CPEC Success Story: Port Qasim 1,320 MW Coal-fired Power Plant

EXPLORING ENVIRONMENTAL EFFECTS

Port Qasim Electric Power Company
(Private) Limited

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Certificate of Appreciation by National Forum for Environment & Health on July 17, 2018


15th
AEEA
2018
15th Annual Environment
Excellence Awards 2018
PRESENTED TO
PORT QASIM ELECTRIC POWER
COMPANY (PVT) LIMITED

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FACTS AT A GLANCE

1st Ever CPEC Energy Project: Port Qasim Coal-fired Power Project	
Capacity	1,320 MW (7.7 % of CPEC Energy Basket)
Total Foreign Investment	USD 2.085 billion
Technology	Super Critical Boiler (First Ever in Pakistan)[1]
Electricity Production till October 2019	14.7 billion units (10% of national power consumption)
Total Direct Employment	8,270 (4,960 Pakistanis + 3,309 Chinese+1 Other)
Direct Employment in Constructional Phase	7,000 (4,000 Pakistanis + 3,000 Chinese)
Direct Employment in Operational Phase	1,270 (960 Pakistanis + 309 Chinese+ 1 Other)
Indirect Local Job Opportunities	10,000[2]
Technology Transfer	150 Pakistani Engineers sent to China for Training
Environmental Awards	Certificate of Appreciation by National Forum for Environment & Health on July 17, 2018
New Tree Plantation	69,000
Primary Schools Upgradation (CSR)	1 million PKR for 130 students
Taxes submitted to GoP till August 2019	219 million USD[3]
Saving of fresh water since the start of project[3]	98,945,745 m^3

[1] These technically advanced plants operate above the critical conditions, (the state of a substance beyond which there is no distinction between liquid and gaseous phase) offer greater efficiency than older sub-critical designs and, most importantly, lower emissions.
[2] Daily Times, "Port Qasim power plant added 10bn units to national grid in one year", May 10, 2019 (PowerChina Resources, Vice Chairman Sun Shuhua)
[3] Port Qasim Coal-fired Power Project, "Diplomatic Focus", October 2019

EXECUTIVE SUMMARY

This report focuses to define the implication of electricity-generation power plants in Pakistan which are not exclusively focused on the provision of power generating, but also highlights the encouragement of viability in their respective areas. There was a prime concern among the general masses about environmental aspects of initiatives constituting under China-Pakistan Economic Corridor such as the Port Qasim Coal-fired Power Plant.

The facts in the report have been described and refined via primary questionnaire answered by the officials at various relevant managerial and administrative tiers of the plant in Port Qasim along with the officials from Environmental Protection Agency (EPA) and Global Environmental Management Services (GEMS). All mentioned facts and figures have been verified and cited from reliable secondary data sources i.e. International Energy Agency (IEA), International Union for Conservation of Nature (IUCN), National Environmental Quality Standards (NEQS)[4] and World Coal Association. Moreover, factual primary data from "Environmental Impact Assessment (EIA)" reports has also been cited which were formulated by "Hagler Bailly Pakistan" in 2014.

Key outcomes of the report enable us to learn that the Port Qasim Coal-fired Power Plant runs on super-critical technology, which is assuring to reduce the volume of all gaseous pollutants and liquid effluents throughout the Karachi. As per the official document "Approval of Environmental Impact Assessment (EIA, Tech/EIA/CFPP/17/2014 in **Appendix A**)[5]", the emissions and effluents discharge of the plant are far less than the given guidelines by Sindh Environmental Protection Agency (SEPA) on 17th June 2014. The real time emissions data has also been cited in **Appendix B** which were recently measured by EMC Pakistan (Private) Limited and Quality Testing Services (Private) Limited. This research report also sheds lights on the adopted mitigation measures to protect the coastal ecosystem through mangroves plantation (appreciation letters have been enclosed in **Appendix C & D**).

This report has been authored by Yasir Arrfat, Senior Associate Research and Communications, Pakistan-China Institute.

[4] National standards of Pakistan by "National Environmental Protection Agency"
[5] Environmental Protection Agency, Govt of Sindh

ABBREVIATIONS

BRI	Belt and Road Initiative
CPEC	China-Pakistan Economic Corridor
CEMS	Continuous Emission Monitoring System
DWT	Dead Weight Tonnage
EIA	Environmental Impact Assessment
EPA	Environmental Protection Agency
ESPs	Electrostatic Precipitators
FGD	Flue Gas Desulfurization
GDP	Gross Domestic Product
GWH	Giga Watt Hour
IEA	International Energy Agency
IUCN	International Union for Conservation of Nature
KWH	Kilo Watt Hour
MW	Mega Watt
NEQS	National Environmental Quality Standards
PKR	Pakistani Rupee
SEPA	Sindh Environmental Protection Agency
SEQS	Sindh Environmental Quality Standards
SEZ	Special Economic Zone
USD	United States Dollar
WWF	World Wildlife Fund

1. PORT QASIM COAL-FIRED POWER PLANT AND ENVIRONMENT

Currently, coal-fired power plants are generating 40% of global electricity (International Energy Agency)[6]. Port Qasim Power Plant is Pakistan's first supercritical coal-fired power plant which consists of 2x660MW, having combined capacity of 1320 megawatts. Its parameters and location have been described below respectively. These technically advanced plants operate above the critical conditions, (the state of a substance beyond which there is no distinction between liquid and gaseous phase) offer greater efficiency than older sub-critical designs and, most importantly, lower emissions.

Items	Parameters
Capacity	2*660MW net
Power Technology	Pulverized coal firing in super-critical boilers
Steam conditions	Main steam25.4 Megapascal (MPa) at 571 C Reheated steam 5.73 MPa at 569 C
Fuel	Sub-bituminous coal
Plant efficiency	38% net
Cooling system	Closed circle cooling water system
Emission controls	ESP 99.7% FGD 92%

Table 1 Source: Hagler Bailly Pakistan, Environmental Impact Assessment Final Report

