4. REFERENCE LAW, REGULATIONS AND STANDARDS

The 1972 UN Conference on Human Development at Stockholm influenced the need for a well-developed legal mechanism to conserve resources, protect the environment and ensures the health and well-being of the people. Over the years, issues concerning the environment are regulated in the UAE through a system of Federal Laws and Executive Regulations. The principal Federal Law covering environmental protection is Federal Law No.24 of 1999, for the Protection and Development of the Environment. This law established the framework for environmental protection in the UAE and is enforced on a country-wide scale by the Federal Environment Agency (FEA) [Now it is enforced by Ministry of Climate Change and Environment (MoCCAE)]. The Emirate of Sharjah, led by His Highness Sheikh Dr Sultan bin Mohammed Al Qasimi, Supreme Council Member and Ruler of Sharjah, established an Environment and Protected Areas Authority (EPAA) in charge of environmental affairs. EPAA aims to protect the environment, and the wildlife and its biodiversity through scientific research, setting appropriate policies to raise awareness, supporting the principle of sustainable development to preserve natural environmental resources and by guaranteed exploitation of natural resources to the benefit of the present generation without wasting the right of future generations. Statutory Environmental obligations for the Sharjah Emirate are regulated by Environment and Protected Areas Authority (EPAA) and Environment Protection Section (EPS) – Sharjah City Municipality (SM). The activities of the proposed project shall be governed by the regulations enforced by EPAA and comply with standards/guidelines of EPAA, Sharjah City Municipality, Federal laws/regulations, standards/guidelines prescribed by UAE-MoCCaE. Equator Principles (EPs), World Bank Group – International Financial Corporation (IFC) regulations and the Japan Bank for International Cooperation (JBIC) guidelines have complied.

4.1. FEDERAL LAWS, REGULATIONS AND STANDARDS

4.1.1. UAE - FEDERAL ENVIRONMENTAL LAW (FEDERAL LAW NO. 24 OF 1999 AND AMENDMENTS)[3]

The Federal Law No. 24 of the year 1999 on protection and development of the environment for the United Arab Emirates (UAE) was signed by the late His Highness Sheikh Zayed Bin Sultan Al Nahyan, President of the United Arab Emirates and published

[3] *English translated version of Federal Law No. (24) of 1999 published in http://faolex.fao.org/docs/pdf/uae67811E.pdf.*

in the UAE official gazette, vol. XXVIII, issue no. 340, October 1999, pp. 97-116. This federal legislation has been implemented to specifically overcome the recent growth and inconsistent application of environmental regulations. Under the new legislative arrangements, the Federal Environmental Agency (FEA) [Now it is enforced by Ministry of Climate Change and Environment (MoCCaE)] has assumed the overall responsibility for the EIA process within the UAE, with provisions for bilateral agreements between the FEA and the municipalities. Projects should generally be administered by the relevant authority where the project is to be undertaken. The main objectives of Federal Law No. 24 of 1999 are:

- Protection and conservation of the quality and natural balance of the environment;
- Control of all forms of pollution to avoid harmful effects resulting from developments;
- Conserve biodiversity and resources with consideration of present and future generations;
- Protection of society and human health from environmentally harmful activities; and
- Compliance with international and regional environmental agreements ratified or approved by the UAE.

Chapter I - Development and the Environment [Section 1 - Environmental Impact of Establishments] - Article (3): The agency, in consultation with the competent authorities and concerned parties shall set the standards, specifications, principles and regulations for the assessment of environmental impact of projects and establishments applying for license and shall undertake the following:

- Identification of categories of projects, which due to their nature may cause harm to the environment;
- Identification of areas and sites which have particular environmental importance or sensitivity such as historical and archaeological sites, wetlands, coral reefs, natural reservations and public parks; and
- Identification of natural resources and major environmental problems of special importance.

Article 4: The concerned agency and authorities are authorized bodies for assessing the environmental impact assessment reports. No activities should be carried out without the approval of the EIA study.

Article 7: Owners of the project or establishment is required to conduct regular analysis and monitoring of waste and effluent discharged.

Article 9: All concerned parties especially parties responsible for planning, economic and construction development shall consider aspects of protection of the environment, control of pollution and rational use of natural resources when developing economic and social plans and when establishing and executing of projects.

Chapter I - Development and the Environment [Section 3 - Environmental Monitoring] - Article (13): The agency, in coordination with the competent authorities and concerned parties, develop a national system for environmental monitoring. The competent authorities shall undertake the establishment, operation and supervision of the environmental monitoring networks.

