DHA Cogen Ltd. Power
and Desalination Unit

Karachi, Pakistan

ESIA & Audit Report

January 2013

FOR PRESENTATION TO

OPIC

PREPARED BY

ECTECH
Environment Consultants

ON BEHALF OF

INTERNATIONAL ELECTRIC POWER

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Annex E 2008 Environmental Compliance Audit Report

Annex F DCL Pakistan EPA Approval

LIST OF ACRONYMS

In most cases, the acronym is defined once in the document and used throughout. This list is provided for reference:

BDL	Below Detection Limits
BOO	Build-Own-Operate
BOOT	Build-Own-Operate-Transfer
CA	Competent Authority
CBC	Cantonment Board Clifton
CCD	Convention to Combat Ozone Depletion
CCGT	Combined Cycle Gas Turbine
CCPP	Combined Cycle Power Plant
CDS	College of Digital Sciences
CEO	Chief Executive Officer
CITS	Convention of International Trade in Endangered Species
CLP	Combined Local Control Panel
DACB	Defense Authority College of Business
DCL	DHA Cogen Limited
DHA	Defence Housing Authority
EA	Environmental Assessment
ECAR	Environmental Compliance Audit Report
EHS	Environmental, Health, and Safety
EIA	Environmental Impact Assessment
EMMP	Environmental Management and Monitoring Plan
EMP	Environmental Management Plan
EMtP	Environmental Monitoring Plan
EOI	Expression of Interest
EPA	Pakistan Environmental Protection Agency
EPC	Environmental Protection Council
ERP	Emergency Response Plan

ESIA	Environmental & Social Impact Assessment
ESMP	Environmental & Social Management Plan
ESPS	Environmental and Social Policy Statement
ET	Environment Tribunal
FAA	Foreign Assistance Act
FATA	Federally Administered Tribal Areas
GHGs	Greenhouse Gases
GIIP	Good International Industry Practice
GoP	Government of Pakistan
GPA	Gas Purchase Agreement
GT	Gas Turbine
GTPS	Gas Turbine Power Station
GTS	Gas Turbine Station
HRSG	Heat Recovery Steam Generator
HSD	High Speed Diesel Oil
IDA	Initial Depreciation Allowance
IEE	Initial Environmental Examination
IEP	International Electric Power, LLC
IFC	International Finance Corporation
IPPs	Independent Power Producers
IPWP	Independent Power and Water Producer
ITTMF	Institute of Textile Technology and Management Foundation
IUCN	International Union for Conservation of Nature and Natural Resources
KESC	Karachi Electric Supply Company
KFH	Karachi Fish Harbour
KPI	Key Performance Indicators
LAA	Land Acquisition Act
LCC	Lower Chenab Canal
LOI	Letter of Intent
MCC	Motor Control Centre

MED	Multi Effect Desalination Plant
MIGD	Million Imperial Gallons per Day
MOCC	Ministry of Climate Change
MSY	Maximum Sustainable Yield
NCS	National Conservation Strategy
NEPRA	National Electric Power Regulatory Authority
NEQS	National Environment Quality Standards
NOC	No-Objection Certificate
NGO	Non-Government Organization
NTDC	National Transmission and Dispatch Company
OPIC	Oversees Private Investment Corporation
PC	Public Consultation
PCSIR	Pakistan Council of Scientific and Industrial Research
PEPA	Pakistan Environmental Protection Act
PEPO	Pakistan Environmental Protection Ordinance
PH	Public Hearing
PKR	Pakistani Rupees
PM	Particulate Matter
POPs	Persistent Organic pollutants
PPC	Pakistan Penal Code
PPE	Personnel Protection Equipment
PPIB	Private Power and Infrastructure Board
PPM	Power Plant Manager
Provincial EPA	Provincial Environmental Protection Agency
P&D	Planning and Development
RAP	Resettlement Action Plan
RFP	Request for Proposals
RITP	Resource Implementation and Training Program
SDPI	Sustainable Development Policy Institute
SEPA	Sindh Environmental Protection Agency

SIA	Social Impact Assessment
SMART	Self-Monitoring and Reporting
SMP	Social Management Plan
SPM	Suspended Particulate Matter
SSGCL	Sui Southern Gas Company Limited
TD	Thermal Discharge
TDS	Total Dissolved Solids
TSP	Total Suspended Particulate (aka TSS)
TSS	Total Suspended Solids (aka TSP)
WAPDA	Water and Power Development Authority
WDU	Water Desalination Unit
WESMP	Working Environment Safety Monitoring Program
WHO	World Health Organization
WWF	World Wide Fund for Nature

1 EXECUTIVE SUMMARY

1 INTRODUCTION

ECTECH Environmental Consultants (ECTECH) is pleased to present this summary of findings of an Environmental and Social Impact Assessment (ESIA) undertaken for the Defence Housing Authority (DHA) Cogen Limited (DCL) Power and Desalination Unit on November 15-17, 2012. The findings of this study supplement those previously attained in the Environmental Impact Assessment (EIA) conducted in October 2004 prior to construction and the Environmental Compliance Audit Report (ECAR) conducted in September 2008, once the facility was commissioned and in operations. Data from these efforts was used to conclude the findings of this ESIA. As in the previous studies, the conclusions of this assessment found no significant impacts that would not be addressed when DCL is rehabilitated and once again operational. In order to facilitate review, **Table 1.1** (on pages 1.13-1.18) consolidates the relevant information collected in the current and past studies and provides summary conclusions pertinent to this ESIA.

The Project

DCL is a Public Limited Company incorporated on January 19, 2003 in Karachi, Pakistan. DCL commissioned a power generation and water desalination Complex (the Complex) in April 2008 to fulfill the needs of the DHA. The Complex generates power using a Combined Cycle Gas Turbine (CCGT) unit designed for a rated electrical output of approximately 86.2MW (gross load at design conditions) or 94MW (ISO conditions). The Complex also integrates Alfa Laval technology for seawater desalination of 3.0Mgal/day.

The Complex is located at Plot No. DSL -1, Coastal Avenue, DHA, Housing Society, Phase-VIII, Karachi, Pakistan and began commercial operation on April 17, 2008. The Complex encountered technical faults resulting in several shut down periods; from September 12, 2008 to August 14, 2009 (51 weeks, 4 days), November 2, 2009 to February 18, 2010 (15 weeks, 4 days) and May 1, 2010 to December 7, 2012 (153 weeks, 1 day). The Complex remains shut down pending rehabilitation.

The Complex is situated in Karachi on the Arabian Sea. The nearest residential area is approximately 5km from the site. There is neither wildlife nor fish of commercial value in, or around, the site. There is no forest located on, or near, the site.

International Electric Power, LLC (IEP) is a Limited Liability Company (LLC) incorporated in Delaware, USA, which is in the process of acquiring a controlling interest in DCL in order to rehabilitate and operate the Complex. The Complex rehabilitation program, which will be led by DCL, will take place over a six month period following financial close and include the following:

- Replacement of all compressor stages with coated blades and vanes in order to better withstand the relatively harsh ambient conditions at the Complex; this should alleviate one of the factors which historically caused surge problems at the Complex
- Replacement of existing air filtration system with a system specifically designed for the humid seaside environment of the Complex; this will help maintain blade and vane integrity for longer periods of time between overhauls
- Modifying the control and early warning systems such that the Complex operating personnel can be alerted to situations in which surges may occur and take the necessary actions to avert surges and/or protect the Complex in the event surges do occur
- Investment in certain Complex system redundancies and a strategic supply of spare parts in order to increase the efficiency and availability of the Complex
- Repair of exposed insulation in certain areas and similar minor maintenance

On September 13, 2012, DCL submitted a petition to the National Electric Power Regulatory Authority (NEPRA) for Approval/Determination of Tariff for DHA Cogen Ltd. post rehabilitation. NEPRA admitted the tariff petition for consideration via their letter No. NEPRA/TRF-224/DCL-2012/10130 and called for a public hearing on November 28, 2012. The public meeting took place on Nov 28, 2012 which was attended by representatives from IEP, SSGC, KESC, local press and public interveners. Following the meeting NEPRA asked certain explanations/information to further process the case via their letter No. NEPRA/TRF-224/DCL-2012/10739. DCL provided answers to all sixteen questions asked by NEPRA on December 21, 2012.

Environmental and Social Impact Assessment Scope

The original ESIA report (2004) for the DCL Complex was prepared by ECTECH, located at Suite 4, 2nd Floor, Link Arcade, Model Town Link Road, Lahore, Pakistan. IEP has re-engaged ECTECH to examine the findings of the 2004 EIA and 2008 ECAR to produce the updated ESIA contained herein.

The Complex is considered to be a Category A Project under the Equator Principles. This ESIA provides a level of detail suitable for Category A projects in full accordance with the applicable Equator Principles, which includes the following process:

<u>Screening Stage:</u>

Because of the rehabilitation envisioned and the impending change of ownership, an updated ESIA is required in addition to the original 2004 EIA and

2008 ECAR to demonstrate compliance with the World Bank, International Finance Corporation (IFC), and Overseas Private Investment Corporation (OPIC) Performance Standards and Guidelines.

Scoping Stage:
This step in the process allows interested and affected parties to participate in the ESIA process. ECTECH canvassed potential stakeholders related to the Complex, documented the findings and used the information to complete this ESIA.

Data Collection:
Collection of sound baseline data is a key element to completing the assessment and recommending any corrective actions necessary. Since ECTECH is producing an updated 2013 ESIA, it has utilized past data from the 2004 EIA and 2008 ECAR and current data collected in November 2012 to serve as the baseline.

Impact Analysis:
ECTECH used the data generated through the collection process and compared the findings against the regulatory framework governing the Complex to determine social and environment impacts.

Mitigation and Monitoring of Impacts:
Depending upon the data, severity of the impacts, and regulatory requirements, ECTECH has recommended mitigation and/or monitoring efforts. Certain findings will require continuous monitoring in accordance with an Environmental Management and Monitoring Program (EMMP) for the Complex.

ESIA Summary Document:
ECTECH has prepared an Executive Summary of the ESIA findings to facilitate review by relevant Pakistani Ministries and OPIC.

2 POLICY AND LEGAL ADMINISTRATIVE FRAMEWORK

The ESIA has considered all legislation identified as relevant to the Complex including that identified by OPIC, IEP, and ECTECH. The following policies, guidelines and legislation have been examined by ECTECH to determine the level of compliance of the Complex.

During its operational phase, DCL held an exemplarily record of compliance and never received any violations.

Compliance to National and Local Legislation
Environmental approval was obtained for the original construction of the Complex. While it is not mandatory to seek approval of this ESIA from the EPA or

Governments of Karachi or Sindh, DCL is committed to working with those bodies to provide opportunities for public postings and public hearings. Upon rehabilitation, the plant will achieve ISO 14001 certification. The ESIA complies with the following applicable Pakistani and local legislation:

- Pakistan Environmental Protection Act (1997)
- Pakistan Industrial Relations Ordinance (2011)

Compliance with International Standards

The ESIA complies with the following international standards:

- OPIC - Environmental and Social Policy Statement (October 15, 2010)
- IFC Performance Standards and Guidance Notes (2012)
- IFC Performance Standards on Environmental and Social Sustainability (January 1, 2012)
- IFC Environmental, Health, and Safety Guidelines for Thermal Power Plants (December 19, 2008)
- IFC Access to Information Policy (January 1, 2012)
- IFC Environmental, Health, and Safety Guidelines, General EHS Guidelines: Environmental Air Emissions and Ambient Air Quality (April 30, 2007)
- International Organization for Standardization (ISO) 14000 Standards
- IFC Environmental, Health, and Safety Guidelines for Electric Power Transmission and Distribution, (April 30, 2007)
- The Workmen's Compensation Act, (1923)
- The Factories Act, (1934)
- The Industrial Relations Ordinance, (2002)
- National Fire Protection Association, (2013)

Public Disclosure

DCL has led and conducted a full and proper public disclosure of the ESIA process and final report to Government Ministries and Agencies, NGOs, Multilateral Institutions, and members of the general public. Upon submission to OPIC, OPIC will post this ESIA on its website.

3 DEMAND ANALYSIS

The ESIA concluded that there is a scarcity of both power and water in Pakistan and that the lack of these resources is a real and substantial impediment to the nation's growth and security. Additional electric power and potable water must be supplied; without these critical elements, the economy of Pakistan will continue to suffer.

Pakistan currently faces severe power shortages, which results in load shedding and unreliable power delivery. Unreliability and unavailability of power has led businesses to fail and Pakistani families to struggle. This shortage is well documented by the Government of Pakistan (GoP) and is estimated at over 6,000MW. Refer to **Table 4.15** for details.

According to a United Nations report, Pakistan is facing a growing threat of water scarcity, with estimated per-capita water availability of less than 1,000m^3. The World Bank agrees, reporting that Pakistan is among 17 countries that are at risk for a severe water shortage by 2025. Refer to **Table 4.16** for details.

4 COMPLEX DETAILS

Major Components

Major components of the Power Plant are shown in **Table 1.2**.

Table 1.2 Power Plant Components

Equipment	Specifics	Supplier
Gas Turbine (GT)	V 64.3A (67MW)	Siemens Germany
Steam Turbine (ST)	NK40/56 (27MW)	Siemens Germany
Boiler	HRSG (110 tons/h)	Babcock-Hitachi
Fuel	Natural Gas	SSGCL Karachi
GT Stack	33.5m height	-
Balance of Plant	-	Various Suppliers

The fuel gas for the Complex is supplied by the Sui Southern Gas Company Limited (SSGCL) via a 20 inch diameter gas pipeline in accordance with the Gas Purchase Agreement (GPA) signed between SSGCL and DCL on 31st May, 2005. The system supplies a total of 17.5mmcf/day of Natural Gas with calorific value of 40743.9kJ/kg. SSGCL has its own substation within the four walls of the Complex, which is duly protected and guarded by a fence and security personnel.

The Alfa Laval Desalination Plant will provide 3 million gal/day of potable water. Its main components are listed below:

- Fine Filtration Unit to filter feed water down to 30 microns
- Automatic final filter, for filtration of feed water to desalination
- Evaporator with titanium plate heat exchanger of the falling film type
- Set of high efficiency chevron type polypropylene demisters
- Condenser, shell and tube type
- Distillate pump, centrifugal type, complete with spacer coupling and electrical motor mounted on steel base plate
- Brine pump, centrifugal type
- Seawater boost pump, centrifugal type

- Condensate pump, centrifugal type
- Seawater and brine piping in Glass Fiber Reinforced Plastics (GRP)
- Distillate and condensate piping in stainless steel
- Steam piping in carbon steel
- Vacuum system consisting of steam ejector system and vent condenser
- Set of instruments of Alfa Laval standards
- Combined Local Control Panel (CLP) and Motor Control Center (MCC)
- Remote control unit
- Set of cables, cable trays and junction boxes
- Set of valves meeting Alfa Laval standards
- Alfa Laval chemical dosing station for sodium hypochlorite solution
- Water filtration system
- Distillate coolers, to reduce distillate temperature

Complex Operations

The Complex will be used for base load generation. When operational, it will produce power that will be transformed and transmitted through existing 132kV underground transmission lines to the existing 132kV Defense Grid and 132kV Creek City Grid situated at distances of about 6.2km and 4.0km, respectively, from the Complex. The GoP forecasts acute power shortages across the country past 2020. Hence, due to the severity of the power shortage in Karachi, power demand is very high; no power surplus is expected.

The potable water produced will be transported through its existing underground water transmission line connected to the main operational water transmission line of the Cantonment Board Clifton (CBC) interfacing at the boundary of the Complex. Analysts at Maplecraft place Pakistan as the 6th most at-risk country in the world facing acute water shortages.[1] Due to the severity of potable water in Karachi, no surplus of desalinated water is expected.

The Complex will be operated by approximately 100 staff with 26 operations personnel on two 12 hour shifts, for 365 days per year.

The ESIA has assumed that the Complex will operate at capacity throughout the year.

[1] http://www.globalresearch.ca/top-ten-countries-at-risk-of-water-shortages/19996

5 ENVIRONMENTAL BASELINE AND POTENTIAL IMPACTS

Baseline Air Quality and Gaseous Emissions Mitigation

Table 1.3 shows the concentration of air emissions measured on November 16-17, 2012 on the road separating the Complex office from the undeveloped DHA grid:

Table 1.3 Ambient Air Monitoring Sampling

Substance	Concentration (BDL – Below Detection Limits)
Sulfur dioxide (SO_2)	<10 µg/m^3 (BDL)
Nitrogen oxides (NO_x)	<6.0 µg/m^3 (BDL)
Carbon monoxide (CO)	<20 µg/m^3 (BDL)
Total Suspended Particulates (TSP)	52.33-62.13 µg/m^3 (24h/8h average)

The average concentration of Carbon Dioxide (CO_2) in the ambient air of Karachi is about 0.391%.

During earlier operations of the Complex, gaseous emissions monitoring was conducted by ECTECH on August 25-27, 2008 and by PERAC Research and Development (PERAC) on August 11, 2008. Emissions of NO_x at the GT stack were measured at 210.0 to 229.0mg/m^3 in the initial test, and 39.0 mg/m^3 in the subsequent test.

The data indicates that the 39.0 mg/m^3 concentration level was in compliance with National Environment Quality Standards (NEQS) limits of 400 mg/m^3 and IFC EHSG limits of 51.0mg/m^3, while the 210.0 to 229.0 mg/m^3 concentration levels were within NEQS limits only.

A further examination of the operational records of the Complex during the two sampling events revealed that the Complex was functioning at suboptimal conditions during the August 25-27, 2008 sampling, which resulted in the higher NO_x emissions (210.0 to 229.0 mg/m^3). During this period, the Complex was undergoing "balancing" by Siemens, which required the unit to be started and turned off several times and tested at various outputs between 30MW and 58MW. Hence, any such test should not have been conducted and these results have been eliminated from ECTECH's evaluation for the ESIA.

The sampling by PERAC on August 11, 2008, which resulted in lower NO_x emissions (39.0 mg/m^3) was conducted under optimal conditions at loads ranging from 75 to 79MW, maintained for a period of 24 hours in steady state operation. Thus, ECTECH regards this sample as valid for the ESIA and should be used.

Table 1.4 Stack Emissions Measurements			
Gaseous Emission	**Stack Measurement**	**IFC Guideline**	**NEQS Limit**
NO_x	39 mg/m^3	51 mg/m^3	400 mg/m^3
CO	310 mg/m^3	-	800 mg/m^3
SO_2	0 mg/m^3	-	1700 mg/m^3

Once operational, the Complex will be subject to further sampling and analysis in accordance with the Environmental Monitoring and Management Plan (EMMP), where DCL will quantify and monitor, on a routine basis, the emissions of Greenhouse Gasses (GHGs).

Baseline Water Quality and Liquid Waste Management

Approximately 13.3% of the intake seawater of the Complex will be used for desalination. The remainder will be discharged in the form of brine without any additional pollutants.

The mass balance for TDS in the effluent of the Complex has been calculated with the worst possible conditions in place. **Table 1.5** shows the results as analyzed by Alfa Laval Process Flow Diagram, Rev. 3, which do not exceeded the NEQS Total Dissolved Solids (TDS) limits of 3500mg/L. The complete calculation for TDS is included as **Annex 4.2: Mass Balance for Outfall TDS**.

Table 1.5 Brine and Seawater Concentrations Total Dissolved Solids (TDS)			
TDS in Seawater Intake	**Total Effluent TDS**	**Brine TDS less Control TDS**	**NEQS TDS Contribution Limit**
45000.0mg/L	48164.97mg/L	3164.97mg/L	3500.0mg/L

By design, the brine from each train is sent to a Fine Filtration Tank where it is first mixed with a large quantity of cooling/sea water originating from other points of the Complex before falling into the sea from the outfall pipe. Based on this design, the TDS of returning water should continue to achieve a TDS well below NEQS limits under the worst conditions. Varying the volumes of sea water in the dilution process becomes the most effective method of controlling discharge concentrations.

Thermal Discharge (TD) in the form of once-through cooling water will be released from the Complex at a temperature of 42°C as compared to the seawater surface and subsurface temperature of 31°C (2004 EIA). By design, the TD water purposefully falls onto large boulders, which causes aeration and heat dissipation. As a result, the discharge water temperature drops considerably before coming in contact with the sea surface interface and is within NEQS limits.

The 2008 ECAR further supported the efficiency of the system through behavior temperature measurements taken at various locations beyond the seawater interface. Through advanced water dispersion modeling (included as **Annex 5.2**), it was found that TD becomes equalized at approximately 35 meters from shore. This constitutes the mixing zone and there are no sensitive ecosystems in this area. Refer to **Figure 1.1** for an image of the discharge pipe (in blue) and the boulders leading to the sea.

Figure 1.1: Discharge Pipe and Boulders

The point of discharge for TD from the Complex is not directly into the sea, but on the shore 15-20m away. The system is in compliance with NEQS standards based upon the 2004 EIA and its efficiency is not in question. This method of reducing thermal discharge is acceptable since extending the discharge pipe over the sea would increase the intensity of thermal discharge. Nevertheless, TD is generally of more concern with inland lakes and rivers. Due to the relatively small mixing zone of 35m and the absence of significant aquatic life in the area, TD is not expected to have any appreciable impact on the Arabian Sea. This cooling of steam is acceptable since extending the discharge pipe onto the sea floor is likely to cause greater impacts to the ecosystem and would raise the risks associated with human activity in the future. The EMMP will provide continuous data to demonstrate the effectiveness of the system. As a result of the closed once-through cooling design, no pollutants are added to the seawater by the Complex.

Solid Waste Management and Hazardous Materials Control

ECTECH has determined that the Solid and Hazardous Waste Management Program (SHWMP) is in compliance with required standards and has observed that DCL is committed to minimizing the generation of hazardous and non-hazardous wastes. All solid and hazardous waste produced by the Complex is currently managed through a certified waste management contractor, Urba Marker Pvt., which is responsible for collecting, processing and disposing of the waste according to internationally recognized standards for environmental sustainability. Disposal of non-hazardous waste occurs at an approved facility at Tool Plaza in Karachi, while disposal of hazardous waste takes place at Mataro Moar in Sindh. Urba Marker is a premier waste management contractor in Pakistan; its clients include British Petroleum, etc. Urba Marker is in the process of obtaining the necessary international licenses. If Urba Marker is unable to obtain those licenses, DCL has other options for waste disposal, such as contracting through Global Environmental Management Services (GEMS) or Waste Management Company (WMC), which do meet international standards.

In addition, DCL operational protocol emphasizes avoiding:

- The use of ozone-depleting substances such as Freon and Polychlorinated Biphenyls (PCBs), as well as asbestos
- The use of pesticides and any products classified by the World Health Organization as Hazard Class Ia, Ib, or II

And will be strengthened by:

- Implementing a Spill Prevention and Response Program (SPRP) for hazardous materials stored and used at the Complex
- Improving waste segregation at the Complex, which lessens the uncertainties that may exist when allowing segregation to occur at a certified disposal site outside of the Complex

Noise

The range of baseline noise levels were established by conducting sampling outside of the four boundary walls and at the nearest DHA residential locations to the Complex. Sampling programs were conducted on November 16 and 17, 2012 (while the Complex was not operating) and on August 25 to 27, 2008 (while the Complex was operating). **Table 1.6** shows the resulting noise levels, which ECTECH has concluded are below IFC guidelines.

Table 1.6 Noise Measurements		
	Baseline Noise at Boundary Walls (2012)	**Noise at Boundary Walls During Operation (2008)**
Low	36.31dBA	62.0dBA
High	47.98dBA	80.0dBA[2]
	Noise at DHA Residential Area During Operation (2008)	**IFC Residential Noise Limit**
Night	38.6dBA	45dBA
Day	50.1dBA	55dBA

Occupational Health and Safety

DCL follows the Industrial Relations Ordinance and the Provincial Employees Social Security Ordinance for working conditions and abides by the National Fire Protection Association Codes and Standards. This includes policies and procedures for non-discrimination, equal opportunity, retirement, and grievances. Non-employment of child and forced labor is strictly enforced.

DCL recognizes the potential hazards to employees at thermal power plants, including non-ionizing radiation, heat, noise, confined spaces, electrical hazards, fire and explosion hazards, chemical hazards, and dust. To further protect against hazards, adequate Personnel Protection Equipment (PPE) is provided to employees of DCL and its use is mandatory. Employees receive safety and procedural training. Medical emergency equipment such as first aid boxes, BP measuring equipment, stretcher and ambulance are made available. While accident avoidance is a priority at the Complex, the details of accidents are recorded for training and comparison purposes. Please refer to Chapter 6 for detailed tables demonstrating compliance with Section 2 of IFC General EHS Guidelines.

In order to assure continued compliance once the Complex is again operational, DCL will also implement a Working Environment Safety Monitoring Program (WESMP) to evaluate occupational health and safety performance against internationally published guidelines.

Community Health and Safety

No inherent risk to the health and safety of the community will exist once the Complex is operational. DCL is committed to avoiding or minimizing any adverse impacts of Complex operations on air, soil, water, and other natural resources in

[2] The noise measurement of 80dBA was taken on-site and at the boundary walls of the Complex. Therefore, it does not violate IFC General EHS guidelines for noise, which mandate a maximum of 70dBA at the nearest receptor location *off-site*. Nevertheless, the noise produced by the Complex will be reduced considerably by optimization and tuning of the turbine and generators during the rehabilitation phase.

use by adjacent communities. Complex activities do not have the potential for community exposure to waterborne, airborne, or other communicable diseases. The use of water by the Complex will not compromise the availability of water for personal hygiene, agriculture, recreation, or other community needs. The Complex will in fact have a positive impact by providing 3.0 million gallons of potable water per day to the community.

There are no existing buildings adjacent to the Complex. There is no significant brush that could support the spread of a fire to any other building. Therefore, the effect of a fire spreading in the area is minimal.

There is a modest average traffic rate of 180 vehicles per hour on the main road to the East of the Complex during the day (10:00-16:00). Around 20:00, traffic increases to approximately 390 vehicles per hour due to nightlife and dining. The adjoining restaurants have one year left on their lease and according to the landowners, DHA, they will not be renewed as they are considering other development opportunities for the area. The increased traffic flow does not create congestion problems. This road and others in the surrounding area are well-designed for increased traffic volume. During the rehabilitation and subsequent commencement of commercial operations, the slightly increased occasional traffic of heavy trucks and equipment associated with Complex operations will occur mostly during the day and thus, given the modest traffic rate of 180 vehicles per hour, will not have an appreciable impact on the local community. The expected modest increase during the day will be approximately 10-15% of current levels and thus will not reach nighttime levels of 390 vehicles per hour.

Public consultations and disclosures were conducted to inform local stakeholders and community members of the project and to garner their opinions on the subject. A diverse range of community members were interviewed, and the response for rehabilitation and operation of the Complex was overwhelmingly positive. Refer to Chapter 8 of this ESIA for details of public consultations and disclosures.

Security

As part of its ongoing operations, DCL contracts security services from registered and approved agencies. As the Complex becomes operational, these services will be augmented as necessary to assure robust coverage. Security services will conform to international practices and all applicable law. In addition, DHA maintains a Vigilance force that monitors activities in the DHA area.

Ecology and Biodiversity

It is clear that rehabilitation and operation of the Complex will not lead to any destruction of habitat or threat to biodiversity. The Complex was originally

constructed on reclaimed land and does not occupy critical habitat areas or legally protected areas. Very little biodiversity exists at the site and in the nearby seawater. No alien species will be introduced to the site.

Land Use, Cultural Heritage and Indigenous Peoples

According to definition, no Cultural Heritage artifacts or lands exist at the site. Should any items of Cultural Heritage be discovered, DCL is committed to protecting and preserving those items.

Phase VIII of the DHA is located on reclaimed land and as such there are no Indigenous People on, or around, the site and the original acquisition of land by DCL did not involve any relocation of people from traditional or customary lands. The land transaction was completed voluntarily, according to established pricing metrics at the time. Complex activities are not expected to adversely impact the cultural, ceremonial, or spiritual livelihoods of any peoples.

6 ENVIRONMENTAL MANAGEMENT AND MONITORING PROGRAM

A Resources Implementation and Training Program (RITP) is included in the EMMP for documenting environmental compliance status. The EMMP also meets the requirements of ISO 14001 certification. After rehabilitation, DCL will begin the process to earn ISO 14001 certification.

Under the EMMP, DCL will report on a monthly basis using Self-Monitoring, Analysis and Reporting Technology (SMART). The EMMP includes an audit program, with public consultations from the administration of DHA, Residents of DHA Housing Society, real estate agents, money exchangers, shopkeepers, petrol pump owners, food shops, Cantonment Board Clifton, and NGOs. ECTECH has included comments from these parties in Chapter 8 of this document.

The EMMP includes specific emergency procedures defining control mechanisms and operational requirements, as well as a training program for workers to ensure appropriate response in case of accidental events.

7 CONCLUSIONS

Based on the data collected for the 2004 EIA, 2008 ECAR and 2012 ESIA, ECTECH has concluded that operations of the rehabilitated DCL Complex will not present unacceptable impacts on the environment or society. Mitigation measures are considered satisfactory and monitoring protocols are either in-effect or will be enhanced to address any environmental or social impacts that may arise from Complex operations.

Table 1.1 Executive Summary of ESIA Findings

Criteria	2004 EIA Data (Pre-Construction)	2008 ECAR Data (During Operation)	2012 ESIA Data (During Shutdown)	Conclusions
Vegetation & Wildlife	• The project site does not occupy valuable habitat for any wildlife. No mangroves were present even prior to Complex construction.	• Not examined	• The project does not encroach upon valuable habitat for wildlife or vegetation.	• The project does not disturb vegetation and wildlife in the area. No mitigation is necessary.
Baseline Ambient Air Quality	• SO_2 below detection limits in 26 tests • CO below detection limits in 26 tests • NO_x below detection limits in 26 tests	• SO_2 below detection limits in 11 tests • CO below detection limits in 11 tests • NO_x below detection limits in 11 tests	• SO_2 below detection limits in 10 tests • CO below detection limits in 10 tests • NO_x below detection limits in 10 tests	• The ambient air in the project area is consistently below detection limits for SO_2, CO, and NO_x concentrations.
Gaseous Emissions During Operations	• There will be no SO_2 emissions because natural gas is the fuel. • Estimated SO_2 at stack: 0.0 ppm • CO will be minimized with high efficiency burning. Estimated maximum CO at stack: 31 ppm • Low NO_x burners will keep NO_x emissions within NEQS limits. Estimated maximum NO_x at stack: 34ppm	• SO_2 at stack: 0.0mg/m^3 • 3 tests for CO average at stack: 297.0mg/m^3 • 3 test NO_x average at stack: 219.0mg/m^3 (tests rejected because they were collected during Complex "balancing") • Valid NO_x test conducted while system is stable by PERAC on Aug. 11, 2008 measured at the stack: 39mg/m^3	• Stack emissions could not be measured because the Complex was not operational at this time.	• SO_2 and CO emissions are within IFC Guidelines • After turbine rehabilitation and optimization, NO_x is expected to be 34-40mg/m^3 – below the IFC limit of 51mg/m^3

Table 1.1 Executive Summary of ESIA Findings (Cont'd)				
Criteria	**2004 EIA Data (Pre-Construction)**	**2008 ECAR Data (During Operation)**	**2012 ESIA Data (During Shutdown)**	**Conclusions**
Baseline Particulate Matter Presence	• East Side: 0.6mg/m^3 • South Side: 0.9mg/m^3 • West Side: 0.6mg/m^3 • North Side: 0.8mg/m^3 • Center: 0.5mg/m^3	• Main gate: 2.41mg/m^3 • Control room: 0.29mg/m^3 • Car park: 1.73mg/m^3 • Cooling tower: 1.09mg/m^3 • Generator area: 1.13mg/m^3 • Intake area: 3.15mg/m^3 • Inside office: 0.21mg/m^3 • Main road: 2.09mg/m^3 • Desal plant: 0.99mg/m^3 • Near fine filtration: 0.94mg/m^3 • Near emergency engine: 0.87mg/m^3 • Near CCR: 2.39mg/m^3	• Road between office and grid: 0.0562mg/m^3 • Near discharge to sea: 0.0631mg/m^3 • Near workshop area: 0.04675mg/m^3 • Near fine filtration: 0.05825mg/m^3 • Near lube oil storage drum: 0.03605mg/m^3	• The 2008 measurements exceed IFC limiting value of 0.230mg/m^3 and the NEQS of 0.550mg/m^3. Combustion of natural gas at the power plant will not contribute additional PM.
Particulate Matter (PM) Emissions During Operations	• Only the combusted air can contribute PM. Highly efficient air filters will be used to keep PM emissions well below NEQS limits. • Estimated maximum PM at stack: 0.2 mg/m^3	• Average PM measured at stack: 3.3mg/m^3	• PM emissions could not be measured at the stack while Complex was shut down.	• The natural gas burned at the Complex does not contribute to PM emissions; only ambient air does.

Table 1.1 Executive Summary of ESIA Findings (Cont'd)				
Criteria	**2004 EIA Data (Pre-Construction)**	**2008 ECAR Data (During Operation)**	**2012 ESIA Data (During Shutdown)**	**Conclusions**
Baseline Ambient Noise Level	• Daytime average of 13 measurements: 40.12dB(A) • Nighttime Average of 13 measurements: 42.43dB(A)	• No sampling conducted	• Daytime average at boundary walls (4 locations, 40 measurements): 45.1dB(A) • Nighttime average at boundary walls (4 locations, 40 measurements): 39.4dB(A) • Daytime average inside Complex (4 locations, 40 measurements): 47.5dB(A) • Nighttime average inside Complex (4 locations, 40 measurements): 39.6dB(A)	• Ambient noise levels are well within NEQS limits.
Noise Level During Operation	• The Complex is designed to minimize noise levels • Noise levels both within the Complex and at the boundary walls will be within NEQS limits • Hearing protection will be provided for those working in loud areas	• Average at boundary walls (5 locations, 50 measurements): 67.9dB(A) • Average inside Complex (15 locations, 150 measurements): 71.4dB(A) • Daytime average at nearest DHA housing: 50.1dB(A) • Nighttime average at nearest DHA housing: 38.6dB(A)	• No samples taken	• Noise levels are within NEQS limits and IFC limits (both of 85dB(A)) at the boundary walls • Hearing protection is provided for those working in loud areas • Noise levels at DHA are within IFC residential limits of 55dB(A) (day-time) and 45dB(A) (night-time). No further mitigation is necessary.

Table 1.1 Executive Summary of ESIA Findings (Cont'd)

Criteria	2004 EIA Data (Pre-Construction)		2008 ECAR Data (During Operation)	2012 ESIA Data (During Shutdown)		Conclusions
Baseline Water Quality	**Substance**	**Result**	• No samples taken	Seawater samples collected 5m from the shore of the Complex at a depth of 7m.		• Concentrations of some substances in the surrounding seawater actually exceed IFC guidelines for effluents. Operations and effluents of the Complex will not contribute to this situation.
				Substance	**Result**	
	pH	7.2		pH	8.5	
	Turbidity (ppm)	7.0		Turbidity (NTU)	19.0	
	TSS (ppm)	6.0		TSS (mg/l)	48.2	
	TDS (ppm)	37000		TDS (mg/l)	44587	
	COD (ppm)	2250		Conductivity (ms/cm^3)	58.0	
	BOD_5 (ppm)	1595		Calcium (mg/l)	2345	
	Sulphates (ppm)	552		Sulphates (SO_4 mg/l)	4420	
	Sulphides (ppm)	N.D.		Sodium (mg/l)	13593	
	Chlorides (ppm)	21050		Chlorides (mg/l)	22400	
	Free Chlorine (ppm)	0.05		R-Cl_2 (mg/l)	0.6	
	$CaCO_3$ (ppm)	3350		$CaCO_3$	8400	
	Chromium (ppm)	N.D.		Magnesium (mg/l)	6136	
	Copper (ppm)	0.21				
	Iron (ppm)	N.D.				
	Nitrates (ppm)	2.3				
	Ammonia (ppm)	0.08				
	Manganese (ppm)	N.D.				
	Oil & Grease (ppm)	0.7				

Table 1.1 Executive Summary of ESIA Findings (Cont'd)

Criteria	2004 EIA Data (Pre-Construction)	2008 ECAR Data (During Operation)	2012 ESIA Data (During Shutdown)	Conclusions
Liquid Effluents During Operations	• 13.3% of sea water will be retained for potable water production. The rest will be discharged to the sea in a closed loop system. No effluent will be generated in this process	**Wastewater Characterization** (measured at outflow pipe immediately before discharge) pH: 8.1 TSS: 21mg/l TDS: 710mg/l TD: 42˚C COD: 51.9mg/l BOD_5: 37.0mg/l Chloride: 48mg/l Sulphate: 80mg/l Iron: 1.1mg/l Copper: 0.05mg/l Chromium: 0.01mg/l Oil/Grease: 2.1mg/l	• No samples taken	• Liquid effluents are well within NEQS limits. Iron very slightly exceeds the IFC Thermal Power Plant Guideline of 1.0mg/l. The concentration of iron in the effluent, as well as all other effluent parameters, will comply with IFC guidelines upon completion of Complex rehabilitation.
Solid Waste Disposal	• Solid wastes will be collected for reuse (as in empty steel and plastic drums of chemicals), sold on the open market (as in wiring, wooden packaging, auto parts, etc.), or collected by the contractor for recycling or landfilling	• No observations taken	• Solid waste is collected for reuse, recycling, or landfilling according to environmentally safe practices • Segregation occurs on and off-site • Waste management contractors are certified	• A safe and reliable system of solid waste disposal is in place at the Complex. No further mitigation measures are necessary, although improvements to upstream segregation will be implemented
Environmental Monitoring	• Third party monitoring of all environmental concerns will be carried quarterly.	• No observations taken	• No observations taken	• DCL with modest modifications will implement a comprehensive EMMP

Table 1.1 Executive Summary of ESIA Findings (Cont'd)

Criteria	2004 EIA Data (Pre-Construction)	2008 ECAR Data (During Operation)	2012 ESIA Data (During Shutdown)	Conclusions
Thermal Discharge (TD)	• No sample taken. Complex was not operational. No design changes recommended for compliance purposes	• Thermal Discharge (TD) from the power Complex, after cooling the condensers, is discharged onto a large stone blanket above the sea water interface, where it dispersed and aerated and cooled • TD measurements of the Discharge Behavior were made at various points in the sea water from its discharge point • TD is equalized with the ambient sea water at a distance of about 35 meters from its discharge point into the sea	• The TD design remains unchanged since 2008	• Although the thermal discharge pipe does not drain directly into the sea, the system of splashing TD over the rocks before mixing with the sea more effectively dissipates heat with no additional harm to the environment • The system is designed to effectively minimize impacts upon the marine ecosystem. It remains in compliance with NEQS standards.

