauna, in addition to acting as shelter belts against noise. Trees should be raised all along the roads and paths in the Project Area after the construction of the proposed power plant. A number of grassy lawns must also be established, spreading uniformly in the Project area to promote good environment friendly practices. Campsites and asphalt plants will be established on vacant land rather than on green areas. However, if such type of land is not available, it will be ensured that minimum clearing of the vegetation is carried out and minimum damage is caused to trees and undergrowth. Construction vehicles, machinery and equipment will remain confined within their designated areas of movement. The Contractor's staff and labor will be strictly directed not to damage any vegetation such as trees or bushes. Contractor will provide gas cylinders at the camps for cooking purposes and cutting of trees/bushes for fuel will not be allowed. Prophylactic measures against snakes and scorpions must be taken for the health and safety of workers. Malaria and stomach ailment measures be adopted by establishing adequate number of Health Care Units/Centers in the residential area and in nearby population. The impact on reptiles, rodents and birds will also remain to a negligible level on account of proportionately small area for Project installation and can, however, be avoided with vigilant movement of heavy machinery and equipment		

		during construction. Hunting, poaching and harassing of wild animals and birds will be strictly prohibited and contractor shall be held responsible for any such act of his men.		
e.	**Impact on Socio-Economic Environment**			
	During the construction period, the movement of construction vehicles from the main highway into the proposed plant boundary may affect traffic on Sheikhupura- Faisalabad Road and may create minor annoyances to the residents and traffic on the road. Transportation of heavy construction equipment and material is likely to damage the road. Induction of outside workers in the Contractor's labor force may cause cultural issues with the local community as the local community is very sensitive about their cultural values. Also theft problems to the local community may arise by the labor force and vice versa. Unmonitored construction activities may create an accident risk for the local residents particularly the children and labor force. Disturbance may happen to the privacy of the local women residing in the Study Area when workers will work at height. The community belonging to the villages of project areas can be affected during the construction phase as follows: ▪ The general mobility of the local	▪ Efforts should also be made to discuss traffic conditions with the NHA and C&W so that regular traffic is not disturbed. Transporters engaged by the plant would be forced to adhere to the load specifications of the access road. No overloading would be allowed in any case; ▪ Good relations with the local communities will be promoted by encouraging Contractor to provide opportunities for skilled and unskilled employment to the locals, as well as on-the-job training in construction for young people. Contractor will restrict his permanent staff to mix with the locals to avoid any social problems; ▪ The Contractor should prefer local labor from nearby villages. The Contractor will keep the copies of CNIC of his employees and will warn the workers not to involve in any theft activities and if anyone would involve, he will have to pay heavy penalty. Similarly, at the time of employment, Contractor has to take care that the workers should be of good repute. The Contractor camp will be properly fenced and main gate will be locked at night with a security guard to check the theft issues; ▪ Contractor should arrange first aid kits along with medical officer in the field. Routine medical check-ups of all the field staff including unskilled labor need to be conducted by a qualified doctor; ▪ Training of workers in construction safety procedures, environmental awareness, equipping all construction workers with PPEs, safety boots, helmets, gloves, and protective masks, and monitoring their proper and sustained usage will be carried out. In case of accidents contractor will provide free medical treatment to the community; ▪ Contractor will have to take care as much as possible	Proponent/District Government Sheikhupura/ EPC Contractor	EPD/Proponent/EMC

	residents and their livestock in and around the Study Area is likely to be hindered; ▪ Unmonitored construction activities; ▪ Usage of community common resources like potable water, fuel wood etc. by Contractor workforce may create conflicts between the community and the Contractor; and ▪ Community will have to face the noise and dust problems during the construction activities.	that the construction activities should not affect the privacy particularly with reference to women; ▪ Large noise generating activity will be carried out during the fixed hours (preferably during the mid-day). The timing will be made known to all the people within 500 m (1640 ft) radius of the site; ▪ Construction camp will be located at least 500 m (1640 ft) away from the local settlements to prevent the contamination of community-owned water resources; ▪ Approval from the locals (elders and leaders of nearby population) will be obtained before using the local water resources; ▪ The Contractor will be responsible for the sensitivity towards the local customs and traditions; ▪ The Contractor will be required to maintain close liaison with the local communities to ensure that any potential conflicts related to the common resource utilization for the project purposes are resolved quickly; ▪ Mitigation suggested to control air and noise pollution should be enforced by the Contractor; ▪ Effective construction controls by the Contractor to avoid inconvenience to the locals due to noise, smoke and fugitive dust should be provided; ▪ Haul-trucks carrying concrete, aggregate and sand fill materials will be kept covered with tarpaulin to help contain construction materials being transported between the sites, thus preventing environmental pollution; and ▪ Local vendors will be preferred for purchase of camp site goods and services. ▪ Some Confidence Building Measures (CBMs) in the form of general improvement of the social infrastructure in the villages should be planned and implemented by the proponent to lessen the loss of the local community and to build trust and confidence.		
		Operational Phase		
a. Impact on Land Resources				
1	**Fire Breaking:** For the proposed power	Fire protection and detection systems shall be provided to	HSE Section	EPD

	plant there is also a risk of fire breaking out that may become a serious risk for residents living in the allied facilities and/or nearby in the vicinity of the proposed Power Plant.	protect life, property, equipment, and operation of the Plant. The detection and fire alarm, fire protection and fire-fighting systems shall include, but not be limited to the following: • Firefighting water storage, may be combined with raw water tank, depending on local regulations; • Firefighting pumps; • Fire water ring main system, including hydrants; • Fire protection systems; and • Fire alarm and detection system. All systems shall be subject to the approval of the insurance company. The systems shall be complete with all necessary piping, pumps, safety valves, mobile equipment, vehicles etc.		
2	**Solid Waste from Office Building and Other allied facilities:** The project operation will result into generation of organic as well as in-organic waste from the Power Plant. This waste may have significant impact on soil, ambient air, residents living in proximity to the Power Plant, as well as on the aesthetic values if improper systems are adopted. In order to assess the impacts and proper designing of collection, transportation and disposal system, it is imperative to quantify the solid waste generation and assess its characterization. It is estimated that about 150-200 persons will be employed during operation phase. In case of solid waste generation from office building and other facilities. Given that there will be 200 personnel, and using a rate of about 0.8 kg/day (1.7 lb/day), about 160 kg/day (353 lb/day) of solid waste will be	Provisions should be made for proper solid waste management as per the guidelines of the WMF in Chapter 8 of this report, which will involve the following major operations: ▪ Storage at Source; ▪ Component Separation at Source; ▪ Collection of Waste; ▪ Storage; ▪ Transportation; ▪ Resource Recovery for recycle and reuse items; and ▪ Disposal of Waste (sanitary landfill). Proponent should make final disposal arrangements in consultation with the concerned government department and should take approvals for final disposal of the waste at the designated disposal site. A separate solid waste management system for waste from the office building and other allied facilities will be required. During the collection of solid waste, recyclable and reusable waste will be separated for resource recovery and reuse of the generated material.	HSE Section	EPD

	generated.			
3	**Soil Contamination:** The soil can be contaminated during the operation phase due to the many chemicals used in the Power Plant processes. If proper care is not taken for handling, storing and transportation of these toxic substances, they may cause damage to the health of the workers as well as their spills which will not only contaminate the soil and may also impact the workers. Even solid waste generated from the plant and from the office building and other allied facilities can contaminate the soil.	SOPs should be developed for handling and disposal of waste to prevent soil contamination. The top-surface should be designated to avoid the contamination of soils. However, in case soil contamination due to spillage of oil occurs, the contaminated soil should be removed to avoid further contamination of soils.		
b. Impacts on Water Resources				
1	**Impact on Water Requirements:** Cooling water for main cooling cycle will be taken from QB Link irrigation canal next to project site. During a yearly period of canal closure (6-8 weeks) the cooling demands of the power plant will be met using cooling towers. During this period, water will be taken from underground wells that have to be developed as part of the EPC Contract. The impact of the extraction of the water on the aquifer should be determined on the basis of recommendations of Hydrogeological and Electical Resistivity Survey.	The volume extracted from the canal will be less than 5% of the total water volume, therefore, the impact is not expected to be significant. According to preliminary findings of Groundwater Availability Study, the existing wells show sufficient quantity and suitable quality of well water to provide for the needs of the cooling tower as well as other water needs. However, the main source of recharge of the underground aquifer is judged to be vertical penetration of canal water flowing parallel to the site. This is crucial, since the expected times of high well water extraction is during the period when the canal is empty. It has to be determined if and how the extraction of the needed quantities of raw water from the aquifer will be possible during unavailability of the main recharge source (canal water). Special attention shall be paid to the stability of buildings and foundations of heavy equipment such as gas turbines and the cooling tower structure.	HSE Section	EPD
2	**Wastewater Produced from Plant Operations:** The plant operation will generate Industrial as well as sanitary wastewater. It is estimated that about a maximum of 2m³/h of sanitary, 4m³/h of industrial wastewater will be generated	Wastewater treatment system needs to be selected carefully considering the characteristics of wastewater generated from the power plant. The Contractor shall investigate the possibility of discharge into the canal during the annual canal closure period. In case treated water discharge is not permitted during this time by the canal	HSE Section	EPD

	generated.			
3	**Soil Contamination:** The soil can be contaminated during the operation phase due to the many chemicals used in the Power Plant processes. If proper care is not taken for handling, storing and transportation of these toxic substances, they may cause damage to the health of the workers as well as their spills which will not only contaminate the soil and may also impact the workers. Even solid waste generated from the plant and from the office building and other allied facilities can contaminate the soil.	SOPs should be followed to avoid spilling of oil and other waste to prevent soil contamination. Floors with impervious top-surface should be designated to avoid the contamination of soils. However, in case soil contamination due to spillage of oil occurs, the contaminated soil should be removed to avoid further contamination of soils.	HSE Section	EPD
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	along with cooling tower blow down (expected concentration factor: 4 - 5) in canal closure period.	authorities, a sufficiently sized seepage pit for all cleaned effluents shall be provided. It is highly recommended that a separate water quality modeling study be conducted to monitor water quality along a stretch of the QB- Link Canal from the point of discharge of hot water into canal. Sanitary waste water from the plant area shall be treated in biological treatment plant where all sanitary effluents will be reduced from organic matter to stable sediment. The water discharged from this plant shall be conveyed to the cooling water outfall. Separated sludge shall be collected in a sludge collector pond and suitably disposed of. The system shall have a sufficient treatment capacity and will be divided into several pits each performing a phase of the treatment (retention basin, aeration basin, clarifier, sludge pit). The separated clear water phase shall be chlorinated before discharge. The chlorination shall be performed by hypochlorite solution generated in the chlorination plant. The treated effluent from the sanitary wastewater treatment plant shall be transferred through piping to the treated water monitoring basin by gravity or dedicated pump station. The industrial waste water treatment plant shall be constructed to treat all wastewater occurring during operation and maintenance of the power plant. The facilities have to be capable to achieve discharge limits for discharge into surface waters, stipulated in the most recent issue of the NEQS, Pakistan. In industrial wastewater treatment plant, all oil contaminated drains and wash waters from the plant area shall be collected and treated by oil separators. The oil separators shall have two stages and shall be designed to meet the applicable wastewater discharge standards for residual oil		

		and grease. In case of accidents, large amounts of oil may lead to a blocking of the oil separators. Therefore, the de-watering of transformer areas shall be equipped with a retention basin with sufficient capacity to hold up the maximum possible oil discharge plus the firefighting water used in case of fire. The oil free water from the oil separators and all other industrial drains shall be directed to the wastewater retention basin. The wastewater will be treated by the following steps: clarifier, secondary oily cleaning stage, and mechanical filters. The effluent from the mechanical filters and the boiler blowdown shall also be directed to the treated wastewater basin for regular sampling and analyses in the plant chemical laboratory. From there, all plant effluents shall be finally discharged through the cooling water outfall pipes to the canal. Chemical drains from the water demineralisation plant, electrochlorination plant, battery room, etc. shall be collected in a separate drainage system, stored in a chemical waste water pit and treated on demand in a waste water treatment tank by means of precipitation and neutralisation chemicals. The treated effluent from the chemical waste water treatment tank shall be discharged treated waste water monitoring basin and from there to the cooling water outfall. Separated sludge from waste water and oily water treatment, as well as effluents from boiler acid cleaning and GT compressor washing shall be disposed of externally by a certified waste disposal contractor. The gas turbine wash waters and effluents boiler acid cleaning shall be collected during the washing procedure in dedicated tanks (to be provided) and disposed of externally by a certified waste disposal contractor.		

3	**Raw Water Reservoir:** If raw water reservoir will be constructed during the canal closure to store ground water, the water quality of this reservoir (if uncovered) can be impacted by solid wast or sewage. Furthermore, there is risk of vector borne diseases like malaria or dengue if the reservoir is uncovered or not properly monitored.	The raw water reservoir must be managed properly by the Project proponent with a plan to ensure that it is not contaminated. Preferably, it should be covered.	HSE Section	EPD
c. Impacts on Air Resources				
1	Air quality can be impacted from SO_x, NO_x, CO, and PM emissions which are typical air pollutants. Oxides of Nitrogen are formed when combustion temperatures exceed 1,300 degree Celsius. Oxides of Sulphur, and PM are emitted depending upon the fuel characteristics. The plant will utilize the RLNG as main fuel and HSD as a backup fuel. The impact on air quality is not expected to be significant for RLNG (main fuel) which is a clean fuel with very less air emissions Table 7.6 shows that the concentration being emitted from power plant are within the thresholds of NEQS. NEQS also lays down the compliance criteria for maximum allowable ground level increment to ambient and maximum SO_2 emissions in tons/day/plant. This criteria cannot be precisely adopted as the annual average interval measured values of SO_2 are not available. The data can only be obtained once the EPA starts continuous monitoring under national	The long term baseline monitoring for $PM_{2.5}$ spreading atleast over a period of one year before commissioning of power plant or start of power plant construction should be done to determine the average annual concentration to assess compliance during plant operation. The stacks of the power plant will be kept high i.e. at minimum 45 m and 60 m above ground level for bypass stack and the main HRSG stack. Low NOx burners will be used in GT to control emissions and the water will be injected during the use of HSD to control the NO_x emissions. A continuous emission monitoring system (CEMS) will be installed, including flue gas analysers at each HRSG stack for NO_x, SO_2, Particulate Matter, CO, Volatile Organic Carbon (VOC, only at Aux. Boilers) and the reference parameters O_2, flue gas pressure and flue gas temperature, sample conditioning equipment, calibration gases, analysers for temperature, data acquisition module, data evaluation and visualisation equipment for the measured emission data with connection to the DCS. During the monitoring of the power plant during its operation, it will be determined if the occasional use of HSD fuel requires a flue gas desulphurisation system to be installed. The designer should comply with the standards for CEMS i.e. ISO 10396: Stationary Source Emissions – Sampling for	HSE Section	EPD

	program. However, 24-hour monitoring was done at the proposed project site and indicated a maximum of 24-hour concentration of about 33.61 $\mu g/m^3$ of SO_2. Considering this concentration, it is likely that the airshed would be classified as Unpolluted. Furthermore, the SO_2 emissions in tons/day/plant is calculated as 163.5 tons/day for a maximum capacity of 1,500 MW for single cycle operation on HSD which is less than value of 500 tons/day/plant specified in NEQS, therefore the plant meets the maximum SO_2 emission requirements laid down in NEQS. The Air Dispersion Modeling (ADM) software ISC-AERMOD View was used for predicting ground level concentrations of the pollutants (SO_2, NO_x, PM_{10} and $PM_{2.5}$) in order to check the compliance with the standards and assess the impacts on receptors. The baseline values of NO_x, SO_2, PM_{10} and $PM_{2.5}$ were measured for 24 hours averaging period. The values are expected to be lower if measured for average annual periods. The 24 hours averaging measurements for SO_2, NO_x and PM_{10} are also lower than average annual thresholds specified by NEQS 2010. However, 24 hours averaging measurement for $PM_{2.5}$ is slightly above the average annual threshold specified by NEQS 2010. The maximum ground level concentrations as determined by ADM are within limits of NEQS 2000 and 2010	the Automated Determination of Gas Concentrations (2007) and ISO 10849: Stationary Source Emissions – Determination of the Mass Concentration of Nitrogen Oxides – Performance Characteristics of Automated Measuring Systems (04/1996).		