Article 14: The environmental monitoring networks shall notify the agency, competent authorities and concerned parties of any violation of the permissible limits of environmental pollutants and should submit periodic reports of the results following the provision of the executive order.

Chapter 2 - Protection of Water Environment [Section 1 - The scope of Environmental Protection] - Article (17): Protection of water environment from pollution aims to achieve the following:

- Protection of the coasts, beaches and seaports of the state from all kinds and forms of pollution.
- Protection of the marine environment and its living and non-living natural resources by prevention, reduction and control of pollution regardless of its source.
- Protection of drinking water and groundwater and development of water resources.

Chapter 2 - Protection of Water Environment [Section 2 - Protection of the Marine Environment (Part II - Pollution from Land Sources] - Article (35): All establishments including public premises and commercial, industrial, agricultural, tourism and service establishments are prohibited from discharging untreated substances, wastes or liquid which may directly or indirectly cause pollution to the water environment.

Article (36): Licensing for the establishment of premises or shops on or near the coastline discharging pollutants in contradiction to the terms of this law and its executive order, is subject to conducting studies on environmental impact by the applicant and providing waste treatment units and undertake to start their operation immediately.

Article (37): Executive order shall determine the specifications and standards to be observed by industrial establishments authorized to discharge degradable polluting substances after treatment.

Executive order shall also specify persistent polluting substances that industrial establishments are prohibited from discharging into the marine environment.

Chapter 2 - Protection of Water Environment [Section 3 - Protection of Drinking and Underground water] - Article (39): The concerned parties shall consult and coordinate with the agency and the competent authorities in all matters related to drinking and underground water including the preservation and development of the sources of water resources.

Chapter 3 - Soil Protection - Article (43): It is prohibited under the executive order to undertake any activity contributing directly or indirectly to damaging, disturbing the natural properties or polluting the soil in any way that may affect its productivity.

Chapter 4 - Protection of air from pollution - Article (48): Establishments during operation shall ensure that air pollutants must not exceed the permissible limits specified in the Executive Order.

Article (49): Machines, engines or vehicles producing exhaust gases that exceed the limits specified in the Executive Order shall not be used.

Article (50): It is prohibited to throw, treat or burn garbage and solid wastes except in places designated for such purposes away from residential, industrial and agricultural areas and the water environment. The executive order shall determine the specifications, regulations and the minimum distance of the designated places from such areas.

Article (52): All parties and individuals shall, at the time of exploration, drilling, construction, demolition or transportation of wastes or dusts produced as a result, during these activities, undertake the necessary precautions in addition to the precautions required for storage or safe transportation to prevent dispersion of such wastes and dusts as specified in the executive order.

Article (56): Closed and semi-closed public spaces should have adequate ventilation proportionate to the size, capacity and activity.

Chapter 6 – Natural Reserves - Article (63): Reserve areas in the State and the boundaries of each area shall be determined by a decree issued by the Cabinet of Ministers or the Competent Authorities. Certain areas may be considered reserve areas in accordance with a proposal from the agency.

Article (64): Work, activities and acts prohibited in reserve areas which may lead to damage or deterioration of the natural environment cause harm to wild or marine life or affect their aesthetic value, shall be determined by a decree issued by the Cabinet of Ministers or the Competent Authorities in accordance with Agency.

It is also prohibited to set up establishments, buildings or construct roads, drive vehicles or practice any agricultural, industrial or commercial activities in reserve areas without the permission of the Competent Authorities.

Article (65): Wild and marine animals and birds using reserves for resting, hatching or habitation shall be protected in accordance with the provision of this Law.

Article (66): It is prohibited to practice any activities, acts or works in areas surrounding the reserves if such practices affect the environment of the reserves or their natural phenomena without permission from the Competent Authorities in consultation with the Agency.

4.1.2. UAE – FEDERAL LABOR LAW (FEDERAL LAW 8 OF 1980 AND AMENDMENTS)

Chapter 5: Safety, Protection and Health and Social Care of the employees.

Article (91) - Every employer shall provide adequate preventive equipment to protect workers against the dangers of employment accidents and occupational diseases that may occur during the work, and also against fire hazards and other hazards that may result from the use of machines and other equipment. He shall also adopt all other preventive methods ordered by the Ministry of Labour and Social Affairs. Every worker shall use the protective equipment, and the clothing supplied to him for this purpose, shall comply with all instructions given by the employer to protect him against hazards, and shall not take any action liable to hamper compliance with such instructions.