2 INTRODUCTION & SCOPE OF ESIA STUDY

2 Introduction & Scope of ESIA Study

2.1 Introduction & Scope

Karachi, capital of the Sindh province, is the largest city, main seaport and financial centre of Pakistan. The city has an estimated population of 21 million as of April 2012, with growth estimated at 5% per year. Population density is nearly 6,000 people per square kilometer (15,500 per square mile).[1] As the economic and commercial capital of the country, Karachi is home to two of South Asia's largest and busiest ports.

The city is located in the south of the country, along the coastline of the Arabian Sea. It is spread over 3,527 km^2 (1,362 mi^2) in area, almost four times larger than Hong Kong. [1] The residents of Karachi represent a diverse mix of ethno-linguistic groups from all parts of Pakistan and South Asia.

Population growth[1]		
Census	**Pop.**	**%±**
1881	73,560	—
1891	105,199	43.0%
1901	136,297	29.6%
1911	186,771	37.0%
1921	244,162	30.7%
1931	300,799	23.2%
1941	435,887	44.9%
1951	1,068,459	145.1%
1961	1,912,598	79.0%
1972	3,426,310	79.1%
1981	5,208,132	52.0%
1998	9,339,023	79.3%

Source: 1 Wikipedia, the free encyclopedia

Trend of population growth (in millions) in Karachi[1]

With the exploding population, the city faces a serious crisis of potable water and an acute shortage of electricity resulting in daily load shedding. As a result, Karachi's DHA established DCL to address both issues. DCL is a joint venture between DHA and Sacoden Investments of Singapore.[3] DCL is a Public Limited

[3] **References:**

1. wikipedia
2. DHA Cogen Limited
3. Dawn Newspaper Report on Plant Inauguration
4. Google Earth
5- DHA NEWS - A Publication of Pakistan Defense Officers Housing Authority Karachi Spring - 2006 Edition
6- www.siemens.com

Company incorporated on January 19, 2003, in Karachi, Pakistan. The primary purpose of the Company was to build and operate a power generation and water desalination plant to fulfill the needs of electricity and potable water of the entire Defense Housing Scheme of Karachi.

DCL installed Pakistan's first private co-generation plant to produce both electrical power and potable water for public consumption, drawing investors from both the public and private sectors. This innovative solution includes the use of Alfa Laval technology—a desalination process to convert seawater into fresh potable water.

DCL is an independent power and water producer (IPWP) consisting of a combined cycle natural gas power plant and a multi effect desalination plant (MED). The Complex was designed for a rated electrical output of approximately 87 MW (base load design conditions) or 94 MW (ISO conditions), and steam production for seawater desalination of 3.0 million gallons per day (MGD). The power plant and the desalination unit work in tandem and are operated by 100 employees with 64 operational staff, working in two 12 hour shifts.

The Complex is located at Plot No. DSL -1, DHA Housing Society, Phase-VIII, Karachi. Commissioning began in July 2007, with a subsequent start of commercial operation on April 17, 2008. Soon after, the Complex experienced shutdowns due to technical faults from September 12, 2008 to August 14, 2009 (51 weeks, 4 days), November 2, 2009 to February 18, 2010 (15 weeks, 4 days), and May 1, 2010 to present (153 weeks and counting). For details refer to **Annexes 2.1 & 2.2**.

IEP, USA is prepared to acquire and rehabilitate DCL. As a part of the financing considerations, OPIC requires updated ESIA and Audit reports for the Complex.

This ESIA and Audit Report demonstrate compliance with the following international standards:

- OPIC Environmental and Social Policy Statement (ESPS) (October 15, 2010)
- IFC Performance Standards on Environmental and Social Sustainability (January 1, 2012)
- IFC Environmental, Health, and Safety Guidelines for Thermal Power Plants (December 19, 2008)
- IFC Policy on Environmental and Social Sustainability (January 1, 2012)

- IFC Access to Information Policy (January 1, 2012)
- IFC Environmental, Health, and Safety General Guidelines (April 30, 2007)
- IFC Environmental, Health, and Safety General Guidelines: Environmental Air Emissions and Ambient Air Quality (April 30, 2007)
- IFC Environmental, Health, and Safety Guidelines for Electric Power Transmission and Distribution, (April 30, 2007)
- International Organization for Standardization (ISO) 14000 Standards.
- The Workmen's Compensation Act, (1923)
- The Factories Act, (1934)
- The Industrial Relations Ordinance, (2002)
- National Fire Protection Association, (2013)[4]

Environmental approval, as required under the Pakistan Environmental Protection Act 1997 (PEPA), Section 12 subsection (4), was duly obtained from the Environmental Protection Agency (EPA) and Governments of Karachi and Sindh for the project. Therefore, it is not legally required to provide a copy of this ESIA report to those bodies. However, IEP may distribute this report to those bodies in the interest of the project.

A team of experts from ECTECH visited DCL from November 15 to 17, 2012 to conduct the following operations:

- Consultations with Complex staff
- Collection of relevant documents
- Environmental monitoring
- Public consultations
- Site assessment to assess possible contamination of soil by oil and grease, glass wool/mineral wool, and hazardous or toxic chemicals
- Assessment of state of housekeeping
- Collection of two seawater samples
- Assessment discharge of wastewater and brine
- Analyzed security and safety status at the Complex
- Registered a traffic count near the Complex site

2.2 Methodology for Evaluating Impacts

Baseline data and conditions form the basis of evaluation for DCL's environmental impact.

[4] http://www.nfpa.org/aboutthecodes/list_of_codes_and_standards.asp

Table 2.1 shows ECTECH's methodology for establishing the extent of environmental impact based upon national and IFC standards.

Table 2.1 Evaluation of Impacts	
Extent of Environmental Impact	**Description**
High	International and National Standards are exceeded.
Medium	Between International and National Standards.
Low	International and National Standards are met.

2.3 Methodology for Evaluation of Socio-Economic and Cultural Conditions; Aesthetic Values; Population and Communities

2.3.1 Objective

The socio-economic study of the Project area incorporates the following objectives:

- To furnish appropriate information about the baseline socio-economic conditions
- To identify and assess any significant social impacts of the Project activities on the surrounding area and people
- To propose suitable means for mitigation of any significant adverse social impacts

2.3.2 Data sources and collection methodology

The information collected for this part of study includes:

- General information about the human settlements
- Basic facilities available in the settlements
- Educational, medical & recreational facilities
- Sources of income
- Public comments regarding the Complex
- Perceived positive impacts during operation
- Perceived negative impacts during operation
- Gender role and status
- Secondary data regarding settlements, local people and the Complex
- Published data provided by the Project Proponent and other relevant sources
- Public consultations (detailed in Chapter 8)

2.3.3 Study area

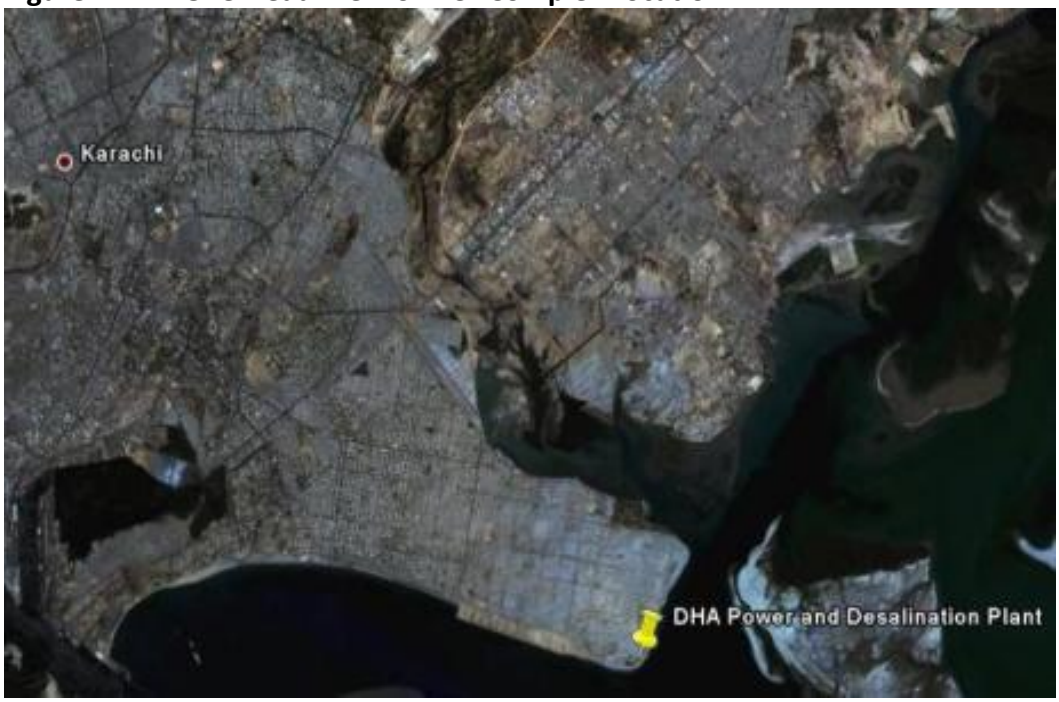
The study area included the area under the direct and immediate effect of the operations of the Complex.

2.4 Location of the CCP Complex

The Complex is located at Plot No. DSL-1, Phase VIII, Defence Housing Authority (DHA), Karachi, Pakistan. **Figures 2.1 A** and **B** illustrate the locations of the Complex within the broader context of the country.

Figure 2.1 A: DCL Complex Location

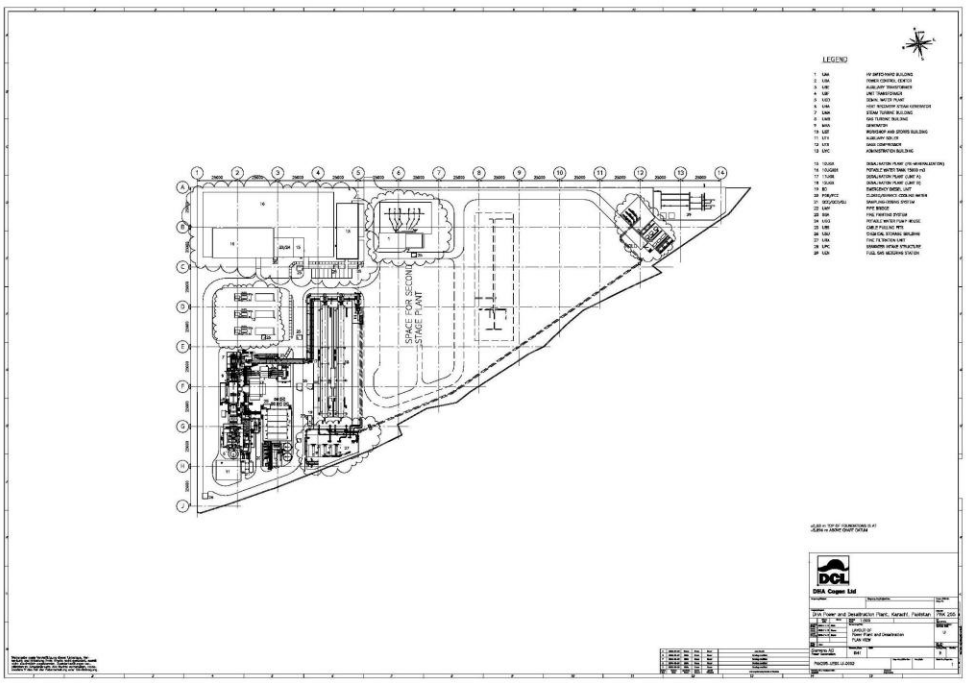
Figure 2.1 B: Overhead View of DCL Complex Location



2.5 Complex Layout

The layout of DHA Power Plan & Desalination Unit is shown in **Figure 2.2**.

Figure 2.2: Complex Layout



2.6 CCPP & Water Desalination Unit Capacity and Process Description

A detailed process flow diagram is presented as **Annex 2.3**.

2.6.1 CCPP Capacity and Process Description

A. Combined Cycle Power Generation

The Complex is equipped for power generation as follows:

Equipment	Specifics	Supplier
Gas Turbine (GT)	V 64.3A (67MW)	Siemens Germany
Steam Turbine (ST)	NK40/56 (27MW)	Siemens Germany
Boiler	HRSG (110 tons/h)	Babcock-Hitachi
Fuel	Natural Gas	SSGCL Karachi
GT Stack	33.5m height	-
Balance of Plant	-	Various Suppliers

The gas for the complex is supplied by SSGCL via a 20 inch diameter gas pipeline in accordance with the GPA signed between SSGCL and DCL. The system supplies total of 17.5mmscf/day of Natural Gas with calorific value 40743.9kJ/kg. SSGCL has its own substation within the four walls of the complex, which is duly protected and guarded by a fence and security personnel.

B. SIEMENS Gas Turbine System V64.3A:

The low cage model V64.3A gas turbine is a single-casing gas turbine of heavy duty design with a common shaft for compressor and turbine and a nominal rating of 70 MW (ISO condition, 100 % methane). The gas turbine system includes:

- Gas turbine (67 MW)
- Electrical auxiliaries
- Air intake system
- Enclosure
- Exhaust gas system
- Starting frequency converters
- I&C system TXP
- Gas detection system
- Generator
- Excitation system
- Generation protection

The principal benefits and characteristic of this gas turbine system include:

- Annular combustion chamber with hybrid burners for firing gaseous fuels

- Hybrid burners accomplish dry low-NO_x control when firing gas in the upper-load range; depending on the specified emission requirements, water injection is possible
- The design of the entire combustion system is uniquely simple and conservative with resultant high reliability
- 24 burners ensure a uniform hot-gas temperature field ahead of turbine blading
- Film cooling ensures high cooling efficiency in the first two turbine stages
- The extremely stiff lightweight rotor is supported by only two bearings located outside the pressurized region at compressor intake and turbine exhaust
- Smooth running performance under non-steady-state operating conditions due to rotor construction of bladed disks with self-centering facial serrations clamped together by a single central tie rod
- Rapid start-up and loading capability due to small thermal time constants of the built-up rotor
- The generator can be motored using the variable-frequency converter which ensures not only fast, but also smooth start-up of the gas turbine
- It is not necessary to over fire the gas turbine, as in the case of start-ups using a relatively low-powered starting motor and a torque converter
- High design efficiency maintained during operation by thermally flexible support of rear compressor area and turbine inner-casing sections within common separate rigid outer-casing
- Simple axial diffuser allowing unobstructed in-line ducting of exhaust gas to any heat-recovery boiler since the generator is coupled to the compressor end of the machine
- Heavy-duty machine design and special construction features minimize maintenance costs
- All the compressor and turbine stationary and moving blades can be individually replaced in situ, if necessary, and without lifting the rotor

C. Babcock Hitachi Heat Recovery Steam Generation

The steam generator produces steam at two pressure stages – high pressure & low pressure

- Gas ductwork and stack
- Structural steelwork
- High pressure steam system
- Low pressure steam system
- Condensate preheating system
- Drain and venting system

D. Siemens Germany Steam Turbine NK 40/56 (27MW)

- Steam turbine
- Gearbox
- Clutches
- Base frame
- Accessories

E. Balance of Complex

- Water distribution system
- Steam/water system
- Cooling water system
- Instrument-controlled air system
- Fire extinguisher system

F. Electrical System

- Generator bus ducts
- Generator circuit breaker
- Transformers
- MV and LV switchgears
- 132 KV Gas Insulated Switch gear (GIS)
- DC supply and UPS uninterrupted power system
- Generator and transformer protection
- Measuring and metering equipment
- Synchronizing equipment
- Power control center
- Emergency diesel generator
- Earth and lightning protection
- Cabling
- Lighting and small power systems
- Telephone system

G. Control and Instrumentation System PCS 7

- Operation system
- Monitors and printers
- Control room equipment
- Temperature measurement equipment
- Pressure measurement equipment
- Level measurement equipment
- Flow measurement equipment

2.6.2 General Description of Water Desalination Plant

The Alfa Laval desalination plant will provide 3 MGD of potable water. Its main components are listed below:

- 200 micron debris filter downstream of end condenser of each desalination train
- Fine filtration unit to filter feed water down to 30 microns
- Automatic final filter, for filtration of feed water to desalination
- Evaporator consisting of effects with titanium plate heat exchanger of the falling film type
- Set of high efficiency chevron type polypropylene demisters
- Shell and tube type condenser
- Distillate pump, centrifugal type, complete with spacer coupling and electrical motor mounted on steel base plate
- Brine pump, centrifugal type
- Seawater boost pump, centrifugal type
- Condensate pump, centrifugal type
- Seawater and brine polypropylene piping
- Distillate and condensate stainless piping
- Steam carbon steel piping
- Vacuum system consisting of steam ejector system and vent condenser
- Set of Alfa Laval instruments
- Combined Local Control Panel (CLP) and Motor Control Center (MCC)
- Remote control unit
- Set of cables, cable trays and junction boxes
- Set of Alfa Laval standards valves
- Alfa Laval chemical dosing station for sodium hypochlorite solution
- Water filtration system
- Distillate coolers, to reduce distillate temperature

2.6.3 Emission Data

Stack height: 33.5m above ground
Stack inside diameter: 3.8m

A. Emissions at 15°C Ambient Temperature

At 15°C ambient temperature and 60% relative humidity, the exhaust gas coming from the Power Plant stack is:

- Stack exhaust gas mass flow = 656.76t/h
- Stack exhaust gas temp = 116.3^{o}C (389.49K)
- Stack exhaust gas flow (at 116.3^{o}C) = 251.6m^{3}/s
- Stack exhaust gas exit velocity = 27.7m/s

Emissions:

NO_x	**(g/s)**	**=**	**16.1**
CO	**(g/s)**	**=**	**18.5**
SO_x	**(g/s)**	**=**	**10.1**
PM_{10}	**(g/s)**	**=**	**3.5**

B. Emissions at 30°C Ambient Temperature

At 30°C ambient temperature and 60% relative humidity, the exhaust gas coming from the Power Plant stack is:

- Stack exhaust gas mass flow = 719.2t/h
- Stack exhaust gas temp = 121°C
- Stack exhaust gas flow (at 121°C) = 232.5m^3/s
- Stack exhaust gas exit velocity = 25.6m/s

Emissions:

NO_x	**(g/s)**	**=**	**17.6**
CO	**(g/s)**	**=**	**20.3**
SO_x	**(g/s)**	**=**	**11.1**
PM_{10}	**(g/s)**	**=**	**3.5**

2.6.4 Energy/Fuel Type

Natural gas as supplied by Sui Southern Gas Company (SSGC), Karachi.

2.6.5 Water Desalination Unit (WDU) capacity and process description:

A. WDU capacity (Phase I)

Equipment	Specifics	Manufacturer
Desalination	MED (Plate Type) 2x1.5 MIGD	Alfa Laval Copenhagen

B. Process Description

The DCL Desalination plant operates as a distilled water producer. The energy for the desalination plant is supplied from waste heat from DCL's combined cycle power plant.

The desalination plant is based on the multiple effect technology, in which sea water is partly evaporated utilizing the condensing energy of steam or vapor on the other side of a heat transfer surface.

The desalination units for this project are Alfa Laval MEP-7-6840, with 7 effects. The units are based on an evaporator heat transfer surface with titanium plates, a proprietary technology of Alfa Laval.

The main energy for the evaporation process is provided in the form of low pressure exhaust steam from the steam turbine of the power plant. Auxiliary steam is provided to the desalination plant for establishment and maintenance of vacuum conditions in the desalination units whereby the evaporation of sea water can be conducted under vacuum conditions.

The seawater is provided from a seawater intake, in which the sea water is filtered and treated with biocide. A seawater and chlorine injection system is integrated into the individual desalination units.

Compressed air for instrumentation and control are provided to the desalination units.

The condensate of the low pressure steam, excluding internal losses, is discharged from the desalination units and returned to the power plant.

The desalinated water produced is directed to the potable water treatment plant for further treatment. A portion of the desalinated water is separately directed from the desalination units for use in the power plant.

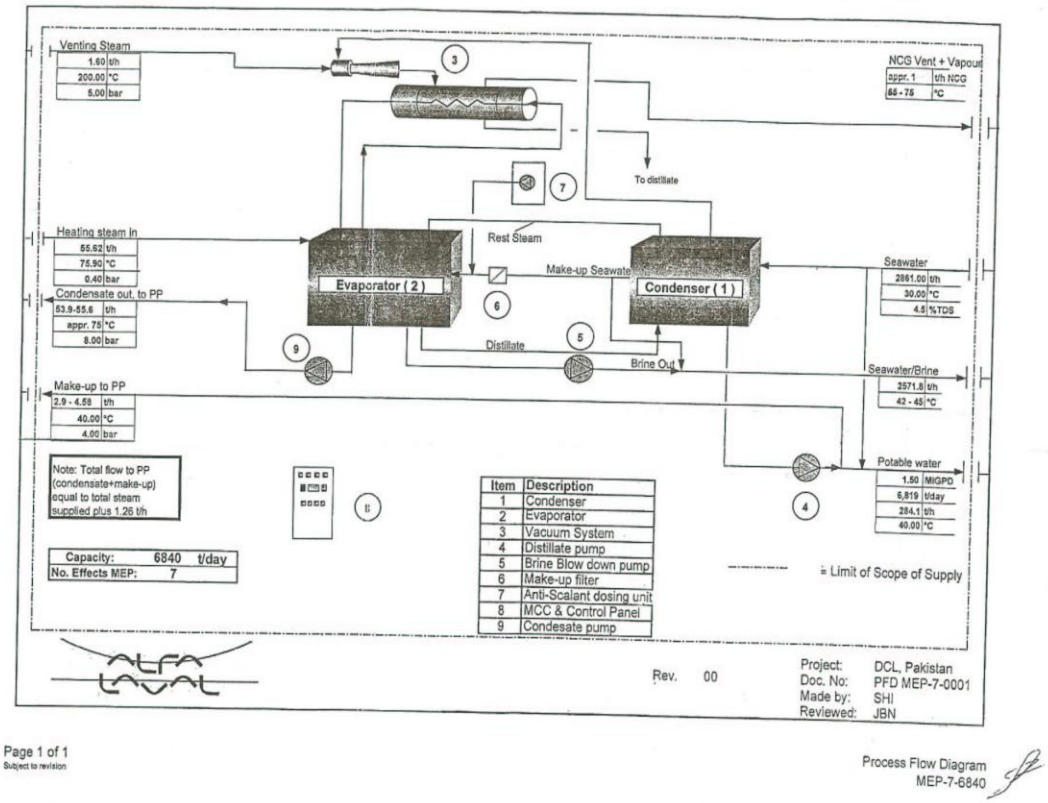
A mixture of brine and seawater return is discharged from the desalination units and returned to the sea.

The MCC and process control panels for the desalination plant are installed in a 40' insulted and air-conditioned standard shipping container. The MCC Panels are provided with a low voltage power supply of 3-400V systems.

The desalination plant can be operated from the remote or local control panel. Selected operational signals are available from the control container via Modbus for inclusion in the central control system of the power plant.

The potable water is treated by the addition of appropriate mineral solutions dosed into the potable water pipeline. It is then adjusted to a natural level according to the Langlier Saturation Index (LSI). This is achieved by injection of a calcium chloride solution to add calcium to the potable water, and the injection of Sodium Carbonate to increase the pH value of the water. The dosing of minerals is automatically controlled via measurement of conductivity and pH value of the potable water. **Figure 2.3** is a process flow diagram of the system.

Figure 2.3: Desalination Process Flow Diagram



2.6.6 Water

Water flow rates and water balance is shown in **Table 2.2**.

Table 2.2 Water Flow Rates	
Water Flow Process	**Rate (metric tons per hour)**
Seawater intake for desalination	2861.0 tons/h
Water returned to sea from desalination process	2571.8 tons/h
Water retained for desalination	289.2 tons/h
Seawater intake for power plant cooling	1108.8 tons/h
Water returned to sea from power plant cooling	1108.8 tons/h
Total seawater intake	**3969.8 tons/h**
Total water returned to sea	**3680.6 tons/h**

Water quality of seawater intake and effluent from the Complex is shown in **Table 2.3.**

Table 2.3 Water Quality				
Substance or Parameter (Intake)	**Baseline Seawater Intake Measurement (2012)**		**Substance or Parameter (Effluent)**	**Effluent Discharge Measurement (2008)**
pH	8.5		pH	8.1
Turbidity (NTU)	19.0		TD (˚C)	42
TSS (mg/l)	48.2		TSS (mg/l)	21
TDS (mg/l)	44587		TDS (mg/l)	710
Conductivity (ms/cm^3)	58.0		COD (mg/l)	51.9
Calcium (mg/l)	2345		BOD_5 (mg/l)	37.0
Sulphates (SO_4 mg/l)	4420		Chloride (mg/l)	48
Sodium (mg/l)	13593		Sulphate (mg/l)	80
Chlorides (mg/l)	22400		Iron (mg/l)	1.1
R-Cl_2 (mg/l)	0.6		Copper (mg/l)	0.05
$CaCO_3$	8400		Chromium (mg/l)	0.01
Magnesium (mg/l)	6136		Oil/Grease (mg/l)	2.1

2.6.7 Wastewater Treatment

There is no onsite treatment facility for toilet waste. Small quantity of sewage wastewater is currently collected by the CBC contractor and transferred to the Cantonment Board Clifton (CBC) sewage system for treatment. When the Complex is operating after rehabilitation, sewage will be treated by GEMS or WMC, which will meet international standards.

2.7 Comparative Evaluation of Alternatives and Identification of the Preferred Option

Karachi, with its growing population, is facing serious difficulty in providing for basic needs—including potable water and electricity—for its people. Although the Government of Pakistan is attempting to fulfill these vital needs, private sector participation is necessary to meet the demand. This project presents a vital part of the solution and aligns with the policies of the Government. DCL aims to produce power and water for the people of Karachi at the lowest possible cost. In addition to being the most cost-effective option for providing power and water to Karachi, rehabilitation of this existing asset is also much more environmentally sound compared to building any type of new facility. The design of a combined cycle power plant such as the Complex makes it the most efficient thermal power plant option

2.7.1 Siting Power and Desalination Plants on the Same Campus:

The following factors make it advantageous to site both plants on the same campus:

- Both the power and water produced are being used by the adjacent DHA housing complex, so it is convenient to locate both facilities nearby.
- Waste heat from the power plant was to be used for production of potable water. This efficient design requires that both plants are installed in the same location.

2.7.2 Basis/Criteria for Site Selection

Among others, the following important factors were considered for the original site selection for the power plant and water desalination unit:

A. Water Availability:

Because the Complex was to produce potable water through desalination of sea water and to supply it to DHA, a piece of land along the seashore near DHA was required. The present site fulfills this requirement.

B. Land Availability:

Land in Karachi is quite costly and its availability near to DHA Housing Society was a necessity. Since the DHA had already purchased that land for housing at a reasonable price, the present site was very appropriate.

C. Basic Infrastructure Availability:

Availability of basic infrastructure including roads, telephone lines, water lines, etc. was considered during site selection. All of these facilities were available at the present site of the Complex.

D. Electric Power Grid Availability:

In order to transmit the power produced by the power Complex, connectivity to the electricity Transmission and Distribution (T&D) system of Karachi Electric Supply Company (KESC) was an important consideration in site selection. The "Defense Grid" is only about 5.0km from the power Complex site, and the Complex is already connected to the Defense Grid.

The "Creek City Grid," at a distance of about 2km, is considered as the alternate T&D system for the Complex.

E. Bathymetry of the sea

i. Thermal Discharge:

The discharge point bathymetry near the site is considered suitable to dissipate the nominal heat from thermal discharge within the required distance as permissible by the NEQS, and international guidelines. Refer to **Figure 1.1, Figure 2.4, and Figure 2.5** for photographs of the TD and brine

discharge pipe. Figure 2.4 also shows a smaller pipe to the right side of the frame. This pipe is a temporary rainwater drainage pipe and does not contribute effluent of any type from the operations of the Complex.

Figure 2.4: View of the TD and Brine Discharge Pipe

ii. Brine Discharge:

The surrounding water of the site was found to have sufficient volume and current for quick dilution of the brine discharged from the desalination facility. The design and nature of the TD and brine discharge location minimize damage to aquatic life within the area of influence. The system combines brine discharge with closed-loop cooling water to minimize the concentration of brine in the overall effluent. Refer to **Figure 1.1, Figure 2.4, and Figure 2.5** for photos of the TD and brine discharge pipe.

iii. Aquatic Life:

As a result of the design of the effluent system and site location, effects on aquatic life are minimized. There is no rare and limited commercially fished aquatic life in the waters adjacent to the site. The site is well-suited to minimize impacts on aquatic life. Refer to **Figure 2.5** for a photo from the discharge pipe. While small scale fishing takes place several miles offshore, the waters immediately surrounding the site do not have the aquatic live to attract fishing vessels. **Figure 2.5**, taking during midday, shows no fishing vessels in the waters near the Complex.

Figure 2.5: View of Sea from Discharge Pipe

F. Convenient Access to the Site

The project site affords excellent access by road and sea throughout the year.

G. Land Availability for Future Expansion

Land for future expansion of the Complex is available at the site of the operational power plant and water desalination unit.

H. Government Policies for Land Use

The land adjacent to the site is owned by DHA, who is the co-partner of the project. Additionally, the Government has not imposed any restrictions on the land use in that area. Both the provincial and the Federal governments encourage power generation and water desalination activities in this area.

I. Environmental Considerations

The power plant and water desalination unit are committed to operate with minimum environmental impacts in accordance with NEQS and international guidelines. The current site satisfies these requirements.

3 POLICY, LEGAL & ADMINISTRATIVE FRAMEWORK

3 Policy, Legal & Administrative Framework

A comprehensive environmental framework is in force in Pakistan covering environmental management and regulations to control environmental degradation.

With the approval of the 18th Amendment in the constitution of The Islamic Republic of Pakistan (1973), the subject of environment has largely been delegated to the provinces. The Federal Ministry of Environment has been abolished and instead a Ministry of Climate Change (MOCC) has been created. The MOCC is the focal point for national policy, legislation, plans, strategies and programs with regard to disaster management and environmental protection and preservation, including climate change. It also deals with other countries, international agencies and forums for coordination, and monitoring and implementation of environmental agreements.

The Pakistan Environmental Protection Agency (EPA, **http://www.environment.gov.pk/**), is an attached department of the MOCC and is responsible to implement the Pakistan Environmental Protection Act (PEPA) (1997) in the country. The PEPA provides for the protection, conservation, rehabilitation and improvement of the environment, for the prevention and control of pollution, and for promotion of sustainable development.

The EPA provides various types of technical assistance to the MOCC. In addition, various Government departments such as the Pakistan Environmental Protection Council, Pakistan Environmental Planning and Architectural Consultants Limited, and the Global Environmental Impact Study Centre provide support to MOCC on environmental issues. The National Disaster Management Authority also comes under the MOCC and deals with issues related to natural disasters. While the EPA protects the environment of federally controlled areas and territories, provinces have individual environmental laws, rules and regulations. When these are below the EPA standards, the federal laws apply.

The National Environmental Regulatory/Legal Framework is described hereunder:

3.1 National Conservation Strategy (NCS) – Pakistan

NCS – Pakistan, as approved by the Federal Cabinet in March 1992, is the guiding document on the environmental issues in the country (Ref. EUAD/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 project are pollution prevention and abatement, restoration of supporting forestry and plantations, and preservation of cultural heritage. A mid-term review of the achievements, impacts and prospects of Pakistan's NCS was undertaken between years 1999 - 2000.

The Government of Pakistan promulgated PEPA in 1977. Two organizations, the Pakistan Environmental Protection Council (EPC) and the EPA, are primarily responsible for administering the provisions of the act. The EPC oversees the functioning of the EPA. Among its major members are representatives from the Federal and Provincial Governments, including the Provincial Environmental Protection Agencies (Provincial EPAs), industry, non-governmental organizations, academia, environment experts, the Federation of Chamber of Commerce and Industry, and the private sector.

The EPA, through the Provincial EPAs, is required to ensure compliance with the National Environmental Quality Standards (NEQS) and establish monitoring and evaluation systems. As a primary implementing agency in the hierarchy, it is responsible for identifying the need for and initiating legislation whenever necessary. EPA is also authorized to delegate powers to its provincial counterparts. One of the functions delegated by the EPA to the Provincial EPAs is the review and approval of Environmental Impact Assessment (EIA) and Initial Environmental Examination (IEE) reports of the projects undertaken in their respective jurisdictions.

3.2 Pakistan Penal Code (1860)

Pakistan Penal Code (PPC) (1860), adopted from British legacy, is the general criminal law, and applies all over the country. Among other functions, it prohibits mischief by killing or maiming animals, damaging works of irrigation or a river or road or bridge or drain, and firing explosive substances with intent to cause damage. The Code also prohibits public nuisance by acting negligently to spread infection of disease or disobeying quarantine rule or causing adulteration of food or drink or drug, or fouling water or making the atmosphere noxious to health, etc.

3.3 Pakistan Environmental Protection Ordinance (PEPO), 1983

Promulgation of the Pakistan Environmental Protection Ordinance (PEPO) (1983) was the first codifying legislation on the issue of environmental protection. The PEPO was comparatively more comprehensive than the patchy and incoherent provisions of environmental protection contained in the PPC.

3.4 Pakistan Environmental Protection Act, 1997

The PEPO was considered to fall short of the desired levels of environmental protection. Therefore, the Government passed another, more comprehensive law: Pakistan Environmental Protection Act (PEPA) (1997) (**Annex 3.1**). The PEPA has been the major act regulating the management and protection of the environment since 1997. The act is far more comprehensive than the PEPO and forms the legal basis of IEE/EIA studies carried out in Pakistan.

PEPA contains concrete action plans and programs for the prevention of pollution and promotes sustainable development. The salient features of the law include:

- Coverage of air, water, soil, marine and noise pollution including pollution caused by motor vehicles
- Provision of NEQS for wastewater, air emissions and noise
- Provision of clear guidelines for IEE/EIA for various projects according to their magnitude and anticipated impacts
- Empowerment of Federal Government to issue and enforce notices for the protection of the environment

For the effective implementation of the provisions of PEPA, EPA, headed by a Director General, was constituted. In the same pattern, Provincial EPAs have been created in all the provinces.

Environmental Tribunals have also been constituted according to PEPA.

3.5 Policy and Procedures for the Filing, Review, and Approval of Environmental Assessments

The PEPA sets out the key policies and procedural requirements. It contains a brief policy statement on the purpose of environmental assessment and the goals of sustainable development and requires that environmental assessments be integrated with feasibility studies. It also defines the jurisdiction of the Federal and Provincial EPAs. It lists the responsibilities of the proponents and states the duties of responsible authorities. It provides schedules of proposals that require either an IEE or EIA.

3.6 Guidelines for the Preparation and Review of Environmental Reports (November 1997/2000)

These guidelines are descriptive documents regarding the format and content of IEE/EIA reports to be submitted to the EPA for "No-Objection Certificate (NOC)/Environmental Approval (EA)." The major areas covered by these guidelines include:

- The IEE report (scope, alternatives, site selection, and format of IEE report)

- Impact Assessment (identification, analysis and production, baseline data, significance)
- Impact Mitigation and 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, purpose, effective data management)
- Project Management (inter-disciplinary teams, programming and budgeting)

3.7 Guidelines for Public Consultations

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 legitimate concerns in any impact assessment study. These guidelines cover:

- Consultation, involvement and participation of stakeholders
- Techniques for public consultation (principles, levels of involvement, tools, building trust)
- Effective public consultation (planning, stages of EIA where consultation is appropriate)
- Consensus building and dispute resolution
- Facilitation involvement (including the poor, women, building community and NGO capacity)

3.8 National Environmental Quality Standards (NEQS) (1993, Amended November 2010)

The following standards are specified in the NEQS:

- Maximum allowable concentrations of pollutants (32 parameters) in municipal and liquid industrial effluents discharged to inland waters, sewage treatment facilities, and the sea (three separate sets of numbers).
- Maximum allowable concentrations of pollutants (16 parameters) in gaseous emissions from the industrial sources.
- The Guidelines for "Self-Monitoring and Reporting" (SMART) (attached as **Annex 3.2**) for the industry as approved by the PEPA.

A copy of the Government of Pakistan, Gazette Notification dated August 10, 2000 regarding NEQS is attached as **Annex 3.3**.