[6] International Energy Agency (IEA) 2016

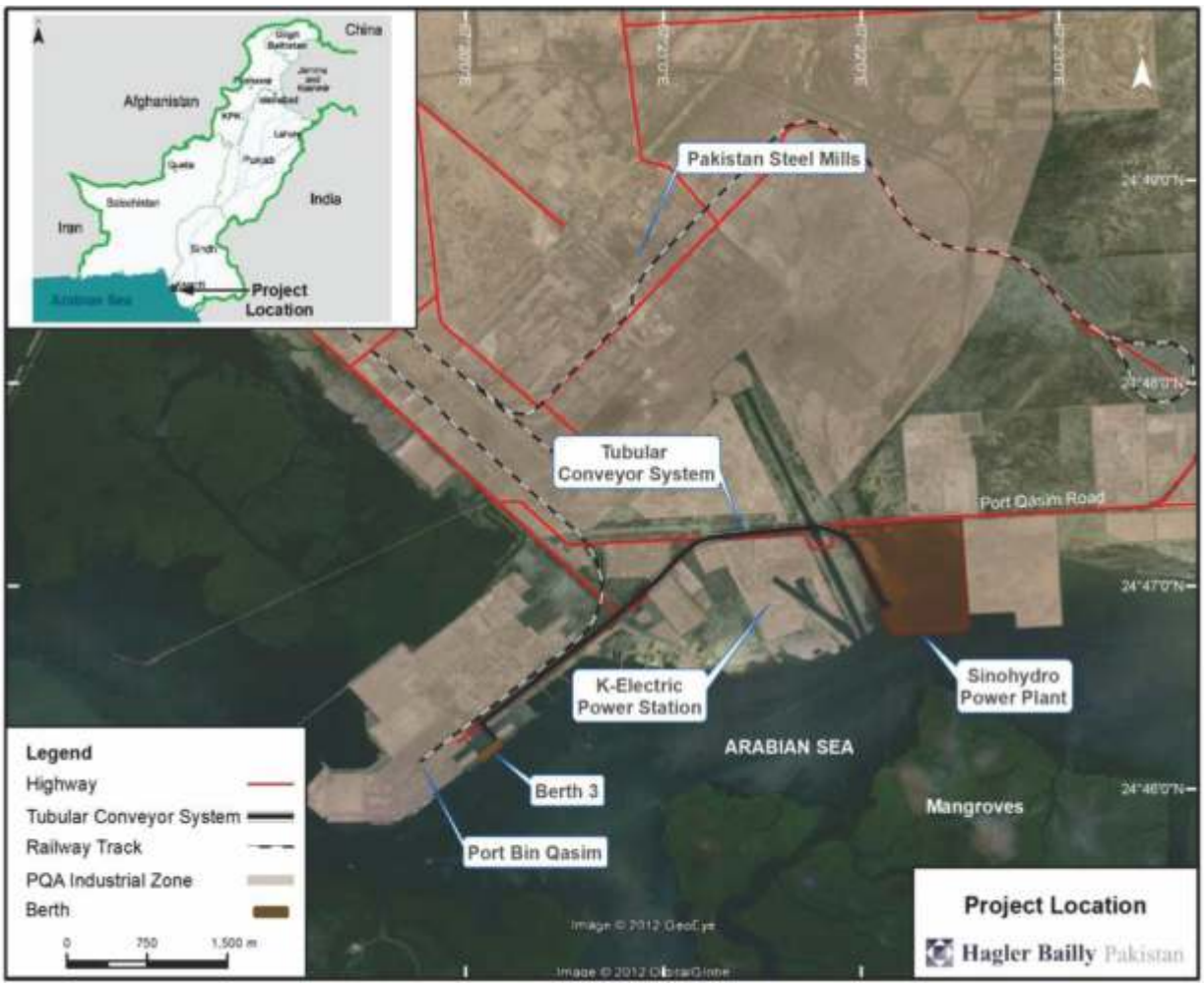


Figure 1 Source: Hagler Bailly Pakistan, Environmental Impact Assessment Final Report

According to the report of World Coal Association, "A one percentage point improvement in the efficiency of a conventional pulverized coal combustion plant results in a 2-3% reduction in CO2 emissions."[7] This project has used China's most efficient and developed technology of 660 MW, entrust best design team, the most advanced design tools to ensure the automation of project, safe and reliable and environmentally friendly technology.

In three defined stages the coal is transformed into the electricity. The **first** conversion of energy takes place in the boiler. Coal is burnt in the boiler furnace to produce heat. Carbon in the coal and Oxygen in the air combine to produce Carbon Dioxide and heat.

The **second** stage is the thermodynamic process. The heat from combustion of the coal boils water in the boiler to produce steam. In modern power plant, boilers produce steam at a high pressure and temperature. The steam is then piped to a turbine. The high pressure steam impinges and

[7] World Coal Association 2019

expands across a number of sets of blades in the turbine. The impulse and the thrust created rotate the turbine. The steam is then condensed and pumped back into the boiler to repeat the cycle. To condense the steam each unit is provided with giant natural draft cooling tower used to cool down the cooling water. Port Qasim power plant uses two natural draft hyperbolic type cooling towers to cool the circulating water used for condenser cooling. Since water resources are limited, power plants have no other option but to adopt the closed cooling system with cooling towers. Hot water from the condenser pours down from the top and the air moves up from the bottom to top removing the heat in the form of water vapors disappearing in the sky. In the **third** stage, rotation of the turbine rotates the generator rotor to produce electricity based on Faraday's Principle[8] of electromagnetic induction.

As per the discussion with EPA officials, there are four key parameters on which environmental effects can be gauged i.e. quality of fuel, technology, monitoring of emissions and fuel's handling (transportation & storage)[9]. This whole report will be directly focusing on these four parameters in the context of mitigating environmental effects at large.

[8] "Whenever a conductor is placed in the varying magnetic field, electromagnetic fields are induced known as induced emf. If the conductor circuit is closed, a current is also induced which are called induced current."
[9] Farzana Altaf Shah, Director General, Pakistan Environmental Protection Agency

2. ENVIRONMENTAL PROTECTION MEASURES

Following are the environmental protection measures taken by the company to prevent pollution and ensure environmentally friendly operation of the power plant.

2.1. Dust Control Measures

Electrostatic Precipitators (ESPs) along with Limestone-Gypsum wet desulfurization technology act as great dust removal system Integrated dust removal efficiency of the flue gas treatment technologies are within National Environmental Quality Standards. Horizontal ESPs for coal-fired boiler designed and produced by Fujian Longking Co., Ltd. Each boiler is provided with two double-chamber, four-field, low temperature ESPs and all the four fields are provided with high frequency power supply. The ESP uses high voltage DC field so that the dust in the flue gas can enter the field in corona status in the direction perpendicular to the electric line[10]. The dust particles are charged electrically in collision charge and diffusion charge mechanisms and are absorbed to the collecting plate under the action of the electric field force and the electrostatic force. Then the dust on the collecting plate falls to the dust storage device under the action of rapping device and self-gravity and then is transported to the ash silo through ash conveying system so that the flue gases purified through the ESP.

Figure 2 Electrostatic Precipitator

[10] Liang Baihua, GM, PowerChina Gansu Energy Investment Company Limited

2.2. SOx Control Measures

Port Qasim power plant has Limestone-Gypsum Flue Gas Desulfurization designed to remove SOx. After being treated in electrostatic precipitator (ESP) and pressurized by induced draft fan, flue gas from boiler enters FGD system. The flue gas entering FGD system flows into absorber via ducts. In the absorber, flue gas flows from bottom to top and limestone slurry is sprayed from top to bottom, allowing for full contact and chemical reaction between limestone slurry and flue gas. In this way, more than 90% of SO2 in flue gas is removed. In this chemical reaction, limestone serves as absorbent that removes SO2 in flue gas producing gypsum (CaSO4·2H2O) as major by-product. The desulfurized flue gas goes through mist eliminator and is discharged through the outlet on the top of absorber. Finally, it is emitted to atmosphere through clean ducts of FGD system and stack. Exhaust Gas from the chimney will have SOx concentration within the National Environmental Quality Standards (NEQS)[11].