Article (92) - Every employer shall display detailed instructions in a conspicuous position at the workplace indicating the measures to be taken to prevent fire and protect the workers against hazards to which they may be exposed while performing their work. Such instructions shall be in Arabic and if necessary in another language understood by the worker.

Article (93) - Every employer shall provide one or more first-aid boxes containing medicines, bandages, antiseptics and such other first-aid material as may be ordered by the Ministry of Labour and Social Affairs. There shall be one first-aid box for every 100 workers. The box shall be located in a conspicuous place and within easy reach of the workers. Use of the box shall be entrusted to a person specialized in giving first aid.

Article (94) - Without prejudice to the provisions of the regulations and orders issued by the competent government authorities, an employer shall ensure perfect cleanliness and ventilation in each workplace and shall provide each workplace with adequate lighting, drinking water and toilets.

Article (95) - The employer shall entrust one or more physicians with the complete examination of the workers thereof liable to contract an occupational disease set in the schedule enclosed herewith once every six months at most in a periodic manner. The employer shall also record the result of such examination in the records thereof and the files of such workers.

The physicians must notify the employer and the labor department immediately of the cases of occupational diseases appearing among workers, and the deaths resulting from there-form after verification thereof through necessary medical and practical researches. The employer shall, in turn, notify the labor department thereof.

The physician undertaking the periodic examination may request the re-examination of any worker having contracted an occupational disease after a period shorter than the periodic period provided for in the first paragraph of the present article, should he find that his condition so requires.

Article (96) - An employer shall provide his workers with medical care facilities corresponding to the standards laid down by the Minister of Labour and Social Affairs in co-operation with the Minister of Health.

Article (97) - The Minister of Labor and Social Affairs in consultation with Minister of Health shall determine suitable general precautions and health safety measures to be taken against fire and electrical current for all establishments.

Article (98) - The employer or the representative thereof shall inform the worker upon the employment thereof of the hazards of the job and safety measures by which he must abide. He shall post detailed written instructions in this regard in the workplace.

Article (100) - The worker shall abide by the orders and instructions related to industrial security and safety precaution. He shall use safety measures and commit for treatment such devices in his possession with due care. The worker shall be prohibited from carrying out any actions entailing the non-execution of the said instruction, the ill use of the means set for the protection of the health and safety of the workers or the harm and destruction of such means.

4.1.3. EXECUTIVE REGULATIONS

In addition to the requirements of Federal Law No. 24 of 1999, the numbers of executive regulations have been published dealing with specific environmental aspects. A brief review of the main provisions of these regulations is provided below.

4.1.3.1. Regulation for Environmental Impact Assessment of Establishments

The regulation requires that an Environmental Impact Assessment (EIA) study shall be conducted for specific projects before the competent authority issues a license to develop/operate the project. The procedures for applying for an environmental license and the information requirements are specified in the regulation. Any person, who wants to set up or modify any project or activity, must obtain an environmental license from the competent authority. An application for the license for specific projects listed in the regulations must include an assessment of the environmental effects of the project, including specific information identified in Appendix 2 of the regulations. The specified information to be covered in the environmental assessment is:

- description of the project in its preliminary phases;
- Statement of the objectives of the project;
- description of the current environmental situation which may be affected by the project, if executed;
- Environmental aspects of the project in all phases (preliminary, construction, operation);
- Analysis of the expected environmental consequences of the project, including the use of power;
- Management measure for the protection of the environment and an assessment of their efficiency;
- The consequences of not executing the project;
- Commitments to continuing observation and controlling of environmental contamination resulting from the project.

4.1.3.2. Regulation for the Protection of Marine Environment

Chapter 2 of the Federal Law No. 24 of 1999 (Protection of Water Environment) - [Section 2 - Protection of the Marine Environment (Part II - Pollution from Land Sources] addresses the issues of pollution from land sources (Articles 35-37). This regulation describes the specifications and standards to be observed by industrial establishments authorized to discharge degradable polluting substances after treatment. These are as follows:

Chapter 4 – Contamination by Land Sources - Article 21 – Industrial installations authorized for discharging degradable contaminants to the marine environment must treat the same without exceeding the allowable limits stated under Appendix No. (8) of the regulation.

Article 22 – No industrial installation is allowed to discharge or dispose of any non-degradable contaminants as stated under Appendix No. (9) of the regulation.