NEQS prescribed limits for gaseous emissions are included as **Table 3.1.**

Table 3.1: NEQS Gaseous Emissions Limits		
Gaseous Emission	**Unit**	**NEQS Limit**
Nitrous Oxides (NO_x)	mg/Nm^3	400
Carbon Monoxide (CO)	mg/Nm^3	800
Sulfur Dioxide (SO_2)	mg/Nm^3	1700

NEQS prescribed limits for liquid effluent discharges are included as **Table 3.2.**

Table 3.2 NEQS Liquid Effluent Limits		
Effluent Parameter	**Unit**	**NEQS Limit**
pH	---	6-9
Total Dissolved Solids (TDS)	mg/l	3500
Total Suspended Solids (TSS)	mg/l	200
Chloride(Cl)	mg/l	1000
Sulfate(SO_4)	mg/l	600

3.9 National Environmental Quality Standards for Ambient Air (November 2010)

The Ministry of Environment, Government of Pakistan, via its notification in Islamabad (October 18, 2010) under S.R.O. 102 (1)/2010, established standards of the maximum allowable limits in the ambient air of sulphur dioxide (SO_2), oxides of nitrogen (NO_x), carbon monoxide (CO), suspended particulate matter (SPM), respirable particulate matter (PM_{10}), respirable particulate matter ($PM_{2.5}$), and lead (Pb).

3.10 National Standards for Drinking Water Quality (2010)

The EPA, via its notification in Islamabad (October 18, 2010), under S.R.O. 1062(1)/2010, established standards for drinking water quality. Various quality parameters and limits are established for drinking water under four main headings: bacterial, physical, chemical and radioactivity.

3.11 National Environmental Quality Standards for Noise (2010)

The EPA, via its notification in Islamabad (October 18, 2010), under S.R.O. 1064 (1)/2010, established standards for noise. These standards are based on four zoning categories: residential area, commercial area, industrial area and silence zone. The limiting values for day and night have also been fixed for all zoning categories.

3.12 Sector Guidelines for Environmental Reports

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. The Sector Guidelines include:

- Sector overview of the industry and the processes
- Potential impacts on the environment
- Mitigation measures
- Monitoring and reporting
- Management and training
- Checklist of likely environmental impacts and mitigation measures

3.13 Guidelines for Sensitive and Critical Areas

These guidelines identify sensitive and critical areas in Pakistan, in relation to both the natural environment and cultural values.

3.13.1 Forest Act (1927)

All India Forest Act (1927) was adopted by the Government of Pakistan and implemented by the respective provinces, including the province of Sindh. Accordingly, the Government of Sindh implements this Act in all of its study areas. The law was enacted to conserve and protect the forest resources of the country for sustainable development. It outlines rules and regulations for exploitation of various categories of forests such as reserved, protected or unclassified forests. The Act describes licensing method for hunting, grazing, timber cutting etc. The Act also provides details of magisterial powers of Forest Department Officers and penalties for offences committed with regard to forest resources and products.

3.13.2 Sindh Wildlife Protection Ordinance (1972)

The Sindh Wildlife Protection Ordinance (1972) was enacted to protect Sindh's wildlife resources directly and other natural resources indirectly. It classifies wildlife by degree of protection, including animals which may be hunted on a permit or special license and species that are protected and cannot be hunted under any circumstances. The Ordinance specifies restrictions on hunting and trade in animals, trophies, or meat. The Ordinance also provides for the creation of three classes of special protected areas:

- Wildlife Sanctuaries
- National Parks
- Game Reserves

In a Wildlife Sanctuary it is prohibited to:

- Enter or reside
- Cultivate any land

- Damage or destroy any vegetation
- Hunt, kill, or capture wild animals or fire any gun or other firearm within three miles of the boundaries of the sanctuary
- Introduce any exotic species of animal or plant
- Introduce domestic animals or allow them to stray within the sanctuary
- Cause a fire
- Pollute water

In a National Park, the following activities are prohibited:

- Hunting, shooting, trapping, killing, or capturing any wild animal in a national park or within three miles radius of its boundaries.
- Firing a gun or performing any other act which may disturb animals or birds or interfere with their breeding areas.
- Felling, tapping, burning, or in any way damaging or destroying, taking, collecting, or removing any plant or tree from the park.
- Clearing or breaking up any land for cultivation, mining or for any other purpose.
- Polluting water flowing in and through the national park.

Sections 14 and 15 were amended in Year 2001 to allow for the laying of oil and gas pipelines and petroleum exploration and production in the protected areas. The amendment states that the restrictions are not applicable for oil and gas exploration and production activities, are subject to the approval of an EIA of the proposed project, are to be conducted under the PEPA, and are to be approved by the concerned Provincial EPA.

3.14 National Resettlement Policy and Ordinance

Currently, the only legislation regulating land acquisition and compensation is the Land Acquisition Act (LAA) of 1894. Following a national consultative process, a national resettlement policy and a related ordinance were drafted. The draft policy and the ordinance are presently being reviewed by the provinces and have yet to be approved and notified by the government. The salient applicable features of the Draft Resettlement Policy include:

- The EPA will be responsible for both environment-related as well as resettlement-related matters,
- The responsibilities for implementation at a provincial level are to be delegated to the concerned Provincial EPAs with overall control of the provincial Planning and Development (P&D) Departments.
- All categories of 'loss' arising from development projects that entail resettlement need to be addressed: these include not only loss of land, built-up property, other infrastructure and crops and trees, but also loss of income, job opportunities, and access to natural resources, etc.

- Vulnerable groups whose issues need to be addressed in particular include: women, children, destitute persons, tribal communities, squatters, those with usurper rights, and landless groups.
- There should be a special emphasis on consultation with affected groups when preparing a Resettlement Action Plan (RAP).

The provisions of the Draft Resettlement Policy are consistent with the requirements of the World Bank OD 4.30 on involuntary resettlement.

3.15 Other Relevant Laws

Some of the other relevant laws and legislations are listed below:

- Industrial Relations Ordinance, 1969
- Canal and Drainage Act, 1873
- The Explosives Act, 1884
- The Fire Wood and Charcoal (Restriction) Act, 1964
- Motor Vehicles Ordinance, 1965
- The West Pakistan Regulation and Control of Loudspeaker and Sound Amplifier Ordinance, 1965
- Agriculture Pesticides Ordinance, 1971
- The Antiquities Act, 1975

3.15.1 National Electric Power Regulatory Authority (NEPRA) Act (1997)

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

3.15.2 Power Policies 1994-2002[5]

The Government of Pakistan (GoP) issued its Power Policy for private power generation in 1994. This was followed by the Hydroelectric Policy (1995) and Transmission Policy (1995). The Power Policy was revised first in 1998 and again in 2002. The main objectives and intentions of the GoP are to move toward the creation of a competitive power market in Pakistan. It proposes to do so by restructuring and privatizing the existing thermal power generation, the power transmission and distribution functions and assets of existing public sector

[5] DCL's generation license was issued in 2003 under Electric power act 1997. 1998 Policy has minimum relevance today.

utilities including the Pakistan Water and Development Authority (WAPDA) and KESC.

The salient features of the Power Policy (2002) include:

- Scope of the 2002 Policy covers Private, Public-Private, and Public sector projects
- All projects for which feasibility studies are available with the GoP will be offered on the basis of international competitive bidding. Variable tariffs over the life of the project are permitted under terms specified prior to bidding. The process of selection involves pre-qualification, issuance of a Request for Proposals (RFP), bidding and evaluation of bids against bid criteria clearly laid out in the RFP.
- For raw hydel and coal site projects, Expression of Interests (EOIs) will be invited through advertisement in press and Sponsors with the best proposal, as decided by the Private Power and Infrastructure Board (PPIB), will be issued a Letter of Intent (LOI) for the feasibility study
- '*Hydropower*' projects on a Build Operate Own Transfer (BOOT) basis; '*Thermal*' projects on a Build Own Operate (BOO) basis
- Long-term Security Package including Implementation and Power Purchase Agreements, and Water Use License (for Hydropower Projects)
- Two-part tariff structure consisting of fixed '*Capacity*' and variable '*Energy*' components
- *Capacity Payments* to cover fixed costs, i.e. Fixed O&M, Debt Servicing, and Return on Equity (ROE); independent of project/energy dispatch
- Exemption from corporate *Income Tax* and *Turnover Tax*
- 100% foreign ownership allowed with minimum 20% equity contribution requirements
- Sponsors can divest equity after six (6) years of project commissioning
- Performance obligations of Power Purchaser and Provinces/AJK guaranteed by GoP
- Continuity of payments in case of Political Force Majeure
- Pass-through of additional taxes/costs incurred due to Change in Law
- Adjustments in Tariff for changes in Benchmark Interest Rates (LIBOR/KIBOR)
- Compensation Payment in case of project termination due to GoP default
- Foreign component of fixed and variable O&M Cost to be indexed with US CPI
- Term of concession period for hydropower projects is up to 50 years
- For hydropower projects, *Hydrological Risk* to be borne entirely by the Power Purchaser such the National Transmission and Despatch Company Ltd. (NTDC), WAPDA and KESC.

- For hydropower projects, tariff adjustment based on the following four tariff re-openers is allowed:
  - (a) Cost variation due to geology in the tunnel(s)
  - (b) Cost variation due to Civil Works
  - (c) Cost variation due to Hydraulic Steel Structure and M&E works
  - (d) Cost variation due to Resettlement Cost
- For unsolicited proposals, NEPRA will determine tariff in consultation with the Independent Power Producer (IPP) and the power purchaser;
- IPPs are not exposed to impact of exchange rate variation for US Dollar, Euro, Pound Sterling and Japanese Yen up to Commercial Operation Date (COD); EPC contracts denominated in these four currencies besides Pak Rupee are thus accepted by NEPRA
- At COD, Capital Cost to be fixed in US dollars based on any of the four currencies of EPC contract accepted by NEPRA at the time of tariff determination, sources of financing, payments and actual exchange rates against rupee for these currencies
- Foreign debt may be obtained by the IPP in US Dollar, Pound Sterling, Euro and Yen; periodic adjustments in the Debt Service Component of tariff will be made to cover exchange rate variation for these currencies
- For foreign O&M costs, adjustment for exchange rate variations between Pak Rupee and US Dollar have been allowed
- Performance Guarantees to PPIB/GOP and Letters of Credit in favor of Power Purchaser to be accepted in Euro, Pound Sterling and Yen in addition to US Dollar
- ROE will be adjusted for variations in US Dollar / Pak Rupee rates
- The GoP does not guarantee payment obligations of the Fuel Supplier; however, nation-wide shortage of fuel oil would be recognized as a Pakistan Political Force Majeure Event.

3.15.3 Provincial Local Government Ordinances (2001)

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

3.15.4 Factories Act (1934)

The clauses relevant to the project are those that concern the health, safety and welfare of workers, disposal of solid waste and effluent, and damage to private and public property. The Factories Act also provides regulations for handling and disposing of toxic and hazardous materials.

3.15.5 Land Use

The land from agriculture use is rapidly increasing due to speedy industrialization of the area. Government policies for land use encourage industrialization. The location of the Complex near a residential development is a result of the production of the much-needed potable water for the residential community.

3.15.6 Regulatory/ Institutional/Administrative Framework

GoP is facilitating investment, both local and foreign, in the industrial sectors in Pakistan. Liberalization and industrialization in the country are well-represented as a policy of the Government.

3.15.7 Deregulation of the economy

Deregulation is the prioritized policy of the GoP. There is a systematic movement towards deregulation of the economy and privatization of the state owned companies.

3.15.8 Import policy

Import policy has been liberalized to a large extent through the provision of various incentives. The development of the industrial sector is bolstered by increased international trade.

3.15.9 Infrastructure facilities

In order to facilitate fast industrialization, basic infrastructure facilities such as roads, pipelines for natural gas and water, and power transmission and communication lines are continually under development.

3.16 Incentives

In order to maintain Pakistan's competitiveness in international markets and support viability of local and foreign investments in the country, the following incentives are available equally to both the foreign and the local investors:

a. Initial depreciation allowance (IDA)
b. Amortization
c. Normal tax rates

3.17 Provincial Environmental Protection Agencies

Each provincial government has its own environmental protection agency (Provincial EPA) responsible for environmental protection and pollution control.

The Sindh Environmental Protection Agency (SEPA) is the provincial agency responsible for the environmental protection and pollution control in the province of Sindh. Accordingly, the proposed project falls in the jurisdiction of SEPA. Like other projects under the jurisdiction of SEPA, this ESIA report was prepared according to the Guidelines for the Preparation and Review of

Environmental Reports, Government of Pakistan (November 1997/2000), as approved by the Federal Ministry/EPA and followed by all four provincial EPAs. Accordingly, the Complex was approved by the Sindh EPA.

3.18 International and National Non-Governmental Organizations

International and National Non-Government Organizations (NGOs), such as the International Union for Conservation of Nature and Natural Resources (IUCN) and the World Wide Fund for Nature (WWF), have been active in Pakistan for some time. Both of these NGOs have worked closely with the governments at the federal and provincial levels and have contributed positively to the cause of environment. They have played a significant role with regard to the formulation of environmental and conservation policies. In this regard a prominent NGO, Sustainable Development Policy Institute (SDPI) has played a very significant role in upholding the cause of environmental protection in Pakistan.

Environmental NGOs have been particularly active in the advocacy for promoting sustainable development approaches. Most of the government's environmental and conservation policies, even at the provincial and federal levels, have been formulated in consultation with these leading NGOs, who have also been involved in drafting new legislation on conservation.

3.19 International Framework

For the purpose of assessing the environmental impacts of the proposed project on air, water and noise according to international legal standards, ECTECH has relied upon international guidance documents primarily, from OPIC and the IFC. These documents are described herein.

Within this handbook, different guidelines are mentioned for the purpose of assessing industrial facilities with respect to their environmental compliance. In the present case, the guidelines for new thermal power plants are applicable for the preparation of the environmental impact assessment.

ECTECH has also examined the relevant treaties that Pakistan has entered into internationally. Pakistan is a party to the following treaties and agreements to support its environmental goals and program:

Treaty	Pakistan Status
Convention on the Protection of Ozone Layer on Dec 18, 1992	Ratified
The Amendment to Montreal Protocol on Substances that Deplete the Ozone Layer	Signed
UN Framework Convention on Climate Change on June 13, 1992	Signed

Treaty	Pakistan Status
Convention on the Continental Shelf on October 31, 1958	Signed
The Convention on High Seas on October 31, 1958	Signed
Convention on the Fishing and Conservation of the Living Resources of the High Seas on October 1958.	Signed
The UN Convention on Law of the Sea on December 10, 1982	Signed
The Convention on Territorial Sea and the Contagious Zone and the Agreement for the establishment of Network of Aquaculture Centers in Asia and the Pacific	Signed
The Convention on Wetlands of the International Importance on July 23, 1976	Ratified
The Convention on protection of the World Cultural and Natural Heritage on July 23, 1976	Ratified
The Convention on International Trade in Endangers Spice of Wild Fauna and Flora	Signed
The Convention on Conservation of Migratory Species of Wild Animal on Dec 01, 1987	Signed
The Convention on Biological Diversity in 1994 recognizes the intrinsic value of biological diversity, genetic, social, economic, cultural, educationist, recreational and esthetic values of biodiversity and its components	Ratified
The International Plant Protection Convention	Signed
The Plant Protection Agreement for Area & Pacific Region	Signed
The Agreement for the establishment of a convention for controlling the desert lost in eastern region of its Distribution Area in South East Asia	Signed
The Treaty Banning Nuclear Weapon Test in the Atmosphere, in Outer Space and Under Water on March 3, 1988	Signed
The International Convention on Oil Pollution Preparedness Response and Corporation	Signed
The Convention on prohibition of Military or any other Hostile Use of Environmental Modification Techniques and Accession of Feb 27, 1986	Acceded
Pakistan became a party to Montreal Protocol by Ratifying the protocol and its London amendment on Dec 18, 1982; the subsequent amendments known as Copenhagen Amendment	Signed
Convention of International Trade Endangered Species (CITS)	Signed
World Heritage Convention Ramsar Convention	Signed
United Nation Convention to Combat Ozone Depletion (CCD). The convention signed and ratified in 1996	Signed
Stockholm Convention for Phasing out Parenting Organic pollutants (POPs) in 2001	Signed

3.20 Requirements of Potential Investors, Lenders and Insurers

IEP intends to obtain financing for the project from OPIC. Therefore, the project shall be managed according to the OPIC requirements, which are described below.

3.20.1 OPIC Environmental and Social Policy Statement, October 15, 2010

According to OPIC Mission Statement it aims at "mobilizing and facilitating the participation of United States private capital and skills in the economic and social development of less developed countries and areas and countries in transitions from non-market to market economies, thereby complementing the development assistance objectives of the United States."

The Policy Statement takes into account OPIC's commitments regarding the environmental and social dimensions of sustainable development and provides Applicants the general environmental and social requirements that OPIC uses while evaluating prospective projects seeking OPIC support on the one hand and monitoring on-going OPIC funded projects.

As a development assistance agency of the United States Government, OPIC policies, reflect the following five principal goals of the United States development cooperation policy (Section 101 of Foreign Assistance Act):

- The alleviation of the worst physical manifestation of poverty among the world's poor majority
- The promotion of conditions enabling developing countries to achieve self-sustaining economic growth with equitable distribution of benefits
- The encouragement of development process in which individual civil and economic rights are respected and enhanced
- The integration of developing countries into an open and equitable international economic system
- The promotion of good governance through combating corruption and improving transparency and accountability

The Policy statement provides guidance on how OPIC puts into practice its commitment to investing in development in an environmentally sustainable context. OPIC supports projects that:

- Are environmentally and socially sustainable
- Are compatible with low and no-carbon economic development
- Respect human rights, including the rights of workers and the rights of effected communities
- Avoid negative impacts and if such impacts are unavoidable, properly mitigate or compensate for the impacts
- Provide timely information regarding project activities to effected people
- Are undertaken in countries that have taken steps to adopt and implement laws that extend Internationally Recognized Workers Rights.

The standards for the environmental and social review process according to OPIC Policy are those by the IFC Performance Standards on Social and Environmental Sustainability (Performance Standards and Industry Sector Guidelines and any subsequent revisions to those standards).

3.20.2 Required Environmental Management and Monitoring Plan

OPIC requires that an Environmental Management and Monitoring Plan (EMMP), sometimes called an Environmental Action Plan (EAP), is prepared to specify the actions—both technical and managerial—that the applicant or sponsor will undertake in order to mitigate anticipated adverse impacts of the project on the environment, health and safety. It also describes the technology and methodology used to monitor the actual impacts of the projects on the environment, and the standards and procedures to be used for adjusting mitigation measures as necessary to maintain impacts within an acceptable range.

3.21 The World Bank and IFC Environmental Assessment Process

The guidance of The World Bank was also utilized in assessing the significance of impacts from the proposed development and determining content and form of reporting.

The World Bank Operational Policies OP4.01 Environmental Assessment (January 1999) sets out the World Bank's policy on projects requiring an EIA, defines what the assessment is designed to achieve, and what issues must be considered. It also sets out guidance for screening projects and identifies other World Bank guidance and policies that may be relevant.

The World Bank Pollution Prevention and Abatement Handbook (1998) delineate the basic principles that are considered appropriate to evaluating and controlling pollution from any defined project. The handbook provides guidance on pollution management and sets out generic environmental standards for air, water and soil pollution. This handbook also provides sector guidance. Of most significance to this project is the guidance for Thermal Power Plants: Guidelines for New Plant (July 1998).

ECTECH has closely followed IFC's guidelines, particularly those referenced below.

3.21.1 IFC Environmental, Health, and Safety (EHS) Guidelines for Thermal Power Plants (2008)

The EHS Guidelines contain the performance levels and measures that are generally considered to be achievable in new facilities by existing technology at reasonable costs. The applicability of the EHS Guidelines should be tailored to

the hazards and risks established for each project on the basis of the results of an environmental assessment in which site-specific variables, such as host country context, assimilative capacity of the environment, and other project factors, are taken into account.

3.21.2 IFC Policy and Performance Standards on Social and Environmental Sustainability (January 1, 2012)

The IFC applies Performance Standards 1-8 to manage social and environmental risks and impacts and to enhance development opportunities in its private sector financing in its eligible member countries.

Environmental Assessment is the primary administrative tool to integrate environmental considerations into decision making of all types of development initiatives such as formulating policies, programs and project funding.

3.21.3 IFC Environmental, Health, and Safety Guidelines for Thermal Power Plants (December 19, 2008)

The Environmental, Health, and Safety (EHS) Guidelines are technical reference documents with general and industry-specific examples of Good International Industry Practice. When one or more members of the World Bank Group are involved in a project, these EHS Guidelines are applied as required by their respective policies and standards. These industry sector EHS guidelines are designed to be used together with the General EHS Guidelines, which provide guidance to users on common EHS issues potentially applicable to all industry sectors. For complex projects, use of multiple industry-sector guidelines may be necessary.

The EHS Guidelines contain the performance levels and measures that are generally considered to be achievable in new facilities by existing technology at reasonable costs.

The IFC Environmental, Health and Safety Guidelines for Thermal Power Plants include information relevant to combustion processes fueled by gaseous, liquid and solid fossil fuels and biomass and designed to deliver electrical or mechanical power, steam, heat or any other combination of these, regardless of the fuel type. Refer to **Table 3.3** for IFC EHS Emissions Guidelines for Thermal Power Plants and **Table 3.4** for IFC EHS Liquid Effluent Guidelines for Thermal Power Plants.

Table 3.3: IFC EHS Emissions Guidelines for Combustion Turbines

Combustion Technology/Fuel	Particulate Matter	Sulfur Dioxide (SO_2)	Nitrogen Oxides (NO_x)	Dry Gas, Excess O_2 Content (%)
Natural Gas (>50MWth)	N/A	N/A	51 mg/Nm^3 (25 ppm)	15%

Table 3.4: IFC EHS Liquid Effluent Guidelines for Thermal Power Plants	
Parameter	**Mg/L, except pH and temp**
pH	6 – 9
TSS	50
Oil and grease	10
Total residual chlorine	0.2
Chromium – Total (Cr)	0.5
Copper (Cu)	0.5
Iron (Fe)	1.0
Zinc (Zn)	1.0
Lead (Pb)	0.5
Cadmium (Cd)	0.1
Mercury (Hg)	0.005
Arsenic (As)	0.5
Temperature increase by thermal discharge from cooling system	Site specific requirement to be established by EA. Elevated temperature areas due to discharge of once-through cooling water (e.g., 1 Celsius above, 2 Celsius above, 3 Celsius above ambient water temperature) should be minimized by adjusting intake and outfall design through the project specific EA depending on the sensitive aquatic ecosystems around the discharge point.

3.21.4 IFC Performance Standards and Guidance Notes (January 1, 2012)

IFC's Performance Standards define client roles and responsibilities for managing projects and requirements for IFC support. The standards include requirements to disclose information.

The Guidance Notes are companion documents to the Performance Standards, providing guidance to clients (and IFC staff) in meeting the Performance Standards.

3.22 Categorization of the Project

Although the land surrounding the project site is not developed, the site is effectively, surrounded on three sides by residential and commercial areas, with the fourth side abutting the Arabian Sea.

Pollutants generated during regular operation of the power plant and the water desalination unit include nitrogen oxides (NO_x), carbon monoxide (CO), thermal discharges (TD), sewage, noise, and brine. The Complex was therefore defined as a “Category A” project both for its original construction and for its pending rehabilitation.

Following the original EIA Report for the Complex (October 2004), the Sindh EPA issued an Environmental Approval (EA) for the project.

3.23 Hierarchy of obtaining Environmental Approval (EA):

According to PEPA, Section 12, sub-section 1 and 4:

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

"(4) The Government Agency shall communicate its approval or otherwise within a period of four months from the date the initial environmental examination or environmental impact assessment is filed complete in all respects in accordance with the prescribed procedure, failing which the initial environmental examination or, as the case may be, the environmental impact assessment shall be deemed to have been approved, to the extent to which it does not contravene the provisions of this Act and the rules and regulations."

The hierarchy of obtaining the EA involves submission of EIA report to the EPA. The EIA report is to be examined by the officials of the EPA. If any further clarification is needed, it will be provided by the consultant preparing the report and the project proponent. After satisfying the concerned EPA, the project proponent according to the directions of the EPA, will publish two public notices in two separate daily newspapers of the choice of EPA inviting the public to give their written comments on the project. The invitation of comments period will be 30 days as required under the PEPA. On the 31st day, a Public Hearing (PH) will be held at a location determined by the EPA. The environmental consultants are to present the EIA report to the participants of the Public Hearing and reply to their questions. After the PH, in case the EPA has any objection/question, they will be answered by the environment consultants and the project proponent. At this point, an EA will be issued by the EPA.

After the construction phase is completed, the project proponent is required to request the EPA for issuance of an EA for the operational phase of the project. The concerned EPA official will visit the project site and determine whether the required conditions were met. If the Complex meets requirements, the concerned EPA will issue EA for the regular operation of the project.

The EPA retains the right to monitor the project any time of its own choice. If the project does not operate in compliance with required national environment quality standards, the EPA will serve a notice under section 16 of the PEPA requiring compliance within thirty days. If the project is still found in non-compliance with the NEQS, the case is refer to the Environment Tribunal (ET) which, after verifying that the project is not in compliance with the NEQS, will impose a fine of One Million Pakistan Rupees with the condition that if the project continues in violation of the required standards, then a fine of one Hundred Thousand Pakistan Rupees for each day of default will be imposed. If, after 30 days, the project still fails to comply with NEQS, then the project will be closed until the proponent practically demonstrates NEQS compliance.

3.24 Status of the Project Approval for EA from the EPA Sindh:

The Sindh EPA, on the basis of the PH held and the EIA report submitted, issued an EA for the operational phase of the Complex.

3.25 Status with Private Power and Infrastructure Board (PPIB):

The project was approved by PPIB.

3.26 Status with National Electric Power Regulatory Authority (NEPRA):

The project was originally approved by National Electric Power Regulatory Authority (NEPRA). The Complex was allowed to sell electricity to KESC under Rule 6(1)(C) of NEPRA Licensing Rules at the approved Tariff. However, following technical difficulties at the Complex, the original Power Purchase Agreement was cancelled. The Complex has reapplied for a tariff and is negotiating a new PPA with KESC.

On September 13, 2012, DCL submitted a petition to NEPRA for Approval/Determination of Tariff for DHA Cogen Ltd. the complex post rehabilitation. NEPRA admitted the tariff petition for consideration vides their letter No. NEPRA/TRF-224/DCL-2012/10130 and called for a public hearing on November 28, 2012. The public meeting took place on Nov 28, 2012 which was attended by representatives from the company, SSGC, KESC, local press and public interveners. Following the meeting NEPRA asked certain explanations/information to further process the case vide their letter # NEPRA/TRF-224/DCL-2012/10739. DCL provided answers to all sixteen questions asked by NEPRA on Dec 21, 2012.

3.27 Record of Excellence

During its operational phase, DCL held an exemplarily record of compliance and recorded no violations.

4 BASELINE CONDITIONS IN AREA POTENTIALLY AFFECTED BY PROJECT

4 Baseline Conditions in Area Potentially Affected By Project

4.1 Designation of Project Area Perimeters

4.1.1 Spatial and Temporal Boundaries Adopted for the Various Aspects of the Study

The existing status of the environmental settings around the project site along with future likely trends of development and any change to occur in the land use pattern, especially industrialization and housing trends, were the major considerations under this ESIA.

4.1.2 Existing (Baseline) Condition of the Biophysical and Socio-Economic Environment, Trends and Anticipated Future Environmental Conditions Should the Project Not Go Ahead.

The project site is situated in between the Arabian Sea and residential areas of the DHA housing scheme. During the recent past, about 15 small-scale holiday resort type restaurants have come into existence in the neighborhood of the power plant site. These are constructed along the coast line of the sea. The restaurants are heavily attended in the evenings.

The proposed project is required to operate under strict environmental controls to ensure that the environment will remain virtually pollution-free. Implementation of the proposed EMMP further guarantees protection of the environmental settings as they exist now. All type of emissions and wastes to be generated will be managed in line with internationally accepted environmentally-safe practices and remain within compliance of the requirements of the NEQS under the PEPA and the IFC, EHS Guidelines for Thermal Power Plants (2008). This is expected to safeguard against pollution from project activity.

During the construction period which took place in 2006-2007, the project provided jobs to many people, especially those of the labor class. Once the Complex is rehabilitated and operational, about 100 jobs with 64 operational personnel of all demographic categories will be employed.

Regular operation of Phase I will provide 94MW of power and 3MMGallons/Day of drinking water. Returning the project to operations should provide residents of Karachi some relief from load-shedding of electricity and the residents of the DHA housing complex access to potable water piped into their homes. The GoP will benefit from taxes and duties assessed to the plant on a recurring basis. Poverty alleviation, provided indirectly through the generation of economic activity in the industrial sector, will be yet another benefit for the residents of Karachi.

Presently, serious power shortages lead to frequent load shedding actions by Pakistani utilities. The gap between power supply and demand has been and is expected to continue to increase. Consequently, all walks of life are being adversely affected. Currently, Pakistan has an installed electric generating capacity of about 19,400 MW of which around only 12,000 MW is utilized. Projection for the demand in year 2030 is 100,000 MW. At this time it is not expected that there will be any relief from load shedding in the country until at least the year 2020.

To sustain growth, Pakistan needs an integrated National Energy Plan. The GoP is making concerted efforts to ensure the continued development of energy resources. The government has encouraged the private sector to meet this additional demand. In order to bridge the gap between power demand and supply, the GoP has liberalized its investment policies.

This has resulted in not only investments in the power production sector from local resources, but has also encouraged foreign investors to participate in large numbers as well.

Over the last few years, industrial production has sharply decreased due to the frequent power shortages. Consequently, target levels of exports are not accomplished, resulting in curtailment of foreign exchange earnings. This project will positively affect the industrial sector as well as fulfill local demand for a reliable source of potable water.

4.2 Physical Geography: Climate, Geology, and Topography

Physical features of the project area include:

- Topography
- Geology
- Soils
- Climate
- Water

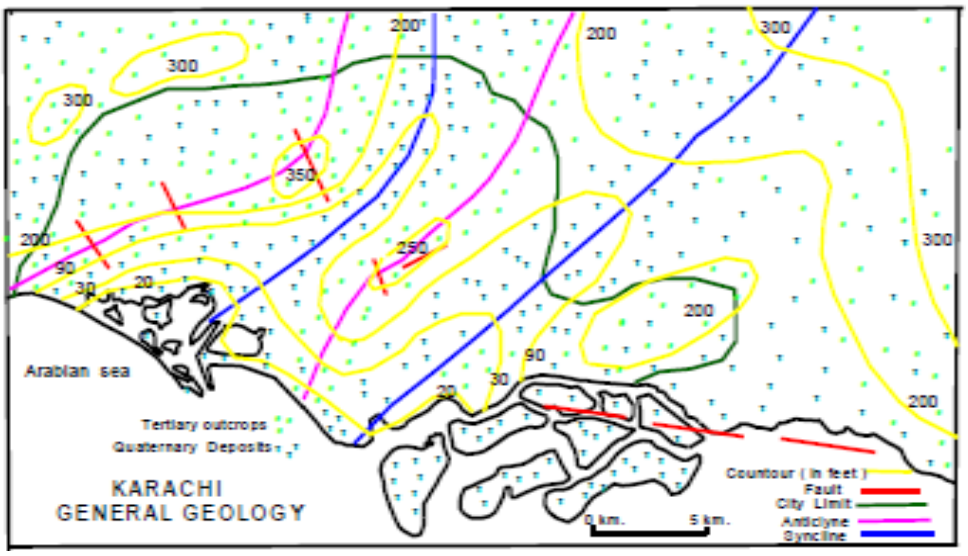
Ecological resources of the project area include:

- Fisheries and aquatic biology
- Biodiversity
- Forestry
- Wildlife
- Scientific institutions
- Socio-economic and cultural heritage

4.3 Physical Resources of the Project Area

4.3.1 Topography and Geology[6]

Karachi is sited in the south of Pakistan, on the coast of the Arabian Sea, with its geographic coordinates at 24.85° N, 67.02° E. It is mostly a flat city with some rolling plains, with hills on the western edge and Manora Island and Oyster Rocks to the southwest. The Arabian Sea beach lines the southern coastline of Karachi. On its southeast side, mangroves and creeks of the Indus delta are found, while towards the west and the north is Cape Monze, locally known as Raas Muari, an area marked with projecting sea cliffs and rocky sandstone promontories. There are several beautiful beaches in this area. The Khasa Hills lie in the northwest and form the border between North Nazimabad Town and Orangi Town. The Manghopir mountain range lies in northwest of Karachi and between Hub River and Manghopir. The coast of Karachi is dominated by cliffs, sea stacks, sandy beaches, sand bars, sand spits, swamps, mudflats and salt marshes.



Natural drainage in Karachi

4.3.2 Soils

Soils are an important aspect of the environment; they influence it through their composition and their fertility.

Soil should not be considered a lifeless residual layer but as a dynamic element of the environment in which very complicated physical, chemical and biological activities are constantly proceeding. In this way, it is a dynamically changing and

[6] Courtesy: Google

developing body. Soil scientists restrict the word soil or solum merely to the surface material, which has developed with distinct layers or horizon over an extended period of time.

The soil in the plains of Sindh is primarily plastic clay that has been deposited by the Indus River. It is a sandy substance in dry conditions, and it develops into a rich mud when exposed to water. Nearly the entire Indus valley has soil that is extremely friable and easily disintegrated by the flow of water. As a result, the water usually contains a large amount of suspended silt.[7]

4.3.3 Climate

Pakistan extends north/south from 24° N to about 37° N. Its western border lies close to 62° E, and its northeastern border extends to about 74° E and lies on the western margin of one of the major climatic regions of the world. A major part of Pakistan is dominated by an arid climate.

Karachi has an arid climate with low average precipitation levels (approx. 250 mm (9.8 in) per annum), the bulk of which occurs during the July–August monsoon season. Winters are mild and dry, while the summers are warm and humid; the proximity to the sea maintains humidity levels at a near-constant high and cool sea breezes relieve the heat of the summer months. December and January are dry and pleasant as compared to the warm summers that dominate through the late spring (March) to the pre-monsoon season (June). Compared to other parts of Pakistan, Karachi's weather is considered mild and can be compared to Florida's weather (except for the much lower precipitation).

Karachi's highest recorded temperature is 47 °C (117 °F), which occurred on 18 June 1979, and the lowest is 0.0 °C (32.0 °F), recorded on 21 January 1934. **Figure 4.1A** and **B** shows the precedent wind, temperature and precipitation trends in Karachi.

[7] Sindh, State of Environment & Development – 2004, IUCN

Figure 4.1 A – Prevalent Temperature and Precipitation in Karachi

Climate data for Karachi[8, 9, 10]

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Record high °C (°F)	32.8 (91.0)	36.1 (97.0)	41.5 (106.7)	44.4 (111.9)	47.8 (118.0)	47.0 (116.6)	42.2 (108.0)	41.7 (107.1)	42.8 (109.0)	43.3 (109.9)	38.5 (101.3)	34.5 (94.1)	47.8 (118.0)
Average high °C (°F)	25.6 (78.1)	26.4 (79.5)	28.8 (83.8)	30.6 (87.1)	32.3 (90.1)	33.3 (91.9)	32.2 (90.0)	30.8 (87.4)	30.7 (87.3)	31.6 (88.9)	30.5 (86.9)	27.3 (81.1)	30.0 (86.0)
Average low °C (°F)	14.1 (57.4)	15.9 (60.6)	20.3 (68.5)	23.7 (74.7)	26.1 (79.0)	27.9 (82.2)	27.4 (81.3)	26.2 (79.2)	25.3 (77.5)	23.5 (74.3)	20.0 (68.0)	15.7 (60.3)	22.2 (72.0)
Record low °C (°F)	0.0 (32.0)	3.3 (37.9)	7.0 (44.6)	12.2 (54.0)	17.7 (63.9)	22.1 (71.8)	22.2 (72.0)	20.0 (68.0)	18.0 (64.4)	10.0 (50.0)	6.1 (43.0)	1.3 (34.3)	0.0 (32.0)
Rainfall mm (inches)	3.6 (0.142)	6.4 (0.252)	8.3 (0.327)	4.9 (0.193)	0 (0)	3.9 (0.154)	66.4 (2.614)	44.8 (1.764)	22.8 (0.898)	0.3 (0.012)	1.7 (0.067)	4.5 (0.177)	167.6 (6.598)

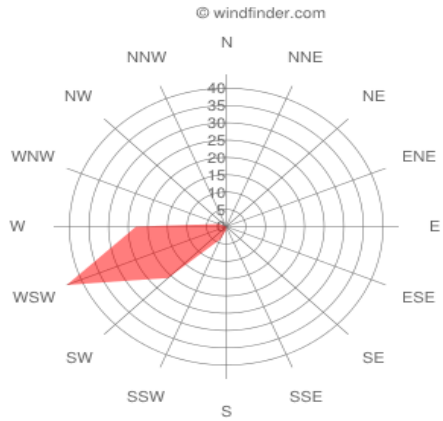
Figure 4.1 B – Precedent Wind Behavior in Karachi

Jinnah Airport/Karachi (KARACHI)
Statistics based on observations taken between 4/2009 - 10/2012 daily from 7am to 7pm local time.