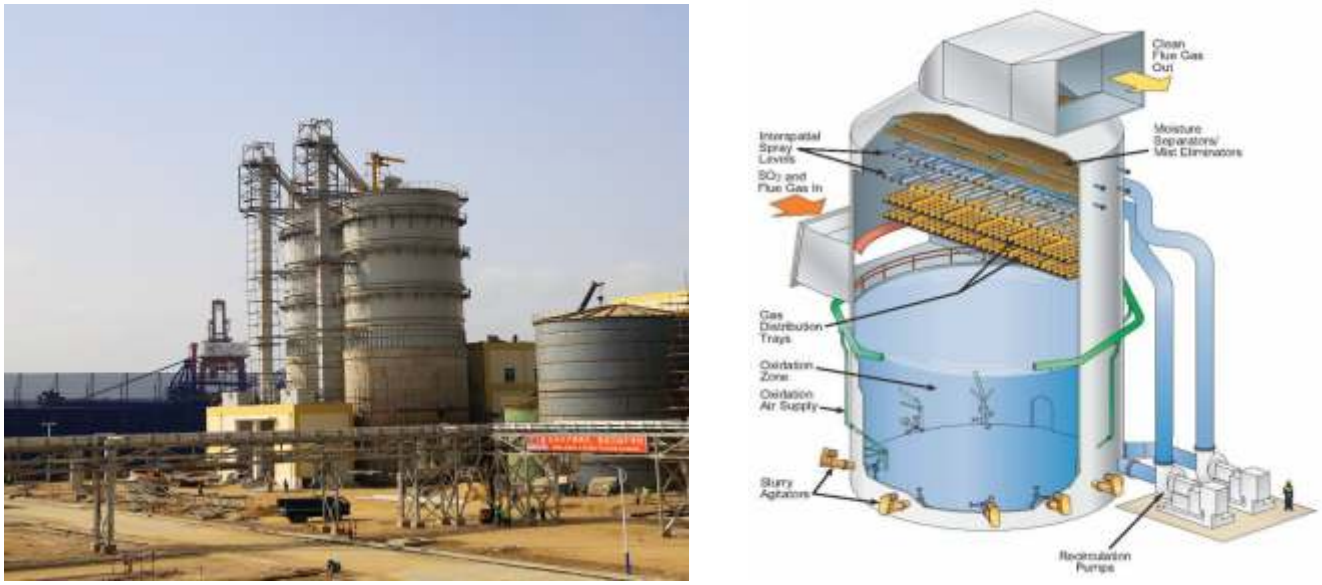


Figure 3 Desulfurization Tower

Source: Hagler Bailly Pakistan, Environmental Impact Assessment Final Report

[11] Primary data | PowerChina Gansu Energy Investment Company Limited

2.3. NOx Control Measures

Port Qasim power plant uses Low NOx combustion technology in boiler, the concentration of NOx in emission will be below the environmental standards.

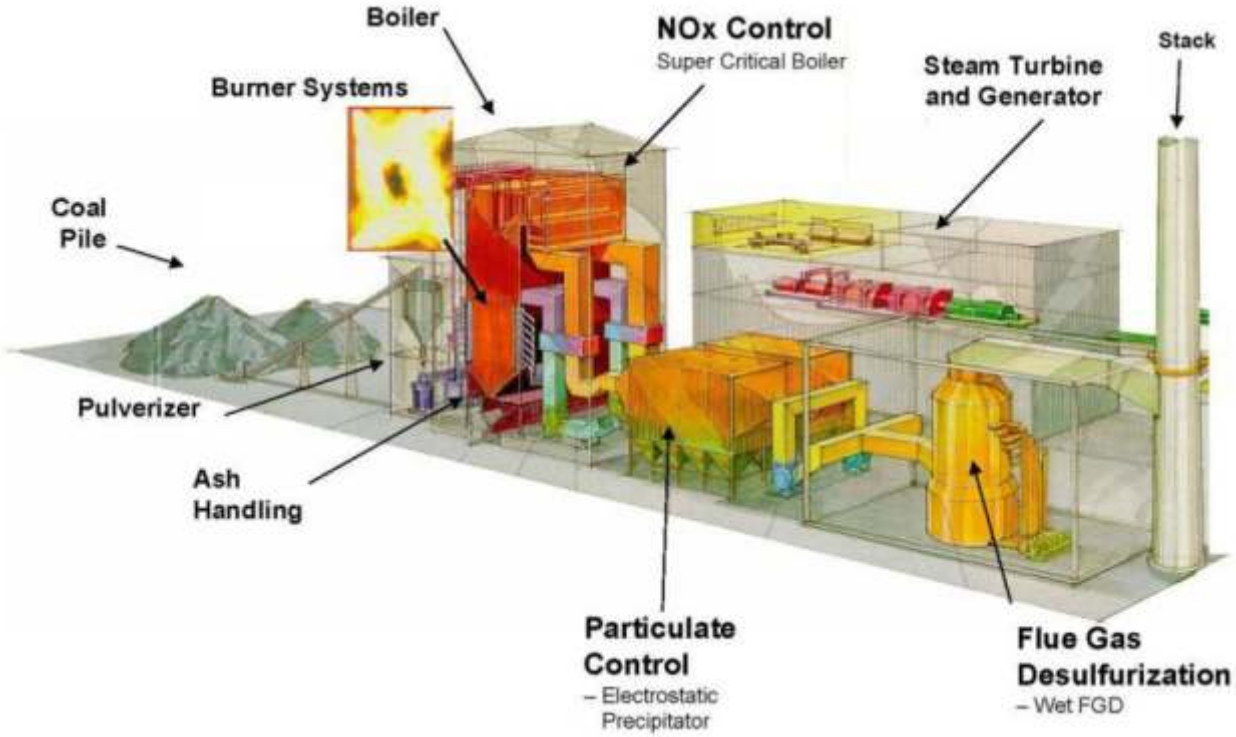
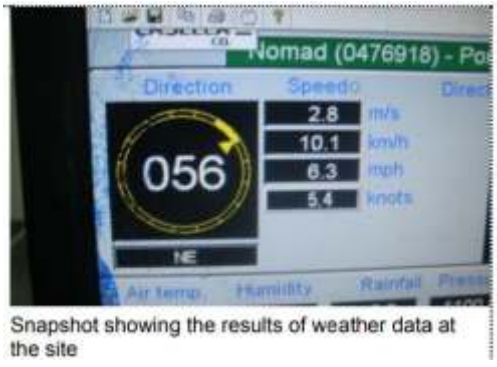


Figure 4 Source: Hagler Bailly Pakistan, Environmental Impact Assessment Final Report

2.4. Chimney

The height of the chimney for this project is 180m which has been designed after studying the wind patterns, climate and other related factors as shown in real time dashboard picture of the equipment.



Snapshot showing the results of weather data at the site

Figure 5 Source: Hagler Bailly Pakistan, Environmental Impact Assessment Final Report

Figure 6 Blue sky and chimney tower of the Plant

2.5. Continuous Emission Monitoring System (CEMS) & Ambient Air Quality Monitoring

The main mode of air pollution from a thermal power plant is point emission–emissions from the boiler and the combustion of fuel (such as coal) results in the emission of various types of pollutants from the plant stack. The main pollutants are particulate matter, oxides of nitrogen (NOx), sulfur dioxide (SO2) and particulate matter (PM). To ensure protection of human health, standards and limits have been prescribed by national regulatory authorities on the maximum acceptable concentration of these pollutants in the ambient air. The impact of the proposed project was assessed using US EPA approved ambient air quality model in order to ensure compliance with the ambient air quality standards and guidelines.

The Project has been equipped with the following systems and equipment to ensure compliance with national environmental standards and emission limits:

- Supercritical boiler technology, which results in reduced generation of Nitrogen Oxides (NOx) (discharge concentration at the boiler outlet lower than 450mg/Nm3)
- Flue Gas De–sulfurization (FGD) system inside the boilers for reduced generation of Sulphur Oxides (SOx) (92 % efficiency)
- Electrostatic Precipitators (ESP) as a collecting device to remove dust particles from the exhaust gases resulting from coal combustion (99.7 % efficiency)
- Continuous Emission Monitoring system at emission ducts

Project Company has also set up Ambient Air Quality Monitoring Station[12] to keenly monitor the air quality and to make sure air quality is according to NEQS[13].