	both for RLNG and HSD for 24 hours averaging period. For annual averaging, the results of SO_2, NO_x, and PM_{10} are within thresholds of NEQS 2000 and 2010. The maximum annual average ,contribution of $PM_{2.5}$ from the power plant will be 0.036 $\mu g/m^3$ which is quite low.			
d. Impacts on Noise				
1	There are various villages adjacent to the Project Area. Noise and vibration during the operation phase are likely to affect the health of local residents and animals. Some of the noise sources from the proposed Power Plant during the operation phase include noise from the operation of the turbines, boilers (steam blowing and purging) as well as combustion	The plant will be designed to control the noise generated to meet National regulations within the plant and at the fence line. It is already recommended to provide and adjust the height of boundary wall as per distribution of living structures outside the project area. Noise during Plant Operation would be significantly blocked by trees to be planted all along the periphery of the Project Area. Tree plantation should be started during the construction phase Equipment noise will be controlled using conventional noise control measures, such as insulation, lagging, ear protection, and enclosures as needed to comply with the Pakistan NEQS. Each gas turbine shall be located in a compartment, which shall reduce the dissipated noise. The noise reduction shall achieve a noise level of 85 dB(A) measured one meter away at 1.5 meter height from the floor level. Additional efforts will include the declaration of a "no horn zone" and construction of a wall around the project site. An ambient noise measurement program will be instituted upon executions of the Project which will cover the construction and operation of the project. The monitoring program will consider the noise limits during day-time and night-time at the closest point of public contact.	HSE Section	EPD
e. Impacts on Aesthetics				
1	Aesthetics plays an important role in improving the working environment of an area. Similarly the design provision can	In order to improve the working environment, good house-keeping, cleaning, efficient solid waste management system should be implemented. Moreover, it is suggested that use	HSE Section	EPD

	improve the aesthetics of an area and thereby improve the working efficiency of labor. In this regard greenery and plantation play an important role.	of flower pots and other techniques should be used inside the buildings to improve the working environment of the area. As already suggested that tree plantation and vegetation will be carried out within the plant area, this activity will also add to the aesthetics to the natural outlook of the area.		
f. Impacts on Ecological Environment				
1	RLNG based Power Plant will not release any considerable emissions to be detrimental to Fauna (Avi-fauna as well as Terrestrial) and Flora including trees and agricultural crops. However, such emissions if any, will be lowered by control technologies. Raising of Livestock is one of the primary sources of livelihood of local economy. No damage to Livestock in the area is expected through release of wastewater, noise and vibration from the plant, thus will have no effect on Livestock productivity. All the same way, negative effect on the productivity and vigor of agriculture crops mainly comprising of Rice, Wheat, Cotton, Maize, Sugarcane, Potatoes and other fodder crops and vegetables will be very minimal / negligible.	• In order to offset the negative impacts on agriculture crops and other vegetation in the Study Area, the mitigation technologies prescribed for air and wastewater treatment must be implemented at the desired level as discussed in earlier sections concerning mitigation of impacts on air and water resources. • Strict control must be exercised for stoppage of killing/poaching of available wildlife species by enhancing protection practices and deploying effective watch and ward system. • Large scale planting with suitable indigenous trees, shrubs and ornamental plants in the form of Tree Groves, and Linear plantation will be carried out in accordance with the Tree Plantation Plan to improve aesthetic value and offset the effect of removal of vegetation. Plantations so raised must be maintained according to the Silvicultural practices which include proper irrigation, cleaning, pruning, thinning at prescribed intensity, silt clearance and Trench-opening, etc. in accordance with the approved practices of Punjab Forest Department.	HSE Section	EPD
g. Impacts on Socio-economic Environment				
1	**Gender Issues:** At operational stage the induction of outside labor may create social and gender issues due to the unawareness of local customs and norms. It will also cause hindrance to the mobility of the local women. Disturbance may occur to the privacy of the local	Power plant staff should respect the local community's sensitivity towards their customs and traditions. The staff must not involve any un-ethical activities and should obey the local norms and cultural restrictions particularly with reference to women.	HSE Section	EPD

	women residing in the nearby villages.			
2	**Noise:** Due to the operation of plant noise and vibration will be produced which will have impact in the adjoining chak/villages, poultry industry etc. this will be an impact on the local population.	To minimize the noise of the proposed power plant pollution barriers should be placed around the boundary of the power plant and continuous monitoring should be done to determine noise levels and ensure that they are within the NEQS limits.	HSE Section	EPD
3	**Wastewater:** With the operation of this power plant, wastewater will be generated. The disposal of wastewater without proper treatment will have impact on the local community. If the wastewater is discharged into the QB-Link Canal, it is likely to cause damage to the livestock as it is used for their drinking purposes. Similarly some villagers use this water for washing purposes of their clothes and other domestic uses.	As discussed in the mitigation of impacts on water resources due to wastewater, the wastewater should be treated to prevent any impacts.	HSE Section	EPD

8.6 INSTITUTIONAL ARRANGEMENTS FOR THE IMPLEMENTATION OF EMP AND ROLES & RESPONSIBILITIES

After the 18th amendment in the Constitution of Pakistan, the provinces are now vested with full authority to develop power projects of any capacity through public or private sector and establish required regulatory framework. In view of lingering energy crisis and opportunity provided by the new enabling framework, the GoPb has decided to play a proactive role in the energy sector. An independent Quaid-e-Azam Thermal Power Company (Pvt.) Limited under the GoPb has been established accordingly for the project.

The organizational structure of Quaid-e-Azam Thermal Power Company (Pvt.) Limited is shown in Figure 8.1. Quaid-e-Azam Thermal Power Company (Pvt.) Limited will mainly be responsible for Engineering procurement Construction, (EPC), Long Tem Service Agreement (LTSA), Operation and Maintenance (O&M) and Fuel Supply Agreement (FSA). The Power Purchase Agreement (PPA) will be done by Central Power Purchase Agency (CPPA).

8.6.1 Proposed Organization Structure

Considering the upcoming thermal power projects, it is strongly recommended that proponent should establish its own environment and social setup. The proposed organizational setup for both phases of the Project is shown in Figures 8.2 and 8.3 respectively. The immediate requirement considering the existing institutional setup of proponent is the establishment of EMC. The cell will have a competent Environment & Resettlement Team (E&RT) that will render its duties in close coordination with the EPC Contractor. It is a pre-requisite that all the land acquisition issues and compensation to Project Affected People (PAP) need to be handled and covered before mobilization of EPC Contractor.

The E&RT will focus its activities as a monitor specifically during the construction phase of power plant and other allied facilities. This E&RT will remain on-board throughout the construction time and will finally be merged into the proposed HSE Section. The HSE Section is highly recommended to be on-board within the existing setup of proponent. The department will primarily be responsible for tackling all the Health Safety and Environment (HSE) issues throughout the project cycle.

The proposed staff is listed below:

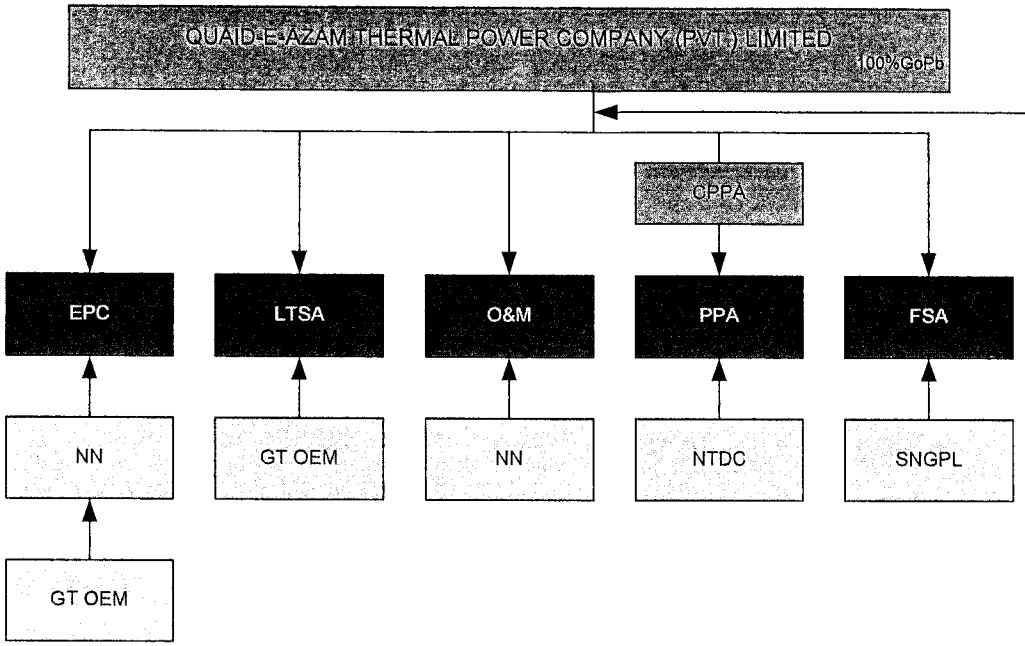
a) E&RT:

- Senior Environmental Engineer (Masters in Environmental Engineering or related Field)– will 5 years' experience in power plant sector; and
- Senior Sociologist (Master in Social Work/Sociology or related Field) will 5 years' experience in resettlement sector.

b) HSE Section:

- Senior Safety Engineer (Masters in Mechanical/Electrical/Environmental Engineering) will 5 years' experience in power plant; and
- HSE Engineer Masters in Environment/Chemical/Mechanical Engineering will 5 years' experience in power plant sector.

EPC Contractor must have an HSE Section having qualified professional staff. Proponent must consider this matter while selecting the EPC Contractor.



Consulting Team

NESPAK

TA-Lahmeyer FA LA

Abbreviation:
CPPA – Central Power Purchase Agency
EPC – Engineering Procurement Construction
FSA – Fuel Supply Agreement
GT OEM – Gas Turbine Original Equipment Manufacturer
NN – Non defined
NTDC – National Transmission & Distributing Company, Pakistan
LTSA – Long Term Service Agreement (GTs)
O&M – Operation & Maintenance
PPA – Power Purchase Agreement
SNGPL – Sui Northern Gas Pipelines Limited

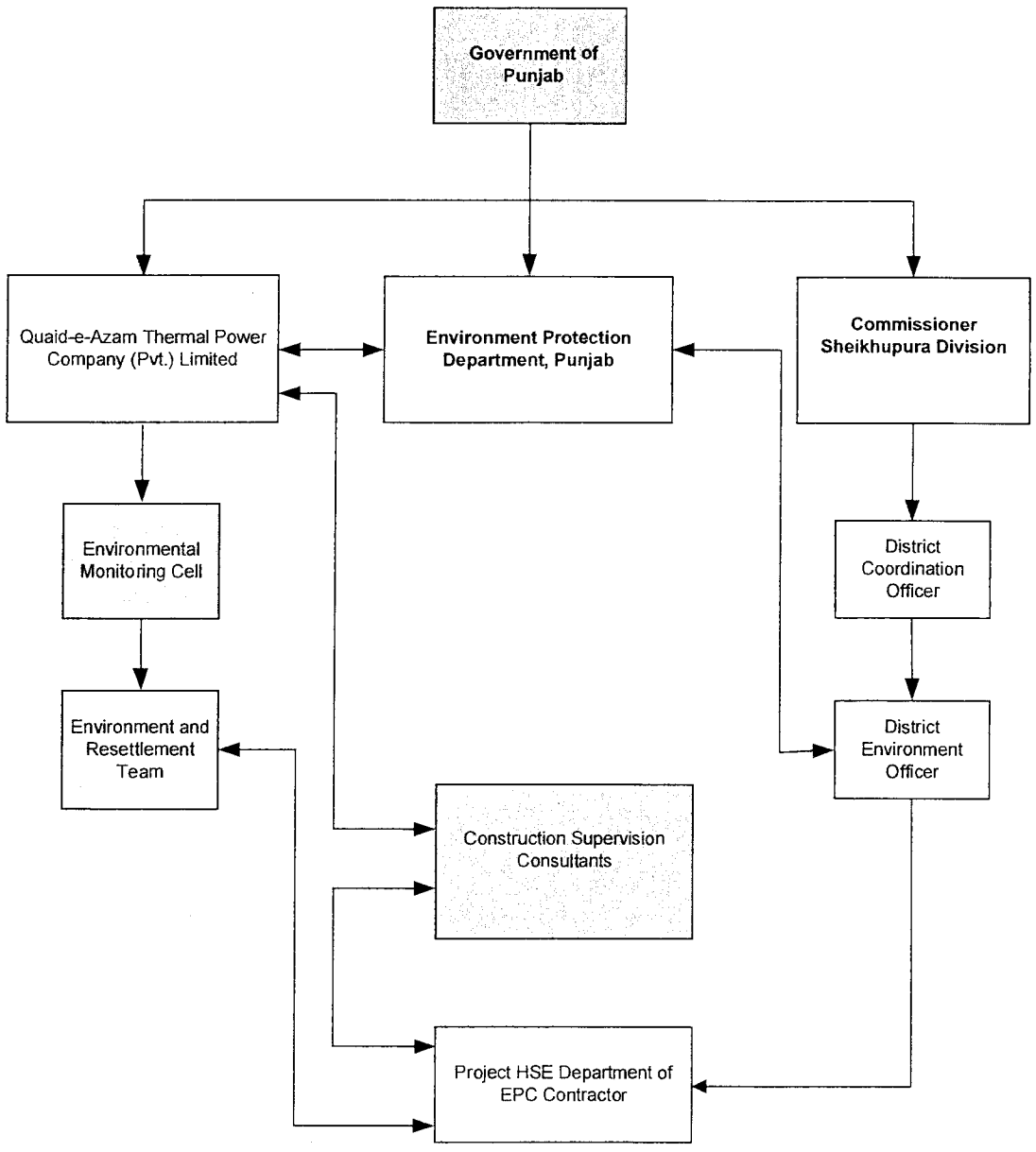
ORGANIZATIONAL STRUCTURE OF QUAID-E-AZAM THERMAL POWER COMPANY (PVT.) LIMITED

1,000-1,500 MW (Gross) RLNG based Combined Cycle Power Plant at Bhikki, Sheikhupura

Figure 8.1

Source: *Pre-feasibility Study, April 2015*

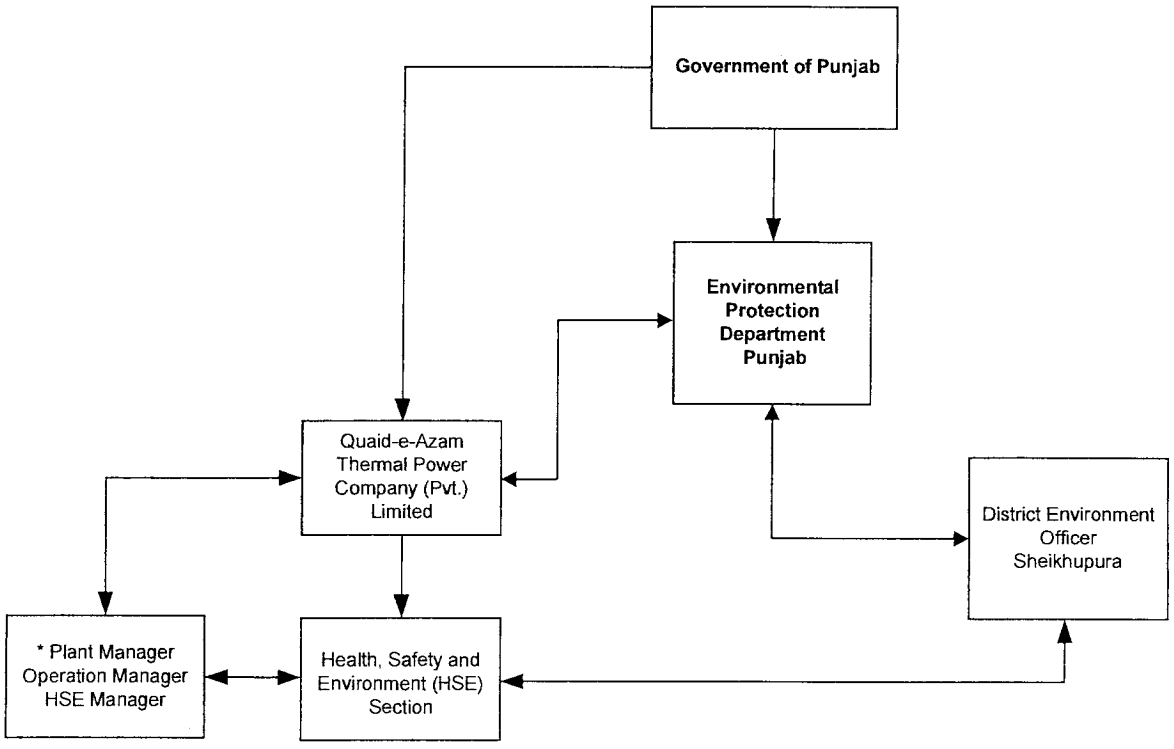
Figure 8.2



PROPOSED ORGANIZATIONAL SETUP DURING CONSTRUCTION PHASE

1,000-1,500 MW (Gross) RLNG based Combined Cycle Power Plant at Bhikki, Sheikhupura

Figure 8.3



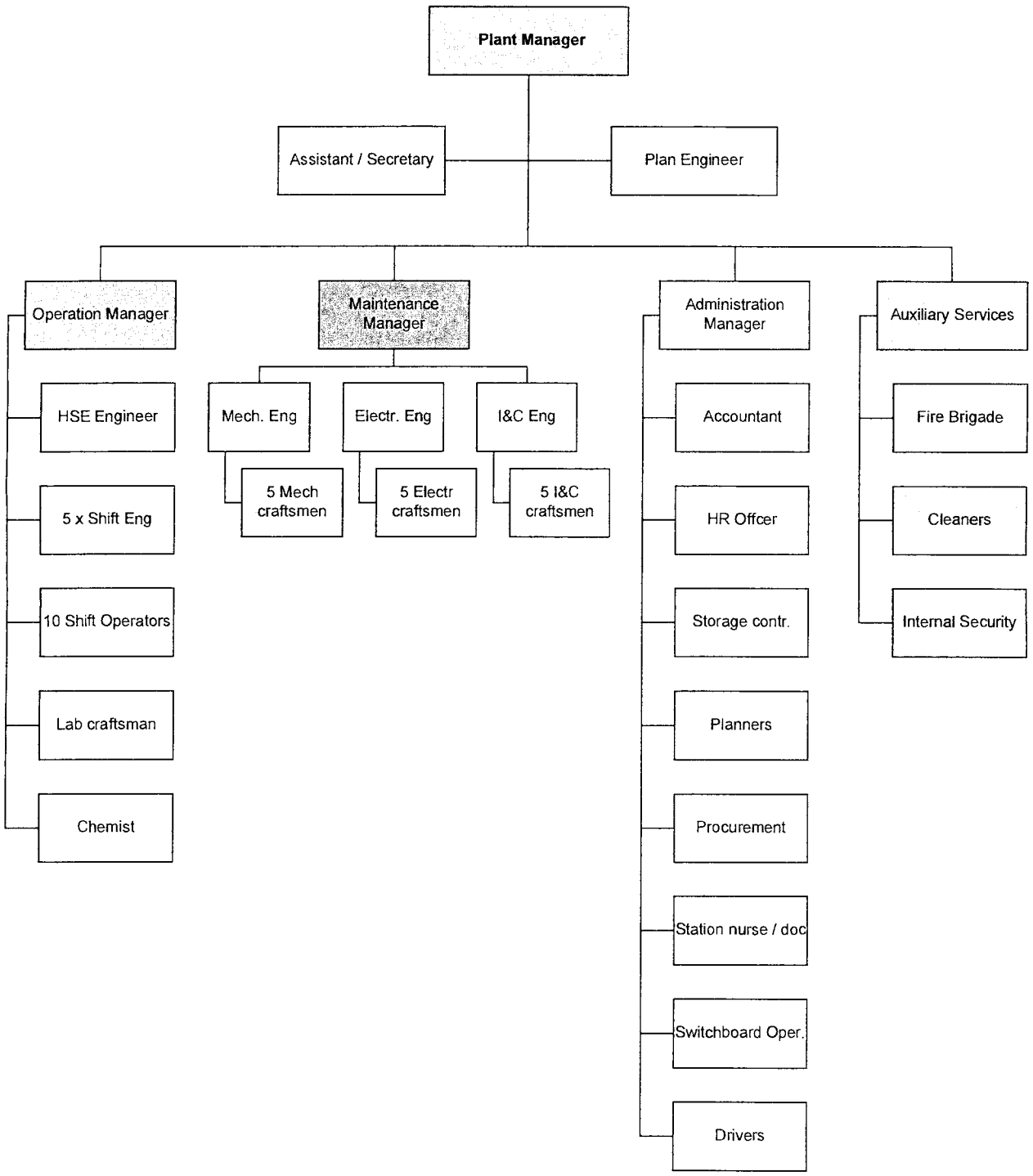
* The Plant Manager and HSE and Training Department are the part of O&M Organization

Sheet 01 of 02

PROPOSED ORGANIZATIONAL SETUP DURING OPERATION AND MAINTENANCE PHASE

1,000-1,500 MW (Gross) RLNG based Combined Cycle Power Plant at Bhikki, Sheikhupura

Figure 8.3



Sheet 02 of 02

TYPICAL O&M STRUCTURE

1,000-1,500 MW (Gross) RLNG based Combined Cycle Power Plant at Bhikki, Sheikhupura

Source: *Pre-feasibility Study, April 2015*

EPD-Punjab is the regulatory authority for issuance of NOC for this proposed project. As part of its mandate, protection of environment (water, air and noise) is their responsibility. Therefore, the agency will undertake an audit (as and when required) of the activities of the project (both phases) with respect to the protocols as defined in EMP.