Month of year	Jan 01	Feb 02	Mar 03	Apr 04	May 05	Jun 06	Jul 07	Aug 08	Sep 09	Oct 10	Nov 11	Dec 12	SUM 1-12
Dominant Wind dir.													
Wind probability > = 4 Beaufort (%)	11	22	38	46	69	70	65	55	40	17	14	13	**38**
Average Wind speed (Knots)	7	8	10	10	14	14	14	12	10	8	7	7	**10**
Average air temp. (°C)	22	24	29	32	33	33	32	31	31	31	29	23	29
Select month (Help)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year

Wind direction Distribution August(%)

Wind dir. distribution Jinnah Airport/Karachi August



[8] Courtesy: Google
[9] HKO (normal, 1962-1987)
[10] PakMet (extremes (1931-2008)

4.3.4 Earthquake Factor

Karachi falls in Seismic Zone 2B, with mild to moderate damage possible, Seismic Factor Ground Acceleration (g factor) 0.1 to 0.3.

4.3.5 Water

Karachi is seriously lacking in the availability of water. Underground water is highly brackish. The entire demand for water both for the power plant and the desalination unit will be met from the sea water.

4.4 Natural Events History

Deep beneath the bustling port city, the Indian, Arabian and Eurasian tectonic plates are in constant friction. As a result, seismologists say Karachi is similarly at risk from earthquakes as Los Angeles.[11] Relative to the sprawling coastal city of Los Angeles or other cities lying on or near fault-lines, Karachi is ill-equipped to cope if disaster strikes, according to experts.

4.4.1 Floods:

Floods are not a regular occurrence in Karachi. However, in 2010, heavy rains paralyzed Karachi with flooding as torrential rain fell on southern areas of Sindh.[12]

4.4.2 Storms:

Tropical storms and dust storms occur in the area but are fairly infrequent.

4.4.3 Cyclones:

Cyclones on the Sindh coast are not common but do occur periodically causing considerable damage to coastal villages. Since 1947, major cyclones have occurred in June 1948, November 1993, and May 1999.

4.4.4 Volcanic Eruptions*:*

There is no source of volcanic eruptions anywhere around Karachi.

4.5 Biological Environment (Ecological Resource)

4.5.1 Fisheries and Aquatic Biology

Fisheries play an important role in the national economy. Overfishing, degradation of the ecosystem and unsustainable exploitation of marine resources are a growing concern, along with an alarming rise in pollution levels in fishing waters. They are major factors causing depletion of the coastal and

[11] World News of Architecture, Archi Times – ISSN No. 2073-9001, A+I-ISSN No. 207-901X
[12] BBC News South Asia 2010

deep-sea fish stock. The Karachi Fish Harbour (KFH) is the only harbour equipped for the adequate landing and processing of export.

Resource depletion as a result of overfishing and pollution hazards also remains unrecorded. Foreign vessels have been poaching the waters of local fishermen, causing unrest among them and degrading the marine ecosystem by pushing the resources beyond the maximum sustainable yield (MSY).

Out of the 1,050 km coastline of Pakistan, about 350 km lies in Sindh and is considered to be the most productive.[13] It is comprised of a much broader continental shelf, extending 110 km from the coast, which is indented by a number of creeks in the Indus Delta.[14]

Fishing in Pakistan has so far been dependent on natural sources. There is no move for diversification of resources to induce fisheries to reduce the pressure on wild stock.

The Sindh coastal region is located in the southeastern part of the country between the Indian border along the Sir Creek on the east, and the Hub River along the Balochistan coast on the west.[15] The coastal morphology is characterized by a network of tidal creeks and several small islands with scattered mangrove vegetation which constitute the largest arid land mangroves in the world and the thirteenth largest mangrove forests in terms of coverage.

Situated between the Indus Delta on the southeast and Hub River on the west, the Karachi coastal belt is about 100 km in length.[16] Most of which, with the exception of scattered patches of mangroves, is devoid of any kind of vegetation and consists of shallow lagoons, sea cliffs, stacks and terraces, wave cut platforms, sea caves and notches. The Lyari and Malir Rivers flowing through Karachi are nonperennial in nature and drain into the Arabian Sea. They carry substantial quantities of untreated urban, municipal and industrial effluents.

The coastal waters have high salinity (>36 percent) due to high evaporation rates, combined with negligible rainfall.[17] Oxygen-poor water layers sometimes rise to the surface along the coast, leading to fish mortality. The wildlife along the Pakistani coast consists of both marine and terrestrial species. However, in

[13] United Nations ESCAP in Cooperation with Environment and Urban Affairs Division, Government of Pakistan / National Institute of Oceanography, Government of Pakistan – 6390 – Coastal Environmental Plan for Pakistan.
[14] Ibid
[15] Ibid
[16] Ibid
[17] Dr. Hein Van Gils, M. Shabbir Baig, LARUS-HC, Netherlands, EU-SSP, Pakistan – 6392 – Environmental Profile of Balochistan, Pakistan

the area of influence of the Complex, there are very few species present. Refer to **Figure 4.2** for a photograph of the sea near the Complex. While fishing may occur, there were no fishing vessels and no wildlife present at that time.

4.5.2 Biodiversity

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

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

A. Forestry

In Pakistan, 90% of mangroves are in Sindh province. They have been diminishing in Sindh due to extensive irrigation and lack of water release into the Indus delta. Unplanned urban growth and pollution has also contributed to the rapid deforestation of mangroves. Karachi City government has been planning to develop Karachi's skyline, which puts mangroves at great risk; activists from different backgrounds have been protesting for some time.

Avicennia Marina, locally called "Timer" is the dominant species of the area and occurs almost as monotypic stand throughout the area in Korangi Creek. It is a tree species and attains about 10 m height in inundated areas, fringing the creek or growing on the adjoining small Islands, With the increase in elevation and decreasing tidal waves, the tree height is gradually reduced and takes on a bushy appearance. A few stands of Aegicereus Corniculatan and Ceriops Tagal also exist on relatively raised grounds. These forests are located on tidal flats with their richly productive biomass, which, in addition to providing fish nurseries, also form a natural protective barrier system against storms and tidal waves. These mangrove forests, being part of the Indus delta system, are perhaps unique in being the largest area of arid climate mangrove forests in the world. They are almost wholly dependent upon fresh water discharge from the Indus River and a small quantity of fresh water from run off and domestic and industrial effluents from the Korangi Area. These mangrove forests were declared as protected forest under the Forest Act 1927, when the area was transferred to the Forest Department in 1958. All the trees in the mangroves were declared as "preserved" trees. <u>There are no mangroves within the area of influence of the project. Hence, ECTECH has not included baseline data on</u>

mangroves. While some mangroves may be visible from the site, they are outside the area of influence of the project. Refer to **Figure 4.2** for a photograph illustrating the lack of any mangroves in the project area.

Figure 4.2: No Mangroves in the Area

The greatest economic importance of the mangroves comes from the fisheries they harbor. The creeks and mangroves provide excellent nursery areas for young fish, especially shrimp. Shrimp are a major export commodity. A large proportion of the fish caught in Pakistan's coastal water spend at least part of their life cycle in the mangroves, or depend on food webs originating there. Whilst there is room for expansion of some parts of the fishing industry, the most valuable species, shrimp, is seriously overfished and after a number of years of fishing above the estimated maximum sustainable yield, the catches have begun to decline.

The mangroves themselves are used directly for fuel wood and fodder for domestic animals by the coastal villagers, although Avicennia wood is not considered a good fuel wood as other mangrove species, e.g. Rhizopora. However, such wood is still used extensively by local people for domestic purposes.

On the other hand, Avicennia leaves are excellent fodder for animals and are collected regularly by the villagers. In addition to collecting fodder for cattle, sheep and goats kept in the villages it has been observed that at certain time of years large numbers of camels are herded into the mangroves to graze, feeding

on the foliage day and night. This activity puts considerable pressure on the existing stand of mangroves nearest to the coastal villages, to such an extent that many mature stands are stunted due to overgrazing, browsing and lopping.

One of the most important functions of the mangrove ecosystem is to protect the coastline from wind and ocean currents.

Factors responsible for the degradation of mangroves include:

- Reduced flow of sweet water.
- Navigational activities and intermix of industrial effluents.
- Browsing by camels and goats and grazing by buffaloes and cows.
- Wood and fodder harvesting
- Over fishing and use of non-judicious fishing techniques
- Gradual rise in sea level
- Terrestrial Vegetation

B. Wildlife[18, 19]

Pakistan's national parks are a blend of wildlife and vegetation, providing untouched natural beauty to these areas, including Kirthar National Park in Karachi. The Government of Pakistan does not allow any kind of exploitation, hunting, mining, or cultivation in the wildlife area. These regulations have allowed both flora and fauna to flourish in the Karachi's national parks.

Another notable place of interest in Karachi is the Karachi Zoo where the Reptile House is one of the foremost of its type in Pakistan. The house has 13 species of snakes and lizards and sponsors a hatchling project for tortoises and crocodiles. The Mughal Garden, another local attraction, has the finest green floral spots in Karachi.

Because of habitat loss in the project area due to human settlements and interventions, there is little wildlife in the area, other than in the Kirthar National Park.

There are no migratory birds in the Karachi area.

[18] Courtesy Google: "Wildlife in Karachi"
[19] The Sindh Wildlife Protection Ordinance 1972 (with Amendments up to June 01, 2001)

4.5.3 Natural Parks & Other Protected Areas[20, 21]

Karachi is rich in parks and gardens containing a variety of trees, ornamental plants, grasses, shrubs, hedges, flowers etc. National parks and other protected areas do not exist in the project area of influence. In addition to the parks maintained by City District government of Karachi, there are some parks in the private sector also. These parks and gardens provide ample opportunity for recreation in natural settings to the residents of Karachi. Some of these parks and gardens are listed hereunder:

NATIONAL PARKS:

National Parks:	
Kirthar National Park	

Public Parks:	
Abdullah Haroon Park, Hijrat Colony	Aisha Park, Block-14, Gulberg Town
Akhoowat Family Park, 11B, North Karachi	Allah Rakha Park, Machchi Miyani
Annu Bhai Park, Nazimabad	Arambagh Park, Central City
Ashraful Madaris Park, Gulistan e Jauhar	Askari Park, Gulshan Town
Aziz Bhatti Park, Gulshan Town	Azizabad Park, Block 8, Federal B Area
Bagh Ibne Qasim, Old Clifton	Bagh-e-Quaid-e-Azam, Dr Ziauddin Ahmed road and Aiwan-e-Sadar Road
Frere Hall Gardens, Civil Lines	Baloch Park, Central City
Bakhtawar Park, Block 5, Clifton	Baradari Park, Nazimabad
Bedhwar Library Park, Parsi Colony	Beach View Park, Clifton
Bi Amman Park, 11C, North Karachi	Boat Basin Park, Boat Basin
Central Park, Saddar Town	Childrens Park, Saddar Town
Clifton Park, Kyaban e Roomi, Clifton	Coconut Park, Block-15, Gulberg Town
Eidgah Ground, Nazimabad	Eyk Number Park, 11J, North Karachi
Family Park, Block-14, Gulberg Town	Family Park, Off Princes Street
Gabol Park, Kala Kot	Gharib Nawaz Park, 11E, North Karachi
Hasrat Mohani Model Park, Shah Faisal Town	Hill Park, P.E.C.H.S.
Hakeem Muhammad Saeed playground/Park, Gulshan-e-Iqba Karachi	I Own Karachi Park, Nazimabad-4, Nazimabad
Jamia Masjid Park, Bihar Colony	Jahangir Park, Saddar Town
Jheel Park, Tariq Road, P.E.C.H.S.	Jinnah Park, 11F, North Karachi
Khayyal Das Park, Central City	Kidney Hill Park, P.E.C.H.S.
Kite Park, Rehri Goth, Landhi Town	Lalazar Park, Behind Boat Club
Ladies Park, Aiwan e Sadar Road	Lyari Aman Park, Tannery Road, Lyari Town
Maulana Mohammad Ali Jauhar Park, (Kakri Ground), Lyari Town	Mojahid Park, Lyari Town
Moulvi Usman Park, Tannery Road, Lyari Town	Municipal Park, Bandar Road
Municipal Park, Chakiwara Road	Municipal Park, Iqbal Shaheed Road
Municipal Park, Block 2 Clifton	Municipal Park, Block 7 Clifton

[20] Diagnostic Study of the Indus Delta Mangrove Ecosystem, Sindh Forest & Wildlife Dept. and The World Bank, June 01, 1999.
[21] Sindh, State of Environment and Development, 2004 – IUCN.

Public Parks:	
Municipal Park, Block 7, Mai Kolachi Road, Clifton	Municipal Park, Block 8, Federal B Area
Municipal Park, Miran Naka	Municipal Park, New M A Jinnah Road
Municipal Park, 11C, North Karachi	Neighbourhood Park, Block 2, Clifton
Nisar Shaheed Park, Defense Phase4	Nishtar Park, Saddar Town
Noor Ilahi Park, Rangiwara	Parkground, Old Clifton Road, Clifton
Partab Singh Park, Barnes Road	Quaid Mausoleum Park, Jamshed Town
Quaid-e-Azam Park, Steel Mills	Sabri Park, Gulistan Colony, Lyari Town
Safari Park, Gulshan Town	Shaheed Benazir Bhutto Park, Boat Basin
Sheikh Hayat Park, Opp. Mohammad Din Community Hall, Lyari Town	Sheria Park, Landhi Town
Sir Syed Ahmed Khan Park, (Ship Park), Block-13 F.B. Area, Naseerabad, Gulberg Town	Sohrab Katrak Park, Parsi Colony
Talimi Bagh, Gulberg Town	Tikon Park, Machchi Miani
Zamzama Park, Zamzama Street, Clifton	[Kutchi Memon Park], Kutchi Memon Housing Society (CMCHS) [Bahadurabad, Karachi]

Private Parks:	
Aladdin Park, Rashid Minhas Road	Dreamworld Resort, Super Highway
Jibes Playland, Clifton	Sindbad, Rashid Minhas Road

Gardens:	
Karachi Zoological Gardens, Garden Road	Burnes Garden, Burnes Road

4.5.4 Scientific Institutions

Karachi is host to a large number of universities having scientific research institutions and Scientific Institutions functioning under Federal and Provincial Governments, Semi-Autonomous, Autonomous, Public and Private Direction. Hereunder is a list of some universities and scientific institutes:[22]

University:
Aga Khan University
Baqai Medical University
Dawood College of Engineering and Technology
Dow University of Health Sciences
Indus Valley School of Art and Architecture
INJECTSAP
Iqra University
National University of Computer and Emerging Sciences
NED University of Engineering and Technology

[22] Wikipedia

University:
Newports Institute of Communications & Economics
Pakistan Marine Academy
Pakistan Naval Academy
Pakistan Navy Engineering College
PIMSAT
Sir Syed University of Engineering and Technology
Textile Institute of Pakistan
Ziauddin Medical University

A. Granted University Status:

- Meharban Jogari University
- Mid-Asia Institute of Science & Technology
- Al-Khair University (Karachi Campus)
- Asia Pacific Institute of Information Technology
- College Of Digital Sciences (CDS)
- COMMECS Institute of Business and Emerging Sciences, Gulistan-e-Jauhar
- COMSATS Institute of Information Technology
- Institute of Industrial Electronics Engineering (PCSIR)
- Institute of Textile Technology and Management Foundation (ITTMF)
- Karachi Institute of Information Technology
- Pakistan Marine Academy
- Plastics Technology Centre
- Synthetic Fibre Development & Application Centre
- Usman Institute of Technology
- Amjad University of Engineering & Technology
- Mehran University of Engineering & Technology, Jamshoro
- National Institute Of Oceanography, Karachi

4.6 Human Environment

4.6.1 Cultural and Other Heritage

Karachi, with a population of about 15 to 21 million (estimated in 2012) is the most populous city in Pakistan. The city is the commercial capital of the country. More than 70% of the industry of Pakistan is operating in this city. The wealthiest strata of society enjoy a lifestyle similar to what is found in Europe and the USA.

However, there is a substantial contrast of living styles between the poor and the rich. Due to the great economic and commercial opportunities found in Karachi, people from all over the country are drawn to the city.

While the wealthiest segment of Pakistani society often follows the lifestyle of their counterparts in the west, there are a large number of poor people living according to the old traditional Pakistani lifestyle.

With its location on the coast of Arabian Sea, Karachi offers the opportunity for a variety of water sports. The city has many bustling markets, eminent hotels, and restaurants.

Karachi, as previously shown, is a major hub for higher education in Pakistan and hosts over 80 universities, with many other specialized institutes, colleges, schools and centres of learning.

Some of the most popular Karachi tourism sites include the National Museum of Pakistan, Charminar, WWF Wetland Centre, Habib BankPplaza, Unicorn Gallery, Karachi Expo Centre and Pakistan Air Force Museum.

4.6.2 Population and Communities

The project site is located in the upscale residential area of DHA Housing Phase VIII, which is situated on the north side of the project.

Of the minority populations in Karachi, many are migrants from Bangladesh, most of which have obtained Pakistani citizenship. According to various sources, the population of Pakistani Bengalis ranges between 100,000 and 500,000. Much of the Bangladeshi-origin population also includes the thousands of stateless Biharis who were allowed resettlement in Pakistan after the 1971 war in Bangladesh.

There are many Bengali colonies in Karachi, often referred to as "mini Bangladesh." Bengali communities are often found in the same areas as Burmese people in Pakistan due to a shared culture and similar language. The Bengalis and Burmese communities in Pakistan are adopting Urdu and assimilating with Muhajirs.

In addition, to the Bengalis, there are 650,000 Afghans, 200,000 Burmese, and lesser thousands of Iranians, Filipinos, Nepalese, Sri Lankans and Indians living in Karachi.[23]

A. DHA Community

DHA is currently one of the larger investors in DCL, and the water desalination unit provides potable water directly to DHA Phase VIII housing, the only human

[23] Owais Tohid; Arshad Mahmud (29 Nov. 1995). "Homeless in Karachi." http://www.outlookindia.com/article.aspx?200305.

settlement near the project site. DHA Karachi, is a housing developer in Karachi, Pakistan. DHA is a tax-exempt institution, the profits of which are used to the benefit of retired military personnel.

DHA was created through the Presidential Order No.7 of 1980 and was later approved by the National Assembly of Pakistan. The Authority's granted land is spread over 8,852 acres (35.82 km^2) and provides civic facilities to millions of residents.[24] The housing projects are planned to cover every aspect of healthy living and contain parks, educational institutions and clubs. The organization employs a Secretary, Chief Engineer, Directors, and a committed work force to ensure smooth running of the organization.

The functioning of the Authority is vested in the two bodies: the Governing Body headed by Secretary Ministry of Defense and Executive Board Headed by the Corps Commander Posted at Karachi. The Executive Board exercises all administrative, executive and financial powers of the Authority.

B. Major Roads

The following network of main roads connects the entire DHA settlements with the city of Karachi and to the entire country.[25]

- Korangi Road/National Highway
- Sunset Boulevard
- Khayaban-e-Shamsheer
- Khayaban-e-Ittehad
- Khayaban-e-Hafiz
- Khayaban-e-Shaheen
- Gizri
- Zamzama
- Khayaban-e-Bahria
- 26th Street
- Seaview Road/Beach Avenue
- Commercial Avenue
- Zulfiqar Street

C. Defense Authority College of Business

The Defense Authority College of Business (DACB) is situated in DHA Phase VI on 3rd Street off Khayaban-e-Sehar. The institution is affiliated with University of Karachi, one of the three Pakistani universities ranked among top 600 of the world. DACB was established in 2000. The college offers BBA and MBA programs.

[24] Five million illegal immigrants residing in Pakistan
[25] http://www.globalsecurity.org/military/world/pakistan/cantt-clifton.htm

The College maintains qualified faculty and excellent resources. It is one of the few institutions in Pakistan that provides a top quality and cost-effective business education to outstanding candidates. In 2008/09, the college accepted only 220 candidates of which roughly 40% got a full waiver of their tuition fees by virtue of their past scholastic record, 15% got a half-waiver and the rest paid a low fee subsidized by the Defense Authority. As a public institution, DACB is furthering the access of quality higher education in business to talented Pakistani youth.

D. DHA Medical Center

In addition to quality housing, DHA provides its residents with state-of-the-art medical facilities. The addition of a specialist wing to the existing emergency center at the DHA Medical Complex is indicative of the benefits made available to residents of DHA housing. Medical Complex features include:

Services

- Sindlab Collection Unit
- Consultancy Clinics
- National X - Ray and Ultrasound
- 24 hours Emergency Unit
- Ambulance Service

Additional Facilities

- ECG
- Trauma (Minor O.T for Outpatient Procedure)
- Lungs / Respiratory Function (Nebulization and Sprometry)

Salient Features

- Elevator / Wheel Chair Service
- Appointment service for consultants from 0900 to 2200 hours
- Male & Female nurse's aides

4.6.3 Industries

Although there are no major industries in close proximity to the Complex area, the major industries in Pakistan include:

- Textile and garment manufacturing
- Paper manufacturing
- Automobile part manufacturing
- Pharmaceutical products
- Beverage manufacturing
- Art
- Steel manufacturing
- Agricultural pesticides

- Plastic & rubber goods
- Oil and gas extraction and refinement
- Light engineering & re-tooling
- Vacuum glass products
- Petrochemicals
- Pharmaceutical & surgical equipment
- Electric wiring & cables
- Meters and control equipment manufacturing
- Transformer gear & other electrical equipment manufacturing
- Furniture manufacturing
- Paint manufacturing
- Canning & preservation of seafood
- Computer manufacturing

4.6.4 IFC Performance Standard 7: Indigenous Peoples

Although IFC Performance Standard 7: Indigenous Peoples is not directly applicable to the Complex, DCL recognizes the value and importance of fair and proper treatment of Indigenous Peoples.

DCL recognizes that Indigenous Peoples, as social groups with identities that are distinct from mainstream groups in national societies, are often among the most marginalized and vulnerable segments of the population. Although Indigenous Peoples may be more vulnerable to the adverse impacts associated with project development than non-indigenous communities, no Indigenous Peoples will be affected by operating the Complex.

In many cases, private sector projects can create opportunities for Indigenous Peoples to participate in, and benefit from project-related activities that may help them to fulfill their aspiration for economic and social development. DCL recognizes that there is no universally accepted definition of "Indigenous Peoples." Nevertheless, DCL will offer opportunities afforded by operation of the Complex to all groups—including Indigenous Peoples by any definition—equally.

There are no Indigenous Peoples within the project area of influence. No direct or indirect economic, social, cultural, or environmental impacts upon Indigenous Peoples are expected as a result of rehabilitating and operating the Complex. In the unlikely event that any effects upon Indigenous Peoples arise, they will be minimized, restored, or compensated appropriately.

Although Indigenous Peoples will not be affected by the project, relevant stakeholders and members of the local community were involved in public disclosures and given the opportunity to offer feedback. Refer to Chapter 8 of this ESIA for details on Public Involvement and Disclosures.

When the land for the Complex was originally acquired, all transactions were fair and voluntary. Pricing was determined using appropriate market rates. No Indigenous Peoples were relocated from the site at any time, nor does the site of the Complex hold any traditional value or cultural heritage for any Indigenous Peoples. No Indigenous Peoples were involved in the original acquisition of land for the Complex, nor any later proceedings relating to the Complex.

4.6.5 IFC Performance Standard 8: Cultural Heritage

DCL recognizes the importance of cultural heritage for current and future generations. DCL is committed to protect items of cultural heritage should they become discovered during the course of project activities.

Because the Complex is sited upon reclaimed land without any known history of cultural heritage, no artifacts or evidence of cultural heritage are expected to be discovered at the site. In the event that any tangible or intangible forms of cultural heritage are discovered at the site, they will be protected and preserved, and DCL will consult with the appropriate Affected Communities.

4.7 Environmental Quality of the Project Area [Baseline Environmental Data]

This ESIA report for OPIC contains the baseline environmental data of the project area monitored between November 15 and 17, 2012. At the time of this environmental monitoring, the Power Plant and Water Desalination Unit were out of operation since May 1, 2010 for the reasons explained in Section 2 of this report.

Monitoring of the ambient air quality was done for SO_2, CO, NO_x PM (Particulate Matter) and noise. Since wastewater was not available on the project site due to the project's mothballed status, no direct wastewater tests could be conducted. Sea water samples were analyzed for their relevant parameters.

All monitoring for baseline environmental data were carried out on November 16 and 17, 2012 by APEX Environment Laboratory, Lahore approved as Environmental Laboratory by the Environment Protection Agency, Government of the Punjab, Lahore. APEX Environment Laboratory is a sister concern of ECTECH Environment Consultants and operates under the same management.

Along with environmental monitoring, the following studies have also been carried out.

- Environmental Site Assessment: for contamination of soil with oil and grease, mineral wool/glass wool, asbestos or hazardous and toxic chemicals.

- Thermal Discharges: status of their discharge into the sea vis–a-vis compliance with legal requirements with respect to the National Environmental Quality Standards, Pakistan and desired conditions by OPIC.
- Saline Water Discharges: into the sea and their likely impact on aquatic life once the power plant is operational.
- Treatment of waste water (Effluent Discharges): status of wastewater treatment and its ultimate discharge.

In order to fully evaluate baseline conditions, ECTECH also considered data collected in the 2004 EIA Table 1-1 of the Executive Summary, provides a synopsis of the baseline data from both the 2004 EIA and the current 2012 ESIA scoping events.

4.7.1 Ambient Air Quality

A. Ambient Air Monitoring for SO_2, NO_x & CO:

The ambient air quality for sulfur dioxide (SO_2), nitrogen oxides (NO_x), and carbon monoxide (CO) was carried out at five points as **Annex 4.1** in the project site. The monitored data are shown in **Table 4.1**:

Table 4.1 Ambient Air Quality Monitored Data for SO_2, NO_x and CO

Sr. No.	Reference Point	Date	Time	SO_2 ($\mu g/m^3$) 24 hours Average	NO_2 ($\mu g/m^3$) 24 hours Average	CO (mg/m^3) 24 hours Average
1.	On the Road Between Office and Grid	17-11-12	10:00 a.m	B.D.L	B.D.L	B.D.L
			04:00 p.m	B.D.L	B.D.L	B.D.L
2.	Near Final Discharge to Sea	17-11-12	10:00 a.m	B.D.L	B.D.L	B.D.L
			04:00 p.m	B.D.L	B.D.L	B.D.L
3.	Near Workshop Area	17-11-12	10:00 a.m	B.D.L	B.D.L	B.D.L
			04:00 p.m	B.D.L	B.D.L	B.D.L
4.	Near Fine Filtration	17-11-12	10:00 a.m	B.D.L	B.D.L	B.D.L
			04:00 p.m	B.D.L	B.D.L	B.D.L
5.	Near Lube Oil Storage Drum	17-11-12	10:00 a.m	B.D.L	B.D.L	B.D.L
			04:00 p.m	B.D.L	B.D.L	B.D.L
National Environment Quality Standards for Ambient Air (NEQSAA) Limiting Value				**120**	**80**	**5**

B.D.L= Below Detection Limit
D.L for SO_2 = 10 $\mu g/m^3$
D.L for NO_x = 6.0 $\mu g/m^3$
D.L for CO = 20 $\mu g/m^3$

On one side of the project site is the Arabian Sea and on the other side is yet vacant residential area of the DHA Housing Scheme. The nearest housing settlement is about 5 KM away from the project site. The Power Plant and the Water Desalination Unit were non-operational with no other fuel burning activity present. There is neither a residential area, nor any industrial or commercial activity around the project site. The traffic on the nearby road is very insignificant. The dilution of air via the wind from the sea is significant. In these conditions, with the plant not operational, such low ambient concentrations of SO_2, NO_x and CO are not surprising.

Ambient air quality in the area was also measured by DHA in 2009. The findings of this study are recorded in **Table 4.2, Table 4.3, and Table 4.4.**

Table 4.2: Ambient SO_2 Levels Measured by DHA (2009)

Location	January (ppb)			February (ppb)			March (ppb)			NEQS Limit (ppb)
	Max	Min	Avg	Max	Min	Avg	Max	Min	Avg	
Creek Marina	13	7	10	14	8	10	17	8	13	38
Creek Side Mall	12	8	10	15	8	11	19	10	15	38
Crescent Bay	13	7	10	15	8	10	19	10	13	38
	April (ppb)			May (ppb)			June (ppb)			
	Max	Min	Avg	Max	Min	Avg	Max	Min	Avg	
Creek Marina	19	8	14	19	9	13	19	10	14	38
Creek Side Mall	20	10	16	25	10	17	21	12	17	38
Crescent Bay	20	8	14	19	8	13	20	8	14	38

Table 4.3: Ambient NO_x Levels Measured by DHA (2009)

Location	January (ppb)			February (ppb)			March (ppb)			NEQS Limit (ppb)
	Max	Min	Avg	Max	Min	Avg	Max	Min	Avg	
Creek Marina	16	9	13	17	10	13	34	15	26	53
Creek Side Mall	15	10	13	17	10	13	36	18	27	53
Crescent Bay	14	8	11	18	10	14	36	18	27	53
	April (ppb)			May (ppb)			June (ppb)			
	Max	Min	Avg	Max	Min	Avg	Max	Min	Avg	
Creek	36	17	26	28	15	24	37	17	27	53

Marina										
Creek Side Mall	36	18	28	38	12	27	36	20	28	53
Crescent Bay	36	13	23	36	11	23	36	14	27	53

Table 4.4: Ambient CO Levels Measured by DHA (2009)										
Location	**January (ppm)**			**February (ppm)**			**March (ppm)**			**NEQS Limit (ppm)**
	Max	**Min**	**Avg**	**Max**	**Min**	**Avg**	**Max**	**Min**	**Avg**	
Creek Marina	1.5	0.9	1.2	2.3	1.0	1.3	2.9	1.1	1.9	5
Creek Side Mall	1.8	1.0	1.4	1.9	1.0	1.5	2.9	1.2	2.3	5
Crescent Bay	2.5	1.0	1.75	3.1	1.0	1.6	2.9	1.0	1.9	5
	April (ppm)			**May (ppm)**			**June (ppm)**			
	Max	**Min**	**Avg**	**Max**	**Min**	**Avg**	**Max**	**Min**	**Avg**	
Creek Marina	2.2	1.1	1.8	2.6	1.1	1.9	3.9	1.2	2.5	5
Creek Side Mall	3.0	1.0	2.0	2.9	0.8	1.8	3.8	2.1	2.9	5
Crescent Bay	2.1	1.1	1.3	1.9	1.1	1.3	2.9	1.2	2.1	5

i. **Nitrogen oxides (NOx)** in the ambient air consist primarily of nitric oxide (NO) and nitrogen dioxide (NO_2) have much higher toxicity. Nitric oxide is readily converted to the much more harmful nitrogen dioxide by chemical reaction with ozone present in the atmosphere. The direct effects of NO_2, depending upon exposure time and concentration of NO_2, on the respiratory system include increased airway resistance, increase incidence of respiratory illness and damage to lung tissues and emphysema. Emphysema is a long-term, progressive disease of the lungs that primarily causes shortness of breath.

ii. **Sulfur Dioxide** is particularly irritating to mucous membrane of upper respiratory tract. Chronic effects include rhinitis, dryness of the throat, and cough. Acute over exposure may result in death from asphyxia. Chronic exposure may result in nasopharyngtis, fatigue, altered sense of smell and chronic bronchitis symptoms such as dyspnea on exertion, cough and increased mucous excretion.

iii. **Carbon Monoxide** combines with hemoglobin to form Carboxyhemoglobin which interferes with the oxygen carrying capacity of blood, resulting in a state of tissue hypoxia. The typical signs and symptoms of acute CO poisoning are headache, dizziness, drowsiness, nausea, vomiting, collapse, coma and death. Initially the victim is pale; later the skin and mucous membranes may be cherry red in color. Loss of consciousness at about the 50% Carboxyhemoglobin level. Sever CO poisoning has been reported to permanently damage the extra pyramidal system, including the basic ganglia.]

B. Total Suspended Particulates (TSP)

Monitoring for Total Suspended Particulates (TSP) in ambient air was carried out at five points as **Annex 4.1** on the project site. The monitored data is shown in **Table 4.5**.

Table 4.5 Total Suspended Particulates (TSP)

Sr. No.	Reference Point	Date	Time	Total Suspended Particulate Matter (TSP) (µg/m^3) 24 hours Basis	Total Suspended Particulate Matter (TSP) (µg/m^3) 24 hours Average
1.	On the Road Between Office and Grid	17-11-12	10:00 a.m	57.3	56.2
			04:00 p:m	55.1	
2.	Near Final Discharge to Sea	17-11-12	10:00 a.m	62.8	63.1
			04:00 p:m	63.4	
3.	Near Workshop Area	17-11-12	10:00 a.m	47.2	46.75
			04:00 p:m	46.3	
4.	Near Fine Filtration	17-11-12	10:00 a.m	58.6	58.25
			04:00 p:m	57.9	
5.	Near Lube Oil Storage Drum	17-11-12	10:00 a.m	35.9	36.05
			04:00 p:m	36.2	
National Environmental Quality Standards for Ambient Air (NEQSAA) Limiting Value					**550.0**
World Bank Limiting Value for Ambient Air Quality in Thermal Power Plants					**230.0**

DHA also undertook a study of suspended particulate matter in ambient air in 2009. The data collected in this study is presented in **Table 4.6.**

Table 4.6: Ambient Particulate Matter Levels Measured by DHA (2009)										
Location	**January (µg/m^3)**			**February (µg/m^3)**			**March (µg/m^3)**			**NEQSAA Limit (µg/m^3)**
	Max	**Min**	**Avg**	**Max**	**Min**	**Avg**	**Max**	**Min**	**Avg**	
Creek Marina	132	128	130	142	125	133	142	123	130	550
Creek Side Mall	130	127	138	148	127	138	142	123	130	550
Crescent Bay	132	119	126	141	120	132	136	120	127	550
	April (µg/m^3)			**May (µg/m^3)**			**June (µg/m^3)**			
	Max	**Min**	**Avg**	**Max**	**Min**	**Avg**	**Max**	**Min**	**Avg**	
Creek Marina	150	130	142	152	135	145	179	142	161	550
Creek Side Mall	170	135	159	169	145	156	205	180	192	550
Crescent Bay	189	160	183	189	162	178	206	182	198	550

C. Noise Levels

The noise levels were measured on the outside of the four boundary walls of the plant site as well as within its battery limits. The noise levels on the four boundary walls range between 36.31 dB(A) to 47.98 dB(A).

These measurements were carried out at a total of eight points of which four are outside the boundary walls and four are within the boundary walls. These points are exhibited in the **Annex-4.1**. Monitored data is shown in **Table 4.7**:

Table 4.7 Baseline Noise Levels Measured by ECTECH (2012)

Exterior Reference Point #1: Plant Boundary Line A: Sea Side

Date	Time	dB(A)										Leq
17-11-12	Day	43	43	43	44	44	44	45	45	46	46	44.44
17-11-12	Night	36	36	36	37	37	37	37	38	38	38	37.06

Exterior Reference Point # 2: Plant Boundary Wall B: Recreation Area (Restaurants)

Date	Time	dB(A)										Leq
17-11-12	Day	40	40	40	40	41	41	41	42	42	42	40.98
17-11-12	Night	35	35	35	36	36	36	37	37	37	38	36.31

Exterior Reference Point # 3: Plant Boundary Wall C: (DHA) Defence Housing Authority Undeveloped Area

Date	Time	dB(A)										Leq
17-11-12	Day	46	46	46	46	47	47	47	48	48	49	47.11
17-11-12	Night	42	42	42	43	43	44	44	45	45	45	43.68

Exterior Reference Point # 4: (Salt n Pepper Hotel) Side- Plant Boundary Wall D

Date	Time	dB(A)										Leq
17-11-12	Day	47	47	47	47	48	48	48	49	49	49	47.98
17-11-12	Night	40	40	40	41	41	41	42	42	43	43	41.44

Interior Reference Point #1: Near Gas Turbine

Date	Time	dB(A)										Leq
17-11-12	Day	50	50	50	51	51	51	52	52	52	53	51.31
17-11-12	Night	42	42	42	43	43	43	43	44	44	44	43.06

Interior Reference Point # 2: Near Desalination Brine Collection point

Date	Time	dB(A)										Leq
17-11-12	Day	43	43	43	43	44	44	44	45	45	45	43.98
17-11-12	Night	37	37	37	38	38	38	38	39	39	39	38.06

Interior Reference Point #3: Near Lube Oil Tank

Date	Time	dB(A)										Leq
17-11-12	Day	43	43	43	44	44	45	45	45	45	46	44.41
17-11-12	Night	36	36	36	36	37	37	38	38	38	38	37.09

Interior Reference Point # 4: In Between Grid and Office

Date	Time	dB(A)										Leq
17-11-12	Day	49	49	49	49	50	50	50	51	51	52	50.11
17-11-12	Night	39	39	39	40	40	40	40	41	41	41	40.06

In addition to measurements taken by ECTECH, baseline ambient noise levels were also measured in 2009 by DHA in the area surrounding the Complex. Refer to **Table 4.8** for data this noise monitoring data.

Table 4.8: Ambient Noise Levels Measured by DHA (2009)

Location	January (dBA)			February (dBA)			March (dBA)			NEQS Limit (dBA)
	Max	Min	Avg	Max	Min	Avg	Max	Min	Avg	
Creek Marina	41	39	40	47	41	42	49	42	46	80
Creek Side Mall	43	40	42	48	41	44	48	41	44	80
Crescent Bay	46	40	43	48	41	44	48	41	44	80
	April (dBA)			May (dBA)			June (dBA)			
	Max	Min	Avg	Max	Min	Avg	Max	Min	Avg	
Creek Marina	58	49	53	58	45	52	58	51	54	80
Creek Side Mall	58	51	54	58	52	54	68	52	60	80
Crescent Bay	58	51	53	58	44	50	65	52	57	80

D. Water Quality

One sea water sample was taken from outside the Complex site and analyzed for important parameters.