Real Time Impacts on Air Quality

To understand the total impact of plant on the air quality in surrounding environment can be observed in below table in comparison of results with the NEQS.

Compliance with Ambient Air Quality Guidelines and Standards					
Pollutant	Background Concentration Levels ($\mu g/m^3$)	Averaging Time	Incremental Concentration Level ($\mu g/m^3$)	NEQS ($\mu g/m^3$)	Concentration Level ($\mu g/m^3$)
SO_2	12.4	24-hr (98th Percentile)	36.1	120	48.492
		Annual	5.1	80	17.5
NO_2	10.9	24-hr (98th Percentile)	47.4	80	58.275
		Annual	13.4	40	24.28
PM_{10}	82.5	24-hr (98th Percentile)	4.9	150	87.39
		Annual	1.4	120	83.89

Table 2 Source: Hagler Bailly Pakistan, Environmental Impact Assessment Final Report

The results of the air dispersion indicate that SO2, NO2, and PM10 concentrations in the air with the project in operation are compliant with national ambient air quality standards.

[12] Ambient Air Quality monitoring or Testing is a process of measurement of pollutants present in atmosphere. It measures healthiness and safety of our environment.
[13] Primary data | Operations Department PowerChina Gansu Energy Investment Company Limited,

Stack Emissions

The real time compliance status of the Project for stack emissions is shown in below table along with real time dashboard picture of the equipment. This shows that the plant is meeting all the NEQS and WB guidelines for emission parameters.

Compliance with Emission Standards (2nd November 2019)				
Parameter	Units	SEQS	WB	Real Emissions
PM_{10}	mg/Nm^3	300	50	20.81
SO_2	mg/Nm^3	1,700	200	126.1
NO_2	mg/Nm^3	1,200	500	246.7
CO	mg/Nm^3	800		15.80

Source: Primary Data

2.6. Mercury Control Measure

The company has adopted series of measure to control mercury emissions and installed world best technology as instructed by Environmental Protection Department (EPD).

The measures taken up by Port Qasim Electric Power Company (Private) Limited are listed below;

1. Selection of the coal with low mercury content.
2. Selection of the Low NOx Burners to avoid the Oxidation of the Mercury so that It can be easily removed.
3. Installation of the Continuous monitoring system to ensure the level of mercury well below the permissible limits.

2.7. Wastewater Treatment

Wastewater treatment system is designed keeping in mind the "No Wastewater Discharge Techniques". All the wastewater is treated according to NEQS prior to reuse. The industrial wastewater includes regular and irregular wastewater. Regular wastewater includes flushing and backwashing wastewater from DM water treatment system, wastewater from condensate polishing system and drain from laboratory building[14]. The regular wastewater is collected separately and treated on site for reuse.

Figure 7 Complete view of "Seawater desalinization"

Irregular wastewater includes boiler acid cleaning and flushing water, air heater cleaning effluent, boiler starts up effluent, boiler primary starts up effluent and so on. There is acid, alkali, SS, Iron

[14] Kang Congqin, Director Administration, & Assistant of GM, Port Qasim Electric Power Company (Private) Limited

and some others impurity in the waste water, which need to be neutralized with acid and alkali and treated by flocculate-settler and reused after meeting the requirement.

There are only two effluent streams discharged outside the battery limits of the plant. The two streams include cooling tower blow–down and discharge from the seawater desalination system. Together, the discharge contains a TDS concentration which is only 1.4 times higher than the intake concentrations. The temperature of the discharged does not cross 3°C higher than the existing sea water temperature. The effluents are well below the prescribed NEQS limits for effluents discharged into the sea.

All other industrial waste water treatment system is being treated via using reaction ponds, flocculating ponds, settling basins, automatic chemical dosing facilities, bulk chemical storage tank, air blowers, backwash facilities, and other recycling provisions. The slurry generated transfers to a slurry thicker. The industrial wastewater treatment plant is equipped with continuous pH, flow, and suspended solids monitoring devices to monitor the quality of wastewater discharge. Wastewater composition for other contaminants tests by sampling method. Treated effluents are collected and reused.

Concentrations of Pollutants in Sewage Before and After Treatment				
No.	Parameter	Before Treatment (mg/l)	After Treatment (mg/l)	NEQS (mg/l)
1	BOD_5	200	25	80
2	COD	400	125	400
3	Suspended Solids	250	15	200
4	Oil	30	5	10

Table 3 Source: Hagler Bailly Pakistan, Environmental Impact Assessment Final Report

Mitigation Measures Based upon the above analyses, the following mitigation measures have been adopted:

1. Effluents being discharged by the plant into the sea or the creeks meet the NEQS. The incremental impact from the project on water in the creeks is quite small (mainly from cooling tower blowdown during normal operation and storm water especially during rain) and is unlikely to have significant impacts on creek ecology downstream.

2. The project intends to utilize as much of the treated effluents as required for their dust suppression systems installed in the coal yard and other coal handling facilities within the plant. The wastewater quality is suitable for irrigation purposes; therefore, is being used for plantation.
3. Although the possibility of deterioration of water quality in the creeks due to this plant is remote, however areas downstream of the discharge point is being monitored periodically.

The mitigation effects can also be evaluated in the table which is showing the real time liquid discharge data in comparison with SEQS;

No	Parameters	Units	SEQS	Results (29th Sep 2019
1	Temperature	^{o}C	40	27
2	pH value	-	6-9	8.12
3	BOD	mg/L	200	168
4	COD	mg/L	400	341
5	Total Suspended Solids	mg/L	200	16
6	Total Dissolved Solids	mg/L	3500	3145
7	Oil & Grease	mg/L	10	1.0

Source: Monthly Emission Reports by "EMC Pakistan (Private) Limited and Quality Testing Services (Private) Limited, Appendix B"

Moreover, the cooling water requirement for the power plant is being met through extracting water from the Arabian Sea and treating it in Seawater Desalination System (SDS). Since the start of the project, 98,945,745 meters cubic of fresh water has been saved for Pakistan, of which the amount can ensure the whole year water usages of 4 million people in Pakistan[15].

[15] Port Qasim Coal-fired Power Project, "Diplomatic Focus", October 2019

2.8. Coal Transportation, Handling and Storage

Coal Transportation

Coal for the plant is being imported from Indonesia, South Africa or Australia, with design, as received, net calorific value of 4,340 kcal/kg. The design ash content is expected to be 15 % and the design sulfur content is 0.85%.

Coal requirement for the boiler depends on the heating values of the coal and demand is expected to reach 4.66 million tons per annum. Each boiler requires continuous fueling at a rate of about 324 tons of coal per hour which translates to an annual demand of about 4.66 million tons at 82% load factor.

Coal Import

Coal is being transported to Pakistan through shipping vessels. The preferred vessel for shipment of coal is Handymax. Handymax are bulk carriers with a capacity typically between 35,000 and 50,000 DWT[16].

These types of vessels are well suited for small ports with length and draught restrictions, or ports lacking transshipment infrastructure[17]. As a result, Handymax along with Supramax, a relatively larger vessel type with capacity typically between 50,000 and 60,000 DWT, represent the majority of bulk carriers of over 10,000 DWT capacity. These bulk carriers are primarily used for carrying dry cargo such as iron ore, coal, cement, finished steel, fertilizer, and grains. A handymax vessel is typically 150-200 m (490-655 ft) long. As they are equipped with on-deck cranes, they provide best options for carrying cargo to less sophisticated ports.