8.6.2 Roles and Responsibilities

The foremost responsibilities of proponent, EMC (E&RT/HSE Section) and EPC Contractor are given in Table 8.2 below.

EPC Contractor is the main force behind meeting the project goals. EPC Contractor is essentially deemed as the commercial leader of the project, in close coordination with the proponent, he has to manage and ensure some of the most important elements of the project including safety of the project workers, equipment handling, HSE compliance, budget control, time allocation and remaining costs of the project.

Table 8.2: Roles and Responsibilities

Organization	Designation	Responsibilities
Proponent	Plant Manager	▪ Overall in-charge and supervision of EMC's activities. ▪ To ensure the project's compliance with the PEPA 1997 (Amended, 2012) and other national environmental regulations and stakeholder participations in the project construction and operation phases. ▪ Liaison with EPC Contractor.
EMC (E&RT)- *Construction Phase*	E&RT	▪ Monitor the and check the proper implementation of all mitigation measures for physical, ecological and social sectors. ▪ Liaison with HSE department of EPC Contractor. ▪ Ensure compliance and implementation of national and provincial rules and regulations enforced by EPD, Punjab especially regarding social and environmental aspects. ▪ To assist EPC Contractor for obtaining necessary approvals from the concerned departments. ▪ To document the social complaints and prepare the social complaint register. ▪ Monitoring and evaluation of environmental & social related matters of the project. ▪ Carry out consultation with the locals with regards to any social issue that needs to be settled down. ▪ Supervise the EPC Contractor activities and make sure that all the contractual obligations related to the environmental and social compliance are met. ▪ Prepare periodic Environmental Reports and distribute according to the requirement of EMP.
Proponent (HSE Section) *Operational Phase*	HSE[2]	▪ Oversee all the HSE activities being carried out. ▪ Implement the HSE activities as provided in HSE plan. ▪ Conduct site visits to ensure compliance with HSE protocols. HSE department will also ensure the compliance of all safety and health protocols during the operation phase.

[2] If EPC Contractor remain responsible for O & M of project for one year.

Organization	Designation	Responsibilities
EPC Contractor	HSE Team	▪ Compliance of all the monitoring programs as given in EMP (MMM, emergency plan, plantation plan, waste management plan etc.). ▪ Ensure health & safety of site workers. ▪ Liaison with EMC Section Proponent. ▪ Training of workers. ▪ Strict compliance of social mitigation measures. ▪ Effective liaison with locals and heads of the villages.
EPD-Punjab	Monitoring Team	▪ Audit of the activities being undertaken by EPC Contractor and all other organizations as given in the proposed institutional plan. ▪ Liaison with the Proponent and HSE Section to check compliance of measures as given in the EMP during operation phase.

8.7 ENVIRONMENTAL MONITORING PLAN

8.7.1 General

Environmental Monitoring provides timely and useful information to the project management and implementation agencies. Conceptually, "monitoring" means to check and balance, on a regular basis, the status of the project activities and realization of various developmental targets during construction, operation and maintenance. It helps in timely identification/analysis and removal of the bottlenecks and expedites actions. Certain environmental parameters (physical, chemical and ecological) are selected and quantitative analysis is carried out. The results of analysis are compared with the guidelines; standards and pre-project condition to investigate whether the EMP and its implementation are effective for the mitigation of impacts or not.

8.7.2 Objectives

The objective of environmental monitoring program during the Construction and O&M phases will be as follows:

- Monitor the actual project impacts on physical, ecological and socio-economic receptors;
- Recommend mitigation measures for any unforeseen impact or where the impact level exceeds the anticipated level in the EIA;
- Ensure compliance with legal and community obligations including safety during construction and operation phases;
- Ensure the safe disposal of excess construction materials, solid waste, water and wastewater and gaseous emissions;
- Appraise the adequacy of the EIA with respect to the project's predicted long-term impacts on the area's physical, ecological and socio-economic environment;
- Evaluate the effectiveness of the mitigation measures proposed in the EMP and recommend improvements in EMP, if required; and
- Compile periodic incidents/accidents data to support analyses that will help to minimize future risks.

8.7.3 Monitoring Strategy

During the EIA process, environmental monitoring was done by an EPD approved laboratory to establish base line conditions. The main purpose to conduct the monitoring is to get the results of various parameters of water, air & noise and to compare them with monitored parameters during the construction of the power plant as well as EPC Contractor can

compare them with the NEQS. The monitoring during the construction phase will be carried out by EPC Contractor and afterwards HSE Section of Proponent will take the responsibility of all environmental monitoring activities.

a) Major Receptors

The main receptors during the Design/Pre-construction, construction and Operational phases are mainly:

- Water Bodies including QB Link Canal, Minors, Tube wells, Water outlets, the sources of drinking water and the boundaries of the proposed project;
- Agricultural areas including crops; and
- Villages near the Project Area.

b) Reliability Test Run

Before the commissioning of the power plant, EPC Contractor will conduct a Reliability Test Run (RTR) of the power plant for continuous 72 hours at various loads to check the reliability of the power plant. It is recommended that all the environmental parameters such as emissions of gases from stacks, noise levels, effluent from treatment plant should be monitored at all plant loads during the test run. It should be ensured that these environmental parameters should be within the applicable standards at all loads and as per specifications.

c) Implementation of monitoring

i) EPC Contractor

Physical implementation of the EMP is the sole responsibility of EPC Contractor during the construction of the project. Contractor will be responsible for in-house monitoring to ensure that the construction activities are being carried out as specified in the EMP. However, EPC Contractor's presence later in the operation phase is dependent upon the agreement between Proponent and EPC Contractor.

ii) EMC/Proponent

EMC/Proponent will be responsible to check the environmental monitoring activities (during construction phase only) being carried out by the Contractor and will perform the following activities.

- Check whether monitoring of the environmental aspects of project during construction phase is being properly carried out and to ensure that the environmental requirements of the contract and the mitigation measures proposed in the EMP are implemented;
- Undertake routine visual monitoring of construction activities, waste disposal, storm water drainage management, noise levels, exhaust gases etc.;
- Review the monitoring reports that would be prepared by the Contractor and make recommendations (if any); and
- To submit a monitoring report to Proponent and actions taken for rectification.

iii) Auditing

The internal audit of the power plant at operational phase will be carried out by the Plant Manager who will be assisted by HSE Manager. It is recommended EMC should be involved in auditing throughout during the construction phase while Supervisory Consultant (SC) will involve on quarterly basis. Audit will also suggest remedial measures to overcome the

environmental and social problems.

8.7.4 Monitoring Parameters and Frequency

The major negative impacts of the Project activities are related to ambient air & noise, and water resources, which will directly or indirectly effect the environment and will cause health problems to the receptors residing in the surrounding of the power plant. In order to counteract these problems an environmental monitoring protocol has been proposed (Table 8.3). The proposed protocol contains the following monitoring parameters:

a) Physical Environment

For physical environment, following parameters will be monitored:

- Ambient air quality;
- Stack emissions;
- Smoke, dust;
- Noise levels;
- Water (Ground and surface);and
- Wastewater.

b) Ecological Environment

During construction activities, it will be required to check whether plantation of trees was carried out or not and EPC Contractor staff is advised not to cut the existing trees in the Study Area. During operation phase, monitoring team will be required to observe the growth of new plantation to be carried out by the HSE staff.

c) Socio-economic Environment

Effects on the socio-economic environment during construction phase will be monitored by EMC, considering parameters like hiring of local employment, community health and safety, mobility of local women, cultural compliance due to presence of foreign EPC Contractor. Similarly, the above parameters will be monitored by HSE Section of proponent during operation phase. EMC at construction phase and HSE Manager at operation phase will maintain a Social Complaint Register.

8.8 WASTE MANAGEMENT FRAMEWORK

The WMF describes the framework of waste management program and provides general procedures or guidance on routine waste management issues. It has been assessed that various types of waste will be generated during the construction and operation of the proposed power plant. This plan also addresses how potentially hazardous and non-hazardous waste will be managed by EPC Contractor during construction and operation.

This WMF is intended to serve as;

- A primary waste management reference document;
- A basis for the EPC Contractor and proponent to develop a detailed WMP during construction and operation phase respectively; and,
- A compliance bench mark.

8.8.1 Relevant National Rules, Regulations and Institutions

- PEPA 1997 (Amended 2012) Section 11;

- NEQS for Wastewater Effluents;
- Hospital Waste Management Rules, 2005;
- Draft Hazardous Substances Rules, 2003;
- Draft Guideline for Solid Waste Management, 2005;
- Final Report for Domestic Solid Waste Management in Pakistan, 2002;
- Public Health Engineering Department;
- Local Government Acts;
- EPD-Punjab; and
- Tehsil Municipal Authority (TMA).

8.8.2 Type of Power Plant Waste

- Solid Waste;
- Wastewater; and
- Other hazardous waste.

Table 8.3: Proposed Environmental Monitoring Protocol

Project Phase	Parameters	Location	Frequency	Estimated Points
(a) Air Quality				
Design /Pre-Construction	SO_2, NO_x, PM_{10}, $PM_{2.5}$, CO, CO_2 and VOC, and (Ambient Air Quality)	▪ At the boundary of Plant Area. ▪ Nearby communities where major settlements are seen around the area like Bhikki, Chah Waris, Thata Maina, Nawa Kot, Theria, Bahuman, and other major settlements. One monitoring reading should be taken at Sheikhupura city. ▪ At the access Road.	Once before the start of construction	10 Nos.
Construction	SO_2, NO_x, PM_{10}, $PM_{2.5}$, CO, CO_2, and VOC. (Ambient Air Quality)	▪ At the boundary of Plant Area. ▪ Nearby communities where major settlements are seen around the area like Bhikki, Chah Waris, Thata Maina, Nawa Kot, Theria, Bahuman, and other major settlements. One monitoring reading should be taken at Sheikhupura city. ▪ At the access Road. ▪ Workers Camp Area ▪ Near Concrete mixing plant. ▪ Excavated areas.	Monthly	15 Nos.
Operation & Maintenance	SO_2, NO_x, PM_{10}, $PM_{2.5}$, CO and HC (Ambient Air Quality).	▪ At the boundary of Plant Area. ▪ Nearby communities where major settlements are seen around the area like Bhikki, Chah Waris, Thata Maina, Nawa Kot, Theria, Bahuman, and other major settlements. One monitoring reading should be taken at Sheikhupura city. ▪ At the access Road. ▪ Maintenance Facilities	Bi-Annually	15 Nos.
	SO_x, NO_x, PM_{10}, $PM_{2.5}$, CO, and HC (For Stack Emissions).	▪ All the stacks.	Monthly	3 Nos. (Three readings @ 8 hrs interval) and Monitoring through CEMS

Project Phase	Parameters	Location	Frequency	Estimated Points
(b) Water Quality				
Design/Pre-construction (Ground Water/Drinking Water)	Colour, pH, Odor, Taste, Turbidity, TDS, TSS, Heavy Metals, Phosphate, NH_3, Arsenic, Sulphate, Sulphide, Coliforms, other Heavy Metals and Fecal Coliforms.	▪ Tube wells and any other drinking water Source approx. in 5 km radius where major settlements and villages exist.	Once before the start of construction	10 Nos.
Construction (Ground Water/Drinking Water)	Colour, pH, Odor, Taste, Turbidity, TDS, TSS, Heavy Metals, Phosphate, NH_3, Arsenic, Sulphate, Sulphide, Coliforms, Other Heavy Metals and Faecal Coliforms	▪ Tube wells and any other drinking water Source approx. in 5 km radius where major settlements and villages exist. ▪ Camp Area (Tube well / Drinking Water Source).	Monthly	10 Nos.
Operation (Ground Water/Drinking Water)	Colour, pH, Odor, Taste, Turbidity, TDS, TSS, Heavy Metals, Phosphate, NH_3, Arsenic, Sulphate, Sulphide, Coliforms, Other Heavy Metals and Faecal Coliforms	▪ Tube wells and any other drinking water Source approx. in 5 km radius where major settlements and villages exist. ▪ Ground Water / Drinking Water Samples from Plant Building and Maintaince Facilities.	Quarterly	10 Nos.
Pre-construction (Surface Water)	Colour, pH, TSS, TDS, Turbidity, DO, BOD_5, (COD), Total Toxic Metals etc.	▪ QB- Link Canal ▪ Ponds in villages around Study Area. ▪ Drain near Al Rahim Industries. ▪ Water Channels / Minors near the Project Area	Once before the start of construction	10 Nos.
Construction (Surface Water)	Colour, pH, TSS, TDS, Turbidity, DO, BOD_5, COD, Total Toxic Metals etc.	▪ QB- Link Canal. ▪ Drain near Al Rahim Industries ▪ Water Channels / Minors near the Project Area . ▪ Other sources like ponds in the villages	Monthly	10 Nos.

Project Phase	Parameters	Location	Frequency	Estimated Points
Operation (Surface Water)	Colour, pH, TSS, TDS, Turbidity, DO, BOD_5, COD, Total Toxic Metals etc.	▪ QB- Link Canal. ▪ Drain near Al Rahim Industries ▪ Water Channels / Minors near the Project Area ▪ Other sources like ponds in the villages	Quarterly	10 Nos.
Construction and Operation (Wastewater)	NEQS 32 Parameters.	▪ Composite discharge outside the plant boundary. ▪ Drain near Al Rahim Industries ▪ Wastewater ponds in villages	Monthly	5 Nos.
(c) Noise				
Pre-Construction	Noise levels on dB(A) scale	▪ In the area of about 1-2 Km from the proposed Gas Turbines and in the Plant Boundary. ▪ Nearby communities where major settlements are seen around the area like Bhikki, Chah Waris, Thata Maina, Nawa Kot, Theria, Bahuman, and other major settlements. One monitoring reading should be taken at Sheikhupura city. ▪ At the access Road. ▪ Workers Camp Area, ▪ Near Concrete mixing plant. ▪ Excavated areas.	Once before the start of construction	10 Nos.
Construction	Noise levels on dB(A) scale.	▪ In the area of about 1-2 Km from the proposed Gas Turbines and in the Plant Boundary. ▪ Nearby communities where major settlements are seen around the area like Bhikki, Chah Waris, Thata Maina, Nawa Kot, Theria, Bahuman, and other major settlements. One monitoring reading should be taken at Sheikhupura city. ▪ Construction Camp Site. ▪ At the access Road. ▪ Near batching / asphalt plant.	Monthly	15 Nos.

Project Phase	Parameters	Location	Frequency	Estimated Points
Operation	Noise levels on dB(A) scale.	▪ In the area of about 1-2 Km from the proposed Gas Turbines and in the Plant Boundary. ▪ Nearby communities where major settlements are seen around the area like Bhikki, Chah Waris, Thata Maina, Nawa Kot, Theria, Bahuman, and other major settlements. One monitoring reading should be taken at Sheikhupura city ▪ At the access Road. ▪ Maintenance Facilities	Quarterly	15 Nos.
(d) Soil				
Pre-Construction	Oil and grease, Total Toxic Metals, Nitrate and Phosphate.	▪ Camp site location. ▪ Proposed chemical Storage tank and pit sites.	Once before start of construction	5 Nos.
Construction	Oil and grease, Total Toxic Metals, Nitrate and Phosphate.	▪ At access road, fuel and chemical storage sites, camp site.	Once a month	5 Nos.
Operation	Oil and grease, Total Toxic Metals, Nitrate and Phosphate.	▪ Tank farm area, fuel and chemical storage areas.	Bi-annually	5 Nos.