4.1.3.3. Regulation concerning Protection of Air from Pollution

Chapter 4 of the Federal Law No. 24 of 1999 for the "Protection and Development of the Environment" addresses the issue of Air Pollution (Articles 48-57). The Executive Bye-Law (Cabinet decree 12 of 2006) regarding "Regulation concerning Protection of Air from Pollution" specifies several conditions that an operating industrial unit has to comply with the regulation.

Article 2 – All facilities shall not exceed the maximum allowable limits specified in Annex (1) of the regulation (Table 15 of the report) regarding the emission or the leakage of the gaseous and solid pollutants and vapours to the ambient air.

Table 15 - Air Pollutants Emission Limits for Stationary Sources

Substance	Symbol	Sources	Emission Limits (mg/ Nm^3)
Visible Emissions		Combustion sources Other sources	250 None
Carbon Monoxide	CO	All sources	500
Nitrogen Oxides (expressed as Nitrogen dioxide)	NO_X	Combustion sources Material producing industries Other sources	See **Table 16** of this report 1500 200
Sulphur Dioxide	SO_2	Combustion sources Material producing industries Other sources	500 2000 1000
Sulphur Trioxide Including Sulphuric Acid Mist (express as sulphur trioxide)	SO_3	Material producing industries Other sources	150 50
Total Suspended Particulates	TSP	Combustion sources Cement industry Other sources	250 50 150
Ammonia and Ammonium Compounds (expressed as ammonia)	NH_3	Material producing industries Other sources	50 10
Benzene	C_6H_6	All sources	5
Iron	Fe	Iron & steel foundries	100
Lead and its Compounds (expressed as lead)	Pb	All sources	5
Antimony and its Compounds (expressed as antimony)	Sb	Material producing industries Other sources	5 1
Arsenic and its Compounds (expressed as arsenic)	As	All sources	1
Cadmium and its Compounds	Cd	All sources	1

Substance	Symbol	Sources	Emission Limits (mg/ Nm^3)
(expressed as cadmium)			
Mercury and its Compounds (expressed as mercury)	Hg	All sources	0.5
Nickel and its Compounds (expressed as nickel)	Ni	All sources	1
Copper and its Compounds (expressed as copper)	Cu	All sources	5
Hydrogen Sulphide	H_2S	All sources	5
Chloride	Cl^-	Chlorine works Other sources	200 10
Hydrogen Chloride	HCl	Chlorine works	200
		Other sources	20
Hydrogen Fluoride	HF	All sources	2
Formaldehyde	CH_2O	Material producing industries Other sources	20 2
Carbon	C	Odes production Waste incineration	250 50
Total Volatile Organic Compounds (expressed as total organic carbon (TOC)	VOC	All sources	20
Dioxins & Furans		All sources	1 (ng TEQ/m^3)

Article 4 – All authorities and facilities shall take into account, during the combustion of any hydrocarbon fuels, that smoke, gases, and vapor emitted shall be within the allowable limits specified in Annex (2) of the regulation (Table 12 of this report). All authorities and facilities shall take the necessary precautions to reduce the level of pollutants resulting from combustion as follows:

- The diesel fuel which contains more than 0.05% of its weight of sulphur shall be banned. The competent authorities in each of the UAE Emirates shall lay down the phased policies, work plans, and the detailed mechanism for the gradual subrogation of clean fuel until the internationally approved percentage which is (10) parts in a million of weight is reached, in coordination with the State's producing authorities.
- The competent authorities in each of the Emirates shall lay down the phased policies, work plans, and the detailed mechanisms achieving the use of the compressed natural gas (or any other clean fuel/energy) as an alternative fuel in a certain percentage of the general vehicles following them.
- Emissions shall be reduced to control air pollution by specific tools and equipment which comply with the techniques of control and cleaner production.

Table 16 - Air Pollutants Emission Limits for Stationary Combustion Sources Using Hydrocarbon Fuel

Substance	Symbol	Sources	Emission Limits (mg/Nm^3)
Visible Emissions		All sources	250
Nitrogen Oxides (expressed as Nitrogen Dioxide – NO_2)	NO_X	**Fuel combustion units**	
		- Gas fuel	350
		- Liquid fuel	500
		Turbine units;	
		- Gas fuel	70
		- Liquid fuel	150
Sulphur di-oxide	SO_2	All sources	500
Total Suspended Particles	TSP	All sources	250
Carbon Monoxide	CO	All sources	500

Article 7 – All authorities and facilities, according to the business requirements of each, shall consider the following elements on designing the chimneys used for the emission of air pollutants:

1- The chemical and physical nature of emissions.
2- Height from the surface of the earth.
3- The height of facilities and buildings in the surrounding area.
4- The external diameter.
5- The internal diameter.
6- The materials used for construction.
7- The size of the materials and the speed of emission.
8- The temperature of emissions.
9- The current wind direction.
10- Humidity in the ambient air.