Coal Handling at the Port

The exclusive 1,600-meter-long (12.5 draft) coal unloading jetty has also been constructed at the plant to make the plant operations more efficient and smoother. It is being operated by PowerChina SinoHydro Harbour Co. Limited under a legal subcontract agreement with Port Qasim Electric

[16] DWT or Deadweight tonnage is the total weight a ship can carry (includes weight of cargo, fuel, stores, fresh water, etc.) It is the difference in the actual weight of a fully loaded ship and that of the empty ship. Source: http://www.coracleonline.com/courses/material/published/intro1/a03_the_ship/is_03t_3_1_1.
17 htm (Accessed September 27, 2013) 3 Source of information on Handymax and Supermax provided here is http://maritimeconnector.com/wiki/handymax/ (Accessed September 27, 2013)

Power Company (Private) Limited. A dedicated covered conveyor (to avoid its air contact) belt system is being used for transporting coal from coal jetty (CJ) to the plant site. Coal is offloaded from the vessels to the plant storage area using grab cranes installed on the jetty. A clear rendering of the terminal is shown in figure below.

Figure 8 Complete view of in-house "Coal Unloading Jetty and Covered Conveyor Belt"

Figure 9 Covered Conveyor Belt

The coal storage yard has been developed in the southern part of the plant's premises. The coal yard has a storage capacity for more than 45 days of the plant requirement (two boilers at 100% load). The yard has been divided into three sections and installed with two bucket wheel stackers and reclaimers. The crushers partially crush the coal before transferring it to the coal bunker for storage via a conveyer system. Coal weighing arrangement has also been provided in the coal handling system and the yard is fully equipped with an appropriate firefighting system.

Figure 10 Coal Yard and the Plant

The designed parameters of the coal yard are;

- ✓ Height of the coal yard 14 m
- ✓ Length of the coal yard 510 m
- ✓ Cross-section of the coal pile 41 m×59 m×41 m
- ✓ Capacity of the coal yard 4,70,000 tons

Coal Dust Control

The dust control system consists of the dust suppression system and dust collection system. The dust collection system in being provided for transfer tower, crusher house, and coal bunkers. Wash down systems have also been provided in transfer tower, crusher house, tunnels and trestles. Water spray installed in coal storage yard to suppress dust during coal transportation and handling as shown in below figure.

According to the EIA requirements, Project Company has set wind dust-controlling nets around coal yard, having height 2 m higher than the coal pile, which can effectively control the coal dust. Wind breaks are made of steel mesh. The height of the walls is typically kept at least 30% more than the height of the coal pile. Typical wind breakers and the profile of each element in the windshield are shown in below figure.

Figure 11 Wind Breakers and Water Sprinklers across the coal yard

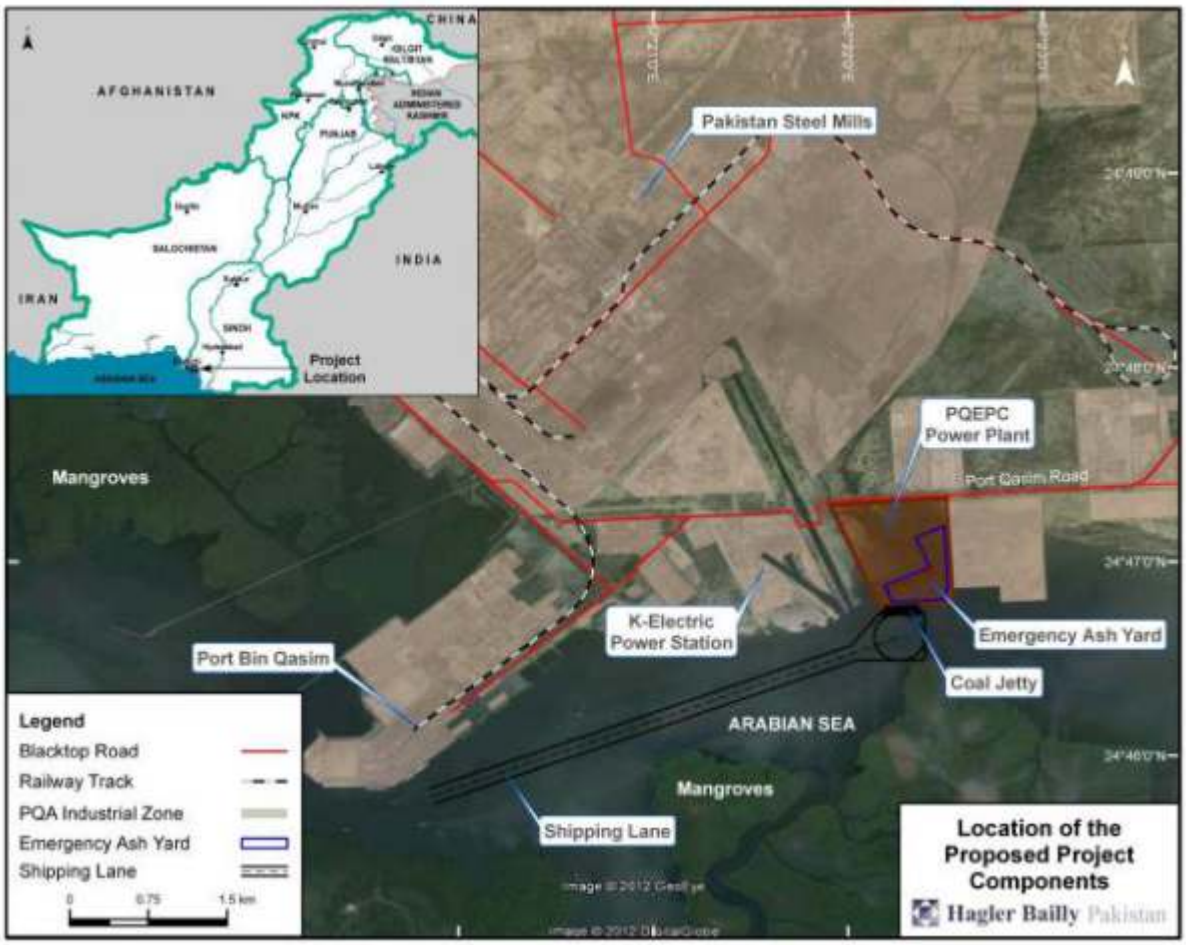
Wind break ensures that no wind enters the coal yard and cause propagation of coal dust. The advanced steel windbreak can effectively control the dust pollution of bulk material in the open air. It is claimed that the technology can reduce dust emission from coal yard by more than 80%.

Coal Wastewater Treatment

A separate waste water treatment system is being supplied for the treatment of waste water from the coal storage and handling areas. The waste water dose, coagulate, deposit in coal wastewater storage pond, filter and then pump to the coal yards as spray water.

2.9. Emergency Ash Yard/Ash Disposal Yard

According to the Environmental Impact Assessment approval by SEPA on June 17, 2014, provision had been made within the proposed power plant for an emergency ash disposal yard (the 'Emergency Ash Yard' in below figure).



Source: Hagler Bailly Pakistan, Environmental Impact Assessment Final Report

The Emergency Ash Yard has a design area of 182,000 meter square (45 acres) and is able to store up to 1,483,400 meter cubic of ash and gypsum with the height of the ash pile extending up to 11 m. 14 m high wind barriers are bolted upright around the Emergency Ash Yard to reduce wind velocities and prevent the emission of fugitive dust due to wind erosion. The Emergency Ash Yard is being used temporarily. No ash will be permanently stored in the Emergency Ash Yard. For the plant's default operational ash disposal arrangement, a 13m high ash disposal yard covering an area of, approximately, 121 acres (49 hectares) has been developed outside the plant area (the 'Ash Disposal Site').