8.8.3 Construction and Operational Waste and Disposal Method

The waste envisaged to be generated during the construction and operation phases of the proposed project include;

- Steel
- Concrete
- Black Water
- Wood
- Cotton
- Paper
- Plastics
- Rubbish
- Food
- Organic Waste
- Wastewater
- Waste Oil
- Medical treatment materials such as bandages, swipes etc.
- Other types of wastes

The anticipated waste should be collected, handled and stored through a properly designed Waste Management System. EPC Contractor will develop details of this system for construction and operation phases based on the general protocols as follows:

- Color coded waste buckets should be provided within the Contractor's Camp so that the waste should be categorized and separated accordingly;
- Some of the construction waste/waste material to be generated at the construction site may be hazardous to the environment or to personnel. It is always important to read the MSDS of the materials or products that are located on-site; they may contain warning information that indicates a potential problem. All hazardous wastes shall be clearly labeled. Scrap, Trash other waste shall be placed in designated containers;
- Divert the filtered waste to the nearest available landfill site. If the landfill site is not available then EPC Contractor needs to develop a landfill at the area mutually agreed with the Proponent, EMC, Local Community and District Government, Sheikhupura;
- Based on the conditions of the region, organic waste should be frequently collected to avoid odour problems;
- Temporary waste storage area should be prepared, maintained and visually inspected and recorded on regular basis by the HSE Section of EPC Contractor during the construction phase;
- Wastewater generated at contractor's camp will be disposed of in the soaking pit and the pits should be away from the QB Link canal;
- The final location of the pits will be mutually agreed on-site with EMC, HSE Section of EPC Contractor and Proponent;
- The contractor will keep accurate records that track the amount of waste generated and the disposal method used;
- A wastewater treatment plant is proposed during the operation phase. The wastewater will be treated up to secondary or tertiary level (if required); and
- Regular clean-up of scrap material, saw dust, rags, oil, paint, grease, flammable solvents and other residue of construction operation shall not only remove or reduce the fire hazard, but shall promote general safety at the same time.

8.8.4 Transportation and Disposal Record Sample

EPC Contractor and its sub-contractors will be responsible for the lawful transportation and disposal of the collected waste in approved facilities, a sample sheet of Transportation and Disposal Records is shown below:

Table 8.4: Transportation and Disposal Record

NAME OF STATION				
MODE OF TRANSPORTATION				
WASTE DISPOSAL STATION				
VEHICLE NUMBER				
Waste Type	Hazardous Yes/No	Non-Hazardous Yes/No	Quality and Quantity of waste	Disposal
SUPERVISOR SIGNATURE DATE			FACILITY SUPERVISOR SIGNATURE DATE	

8.8.5 Staff Training

For the given WMF, it has been envisaged that the waste management and handling is an important aspect during the construction and operational phases of the project and therefore it requires training of relevant staff. Detailed training plan will be prepared by the EPC Contractor as a part of the WMF prior to the start of the construction work, which will be implemented after approval from Proponent.

8.9 EMERGENCY PREPAREDNESS AND RESPONSE FRAMEWORK (EPRF)

The EPRF provides an overview of the procedures to mitigate and control the impacts on community, on occupational health and safety, on the environment and on the Project in the event of emergency situations and to respond in life threatening situations usually occurring suddenly and unexpectedly during the construction and operational phases of the proposed RLNG based power plant project. This plan applies to all the processes of emergency responses to accidental calamities that can occur in an office, construction area and living area as well as first aids and emergency responses as per actual environmental situations during construction. This plan provides a general reference and a basis for a detailed sub-plans and procedures that have to be developed by EPC Contractor before the initiation of the construction of the power plant and will be approved by proponent.

8.9.1 Objectives

- Outline the applicable standards with regards to emergency preparedness and response;
- Define the emergency preparedness and response procedures utilized during the construction phase;
- Define departments involved and their roles and responsibilities;
- Define training requirements; and,
- Signpost supplementary emergency scenario or facility plans where response procedures are detailed.

8.9.2 Types of Risks (Emergencies/Accidents) in a Power Plant

The response to each hazard in a power plant will be different. A few types of emergencies/accidents will include the following;

a) **Natural risk:** earthquake, flood, and other natural disaster
b) **Political risk:** civil strife, upheaval, riot, kidnap, and terrorist attack
c) **Construction:** fire, traffic accident, falling, hit and electric shock
d) **Public health:** dengue fever, malaria, food sanitation, high-temperature operation and insect sting
e) **Security:** injury and property loss resulted from theft, robbery, and law case

8.9.3 Action Response Planning

To minimize human suffering and financial losses, all personnel must know their responsibilities under the emergency preparedness and response plan. The plan should be used to set emergency procedures, implement and communicate the procedures and ensure that any required training has been completed. Planning for emergencies should include the following points:

- Hazard identification/assessment;
- Emergency resources;
- Communication systems;
- Administration of the plan;
- Emergency response procedure;
- Communication of the procedure; and
- Debriefing and post-traumatic stress procedure.

The Following are the main features of the plan:

- **Details of Emergency Preparedness and Response Plan:** Contact information of concerned persons for those who need more information or clarification about any aspect of the plan;
- **Emergency Exit Routes:** Emergency escape procedures and emergency escape route assignments and drills. Map of construction and operation site with exits, access points, evacuation routes, alarms, emergency equipment, a central control or command centre, first aid kits, emergency shut-down buttons, and any other important information;
- **Medical Staff:** Provision of first aid kits on site. Rescue and medical training for those employees who are to perform them;
- **Accident and Emergency Register:** Preferred procedures for reporting accidents and other emergencies. Maintaining a log register for such cases;
- **Communication:** 24 hours mobile phone service should be available to communicate with

fire department, ambulances, police and security department, plant manager, first aid department etc., and

- **Chain of Command:** An organizational chart will be hung in all noticeable locations of the construction site illustrating the chain of command with phone numbers and names.

8.9.4 Suggested Contents of EPRF

EPC Contractor should prepare the EPRF based on the guidelines provided in the above section. The suggested structure of the EPRF is listed below:

1. Purpose
2. Applicable Scope
3. Preparation Basis
4. Emergency Response System
   - 4.1 Generals
   - 4.2 Emergency Response System
   - 4.3 Responsibilities
5. Major Safety Risks
6. Precautionary Measures
   - 6.1 Training and Exercise
   - 6.2 Hazard Source Monitor
   - 6.3 Alert Action
   - 6.4 Management Measures
7. Control Measures
   - 7.1 Response
   - 7.2 Response Procedures
   - 7.3 Emergency Response
   - 7.4 Emergency Completion and Restoration
8. Emergency Response Report and Settlement
9. Supporting Measures
   - 9.1 Communication
   - 9.2 Emergency Team
   - 9.3 Funding for Emergency
   - 9.4 Provisions and Resources
10. Records

8.10 EVACUATION FRAMEWORK

The Evacuation Framework ensures that all personnel at the project site should be evacuated to a safe place after an emergency or an accident happens and to do the best to reduce the loss to fixed-assets or properties.

8.10.1 Evacuation Team and Responsibilities

EPC Contractor will be held responsible for making a detailed evacuation plan and giving trainings to the HSE Section of the Proponent who will execute it. E&RT should be involved during the construction period. However, this document provides general details of an evacuation plan and the key components that will be required for the before the preparation of a detailed plan before the construction of the Project.

HSE Section will issue the evacuation notice as and when required. The evacuation plan should also be displayed in and around the power plant premises and should be presented in such a

way that it is easily understood by all the workers and laymen. An Evacuation Plan Implementation Team comprising trained persons from the HSE Section headed by the Plant Manager will be created. The following emergency evacuation measures that should be taken by the Team during any emergency include:

- The Plant Manager should issue evacuation notice when received from the HSE Section;
- Management for evacuation of personnel, materials, equipment and documents to ensure all personnel to be evacuated and equipment & materials to be shifted to a safe place and make sure the evacuation is carried out in order;
- To prevent traffic accidents during evacuation vehicles should be strictly restricted to enter the Project Area;
- Supply of first aid to the person injured or ambulance for those suffering from an acute accident during the evacuation or after; and
- Material supply should be inline in case of any evacuation situation like life vest and safety rope, crane, dump truck, the location of which shall be identified in the evacuation documents.

The evacuation team will include the following sub-teams:

a) Security Team

- To maintain the order of evacuation and to ensure it is being carried out properly;
- To check site to ensure that all important items and persons have been carefully shifted; and,
- To carry out safety inspection and prevent traffic accident during evacuation.

b) Emergency Action Team

- To turn off the power supply;
- To shift the construction equipment and material (that can be moved) to a safe place; and,
- To ensure that all persons have evacuated the site under danger.

c) First Aid Team

- To apply simple medical procedures and help the injured or those suffering from any acute disease under emergency situations.

d) Equipment and Material Supply Team

- To prepare the equipment and materials necessary for emergency evacuation plan.

8.10.2 Evacuation Sequence and Emergent Evacuation Routes

The details of evacuation sequence and routes will be finalized after comprehending the layout plan by the EPC Contractor. The emergency exits will be provided with enough light and drills will be conducted for the labor working at site. When preparing an evacuation plan, primary and secondary evacuation routes and exits will be clearly marked. To the extent possible under the conditions, it will be ensured that evacuation routes and emergency exits meet the following conditions:

- Clearly marked and well lit;
- Wide enough to accommodate the number of evacuating personnel;

- Unobstructed and clear of debris at all times; and
- Unlikely to expose evacuating personnel to additional hazards.

The drawings and Figures that show evacuation routes and exits should be posted prominently.

8.10.3 Training and Awareness

Training and awareness will be conducted to educate the employees about the types of emergencies that may occur and train them in the proper course of action. General training the employees should address the following:

- Individual roles and responsibilities;
- Threats, hazards, and protective actions;
- Notification, warning, and communications procedures;
- Means for locating family members in an emergency;
- Emergency response procedures;
- Evacuation, shelter, and accountability procedures;
- Location and use of common emergency equipment; and
- Emergency shutdown procedures.

8.10.4 Suggested Contents of Evacuation Plan

EPC Contractor will be responsible for preparing a detailed evacuation plan based on the above guidelines. A suggested content and structure of evacuation plan is given below:

- Purpose;
- Organization;
- Roles and Responsibility;
- Preparative Measures for Evacuation; and
- Emergency Action required before Evacuation.

8.11 HEALTH AND SAFETY MANAGEMENT FRAMEWORK

The Health and Safety Management Framework provides a basis for EPC Contractor to create a detailed plan to reduce and remove any harm due to construction activities to local management, construction staff and local residents' health and ensure human safety of the management and construction staff at the power plant.

8.11.1 Occupational Health and Safety Hazards

Hazards at the power plant can occur due to:

- Over-exertion;
- Slips and Fall;
- Working on Heights;
- Struck by Objects;
- Moving Machinery;
- Dust;
- Confined Spaces and Excavations; and
- Other Site Hazards etc.

8.11.2 Safety Planning

The potential safety requirements that should be taken care of during construction are as follow:

- Everything needs to be properly ordered;
- Complying with safety belt requirements;
- Provision of protection rail;
- Provision of safety signs on construction site;
- Inspection at open bulk excavation area;
- Measure for operation of electrical and mechanical equipment;
- Forecasting and precautions against natural disaster;
- Providing driving/operating safety requirements;
- Installation of traffic signs on construction roads;
- Safety guard during transportation of dangerous products;
- Providing slip and fall trainings;
- Use of Personal Protective Equipment (PPE) provides additional protection to workers exposed to workplace hazards;
- Controlled measures for confined spaces; and
- Disciplinary sanctions against offenders.

8.11.3 Health Plan

The HSE Section of the EPC Contractor will be responsible for publicizing and implementing labor protection, vocational health and sanitary epidemic prevention policies and standards during construction, offering health training to the staff and applying preventive measures. Some of the clauses that should be duly taken care while preparing a Health Plan will include the following:

- Measures to avoid diseases on site;
- Establishment of the construction staff's vocational health file; and
- Establishment of the medical treatment room and configuring professional medical treatment and nursing staff.

8.11.4 Responsibility

EPC Contractor will establish HSE Section as a standing organization for health and safety management during the construction phase. The contractor and sub-contractor construction units will be responsible for establishing the management system, implementation of management measures and ensuring realization of its objectives. While during the operation phase, Proponent and Plant Management will be held responsible for all HSE issues.

The details of organizational structure, roles and responsibilities will be determined in detailed plan to be prepared by EPC Contractor.

8.11.5 Health and Safety Documentation

EPC Contractor will be responsible for implementing the following procedure and rules during the construction phase. These include:

- The field safety management rules;
- Labor protection management rules;
- Fire-fighting management rules;

- The field traffic management rules;
- Working order management rules for special operation;
- Emergency proposal;
- Management rules for safety meeting;
- Various safety check records and meeting minutes; and
- Training records.

8.11.6 Trainings and Awareness Programs

Training and awareness programs should be developed and implemented by the EPC Contractor. This program should be circulated among all the relevant personnel prior to construction activities. Following trainings as a minimum should be given to the Project Team during the course of the project:

- HSE awareness training; and
- Preventive Medical Treatment, Checkups and Pre-examination.

8.11.7 Suggested Contents of Health and Safety Plan

The suggested contents of Health and Safety Plan to be developed by EPC Contractor are described below:

a Purpose
b Scope of Application
c Complying Basis
d Health and Safety Objectives
e Organization and Responsibility
  - Project Manager
  - HSE Management Department of the EPC Contractor
  - EPC Contractor Medical Treatment Room of the EPC Contractor
  - Subcontractor's Project Manager
  - Subcontractor's HSE Managers
  - Occupational Health and Safety
  - Community Health and Safety

f Health Plan
  - Labour Protection
  - Sanitary Epidemic Prevention

g Safety Plan
  - Summary
  - Qualification Review
  - Safety Training
  - Construction Plans and Documents
  - Control Measures
  - Monitoring Measures
  - Management of the Key Safety Accidents

h Public Security Plan
i Local Community Health and Safety

8.12 SITE RESTORATION

The main areas to be considered for site restoration include the access road, construction area, camp site area, temporary tracks, land used for vehicle and material storage, material

excavation pits etc. These areas should be restored to its original condition with maximum possible effort. The restoration work comprises the removal of temporary construction works and removal of any fence installed, leveling of areas (wherever required), etc. The following procedures will be adopted for the restoration of the site:

- All temporary construction material (debris) used for the site development will be removed;
- Site for construction camps should be restored to its previous conditions as much as possible;
- All the toxic and hazardous chemicals/materials will be completely removed from the site. Efforts will be made to completely remove oils and chemical spills during the construction;
- Land will be contoured to match adjacent undisturbed areas;
- Re-construction of interrupted drainage channels and foreign lines;
- At the completion of excavation from borrowing site the contractor should ensure giving flat slopes to the edges of pits. Leveling the surface should be done as far as possible; and
- All fencing and gates will be removed and pits will be backfilled.

EPC Contractor will prepare a site restoration plan well before the completion of construction activities and submit it to Proponent through EMC for approval. Finally, after the completion of the restoration process, EMC in consultation with Proponent will inspect the site and give restoration clearance to the EPC Contractor.

8.13 CHANGE MANAGEMENT PLAN (CMP)

If some changes in the operation of Project or the EMP may be required, a CMP manages such changes. The management of changes is discussed under two separate headings, i.e. additions to the EMP and changes to the operation and the EMP.

8.13.1 Additions to the EMP

The EMP has been developed based on the best possible information available at the time of the study. However, it is possible that during the conduct of the proposed operation, additional mitigation measures based on the findings of environmental monitoring during the construction and operation may have to be included in the EMP. In such cases following actions will be taken for changes during the construction phase:

- A meeting will be held between Proponent, EPC Contractor and the EMC. During the meeting, the proposed addition to the EMP will be discussed and agreed upon by all parties;
- Based on the discussion during the meeting, a change report will be produced by EPC Contractor, which will include the additional EMP clause and the reasons for the addition;
- The report will be signed by all parties and finalized at the site office. A copy of the report will be sent to Proponent, EPC Contractor and EMC; and
- All relevant project personnel will be given information about the addition/change.

During the operation phase, all actions would mainly be the responsibility of Plant Management.

8.13.2 Changes to the Operation and EMP

The change management system recognizes three orders of changes:

a) First Order

A first order change is one that leads to a significant departure from the project described or the

impacts assessed and consequently require a reassessment of the environmental impacts associated with the change. Action required in this case will be that the environmental impacts of the proposed change to be reassessed by EMC and forward to the EPD by Proponent.

Examples of such change include:

- Deviations from the minimum requirements for Effects Monitoring specified in the EMP; and
- Changes in the design/alignment, documentation, communication, or stakeholders' consultation program such as if the overall objective of documenting compliance with the EMP and its communication to Proponent, EMC and the EPC Contractor or interested stakeholders at regular intervals is not being met.

b) Second Order

A second order change is one that does not result into change in the project description or impacts that are significantly different from those in the EMP.

Action required for such changes will be that EMC will reassess the impact of the activity on the environment and specify additional mitigation measures, if required, and report the changes to Proponent.

c) Third Order

A third order change is one that does not result in impacts above those already assessed in the EMP, rather these may be made on-site to minimize the impact of an activity such as relocation of certain areas of construction camp to minimize effects on the environment. The only action required for such changes will be to record the change.

8.14 CONSTRUCTION MATERIAL TRANSPORTATION

The document provides an overview to consider unique handling requirements and to evaluate alternative transportation approaches during construction of the proposed RLNG based power plant.

8.14.1 Material Transportation Routes

These routes would be specified for construction camp and should be established in such a way that there is a minimum hindrance or disturbance to the local communities and to the flow of traffic. The routes should be marked on a map by the EPC Contractor and approved by District Traffic Police, District Government and concerned line.