As for chimneys serving public places like restaurants, hotels and other commercial purposes, its height should be no less than 3 meters higher than the height of the building in which the commercial activity is carried out, or that of the surrounding buildings, whichever is higher.

Article 11 - While carrying out the productive and service activities or any other activities and specially when operating the equipment, and using horns and microphones, all authorities, facilities, and people may not exceed the maximum allowable levels of noise and maximum span for exposure, specified in **Annex (6)** of the regulation (Table 17 of this report).

Table 17 - Allowable Noise Limits in Different Areas

Area	Allowable Limits For Noise Level (dBA)*	
	Day (7 a.m. – 8 p.m.)	Night (8 p.m. – 7 a.m.)
Residential Areas With Light Traffic	40 - 50	30 – 40
Residential Areas In The Downtown	45 - 55	35 – 45
Residential Areas Which Include Some Workshops & Commercial Business or Residential Areas Near The Highways	50 - 60	40 – 50
Commercial Areas & Downtown	55 - 65	45 – 55
Industrial Areas (Heavy Industry)	60 - 70	50 – 60

*dBA means decibels adjusted. dBA is used for determining the sound exposure to humans.

Article 12 – All authorities and facilities must ensure enough ventilation inside the sites of work, taking the necessary precautions and measures to prevent the leakage or emission of air pollutants, except within the specified allowable limits specified in Annex 7a & 7b of the regulation (**Table 18** and **Table 19** of this report).

Table 18 - Maximum allowable limits for air pollutants in the working areas (Dust)

Substance	Max. Allowable limits (mg/m^3)
Respirable Dust	
Crystalline silica (Quartz)	0.05
Un-crystalline silica (Asbestos)	2.5
Asbestos (Crysotile)	0.1(fiber/cm^3)
Total Dust	
Un-crystalline silica (Graphite)	10
Stone wool	5
Silica gel	6
Portland cement	10
Dust from biological sources	
Hardwood vapors	1
Softwood vapors	5
Inorganic lead	0.05

Table 19 – Maximum allowable limits of air pollutants in working areas (chemical substances)

S. No.	Substances*	Threshold Limit Values (TLV)		Unit
		TWA	STEL	
1	Aluminium	10	--	mg/m^3
2	Ammonia	17	24	mg/m^3

S. No.	Substances*	Threshold Limit Values (TLV)		Unit
		TWA	STEL	
3	Arsenic (elemental)	0.01	--	mg/m^3
4	Asphalt (fumes)	5	--	mg/m^3
5	Benzene	3	16	mg/m^3
6	Butane	1900	--	mg/m^3
7	Arsenic (elemental)	0.02	-	mg/m^3
8	Carbon dioxide	5000	30000	ppm
9	Carbon monoxide	29	--	mg/m^3
10	Chlorine	1.5	2.9	mg/m^3
11	Copper (Dust)	1.0	--	mg/m^3
12	Copper (Fumes)	0.2	--	mg/m^3
13	Cotton Dust	0.2	0.6	mg/m^3
14	Ethylbenzene	434	543	mg/m^3
15	Fluorides (as F)	2.5	--	mg/m^3
16	Fluorine	1.6	3.1	mg/m^3
17	n-Hexane	176	--	mg/m^3
18	Lead elemental	0.05	--	mg/m^3
19	Mercury (Fumes)	0.05	--	mg/m^3
20	Nitrogen Dioxide	5.6	9.4	mg/m^3
21	Ozone	--	0.2	mg/m^3
22	Sulphur dioxide	5.2	13	mg/m^3
23	Silica (Inhalable particles)	10	--	mg/m^3
24	Silica (Respirable particles)	3	--	mg/m^3
25	Toluene	188	--	mg/m^3
26	Welding Fumes	5	--	mg/m^3
27	Xylene (all isomers)	434	651	mg/m^3
28	Yttrium compounds (as Y)	1	--	mg/m^3
29	Zirconium Compounds (as Zr)	5	10	mg/m^3

***** Some of the substances are only presented as the reference.

Article 14 – Environment Observatories shall notify the Agency, the competent and the concerned authorities of any violation of the allowable limits of air pollutants, as specified in **Annex (8)** of the regulation (Table 20 of this report) and undertake to provide periodical reports for such authorities summing up the results of their work.