The Project adopted a dry ash handling and wet slag removal scheme with positive-pressure-pneumatic ash removal system for fly ash and wet discharge system for boiler bottom ash. Scraper conveyor for transportation of ash to storage area directly connected to the slag bin. Stored ash is being sprinkled with water to prevent dispersion of ash dust during its dumping at the ash yard as shown in the picture.

Seepage control measures are also taken. Given Pakistan has no regulations to control ash seepage and permeability, so ash yard is designed according to Chinese standards, dam slope and ash fields laying of polyethylene geo-membrane (two cloth one membrane) of the design to (artificial barrier layer) has the equivalent permeability coefficient of 1.0x10-7cm/s and 1.5M thick clay layer to control seepage.

The following measures will be taken to prevent environmental pollution from the ash disposal yards:

- Bottom lining of the ash disposal yard using impervious geo-membrane to avoid leaching
- Continuous water sprinkling to suppress ash dust
- Compaction of ash stacks through compactors to compact their surface area and prevent wind erosion

- Covering ash pile surface with a 0.3m-thick layer of soil and then planted with grass after full storage capacity is reached (applicable for Ash Disposal Site only)
- A 20 m thick green belt of trees will be planted around the disposal site (applicable for Ash Disposal Site only)
- Disposal in zones and blocks to reduce working surfaces
- For the Emergency Ash Yard, in addition to the above, the erection of 14 m high wind dust nets around the disposal yard and construction of a cofferdam around the ash pile to prevent uncontrolled runoffs during rainfall as shown in the picture

As part of the EIA process, a field survey was conducted by the marine-ecology, public consultations and ash-disposal-site-feasibility teams in July, 2014. Consultations with industries around the Project site, fishermen communities and nature conservation Non-Governmental Organizations (NGOs) were also held during this period. Summarized parameters of both "Emergency Ash Yard" and "Ash Disposal Yard" have been shown in the table.

Emergency Ash Yard	➢ **Located within the Plant** ➢ **Design area: 182,000 m^2 (45 acres)** ➢ **Effective storage capacity:** • **1,483,400 m3 with ash stack height reaching 11m** ➢ **Fugitive dust emission and leaching prevention technologies:** • **Water-sprinklers** • **Wind dust nets** • **Impermeable**
Ash Disposal Site	**Location** ➢ The Ash Disposal Site is located in a barren area outside the Plant area. It is at a distance of approximately, 2 km from the plant. **Design features** ➢ 13m high Ash Disposal Site covering an area of, approximately, 121 acres (49 hectares) **Fugitive dust emission and leaching prevention technologies** ➢ Water-sprinklers ➢ Impermeable geo-membrane ➢ A 20 m thick green belt of trees around the site

Source: Hagler Bailly Pakistan, Environmental Impact Assessment Final Report

2.10. Tree Plantation and Coastal Ecosystem

Project Company has invited one of the best companies, Global Environmental Management Services (GEMS) to design and plant the trees on the entire area of the site.

Tree Plantation at the Plant

In order to improve the marine ecological environment and mitigate the land reclamation issue and habitat loss for marine organisms, continuous efforts have been made to select the trees that can be planted depending upon their ornamental and ecological growth based on Pakistan's climate. Some highlights have been shown here.

Plant Model

Moreover, before the construction work, there were mangroves plants (Juvenile)[18] on around 25 acres land area then the management of the plant decided to compensate the coastal ecosystem by planting and managing 5 times more mangroves plants (Rhizophra Mucrinata, Avicennia Marina) in conjunction with SEPA and ongoing mangrove plantation programs organized by WWF and IUCN. They planted mangroves tress (67,000) at another area of 125 acres which is 8-10 km away from the plant location[19]. Moreover, the new planted area was also visited (27th December 2017) and appreciated (28th December 2017, letters enclosed in **Appendix C and D**) by Divisional Forest Office-Range Management Division, Karachi and Sindh Environmental Protection Agency, Government of Sindh.

[18] The removal of mangroves was done after geting permission from the Sind Forest Department (SFD) None of these species are included in the IUCN Red List 2012 and are abundantly found in other parts of the coast.
[19] Primary data | Port Qasim Electric Power Company (Private) Limited

Mangroves Area without Plantation

Plantation at Mangroves Area

Mangroves Area after Plantation

Sea Birds at the clean coast of the Plant

Coal Jetty and Clean Sea View

Plant and the Green Residential Area

3 CONCLUSION

These technically advanced plants operate above the critical condition, (the state of a substance beyond which there is no distinction between liquid and gaseous phase) offer greater efficiency than older sub-critical designs and, most importantly, lower emissions.

According to the report of World Coal Association, "A one percentage point improvement in the efficiency of a conventional pulverized coal combustion plant results in a 2-3% reduction in CO2 emissions."[20] This project has used China's most efficient and developed technology of 660 MW, entrust best design team, the most advanced design tools to ensure the automation of project, safe and reliable, and environmentally friendly technology clubbed with fulfilling all the guidelines of its official document "Approval of Environmental Impact Assessment (EIA, Tech/EIA/CFPP/17/2014)[21]" by SEPA in **Appendix A**.

The EIA reports (Hagler Bailly Pakistan) have documented all major environmental concerns associated with the project i.e. air quality issues, spillage during land reclamation, diversion of the natural rainwater course, marine ecology issues and effluent discharge.

A series of mitigation and monitoring measures have been included to address all the environmental concerns for these measures. Plant management executed effective implementation of the mitigation measures and monitoring requirements as outlined in the Environmental Management Plan in EIA's. The adverse environmental and social impacts of the proposed project are far less than acceptable limits of SEQS. Real time emissions data has been observed in **Appendix B**. This evidence-based research report also sheds lights on the adopted mitigation measures to protect the coastal ecosystem through mangroves plantation (appreciation letters have been enclosed in **Appendix C & D**).

Adopting low cost imported coal, world's leading supercritical boiler technology, the secondary seawater circulating and cooling system, seawater desalination system and limestone-gypsum wet desulfurization, the project meets the environmental protection standards of Sindh Environmental Protection Agency and the World Bank[22]. In nutshell, this plant is completely fulfilling all the basic and advance parameters to mitigate the environmental effects i.e. quality of fuel, technology, monitoring of emissions and fuel's handling (transportation & storage).

[20] World Coal Association, 2019
[21] Environmental Protection Agency, Govt of Sindh
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Appendix A

Reference No: EPA/ Tech/EIA/CFPP/17/2014

ENVIRONMENTAL PROTECTION AGENCY
GOVERNMENT OF SINDH

Plot # ST-2/1, Sector 23, KIA, Karachi-74900
Ph: 5065950, 5065596, 5065637
5065532, 5065946, 5065621
epasindh@cyber.net.pk
Facsimile: 5065940

Date: 17th June, 2014

SUBJECT: - APPROVAL OF ENVIRONMENTAL IMPACT ASSESSMENT OF PORT QASIM COAL-FIRED POWER PROJECT

1.	**Name and Address of Proponent:**	Sinohydro (Hong Kong) Holding Company Ltd (as main sponsor). 5001, 50th Floor, Central Plaza, 18 Harbour Road, Wanchai, Hong Kong
2.	**Description of Project:**	Pakistan Port Qasim Coal-fired Power Project(660x2MW). The project is jointly developed by Sinohydro (Hong Kong)Holding Company Ltd and Al Mirqab capital S.P.C. A project company in Pakistan will be established for the development of the project.
3.	**Location of Project:**	Port Qasim, Karachi.
4.	**Date of Filing of EIA:**	30th March, 2014

5. After careful review of the Environmental Impact Assessment (EIA) the Environmental Protection Agency (EPA), Sindh, has decided to accord its approval subject to the following conditions:

(i) The Sinohydro(Hong Kong) Holding Company Limited(hereinafter referred as "proponent") shall comply with all Environmental Quality Standards applicable to the project activities and in force during construction and operation phase of the project.