8.14.2 Material Transportation and HSE Arrangements

Following arrangements should be made for Material Transportation and HSE:

- Transportation timings should preferably be at night, to minimize the traffic conflicts;
- Filled trucks should be covered with tarpaulin to avoid fugitive dust and should be visually inspected for proper loading, sealing and decontamination;
- Bulk solid debris should be removed from the trucks with shovels before leaving the site. Where necessary, trucks should be pressure washed before leaving the site. Pressure washing should only be used if other methods do not work;
- Vehicles should have passed an annual inspection and carry a fitness certificate;

- A summary chart representing the load and maps showing the proposed route to the disposal facility will accompany each truckload. In the event of an accident involving the transported material, it will immediately be notified to HSE Section of Proponent, Traffic Police; and,
- The truck drivers will be strictly instructed not to play music and use horns at night time to minimize disturbances.

8.14.3 Material Transportation Documentation

A field logbook will be maintained for the documentation. This logbook will additionally serve to document observations, personnel onsite, equipment arrival and departure times, a truck exit inspection checklist and other project information.

Field logbooks will document where, when, how, and from whom any vital project information is obtained. Logbook entries will be completed and accurate enough to permit reconstruction of field activities. Logbooks will be bound with consecutively numbered pages. Each page will be dated and the time of entry will be noted. All entries will be legible, written in black ink, and signed by the individual making the entries. Language will be factual, objective, and free of personal opinions or inappropriate terminology. If an error is made, corrections will be made by crossing a line through the error and entering the correct information. Correction will be dated and initialed. No entries will be obliterated or otherwise rendered unreadable.

Entries in the field logbook will include at a minimum the following for each field work date:

- Site name and address;
- Recorder's name;
- Time of site arrival/entry at site and time of site departure;
- A Summary of any onsite meeting;
- Description of transport vehicles;
- Quantity of materials in truck (approximate percentage of full load);
- Names of waste transporters and proposed disposal facilities;
- Quantity of borrow material in truckloads; and
- Levels of safety protection.

8.15 TRAFFIC MANAGEMENT

During the course of the construction of proposed Project, EPC Contractor will provide the signage and/or traffic control to the extent deemed necessary by the conditions and amount of traffic using or accessing the site roads.These signs will inform, control, warn, shift, or stop traffic on all site roads affected by the project's heavy traffic. The following measures will be taken during the construction phase for the effective implementation of the traffic plan:

- Pakistan national and local traffic rules and regulations, instructions manual for motor vehicle and mobile machinery operation is to be followed;
- No one will be allowed to drive motor vehicle or operate mobile machinery without a driving license;
- It should be prohibited to drive or operate vehicle in case of over fatigued or mental disease;
- Traffic speeds on unpaved roads should be limited to no more than 30 Km per hour;
- Traffic speed signs should be displayed prominently at all site entrances;
- A daily routine checkup of vehicles should be conducted no less than 5 minutes before its service;
- Use of appropriate signs, equipment, and traffic control measures that conform to the

provisions in the Traffic Manual of city traffic police;
- Traffic inspection and security during transportation;
- Limit vehicular traffic designated access roads, construction laydown area worker, parking areas and the project site;
- All damaged, destroyed or modified pavement legend, traffic control devices, signing and striping associated with the proposed development should be replaced as required prior to issuance of a certificate of Occupancy; and
- Construction signs, lighting and barricading should be provided during construction as required.

8.16 TRAINING PROGRAM

8.16.1 Training Strategy

Environmental training will form a part of the Environmental Management System and in order to build the different key staff and the community's capacity to effectively implement the project specific EMP. The training will be directed towards concerned personnel for general environmental awareness. In addition to the above training, additional trainings will be imparted as and when required.

8.16.2 Objectives

The key objective of the training program will be to ensure that the requirements of the EMP are clearly understood and followed throughout the project. The trainings will help in communicating environment related restrictions specified in the EIA and EMP.

The main objectives are as follow:

- To train the project staff on how to interact and involve the concerned communities;
- To train the managers for the protection of the health and safety of the workers/labor;
- To define the roles and responsibilities of the concerned stakeholders according to the EMP; and
- To train the concerned communities for protection of water bodies such as QB Link Canal and their participation and cooperation in the proposed project.

8.16.3 Roles and Responsibilities

EMC will primarily be responsible for providing environmental training to concerned project personnel on potential environmental issues of the project. EPC Contractor will be responsible to arrange trainings and ensure the presence of targeted staff. EMC will prepare a project specific training program for this purpose. EPC Contractor will be required to provide induction training/briefing to all their staff before the start of any activity in the Project Area. It is proposed that before the commissioning of plant, HSE Manager of Proponent having HSE certification should also get a foreign training course to be arranged by EPC Contractor.

8.16.4 Training Aspects

a) Training Log

- Topic;
- Date, time and location;

- Trainer; and
- Participants.

b) Training Needs Assessment

In addition to the trainings identified in the training logs, additional trainings will be provided during the project activity. The criteria to assess the need of training will be based on the following:

- When a specified percentage of staff is newly inducted in the project;
- When any non-compliance is repeatedly reported refresher training will be provided regarding that issue;
- When any incident/accident of minor or major nature occurs;
- Arrival of new sub-contractor; and
- Start of any new process/activity.

8.17 COMMUNICATION AND DOCUMENTATION

8.17.1 Kick-Off Meeting

One kick off meeting will take place between Proponent/EMC and EPC Contractor before the start of construction. The purpose of this kick off meeting will be to demonstrate the regulatory and monitoring requirements prior to the start of the individual project activities to be met and to have an understanding of the proposed activity of monitoring.

8.17.2 Meetings and Reports

Monthly meetings will be held during the construction phase at construction camp office. The purpose of these meetings will be to discuss the activities of the last months, non-compliances as pointed out by EMC and their remedial measures. The meeting will be chaired by the representative nominated by CEO of Proponent. The meeting will be recorded in the form of a Monthly Environmental Report (MER) to be prepared by EPC Contractor and reviewed by EMC and will be submitted to Proponent for final approval. The report will include but will not be limited to:

- Summary of project activities during last month;
- EMC and EPC Contractor environmental personnel present onsite;
- Summary of monitoring activities; and
- Non-compliances observed and mitigation measures taken or required.

8.17.3 Social Complaints Register

The EMC will maintain a register of complaints received from local communities and measures taken to mitigate these concerns. All community complaints will be resolved by HSE-Manager; however, if any dispute arises the case will be forwarded to the CEO by the HSE Manager.

8.17.4 Change Record Register

All changes to the EMP or the project will be handled through the Change Management referred earlier. During the construction phase, EMC will be responsible to maintain the change record register while during operation phase, HSE Section of Proponent working at the power plant will

maintain the register. This register will include details such as date, type of change, person/s responsible for change and action taken to get approval for change from competent authority.

8.17.5 Photographic Record and Data Base

EPC Contractor and EMC will maintain a photographic record of all areas to be used during the implementation of the project. As a minimum the photographic record will include the photographs of the sites, access track, camp sites, and monitoring of different categories, Data base of persons involved in monitoring, compliance and effects, HSE database and compliance and non-compliance record according to HSE Plan.

8.18 PLANTATION PLAN

10 (ten) number of plants will be raised in lieu of each tree removed as mitigation measure/replenishment plan. Total number of trees available in the Project Area are 58 of mix species, mainly kikar, shisham and eucalyptus. The distribution of trees presently growing on permanently acquired, temporary acquired land and along proposed road strip is given as Table 8.5.

Table 8.5: Tree Distribution as per Land Category

Sr. No.	Category of Land	No. of Trees		
		Large & Med. size	Small size	Total
1.	Permanent Acquisition	5	8	13
2.	Temporary Acquisition	7	13	20
3.	Road Strip	9	16	25
Total:		**21**	**37**	**58**

A total of 580 (or say 600) trees will be planted in lieu of loss of trees as discussed below:

i) Tree Groves: Compact planting of 300 saplings in groves each of about 0.10 acre to 0.15 acre size uniformly staggered in the Project area will be undertaken with suitable indigenous species, like shisham, mulberry, kikar, neem, and bakain, etc. at a spacing of 10' x 10' as shown in Table 8.6.

ii) Linear Plantation: Planting of balance 300 plants will be carried out in linear pattern along the peripheral boundary of Project area at 10 feet spacing in multi-storey pattern with trees and shrubs of varying height like simal, shisham, silver oak, kachnar, siris, chinar, alstonia, bottle brush, gul mohar, pilkan, sukhchain, bogainvilla, legerstroemia and other ornamental plants as given in the Table 8.7.

Table 8.6: Trees for Grove Planting

Sr. No.	Local Name	*Scientific Name*	Remarks
1.	Shisham	*Dalbergia sisso*	Tree
2.	Mulberry	*Morus alba*	Tree
3.	Kikar	*Acacia nilotica*	Tree
4.	Bakain	*Melia azadarch*	Tree
5.	Siris	*Albizzia lebbek*	Tree
6.	Neem	*Azedracta indica*	Tree

Table 8.7: Trees and Shrubs for Linear Planting

Sr. No.	Local Name	*Scientific Name*	Remarks
1.	Amaltas	*Cassia fistula*	Tree

2.	Sukhchain	*Pongamia pinnata*	Medium size Tree
3.	Bakain	*Melia azadarach*	Medium size Tree
4.	Kachnar	*Bauhinia variegata*	Medium size Tree
5.	Siris	*Albizzia lebbek*	Medium size Tree
6.	Jacaranda	*Jacaranda mimosifolia*	Medium size Tree
7.	Silver Oak	*Grevillea robusta*	Medium size Tree
8.	Pilkan	*Ficus infectoris*	Medium size Tree
9.	Alstonia	*Alstonia scholaris*	Medium size Tree
10.	Amla	*Phyllanthus emblica*	Small size Tree
11.	Bottle brush	*Callistemon lanceolatus*	Small size Tree
12.	Gul mohar	*Poinciana regia*	Small size Tree
13.	Gul-e-nishtar	*Erythrina spp.*	Small size Tree
14.	Gul-e-fanoos	*Kigelia pinnata*	Small size Tree
15.	Gul-e-chin	*Plumeria alba*	Shrub
16.	Bogainvilla	*Bogain villae spp.*	Shrub
17.	Legerstroemia	*Lagerstromia indica*	Shrub
18.	Peeli booti	*Cassia glauca*	Shrub

8.19 ENVIRONMENTAL COST

8.19.1 Environmental Monitoring Cost

An estimated cost for instrumentation monitoring for all the three phases of the Project is given in Table 8.8 For details such as sampling parameters, location, frequency and estimated number of points please refer to Table 8.3.

Table 8.8: Environmental Monitoring Cost

Project Phase	Environmental Monitoring Cost
Pre-Construction	Rs. 955,000/-
Construction (annualy)	Rs. 17,400,000/-
Operation and Maintenance (annually)	Rs. 4,998,200/-

8.19.2 Cost of Establishment of EMC

The Initial cost for establishment of EMC has been calculated. The details are presented in Table 8.9 below.

Table 8.9: Cost of Establishment of EMC

Project Phase	Costs
Setting up EMC during Construction (2 years & 3 Months)	Rs. 27,600,000
Site visits by HSE Section persons Operation (annual)	Rs. 14,600,000/-

Note: The above cost for setting up EMC during construction includes the salary cost, daily allowance, accommodation charges, purchase of equipment and vehicles Cost at operation stage includes all the above mentioned items excluding purchase of equipment and vehicles.

8.19.3 Plantation Cost

As discussed earlier, number of trees to be raised will be 10 times the number to be removed, thus 600 plants will be raised in lieu of approximately 58 trees which are liable to be removed during construction phase of the project. The cost of plantation includes the initial planting (including restocking during first 2 years), and maintenance cost for first four years of plantation

The cost break-up of planting and maintenance for a period of four years is given in (Tables 8.10 to 8.13) on the basis of Rs. 500/- per diem:

Table 8.10: Estimated Cost of Plantation of 500 Plants for First Year

Sr. No.	Particulars of Work	Quantity	Rate (Rupees/MD)	Amount (Rs.)
1	Clearance of site	500 plants	2 MD	1,000
2	Layout	500 plants	2 MD	1,000
3	Digging of Pits 2.65 x 500 = 1325 cft.	500 pits	20 MD	10,000
4	Average cost of plants	500 plants	Rs. 20/-	10,000
5	Carriage of plants 500 Nos. from Nursery to Site including loading/unloading	500 plants	Rs.3/-	1,500
6	Planting of plants with ball of earth	500 plants	10 MD	5,000
7	Replacement of earth with silt 1 cft. per pit	500 cft.	LS	5,000
8	Hand watering 50 times x 500 plants with bowser	25,000 plants	5 MD per 1000 plants	62,500
9	Weeding 4 times 500x4	2,000 plants	5 MD per 1000 plants	5,000
10	Miscellaneous/ Contigencies		LS	5,000
Sub-total				**106,000**

Table 8.11: Estimated Cost of Restocking and Maintenance for 2nd Year

Sr.No.	Particulars of Work	Quantity	Rate (Rupees)	Amount (Rs.)
1	Cost of plants (20% restocking)	100 plants	Rs 20/- per plant	2,000
2	Planting operation cost	100 plants	Rs. 10/- per plat	1,000
3	Carriage of plants from Nursery to site including loading/unloading	100 plants	Rs. 3/- per plant	3,000
4	Hand watering 50 times x 500 plants with bowser	25,000 plants	5 MD per 1000 plants	62,500
5	Reopening of pits twice (1 cft per pit)	1000 cft	5 MD per 1000 cft	2,500
6	Weeding 500x2	1,000 Nos. of plants	5 MD per 1000 plants	2,500
7	Miscellaneous			5,000
			Sub-total	**78,500**

Table 8.12: Estimated Cost of Restocking and Maintenance for 3rd Year

Sr.No.	Particulars of Work	Quantity	Rate (Rupees)	Amount (Rs.)
1	Cost of plants for 10% Restocking	50 No.	Rs 20/-	1,000
2	Carriage of plants from Nursery to site including loading/ unloading	50 No.	Rs. 3/- per plant	150
3	Re-digging of pits	50 No. (2 MD)	500/MD	1,000
5	Hand watering (40 times x 500 plants)	20,000 plants	5 MD per 1000 plants	50,000
6	Reopening of pits (1 cft per pit)	500 cft	5 MD per 1000 cft	1,250
7	Weeding twice 500x2	1,000 Nos. of plants	5 MD per 1000 plants	2,500
8	Miscellaneous			5,000
			Sub-total	**60,900**

Table 8.13: Estimated Cost of Maintenance for 4th Year

Sr.No.	Particulars of Work	Quantity	Rate (Rupees)	Amount (Rs.)
1	Hand watering 30 times =12,000 plants	15,000 plants	5 MD per 1000 plants	37,500
2	Trimming/pruning/cleaning of plants	500 plants	10 MD per 1000 plants	2,500
3	Miscellaneous			3,000
			Sub-total	**43,000**
			Grand Total of Subtotal for Tables (8.10-8.13)	**288,400**

Table 8.14: Total Plantation Cost

Sr. No.	Item	Cost (in Rs.)
1	Cost of raising 500 plants and maintenance upto four years	288,400
2	Cost of raising 600 plants and maintenance upto four years	346,080 (or say) 350,000
	Total Cost	Rs. 350,000

Cost of raising one plant with four years maintenance: Rs. 585/- per plant.

8.19.4 Summary of Environmental Costs

Table 8.15 presents a summary of all the environmental costs.

Table 8.15: Summary of Environmental Costs

Activities	Environmental Cost (Rs.)	
(A) Environmental Monitoring Cost		
Pre-Construction (One time only)	955,000/-	Say 1,000,000/-
Construction (annually)	17,400,000/-	Say 18,000,000/-
Operation and Maintenance (annually)	4,998,200 /-	Say 5,000,000/-
(B) Tree Plantation		
Cost of Plantation	346,080/-	Say,350,000/-
(C) EMC Cost		
Setting up EMC during Construction (2 years & 3 months)	27,600,000/-	Say 28,000,000/-
Site visits by HSE Section persons Operation (annual)	146,00,000/-	Say 15,000,000/-

CHAPTER – 9

CONCLUSIONS AND RECOMMENDATIONS

This chapter summarizes the conclusion drawn and provides recommendations based on these conclusion.

9.1 CONCLUSION

The studies conducted for the RLNG Based Thermal power plant near Bhikki, Sheikhupura has the following set of major conclusion:

1. The proposed Project is essentially a 1,000-1,500 MW (Gross) RLNG Based CCPP. The Power Plant has a capacity of producing maximum of 1,500 MW of electricity. The Power Plant will operate on imported RLNG to be transported from Karachi through pipelines. The site is adjacent to QB-Link Canal and Lahore to Nankana Sahib single track railway line. The power will be evacuated by connection to the existing 500 kV high voltage line which is located 2.2 km from the Project Site.

2. This report has been prepared in accordance with the requirements of the Punjab Environmental Protection Act, 1997 (amended 2012); Pak-EPA Regulations, 2000 for review of IEE and EIA; Pakistan EIA procedures; and Sectoral guidelines for environmental reports: Major Thermal Power Stations, October 1997.

3. Different site options for the Power Plant were appraised and all three sites have the essentials for a thermal power plant, such as, proximity to major roads and railway track, proximity to canals for cooling water and proximity to 500 kV transmission lines for power evacuation. Other alternatives considered include the fuel, technological, cooling system, wastewater disposal and power generation options.

4. Provincial and Local (villages) level stakeholder consultations were carried out in order to record the concerns and observations of the stakeholders, especially the affected people.

5. The major positive impacts of the Project include the following:

   - ***Electricity Generation:*** Given that Pakistan currently faces a shortfall of about 4,000 to 6,000 MW per day, the generation capacity of this power plant will help towards meeting a portion of the shortfall. The generation of electricity will not only help the industrial sector and its outputs but will also help to raise the standard of living as it will reduce load shedding;

   - ***Employment Opportunities:*** During construction phase of the project, the requirement of engineers, workers, laborers, technicians, para-professionals etc. will generate employment opportunities. It is estimated that about 2,500 workers during the construction phase and about 150-200 during the operation phase will be employed.