Table 4.9 Sea Water Laboratory Test Results				
Sr. No.	**Parameter**	**Unit**	**Result**	**NEQS Limits**
1	Temp ^{o}C	^{o}C	---	
2	pH	---	8.5	6-9
3	Conductivity	ms/cm^2	58.0	---
4	Total Dissolved Solids (TDS)	mg/l	44,587.0	3500
5	Turbidity	NTU	19.0	---
6	Total Suspended Solids (TSS)	mg/l	48.2	200
7	Total Hardness as ($CaCO_3$)	mg/l	8,400.0	---
8	Calcium (Ca^{++})	mg/l	2,345.0	---
9	Magnesium(Mg^{++})	mg/l	6,136.0	---
10	Sodium(Na^{+})	mg/l	13,593.0	---
11	Chloride(Cl)	mg/l	22,400.0	1000
12	Sulfate(SO_4)	mg/l	4,420.0	600
13	R – Cl_2	mg/l	0.6	---

E. Thermal Discharge

Because the power plant and Water Desalination Unit are not operational, a Thermal Discharge (TD) samples were not available.

TD in the form of once-through cooling water will be released from the Complex at a temperature of 42°C as compared to the seawater surface and subsurface temperature of 31°C (2004 EIA). By design, the TD water purposefully falls onto large boulders, which causes aeration and heat dissipation. As a result, the discharge water temperature drops considerably before coming in contact with the sea surface interface and is within the regulatory tolerance range. The 2008 ECAR further supported the efficiency of the system through behavior temperature measurements taken at various locations beyond the seawater interface. It was found that TD becomes equalized at approximately 35 meters from shore.

The point of discharge for TD from the Complex is not directly into the sea, but on the shore 15-20m away. The system is in compliance with NEQS standards based upon the 2004 EIA and its efficiency is not in question. This cooling of steam is acceptable since extending the discharge pipe onto the sea floor is likely to cause greater impacts to the ecosystem and raise the risks of human activity in the future. This system adheres to IFC Guidelines for Thermal Power Plants by minimizing the temperature of TD when it is exposed to sea water. This in turn minimizes elevated temperature areas. The EMMP will provide continuous data

to demonstrate the effectiveness of the system. Refer to **Figure 1.1** for a photograph of the discharge system, the boulders, and the sea.

F. Waste Water

Because the Power Plant and Water Desalination Unit are not operational, a wastewater sample was not available in 2012. Refer to **Table 4.6** for wastewater results from the 2008 ECAR.

G. Brine Discharges:

Because the Water Desalination Unit is not operational, a brine sample was not available in 2012. However, analyses of two brine samples carried out by the DCL Power Plant Laboratory on March 17, 2008 and March 22, 2008, are reproduced in **Table 4.10** and **Table 4.11**.

Table 4.10 Brine Laboratory Test Results

Parameters	Sample Collected 11:30 hrs				Sample Collected 11:30 hrs
Parameters	**Unit**	**Brine Water March 17, 2008**	**Sea Water March 17, 2008**	**Sea Water March 22, 2008**	**Brine Water March 22, 2008**
Temp ^{o}C	^{o}C				
pH	---	8	8	8	8
Conductivity	ms/cm^2	62	57	58	67
Turbidity	NTU	22	18	20	25
Total Suspended Solids (TSS)	mg/l	55.22	45.18	50.2	62.75
Total Hardness as ($CaCO_3$)	mg/l	9,500.00	8,200.00	8,300.00	10,100.00
Calcium (Ca^{++})	mg/l	2,900.00	2,200.00	2.250.00	3,100.00
Magnesium(Mg^{++})	mg/l	6,600.00	6,000.00	6,050.00	7,000.00
Sodium(Na^{+})	mg/l		12,662.00		
Chloride(Cl)	mg/l	30,000.00	22,123.00	23,250.00	31,120.00
Sulfate(SO_4)	mg/l	5,800.00	4,250.00	4,300.00	5,850.00
R – Cl_2	mg/l	Nil	0.5	0.6	Nil

Approximately 13.3% of the intake seawater of the Complex will be used for desalination. The remainder will be discharged in the form of brine without any additional pollutants.

The mass balance for TDS in the effluent of the Complex has been calculated with the worst possible conditions in place. **Table 4.11** shows the results as analyzed by Alfa Laval Process Flow Diagram, Rev. 3, which do not exceeded the NEQS Total Dissolved Solids (TDS) limits of 3500mg/L. The complete calculation for TDS is included as **Annex 4.2: Mass Balance for Outfall TDS**.

Table 4.11 Brine and Seawater Concentrations Total Dissolved Solids (TDS)			
TDS in Seawater Intake	**Total Effluent TDS**	**Brine TDS less Control TDS**	**NEQS TDS Contribution Limit**
45000.0mg/L	48164.97mg/L	3164.97mg/L	3500.0mg/L

By design, the brine from each train is sent to a Fine Filtration Tank where it is first mixed with a large quantity of cooling/sea water originating from other points of the Complex before falling into the sea from the outfall pipe. Based on this design, the TDS of returning water should continue to achieve a TDS well below NEQS limits under the worst conditions. Varying the volumes of sea water in the dilution process becomes the easiest method of controlling discharge concentrations.

Refer to **Table 4.12** for quantified intake and outflow rates of seawater for the Complex.

Table 4.12 Water Flow Rates	
Water Flow Process	**Rate (metric tons per hour)**
Seawater intake for desalination	2861.0 tons/h
Water returned to sea from desalination process	2571.8 tons/h
Water retained for desalination	289.2 tons/h
Seawater intake for power plant cooling	1108.8 tons/h
Water returned to sea from power plant cooling	1108.8 tons/h
Total seawater intake	**3969.8 tons/h**
Total water returned to sea	**3680.6 tons/h**

H. Sanitary Water

Presently, the wastewater from toilets in the administration building and near the Eastern perimeter wall is transferred to the Cantonment Board Clifton (CBC), through their own bouzer and discharged into their sewer for treatment. When the Complex is operating after rehabilitation, sewage will be treated by GEMS or WMC, which will meet international standards. According to the IFC Environmental, Health, and Safety Guidelines for Thermal Power Plants, December 19, 2008 and IFC Environmental, Health, and Safety, General Guidelines, April 30, 2007 and NEQS Pakistan, under the PEPA, the entire waste water shall have to be treated to the following levels before it is discharged to the sea or elsewhere.

Table 4.13 Sanitary Sewage plus Thermal Discharges Discharge Levels:			
Sr. No.	**Pollutant**	**Units**	**Guideline values**
1	Temperature increase by thermal discharge from cooling system	^{o}C	$\leq 3^{0}$C*
2	pH	pH	6-9
3	BOD	mg/l	30
4	Total nitrogen	mg/l	10
5	Total phosphorous	mg/l	2.0
6	Oil & grease	mg/l	10.0
7	Total suspended solids	mg/l	50.0
8	Total Coliform bacteria	MPN/100ml	400

*The effluent should result in a temperature increase of no more than 3^{0}C at the edge of the zone where initial mixing and dilution take place. Where the zone is not defined, use 100meters from the point of discharge when there are no sensitive aquatic ecosystems within the distance.

I. Stack Gases Emissions:

ECTECH carried out environmental monitoring of the complex between August 25 and 27, 2008, while the Power Plant and Water Desalination Unit were operational. In addition, PERAC Data was collected on August 11, 2008. See **Table 4.14**. Therefore, environmental data monitored at these times has been used to determine whether these units were in compliance with OPIC and IFC environmental standards or are anticipated to be in compliance once the plant is rehabilitated and operational.

Table 4.14 - Monitored Data Regarding Stack Gaseous Emissions[26]			
Reference point and Sampling Event	**CO (mg/Nm^3)**	**SO2 (mg/Nm3)**	**NOx (mg/Nm^3)**
ECTECH (August 25-27, 2008) Turbine Stack	285.0 310.0 296.0	0.0 0.0 0.0	210.0 229.0 218.0
PERAC (August 11, 2008) Turbine Stack	-----	-----	39
Permissible limits by IFC[27] (Combustion Turbines)	-----	-----	51
Permissible values under NEQS Pakistan	800.0	1700.0	400.0

SO_2 values were found to be 0.0mg/Nm^3 and therefore in compliance with both NEQS and IFC requirements. Maximum recorded emissions of CO at 310 mg/Nm^3 are also well within the limiting value of 800 mg/Nm^3 as set by NEQS. IFC does not specify any standard for CO emissions.

[26] Monitoring was carried out using LANCOM III, Portable Flue Gas Analyzer, LAND Instruments International, Combustion Environmental Monitoring, and meets US EPA CTM 034 Reference Method.

[27] IFC Environmental, Health, and Safety Guidelines, THERMAL POWER PLANTS, December 19, 2008.

During the time of the ECTECH stack emissions monitoring, the Power Plant was not operating properly. According to the DCL Plant Status Report and Major Shutdowns after COD, the turbine was not operating under normal conditions. The resultant NO_x emissions at the stack are not a true representation of the emissions when the plant is operating under normal conditions.

During the time of NO_x emissions monitoring at the stack by PERAC, the Power Plant was operating under optimal load conditions at loads ranging from 75 to 79MW, maintained for a period of 24 hours in steady state operation. The NO_x measurement of 39mg/Nm^3 collected by PERAC is a true representation of Power Plant emissions and demonstrates compliance with IFC guidelines.

J. Solid Waste

Presently, solid wastes (SW) are collected by a certified waste management company, Urba Marker, Pvt., and disposed of at Mataro Moar, which is registered as a hazardous waste facility about 100km from Karachi. The non-hazardous waste is disposed of at a landfill site at Tool Plaza in Karachi. Urba Marker is among the premier waste management contractors in Pakistan, whose clients include British Petroleum and others. However, Urba Marker is still in the process of obtaining the most up-to-date international licenses. If Urba Marker does not obtain those licenses, DCL will contract Global Environmental Management Services (GEMS), or Waste Management Company (WMC), which do meet international standards, for solid and hazardous waste disposal. Refer to **Annex 4.3** for a detailed profile of GEMS and **Annex 4.4** for a detailed profile of WMC.

K. Soil Contamination by Oil and Grease:

There is a very isolated area contaminated by oil at the Complex that is composed of paved and unpaved surfaces. A photograph of this area is included as **Figure 4.3**. This contamination is a result of the temporary disconnection of main power line, which required the temporary use of generators. This situation has been corrected.

Figure 4.3: Oil and Grease Contamination at the Complex

DCL will correct the oil contamination prior to the rehabilitation phase. The contamination will be remediated by a specialized hazardous waste contractor. Proper procedures will be reviewed with employees and contractors. During future operations, DCL will ensure that contamination of the adjacent soil by oil and grease shall not occur.

L. Deterioration of Glass Wool/Mineral Wool Lagging:

It was observed that glass wool/mineral wool used in the "lagging" of various pipes in the Water Desalination plant had deteriorated at points. At two places at the plant the glass wool joints were opened, exposing the glass to the air.

At various points, the glass wool/mineral wool lagging has worn out while at other places it is in various stages of degradation. This issue will be remediated by DCL during rehabilitation to avoid the potential inhalation of this material.

M. Housekeeping and Safety;

It was observed that about 40 to 50 drums, each of about 20 kg capacity and full of chemicals were stacked in the middle of the desalination unit. These drums do not pose a security risk to the plant because they are neither flammable nor toxic. In fact, the chemical is a food grade item used in desalination as anti-scalant. The drums pose no hindrance to operations or maintenance.

Sand bags were also present as protection against rain in certain areas. These contain a fine sand that is not hazardous in any way.

Thus all construction activity undertaken to lay underground cables for the transfer of electricity from the power plant to the grid was accomplished in compliance with the requirements of the IFC's "Environmental, Health and Safety Guidelines for Electric Power Transmission and Distribution," April 30, 2007.

During the proposed rehabilitation, no subsurface waste is anticipated.

N. Infrastructure Impacts, gas Supply lines:
All activities of gas supply were carried out by Sui Southern Gas Pipe Line (SSGPL). SSGPL has its own well-established EHS standards very similar to those of the IFC. The laying of the piping system for gas supply was done in strict compliance with these guidelines.

O. Potable Water Supply
The potable water to be produced by the Complex will be transported through its existing underground water line, which is currently connected to the main operational water line of the Cantonment Board Clifton passing at a distance of about 6km from the complex.

4.8 Archaeological, Historical and Cultural Resources

During the original construction activity of the underground transmission cables, there were no encounters with any cultural resources, archaeological resources, historical resources, geotechnical hazards, or other important features. Project development and construction activities did not face any road construction or upgrade, site preparation and development, removal of select vegetation, grading and excavation of soils for the laying of the cables and other relevant infrastructure. The excavated soil was duly used for backfilling. All solid wastes were duly disposed of according to environmentally-sustainable practices.

4.9 Gaps in Knowledge and Uncertainties Encountered

The information required for the ESIA report was available. No uncertainty was encountered.

4.10 Alternatives Analysis

Karachi, with its growing population, is facing serious difficulty in providing for basic needs—including potable water and electricity—for its people. Although the Government of Pakistan is attempting to fulfill these vital needs, private sector participation is necessary to meet the demand. This project presents a

vital part of the solution and aligns with the policies of the Government. DCL aims to produce power and water for the people of Karachi at the lowest possible cost. In addition to being the most cost-effective option for providing power and water to Karachi, rehabilitation of this existing asset is also much more environmentally sound compared to building any type of new facility. The design of a combined cycle power plant such as the Complex makes it the most efficient thermal power plant option. Natural gas is the cleanest-burning fossil fuel, and a combined cycle power plant utilizes waste heat from a gas turbine to maximize the efficiency of power generation from each unit of fuel. Refer to **Table 4.11** for the deficit of power in Pakistan and **Table 4.12** for Pakistan's ranking in the top ten countries in the world facing water scarcity.

Table 4.15: Power Deficit in Pakistan

Peak Power Demanded (MW)	Power Supplied (MW)	Power Deficit (MW)
19,000	<13,000	>6,000

Table 4.16: Top Ten Countries at Risk of Water Shortages[28]

Risk Ranking	Country
1	Somalia
2	Mauritania
3	Sudan
4	Niger
5	Iraq
6	Uzbekistan
7	**Pakistan**
8	Egypt
9	Turkmenistan
10	Syria

[28] http://www.globalresearch.ca/top-ten-countries-at-risk-of-water-shortages/19996

5 POTENTIAL (UNMITIGATED) ENVIRONMENTAL, HEALTH & SAFETY IMPACTS

5 Potential (Unmitigated) Environmental, Health & Safety Impacts

5.1 Sources and Volumes of Untreated Airborne, Liquid and Solid Waste and Potential Impact of Unmitigated Discharge on the Environment

5.1.1 Methodology for Anticipating Environmental Impacts

Baseline data and conditions form the basis for evaluation of the environmental impacts of the existing DHA Cogen Ltd. Power Plant & Water Desalination Unit. This chapter exclusively covers potential (unmitigated) environmental, health, and safety impacts, while mitigation measures are delineated in Chapter 6 according to the OPIC format.

The following standards were considered to evaluate and categorize environmental, health, and safety impacts:

- National Environmental Quality Standards (NEQS) Pakistan
- National Ambient Air Quality Standards (NAAQS) Pakistan
- IFC General EHS Guidelines, Occupational Health and Safety
- IFC EHS Guidelines for Thermal Power Plants (2008)
- World Health Organization (WHO) Air Quality Guidelines for Particulate Matter, Ozone, Nitrogen Dioxide and Sulfur Dioxide (Global Update 2005)

The Extent of Impact Scale and Evaluation of Impacts used for this ESIA study are as follows:

<u>Scale: Extent of Impact</u>

▲▲▲ = High
▲▲ = Medium
▲ = Low
O = No impact
▼▼ = locally favorable
▼ = regionally favorable.

Table 5.1 Evaluation of Impacts

Extent of EHS Impact	Description
High	International and National Standards are Exceeded
Medium	Between International and National Standards
Low	International and National Standards are Met

5.2 Potential Impacts on Natural and Biological Resources

5.2.1 Environmental Impacts Assessment during Operations Phase

Because the commissioning began in July 2007, it is not relevant to include the construction period of the EIA. Only the environmental impacts of the operational phase of the complex are described here.

In 2008, while the Complex was operational, ECTECH Environment Consultants conducted environmental monitoring of the following items:

- Gaseous emissions from the stack
- Ambient gas concentrations
- Ambient particulate matter concentrations
- Ambient and operational noise levels
- Drinking water analysis
- Wastewater analysis

The environmental performance status of the Complex during its operational phase is based on the Environmental Monitoring Report, carried out on August 25-27, 2008 by ECTECH, which is the only prior report of its type for the Complex.

5.2.2 Extent of Impact on Air Quality

According to the results monitored during regular operation of the Complex, NO_x concentration was found to be 39 mg/Nm^3 as measured by third party M/S PERAC. The result is in compliance of both NEQS and IFC guidelines which are 400 and 51 mg/Nm^3 respectively.

The emission of CO at a concentration of 310 mg/Nm^3 is within the limiting value of 800 mg/Nm^3 as set by NEQS Pakistan. IFC does not specify a standard for CO emissions.

Gaseous Emission	Stack Measurement	IFC Guideline	NEQS Limit
NO_x	39 mg/Nm^3	51 mg/Nm^3	400 mg/Nm^3
CO	310 mg/Nm^3	-	800 mg/Nm^3
SO_2	0 mg/Nm^3	-	1700 mg/Nm^3

Strict adherence to the Environment Management & Monitoring Plan (EMMP) will ensure safeguards against any likely adverse environmental impacts from the project operation in this regard.

<u>Extent of Impact on Air Quality = ▲ (Low)</u> (after Complex rehabilitation and optimization)

5.2.3 Extent of Impact on Fauna & Flora

During preparation of the local EIA report, no nest or nesting birds were observed on or near the project site. Emissions are not expected to have an appreciable impact on birds in the area.

The site area does not include sensitive habitats or protected areas designated as conservation sites for endangered species. Furthermore, noise limits and stack emission standards will not be exceeded. Thus, the impact of the Complex operations on fauna and flora will be low.

Extent of Impact on Fauna & Flora = ▲ (Low)

5.2.4 Landscape and Visual Impact

The site is dominated by buildings, plant & machinery, stack, and storage tanks. Rehabilitation and operation of the existing Complex will have virtually no visual impact.

Extent of Impact on Landscape = ▲ (Low)

5.2.5 Supply of Water

All water needs for project activity are fulfilled using seawater. The underground water in Karachi is not suitable for treatment to drinking water; most drinkable water is supplied to Karachi from outside the city. As a result, project activity will not have any adverse impact on the water supply.

Extent of Impact on Water Supply = ▲ (Low)

5.2.5 Solid Waste Management

M/S URBA MARKER, C-44, Block-10-A, Gulshan-e-Iqbal, Karachi, are the contractors who dispose of solid wastes (SWs). **Annex 5.1** includes the type and quantities of the solid wastes that were being generated at the Complex during its operation.

Urba Marker has one waste disposal site located in district Badin of Sindh, near Mataro Moar, 20km from Matli on Matli Badin road. This site caters to complete waste disposal for United Energy Pakistan's, Schlumberger's, BGP, Sinopac, and Moody's International generated from their operations in Badin concession area Sindh.

The waste disposal site has two incinerators and a waste disposal landfill spread over four acres. The site can handle both hazardous and non-hazardous waste and can segregate recyclable waste.

The second waste disposal site of M/S Urba Marker is located about 10km off Tando Allahyaar on Tando Adam Tando Allahyaar road. It has similar facilities of waste disposal and it caters for United Energy Pakistan's and BGP's survey waste disposal.

Domestic waste from DHA Cogen is collected from the site and is segregated in Karachi, non-hazardous waste is disposed of in Karachi, while hazardous waste is transported to the Mataro waste facility. The vehicles go to Mataro from Karachi regularly at a frequency of approximately once a week providing regularly scheduled waste disposal.

Urba Marker is among the premier waste management contractors in Pakistan, whose clients include British Petroleum and others. However, Urba Marker is still in the process of obtaining the most up-to-date international licenses. If Urba Marker does not obtain those licenses, DCL will contract Global Environmental Management Services (GEMS), or Waste Management Company (WMC), which do meet international standards, for solid and hazardous waste disposal. Refer to **Annex 4.3** for a detailed profile of GEMS and **Annex 4.4** for a detailed profile of WMC.

Extent of Impact of Solid Waste = ▲ (Low) (with adoption of mitigation measures)

5.2.7 Noise Impact

The range of baseline noise levels on the outside of the four boundary walls were measured on November 16 & 17, 2012 (while the Complex was not operating) and on August 25 to 27, 2008 (while the Complex was operating).

	Baseline Noise at Boundary Walls (2012)	Noise at Boundary Walls During Operation (2008)
Low	36.31dBA	62.0dBA
High	47.98dBA	80.0dBA

Noise level during Complex operation was measured at the nearest DHA residential area. Noise measured in this area was within IFC guidelines.

	Noise at DHA Residential Area During Operation (2008)	IFC Residential Noise Limit
Night	38.6dBA	45dBA
Day	50.1dBA	55dBA

Extent of Impact on Noise Level = ▲ (Low)

5.2.8 Soil, Surface Water, and Groundwater

During Complex operation, all sewage is collected in a pit and disposed of through the CBC contractor using a bouzer to the CBC network. When the Complex is operating after rehabilitation, sewage will be treated by GEMS or WMC, which will meet international standards. No soil, surface or ground water is generated during Complex operation.

Extent of Impact on Soil, Surface Water, and Groundwater = ▲(Low)

5.3 Potential Human Impacts

5.3.1 Societal Impacts during Operations

A. Neighborhood and Community

The nearest human settlement in the project area of influence is the DHA Housing Society. The project produces electricity for the national grid and potable water exclusively for residents of DHA. No negative societal impacts are foreseen for this community.

Extent of Impact = ▲ (Low)

B. Relocation Impact

Relocation impact is not applicable to the project. No relocation was ever required during original construction of the Complex. The rehabilitation and operation of the Complex will similarly have no effect.

Extent of Impact = ▲ (Low)

C. Traffic Impact

There is a modest average traffic rate of 180 vehicles per hour on the main road to the East of the Complex during the day (10:00-16:00). Around 20:00, traffic increases to approximately 390 vehicles per hour due to nightlife and dining. The adjoining restaurants have one year left on their lease and according to the landowners, DHA they will not be renewed as they are considering other development opportunities for the area. The increased traffic flow does not create congestion problems. This road and others in the surrounding area are well-designed for increased traffic volume. The occasional traffic of heavy trucks and equipment associated with Complex operations will occur mostly during the day will not have an appreciable impact on the local community. No appreciable impact on local traffic was observed when the Complex was in operation. During the expected rehabilitation and subsequent commencement of commercial operations, the slightly increased occasional traffic of heavy trucks and equipment associated with Complex operations will occur mostly during the day

and thus, given the modest traffic rate of 180 vehicles per hour, will not have an appreciable impact on the local community. The expected modest increase during the day will be approximately 10-15% of current levels and thus will not reach nighttime levels of 390 vehicles per hour.

Extent of Impact = ▲(Low)

D. Socio-Economic Impact

Rehabilitation of the Complex will restore an important source of electricity and potable water for the residents of the DHA Housing Society. Provision of these important utilities will afford great economic benefit to the community. Medical bills will be reduced with less exposure to water-borne diseases; reliable electricity will allow businesses to function and remain profitable; and the Complex itself will create several dozen local jobs. These factors combine to significantly bolster the local economy.

The project will not have any negative or detrimental impacts on the socio-economic conditions of the area.

Extent of Socio-Economic Impact = ▼▼(locally favorable)

5.4 Potential Occupational Health and Safety Hazards

Major emergencies or disasters in power plants usually occur from one or any combination of the following:

- Fast-spreading fires
- Explosions
- Bursting of pipe lines or vessels
- Uncontrolled release of toxic, corrosive, or flammable liquid
- Uncontrolled release of toxic or flammable gas
- Structure collapse due to natural disasters such as earthquakes and storms
- Sabotage and terrorist attacks on installations
- Destructive trade union activities, strikes and mob violence

Depending upon the nature, scale, velocity and impact on environment, each of these may constitute an emergency.

5.4.1 Hazard Potential of Various Plant Sections

A. Fire Hazard:

- Cable galleries and cable trays

- Transformer oil
- Turbine hall
- Natural Gas Area
- Switch yard (132 KV)
- Transformer (132 KV)

There will be less probability of fire in cable galleries, cable trays, transformer oil, turbine areas and gas handling system, switch yard, transformers after adequate detection, manual and automatic fire fighting arrangement have been made and those are checked at fixed intervals.

An adequate firefighting system is in place, some details of the same are given below. In view of the current system, fire hazards are manageable. The firefighting system includes the following:

- Fire detection and control system
- Fire alarm
- Fire control
- Firefighting water pump
- Portable fire extinguishers
- CO_2 fire extinguishing system
- Staff preparedness

The status of the fire system is checked on a weekly basis by simulating a diesel pump fire. A minimum of 1.5 meters of water level is maintained in the underground water tank to fight any potential fires.

In-house training on fire prevention and firefighting is conducted by an EHS supervisor every six months.

The firefighting facilities in the Complex are fully operational. They are properly maintained and manned by trained personnel, who are fully capable of operating the fire system and controlling any fire-related emergency**.**

For more details of the firefighting system available at the project site refer to **Annex 6.1**.

5.4.2 Explosion Hazard:

- Transformers
- Gas compressor building
- There is a low probability of an explosion in the Complex and the piping system includes adequate detection and protection systems.

5.4.3 Bursting of Pipe Lines / Vessels:

- Water and steam pipes due to high pressure,
- Oil lines due to high pressure and temperature.
- There is a low probability of pipes in the Complex bursting; they are solidly constructed and are periodically checked by a certified chief boiler inspector.

5.4.4 Release of Hazardous Liquid:

- Chemical tanks in DM plant
- Fuel oil from oil storage tanks
- Lubricating oil from turbines and generators
- There is a low probability of a major emergency due to the release of hazardous chemicals because such chemicals are not typically stored in large quantities at the Complex.

5.4.5 Natural Disasters:

- Structure collapse may occur due to natural disasters like earthquakes.

5.4.6 Sabotage and Terrorist Attacks:

- Depending upon the location of sabotage and terrorist attacks, emergencies may arise from the above factors.
- The probability of sabotage and terrorist attacks as well as destruction by union activities and strikes or mob violence is very low. Presently, the Complex is patrolled by security personnel at all times, and equipped with three security cabins. During rehabilitation, a barbed wire fence near the sea and watch towers at the boundary walls will be constructed, further increasing security. Visitors are screened by security personnel and photo passes will be required for each visitor.

5.4.7 Destructive Trade Union Activities, Strikes and Mob Violence

- Depending upon the situation, the emergencies arising from the above factors may have risk potential from destructive trade union activities, strikes, and mob violence. As previously mentioned destruction by union activities and strikes or mob violence is low.

- The Security force of the Complex includes:
  - 2 supervisors and 9 guards during the morning shift
  - 1 supervisor with 13 guards during the night shift
  - Security personnel are equipped with rifles, detectors, whistles, and lights

5.4.8 Deterioration of Glass Wool/Mineral Wool Lagging

The glass wool/mineral wool used for lagging various pipes in the water desalination plant is deteriorating in some places.

At two points at the Complex, the glass wool joints were opened for maintenance purposes. Any insulation removed or exposed for maintenance of the pipes and surfaces is reinstalled after completion of the maintenance activity.

5.4.9 Housekeeping and Safety

The chemical stored in drums between the desalination trains is a food grade item which is neither flammable nor toxic. The chemical is used in desalination as anti-scalant and the drums pose no hindrance to operation & maintenance.

For more detailed account refer to Section 4 of this report.

5.4.10 Radioactivity

There is no source of radioactivity in the Complex area.

5.5 Potential for Major Safety and Health Hazards Beyond the Workplace

5.5.1 Fire

There are no existing buildings directly adjacent to the Complex. There is no significant brush that could support the spread of a fire to any other building. Therefore, the effect of a fire spreading in the area is minimal

5.5.2 Effluents

The possibility of contaminating seawater exists. This would happen if effluent from the Complex, especially the sewage, were discharged into the sea without treatment. However, this scenario is highly unlikely

5.5.3 Thermal Discharges (TD)

TD in the form of once-through cooling water will be released from the Complex at a temperature of 42°C as compared to the seawater surface and subsurface temperature of 31°C (2004 EIA). By design, the TD water purposefully falls onto large boulders, which causes aeration and heat dissipation. As a result, the discharge water temperature drops considerably before coming in contact with the sea surface interface and is within the regulatory tolerance range. The 2008 ECAR further supported the efficiency of the system through behavior temperature measurements taken at various locations beyond the seawater interface. It was found that TD becomes equalized at approximately 35 meters from shore. This constitutes the mixing zone for the discharge and there are no sensitive marine ecosystems within this zone.

Ambient Water Temperature (2004 EIA)	Thermal Discharge Temperature (2008 ECAR)	Mixing Zone & Temperature Equalization Point (2008 ECAR)	NEQS and IFC TD Mixing Zone Limit
31°C	42°C	35m	100m

The point of discharge for TD from the Complex is not directly into the sea, but on the shore 15-20m away. The system is in compliance with NEQS standards based upon the 2004 EIA and its efficiency is not in question. This cooling of water is acceptable since extending the discharge pipe onto the sea floor would only increase the temperature of TD and raise the risks of human activity in the future. This system adheres to IFC Guidelines for Thermal Power Plants by minimizing the temperature of TD when it is exposed to sea water. This in turn minimizes elevated temperature areas. The EMMP will provide continuous data to demonstrate the effectiveness of the system. Refer to **Figure 1.1** for a photograph of the discharge system, the boulders, and the sea.

The water dispersion test conducted for the effluent and seawater mixing utilized the "Cormix Mixing Zone Expert System" and was undertaken while the Complex was operational. The full results of the test, which are included as **Annex 5.2**, show that the thermal discharge mixes with seawater to reach an equilibrium temperature of 31˚C at a distance of 35m from the discharge pipe. A new study of the thermal discharge mixing zone will be undertaken when the plant is operational. Any necessary changes will be made to the system in order to remain in compliance with IFC guidelines.

5.5.4 Solid Waste

Presently, solid wastes (SW) are picked up by a certified waste management company, Urba Marker, Pvt., and disposed of at Mataro Moar, which is registered as a hazardous waste facility The hazardous waste is disposed of on a designated site at Mataro about 100km from Karachi. The non-hazardous waste is disposed of at a landfill site at Tool Plaza in Karachi. Urba Marker is among the premier waste management contractors in Pakistan, whose clients include British Petroleum and others. However, Urba Marker is still in the process of obtaining the most up-to-date international licenses. If Urba Marker does not obtain those licenses, DCL will contract Global Environmental Management Services (GEMS), or Waste Management Company (WMC), which do meet international standards, for solid and hazardous waste disposal. Refer to **Annex 4.3** for a detailed profile of GEMS and **Annex 4.4** for a detailed profile of WMC.

5.5.5 Sewage

Raw sewage is picked up by the Cantonment Board Clifton in their bouzer and is responsibly treated along with sewage from the nearby DHA communities.

5.5.6 Brine

Approximately 13.3% of the intake seawater of the Complex will be used for desalination. The remainder will be discharged in the form of brine without any additional pollutants.

The mass balance for TDS in the effluent of the Complex has been calculated with the worst possible conditions in place. **Table 5.2** shows the results as analyzed by Alfa Laval Process Flow Diagram, Rev. 3, which do not exceeded the NEQS Total Dissolved Solids (TDS) limits of 3500mg/L. The complete calculation for TDS is included as **Annex 4.2: Mass Balance for Outfall TDS**.

Table 5.2 Brine and Seawater Concentrations Total Dissolved Solids (TDS)

TDS in Seawater Intake	Total Effluent TDS	Brine TDS less Control TDS	NEQS TDS Contribution Limit
45000.0mg/L	48164.97mg/L	3164.97mg/L	3500.0mg/L

5.5.7 Soil Contamination by Oil and Grease

There is a very isolated area (approximately 1m square) contaminated by oil at the Complex that is composed of paved and unpaved surfaces. A photograph of this area is included as **Figure 4.3**.

DCL will correct this situation during the rehabilitation phase. The contamination will be remediated by a specialized hazardous waste contractor. During future operations, DCL will ensure that contamination of the adjacent soil by oil and grease shall not occur.

5.6 Worker Health and Safety

Rehabilitation and operational activities could expose workers to health and safety risks. In particular, the following activities could have negative health and safety impacts:

- Noise and dust from demolitions and excavations
- Working with heavy equipment
- Working in confined spaces
- Heavy lifting
- Storage, handling and use of dangerous substances and waste
- Working under noisy conditions
- Excavating and transporting materials

Since the construction phase is completed, it is not necessary to include Potential Occupational Health & Safety Hazards regarding the construction phase. Only potential Occupational Health & Safety Hazards pertaining to rehabilitation and operational phases of the project are included.

The operational phase employee coverage is already provided to DCL employees under its EHS policy. Without a fully functional Health and Safety plan and safety training for workers, the risks for worker health and safety are high. Therefore, DCL will adopt the following measures to minimize these risks:

- Will develop a best practice occupational health scheme, and share plans for the health maintenance and emergency services for its employee.
- Will form working partnerships with local healthcare providers
- Ensure contractors will adopt strict operational practices with the best technology and health and safety training to ensure the safety of its workers

With occupational health protection in place, risk to health will be reduced from high to low.

5.6.1 Health Infrastructure

Local health infrastructure may be impacted should the employees choose to use local health care services or do not have access to health care. If appropriate medical services are not provided by DCL and contractors, the risk of workers overloading local health services is moderate.

DCL will minimize this risk with the following measures:

- Provision of health services to Project workers
- Support to local health services through the Health Management Plan

With these mitigation measures in place the risk of negative impacts on local health infrastructure should be low to very low. Indeed, with support from DCL, local health impacts could be net positive.

5.6.2 Injury and Accidental Health Damage

The large number of transport vehicles and the traffic system in the area could expose both workers and residents to the risk of traffic accidents. During operations there is a risk of operational emergencies which could cause injury to community and workers. Community members will be concerned about the possibility of industrial accidents and emergencies. Although these risks are improbable, some residents may claim that oil leaks are polluting the sea water, underground water and accumulating in the soil, which may catch fire, threatening lives and property.

To mitigate the risk of potential traffic accidents and less frequent but potentially large-scale operations accidents, DCL will take the following measures:

- Development, communication and implementation of the health components of a robust Emergency Preparedness Plan for both local communities and Complex workers
- Consultation of healthcare providers for development of the Emergency Preparedness Plan

5.6.3 Environmental Health & Safety (EHS) Policy

DCL is committed in achieving EHS excellence. This will be the responsibility of the management, employees and all DCL Contractors in all areas of work. DCL strives to provide a safe and healthy working environment, enhance the quality of performance, and avoid any adverse impacts or injury to people, equipment, environment or the local community.

An EHS Manual will be followed in order to achieve the following objectives:

- Elimination of injuries to all employees, personnel, and contractors
- Elimination of any harm to the environment or the community
- Prevention of accidental damage to DCL or client assets
- Better understanding and cooperation within DCL, as well as with customers, surrounding communities, and governmental bodies
- Compliance with all applicable local and international laws and regulations
- To follow the Original Equipment Manufacturer (OEMs) safety instructions while carrying out activities

To achieve the listed objectives, the following requirements and methods will be used:

- Integration of environmental, health and safety performance into DCL business plans and decisions
- Taking appropriate measures to prevent workplace injuries and illnesses, and providing employees with a safe and healthy working environment
- Encouragement of innovation and evolving industry practices
- Meeting regulatory requirements and societal standards of care to address EHS issues
- Elimination of unreasonable risks from DCL Site, services and activities and implement continual cost-effective improvement in EHS performance
- Commitment to reducing the use and release of toxic and hazardous materials and preventing pollution

- Implementation of a policy and procedure to promote awareness, understanding and involvement of employees at all levels and contractors in EHS issues and programs through consultation and training
- Implementing a plan and traffic control measures to limit the risk of construction, operational and transport accidents is available
- Conducting a road safety campaign to reduce the risk of traffic accidents for community members, particularly children.
- Provision of first aid training for operational accidents as part of the improved community health program/Health Management Plan

5.7 Green House Gases (GHGs), Carbon Dioxide (CO_2) Abatement

CO_2, one of the major GHGs under the UN Framework Convention on Climate Change, is emitted from the combustion of fossil fuels. The IFC "EHS Guidelines for Thermal Power Plants (Dec. 19, 2008)" recommends that with the use of combined cycle power generation will minimize and offset emissions of CO_2 from new thermal power plants.

The Siemens Gas Turbine, V64.3A (GT) will generate 66.6 MW of electricity, while the HRSG and steam turbine installation will further generate 27.4 MW. Total power generated by Combined Cycle Power Plant (CCPP) will be 94 MW. **Table 5.3** compares CO_2 emissions with and without the use of combined cycle technology in gas turbines. Addition of a HRSG and steam turbine reduce CO_2 emissions by 149,640 tonnes per annum.