(ii) Emissions from stacks and the ambient air quality will be monitored to ensure compliance of Environmental Quality Standards in force.

(iii) An Environmental Impact Assessment for effective and environmental friendly ash disposal system will be developed and submitted to Sindh EPA for approval.

(iv) The proponent shall submit quarterly monitoring reports for stack emissions, ambient air quality and wastewater in order to check compliance status of Environmental Quality Standards.

DIRECTOR GENERAL
Environmental Protection Agency
Always Remember: Reduce, Reuse & Recycle

17th June, 2014

(v) The proponent shall ensure installation of proposed emission control measures before commissioning of the power plant.

(vi) A dedicated wastewater treatment plant will be constructed to ensure compliance of the wastewater with Environmental Quality Standards in force.

(vii) Adherence to mitigation measures recommended in the EIA report must be strictly ensured to minimize any negative environmental effect on the ecology of the project area.

(viii) Due to land reclamation activity, a plan will be developed for conservation and rehabilitation of mangroves in the PQA limits. For this purpose proponent will sponsor plantation of mangroves in the existing swamps. This plan should be developed in consultation with the NGOs like WWF and IUCN Pakistan.

(ix) The proponent shall hire an Independent Monitoring Consultant (IMC) having expertise in carrying out Environmental & Social Impact monitoring. IMC shall monitor the implementation of proposed activities against the commitments made in EIA report and during public hearing. The report of the same shall be submitted to SEPA on quarterly basis during construction and annually after commissioning.

(x) Implementation of Environmental management plan, components of mitigation, monitoring, communication and environmental training will be the sole responsibly of proponent.

6. This approval and any considerations thereof shall be treated as null and void, if the conditions are not complied with above mentioned in para-5 and the proponent unreasonably refuses to comply with the conditions after noticed by SEPA.

7. The proponent shall be liable for compliance of EIA/IEE Regulations, in force relating to conditions for approval, confirmation of compliance, entry, inspection and monitoring.

8. This approval does not absolve the proponent of the duty to obtain any other approval or consent that may be required under any law in force.

9. The approval is accorded only for the project activity described in the EIA Report. Proponent shall submit separate EIA or IEE as required under regulation for significant and material changes of the design of the project.

10. The approval comes into effectiveness right upon its issuing and will be automatically transferred to the project company after its establishment. All the rights and obligation of the proponent under this approval will be succeeded by the project company.

DIRECTOR GENERAL
Environmental Protection Age
Government Of Sindh

Naeem Ahmed Mughal
Director General

Appendix B

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EPA Certified Lab
EPA/LAB/Certificate/QTS-11/2013

QMS/III/018 WA
Revision: 02 | Date:10.09.2013

Lab Report Ref. No. : QTS/PQEPCL/19/1540 Reporting Date: 30/09/2019

Report to: Port Qasim Electric Power Company Pvt Limited Eastern Industrial Zone Port Qasim, Karachi

SAMPLE DESCRIPTION

Sample ID: Waste water (Main Discharge)
Sample Type: Liquid/Grab
Sample Collected/Submitted by: QTS representative
Sampling Date: 23/09/2019
Sample Receipt at QTS – Date: 23/09/2019

ANALYTICAL TEST REPORT

S.NO.	PARAMETERS TO BE ANALYZED	STANDARD SEQS	UNITS	RESULTS	TEST METHOD
1	Temperature	40	°C	27	Thermometer
2	pH value	6-9	-	8.12	USEPA150.1
3	Biochemical Oxygen Demand(BOD_5 at 20°C	200	mg/L	168	Hach method
4	Chemical Oxygen Demand(COD)	400	mg/L	341	Hach 8000
5	Total Suspended Solids(TSS)	200	mg/L	16	Hach 8006
6	Total Dissolved Solids(TDS)	3500	mg/L	3145	Hach 8160
7	Oil & Grease	10	mg/L	1.0	Hach 10300

SEQS=Sindh Environmental Quality Standards for Municipal & Liquid Industrial into Sewage treatment for Sea Water
USEPA=United State Environmental Protection Agency method
Hach USA, method
**SDL= Below Detection Limits

Terms & Condition:

- This report is not valid for any negotiations
- Report is valid for current batch(sample)
- The remaining portion of the sample will be discarded after 07 days unless otherwise instructed
- This report is intended only for your guidance & not for legal purpose or for advertisement.

Comments:
All tested parameter results are within the permissible limits (SEQS) established for Municipal and Liquid Industrial Effluents.

Sample Analyzed by: Saira Tariq	Signature of Laboratory In charge: Name : Muhammad Farooq Khan

Office No.505, Anum Estate Building, Opposite Duty Free Shop, Main Shahrah-e-Faisal, Karachi.
Tel. No. 92-21-34311466, 92-21-34382860, 92-21-34321532, Fax. No. 92-21-34311467
Email: info@qts.com.pk

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EPA LAB Certificate/QTS-11/2013

QMS/III/018 WA
Revision 02 | Date10.09.2013

Lab Report Ref.No. : QTS/PQEPCL/19/1093 Reporting Date: 30/09/2019
Report to: Port Qasim Electric Power Company Pvt Limited Eastern Industrial Zone Port Qasim, Karachi

SAMPLE DESCRIPTION

Sample ID: R.O Product Water
Sample Type: Liquid Sample
Sample Collected/Submitted by: QTS Representative
Sampling Date: 23/09/2019
Sample Receipt at QTS - Date : 23/09/2019