   - ***Increase in Businesses:*** With the influx of labourers for the proposed Project, there will generate more opportunities for small scale business;

   - ***Increased Accessibility:*** Construction of access road for the construction of Power Plant and upgradation of existing track to the project area will result in improved accessibility;

- ***Socio-economic Uplift:*** The project will result in the general economic and social uplift of the people particularly in areas of the Punjab Province and will also provide basic infrastructure and raw material for other projects in the region.

The negative impacts foreseen and their mitigation include:

6. The project will be constructed over a land area of 315,964.34 sq.m (including permanent area and access road area only) and temporary area of 137,710.65 sq.m for construction purpose. Govt. will acquire the permanent private land as per provision of LAA,1894. The implementation of the Project will affect the built up area, crops, water courses, katcha track, transmission line and 3 No. of tube wells that will come under permanent, temporary and access road area.

7. The loss of private built up area, infrastructure and crops should be compensated according to the provisions of the LAA,1894. Other government infrastructure should be relocated by the concerned department in consultation with the project proponent.

8. Impact of Soil erosion as a result of improper runoff from construction activities should be mitigated by good engineering practices such as mulching and compaction.

9. Contamination of soil by toxic/fuel based/chemical materials by improper handling should be mitigated by appropriate storing of the chemicals in drums and necessary precautions taken by the contractor's staff.

10. Loss of vegetation cover due to removal of trees, shrubs, and fruit plants etc. should be mitigated by planting additional trees in appropriate and suitable areas around the proposed power plant which will also act as a noise barrier;

11. Aesthetic value of the area should be improved by placing vegetative barriers around the proposed power plant site and developing green areas in the Project Area as well as in the vicinity of the proposed Project site.

12. Degraded quality of irrigation water and surface water due to contamination (if any) should be mitigated by containing chemical and oil spills directly into open drains and from preventing untreated wastewater and sewage to flow towards the irrigation channels by channeling it towards septic tanks and soakage pits.

13. Impacts on ambient air and noise quality due to gaseous/fugitive dust emissions and movement of vehicles, vibration by machinery/equipment etc. should be mitigated by fine tuning of the vehicles, sprinkling water on the soil to prevent dust dispersion, and by adjusting timing of construction activities so that there is no excessive noise during the night.

14. Impacts on downstream water users due to wastewater discharge should be mitigated by the treatment of wastewater to meet NEQS limits before it is discharged.

15. Increase in solid waste generation should be mitigated by adopting a solid waste management plan for the collection and disposal of all types of wastes. and

16. Impacts on Socio-economic aspects should be mitigated by ensuring that cultural sensitivity should be understood by the contractor and good relationships are maintained between the locals and the power plant staff.

17. Air quality can be impacted from SO_x, NO_x, CO, and PM emissions which are typical air pollutants. The plant will utilize the RLNG as main fuel and HSD as a backup fuel. The impact on air quality is not expected to be significant considering the RLNG which is a

clean fuel having less air emissions. The stack air emission will be well within the applicable NEQS limits. The maximum ground level concentrations as determined by ADM are within limits of NEQS 2000 and 2010 both for RLNG and HSD for 24 hours averaging period. For annual averaging, the results of SO_2, NO_x, and PM_{10} are within thresholds of NEQS 2000 and 2010. The maximum annual average contribution of $PM_{2.5}$ from the power plant will be 0.036 $\mu g/m^3$ which is quite low.

18. The stacks of the power plant will be kept high i.e. minimum 45 m and 60 m above ground level for bypass stack and the main HRSG stack respectively. Low NOx burners will be used in GT to control emissions and the water will be injected during the use of HSD to control the NO_x emissions.

19. The detection and fire alarm, fire protection and fire-fighting systems shall include:

- Firefighting water storage, may be combined with raw water tank, depending on local regulations;
- Firefighting pumps;
- Fire water ring main system, including hydrants;
- Fire protection systems; and
- Fire alarm and detection system.

20. Once through cooling system was considered during ten to eleven months per year, when main cooling water will be available from QB Link Canal. During approx. one to two months per year, water from the canal will be unavailable. In this period, mechanical draft cell-type cooling towers will serve as the heating sink.

21. Cooling water for main cooling cycle will be taken from QB Link canal. During a yearly period of canal closure (6-8 weeks) the cooling demands of the power plant will be met using cooling towers. During this period, water will be taken from underground wells that have to be developed as part of the EPC Contract. The impact of the extraction of the water on the aquifer can be determined as soon as more details of the wells are known. Since the wells will be used only for up to maximum of 8 weeks per year, a permanent impact is not expected. The volume extracted from the canal will be less than 5% of the total water volume, therefore, the impact is not expected to be significant. Recommendations of Hydrogeological study and groundwater study should be kept in consideration.

22. The plant operation will generate Industrial as well as sanitary wastewater. It is estimated that about a maximum of $2m^3/h$ of sanitary, $4m^3/h$ of industrial wastewater will be generated along with cooling tower blow down (expected concentration factor: 4-5) in canal closure period. Wastewater treatment systems will be designed and implemented to treat the wastewater and ensure compliance with the NEQS.

23. Impact on surface water bodies due to improper handling and disposal of many chemicals being used at the power plant should be mitigated by using drums and storage containers that are tight and do not leak as well as ensuring that the staff is trained to deal and contain accidental spills;

24. Impact on Human health due to improper disposal of sanitary waste from residential colony and solid waste should be mitigated by proper solid waste management plan to deal with collection and disposal of waste: and

25. Impacts on Socio-economic aspects such as gender issues due to outside labor at the power plant/privacy issues, impacts of noise and air pollutants on local population etc. should be mitigated by continuous monitoring to ensure that emissions are not

exceeding NEQS limits and the contractor should make an effort to follow the local norms and be culturally sensitive to the local population.

An Environmental Management Plan (EMP) for both the phases (construction and operation) has been developed as part of the report which provides a detailed mitigation matrix that covers impacts, mitigation measures roles and responsibilities and timings to avoid, minimize or mitigate the adverse impacts and justify the friendly nature of the power plant Project.

During the construction phase, the Monitoring plan shall be implemented by the EPC Contractor and EMC. For the first year during operation phase EPC Contractor will be responsible for monitoring activities after which Proponent will be entirely responsible for implementation of monitoring and execution of EMP.

The institutional capacity of the proponent need to be strengthened with respect to the environmental and social aspects for the effective implementation of EMP.

9.2 RECOMMENDATIONS

Following are the set of major recommendations;

1. Proponent on priority basis shall initiate the establishment of EMC within its existing institutional structure.

2. EMP will be made a part of all bidding/tender documents.

3. EPC Contractor will be bound to completely implement relevant mitigation measures set out in the EMP to ensure environmental sustainability. Also the cost related to these mitigation measures has to be borne by the EPC Contractor.

4. PAP's must be compensated for their lost land, property or any other asset as per existing market rates. This step will reduce any future social impacts or political strains due to power plant Project implementation. Livelihood assistance should be provided to the PAP's.

5. Proponent should do more consultations with the local community of the study area before the commencement of the project to satisfy their concerns. Some Confidence Building Measures (CBMs) in the form of general improvement of the social infrastructure in the villages should be planned and implemented by the proponent to lessen the loss of the local community and to build trust and confidence.

6. The loss of agriculture due to conversion of agriculture land in to built-up area will be compensated (apart from the compensation as per LAA, 1894) by adopting and promoting modern and scientific irrigation techniques and agricultural practices to be promoted in consultation with the agriculture and irrigation departments like improved variety of seeds, fertilizers and machinery on subsidized rates that will increase the yield and soil fertility.

7. EPC Contractor shall prepare Borrow and Quarry Material Plan and a Restoration Plan and get approval from Proponent.

8. EPC Contractor will prepare an Evacuation, Emergency Preparedness and Response, Waste Management and Health and Safety Plan based on the frameworks provided in EMP.

9. According to preliminary findings - Groundwater Availability Study, the existing wells show sufficient quantity and suitable quality of well water to provide for the needs of the cooling tower as well as other water needs. However, the main source of recharge of the underground aquifer is judged to be vertical penetration of canal water flowing parallel to the site. This is crucial, since the expected times of high well water extraction is during the period when the canal is empty. It has to be determined if and how the extraction of the needed quantities of raw water from the aquifer will be possible during unavailability of the main recharge source (canal water). Special attention shall be paid to the stability of buildings and foundations of heavy equipment such as gas turbines and the cooling tower structure.

10. Efforts should be made to draw water from deep aquifers which do not influence the top unconfined aquifer which is being exploited by the local community. Recommendations of Hydrogeological studies and Electrical Resistivity Survey should be follower;

11. The long term baseline monitoring for $PM_{2.5}$ spreading atleast over a period of one year before commissioning of power plant or start of power plant construction should be done to determine the average annual concentration to assess compliance during plant operation.

12. If there are any changes in Plant layout, or any other changes in Project description then change should be carried out through CMP included in EMP of this EIA report.

ANNEXES

Annex-1: Scoping & Term of Reference (TOR)

1,000-1,500 MW (GROSS) RLNG BASED CCPP AT BHIKKI

SCOPING BRIEF

1) INTRODUCTION

Scoping is a vital step which identifies the issues that are likely to be important during the environmental impact assessment, and eliminates those that are not. Scoping for the project started early during the EIA process and review of scope continued through the EIA process.

The sections below described the objectives of the scoping, approach adopted for the scoping, proposed EIA methodology and important issues identified during scoping which are required to be addressed during the EIA.

2) OBJECTIVES OF SCOPING

Scoping of the project was done with the following objectives:

- The appropriate boundaries of the Environmental Impact Assessment (EIA);
- The important issues and concerns;
- The information necessary for decision-making; and
- The significant impacts and factors to be considered.

3) APPROACH ADOPTED FOR SCOPING

3.1) Initial Review of Information and Documents

Prior to field activities, a desk review of the available Project documents was conducted. The documents included applicable legal, regulatory and policy framework, current field's survey conducted for the project site, conceptual layout plan/maps, location maps, and other previous studies related to the project to develop an understanding of the project.

3.2) Internal Meetings

After the review of the available data set, the internal meetings were held between technical experts, international counterpart and environmental team comprising Environmental Engineers, Ecologists, Environmentalist & Sociologist to discuss the objectives of the EIA Study, broad work plan, field visit and its logistics, the overall time schedule, extent and boundaries of EIA, important issues to be considered and other aspects.

One of the major point discussed during the meeting with the international counterpart (designer) was to be identify the technical aspects related to emissions, wastewater generation, technology being considered and other technical details to be used in the impact assessment.

3.3) Detailed Document Review

Parallel to the internal meetings, members of the EIA team thoroughly studied and reviewed the Project documents mentioned earlier. During this review, adequacy of these documents was particularly determined and gaps identified. This review was guided by focused Project's potential impacts on physical, biological as well as social environment.

Applicable Legal, Regulatory and Policy Framework have been thoroughly reviewed as shown in Table 1:

Table 1: Reference Documents/Manuals Consulted

Sr. No.	Reference Documents/Manuals	Organization
1	Punjab Environmental Protection Act 1997 (amended, 2012)	Government of Punjab
2	Review of IEE/EIA Regulations, 2000	Pakistan – Environment Protection Agency Government of Pakistan
3	Guidelines for the Preparation and Review of Environmental Reports November, 1997	Pakistan – Environment Protection Agency Government of Pakistan
4	Policy and Procedures for Filling, Review and Approval of Environmental Reports, November, 1997.	Pakistan – Environment Protection Agency Government of Pakistan
5	Sectoral Guidelines for Major Thermal Power Stations	Pakistan – Environment Protection Agency Government of Pakistan
6	Guidelines for Public Consultations	Pakistan – Environment Protection Agency Government of Pakistan

These legislations and regulations relevant to the project will be discussed in Chapter 2 of EIA Report.

3.4) Meetings with Proponent

A meeting/discussion sessions were held with the proponent. The purpose of these meeting was to obtain information on the current Project status, any future plans, sharing the process employed for conducting EIA and identification of major issues and concerns.

3.5) Identification of the Key Stakeholders and Major Concerns

The potential stakeholders were identified during the scoping are people affected directly, agencies responsible for administration & impact management, the organizations having interest in monitoring proponent activities and private sector entities.

Major stakeholders which were identified during the scoping and will be consulted throughout the project cycle are listed below:

- Environmental Protection Agency
- Irrigation Department
- Wildlife Department
- Agriculture Department
- Fisheries Department
- PAPs and local communities
- Local NGOs

The process of consultation will be an on-going process which continues during the project life cycle and even after the submission of the report and so on. Details will be provided in Chapter 6 of the EIA Report.

Focus Group Discussion were conducted for the project during the detailed site visits. A focus group is a loosely -structured roundtable discussion conducted by a facilitator among a

small number of participants, usually 8 to 12 people. Participants for the groups are selected on the basis of having shared a common concern (e.g. Project Affected People, groups might be wood cutters, laborers, educators, health workers, government civil servants, shop-keepers, farmers, herders, or natural resource user group members). A check list or topical guide will be developed to facilitate the discussion, which covers the key areas of inquiry or concern. As discussion points come up, and opinions are shared, they are listed accordingly. The objective of this method is to encourage participants to talk openly and freely about a topic relevant to a specified activities, issue, concern, resource, product or service. Thus, it is important that both the facilitator and the setting of the meeting encourage free expression of opinions and feelings.

A series of public consultations (4 Nos.) were conducted to get the feedback/concerns. The main issued/concerns discussed were:

- There is no government water supply scheme laid in the area due to which people use to drink water from hand pumps and ultimately it leads to several diseases, despite of good apparent quality of water;
- Drainage and sewerage systems are a big issue and people use domestic draining channels which leads to a pond and become a severe source of pollution;
- The proposed power plant should also take measures for establishing health, education and recreational facilities in the study area;
- No NGO or any welfare organization is present in the area. Even, the relevant MNA/MPA do not take any necessary or productive measure towards the improvement of life quality of the villagers;
- Locals should also get benefit from this project as the villagers lack the natural gas for their domestic house use; and
- The project land belongs to us (affectees) after our migration from india and we only know agriculture as main skill.

3.6) Reconnaissance of the Project Area

A team of experts carried out reconnaissance to the proposed Power Plant site (Project and Study Area), adjoining areas like Thatha Miana, Therian, Chah Waris and Bhikki.

4) EXTENT AND BOUNDARIES OF EIA

For an EIA study, it is imperative to delineate the area where the potential significant impacts of the proposed Project can be envisaged. The Study Area is the area within which the potentially significant adverse environmental and social impacts of the proposed intervention are envisaged. In the light of this, potential impacts on the existing environment have to be considered in a larger geographical area than the proposed "Project Area" depending upon the extent of direct/indirect impacts.

Based on the experience of the Consultant, the available secondary information of the proposed Project Area, and technical details of the Power Plant, criteria was developed to delineate the Study Area for the proposed Project. In the criteria, critical parameters of physical (wind direction and speed, topography), ecological and social (location of settlements, other receptors and existing land use resources) domains of the environment for the RLNG-Based Power Plant have been considered. The Study Area was marked using the GT sheets and Google Earth Image during desk studies which was later finalized during the field visit.

Study Area includes the actual proposed Project boundary or the area which is considered to be acquired for the Project, as well as the area in the surroundings in which potential

adverse impacts may be foreseen due to the implementation of the proposed Project like location of construction camp, residential and non-residential buildings, workshops etc.

So the "Study Area" includes the Project Area, nearby land having settlements, agriculture fields, canal and other infrastructure as shown in the photolog of EIA report on which the proposed Power Plant is likely to have any impact.

5) IMPORTANT ISSUES AND CONCERNS/FACTORS BE CONSIDERED IN EIA STUDY

The major issue highlighted during the scoping and their addressals in the EIA Study at the later stage are as below:

5.1) Land Requirement and Impact on Agriculture and Livelihood

The proposed project will require considerable land for the project to be executed that will convert the existing agriculture land into built-up area. The residents of the area have agriculture as main livelihood which will be affected due to the project implementation. This aspect will require the quantification of the land to be used for the plant and access roads to determine the impact and assessment of affect on livelihood.

5.2) Removal/Cutting of Trees

It has been initially assessed from the Google Earth and field reconnaissance that trees exist in the project area and will be removed before the start of construction. Loss of vegetative cover in the form of removal of these trees will occur while clearing land. A comprehensive tree plantation plan will be required to be prepared for the project that will be specified in Environmental Monitoring Plan (EMP) which shall be adjusted in the future landscape of the power plant.

5.3) Waste Generated during Construction and Operation

It has been assessed that various types of waste will be generated during the construction and operation of the proposed power plant that may affect the existing physical, ecological and social receptors. To address this impact, wastewater treatment plants need to be designed and Waste Management Framework (WMF) will be prepared during the course of the EIA Study to describe the framework of waste management program and provides general procedures or guidance on routine waste management issues.

5.4) Plant Emissions due to Backup Fuel-High Speed Diesel (HSD)

Initially plant was to be operated on RLNG only which is a clean fuel with lesser emissions. At a later stage, it was decided that apart from the LNG (main fuel), High Speed Diesel (HSD) will also be required for the Power Plant as a backup fuel. The data related to the plant emissions will be obtained from Lahmeyer International and it was decided that Air Dispersion Model (ADM) will be run for the project to predict ambient air quality concentrations based on air pollutant emissions from stacks of the Power Plant. ADM will be done with an objective to determine the ground level concentrations of SO_2, NO_x, and PM in order to check the compliance with the standards and assess the impacts on receptors.

5.5) Health and Safety Concerns

The construction and operational phases of the project may arise several health and safety issues related to local community and the onsite staff involved in the construction activates. The Health and Safety Management Framework will be prepared that will provides a basis for EPC Contractor to create a detailed plan to reduce and remove any harm due to

construction activities to local management, construction staff and local residents' health and ensure human safety of the management and construction staff at the power plant.