Table 5.3 Comparison of CO_2 Emissions with and without the use of Combined Cycle Technology in Gas Turbines	
PROJECT POWER GENERATION	
Siemens Gas Turbine (GT), V64.3A, MW	66.6
Total Gas Turbine Power Generation, Annual, MW	527,472
Steam Turbine Power Gross Generation, MW	27.4
Total CCPP, Power Generation, Annual, MW	744,480
EQUIVALENT CO_2 GENERATION WITH CC TECHNOLOGY	
Annual Production of Power, GT Alone, MW	527,472
CO_2 Emission Coefficient, tonnes CO_2/MWh	0.690
Annual CO_2 Generated, tonnes	363,723.6
EQUIVALENT CO_2 GENERATION WITHOUT CC TECHNOLOGY	
Annual Production of Power, GT Alone, MW	744,480
CO_2 Emission Coefficient, tonnes CO_2/MWh	0.690
Annual CO_2 Generated, tonnes	513,363.6
ANNUAL CO_2 ABATEMENT WITH CC TECHNOLOGY	
CO_2 Equivalent Production with CC, tonnes	363,723.6
CO_2 Equivalent Production without CC, tonnes	513,363.6
ANNUAL EXPECTED CO_2 ABATEMENT, tonnes	**149,640**

5.8 Cumulative impacts:

The Complex operations will be the only industrial activity in area. Therefore, Cumulative Impact (CI) of the project on human health or the environment is quite small. The CI is especially small considering the absence of biodiversity, biological resources, and historic and archaeological sites in the area. According to the ambient air monitoring carried out by ECTECH in November, 2012, the air shed in the project area is not polluted or degraded. This indicates that the biological carrying capacity of the air in the area remains intact. This further supports that no CI will occur due to project operation.

Below is a brief overview of the CI assessment. This includes all possible pollutants from project operations:

5.8.1 NO_x Emissions

Emissions of NO_x have been shown to be within the prescribed limits of 51.0mg/Nm^3 by IFC Environmental, Health, and Safety Guidelines, Thermal Power Plants, December 19, 2008 for natural gas Combustion Turbines (capacity >50MWth). [Ref. DHA Cogen Ltd., Power and Desalination Unit, Karachi.

Environmental Compliance Monitoring Repot, September, 2008, By ECTECH Environment Consultants, Lahore.]

5.8.2 Thermal Discharge

In its 2004 EIA report for the Complex, ECTECH concluded that the Thermal Discharge (TD) was in compliance with the required conditions of the NEQS Pakistan and by IFC Environmental, Health, and Safety Guidelines, Thermal Power Plants, December 19, 2008.

5.8.3 Sewage

The Cantonment Board of Clifton (CBC) contractor currently collects DCL sewage and disposes of it in the existing CBC sewerage system. When the Complex is operating after rehabilitation, sewage will be treated by GEMS or WMC, which will meet international standards.

5.9 Conclusion

Once rehabilitated and operational, the Complex will contribute a low to negligible level of additional pollution in the area.

6 PROPOSED ENVIRONMENTAL PREVENTION & MITIGATION MEASURES

6 Proposed Environmental Prevention & Mitigation Measures

6.1 Mitigation Measures during Operation Phase

For responsible operation of the Complex, conservation of natural resources and protection of the environment are critical. Measures for sustainable development include everything from the fundamental design of the Complex to pollution prevention and mitigation strategies. During rehabilitation, DCL will earn ISO 14001 certification.

After discussions of ECTECH findings with DCL and IEP management, ECTECH has confirmed that the environmental impact mitigation measures as delineated in **Table 6.1** will be undertaken at the Complex as part of the rehabilitation program and during operations.

Table 6.1 Mitigation Measures During Operation Phase

Area of Impact	Mitigation Action
Landscape	Efforts to develop a green belt along the Complex boundary boundaries are already underway. These efforts will be extended and continued to create a more natural landscape. The flora to be used for such a green belt should be tolerant to the local climate requiring only a small amount of water to survive.
Ambient Air Quality	Continuous monitoring of both stack exhaust and ambient air for NO_x, SO_2, and CO will be implemented as part of the EMMP.
Stack Emissions Monitoring	Continuous or indicative monitoring for NO_x will be carried out as part of the EMMP.
Wastewater	Sanitary wastewater, laboratory waste, cleaning wastewater, floor washings water, etc. will be managed to avoid its spillage to the sea. Control and treatment will be conducted for pH, TSS, oil & grease, total residual chlorine, chromium, copper, zinc, iron, lead, cadmium, mercury and arsenic and temperature. These substances and parameters will be controlled to the level required by IFC Environmental, Health, and Safety Guidelines, Thermo Power Plants, December 19, 2008 and monitored before discharging into the sea or any other water body. Monitoring will be conducted in accordance with the EMMP.
Groundwater	Regular inspection of facilities will be conducted to intercept any leaking or spilled liquids. Hazardous chemicals shall be handled only in appropriate segregated, sealed and bundled areas at site. Monitoring will be conducted in accordance with the EMMP.
Thermal Discharge	In order to avoid damage to aquatic life, Thermal Discharge (TD) will be introduced to the sea in a sustainable manner and only after appropriate measures of control have been taken. The TD system will remain in compliance with EPA and international standards. Monitoring will be conducted in

Table 6.1 Mitigation Measures During Operation Phase	
Area of Impact	**Mitigation Action**
	accordance with the EMMP.
Solid Waste	All solid waste will be disposed of according to a set procedure and record of waste collection and/or sale will be kept in the event a retrospective review is required. The contractors to whom any waste is distributed or sold will be made fully aware of the environmental impacts and health effects of the waste. The collector or purchaser will be required to prove it capable of handling such waste in environmentally sustainable way. Monitoring will be conducted in accordance with the EMMP.
Noise	Equipment will be acoustically shielded and/or lagged as thoroughly as possible. A regular noise measurement program during full operation will be implemented to verify that noise levels are in line with the standards under IFC Guidelines for Thermal Power Plants, IFC General Guidelines, and The World Bank Pollution Prevention and Abatement Handbook, Effective July 1998. Noise levels will also comply with the requirements of SR) 1064 (1) 2012 issued by the Pak-EPA. Workers will use ear protection in areas within the plant and for specific work that exceeds the tolerable maximum noise limits. Monitoring will be conducted in accordance with the EMMP.

6.2 Other Mitigation Measures

6.2.1 Thermal Discharge and Effluent

As a result of the once-through closed cooling system of the power plant, this system poses no risk of polluting the seawater. Thermal Discharge (TD), as the most major risk, is effectively mitigated by the design of the effluent pipe. The pipe allows the temperature of the discharge to decrease significantly as it passes over boulders before reaching the sea.

Total Dissolved Solids (TDS) in the effluent from the Complex are dramatically below baseline TDS levels in the seawater. Refer to **Table 6.2** for TDS quantities measured in seawater and in Complex effluent.

Table 6.2: Effluent TDS vs. Seawater TDS		
Baseline Seawater TDS (2004 EIA)	**Baseline Seawater TDS (2012 EIA)**	**Effluent TDS (2008 ECAR)**
37000 mg/l	44587 mg/l	710 mg/l

6.2.2 Waste Minimization Measures

Waste minimization from every source and at every step should be a top priority of the Complex. The principles of "Cleaner Production," the 5 Rs (reduce,

recycle, reuse, retrofit and refurbish), and "Good International Industry Practice" (GIIP) shall be observed as applicable. DCL management has agree to these principals. Monitoring will be conducted in accordance with the EMMP.

6.2.3 Wastewater Treatment and Disposal Measures

Sanitary wastewater, laboratory waste, cleaning wastewater, floor washings water, etc. are currently transferred to the care of CBC. When the Complex is operating after rehabilitation, sewage will be treated by GEMS or WMC, which will meet standards as described under the IFC Guidelines for Thermal Power Plants and General Guidelines. Monitoring will be conducted in accordance with the EMMP.

6.2.4 Effluent Treatment and Disposal Measures

The content of the demineralization tank is treated before being merged with once-through cooling water and discharged to the sea. The waste from the desalination process is sent to a Neutralization Tank (located in the Demineralization Building) where either acid or caustic agents are added depending upon the pH. The solution is thus neutralized before being returned to the sea.

Effluent from the lab or re-mineralization system is currently collected from its respective pit by a CBC bouzer and dispatched according to CBC procedure. When the Complex is operating after rehabilitation, sewage will be treated by GEMS or WMC, which will meet international standards. Monitoring will be conducted in accordance with the EMMP.

6.2.5 Natural Resource Management

Land, water, air, forests, fisheries, wild flora and fauna, and minerals are all important natural resources. Their management through sustainable development is critical. The Complex operations will account for Natural Resource Management at every step.

6.2.6 Mitigation of Human Impacts

A. Economic Environment

The net effect of the Complex is expected to support human welfare and alleviate poverty.

The local economic environment is fraught with high unemployment rates. Problems are exacerbated by frequent power outages and a difficult law and order situation. Within this environment, there is significant potential for positive economic benefits of the Complex. The extent this potential is realized depends on the Complex approach to providing a beneficial work environment

to its workers (e.g. accommodation, transport, canteen services, in-house medical care, etc.).

Mitigation: The Complex will help to fill some of the key gaps in the local economy with the production of affordable electrical power and water. People suffer from critical shortages of both utilities in Karachi. In both cases, the tariffs have been negotiated with local utilities. In the case of power, the tariff has been approved by the regulator, NEPRA. The business viability of the Complex is assured. DCL operates to best local practices with regard to its employees in providing services such as healthcare and transport

DCL understands the complex's significance to the socio-economic baseline context and plans to consult with community leaders and civil society when making economic or industrial development agreements.

B. Employment, Livelihoods and Income Generating Activities

Access to Employment at the Complex is a key priority for the local community, given the levels of poverty and unemployment in Karachi.

In both rehabilitation and operational phases, DCL may utilize skilled and unskilled labor from the surrounding community. New employment opportunities from Complex activities are expected to have a positive impact.

Mitigation Measures:

Karachi is Pakistan's largest cosmopolitan area and with a population of around 20 million offers a large pool of skilled and unskilled labor. As a result, most of the plant employees are based in Karachi.

The DCL has ensured through proper contracting with its O&M contractor to train its employees were necessary in operation and maintenance of the plant and machinery.

DCL is a majority-owned company by a power assets developer/owner, rather than a local family group. The management seeks to provide equal opportunity to all. Rewards will be merit-based, and nepotism is non-existent.

DCL aims to recruit competent staff through a transparent merit-based system regardless of gender, race, ethnic origin, religion, or social background. The recruitment process will comprise the following steps:

- Job description is a key document in the recruiting process. The job description is made available for the vacancy as the first step in the process
- New job additions must be approved by the CEO

- The vacant position must be advertised in the local and national press. Before a post is advertised, staff recruitment form is signed by all relevant persons
- All interviews must be conducted by a panel
- Confidentiality of applications must be respected by those involved in the selection process
- After the closing date, the interviews panel should access the applications to determine which applicants are to be called for interview. It is the responsibility of the short-listing panel to ensure candidates are measured against the requirement outline specified
- The interview should be conducted as close to the closing date as reasonably possible as delays are likely to lead to the loss of a candidate
- The interview panel makes selection decisions and is accountable as such

DCL will provide excellent long-term prospects, a merit-based working environment, and professional opportunities for both experienced and fresh graduates. The DCL will provide excellent employment opportunities at a location adjacent to the city center, unlike many other power Complexes. The DCL believes in enhancing worker skills through training and providing incentives through an equitable reward system.

DCL is working to develop a remuneration package, which would include benefits and facilities correlated with market trends. This remuneration package would be reviewed regularly based on employee performance.

DCL will eliminate, control, and minimize hazards at the Complex. Refer to **Tables 6.3 through 6.11** for information and internal references for Operational Health and Safety considerations taken by DCL. This report demonstrates compliance with Section 2 of the IFC General EHS Guidelines.

Table 6.3: Operational Health and Safety at the Complex: Workplace Design

Workplace Safety	DCL Safe Design and Operation
Integrity of Workplace Structures	Surfaces, structures and installations at the Complex are easy to clean and maintain. They are designed to minimize accumulation of hazardous compounds. Having been built to high standards within the last 10 years, the buildings of the Complex are structurally safe, provide appropriate protection against climate, and have acceptable light and noise conditions. Fire resistant, noise-absorbing materials are

Table 6.3: Operational Health and Safety at the Complex: Workplace Design	
Workplace Safety	**DCL Safe Design and Operation**
	used for cladding on ceilings and walls wherever feasible. Floors at the Complex are level, even, and non-skid. Heavy oscillating, rotating, and alternating equipment is located in dedicated buildings or structurally isolated sections at the Complex.
Severe Weather and Facility Shutdown	Structures of the Complex are designed and constructed to withstand the expected elements for the region and have areas designated for safe refuge in the event of extreme weather. Standard Operating Procedures (SOPs) are in place at the Complex for process shut-down, including an evacuation plan. Drills to practice these procedures are undertaken annually.
Workspace and Exit	The space provided for each worker at the Complex is adequate for safe execution of all activities, including transport and interim storage of materials and products. Passages to emergency exits at the Complex are unobstructed at all times. Exits are clearly marked and visible in total darkness. The number and capacity of emergency exits is sufficient for safe and orderly evacuation of the greatest number of people present at any time. There are a minimum of two exits from every work area. Facilities at the Complex are designed and built to account for the needs of disabled persons.
Fire Precautions	The Complex is designed to prevent the start of fires through the implementation of industrial fire codes. Facilities of the Complex are equipped with fire detectors, alarm systems, and fire-fighting equipment. This equipment is adequate for the dimensions of the facilities, and is designed to be effective against the physical and chemical properties of the substances present at the Complex, even at instances with the maximum number of people present. Fire safety equipment is maintained in good working condition and is readily accessible.

Table 6.3: Operational Health and Safety at the Complex: Workplace Design	
Workplace Safety	**DCL Safe Design and Operation**
	Provision of manual firefighting equipment is easily accessible and simple to use at the Complex. Fire and emergency alarm systems at the Complex are both audible and visible. Refer to **Section 6.7** for more details of the Fire Precautions in place at the Complex.
Lavatories and Showers	Adequate lavatory facilities are provided for the number of people expected to work at the Complex. Allowances are made for segregated facilities. Hot and cold running water, soap, and hand drying devices are also provided. For workers who may be exposed to substances poisonous by ingestion and skin contamination, facilities for showering and changing into and out of street and work clothes are provided.
Potable Water Supply	Adequate supplies of potable drinking water are provided at the Complex with sanitary means of collecting the water for the purpose of drinking. Water supplied to areas of food preparation or for the purpose of personal hygiene meets drinking water quality standards.
Clean Eating Area	The Complex provides clean eating areas where workers are not exposed to any hazardous or noxious substances.
Lighting	Workplaces at the Complex receive natural light wherever feasible. This is supplemented with sufficient artificial illumination to promote workers' safety and health, and enable safe equipment operation. Supplemental "task lighting" is provided where specific visual acuity is necessary. Emergency lighting of adequate intensity is installed at the Complex. It is automatically activated upon failure of the principal artificial light source to ensure safe shut-down, evacuation, etc.
Safe Access	Passageways for pedestrians and vehicles at the Complex are segregated and provide for easy, safe, and appropriate access. Equipment and installations at the Complex

Table 6.3: Operational Health and Safety at the Complex: Workplace Design	
Workplace Safety	**DCL Safe Design and Operation**
	that require servicing, inspection, and/or cleaning have unobstructed, unrestricted, and ready access. Hand, knee and foot railings are installed on stairs, fixed ladders, platforms, permanent and interim floor openings, loading bays, ramps, etc. at the Complex. Openings at the Complex are sealed by gates. Covers are installed, where appropriate and feasible at the Complex, to protect against falling items. Security measures, including dedicated security personnel, are in place to prevent unauthorized access to dangerous areas.
First Aid	DCL ensures that qualified first aid can be provided at all times. Appropriately equipped first aid stations are easily accessible throughout the Complex. Eye-wash stations and emergency showers are provided close to all workstations where immediate flushing with water is the recommended first aid response. Dedicated and appropriate first aid rooms are provided and equipped with gloves, gowns, and masks for protection against direct contact with blood and other body fluids. Emergency procedures are in place to deal with cases of trauma or serious illness up to the point at which patient care can be transferred to an appropriate medical facility.
Air Supply	Sufficient fresh air is supplied for indoor and confined work spaces at the Complex. Physical activity, substances in use, and process emissions were considered in ventilation design. Air distribution systems are designed not to expose workers to draughts. Mechanical ventilation systems are maintained in good working order at the Complex. Point-source exhaust systems required for maintaining a safe ambient environment have

Table 6.3: Operational Health and Safety at the Complex: Workplace Design	
Workplace Safety	**DCL Safe Design and Operation**
	local indicators of correct functioning. Contaminated air is never recirculated at the Complex. Air inlet filters are kept clean and free of dust and microorganisms. HVAC and industrial evaporative cooling systems should be equipped, maintained and operated so as to prevent growth and spreading of disease agents (e.g. Legionnella pneumophilia) or breeding of vectors (e.g. mosquitoes and flies) of public health concern.
Work Environment Temperature	The temperature in work, rest room and other welfare facilities at the Complex is maintained during all operating hours at a level appropriate for the purpose of the facility.

Table 6.4: Operational Health and Safety at the Complex: Communication and Training	
Communication and Training	**DCL Training Procedure**
OHS Training	Provisions are made at the Complex to provide OHS orientation training to all new employees and ensure they are apprised of the basic site rules of work at the Complex and of personal protection and preventing injury to fellow employees. Training consists of basic hazard awareness, site-specific hazards, safe work practices, and emergency procedures for fire, evacuation, and natural disaster. Site-specific hazards and practices are reviewed thoroughly as part of orientation training.
Visitor Orientation	A visitor orientation and control program is established at the Complex for to ensure that visitors do not enter hazard areas unescorted.
New Task Employee and Contractor Training	DCL ensures that workers and contractors, prior to commencement of new assignments, will have received adequate training and information enabling them to understand work hazards and to protect their health from hazardous ambient factors that may be present. New task employee and contractor training includes: • Knowledge of materials, equipment, and tools • Known hazards in the operations and how they are controlled

Table 6.4: Operational Health and Safety at the Complex: Communication and Training	
Communication and Training	**DCL Training Procedure**
	• Potential risks to health • Precautions to prevent exposure • Hygiene requirements • Wearing and use of protective equipment and clothing • Appropriate response to operation extremes, incidents and accidents
Basic OHS Training	A basic occupational training program and specialty instruction is provided at the complex, as needed, to ensure that workers are oriented to the specific hazards of individual work assignments. Training is provided to management, supervisors, workers, and occasional visitors to areas of risk and hazards. Workers with rescue and first aid duties should receive dedicated training so as not to inadvertently aggravate exposures and health hazards to themselves or their co-workers. Training includes education on the risks of becoming infected with blood-borne pathogens through contact with bodily fluids and tissue. Through appropriate contract specifications and monitoring, DCL ensures that service providers, as well as contracted and subcontracted labor, are trained adequately before assignments begin.
Area Signage	Hazardous areas (electrical rooms, compressor rooms, etc.), installations, materials, safety measures, and emergency exits, etc. are marked appropriately at the Complex. Signage is in accordance with international standards and is familiar to and easily understood by workers, visitors, and the general public at the Complex.
Labeling of Equipment	All vessels at the Complex that may contain substances that are hazardous as a result of chemical or toxicological properties, or temperature or pressure, are labeled as to the contents and hazard and/or appropriately color coded. Piping systems at the Complex that contain hazardous substances are labeled with the direction of flow and contents of the pipe and/or color coded whenever the pipe passing through a wall or floor is interrupted by a valve or junction

Table 6.4: Operational Health and Safety at the Complex: Communication and Training	
Communication and Training	**DCL Training Procedure**
	device.
Communicate Hazard Codes	Copies of the hazard coding system are posted outside the Complex at emergency entrance doors and fire emergency connection systems where they are likely to come to te attention of emergency services personnel. Information regarding the types of hazardous materials stored, handled or used at the Complex, including typical maximum inventories and storage locations, is shared proactively with emergency services and security personnel to expedite emergency response when needed. Representatives of local emergency and security services are invited to participate in annual orientation tours and site inspections to ensure familiarity with potential hazards present.

Table 6.5: Operational Health and Safety at the Complex: Physical Hazards	
Potential Physical Hazards	**DCL Physical Hazard Mitigation Measures**
Rotating and Moving Equipment	The machines at the Complex are designed to eliminate trap hazards and to ensure that extremities are kept out of harm's way under normal operating conditions. Machines at the Complex are equipped with emergency stops, guards, and other devices designed and installed in compliance with ISO 11161 Safety of Machinery. All machinery at the Complex is turned off, disconnected, isolated, and de-energized prior to servicing or maintenance, in conformance with CSA Z460 Lockout. Equipment at the Complex is designed and installed, where feasible, to enable routine service, such as lubrication, without removal of the guarding devices or mechanisms.
Noise	No employee at the Complex is exposed to a noise level greater than 85 dB(A) for a duration of more than 8 hours per day without hearing protection. No unprotected ear is exposed to a peak sound pressure of more than 140 dB(C) The use of hearing protection at the Complex is

Table 6.5: Operational Health and Safety at the Complex: Physical Hazards

Potential Physical Hazards	DCL Physical Hazard Mitigation Measures
	mandatory if and when the equivalent sound level over 8 hours reaches 85 dB(A), the peak sound levels reach 140 dB(C), or the average maximum sound level reaches 110 dB(A). The hearing protective devices provided are capable of reducing sound levels at the ear to at least 85 dB(A). Sustained noise levels in excess of 85 dB(A) rarely or never occur at the Complex. If and when noise levels do exceed 85 dB(A), the maximum duration of exposure will be reduced by 50% for each 3 dB(A) increase in noise level. Prior to the issuance of hearing protective devices as the final control mechanism, use of acoustic insulating materials, isolation of the noise source, and other engineering controls were investigated and implemented, where feasible. Periodic medical hearing checks are performed on workers exposed to high noise levels.
Vibration	Workers are not exposed to significant vibration at the Complex. Hand and arm vibration levels do not approach American Conference of Governmental Industrial Hygienists (ACGIH) Threshold Limit Values (TLVs) for exposure:
	Total Daily Exposure Duration (hours) / **Maximum value of frequency weighted acceleration (m/s^2) in any direction**
	4 to less than 8 / 4
	2 to less than 4 / 6
	1 to less than 2 / 8
	Less than 1 / 12
	Whole-body vibrations at the Complex to not approach ISO 2631 limits.
Electrical	All energized electrical devices and lines at the Complex are clearly marked. All energized electrical devices are locked out (decharged and left open with a controlled locking device) and tagged out (warning sign placed on the lock) prior to service or maintenance.

Table 6.5: Operational Health and Safety at the Complex: Physical Hazards	
Potential Physical Hazards	**DCL Physical Hazard Mitigation Measures**
	All electrical cords, cables, and hand power tools are checked for frayed or exposed cords before each use. DCL staff and contractors adhere to manufacturer recommendations for maximum permitted operating voltage of portable hand tools. All electrical equipment used in environments that are, or may become, wet are double insulated and grounded using equipment with ground fault interrupter (GFI) protected circuits. Where appropriate at the Complex, power cords and extension cords are protected against damage from traffic by shielding or suspending them above traffic areas. Service rooms housing high voltage equipment at the Complex are appropriately labeled. The Complex has established "No Approach" zones around and under high voltage power lines in conformance with IFC General EHS Guidelines. Any rubber tired construction or other vehicles that may come into direct contact with, or arcing between, high voltage wires at the Complex would be taken out of service for a period of at least 48 hours for tire replacement. All buried electrical wiring at the Complex is identified in detail and is clearly marked prior to any excavation work.
Eye Hazards	Use of machine guards or splash shields as well as face and eye protection devices when necessary is mandatory at the Complex. Machine equipment guarding conforms to standards published by CSA. The Complex is designed to isolate moving areas where the discharge of solid fragments, liquid, or gaseous emissions can reasonably be predicted. Workers are not usually exposed to these hazards, but are required to use appropriate PPE when exposure in hazardous areas.

Table 6.5: Operational Health and Safety at the Complex: Physical Hazards	
Potential Physical Hazards	**DCL Physical Hazard Mitigation Measures**
	Eye protection that is compatible with prescription eyeglasses is available at the Complex.
Welding/Hot Work	When welding or hot cutting is undertaken at the Complex, proper eye protection is provided for all involved personnel. When necessary, welding barriers and screens are used to secure specific work stations and systems are used to extract noxious fumes at the source. DCL has implemented special hot work and fire prevention precautions and SOPs if welding or hot cutting is undertaken outside established welding work stations, including 'Hot Work Permits,' stand-by fire extinguishers, stand-by fire watch, and maintaining the fire watch for one hour after welding or hot cutting has terminated. When necessary, special procedures are implemented for hot-work on tanks or vessels that have contained flammable materials.
Industrial Vehicle Driving and Site Traffic	DCL ensures training and licensing of industrial vehicle operators in the safe operation of specialized vehicles such as forklifts, including safe loading/unloading and load limits. DCL ensures that drivers undergo medical surveillance DCL ensures that moving equipment with restricted rear visibility used at the Complex is outfitted with audible back-up alarms. The Complex has established rights-of-way, site speed limits, vehicle inspection requirements, operating rules and procedures (e.g. prohibiting operation of forklifts with forks in down position, and control of traffic patterns and direction. DCL restricts the circulation of delivery and private vehicles to defined routes and areas, giving preference to 'one-way' circulation, where appropriate.
Working Environment Temperature	When outdoor work is conducted at the Complex, the assigned workers or contractors are required to monitor weather forecasts to provide advance warning of extreme weather and schedule work accordingly.

Table 6.5: Operational Health and Safety at the Complex: Physical Hazards	
Potential Physical Hazards	**DCL Physical Hazard Mitigation Measures**
	DCL adjusts work and rest periods according to temperature stress management procedures provided by ACGIH, depending on the temperature and workloads. DCL provides access to shelter to protect against the elements during working activities or for use as rest areas when appropriate. DCL mandates the use of protective clothing for workers and contractors operating at the Complex. The Complex provides easy access to adequate hydration and does not allow the consumption of alcoholic beverages.
Ergonomics, Repetitive Motion, Manual Hauling	Facilities and workstations at the Complexare designed to accommodate operational and maintenance workers from the 5th to 95th percentile. The Complex requires use of mechanical assists to eliminate or reduce exertions required to lift materials, hold tools and work objects, and requires multi-person lifts if weights exceed thresholds. DCL has selected tools that reduce force requirements and holding times, and those that allow workers to maintain proper posture. The Complex is equipped with user adjustable work stations. Workers and contractors at the Complex are permitted to incorporate rest and stretch breaks into work processes, and jobs are rotated to avoid repetitive motion. DCL has implemented quality control and maintenance programs that reduce unnecessary forces and exertions. Equipment at the Complex is designed to consider additional special conditions such as left handed persons wherever feasible.
Working at Heights	The Complex incorporates guardrails with mid-rails and toe boards at the edge of any fall

Table 6.5: Operational Health and Safety at the Complex: Physical Hazards

Potential Physical Hazards	DCL Physical Hazard Mitigation Measures
	hazard area. Proper use of ladders and scaffolds is permitted only by trained employees and contractors. Use of fall prevention devices, such as safety harnesses, is mandated at the Complex when the risk of a fall is life-threatening. DCL mandates the appropriate training in use, serviceability, and integrity of the necessary PPE for working at heights. The Complex has rescue and recovery plans in place, as well as equipment to respond to workers after an arrested fall.
Illumination	The Complex utilizes energy efficient light sources with minimum heat emission. The Complex is designed and operated to minimize glare, reflections, and the flickering of lights. The Complex is designed and operated to minimize and control optical radiation including high intensity visible light, high intensity UV radiation, and IR radiation. The Complex does not include the risk of laser hazards. The Complex exceeds IFC Minimum Limits for Workplace Illumination Intensity:

Location/Activity	Intensity Limit	Complex Intensity Level
Emergency light	10 lux	
Outdoor nonworking areas	20 lux	
Simple orientation and temporary visits	50 lux	
Workplace with occasional visual tasks only	100 lux	
Medium precision work	200 lux	
Precision work	500 lux	
High precision work	1000-3000 lux	

Table 6.6: Operational Health and Safety at the Complex: Chemical Hazards	
Potential Chemical Hazard	**DCL Chemical Hazard Mitigation Measures**
Air Quality	DCL will maintain levels of contaminant dusts, vapors and gasses in the Complex at concentrations below those recommended by the ACGIH as TWA-TLV's (threshold limit value). DCL has developed and implemented work practices to minimize release of contaminants into the work environment including: • Direct piping of liquid and gaseous materials • Minimizing handling of dry powdered materials • Enclosed operations • Local exhaust ventilation at emission / release points • Vacuum transfer of dry material rather than mechanical or pneumatic conveyance • Indoor secure storage, and sealed containers rather than loose storage. Where ambient air contains several materials that have similar effects on the same body organs, DCL will account for combined exposures using calculations recommended by the ACGIH. In the rare event that work shifts at the Complex extend beyond eight (8) hours, calculating adjusted workplace exposure criteria recommended by the ACGIH.
Fire and Explosions	DCL stores flammables at the Complex away from ignition sources and oxidizing materials. The flammable storage area is: • Remote from entry and exit points into buildings • Away from facility ventilation intakes or vents • Equipped natural or passive flood and ceiling level ventilation and explosion venting • Equipped with spark-proof features • Equipped with fire extinguishing devices and self-closing doors, and constructed of materials made to withstand flame impingement for a moderate period of

Table 6.6: Operational Health and Safety at the Complex: Chemical Hazards	
Potential Chemical Hazard	**DCL Chemical Hazard Mitigation Measures**
	time. The Complex provides bonding and grounding of, and between, containers and additional mechanical floor level ventilation if materials are being, or could be, dispensed in the storage area. Where flammable material is mainly comprised of dust, electrical grounding, spark detection, and quenching systems are provided. The Complex is equipped with defined and labeled fire hazard areas to warn of special rules. DCL provides specific worker training in worker training in handling of flammable materials, and in fire prevention or suppression.
Corrosive, oxidizing, and reactive chemicals	Corrosive, oxidizing and reactive chemicals are segregated at the Complex from flammable materials and from other chemicals of incompatible class (acids vs. bases, oxidizers vs. reducers, water sensitive vs. water based, etc.), stored in ventilated containers with appropriate secondary containment to minimize intermixing during spills. Workers who handle corrosive, oxidizing, or reactive chemicals at the Complex are provided with specialized training and PPE. Where corrosive, oxidizing, or reactive chemicals are used, handled, or stored, qualified first-aid is available at all times.
Asbestos Containing Materials (ACM)	No Asbestos Containing Materials (ACM) were ever used in the original construction of the Complex. Any possible new operations or construction at the Complex will not use any ACM.

Table 6.7: Operational Health and Safety at the Complex: Biological Hazards	
Potential Biological Hazard[29]	**DCL Biological Hazard Mitigation Measures**
Use of Biological Agents	Biological agents are rarely or never used at

[29] World Health Organization (WHO) Classification of Infective Microorganisms by Risk Group (2004)

	the Complex. Employee exposure to harmful biological agents is extremely unlikely.

Table 6.8: Operational Health and Safety at the Complex: Radiological Hazards	
Potential Radiologicl Hazard	**DCL Radiological Hazard Mitigation Measures**
Non-ionizing radiation	Sources of non-ionizing radiation at the Complex may include high-voltage lines, lights, and other electronic equipment. These sources of radiation are effectively shielded. Employee exposure to non-ionizing radiation is very limited and remains well below IFC limits of 20mSv/year average and 50mSv/year single-year effective dose.
Ionizing radiation	The generator equipment at the Complex does create ionizing radiation. However, the radiation is very effectively shielded from workers. Although all magnetic fields are neutralized during maintenance of this apparatus, PPE is required for all workers when shielding is disabled.

Table 6.9: Operational Health and Safety at the Complex: PPE		
Objective	**Potential Workplace Hazard**	**Personal Protective Equipment (PPE) Provided by DCL**
Eye and face protection	Flying particles, molten metal, liquid chemicals, gases or vapors, light radiation.	Impact- and heat-resistant goggles and facial shields with side protection are required where applicable
Head protection	Falling objects, inadequate height clearance, and overhead power cords.	Hard hats with top and side protection are required at Complex
Hearing protection	Noise, ultra-sound.	Earplugs and hearing protection muffs are required when workers are exposed to noise
Foot protection	Falling or rolling objects, pointed objects. Corrosive or hot liquids.	Protective boots are mandatory at the Complex.
Hand protection	Hazardous materials, cuts or lacerations, vibrations, extreme temperatures.	Protective gloves are mandatory at the Complex
Respiratory protection	Dust, fogs, fumes, mists, gases, smokes, vapors. Oxygen deficiency	Dust masks are provided when necessary at the Complex. On-site rescue equipment is available to respond to oxygen deficiency.
Body/leg protection	Extreme temperatures,	Insulated clothing and

	hazardous materials, biological agents, cutting and laceration.	aprons of protective materials are provided when applicable.

Table 6.10: Operational Health and Safety at the Complex: Special Hazards	
Potential Special Hazard	**DCL Special Hazard Mitigation Measures**
Confined Space	The Complex has been constructed to eliminate, wherever feasible, any confined work spaces. The Complex does not include permit-required confined spaces
Lone and Isolated Workers	The Complex has implemented Standard Operating Procedures to eliminate lone and isolated workers. Emergency eye wash and shower facilities are equipped with audible and visible alarms to summon aid when the unit is activated.

Table 6.11: Operational Health and Safety at the Complex: OHS Monitoring	
DCL OHS Monitoring Measure	**Details and Benefits**
Safety inspection, testing and calibration	All safety features and hazard control measures at the Complex are regularly tested and inspected
Surveillance of the working environment	DCL will document compliance using the appropriate combination of portable and stationary sampling and monitoring instruments.
Surveillance of workers health	Surveillance of workers health is conducted daily after any extraordinary protective measures are required at the Complex.
Training	Emergency training, such as fire drills, have been conducted and documented regularly. Refer to **Section 6.7.6** for details.
Accidents and Disease monitoring	The Complex has a policy in place for occupational accident reporting. This policy is aligned with IFC standards of immediate reporting for fatalities and less than one day to report non-fatal injuries.

6.3 Hazard Prevention & Emergency Response

6.3.1 Definition

A major emergency is one with the potential to cause serious injury or loss of life. It may cause extensive damage to property and serious disruption both inside and outside the work site. It would normally require the assistance of emergency services to respond effectively.

6.3.2 Emergency Planning

An Emergency Response and Disaster Management Plan for a power plant is necessarily a combination of various actions to be taken in a very short time period, but in a precise sequence to respond to any disaster, emergency or major accident. This is the most effective and efficient method of minimizing loss of life, material, plant/machinery, etc.

The objectives of the emergency plan will be:

- To localize any emergency
- To minimize effects on people and property
- To eliminate the emergency

A detailed emergency preparedness and response plan has been established. Some salient features of this plan are as follows:

- Emergency Operations Coordinator
- The Emergency Response Team
- Emergency Organizations and Responsibilities
- Emergency contact numbers
- External important contact numbers
- Emergency classifications system
- Notification methods of on-site staff, off-site response, and to the public
- Protective response
- Emergency response training
- Potential security threats and emergencies including:
    - i. Hazardous material exposure control
    - ii. Unauthorized entry
    - iii. Bomb threats
    - iv. Flooding
- Location of emergency equipment
- Employees trained in the use of emergency equipment
- Emergency Action Plan
- Emergency Communication
- Site Evacuation Map and Routes to Nearest Hospitals

An emergency evacuation drill is rehearsed every two months to ensure that all employees have a thorough knowledge of the proper action to be taken in the event of a real on-site emergency.

6.4 Solid Waste

The production of solid waste was recorded at the Complex for the months of November and December, 2012. Refer to **Table 6.12** and **Table 6.13** for details.

Table 6.12: DCL Solid Waste Volumes (November, 2012) (kg)											
	Date in November, 2012										
Waste Type	**05**	**06**	**07**	**15**	**21**	**26**	**27**	**28**	**29**	**30**	**Total**
Marine	--	--	--	--	--	--	--	--	--	--	**--**
Plastic	70	60	85	50	70	80	55	60	90	70	**690**
Kitchen	75	85	80	80	80	85	80	75	80	90	**810**
Cloth	95	50	65	55	85	50	45	45	40	55	**585**
Garden	75	--	--	85	--	75	--	65	--	75	**375**
Mud	85	--	--	80	--	85	--	55	--	85	**390**
Paper	65	65	65	45	65	40	60	40	65	45	**555**
Other	80	80	45	60	45	40	55	30	55	75	**565**
Total	**545**	**340**	**340**	**455**	**345**	**455**	**295**	**370**	**330**	**495**	**3970**

Table 6.13: DCL Solid Waste Volumes (December, 2012) (kg)											
	Date in December, 2012										
Waste Type	**03**	**05**	**10**	**11**	**24**	**25**	**26**	**28**	**29**	**31**	**Total**
Marine	--	--	--	--	--	--	--	--	--	--	**--**
Plastic	70	50	85	85	95	80	75	65	95	85	**785**
Kitchen	95	85	80	95	65	75	85	95	85	70	**830**
Cloth	75	45	60	65	85	65	65	45	50	45	**600**
Garden	85	--	50	--	95	--	--	85	--	55	**370**
Mud	75	--	--	--	85	75	--	45	--	--	**280**
Paper	45	85	45	65	65	55	85	45	80	75	**645**
Other	80	95	65	85	35	65	75	50	75	65	**690**
Total	**525**	**360**	**385**	**395**	**525**	**415**	**385**	**40**	**385**	**395**	**4200**

6.5 Hazardous Waste

Any hazardous waste that is generated by the Complex is disposed of responsibly. For example, DCL commissioned the recycling of 14 oil filters in August, 2009. The metal and paper components of the filters, as well as the oil itself, were recycled.