ANALYTICAL TEST REPORT

S. NO.	PARAMETERS	STANDARDS SSDWQ - LIMITS	UNITS	RESULTS	TEST METHOD
1	pH value	6.5 – 8.5	SU	8.12	USEPA 150.1
2	Odour	Non Objectionable / Acceptable	Physical	Acceptable	Physical
3	Taste	Non Objectionable / Acceptable	Physical	Acceptable	Physical
4	Color	≤ 15	TCU	1.12	APHA-2020 B/E
5	Turbidity	≤ 5	NTU	0.85	APHA-2130 B
6	Total Dissolved Solids(TDS)	≤ 1000	mg/L	24.6	Hach 8160
7	Total Hardness as $CaCO_3$	≤ 500	mg/L	12	EDTA Titration Hach-8213
8	Fluoride(as F)	≤ 1.5	mg/L	0.13	USEPA 340.1
9	Chloride(as Cl)	≤ 250	mg/L	09	Hach 8206
10	Nitrate (NO_3)	≤ 50	mg/L	0.13	Hach -8039
11	Nitrite (NO_2)	≤ 3	mg/L	0.04	Hach - 8153
12	Cyanide(as CN-)total	≤ 0.05	mg/L	BDL	Hach 8027
13	Phenolic Compound as (Phenols)	-	mg/L	BDL	USEPA-420.1
14	Aluminum (Al)	≤ 0.2	mg/L	BDL	APHA-3111 D
15	Antimony (Sb)	≤ 0.005	mg/L	BDL	APHA-3111 B
16	Arsenic	≤ 0.05	mg/L	BDL	APHA-3130 B
17	Cadmium	0.01	mg/L	BDL	ASTM D-3557
18	Chromium , Total	≤ 0.05	mg/L	BDL	ASTM D-1687
19	Copper	2	mg/L	0.002	Hach 8506
20	Lead	≤ 0.05	mg/L	BDL	ASTM D-3559
21	Mercury	≤ 0.001	mg/L	BDL	ASTM D-3223
22	Selenium	0.01	mg/L	BDL	ASTM D-3859
23	Nickel	≤ 0.02	mg/L	BDL	ASTM D-1886
24	Boron	0.3	mg/L	BDL	ASTM D-3082
25	Residual Chlorine	0.2-0.5 at Consumer End	mg/L	0.23	Hach - 8167
26	Zinc	5.0	mg/L	0.12	USEPA 3500 Zn B
27	Manganese	≤ 0.5	mg/L	BDL	Hach 8034
28	Barium	0.7	mg/L	BDL	Hach 8014
29	Pesticides	-	mg/l	BDL	USEPA 8081-A
30	Polynuclear Aromatic Hydrocarbon (as PAH)	-	g/L	ND	GC-APHA-6440
31	Alpha Emitters	0.1	Bq/l	BDL	Detector (PolonBAD 907)
32	Beta Emitters	1.0	Bq/l	BDL	Detector PolnBAD 907)
	MICROBIOLOGICAL ANALSIS REPORT				
33	Total Coliform	0cfu/100ml	cfu	ND	APHA-SM9221B
34	Fecal Coliform	0cfu/100ml	cfu	ND	APHA-SM9221F
35	Escherichia Coli(E-Coli)	0cfu/100ml	cfu	ND	APHA-SM9221F

SSDWVQ=Sindh Standard for Drinking Water Quality
USEPA=United State Environmental Protection Agency method
Hach USA, method
BDL=Below Detection Limit
ND= Not Detected

- This report is not valid for any negotiations
- Report is valid for current batch(sample)
- The remaining portion of the sample will be discarded after 07 days unless otherwise instructed

Comments:
All parameters are within the SSDWQ limit.

Sample Analyzed by: Saira Tariq	Signature of Laboratory In charge: _____ Name : Muhammad Fareed Khan

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EPA/LAB/Certificate/QTS-11/2013

QMS/W/018 SE
Revision : 02 | Date10.09.2013

Lab Report Ref. No. : QTS/PQEPCL/19/6990 Reporting Date: 30/09/2019

Report to: Port Qasim Electric Power Company Pvt. Limited Eastern Industrial Zone Port Qasim, Karachi

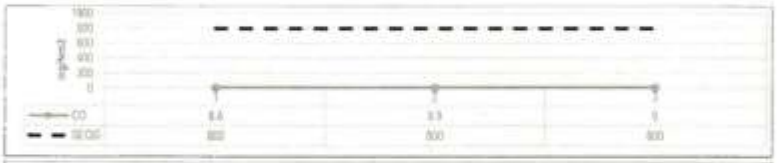
SAMPLE DESCRIPTION

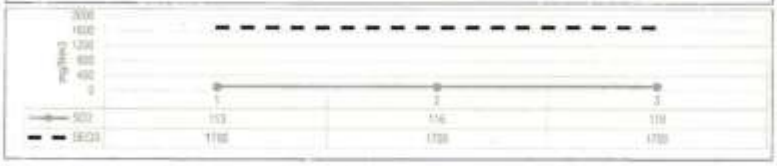
Sample ID: Gaseous Emission
Sample Description: **Main Stack**
No. of samples: 01
Sample Collected/Submitted by: QTS representative
Sampling Date : 23/09/2019
Sample Receipt at QTS – Date: 23/09/2019

EMISSION TEST REPORT

PARAMETERS			CO	NOx	SO_2	PM
UNITS			mg/Nm³	mg/Nm³	mg/Nm³	mg/Nm³
SEQS LIMITS			800	1200	1700	300
SOURCE	FUEL TYPE	LOAD	RESULTS			
Main Stack	Coal	-	8.6	135	113	18.0
			8.9	136	116	
			9.0	138	119	

SEQS=Sindh Environmental Quality Standards





Sample Analyzed By: Ather	Signature of Laboratory In charge : Name : Muhammad Farooq Khan

Page 1 of 1

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Appendix C

OFFICE OF THE
DIVISIONAL FOREST OFFICER
RANGE MANAGEMENT DIVISION
KARACHI

Phone # 02134518896

No: G-II(b)/- 340 of 2017-2018
Karachi, dated: 28-12-2017

TO WHOME IT MAY CONCERN

On the request of Mr. Cai Bin Chief Executive Officer, Port Qasim Electric Power Company (Private) Limited, undersigned visited the recently developed/established Mangrove Plantation site on Wednesday the 27th December, 2017. It was witnessed that the plantation over an area of 125 acres has been raised/established by planting *Rhizophra mucronata* and *Avicennia marina*, looking healthy and as per standard protocols followed by Sindh Forest Department.

(Shehzad Sadiq Gill)
DIVISIONAL FOREST OFFICER
RANGE MANAGEMENT DIVISION
KARACHI

C.C. to:

- The DG, Sindh Environmental Protection Agency, Karachi
- CEO, Port Qasim Electric Power Company (Private) Limited, Karachi

Appendix D

Reference No: EPA/Tech/EIA/CFPP/17/2014/2698/17

ENVIRONMENTAL PROTECTION AGENCY
GOVERNMENT OF SINDH
Plot # ST – 2/1, Sector 23, Korangi
Industrial Area, Karachi – 74900
Ph: 021 – 35065950, 35065621, 35065946
epasindh@gmail.com
Fax No: 021 - 35065940

Dated: 28th December, 2017

Mr. Cai Ban
Chief Executive Officer
Port Qasim Electric Power Company (Private) Limited
Karachi

SUBJECT: **COMPLIANCE STATUS OF MANGROVE PLANTATION SITE**

I am directed to refer your letter reference No: PQEPC/SEPA/2017 dated 11th December, 2017 for the site visit of Mangrove Plantation Site and our visit to the site dated 27th December, 2017 along with a representative of Sindh Forest Department.

Sindh Environmental Protection Agency (SEPA) is satisfied with the plantation carried out by you in compliance, with the condition laid down in the environmental approval and the EIA report.

However, you are advised to ensure the maintenance of the plants for their sustainable growth.

Deputy Director (Tech-II)
for **Director General Sindh EPA**

C.C to: Additional Director General, Sindh EPA, Karachi.
P.A to Director General, Sindh EPA, Karachi

HIGHLIGHTS

Complete view of "1,320 MW (Super Critical Technology) Port Qasim Coal-fired Power Plant"

Blue ocean and "1,320 MW (Super Critical Technology) Port Qasim Coal-fired Power Plant

Green and Clean atmosphere with “1,320 MW (Super Critical Technology)
Port Qasim Coal-fired Power Plant”

7 ACKNOWLEDGEMENTS

This empirical research work would not have been possible without the on ground technical support from **Mr. Xi Peng**, Deputy General Manager-Port Qasim Electric Power Company (Private) Limited (Power China) and the strategic support from **Madam Pang Chunxue**, Deputy Chief of Mission (DCM)-Embassy of People's Republic of China to Pakistan. Moreover, Pakistan-China Institute (PCI) is grateful to all of those with whom PCI have had the pleasure to work during the project. Each of the team members of PCI has provided extensive personal and professional guidance to fulfill the requirements.

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