5.6) Change in the Project Design/Layout

If there will be any change/updation in the project design or project layout then it will also require some changes in the EIA Report. If there are any changes in Plant layout, or any other changes in Project description then change should be carried out through Change Management Plan (CMP) which will be included in EMP of this EIA report

5.7) Water Requirements During Construction and Operation

The construction and operation of the power plant will require substantial quantity of water. This aspect will require an assessment on how much water will be required especially for cooling during the power plant operation. A detailed assessment will be done in consultation with the designer.

6) TERMS OF REFERENCE OF EIA STUDY

The Consultant will conduct EIA study as per requirements of Punjab Environmental Protection Act 1997, and Review of IEE/EIA Regulation, 2000 having the following scope of work:

- Review of available documents and planning of EIA Studies covering general know-how about the project area, existing plant specifications, process flow diagrams, piping and instrumentations diagrams, project activities, location/size of the camps, staffing and project employment, support facilities, policies and procedures, nature and durations of operations and other related information that may be required for achieving the required tasks.
- Data collection of existing baseline environmental conditions covering the physical, ecological and socio-economic domains of environment.
- Conducting one time instrumental environmental monitoring at site covering the ambient environmental conditions.
- Evaluation of project impacts on environment & social setting.
- Conducting, recording and reporting public consultation with stockholders in the project area.
- Mitigation Measures for Adverse Impacts.
- Preparation of Environmental Management Plan (EMP) comprising:
  - Organizational structure and responsibilities
  - Mitigation Plan
  - Environmental Monitoring Plan
  - Communication and Documentation
  - Training of Staff
- Preparation and submission of Draft EIA Report based on Feasibility Report.
- Submission of Final EIA report to Client after receipts of comments.

Annex-2: National Environmental Quality Standards

REGISTERED No. M - 302
L.-7646

The Gazette of Pakistan

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ISLAMABAD, FRIDAY, NOVEMBER 26, 2010

PART II

Statutory Notifications (S. R. O.)

GOVERNMENT OF PAKISTAN

MINISTRY OF ENVIRONMENT

NOTIFICATIONS

Islamabad, the 18th October, 2010

S. R. O. 1062(I)/2010.—In exercise of the powers conferred under clause (c) of sub-section (I) of section 6 of the Pakistan Environmental Protection Act, 1997 (XXXIV of 1997), the Pakistan Environmental Protection Agency, with the prior approval of the Pakistan Environmental Protection Council, is pleased to establish the following National Environmental Quality Standards for Ambient Air.

National Environmental Quality Standards for Ambient Air

Pollutants	Time-weighted average	Concentration in Ambient Air		Method of measurement
		Effective from 1st July, 2010	Effective from 1st January 2013	
Sulphur Dioxide (SO_2)	Annual Average*	80 $\mu g/m^3$	80 $\mu g/m^3$	-Ultraviolet Fluorescence method
	24 hours**	120 $\mu g/m^3$	120 $\mu g/m^3$	
Oxides of Nitrogen as (NO)	Annual Average*	40 $\mu g/m^3$	40 $\mu g/m^3$	- Gas Phase Chemiluminescence
	24 hours**	40 $\mu g/m^3$	40 $\mu g/m^3$	

[2944(2010)/Ex. Gaz.] *Price: Rs. 5.00*

Pollutants	Time-weighted average	Concentration in Ambient Air: Effective from 1st July, 2010	Concentration in Ambient Air: Effective from 1st January 2013	Method of measurement
Oxides of Nitrogen as (NO_x)	Annual Average*	40 $\mu g/m^3$	40 $\mu g/m^3$	- Gas Phase Chemiluminescence
	24 hours**	80 $\mu g/m^3$	80 $\mu g/m^3$	
O^3	1 hour	180 $\mu g/m^3$	130 $\mu g/m^3$	-Non dispersive UV absorption method
Suspended Particulate Matter (SPM)	Annual Average*	400 $\mu g/m^3$	360 $\mu g/m^3$	- High Volume Sampling, (Average flow rate not less than 1.1 m3/minute).
	24 hours**	550 $\mu g/m^3$	500 $\mu g/m^3$	
Respirable Particulate Matter, PM_{10}	Annual Average*	200 $\mu g/m^3$	120 $\mu g/m^3$	-β Ray absorption method
	24 hours**	250 $\mu g/m^3$	150 $\mu g/m^3$	
Respirable Particulate Matter, $PM_{2.5}$	Annual Average*	25 $\mu g/m^3$	15 $\mu g/m^3$	-β Ray absorption method
	24 hours**	40 $\mu g/m^3$	35 $\mu g/m^3$	
	1 hour	25 $\mu g/m^3$	15 $\mu g/m^3$	
Lead Pb	Annual Average*	1.5 $\mu g/m^3$	1 $\mu g/m^3$	- ASS Method after sampling using EPM 2000 or equivalent Filter paper
	24 hours**	2 $\mu g/m^3$	1.5 $\mu g/m^3$	
Carbon Monoxide (CO)	8 hours**	5 mg/m^3	5 mg/m^3	- Non Dispersive Infra Red (NDIR) method
	1 hour	10 mg/m^3	10 mg/m^3	

*Annual arithmetic mean of minimum 104 measurements in a year taken twice a week 24 hourly at uniform interval.

** 24 hourly /8 hourly values should be met 98% of the in a year. 2% of the time, it may exceed but not on two consecutive days.

S. R. O. 1063(I)/2010.— In exercise of the powers conferred under clause (c) of sub-section (1) of section 6 of the Pakistan Environmental Protection Act, 1997 (XXXIV of 1997), the Pakistan Environmental Protection Agency, with the prior approval of the Pakistan Environmental Protection Council, is pleased to establish the following National Standards for Drinking Water Quality.

National Standards for Drinking Water Quality

Properties/Parameters	Standard Values for Pakistan	Who Standards	Remarks
Bacterial			
All water intended for drinking (e.Coli or Thermotolerant Coliform bacteria)	Must not be detectable in any 100 ml sample	Must not be detectable in any 100 ml sample	Most Asian countries also follow WHO standards
Treated water entering the distribution system (E.Coli or thermo tolerant coliform and total coliform bacteria)	Must not be detectable in any 100 ml sample	Must not be detectable in any 100 ml sample	Most Asian countries also follow WHO standards
Treated water in the distribution system (E. coli or thermo tolerant coliform and total coliform bacteria)	Must not be detectable in any 100 ml sample In case of large supplies, where sufficient samples are examined, must not be present in 95% of the samples taken throughout any 12-month period.	Must not be detectable in any 100 ml sample In case of large supplies, where sufficient samples are examined, must not be present in 95% of the samples taken throughout any 12 month period.	Most Asian countries also follow WHO standards
Physical			
Colour	≤ 15 TCU	≤ 15 TCU	
Taste	Non objectionable/Acceptable	Non objectionable/Acceptable	
Odour	Non objectionable/Acceptable	Non objectionable/Acceptable	
Turbidity	⟨ 5 NTU	⟨ 5 NTU	
Total hardness as $CaCO_3$	< 500 mg/l	—	
TDS	⟨ 1000	⟨ 1000	
pH	6.5 – 8.5	6.5 – 8.5	
Chemical			
Essential Inorganic	*mg/Litre*	*mg/Litre*	
Aluminium (Al) mg/l	≤ 0.2	0.2	

Properties/Parameters	Standard Values for Pakistan	Who Standards	Remarks
Antimony (Sb)	≤ 0.005 (P)	0.02	
Arsenic (As)	≤ 0.05 (P)	0.01	Standard for Pakistan similar to most Asian developing countries
Barium (Ba)	0.7	0.7	
Boron (B)	0.3	0.3	
Cadmium (Cd)	0.01	0.003	Standard for Pakistan similar to most Asian developing countries
Chloride (Cl)	< 250	250	
Chromium (Cr)	≤ 0.05	0.05	
Copper (Cu)	2	2	
Toxic Inorganic	*mg/Litre*	*mg/Litre*	
Cyanide (CN)	≤ 0.05	0.07	Standard for Pakistan similar to Asian developing countries
Fluoride (F)*	≤ 1.5	1.5	
Lead (Pb)	≤ 0.05	0.01	Standard for Pakistan similar to most Asian developing countries
Manganese (Mn)	≤ 0.5	0.5	
Mercury (Hg)	≤ 0.001	0.001	
Nickel (Ni)	≤ 0.02	0.02	
Nitrate (NO_3)*	≤ 50	50	
Nitrite (NO_2)*	≤ 3 (P)	3	
Selenium (Se)	0.01(P)	0.01	
Residual chlorine	0.2-0.5 at consumer-end 0.5-1.5 at source	—	
Zinc (Zn)	5.0	3	Standard for Pakistan similar to most Asian developing countries

* indicates priority health related inorganic constituents which need regular monitoring.

Properties/Parameters	Standard Values for Pakistan	Who Standards	Remarks
Organic			
Pesticides mg/L		PSQCA No. 4639-2004, Page No. 4 Table No. 3 Serial No. 20- 58 may be consulted.***	Annex II
Phenolic compounds (as Phenols) mg/L		≤ 0.002	
Polynuclear aromatic hydrocarbons (as PAH) g/L		0.01 (By GC/MS method)	
Radioactive			
Alpha Emitters bq/L or pCi	0.1	0.1	
Beta emitters	1	1	

*** PSQCA: Pakistan Standards Quality Control Authority.

Proviso:

The existing drinking water treatment infrastructure is not adequate to comply with WHO guidelines. The Arsenic concentrations in South Punjab and in some parts of Sindh have been found high then Revised WHO guidelines. It will take some time to control arsenic through treatment process. Lead concentration in the proposed standards is higher than WHO Guidelines. As the piping system for supply of drinking water in urban centres are generally old and will take significant resources and time to get them replaced. In the recent past, Lead was completely phased out from petroleum products to cut down Lead entering into environment. These steps will enable to achieve WHO guidelines for Arsenic, Lead, Cadmium and Zinc. However, for bottled water, WHO limits for Arsenic, Lead, Cadmium and Zinc will be applicable and PSQCA Standards for all the remaining parameters.

S. R. O. 1064(I)/2010.—In exercise of the powers conferred under clause (c) of sub-section (1) of section 6 of the Pakistan Environmental Protection Act, 1997 (XXXIV of 1997), the Pakistan Environmental Protection Agency, with the prior approval of the Pakistan Environmental Protection Council, is pleased to establish the following National Environmental Quality Standards for Noise.

National Environmental Quality Standards for Noise

S. No.	Category of Area / Zone	Effective from 1st July, 2010		Effective from 1st July, 2012	
		Limit in dB(A) Leq *			
		Day Time	Night Time	Day Time	Night Time
1.	Residential area (A)	65	50	55	45
2.	Commercial area (B)	70	60	65	55
3.	Industrial area (C)	80	75	75	65
4.	Silence Zone (D)	55	45	50	45

Note: 1. Day time hours: 6.00 a. m to 10.00 p. m.

2. Night time hours: 10.00 p. m. to 6.00 a.m.

3. Silence zone: Zones which are declared as such by the competent authority. An area comprising not less than 100 meters around hospitals, educational institutions and courts.

4. Mixed categories of areas may be declared as one of the four above-mentioned categories by the competent authority.

*dB(A) Leq: Time weighted average of the level of sound in decibels on scale A which is relatable to human hearing.

[No. F. I(12)/2010-11-General.]

MUHAMMAD KHALIL AWAN,
Section Officer (PEPC).

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NATIONAL ENVIRONMENTAL QUALITY STANDARDS FOR MOTOR VEHICLE EXHAUST AND NOISE

S. No.	Parameter	Standards (maximum permissible limit)		Measuring method
1	Smoke	40% or 2 on the Ringlemann Scale during engine acceleration mode.		To be compared with Ringlemann Chart at a distance of 6 meters or more.
2	Cardon Monoxide	Emission Standards		Under idling conditions: Non dispersive infrared detection through gas analyzer.
		New Vehicles	Used Vehicles	
		4.5%	6%	
3	Noise	85 db (A)		Sound meter at 7.5 meters from the source.

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ISLAMABD, THURSDAY, AUGUST 10, 2000

PART-II

Statutory Notification (S.R.O)

GOVERNMENT OF PAKISTAN

MINISTRY OF ENVIRONMENT, LOCAL GOVERNMENT AND RURAL DEVELOPMENT

NOTIFICATION

Islamabad, the 8th August 2000

S.R.O. 549 (I)/2000.___ In exercise of the powers conferred under clause (c) of sub-section (1) of section of 6 of the Pakistan environmental Protection Act. 1997 (XXXIV of 1997), the Pakistan Environmental Protection Agency, with the prior approval of the Pakistan Environmental Protection Council, is pleased to direct that the following further amendments shall be made in its Notification No. S.R.O. 742(I)/93, dated the 24th August, 1993, namely: ___

In the aforesaid Notification, in paragraph 2._____

[4138(2000)/Ex.GAZ]

Price : Rs. 5.00

(1) for Annex, I the following shall be substituted, namely:_____

Annex-I

"NATIONAL ENVIRONMENTAL QUALITY STANDARDS FOR MUNICIPAL AND LIQUID INDUSTRIAL EFFLUENTS (mg/I, UNLESS OTHERWISE DEFINED)

S. No.	Parameter	Existing Standards	Revised Standards Into Inland Waters	Into Sewage Treatment [5]	Into Sea [ ]
1	2	3	4	5	6
1.	Temperature or Temperature Increase *	40°C	≤3°C	≤3°C	≤3°C
2.	pH value (H^+) .	6-10	6-9	6-9	6-9
3.	Biochemical Oxygen Demand $(BOD)_5$ at 20°C [1]	80	80	250	80**
4.	Chemical Oxygen Demand (COD) [1]	150	150	400	400
5.	Total Suspended Solids (TSS)	150	200	400	200
6.	Total Dissolved Solids (TDS)	3500	3500	3500	3500
7.	Oil and Grease	10	10	10	10
8.	Phenolic compounds (as phenol)	0.1	0.1	0.3	0.3
9.	Chloride (as $C1^-$)	1000	1000	1000	SC***
10.	Fluoride (as F^-)	20	10	10	10
11.	Cyanide (as CN^-) total ..	2	1.0	1.0	1.0
12.	An-ionic detergents (as MBAS) [2]	20	20	20	20
13.	Sulphate (SO_4^{2-})	600	600	1000	SC***
14.	Sulphide (S^{2-})	1.0	1.0	1.0	1.0
15.	Ammonia (NH_3)	40	40	40	40
16.	Pesticides [3]	0.15	0.15	0.15	0.15

1	2	3	4	5	6
17.	Cadmium [4]	0.1	0.1	0.1	0.1
18.	Chromium (trivalent and hexavalent [4] ..	1.0	1.0	1.0	1.0
19.	Cooper [4]	1.0	1.0	1.0	1.0
20.	Lead [4]	0.5	0.5	0.5	0.5
21.	Mercury [4]	0.01	0.01	0.01	0.01
22.	Selenium [4]	0.5	0.5	0.5	0.5
23.	Nickel [4]	1.0	1.0	1.0	1.0
24.	Silver [4]	1.0	1.0	1.0	1.0
25.	Total toxic metals	2.0	2.0	2.0	2.0
26.	Zinc	5.0	5.0	5.0	5.0
27.	Arsenic [4]	1.0	1.0	1.0	1.0
28.	Barium [4]	1.5	1.5	1.5	1.5
29.	Iron	2.0	8.0	8.0	8.0
30.	Manganese	1.5	1.5	1.5	1.5
31.	Boron [4]	6.0	6.0	6.0	6.0
32.	Chlorine	1.0	1.0	1.0	1.0

Explanations:

1. Assuming minimum dilution 1:10 on discharge, lower ratio would attract progressively stringent standards to be determined by the Federal Environmental Protection Agency. By 1:10 dilution means, for example that for each one cubic meter of treated effluent, the recipient water body should have 10 cubic meter of water for dilution of this effluent.

2. Methylene Blue Active Substances; assuming surfactant as biodegradable.

3. Pesticides include herbicides, fungicides, and insecticides.

4. Subject to total toxic metals discharge should not exceed level given at S. N. 25.

5. Applicable only when and where sewage treatment is operational and BOD_5=80mg/l is achieved by the sewage treatment system.

6. Provided discharge is not at shore and not within 10 miles of mangrove or other important estuaries.

* The effluent should not result in temperature increase of more than 3^0C at the edge of the zone where initial mixing and dilution take place in the receiving body. In case zone is not defined, use 100 meters from the point of discharge.

** The value for industry is 200 mg/l

*** Discharge concentration at or below sea concentration (SC).

Note:_____ 1. Dilution of liquid effluents to bring them to the NEQS limiting values is not permissible through fresh water mixing with the effluent before discharging into the environment.

2. The concentration of pollutants in water being used will be substracted from the effluent for calculating the NEQS limits" and

(2) for Annex-II the following shall be substituted, namely:____

Annex-II

"NATIONAL ENVIRONMENTAL QUALITY STANDARDS FOR INDUSTRIAL GASEOUS EMISSION (mg/Nm^3, UNLESS OTHERWISE DEFINED)."