6.6 Occupational Health & Safety Measures

Operational activities could expose workers to health and safety risks. In particular, the following activities and environments could have negative health impacts:

- Exposure to noise
- Exposure to dust

- Working with heavy equipment
- Working in confined spaces
- Heavy lifting
- Storage, handling and use of dangerous substances and waste (strains and accident risks)

The Complex may render the capacity of local health and emergency services inadequate. Without an operational/fully functional Health and Safety plan and health training for workers the risks for worker health and safety are high. A toolbox meeting is conducted daily to discuss and improve occupational health and safety at the Complex. More details of occupational health and safety measures are available in **Tables 6.3 through 6.11.** These tables demonstrate compliance with IFC General EHS Guidelines Section 2.0: Occupational Health and Safety.

Mitigation Measures:
A comprehensive Health and Safety policy has already been developed for all DCL employees, contractors and visitors. The policy is as follows;

"DHA Cogen Limited (DCL) is committed in achieving the environmental, health and safety (EHS) excellence, which is the responsibility of whole management, employees and all DCL Contractors in all areas of work. DCL strives to provide a safe and healthy working environment, enhances the quality performance and avoid the adverse impact and injury to people, equipment, environment and local community".

This policy comprises of many components, few of those are listed below:

- **Job Safety Analysis (JSA):** This activity of hazard identification and risk assessment process is mandatory for all on-site activities
- **Permit to Work System:** The basic purpose of having this system is to perform job in safe way so that accidents do not occur. Work permits are required before start of the job, thus taking required safety measures and precautions as identified in the JSA
- **Lock Out Tag Out (LOTO):** This serves to prevent unexpected energizing, start-up, or release of stored energy, thus preventing injury to personnel and equipment damage
- **Working at Height:** This is used to prevent accidental falls from walking or working surfaces, with unprotected sides or edges, that are 4 feet (1.2 meters) or more above a lower level
- **Ladders, Scaffold & Fall Protection:** This defines the different fall protection systems to protect employees from falling in workplace

locations and outline the requirements for the safe use of ladders and scaffolds

- **Confined Space:** This identifies and evaluate confined space hazards and establish requirements for safe entry into permit-required and non-permit required confined spaces.
- **Hot Work:** The purpose of this procedure is to ensure that appropriate fire prevention precautions are in place before welding, cutting, or brazing takes place on-site
- **Chemical Management and Hazard Communication**: This procedure includes the method for informing employees of chemical hazards, and protective precautions that need to be taken when working with hazardous chemicals
- **Monitoring and Measurement**: The purpose of this procedure is to monitor and measure occupational health, safety and environmental performance so as to determine compliance with policies, procedures, legislation and requirements of EHS Management System
- **Electrical Safety:** This procedure defines the requirements and procedures necessary for safeguarding employees who work near, with or on electrical equipment, special safety requirements for High Voltage work and for working on energized equipment
- **Vehicle Accident Prevention:** The purpose of this procedure is to ensure that all Site vehicles will be operated, maintained in a safe manner thus ensuring that vehicles and drivers comply with all local regulations
- **Fork Truck Safety:** This procedure serves to establish guidelines, provide training and authorize operators for the safe operation and maintenance of fork trucks
- **Cranes and Rigging:** The purpose of this procedure is to provide instructions for the safe operation and maintenance of lifting devices typically found at Site
- **Fire Prevention and Protection:** This provides guidance to prevent on-set of fire in the workplace, provision of training of fire responders, maintenance of all fixed and portable fire equipment and its use
- **Respiratory Protection:** This defines the proper selection and use of respiratory protection equipment in order to prevent excessive exposure of employees to occupational dusts, fumes, mists, gases and vapors
- **Personal Protective Equipment (PPE):** To minimize and control the exposure of all employees to hazards and the potential for injury, appropriate Personal Protective Equipment (PPE) is provided to all employees
- **Hearing Conservation:** This component is used for recognizing possible noise hazard conditions, ensuring that employees are aware of the

hazard and that hearing protection is properly used, maintained and enforced

6.7 Fire Hazard, Fire Prevention, and Fire Control Measures

DCL abides by the National Fire Protection Association codes and standards

The fire detection, control and alarm system is provided to detect a fire, to control remote released fire extinguishing system, and to warn personnel in the event of fire.

A main fire alarm panel is provided in the control room inside administration building. Fire detection loops, starting and ending at the Main Fire Alarm Panel (MFAP) and separate signal lines are provided in various areas of the plant and transmit signal between MFAP and eventually Local Fire Alarm Panel (LFAP), fire detection, fire alarm and fire extinguishing systems.

All alarm, Operation and Trouble signals of the connected local fire alarm panel, fire pump controller, and fire extinguishing system will be transmitted to the MFAP.

Automatic electrical fire alarm detector (smoke, heat, flame) mechanical detectors (detection sprinklers) and manual call points (push buttons) are provided for buildings and outdoor facilities.

The detection devices transmit fire alarm signals to the MFAP / LFAP. All fire detection devices installed in loops are addressable. This allows the system to display the relevant identification number and the detector location in case of fire alarm or system trouble.

A layout of the Complex with Fire Prevention and Control equipment illustrated is included as **Annex 6.2.**

The Fire Prevention and Control System is summarized in **Table 6.14: Firefighting System Summary.** Section 6.7 provides details about this system. In addition to Section 6.7, refer to **Tables 6.3 through 6.11** for more details on Fire Prevention and Control as it relates to Occupational Health and Safety.

Table 6.14: Firefighting System Summary

Building/Area	System Design	Quantity
Outdoors at Complex	Ring main with outside hydrants	Complete system – 1
Fire and Potable Water Pump Station	Portable fire extinguishers & fire alarm system	Trolley type – 1 Wall mounted type – 2
Steam turbine building	Fire hydrant cabinet (indoor) & fire alarm system	Complete system – 1

Gas turbine building	CO_2 spray gas and fire alarm system	Complete system – 1
Generator enclosure	Fire hydrant (indoor type)	Complete system – 1
Aux. generator transformer	Water spray system & fire alarm	Complete system – 1
Main generator transformer	Spray deluge system & fire alarm system	Complete system – 1
Administrative building	Hose reels & fire alarm system	Hose reels – 2
Workshop and storage	Portable fire extinguishers	Wall mounted type – 2
GIS building	Portable fire extinguishers	Trolley type – 1 Wall mounted type – 2
Other buildings	Portable fire extinguishers	Wall mounted type – various (at least 1 per building)
Slam unit	CO_2 spray gas & fire alarm system	Complete system – 1
Fuel gas compressor building	Portable fire extinguishers	Trolley type – 1 Wall mounted type – 2
Demineralization unit	Portable fire extinguishers	Wall mounted type – 2

6.7.1 Fire Alarm

Alarm devices (horns, sirens, strobe lights) are provided inside of buildings and at outdoor facilities to warn personnel in case of a fire alarm. The alarm is indicated at the MFAP, the concerned LFAP and at the alarm devices in the concerned area.

6.7.2 Fire Control

The remote controlled Fire Extinguishing Systems will be released from the MFAP / LFAP. All alarm operation and trouble signals will be displayed at the MFAP / LFAP.

6.7.3 Fire Fighting Water Pump

The firefighting pumps and control arrangements are provided to supply sufficient water at the required pressure to the necessary valve stations, outdoor and indoor hydrants, and hose reel systems.

The firefighting ring main is pressurized at 12.5 bar with the help of a jockey pump which gets its suction from the underground water reservoir. In the event of a drop in pressure (9 bar), the electrical fire pump starts and if pressure can't be maintained or in the event of failure of electrical pump, the standby diesel engine driven fire pump starts at 9 bar and provides sufficient water at the valve stations.

The following building / areas are supplied by ring main using stubs.

1. Administration building
2. Guest House / Wash room lockers

3. Workshop and stores
4. Steam Turbine Building

Furthermore, 10 outdoor (above ground) fire hydrants and 5 indoor fire hydrants are connected with the ring main.

The availability of fire system is checked on weekly basis by simulating the starting of fire diesel pump and a minimum of 1.5 meters of water level is maintained in the underground water tank to fight fire, if required.

6.7.4 Portable fire extinguishers

Portable fire extinguishers are provided inside the buildings and the entire Complex area. There are 13 chemical fire extinguishers using Dry Chemical Powder (DCP) and 38 CO_2 type extinguishers.

Moreover, there are two foam type fire extinguishers for the steam turbine system.

For the fire protection of transformers, Spray Deluge System and Sprinklers Systems have been provided.

6.7.5 CO_2 Fire Extinguishing System

CO_2 is used to extinguish fire in the gas turbine enclosure and its auxiliary system. CO_2 is used to protect high value equipment such as the gas turbine that would be damaged by a water-based extinguishing system. For equipment located in a well-sealed enclosure, the fire protection system design is based on a total flooding concentration concept. The CO_2 is released within the sealed enclosure at a rate which produces the design concentration (37% only for surface fire (GT); 50 % for deep seated fire (PCCs)) to ensure extinguishing of the fire.

The CO_2 extinguishing system, powered by the MFAP consists of a solenoid valve controlled gas supply (cylinders), piping and nozzles. Each system is activated via fire detectors in a dual loop / cross zone arrangement (two separate detector loops within the same protected area). An alarm from each line must be activated either by manual push buttons at the enclosure entrances or by mechanical release at the cylinder (tank) station.

In the event that only one alarm line within the protected area is activated, the CO_2 fire extinguishing system automatically responds as follows:

- Activation of audible alarm (horn with first warning sound pattern), flashing lights within the enclosure and illumination panels at entrances.

- Common audible and individual visual alarm at the LFAP.

When a detector from the second line is also activated within the protected area or when a manual release is initiated, the CO_2 fire extinguishing system automatically responds as follows:

- Activation of an audible gas discharge warning alarm (by a second sound pattern or tone of horn)
- Activation of common audible and individual visual alarm at the LFAP.
- Activation of gas discharge time delay to allow personnel 30 seconds to leave the enclosure.
- Signaling of GT Control System by the MFAP for alarm and GT trip or load shedding.
- Release of gas within the enclosure.

Abort break glass push buttons are provided at each entrance to the CO_2 protected areas. They will stop the system actuation only if pressed before a detector in the second line is activated. The extinguishing sequence, once initiated, cannot be stopped. Only an activated push button will prevent system actuation.

A service switch (lockout) is provided at the CO_2 station to put the system into manual operation mode during commissioning or maintenance.

6.7.6 Staff Preparedness

Control Room Operators are trained to identify the fire/fault area by following the alarm indication appearing on the fire panel located in Main Control Room. The field staff is fully trained in the use of electrical fire water pump, fire diesel pump, and fire hydrants, etc. Services of quality assured training providers such as M/s Haseen Habib are contracted to train all staff every year. Further, in house training on fire prevention and firefighting is conducted by EHS supervisor every six months. Refer to **Annex 6.3** for a copy of the DCL Fire Drill Record.

6.8 Potential Community Hazards

No inherent risk to the health and safety of the community will exist once the Complex is operational. The nearest developed area to the Complex is approximately 5km away. DCL is committed to avoiding or minimizing any adverse impacts of Complex operations on air, soil, water, and other natural resources in use by adjacent communities. Complex activities do not have the potential for community exposure to waterborne, airborne, or other communicable diseases. The use of water by the Complex will not compromise the availability of water for personal hygiene, agriculture, recreation, or other community needs.

There are no existing buildings adjacent to the Complex. There is no significant brush that could support the spread of a fire to any other building. Therefore, the effect of a fire spreading in the area is minimal.

6.9 Greenhouse Gas Allocation

Should the Complex consume the entire 17.5mmcf/d of gas available via its pipeline for 365 days per year, it will produce approximately 340,000 tons of CO_2 per year. This CO_2 emission is equal to the limit specified by OPIC for the Complex. As a result of scheduled outages, the Complex will operate at a capacity factor of less than 100%. Therefore, the Greenhouse Gas (GHG) allocation specified by OPIC will never be exceeded. Refer to **Table 6.15** for a summary of GHG emissions.

Table 6.15: Annual Greenhouse Gas Production

GHG Allocation Specified by OPIC	GHG Emission at 100% Capacity	GHG Emission at 90% Capacity	GHG Emission at 80% Capacity
340,000 tons CO_2/y	340,000 tons CO_2/y	306,000 tons CO_2/y	272,000 tons CO_2/y

6.10 Transport and Infrastructure Impacts

There is a modest average traffic rate of 180 vehicles per hour on the main road to the East of the Complex during the day (10:00-16:00). Around 20:00, traffic increases to approximately 390 vehicles per hour due to nightlife and dining. The adjoining restaurants have one year left on their lease and according to the landowners, DHA they will not be renewed as they are considering alternate development options for the area. The increased traffic flow does not create congestion problems. This road and others in the surrounding area are well-designed for increased traffic volume. During the rehabilitation and subsequent commencement of commercial operations, the slightly increased occasional traffic of heavy trucks and equipment associated with Complex operations will occur mostly during the day and thus, given the modest traffic rate of 180 vehicles per hour, will not have an appreciable impact on the local community. The expected modest increase during the day will be approximately 10-15% of current levels and thus will not reach nighttime levels of 390 vehicles per hour.

Because the Complex is fully built and the community is designed to accommodate it, operating the Complex will not create any negative impacts on the local infrastructure. In fact, the power and clean water produced by the Complex will serve to bolster local infrastructure.

6.11 Cumulative Impacts

Because the Complex is constructed, rehabilitation and operation of it will result in a spatial impact of virtually zero. The area was originally designed by DHA to accommodate the power plant and desalination facilities.

During the rehabilitation phase of the Complex, which will last approximately 6 months, traffic impacts will be minimal. All equipment associated with rehabilitation will be stored at the Complex. Neither the rehabilitation nor the operation of the Complex will disrupt the normal state of the community.

7 SUMMARY OF THE AUDIT, REMEDIATION, SUCCESS OF COMPLETION, AND MONITORING OF THE ESIA

7 Summary of the audit, remediation, success of completion, and monitoring of the ESIA

7.1 Environmental Monitoring:

Summary of environmental monitoring carried out during November 15-17, 2012 and conclusions drawn are given hereunder in **Table 7.1**.

Table 7.1: Environmental Monitoring Summary (2012)

Criteria	2012 ESIA Data (During Shutdown)	Conclusions
Baseline Particulate Matter Presence:	• Road between office and grid: 0.0562mg/m^3 • Near discharge to sea: 0.0631mg/m^3 • Near workshop area: 0.04675mg/m^3 • Near fine filtration: 0.05825mg/m^3 • Near lube oil storage drum: 0.03605mg/m^3	Combustion of natural gas at the power plant will not contribute additional PM.
Particulate Matter (PM) Emissions During Operations	PM emissions could not be measured at the stack while Complex was shut down.	The natural gas burned at the Complex does not contribute to PM emissions.
Baseline Ambient Noise Level	• Daytime average at boundary walls (4 locations, 40 measurements): 45.1dB(A) • Nighttime average at boundary walls (4 locations, 40 measurements): 39.4dB(A) • Daytime average inside Complex (4 locations, 40 measurements): 47.5dB(A) • Nighttime average inside Complex (4 locations, 40 measurements): 39.6dB(A)	Ambient noise levels are well within the NEQS residential noise limits of 45 dB(A) during the day and 55 dB(A) during the night.
Noise Level During Operation	No measurements were done because the complex was shut down.	----------
Baseline Water Quality	Seawater samples collected 5m from the shore of the Complex at a depth of 7m. **Parameter** / **Result** pH: 8.5 Turbidity (NTU): 19.0 TSS (mg/l): 48.2	Concentrations of some substances in the surrounding seawater actually exceed IFC guidelines for effluents. Operations and effluents of the Complex will not contribute to this situation.

Table 7.1: Environmental Monitoring Summary (2012)

Criteria	2012 ESIA Data (During Shutdown)	Conclusions
	TDS (mg/l): 44587 Conductivity (ms/cm^3): 58.0 Calcium (mg/l): 2345 Sulphates (SO_4 mg/l): 4420 Sodium (mg/l): 13593 Chlorides (mg/l): 22400 R-Cl_2 (mg/l): 0.6 $CaCO_3$: 8400 Magnesium (mg/l): 6136	
Effluents During Operations	No samples taken because the complex was shut down.	----------
Solid Waste Disposal	• Solid waste is collected for reuse, recycling, or landfilling according to environmentally safe practices • Segregation occurs on and off-site • Waste management contractors are certified	• A safe and reliable system of solid waste disposal is in place at the Complex. No further mitigation measures are necessary, although improvements to upstream segregation will be implemented
Environmental Monitoring	• No observations taken	• DCL with modest modifications will implement a comprehensive EMMP
Thermal Discharge (TD)	• The TD design remains unchanged since 2008	• Although the thermal discharge pipe does not drain directly into the sea, the system of splashing TD over the rocks before mixing with the sea more effectively dissipates heat with no additional harm to the environment • The system is highly efficient and not impactful to the marine ecosystem and remains in NEQS compliance as originally designed

7.2 Environmental Site Assessment and Remediation:

Environmental site assessment for soil/floors contamination due to oil & grease, glass wool/mineral wool/asbestos or any other hazardous, toxic, reactive chemicals on the project site was carried out during November 15-17, 2012

7.2.1 Soil contamination by oil and grease:

Contamination of cemented floor and soil by oil and grease was found. The maximum contaminated soil was not more than $2m^2$ with a maximum depth of about 20 to 30 cm.

7.2.1.1 Remediation of contaminated soils and floors:

The total quantify of the soil contaminated is not large. There are many possible methods of remediation of the contaminated soil. DCL will wash the surfaces using detergents and scarping techniques and dispose of contaminated soil at a licensed facility.

7.2.2 State of glass wool/mineral wool:

Due to high salt concentration in the air originating from the sea, glass wool used as lagging of various pipes in the water desalination unit was found to be wearing out. DCL will apply suitable protective coating of epoxy resin or similar materials to rectify the situation during the rehabilitation. This remediation technique will avoid health hazards.

7.2.3 House-keeping:

All chemical drums, sand bags, and other materials will be organized and stored in appropriate locations.

7.3 Marine Life at the point of effluent discharge:

Like many populated and industrialized coastal regions, water quality in the coastal waters of Karachi has been considerably affected by domestic and industrial effluents. Furthermore, the oil tanker *Tasman Spirit* ran aground in Karachi Harbour in 2003, spilling 30,000 tons of crude oil into the sea. Marine life was badly affected by this incident.

Coliform bacteria was measured in a seawater sample collected from Clifton and DHA beaches (very near the Complex). This test revealed a presence of Coliform bacteria as high as 800 per 100ml of seawater. This measurement indicates poor water quality in the area. These waters are not suitable for fishing. The effluents from the Complex will not contribute new pollutants to these waters, and the thermal discharge from the Complex will have a minimal effect on the already depleted aquatic life of the area.

7.4 Traffic Count:

There is only one main road near the project site. A detailed traffic count was conducted on November 15, 2012 on this main road was carried. The results of the same are given in **Table 7.2**.

Table 7.2: Type and Number of Vehicles Passing Through the Checkpoint

Date/Time	Bus	Truck	Wagon	Car	Loader	Motor cycle	Rickshaw	Mini bus	Total
15-11-12 8-9pm	3	5	2	8	--	12	--	1	31
15-11-12 1-2pm	--	--	1	11	1	7	--	--	20
15-11-12 4-5pm	1	2	--	5	--	9	1	-	18
15-11-12 6-7pm	-	1	--	14	--	7	--	1	23
16-11-12 8-9am	2	3	2	12	1	12	--	-	32
16-11-12 12am-1pm	1	2	3	10	--	14	--	--	30
16-11-12 3-4pm	--	--	--	13	2	13	2	1	31
16-11-12 5-6pm	3	1	1	12	2	6	--	--	25
16-11-12 7-8pm	--	--	--	6	--	5	--	2	13

The table shows that a relatively low number of vehicles pass the Complex during various hours of the day. The main reason for this is distance of approximately 5km from the Complex to the nearest residential area. Thus, vehicular emissions from the traffic are negligible when compared to the extremely high vehicular emissions on the roads within the congested areas of Karachi. In addition, vehicular emissions near the Complex are further diluted by the sea wind.

7.5 Seawater Temperature Data[(1)]

According to a UNESCAP Report (1996), the average annual sea surface temperature near the Karachi coast, ranges between 20.7˚C and 29.3˚C. During winter months the temperature range is 20.7˚C to 23.8˚C, while temperatures during the summer months fall in a range between 27.9˚C and 29.3˚C. In the creeks along the Indus Delta, the sea surface temperature ranges from 23.4˚C to 29.5˚C. Water temperature in tidal channels in the Indus Delta creeks have been reported form 19˚C in January to 30˚C in June.[30] The temperatures at a depth of 100m are lower and generally have an annual range between 19.5˚C and 24.5˚C. These measurements are recorded in **Table 7.3.**

[30] Harrison, et al. (1994), Zaqoot, 2000

Table 7.3: Monthly Distribution of Air and Sea Temperatures on Pakistan Coast[31]

Location	Jan. (˚C)		Feb. (˚C)		Mar. (˚C)		Apr. (˚C)		May (˚C)		June (˚C)	
	Air	Sea	Air	Sea	Air	Sea	Air	Sea	Air	Sea	Air	Sea
Indus delta	19.2	23.6	20.2	23.8	24.3	24.9	29.0	27.0	29.5	27.9	30.0	29.5
Karachi	19.2	23.5	20.5	23.8	24.0	24.0	27.0	26.5	29.0	27.9	30.0	29.3
Gwadar	18.3	20.2	19.5	20.2	22.3	22.0	27.5	24.2	30.1	26.5	31.2	28.3
	July (˚C)		Aug. (˚C)		Sep. (˚C)		Oct. (˚C)		Nov. (˚C)		Dec. (˚C)	
	Air	Sea	Air	Sea	Air	Sea	Air	Sea	Air	Sea	Air	Sea
Indus delta	29.5	28.7	28.0	28.5	26.5	27.0	27.0	27.8	23.5	26.5	19.5	23.4
Karachi	29.3	28.0	28.0	28.0	28.5	27.3	27.2	27.0	27.5	24.4	27.0	20.7
Gwadar	29.2	27.3	28.5	28.0	29.4	28.3	27.0	28.0	23.1	25.3	20.1	23.2

7.6 Water Temperature:

In the "DHA Cogen Ltd; Report on HYDROGRAPHIC SURVEY; Site Selection for DHA Cogen Power and Desalination Plant, January 2003," surface water samples were collected at different locations in the Korangi Channel using dry thermometers. The mean temperature recorded was 29.1˚C

7.7 Ambient Air Quality

The Ambient Air Quality results are displayed here in **Tables 7.4 & 7.5.**

Table 7.4: Ambient Air Quality Daily Mean (May 9th, 2007)[32]

Location	NO ($\mu g/m^3$)	NO_2 ($\mu g/m^3$)	CH_4 ($\mu g/m^3$)	Non-Methane Hydrocarbons (ppb)	CO (ppm)	SO_2 ($\mu g/m^3$)	$PM_{2.5}$ ($\mu g/m^3$)
Islamabad Fixed Station	54.50	46.00	2332.20	757.10	1.07	17.50	47.20
Islamabad Mobile Station	15.90	32.20	1745.60	630.40	0.69	10.30	43.70
Karachi Fixed Station 1	10.10	30.8	1448.7	308.2	0.43	21.90	77.90
Karachi Fixed Station 2	17.5	43.70	1777.50	299.50	0.56	18.00	65.6

[31] UNESCAP (1996) [14]

[32] Institutional Analysis of Air Quality Management in Urban Pakistan Draft Report 30 June 2009

Table 7.4: Ambient Air Quality Daily Mean (May 9th, 2007)[32]							
Location	**NO ($\mu g/m^3$)**	**NO_2 ($\mu g/m^3$)**	**CH_4 ($\mu g/m^3$)**	**Non-Methane Hydrocarbons (ppb)**	**CO (ppm)**	**SO_2 ($\mu g/m^3$)**	**$PM_{2.5}$ ($\mu g/m^3$)**
Lahore Fixed Station 1	48.8	83.6	2519.30	1138.40	1.91	41.60	91.80
Lahore Fixed Station 2	6.90	33.70	1833.8	317.3	0.63	21.50	57.5
Quetta Fixed Station	3.20	18.80	1317.9	1504.7	0.44	6.60	206.4
Peshawar Fixed Station	29.80	53.30	3015.20	1973.60	1.21	22.00	185.5
Draft PAAQS	40	80	--	--	5	120	40

Table 7.5: Ambient Air Quality Daily Mean (September 20th, 2007)[33]							
Location	**NO ($\mu g/m^3$)**	**NO_2 ($\mu g/m^3$)**	**CH_4 ($\mu g/m^3$)**	**Non-Methane Hydrocarbons (ppb)**	**CO (ppm)**	**SO_2 ($\mu g/m^3$)**	**$PM_{2.5}$ ($\mu g/m^3$)**
Islamabad Fixed Station	29.2	34.50	1706.90	194.80	0.79	2.00	30.60
Islamabad Mobile Station	8.20	26.80	1732.90	140.10	0.55	0.10	29.60
Karachi Fixed Station 1	12.60	21.80	2256.4	305.5	0.38	7.90	105.00
Karachi Fixed Station 2	19.40	28.90	3479.40	374.40	0.28	10.90	90
Lahore Fixed Station 1	6.80	50.40	1732.30	461.00	0.87	16.60	85.50
Lahore Fixed Station 2	5.00	35.30	3453.1	358.2	1.05	46.50	99.6

[33] Institutional Analysis of Air Quality Management in Urban Pakistan Draft Report 30 June 2009

Table 7.5: Ambient Air Quality Daily Mean (September 20th, 2007)[33]

Location	NO (µg/m^3)	NO_2 (µg/m^3)	CH_4 (µg/m^3)	Non-Methane Hydrocarbons (ppb)	CO (ppm)	SO_2 (µg/m^3)	$PM_{2.5}$ (µg/m^3)
Quetta Fixed Station	20.50	42.20	2704.6	762.3	1.28	21.40	106.4
Peshawar Fixed Station	15.10	33.10	4447.30	625.40	1.03	34.90	79.4
Draft PAAQS	40	80	--	--	5	120	40

7.8 Air Dispersion Modeling

The combustion of fuels for power plant operation inevitably results in emission of gaseous pollutants to the atmosphere. The pollutants of potential concern during use of natural gas as fuel are nitrogen oxides (NO_x) and carbon monoxide (CO).

Air Dispersion Modeling: "SCREEN 3" Model:

Detailed air dispersion modeling has been undertaken using the "SCREEN 3" Model. SCREEN 3 uses a Gaussian plume model that incorporates source-related factors and meteorological factors to continuously estimate pollutant concentration from point sources.

This system requires no site-specific meteorological input, as calculations are made for a spectrum of possible combinations of wind speed and atmospheric stability (using Pasquill classes). Concentrations at the downwind point of maximum impact, as well as at other specified distances, are determined. No consideration of wind direction is required because the output represents the concentrations directly downwind.

It is assumed that the pollutants do not undergo any chemical reactions, and that no other removal processes, such as wet or dry deposition, act on the plume during its transport from the source.

In the case of gas turbine at DHA Cogen, air dispersion modeling was run based on operational data from the manufacturer of the gas turbine. While details of the data and ground level concentrations of NO_x and CO obtained through the ADM are presented in **Table 7.6.**

Table 7.6: Summary Results of Air Dispersion Modeling		
Input Parameters	CO	NO_x
Source Type	Point	Point
Stack Height (m)	33.5	33.5
Stack Diameter (m)	3.8	3.8
Stack Exit Velocity (m/s)	22.9	22.9
Emission Rate (g/s)	20.3	17.6
Stack Gas Temperature (K)	394.15	394.15
Ambient Air Temperature (K)	303.15	303.15
Rural/Urban Location	Urban	Urban
Maximum ground level concentration (µg/m^3) at distance (m) – 1 Hour (#)	62.28 (2769.0m)	53.99 (2769.0m)
Maximum ground level concentration (µg/m^3)at distance (m) – 24 Hour (#)	24.91	21.60
Maximum ground level concentration (µg/m^3) at distance (m) – Annual (#)		
IFC EHS Guidelines for Thermal Power (mg/Nm^3)[34]	----	51.0
Pakistan NEQS, Ambient (mg/Nm^3) 24h/8h value	10	120

Air dispersion modeling indicates that stack emissions of CO and NO_x will be in compliance with emissions parameters according to NEQS and IFC standards.

7.9 Public disclosure/consultations:

Public consultations were held for the local EIA report prepared in 2004. These consultations were held from September 30 to October 3, 2004. These consultations were held in the offices of the DHA Housing Society, Karachi; Clifton Cantonment Board Office, Karachi, at business centers, shops, NGOs offices, individual residents houses, public places, on the road sides, business centers of the DHA Cogen Housing Society, etc.

Public consultants were held again between November 15 and 17, 2012. Refer to Chapter 9: Public Involvement & Disclosure for full details. A variety of stakeholders including Officials of the DHA Housing Society, Karachi and Officials of Clifton Cantonment Board Office; people employed at: Business Centers, shops, petrol pumps, money exchangers, shopping plazas, offices; individual residents, people in the public places and road sides, etc. of the DHA Cogen Housing Society were involved.

[34] Emissions from stack unless otherwise noted. Daily average values corrected to 273K, 101.3kPa, 10% O_2, and dry gas, unless otherwise noted.

7.10 ESIA Summary Document:

ECTECH has prepared an Executive Summary of the ESIA findings to facilitate review by relevant Pakistani Ministries and OPIC.

7.10.1 National and Local Legislation:

Environmental Approval; from the EPA, Government of Sindh, Karachi; was obtained for the Complex via the EIA report (2004) prepared in accordance with the legal requirement of the Pakistan Environmental Protection Act, 1997 (PEPA), Section 12. Therefore, it is not legally required to provide a copy of this ESIA report to those bodies. However, IEP may distribute this report to those bodies in the interest of the project.

7.10.2 International Standards

The ESIA complies with the following international standards:

- OPIC - Environmental and Social Policy Statement (October 15, 2010)
- OPIC - Environmental Handbook (February 2004)
- IFC Performance Standards on Environmental and Social Sustainability (January 1, 2012)
- IFC Environmental, Health, and Safety Guidelines for Thermal Power Plants (December 19, 2008)
- IFC Access to Information Policy (January 1, 2012)
- IFC Environmental, Health, and Safety Guidelines, General EHS Guidelines: Environmental Air Emissions and Ambient Air Quality (April 30, 2007)
- International Organization for Standardization (ISO) 14000 Standards
- IFC Environmental, Health, and Safety Guidelines for Electric Power Transmission and Distribution, (April 30, 2007).

7.11 CONCLUSION

Based on the data reported in the 2004 EIA report, 2008 ECAR and 2012 ESIA; operations of the rehabilitated DCL Complex will not present any unacceptable impacts on the environment or human health. Mitigation measures are considered satisfactory and monitoring protocols are either in-effect or will be enhanced to address any environmental or social impacts that may arise from Complex operations.

8 ENVIRONMENTAL MANAGEMENT & MONITORING PLAN (EMMP)

8 Environmental Management & Monitoring Plan (EMMP)

Because the construction phase of the project has been completed, the Environmental Management and Monitoring Plan (EMMP) relates only to the operational phase.

The EMMP will ensure that the Complex is operated with minimum environmental impact as permissible under the National Environmental Quality Standards Pakistan (NEQS); IFC Environmental, Health, and Safety Guidelines, Thermal Power Plants, December 19, 2008; IFC Environmental, Health, and Safety Guidelines, General EHS guidelines, April 30, 2007; and Pollution Prevention and Abatement Handbook, The World Bank Group, Effective July 1998. To accomplish this objective, the EMMP consists of the following:

- Environmental Management Plan (EMP)
- Emergency Response Plan (ERP)
- Environmental Monitoring Plan (EMtP)
- Resource Implementation and Training Program (RITP)
- Social Management Plan (SMP)

This section provides an outline of the EMMP and its major components. The formal document inclusive of all sampling, protocol, and frequencies will be retained at the Complex.

8.1 Environmental Management Plan

The Environmental Management Plan (EMP) delineating the framework for management of the environmental elements of the Project. While the EMP is presented in this section, the mitigation measures essential to meet the various environmental requirements during operation of the project are described in Chapter 6.

The EMP includes the protection, mitigation and environmental enhancement measures to be implemented to minimize adverse impacts on the environment. The possible adverse environmental impacts during the operational phase of the project, under normal operating conditions, primarily stem from air emissions, wastewater generation, noise and solid waste generation.

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

8.2 Emergency Response Plan

The Emergency Response Plan (ERP) states the contingency plans of the Complex concerning all potential accidents and incidents during operation. The detailed ERP includes the following salient features:

1. Emergency Operations Coordinator
2. The Emergency Response Team
3. Emergency Organization and Responsibilities
4. Emergency contact numbers
5. Important External Contact Numbers
6. Emergency Classification System
7. Notification methods of on-site staff, off-site response and for the public
8. Protective Response
9. Emergency Response Training
10. Potential Emergencies including unauthorized entry, bomb threats, flooding, etc.
11. Hazardous Material Exposure Control
12. Location of emergency equipment
13. Employees trained in the use of emergency equipment
14. Emergency Action Plan
15. Emergency Communication
16. Site Evacuation Map and Routes to Nearest Hospitals

An emergency evacuation drill is rehearsed every two months to ensure that all employees have a thorough knowledge of the proper action to be taken in the event of a real on-site emergency.

A training plan for environment health and safety is already in place whereby first aid and firefighting training is given to all employees every year. The EHS supervisor attends various seminars and symposiums held in the city on EHS issues. EHS supervisor conducts safety talks and issues safety bulletins from time to time. A toolbox meeting is conducted daily to discuss safety and occupational health issues. Safety films are shown at the main reception on a regular basis. Safety trainings are held on weekly/monthly basis on the following topics:

- Working at a height
- Hot conditions & confined space
- Safe driving
- Use of power tools
- Electrical safety
- Proper use of PPEs
- Fire prevention and protection
- Chemical handling and storage

8.3 Environmental Monitoring Plan

An Environmental Monitoring Plan (EMtP) has been established for the site. The purpose of this procedure is to define mechanisms and responsibilities for monitoring and measurement of occupational health and safety as well as environmental performance in order to demonstrate compliance with policies, procedures, legislation, and requirements of the EHS Management System. **Table 8.1** describes the monitoring location, frequency, and regulatory agency for each relevant environmental parameter.

The EHS performance is measured by establishing appropriate qualitative and quantitative measures of performance (KPIs). This also covers reactive measures of performance to monitor accidents, ill health, incidents and other historical evidence of deficient performance.

The progress of EHS Objectives is monitored at defined intervals. The EHS Manager is responsible for taking feedback on the progress of EHS Objectives and reporting it to the top management in the Management Review meetings as per the guideline given in section 7.8 of this procedure.

Table 8.1 Contents of the Environmental Monitoring Plan

Environmental Issue	Mitigation Measures and Monitoring Parameters	Compliance with Guidelines and Standards	Dates, Frequency, Schedule, and Persons Responsible for Monitoring and Completion	Progress Reporting
Water quality (Potable water)	Water quality is measured at the main drinking water source/supply point on the project site.	National Standards for Drinking Water Quality., Pakistan, November26,2010; WHO Guideline Values for Drinking Water	Monthly	
Wastewater	The following wastewater parameters are measured at the point of discharge from the Complex boundary: pH, TSS, Oil & Grease, Total Residual Chlorine, Cr.	These parameters are in compliance with IFC Environmental, Health, and Safety Guidelines, Thermo Power Plants, December 19, 2008.	Daily	

Table 8.1 Contents of the Environmental Monitoring Plan				
Environmental Issue	**Mitigation Measures and Monitoring Parameters**	**Compliance with Guidelines and Standards**	**Dates, Frequency, Schedule, and Persons Responsible for Monitoring and Completion**	**Progress Reporting**
	Total, Cu, Zn. Fe, Pb, Cd, Hg, As and Temperature to the level required			
Thermal Discharge	Temperature and mixing zone from the point of discharge into the sea.		Daily	
Air Emissions	Stacks Emissions of NO_x & CO		Quarterly	
Noise	Noise levels at a diverse mix of locations on the site, at all four boundary walls (outside) of the Complex, and at the nearest receptor.		Quarterly	
Solid waste disposal	Ensure that all the points of their generation are duly collected, segregated and disposed of according to legal requirements of the country while keeping a record of the solid wastes to be disposed.		Regularly in connection with environmental and safety rounds	
Soil	Erosion conditions regarding		Regularly in the context of environmental and safety practices.	

Table 8.1 Contents of the Environmental Monitoring Plan				
Environmental Issue	**Mitigation Measures and Monitoring Parameters**	**Compliance with Guidelines and Standards**	**Dates, Frequency, Schedule, and Persons Responsible for Monitoring and Completion**	**Progress Reporting**
	revegetation will be undertaken on all required or affected areas. This includes roadways used exclusively by the Complex.			
Flora and fauna	As no significant flora and fauna exists on the project site, no action is required.		Not applicable	

8.4 Resource Implementation and Training Program (RITP)

A Resource Implementation and Training Program (RITP) will be established in order to effectively implement the EMP.

All Complex staff engaged in effluent monitoring and testing will be fully trained. The on-staff laboratory chemist will be trained in all operations of laboratory testing of effluents and other relevant materials and sampling procedures. The chemist will be trained in applying analytical methods and techniques of testing, data processing, interpretation and reporting. In addition, lab staff should know the local laws, rules and regulations as applicable to the testing of effluents for power plants.