S. No.	Parameter	Source of Emission	Existing Standards	Revised Standards
1	2	3	4	5
1.	Smoke	Smoke opacity not to exceed	40% or 2 Ringlemann Scale	40% or 2 Ringlemann Scale or equivalent smoke number
2.	Particulate malter	(a) Boilers and Furnaces		
	(1)	(i) Oil fired	300	300
		(ii) Coal fired	500	500
		(iii) Cement Kilns	200	300
		(b) Grinding, crushing, Clinker coolers and Related processes, Metallurgical Processes, converter, blast furnaces and cupolas.	500	500
3.	Hydrogen Chloride	Any	400	400

1	2	3	4	5
4.	Chlorine	Any	150	150
5.	Hydrogen Fluoride	Any	150	150
6.	Hydrogen Sulphide	Any	10	10
7.	Sulphur Oxides [2][3]	Sulfuric acid/Sulphonic acid plants		
		Other Plants except power Plants operating on oil and coal	400	1700
8.	Carbon Monoxide	Any	800	800
9.	Lead	Any	50	50
10.	Mercury	Any	10	10
11.	Cadmium	Any	20	20
12.	Arsenic	Any	20	20
13.	Copper	Any	50	50
14.	Antimony	Any	20	20
15.	Zinc	Any	200	200
16.	Oxides of Nitrogen	Nitric acid manufacturing unit.	400	3000
	(3)	Other plants except power plants operating on oil or coal:		
		Gas fired	400	400
		Oil fired	-	600
		Coal fired	-	1200

Explanations:-

1. Based on the assumption that the size of the particulate is 10 micron or more.

2. Based on 1 percent Sulphur content in fuel oil. Higher content of Sulphur will case standards to be pro-rated.

3. In respect of emissions of Sulphur dioxide and Nitrogen oxides, the power plants operating on oil and coal as fuel shall in addition to National Environmental Quality Standards (NEQS) specified above, comply with the following standards:-

A. **Sulphur Dioxide**

Sulphur Dioxide Background levels Micro-gram per cubic meter (ug/m^3) Standards.

Background Air Quality (SO_2 Basis)	Annual Average	Max. 24-hours Interval	Criterion I Max. SO_2 Emission (Tons per Day Per Plant)	Criterion II Max. Allowable ground level increment to ambient (ug/m^3) (One year Average)
Unpolluted	<50	<200	500	50
Moderately Polluted*				
Low	50	200	500	50
High	100	400	100	10
Very Polluted**	>100	>400	100	10

* For intermediate values between 50 and 100 ug/m^3 linear interpolations should be used.

** No projects with Sulphur dioxide emissions will be recommended.

B. Nitrogen Oxide

Ambient air concentrations of Nitrogen oxides, expressed as NO_x should not be exceed the following:-

Annual Arithmetic Mean	100ug/m^3 (0.05 ppm)

Emission level for stationary source discharge before missing with the atmosphere, should be maintained as follows:-

For fuel fired steam generators as Nanogram (10^0-gram) per joule of heat input:

Liquid fossil fuel	130
Solid fossil fuel	300
Lignite fossil fuel	260

Note:- Dilution of gaseous emissions to bring them to the NEQS limiting value is not permissible through excess air mixing blowing before emitting into the environment.

[File No. 14(3)/98-TO-PEPC.]

HAFIZ ABDULAH AWAN
DEPUTY SECRETARY (ADMN)

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Annex-3: Letter from SNGPL

GAS HOUSE, 21 KASHMIR ROAD, P.O. BOX 56, LAHORE

Ref: CP&D/02-6906

Date: March 03, 2015

Mr. Shahid Mahmood,
General Manager / Project Manager,
National Engineering Services Pakistan (Pvt.) Ltd.
NESPAK House, 1-C, Block-N
Model Town Extension
Lahore

RLNG BASED POWER PLANTS IN PUNJAB AT BHIKKI, BALLOKI AND HAVELI BAHADAR SHAH – GAS PRESSURE AND COMPOSITION

Dear Sir,

This refers to your letter No. SA-307/165/SM/01/8233 dated 26.02.2015 on the subject cited above. The desired information is as under:

1- **Pressures at which 200 MMCFD gas will be made available to Power Plants:**

Sr. No.	Plant Location	Delivery Pressures (PSIG)	Remarks
1-	Bhikki, District Sheikhupura	300-400	Pressure at these locations may vary due to the variation in gas consumption as locations of these power plants are close to major gas consumption hubs on SNGPL system.
2-	Balloki, District Kasur	300-400	
3-	Haveli Bahadar Shah, District Jhang	500-700	

2- **Gas Composition:**

RLNG shall be fed to our system from southern side at Sawan (SNGPL's system starting point) and transported to downstream of Swan along with existing southern sources gases. Therefore, gas composition has been determined by commingling the RLNG composition with southern sources gases and shall be dependent upon Qatar Gas Source from where at present RLNG is being purchased. Net composition may change if RLNG is purchased from source other than Qatar Gas / spot purchase.

Component	Units	Composition		
		RLNG	Southern System Gas	Commingled Gas
Methane (C1)	Mole Percent	90.15	87.020	88.852 ±5%
Ethane (C2)	Mole Percent	8	1.122	5.148±5%
Propane (C3)	Mole Percent	0.25	0.266	0.257±5%
Butane and heavier (C4+)	Mole Percent	0.1	0.300	0.183±5%
Nitrogen (N2)	Mole Percent	1.5	9.496	4.815±5%
Carbon Dioxide	Mole Percent	0	1.797	0.745±5%
Gross Calorific Value	Btu/Scf	1050	916.356	950 to 1000

Telephones Exch.: (92-42)99082000, (92-42)99082006 | Telephone:+(92-42)99201376 (Direct) | Fax:+(92-42)99201834 | www.sngpl.cor

SUI NORTHERN GAS PIPELINES LTD
GAS HOUSE, 21 KASHMIR ROAD, P.O. BOX 56, LAHORE

We hope above information shall fulfill your requirement.

Regards,

Yours sincerely,
SUI NORTHERN GAS PIPELINES LTD

(Ali Hussain Qureshi)
Sr. General Manager (T)
For MANAGING DIRECTOR

Cc: DMD(Ops)
Cc: SGM(E S)
Cc: GM(Ops)
Cc: GM(P&D)

Telephones Exch: (92-42)99082000, (92-42)99082006 | Telephone:+(92-42)99201376 (Direct) | Fax:+(92-42)99201834 | www.sngpl.com

Annex-4: Environmental Monitoring, Sampling and Testing Results

Annex-2

Table 1: Ambient Air Monitoring Results

Sr. No.	Monitoring Points	Location	Pollutants							
			Duration (Average)	CO_2 (ppm)	NO (ug/m^3)	NO_2 (ug/m^3)	SO_2 (ug/m^3)	VOC's (ppm)	PM_{10} (ug/M^3)	$PM_{2.5}$ (ug/m^3)
1	AA-1	Project Area	24 Hr.	294.2	0.01	18.2	24.72	0.81	84.6	17.5
2	AA-2	Near Nimer Chemicals	24 Hr.	343.0	0.05	29.5	33.61	0.92	98.4	18.7
3	AA-3	Between Therian & Chahwaris	24 Hr.	315.6	0.03	26.2	29.90	0.89	87.6	15.1
4	AA-4	Near Bhikhi Power Plant	24Hr.	312.7	0.2	25.9	26.28	0.75	81.07	17.3
	NEQS		1 Hr	-	-	-	-	-	-	15
			8 Hr	-	-	-	-	-	-	-
			24 Hr	-	40	80	120	-	150	35

Table 2: Noise Level Monitoring Results

Sr. No	Point	Results Leq	NEQ'S			
		24 Hr. Average	Residential Area (A), Day Time	Commercial Area (B), Day Time	Industrial Area (C), Day Time	Silence Zone (D), Day Time
1	NL-01	**57.68** Nimir Chemicals	55	65	75	50
2	NL-02	**45.5** Within Project Area	55	65	75	50
3	NL-03	**50.16** Near Bhikhi Power Plant	55	65	75	50
4	NL-04	**48.02** Near Therian b/w Chahwaris	55	65	75	50
5	NL-05	**56.62** Near Nawakot	55	65	75	50
6	NL-06	**45.60** Near Therian community	55	65	75	50
7	NL-07	**45.85** Near Thathamiana Village	55	65	75	50
8	NL-08	**44.22** Near Project Area	55	65	75	50

Table 3: Drinking Water/Ground Water Sampling Results

Sr. No	Parameter	Units	GW 01 Hand Pump In Project Area	GW 02 (Within Project Boundary, Tube well)	GW 03 (Near Bhikhi, Hand Pump)	GW 04 (Near Therian Between Chahwarls, Hand Pump)	GW 05 (Near Thathamiana Village, Hand Pump)	NEQS	WHO Standards
1	Temperature (During Sample Collection)	^{o}C	20	23	22	20	21	NS	NS
2	Color	Pt-Co	2	1	N.D	N.D	11	≤15TCU	<15TCU
3	pH	pH unit	7.3	7.2	7.4	7.7	7.5	6.5-8.5	6.5-8.5
4	Turbidity	NTU	1.36	2	1	1	5	<5TCU	NS
5	Total, Hardness	mg/L	81	86	76	56	64	<500.00	NS
6	Total Dissolved Solid (TDS)	mg/L	273	562	306	211	299	<1000.00	NS
7	Total Suspended Solid (TSS)	mg/L	07	05	04	02	02	NS	NS
8	Ammonia	mg/L	N.D	N.D	N.D	N.D	N.D	NS	NS
9	Fluoride F^-	mg/L	N.D	N.D	N.D	N.D	N.D	<1.50	1.50
10	Sulfate (SO_4^{-2})	mg/L	N.D	3.9	N.D	N.D	07	NS	NS
11	Chloride(CL^-)	mg/L	62.4	45.2	38.2	31.2	0.4	<250.00	NS
12	Nitrate (NO_3)$^-$	mg/L	3.1	1.02	1.5	1.5	3.0	<50.00	50.00
13	Odor	-	OK	OK	OK	OK	OK	NS	NS
14	Taste	-	OK	OK	OK	OK	OK	NS	NS
15	Sodium	mg/L	47	29	15	27	33	NS	NS
16	Iodine	Ppm	0.09	0.21	0.08	0.05	0.09	NS	NS
17	Arsenic (As)	mg/L	N.D	0.02	N.D	N.D	N.D	00.01	00.01
18	Iron (Fe^{3+})	mg/L	0.01	0.08	0.01	0.03	0.02	NS	NS
19	Zinc (Zn^{2+})	mg/L	0.78	0.6	0.06	0.03	0.9	05.00	NS
20	Total Coli forms	cfu/100ml	N.D	N.D	N.D	N.D	N.D	0/100 ml	0/100 ml
21	Fecal Coli forms(E.Coli)	cfu/ml	N.D	N.D	N.D	N.D	N.D	0/100 ml	O

NS – No standards Available
N.D- Not Detect

Table 4: Surface Water Sampling Results

S. No	Parameter	Units	Surface Water 01 Start of Project Boundary (QB – Link Canal)	Surface Water 02 QB Link Canal before Regulator	Surface Water 03 (Near Railway Track (QB Link Canal)	Surface Water 04 (Thathamiana (Water Channel)	Surface Water 05 (Bhikhi (Water Channel)	Surface Water 06 Therian (Water Channel)
1)	Temperature Difference	^{o}C	22	22	22	23	23	23
2)	pH	pH unit	8.2	8.0	7.7	6.9	7.5	7.7
3)	COD	mg/L	183	178	141	171	165	177
4)	(BOD_5)	mg/L	130.7	127.1	100.7	122.1	117.8	126.4
5)	Solids, Total dissolved (TDS)	mg/L	1543	1807	1399	1060	1340	1521
6)	Solids, Total suspended (TSS)	mg/L	107	175	59	167	139	143
7)	Chloride	mg/L	0.9	0.4	0.1	0.1	0.2	0.05
8)	Fluoride (F^-)	mg/L	N.D	N.D	N.D	N.D	N.D	N.D
9)	Oil & grease	mg/L	0.005	N.D	N.D	N.D	N.D	0.007
10)	Phenols, Total (Phenolic Compounds)	mg/L	N.D	N.D	N.D	N.D	N.D	N.D
11)	Cyanide(CN-)	mg/L	0.001	0.001	0.002	N.D	N.D	N.D
12)	Anionic Detergents as MBAS	mg/L	N.D	N.D	N.D	N.D	N.D	0.001
13)	Sulfate (SO_4^{-2})	mg/L	N.D	13.3	N.D	N.D	N.D	N.D
14)	Sulfide (S)	mg/L	0.06	0.01	N.D	0.03	0.01	0.01
15)	Ammonia NH_3	mg/L	0.5	0.2	N.D	0.1	0.002	0.001
16)	Cadmium (Cd)	mg/L	N.D	N.D	N.D	N.D	N.D	N.D

17)	**Chromium (Cr) as Hexavalent & Trivalent**	mg/L	N.D	N.D	N.D	N.D	N.D	N.D
18)	**Copper (Cu)**	mg/L	N.D	N.D	N.D	N.D	N.D	N.D
19)	**Lead**	mg/L	0.003	0.006	N.D	0.001	0.001	0.001
20)	**Nickel**	mg/L	0.014	0.024	N.D	0.03	0.01	N.D
21)	**Zinc**	mg/L	3.5	4.3	5.4	0.4	0.3	0.3
22)	**Iron**	mg/L	0.06	0.06	0.01	0.007	0.005	0.005
23)	**Manganese**	mg/L	0.3	0.3	0.01	N.D	N.D	N.D
24)	**Selenium**	mg/L	0.02	0.04	0.09	0.05	0.02	0.01
25)	**Silver**	mg/L	N.D	N.D	N.D	N.D	N.D	N.D
26)	**Arsenic**	mg/L	N.D	N.D	N.D	N.D	N.D	0.03
27)	**Barium**	mg/L	0.3	0.3	N.D	N.D	N.D	N.D
28)	**Boron**	mg/L	0.1	0.2	1.1	N.D	N.D	N.D
29)	**Mercury**	mg/L	N.D	N.D	N.D	N.D	N.D	N.D
30)	**Chlorine**	mg/L	N.D	N.D	N.D	N.D	N.D	N.D
31)	**Total Toxic Metals**	mg/L	N.D	0.002	N.D	0.007	N.D	0.001
32)	**Turbidity**	NTU	33	35	43	39	46	41
33)	**Oxygen, Dissolved**	mg/L	5.4	5.4	5.4	47	56	75
34)	**Pesticides**	µg/L	0.09	N.D	N.D	N.D	0.007	0.002
35)	**Nutrients as Potassium**	mg/L	N.D	0.02	N.D	N.D	N.D	0.001
36)	**Nutrients as Nitrogen**	mg/L	N.D	0.3	N.D	N.D	N.D	N.D
37)	**Nutrients as Phosphorous**	mg/L	N.D	0.005	N.D	0.003	N.D	N.D

NS- no Standards Available
N.D- Not Detected

Table 5: Waste Water Sampling Results

S. No	Parameter	Units	Waste Water 01 (Bhikhi Pond)	Waste Water 02 (Chah Waris Pond)	Waste Water 03 (Thathamiana Pond)	Waste Water 04 (Drain)	NEQS For Inland Discharge
1)	Temperature Difference	^{o}C	21	21	22	22	≤3
2)	pH	pH unit	8.3	8.1	7.9	11.9	6-9
3)	COD	mg/L	288	278	296	276	150
4)	(BOD_5)	mg/L	205.7	198	211.4	197.1	80
5)	Solids, Total dissolved (TDS)	mg/L	1727	1339	948	1996	3500
6)	Solids, Total suspended (TSS)	mg/L	77	86	82	192	200
7)	Chloride	mg/L	09	11	24.2	14.3	1000
8)	Fluoride (F^-)	mg/L	N.D	N.D	N.D	0.09	10
9)	Oil & grease	mg/L	N.D	N.D	N.D	3.9	10
10)	Phenols, Total (Phenolic Compounds)	mg/L	N.D	N.D	N.D	0.075	0.10
11)	Cyanide(CN-)	mg/L	0.002	0.003	0.048	0.008	01.00
12)	Anionic Detergents as MBAS	mg/L	N.D	N.D	N.D	13	20.00
13)	Sulfate (SO_4^{-2})	mg/L	N.D	17.7	12.5	113.7	600
14)	Sulfide (S)	mg/L	N.D	N.D	0.4	0.9	01.00
15)	Ammonia NH_3	mg/L	N.D	N.D	2.2	N.D	40.00
16)	Cadmium (Cd)	mg/L	N.D	N.D	N.D	0.005	0.10
17)	Chromium (Cr) as	mg/L	0.004	0.008	N.D	0.9	01.00

	Hexavalent & Trivalent						
18)	**Copper (Cu)**	mg/L	N.D	N.D	N.D	N.D	01.00
19)	**Lead**	mg/L	0.015	0.067	0.11	0.1	0.50
20)	**Nickel**	mg/L	0.32	0.212	0.33	N.D	01.00
21)	**Zinc**	mg/L	0.01	0.32	0.47	0.07	05.00
22)	**Iron**	mg/L	N.D	0.78	1.1	1.02	08.00
23)	**Manganese**	mg/L	2.1	N.D	N.D	N.D	01.50
24)	**Selenium**	mg/L	0.30	0.90	0.7	N.D	00.50
25)	**Silver**	mg/L	N.D	N.D	N.D	N.D	01.00
26)	**Arsenic**	mg/L	2.5	0.04	N.D	0.58	01.00
27)	**Barium**	mg/L	0.44	4.8	1.9	0.09	01.50
28)	**Boron**	mg/L	N.D	3.7	5.7	1.7	06.00
29)	**Mercury**	mg/L	N.D	N.D	N.D	0.01	0.01
30)	**Chlorine**	mg/L	0.12	N.D	N.D	N.D	01.00
31)	**Total Toxic Metal**	mg/L	N.D	N.D	N.D	0.9	02.00
32)	**Turbidity**	NTU	49	31	39	71	NS
33)	**Oxygen, Dissolved**	mg/L	0.19	7.4	9.1	92	NS
34)	**Pesticides**	µg/L	0.09	N.D	N.D	0.09	NS
35)	**Nutrients as Potassium**	mg/L	N.D	0.001	0.007	0.09	--
36)	**Nutrients as Nitrogen**	mg/L	0.7	0.7	0.9	1.9	--
37)	**Nutrients as Phosphorous**	mg/L	0.009	0.005	0.06	0.2	--

NS- No Standards Available
N.D- Not Detected