The designated Environment Officer will be charged with an ongoing program of environmental training. This will include:

- General promotion of environmental awareness among all staff
- Specific training of EHS staff working in sensitive areas
- Updating staff on changes in environmental standards
- Reporting to staff on the environmental performance of the Complex

The person to monitor gaseous emissions, particulate matter, and noise levels will be extensively trained to conduct this job capably. The training program will include the use of monitoring instruments, data generation, processing, interpretation, recording and presentation.

8.5 Social Management Plan (SMP)

For regular operation of the project, an SMP will be established and include the following:

1. A merit-based transparent recruitment system regardless of gender, race, ethnic, origin, religion or social back ground
2. A merit-based working environment and professional opportunities for both experienced and fresh graduates. The company will provide excellent employment opportunities at a location which is not far from the center of the city unlike other power projects.
3. The company aims at enhancing workers' skills through training and by providing incentives through an equitable reward system.
4. The company aims at fostering favorable community relations with residents of the area by introducing a meaningful and manageable plan of community engagement regarding Complex development, rehabilitation and operations.
5. The regular exchange of information between the Complex management and residents in the project area regarding environmental impacts and safety measures regarding the Complex to build a sense of confidence about safety and environmental stewardship of the Complex.
6. Complex management will explore the formation of direct or indirect female employment opportunities. Such efforts can be fruitful to minimize negative social impacts.
7. Complex management may offer technical training opportunities to local youth to foster an attitude of education and educational development.
8. Generally, a socially-responsible attitude and availability of company management for discussion with local residents will have a significant effect in fostering a positive community opinion of the project.

8.6 Assignment of Responsibility for Implementation (by name or position)

The power station operational workforce will include an EHS Supervisor. The EHS Supervisor will be suitably trained and be responsible for the following:

- Ensuring that environmental protection procedures are followed
- Coordinating environmental monitoring
- Acting as a contact person for liaison with the public, local organizations and all levels of the Pakistani Government
- Ensuring that data on all environmental aspects of Complex operations are continuously updated and available in a form suitable for immediate inspection by authorized personnel, including lender representatives, the EPA, and internal management authority of the Complex
- Monitoring especially hazardous substances on-site to ensure that the possibility of accidental release is minimized

- Promoting on-site environmental awareness

In order to ensure implementation and effective operation of the EMMP, responsibilities shall be allocated to specific persons as shown in **Table 8.2**.

Table 8.2 Delineation of Responsibilities

Official Concerned	Responsibility
Power Plant Manager (PPM)	• Ultimately responsible for all the operations of EMMP • Responsible to ensure the smooth functioning of the EMMP system • Daily review environmental status as reported in writing by the Shift Engineer • All other EMMP matters, issues and problems will be reported to PPM (for rectification) by the Shift Engineer • Work as a bridge between the relevant Government authorities and senior management of the project • Will be answerable to higher management in all matters relating to EMMP and report at least monthly about the state of EMMP operations
EHS Supervisor	• Responsible for implementation of the EMMP • Coordination with other departments with respect to EMMP • Arranging, collecting and reporting environmental monitoring data and publishing of the report required by the EPA
Shift Engineer in Charge	• During each shift, will be responsible to ensure smooth functioning of the entire EMP • Rectifying any problems regarding environmental matters • Directly report to the PPM on all matters relating to EMMP on a daily basis.
Plant Operator	• Operate sound level monitoring systems • Maintain all records of monitoring of all elements of the EMP • Report to the Shift Engineer on all matters relating to EMMP operations on a daily basis or more frequently if required
Laboratory Chemist	• Conduct all laboratory testing of wastewater at all levels • Perform all other lab testing as may be required from time to time in the interest of effective operation of the EMMP • Maintain records of all EMMP operations • Report daily to the Shift Engineer In-charge on any matters relating to EMMP operations

8.7 Reporting and Reviewing Procedures

The EMtP, as described above, will be the guiding principle and reporting will be done regularly according to relevant IFC Guidelines.

All monitored data will be reviewed and scrutinized daily by the Shift Engineer and on a monthly basis at the Power Plant Manager level. The data will also be reviewed monthly at the level of the Project Chief Executive. The data will be documented appropriately at the project level. Any discrepancies will be duly addressed.

For presentation of the data to the concerned agencies, including the EPA and Government of Sindh, the format presented as **Annex 3.2** will be used. The same format will be provided to the lender (OPIC) unless a different format is specified.

8.8 Auditing and Management Review

An auditing program is a key component of many EMMPs. The primary purposes of the audit program are:

- To verify continued conformance to all applicable laws and regulations and to the Company's internal policy and procedures
- To confirm the continued existence and efficacy of compliance and performance management systems
- To assist in the identification of actual and/or potential risks

The benefits of the audit program include:

- Assistance to management in identifying and prioritizing activities and/or practices that have opportunities for improvement
- Reduction in risk through identification of areas of concern and triggering of appropriate corrective action
- Assistance with benchmarking and measuring improvement in management system performance

The benefits of the review process include:

- Assessment of company personnel compliance with policy and procedures using audit reports
- Review of targets, objectives, and environmental performance indicators to ensure continued success in light of changing environmental concerns, regulatory developments, interested parties, market pressures, and internal organization changes
- Determine whether targets and objectives are being met
- Review regulatory compliance and whether EMMP requirements have been achieved
- Determine root causes of potential systemic non-conformance

- Determine whether the operational controls, procedures, corrective actions, preventative measures and continuous improvement efforts have resulted in enhanced environmental performance
- Determine if energy efficiencies, accounting practices and information management systems are adequate
- Determine potential areas of improvement in organizational structure, staff training, work instructions, processes, pollution prevention programs, energy utilization and accounting practices, which may lead to environmental benefits and increased profit margins
- Formulate corrective actions and preventative measures as a result of the review of system non-conformance and verify that corrective actions are effective and appropriate

9 PUBLIC INVOLVEMENT & DISCLOSURE

9 Public Involvement & Disclosure

DCL is using a transparent process during the rehabilitation phase, with full disclosure to all relevant stakeholders and community members. The following entities and individuals were involved in Public Consultations (PCs): local regulators, local communities, the Government Official of the project area, NGOs, the local hospital, and the local business community. A simplified questionnaire was used to communicate the project to stakeholders and collect their feedback.

9.1 Administration of DHA Housing Society

DHA Housing Society is the custodian of the rights of its residents. DHA is directly involved in the venture, and its participation is of utmost importance for its success. Lt. Col. (Rtd.) Ali Amjad Jaffery, DHA Director of Engineering Works, was contacted to express his views about the project on behalf of the DHA.

9.2 Residents of the DHA Housing Society

When consulted, residents of the DHA Housing Society expressed their concerns about the current non-operation of the Complex. The power, water, and economic opportunity afforded by plant operations are a great boon to their community. DCL will keep them well-informed on the future of the project.

Residents of DHA with the following positions were involved in PCs:

- Real estate agents
- Money exchangers
- Shopkeepers
- Petrol pump owners
- Food shop owners
- Department store owners
- Local regulatory officials

9.3 Cantonment Board Clifton

To the present date, the authorities of CBC have provided the use of a bouzer (vacuum truck) to collect sewage from the plant and dispose of it through the CBC sewer. When the Complex is operating after rehabilitation, sewage will be treated by GEMS or WMC, which will meet international standards.

9.4 Complex Staff

Staff members of DCL, including the power plant and the water desalination unit, who are involved in the normal operations of the Complex, were asked to express their views. Their written feedback is annexed in this report

9.5 Local NGOs

The support role of NGOs is important for the progress of such projects of public benefit. An important NGO operating in the project area is "Indus Resource Centre," located in the Clifton area. Officials at Indus Resource Centre were contacted to communicate its views on the project.

9.6 Methodology

In order to establish contact with the targeted people, organizations, NGO, hospitals, etc., ECTECH Team requested that the DHA Housing Authority provide an influential and well-informed consultation.

ECTECH team members contacted the targeted parties, giving them information about the status of the project before requesting their feedback. The project is a popular topic of discussion in the area; all parties were interested to hear about the future rehabilitation and operation of the project. After due discussion, stakeholders provided their written opinions (handwritten responses are included in this report as **Annex 8.1**).

9.7 Community Awareness and Perception about the Project:

The following views were recorded, in addition to the written ones, in reference to the power plant and the water desalination unit:

- The people support project operation as soon as possible. They are in dire need of quality drinking water and suffer from acute shortage of electricity.
- A great deal of money has been invested by the people of DHA without any positive return so far. Therefore, they need concentrated efforts to bring the project to its operational state without losing further time.
- The community anticipates that the supply of quality drinking water help reduce exposure to many waterborne diseases.
- The community anticipates that operations will empower the poor, providing many employment activities.
- The community anticipates that project operations will indirectly bolster the net exports of the country through the export of manufactured goods.
- 100% of the people consulted during PCs welcomed the news of efforts to bring the plant back to operational status. The general opinion of the project is extremely positive.
- The magnitude of positive social impacts of the project is far greater than that of the possible negative social impacts observed during the ESIA.
- The community anticipates that accelerated economic activity due to project operations will make new business opportunities likely to emerge

in the area. Directly or indirectly, hundreds of the residents of the DHA will get increased business due to operation of the plant.

- People foresee many socio-cultural and psychological positive impacts on their lives and the community.
- The community believes that the plant and its related activities will provide a strong base for social progress in the area.
- Increased job opportunities for local people, as a result of project operations bringing reliable power, will improve their income status and allow them to provide their family with food, clothing and an education.

9.8 Summarized Picture of the Public Consultations

Views expressed in writing by the people during PCs, as well as supporting information, are recorded in the following table:

Date and Time of Consultation	Name & Education	Title & Organization	Address	Opinions on the Project
17-11-2012 The office of IRC	Mr. Prince Tom Naz M.A Edu	Constituency Coordinator (IRC) Indus Resource Center—NGO	House#D-42/B, Block#1, Clifton. Karachi.	"It was a great effort in the past pertaining purity water to control the short coming of potable water. Because proper utilization of natural resources is a good sign for inhabitants. So it should be continued in future for good health to full fill lack of water requirement in community. I admire your efforts for future to run this project."
17-11-2012 The office of Mr. Shah	Mr. S.G Abid Shah, B.E.(civil)	Senior Engineer, Cant. Board, Clifton, Karachi	Cant. Board Clifton	"In the sake of water crisis in DHA, the revamping of Cogen plant is of vital importance."
17-11-2012 The business of Mr. Ali	Mr.Sarfraz Ali, MBA	Assistant Manager Operations, Pizza Hut Resident of DHA	Khy-e-Shehbaz DHA	"Project should be started, it does not create any pollution."
17-11-2012 The shop of Mr. Abbas	Mr.Syed Saif Abbas B.Com	TCS Courier Service Resident of DHA	Shop#3, Body 16-c, Lane#2 Shehbaz com, DHA 6, Karachi.	"The power plant and desalination unit should be operational because we are short of electricity and drinking water."
17-11-2012 The office of Mr. Saneen	Mr.Saneen Inter	Sales Man, Aghas Super Market, 71/B Gizri Road Resident of DHA	71/B, Gizri Road	"As already shortage of electricity drinking water in this area. So this plant should be operational."

Date and Time of Consultation	Name & Education	Title & Organization	Address	Opinions on the Project
16-11-2012 The office of Mr. Khan	Mr. Mohammad Zahoor Khan F.A	Estate Agent, Property Guides Resident of DHA	4/c Khy-e-shabaz, Phase 6, DHA Karachi.	"Power must be work. Water problem is Very big problem in DHA. Must work."
16-11-2012 The restaurant of Mr. Sultan	Mr. Muhammad Sultan	Shop Keeper Resident of DHA	Hot BIT Restaurant Shop	"Power must be work. Water problem is Very big problem in DHA. Must work."
16-11-2012 The office of Mr. Afridi	Mr. Naiz Afridi B.A.	Hotel Business Resident of DHA	Greek inn hotel	"Power cogen must be work located in phase#8."
16-11-2012 The office of Mr. Hussain	Mr.Khadim Hussain Inter	R.Manger Resident of DHA	Al-habit restaurant	"Power must be work. Water and electricity problem is Very big problem in society. Must be work."
16-11-2012 The residence of Mr. Khan	Mr.M.Abbas Khan F.A	Nil Resident of DHA	F#1, Akhtar Society.	"Water power is must. Every thing running with generators. Beneficial for residential people."
17-11-2012 The office of Mr. John	Mr. Michel John Inter	R. Manager Resident of DHA	Qahwati Restaurant.	"Power must be run. To produce electricity and water."
17-11-2012 The residence of Mr. Ahmed	Mr. Sohail Ahmed B.COM	Senior Officer Resident of DHA	Shop#3, Plot#4-c, shehbaz com DHA Karachi.	"This property is very use full of over area."
16-11-2012 The residence of Mr. Suleman	Mr. Moosa Suleman. BBA	Student Resident of DHA	Al-Rehmat Beach View Road do darya DHA	"In my opinion it should be started immediately as it is beneficial for our country (city)."
16-11-2012 The restaurant of Mr. Matric	Mr.Nisar Matric	Oder Taker Resident of DHA	Sajjad restaurant	"Power must be work."
17-11-2012 The office of Mr. Asim	Mr.Syed Ali Asim B.E.	Manager Biomedical/maintenance Resident of DHA	St-1, Block #3 Shrah-e-Firidious, Clifton Karachi.	"As for as desalination plant is concerned it may be beneficial for the community to overcome water shortage in DHS and Clifton area depending on its production capacity and possible like in taxes by government."
16-11-2012 The DCL office	Mr. Asif Iqbal Khan BSC (chemical);	EHS Assistant, DCL Local regulatory official	DCL -1 coaster Phase 8 DHA Karachi	"In my point of view it is one of latest technology that is not common in world today. Having a power generation

Date and Time of Consultation	Name & Education	Title & Organization	Address	Opinions on the Project
	MSC (Env.Sci)			and desalination plant in Karachi is major development which will same generates of people related power shortage and water scarcity. This plant should run at its possible capacity which will also help unemployment in Karachi / Pakistan."
17-11-2012 The office of Mr. Khawaja	Mr. Umer Khawaja B.COM.	Out-Let Manger, PSO Resident of DHA	Defense Phase #6,E-10.	"Dr. Hanif has a assignment to visit the people to know about the power project to generate electricity in watt and also provide the clean water to Karachi city. Please help him."
16-11-2012 The office of Mr. Hasan	Mr. Jibran Hasan MEF.M.PHIL in (SCM) Continue	Asst. Store Officer Resident of DHA	L-6/1(st#4) Sector North Karachi.	"Best project in Karachi, due to the shortfall of electricity. Blessing of people live in Clifton. in my opinion power must be."
16-11-2012 The office of Mr. Rizwan	Mr.Rizwan B.E (Mechinal)	AEE Resident of DHA	Baldia Town Karachi West	"DHA colony working at power generation and water desolations having working principle of (CCPP)."
16-11-2012 The DCL office	Mr. Anjum K. Alvi B.E Engineering Graduate	Senior Mechanical Engineer DSL—Local Regulatory Official	DSL-1 Coastal Avenue Phase VIII, DHA Karachi	"i-This CCPP has a best layout and most compact design having single shaft configuration with Desalination plant and it is first of its kind in Pakistan. ii-I have no doubt that the plant can be operational for its life time after its rehabilitation work. iii-The plant has been preserved under excellent conditions as per recommendations of OEMS, and is ready to start after rehabilitation work. iv- It is highly recommended that plant should be operational as soon as possible to meet the growing demand of water and power of the local consumers and encourage other investors to invest similar plants in the country."

Date and Time of Consultation	Name & Education	Title & Organization	Address	Opinions on the Project
16-11-2012 The DCL office	Mr.Muhammad Seraj-ul-Haq B.E (Electrical)	DCL Plant Manager	Phase VIII, DHA Karachi, DSL-I Coastal Avenue	"There is shortage of both electricity and water in Karachi which is a cosmopolitan city with a population of 20 millions. As such, the plant is much needed as it can produce 3 million gallons of water per day and supply to Clifton Cantonment Board. Moreover, it can produce 94 MW of Electricity and supply to KESC Grid. Unfortunately the plant did not operate well after its first commissioning in April 2008 due to problem in the main prime mover i.e., the gas turbine. However, the new prospective owner has most comprehensive plane for revival and rehabilitation of the plant. The plant is expected to start production by the middle of next year. After successful start up of phase I Phase ii should be taken up."
16-11-2012 The DHA office	Lt. Col. (R) Ali Amjad B.Sc, B.E (Civil)	DIR Special Projects DHA DHA Official Representative of about 2.0 million residents of DHA	2B-Easr Street, Phase 1 DHA, Karachi.	"The project was undertaken to facilitate the DHA residents in overcoming the shortage of electricity and water. However unknown reasons the plant after commissioning stopped due to which the residents are deprived of the facility. However, if now the plant is started again the plant will be a source of great esite for DHA residents."

9.9 Public Consultation Conclusions

The process of PCs has confirmed that people within all segments of society with any connection to the project are eagerly awaiting its operations. Community hopes are extremely high for the future benefits of the project.

10 IFC PERFORMANCE STANDARDS ON SOCIAL AND ENVIRONMENTAL SUSTAINABILITY

10 IFC Performance Standards 1 to 8

The assessment of environmental risk and impacts has been undertaken in compliance with the IFC "Performance Standards 1 to 8, on Social and Environmental Sustainability – January 1, 2012."

10.1 Performance Standard 1 – Social and Environmental Assessment and Management

10.1.1 Social and Environmental Assessment

This ESIA Report complies with the requirements of "IFC Performance Standards 1 to 8, on Social and Environmental Sustainability- January 1,2012" while also considering "Environmental, Health and Safety Guidelines for Thermal Power Plants," December 19, 2008 by IFC.

10.1.2 Management Program

Based on the social and environmental risk impacts and mitigation measures requirement, DCL is committed to the establishment of an effective management program. Various policies and procedures have been developed and any remaining policies and procedures necessary to operate successfully are in final development.

10.1.3 Organizational Capacity

DCL is in the process of developing an organizational structure required for the operation stage of the project based on other in-country IPPs of similar size and the prior organizational structure of the plant.

The company is also in the process of reviewing the existing policies and re-defining rules, responsibilities and the authority to implement the management program to enhance the operations and controls. These include policies regarding the delegation of authority, human resource management, compliance and grievance reporting, corporate treasury and accounting, and emergency handling and safety. DCL will retain all current employees, 52 in total, and hire approximately 48 additional employees including a CEO and CFO. Throughout this process, employees will be made aware of the organizational structure and their reporting responsibilities.

10.1.4 Training

The management is committed to training employees and contractors with respect to work skills, hazard response, fire response, environmental protection, emergency response, spill cleanup, accident response, first aid, etc.

10.1.5 Monitoring

Mandatory monitoring, according to the environmental standards as prescribed by the IFC, EHS Guidelines for Thermal Power Plants (2008) [also in the General EHS Guidelines of IFC 2008] will be the criteria for all environmental parameters that need to be carried out during the operational stage of the Project. After rehabilitation, DCL will follow the process of earning ISO 14001 certification.

10.2 Performance Standard 2 – Labor and Working Conditions

10.2.1 Working Conditions and Management of Work Force

It is mandatory for DCL to follow the Industrial Relations Ordinance and the Provincial Employees Social Security Ordinance for establishing working conditions and management of worker relationships. The company has established procedures and policies for non-discrimination, equal opportunity, retirement and grievance mechanism.

Workers unions are very unusual for Pakistani power plants. There is no existing workers union at DCL. Management makes every effort to keep the employees happy, motivated and satisfied.

10.2.2 Protecting the Work Force

A strict policy, as per local laws, is implemented prevent employment of child and forced labour. The company is committed to enforce this policy under as law requires. This policy will apply to contractors and contract labor as well as DCL staff. DCL will strictly address any issues of child and forced labour within its supply chain. It will do so by requiring all contractors and subcontractors to review DCL policies and sign an acknowledgement form requiring them to comply with those policies while contracted by DCL. Social Management Systems are being developed through appropriate policies and reporting mechanisms.

10.2.3 Occupational Health and Safety.

Health & Safety Management System, Health & Safety Procedures and Health & Safety Training Procedures have already been developed and are being implemented accordingly.

Adequate Personnel Protection Equipment (PPE) is procured and compliance of its use is enforced by DCL.

Routine medical exams and records of all employees will be maintained after establishment of dispensary/hospital. Employees will be reimbursed for medical checkups from qualified medical officers when necessary. The medical policy will

include protective measures against HIV/Aids. Adequate and well-equipped first aid kits have been placed at key locations. Ambulance access is readily available.

10.3 Performance Standard 3 – Pollution Prevention and Abatement

After the rehabilitation phase, the Complex will be a state-of-the-art facility. Proper operation of the Complex will prevent pollution and minimize emissions to a level consistent with IFC Environmental, Health, and Safety Guidelines, Thermal Power Plants, December 19, 2008.

DCL incorporates resource conservation and energy efficiency measures in its operations, consistent with the principles of cleaner production.

10.3.1 Liquid Effluents

DCL will only release effluents up to the levels stipulated in the IFC Guidelines.

Brine from the desalination plant is mixed with return water from the closed cooling system and cooling water from Dump Condenser to lower the temperature and salt level before discharging to the sea.

Sewage from the toilet system is currently collected by the CBC contractor and disposed of as per CBC procedure. When the Complex is operating after rehabilitation, sewage will be treated by GEMS or WMC, which will meet international standards.

Other effluents are also collected by the contractor from various pits and disposed of as per the disposal system of the contractor.

For all liquid effluents, including storm water when present, the following parameters will be measured, treated, and/or mitigated:

- pH
- Temperature increase
- Total suspended solids
- Oil & grease
- Total residual chlorine
- Chromium (total)
- Copper
- Iron
- Zinc
- Lead
- Cadmium
- Mercury
- Arsenic

- BOD_5
- COD

10.3.2 Gaseous Emissions

The emission levels of gases will correspond to the IFC Environmental, Health, and Safety Guidelines, Thermal Power Plants, December 19, 2008.

10.3.3 Solid Waste

All solid waste will be disposed of in an environmental and sustainable fashion using internationally recognized practices.

10.3.4 Noise

Plant equipment and machines are designed to operate within permissible noise levels of IFC Environmental, Health, and Safety Guidelines, Thermal Power Plants, December 19, 2008.

10.3.5 Waste

DCL is committed to minimize the generation of hazardous and non-hazardous waste.

10.3.6 Hazardous Materials

DCL will endeavour to avoid the use of hazardous materials. Wherever avoidance is not feasible, DCL will minimize or control the release of any hazardous materials that may result from their production, transportation, handling, storage and use for project activities.

DCL also commits that it will not use ozone depleting substances such as Freon, PCBs and asbestos.

10.3.7 Emergency Preparedness and Response

DCL commits that it will quantify and monitor, on an annual basis, the emissions of GHGs in accordance with internationally recognized methodologies. In addition, DCL commits to evaluate technically and financially feasible options to reduce or offset project-related GHG emissions during the operation of the project.

10.3.8 Pesticide Use and Management

During project activities, DCL will manage the use of pesticides. It will attempt to avoid any use of pesticides. If pesticide use becomes necessary, it will use pesticides with low human toxicity, known to be effective against the target species, and have minimal effects on non-target species and the environment.

DCL will not use products that fall within the World Health Organization Recommended Classification of Pesticides by Hazard Classes Ia and Ib or Class II.

10.4 Performance Standard 4 – Community Health, Safety and Security

DCL will to conform to all requirements of Community Health and Safety.

All gaseous emissions, liquid effluents, noise levels and solid waste will be managed to conform to the IFC Environmental, Health, and Safety Guidelines, Thermal Power Plants, December 19, 2008.

10.4.1 Infrastructure and Equipment Safety

During design, engineering, future construction and operation activities DCL will ensure that structural elements or components are in accordance with international industry practice.

All structural elements of the Complex have been designed and constructed by qualified and experienced professionals and have been certified or approved by competent authorities or professionals.

DCL will ensure that the equipment, safety shut-off instruments, and controls and valves in hazard areas meet the requirement of providing protection from hazards arising from combustibility and flammability of vapors, liquids, gases, dusts or fibers and have mechanical integrity to withstand designed process pressures, temperature and corrosive conditions.

10.4.2 Hazardous Material Safety

DCL will prevent or minimize the potential for community exposure to hazardous materials that may be released by the project. It also commits that where there is potential for the community to be exposed to hazards, particularly those that may be life threatening, it will exercise special care to avoid or minimize their exposure by modifying, substituting or eliminating the condition or substance causing the hazards.

10.4.3 Environmental and Natural Resource Issues

DCL will avoid or minimize adverse impacts due to project activities on soil, water and other natural resources in use by the affected communities.

10.4.4 Community Exposure to Disease

DCL commits that its project activities will not have potential for and will prevent or minimize the potential for community exposure to water-borne, water-based, water-related, vector-borne, and other communicable diseases.

10.4.5 Emergency Preparedness and Response

Details of emergency response measures have been given in Chapter 7 of this report.

10.4.6 Security Personnel Requirement

DCL has hired security services on contract from registered and approved agencies. DCL is committed to hiring security services that will be guided by the principles of proportionality and good international practices in terms of hiring, rules of conduct, training, equipping and monitoring of such security personnel.

10.5 Performance Standard 5 – Land Acquisition and Involuntary Resettlement

Prior to any development on the site, the land was owned by DHA. All of the land was originally purchased from willing owners and the price was determined according to an established formula based on recent land prices and the status of the land. All transactions were voluntary and conducted through negotiated settlements as required by local law. The 10 acres of land on which the plant is situated is still owned by DHA Housing Authority and is leased to DCL for a term of 30 years.

10.6 Performance Standard 6 – Biodiversity Conservation and Sustainable Resource Management

10.6.1 Habitat

The project activities will not lead to any destruction of habitat or threat to the maintenance of biodiversity.

10.6.2 Modified Habitat

The project activities are not expected to affect or modify habitat in any manner.

10.6.3 Natural Habitat

DCL will undertake measures of restoring any disruption to natural habitat by offsetting any losses that are caused by its operation through the creation of ecologically comparable area(s) that are managed for biodiversity.

10.6.4 Critical Habitat

The project area does not fall into any critical habitat areas.

10.6.5 Legally Protected Areas

The project is not located within a legally protected area.

10.6.6 Invasive Alien Species

DCL is committed to not introduce any new alien species. Its activities do not involve the introduction of alien species.

10.6.7 Management and Use of Renewable Natural Resources

DCL is committed to manage renewable natural resources in a sustainable manner. It has plans to grow trees where technically and practically possible within its boundaries.

10.7 Performance Standard 7 – Indigenous Peoples

The Social Impact Assessment indicates that the communities within the project's area of influence will be not be negatively affected by the activities of the project. There are no Indigenous People in the project area according to any possible definition. If any adverse impacts occur due to project activity, DCL will minimize and mitigate them to ensured that no segment of the environment is damaged. For details of grievance mechanisms, refer to Chapter 10.

10.7.1 Development Benefits

DCL has hired labour on contract to share the benefits of its activities with the people of the area through employment in activities like bagging & shipping, loading & unloading, horticultural services, janitorial services, canteen services, etc.

10.7.2 Special Requirements

The establishment of the project at the selected location will not have any impact on traditional or customary land. Its activities are not expected to having any adverse impact on livelihoods or cultural, ceremonial, or spiritual use that defines the identity and community of the local peoples.

10.7.3 Relocation of Indigenous People from Traditional or Customary Lands

The acquisition of land did not involve any relocation of people from their traditional or customary lands, houses or elsewhere.

10.8 Performance Standard 8 – Cultural Heritage

Although there is no cultural heritage, according to its definition, present at the site, the project management is committed to protect any cultural heritage items or artifacts that may be discovered.

10.9 Methodology for Evaluating Environmental Impacts

Baseline data and conditions will form the basis for evaluation of the environmental impacts of project.

11 GRIEVANCE REDRESSING MECHANISM

11 Grievance Redressing Mechanism: Formal Legal Channel

11.1 Environmental Legislation

The Pakistan Environmental Protection Act of 1997 (PEPA) provides a complete code of conduct for addressing grievances stemming from damages to any sector of the environment from power project activities.

The project is required to operate during a minimum of 95% of its operational period in strict compliance with the required emission standards of Pakistan as provided by PEPA and NEQS, as well as the guidelines delineated in the "Pollution Prevention and Abatement Hand Book, July 1998, the World Bank". This ensures that the project owners are legally bound to observe all legal requirements to avoid damaging the environment around the project.

11.2 PEPA and Environmental Management

PEPA regulates the protection, conservation, rehabilitation and improvement of the environment; the prevention and control of pollution; and the promotion of sustainable development. As the prime environmental law of the country, the PEPA of 1997 establishes complete regulatory and monitoring bodies, policies, rules, regulations and national environmental quality standards. To ensure enforcement, the act establishes regulating bodies such the Pakistan Environmental Protection Council (PEPC) and responsible bodies such as the Pakistan Environmental Protection Agency (EPA) at the Federal level and Environment Protection Agencies (Provincial EPAs) at the provincial level. PEPA applies to the whole of Pakistan, including its territorial waters.

The EPA has the power to arrest without warrant any person against whom reasonable suspicion exists of having been involved in an offence under the PEPA. The EPA also carries the power to enter, inspect and search without warrant any premises, vehicle or vessel. It also has the ability to seize of any plant, machinery, equipment, vehicle, substance, record or document that is suspected to violate material proponents of the PEPA. EPA also wields the power to summon and enforce the attendance of any person and issuance of Environmental Protection Order, PO 16 an Environmental Protection Order (EPO) in relation to a person who is contravening a provision of the PEPA.

With the approval of the 18th Amendment to the constitution of The Islamic Republic of Pakistan (1973), the subject of environment has largely been delegated to the provinces. In other words, the Provincial EPAs are now fully empowered to use all the functions of the Federal Government in the matter of environmental protection. Provincial EPAs have localized control over all matters, including redressing any grievances of individuals.

11.3 Enforcement of PEPA and Liability

The GoP and the Provincial Governments are bound to protect the environment in accordance with international commitments under various conventions and treaties it has signed or ratified. The PEPA translates these commitments into a compliance program for industrial establishments. Non-compliance to these commitments may results in loss of credibility, popularity and even financial aid from various international forums.

The EPA is directly responsible for the enforcement of rules and regulations relating to environmental management and protection in the areas controlled by the Federal Government, including Islamabad and the Federally-Administered Tribal Areas (FATA). Both the EPA and Provincial EPAs are responsible to cooperatively ensure implementation of these rules, regulations and standards within the Provinces.

Basic enforcement principles under PEPA stipulate that:

- No person (including companies) under its purview will discharge or emit any effluent or noise in contravention of the NEQS.
- No proponent of a project shall commence construction or operation unless it has filed an EA report with the Pak-EPA considering the type of project and likely causes of adverse environmental impact.
- No person may dispose of waste on public land or on a highway or on land owned or administrated by a local council, unless done in accordance with the provisions of the PEPA.

The following section of the PEPA further clarifies the mechanism of Environmental Management and the Grievance Redress Mechanism.

11.3.1 PEPA Section 11

Regarding prohibition of certain discharges or emissions, section 11 of PEPA stipulates the following:

> *(1) Subject to the provisions of this Act and the rules and regulations no person shall discharge or emit or allow the discharge or emission of any effluent or waste or air pollutant or noise in an amount, concentration or level which is in excess of the National Environmental Quality Standards or, where applicable, the standards established under sub-clause (I) of clause (g) of sub-section (1) of section 6.*
>
> *(2) The Federal (now provincial) Government may levy a pollution charge on any person who contravenes or fails to comply with the*

provisions of sub-section (1), to be calculated at such rate, and collected in accordance with such procedure as may be prescribed.

11.3.2 PEPA Section 12

Regarding initial environmental examination and environmental impact assessment, section 12 of PEPA stipulates the following:

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

11.3.3 PEPA Section 16

Regarding the environmental protection order, section 16 of PEPA stipulates the following:

(1) Where the Federal Agency or a Provincial Agency is satisfied that the discharge or emission of any effluent, waste, air pollutant or noise, or the disposal of waste, or the handling of hazardous substances, or any other act or omission is likely to occur, or is occurring, or has occurred, in violation of the provisions of this Act, rules or regulations or of the conditions of a license, and is likely to cause, or is causing or has caused an adverse environmental effect, the Federal Agency or, as the case may be, the Provincial Agency may, after giving the person responsible for such discharge, emission, disposal, handling, act or omission an opportunity of being heard, by order direct such person to take such measures that the Federal Agency or Provincial Agency may consider necessary within such period as may be specified in the order.

(2) In particular and without prejudice to the generality of the foregoing power, such measures may include;

(a) immediate stoppage, preventing, lessening or controlling the discharge, emission, disposal, handling, act or omission, or to minimize or remedy the adverse environmental effect;

(b) installation, replacement or alteration of any equipment or thing to eliminate, control or abate on a permanent or temporary basis, such discharge, emission, disposal, handling, act or omission;

(c) action to remove or otherwise dispose of the effluent, waste, air pollutant, noise, or hazardous substances; and

(d) action to restore the environment to the condition existing prior to such discharge, disposal, handling, act or omission, or as close to such condition as may be reasonable in the circumstances, to the satisfaction of the Federal Agency or, Provincial Agency.

11.3.4 PEPA Section 17

Regarding penalties, section 17 of PEPA stipulates the following:

(1) Whoever contravenes or fails to comply with the provisions of sections 11, 12, 13 or section 16 or any order issued there under shall be punishable with fine which may extend to one million rupees, and in the case of a continuing contravention or failure, with an additional fine which may extend to one hundred thousand rupees for every day during which such contravention or failure continues:

Provided that if contravention of the provisions of section 11 also constitutes contravention of the provisions of section 15, such contravention shall be punishable under sub-section (2) only.

(2) Whoever contravenes or fails to comply with the provisions of section 14 or 15 or any rule or regulation or conditions of any license, any order or direction, issued by the Council or the Federal Agency or Provincial Agency, shall be punishable with fine which may extend to one hundred thousand rupees, and in case of continuing contravention or failure with an additional fine which extend to one thousand rupees for every day during which such contravention or failure continues.

11.4 PEPA Enforcement Specifications

Contraventions of the provisions of the PEPA are punishable by imprisonment extending up to five years, or with a fine of up to one million PKR, or both. When an offense is committed by a company, the Chief Executive Officer (CEO) and the company shall be deemed guilty of the offense. Action can even be taken against Government Agencies and Local Authorities.

The Government may also constitute an Environmental Tribunal to hear cases relating to the PEPA. The tribunal may only hear cases when the complaint is

made in writing by the EPA, by Local Council, or by any Aggrieved person who has given at least thirty days' notice to the EPA of the offense and of the intent to make a complaint to the Tribunal. The Tribunal may also hear appeals from the Agencies. Appeals from the tribunal shall go to the High Court.

In order to resolve disputes relating to the environment issues, Environmental Tribunal Rules (1999) has been promulgated. When trying the offenses, the Tribunal must follow the Code of Criminal Procedures (1898). The Tribunal shall send the copies of its orders to the concerned parties and the Director General of the EPA and Provincial EPAs. The Tribunal shall conduct its proceedings within 60 days. An appeal to the Tribunal, accompanying a copy of the impugned order and copies of the documents relied and prescribed fees, shall be sent to the Registrar by the appellant. Generally, the proceedings of the Tribunal shall be open.

11.5 Compensation for Environmental Damages

The project is required to conform with IFC Thermal Power Plant Guidelines emissions standards for a factor of at least 95% of its operational time.

Under PEPA, the damages caused to any sector of the environment or property are to be paid to the affected parties.

Under PEPA, the Provincial EPA of the concerned province and the Environmental Tribunal can legally prosecute the project owner for damages occurring from pollution generated by the project.

12 CONCLUSIONS

12 Conclusions

This ESIA involved the compilation and analysis of data to establish the environmental and social impact of the project. The project includes rehabilitating and operating the DHA Cogen Power and Desalination facility. Every aspect of this project was considered, including air emissions, effluent emissions, land impact, noise impact, thermal discharge, and much more.

Based on the data collected for the 2004 EIA, 2008 ECAR and this 2012 ESIA, it has been determined that operations of the rehabilitated DCL Complex will present minimal impacts on the environment or society. The Complex is shown to comply with the following national and international standards:

Compliance with National Standards

- Pakistan Environmental Protection Act (1997)
- Pakistan Industrial Relations Ordinance (2011)

Compliance with International Standards

- OPIC - Environmental and Social Policy Statement (October 15, 2010)
- IFC Performance Standards and Guidance Notes (2012)
- IFC Performance Standards on Environmental and Social Sustainability (January 1, 2012)
- IFC Environmental, Health, and Safety Guidelines for Thermal Power Plants (December 19, 2008)
- IFC Access to Information Policy (January 1, 2012)
- IFC Environmental, Health, and Safety Guidelines, General EHS Guidelines: Environmental Air Emissions and Ambient Air Quality (April 30, 2007)
- International Organization for Standardization (ISO) 14000 Standards
- IFC Environmental, Health, and Safety Guidelines for Electric Power Transmission and Distribution, (April 30, 2007)
- The Workmen's Compensation Act, (1923)
- The Factories Act, (1934)
- The Industrial Relations Ordinance, (2002)
- National Fire Protection Association, (2013)

Mitigation measures are considered satisfactory and monitoring protocols are either in-effect or will be enhanced to address any environmental or social impacts that may arise from Complex operations.

When operational, the Complex will create reliable power and clean water for thousands of people. This will bring some relief from the crippling load-shedding and water shortages faced by residents of Karachi today. There is not an

established standard of adherence to international standards for developments in Pakistan. By honoring international standards and undertaking this ESIA, DCL has set a new standard of excellence in Pakistan for compliance with international standards of sustainable development. This project ushers in a new era of corporate responsibility in Pakistan.