Table 20 - Ambient Air Quality Standards (Air Pollutants Limits in the Ambient Air)

Substance	Symbol	Max. Allowable Limits ($\mu g/m^3$)	Average Time
Sulphur Dioxide	SO_2	350 150 60	1 hour 24 hour 1 year
Carbon Monoxide	CO	30 (mg/m^3) 10 (mg/m^3)	1 hour 8 hour
Nitrogen Dioxide	NO_2	400	1 hour

Substance	Symbol	Max. Allowable Limits (µg/m^3)	Average Time
		150	24 hour
Ozone	O_3	200 120	1 hour 8 hour
Total Suspended Particles	TSP	230 90	24 hour 1 year
Particulate Matter (within 10 microns or less in diameter)	PM_{10}	150	24 hours
Lead	Pb	1	1 year

Article 15 – The owner of the facility or the activity shall carry out a periodic analysis of the air pollutants emitted and shall observe the specifications of such emissions emitted from such facility or activity. The report of such results shall be sent to each of the agency and the competent authorities. The owner of the facility shall also keep a registrar to record the amounts of air pollutants for five years as of each analysis, giving access to the employees of the agency and the competent authorities who shall enjoy the power of judicial seizure to be informed of such records over such span of time.

4.1.3.4. Regulation for Handling Hazardous Materials, Hazardous Wastes and Medical Wastes

Article 4 – It details the requirement for obtaining the license for handling and dealing operation in hazardous material, hazardous wastes and medical wastes. The license is issued for five years by the competent regularity unit (competent authority). Any party purporting to undertake any business or works related to handling or dealing in hazardous material, hazardous waste and medical waste shall submit its application to the regularity authority for obtaining business or work license. The application submitted to the regulatory authority must contain information about:

- Characteristics of the hazardous materials, hazardous wastes and medical wastes handled and the nature and concentration of hazardous elements therein as per international classifications
- The quantity of hazardous waste generated and the description of packing methods (barrels, tanks, bulk).
- Description of intended storage methods and their respective storage periods with an undertaking for making a clear statement on the packages disclosing the contents thereof and the extent of their dangers and actions to be taken in emergency cases.
- The Indication of transport means.
- The method intended to be adopted for treating and disposing of wastes.

- Moreover, to maintain such records for five years from the date of their compilation.
- Previous experience certificate in the field of handling hazardous materials, hazardous wastes and medical wastes.

Article 6 and **7** specifies the packing requirement of hazardous chemical materials and transport of hazardous chemical materials respectively.

Article 8 describes the various storage practices to be followed by the licensed owner for hazardous chemical materials.

Article 10 specifies general rules and procedures for hazardous waste management. The rules and procedures cover generation, collection & storage, transport and treatment & disposal of hazardous wastes. Annexe (1) under the regulation classifies different schedule for defining hazardous waste and its storage:

Schedule 1.1: Classifies Hazardous Materials into 9 different categories of waste.

Schedule 1.2: Hazardous Materials Segregation Requirements

Schedule 1.3: Minimum Segregation Requirements between Hazardous Materials and Public

Transport of hazardous waste is prohibited in the UAE except by licensed carriers who comply with specified conditions.

Article 11 - No installations shall be constructed for treating hazardous wastes without obtaining the license to this effect from the competent authorities in coordination with the Federal Environmental Agency ensuring such installation to have met all environment and personnel safety conditions.

Article 12 - Transport and disposal of locally produced hazardous wastes through land borders, marine environment limits and airspace shall be controlled following the rules, procedures and controls mentioned and specified in Basel Agreement and coordination with Federal Environmental Agency.

Article 13 - Parties producing or handling hazardous wastes, whether, in liquid, the gaseous or solid state shall take all precautions necessary for evading causing any environmental damages shall, in particular, observe the following:

1. Selection of the site on which such materials shall be produced or stored under necessary conditions following the quality and quantity of such materials.
2. Buildings inside which such materials are produced or stored shall be designed following the engineering standards and criteria which must be observed for each kind of such materials. Such buildings shall be subject to periodical inspection by the competent unit.

3. The technology used for the production of such materials as well as all suitable equipment and systems shall not be causing any damage to the installations, environment or personnel.
4. Buildings shall include security, safety, alarm, firefighting and first aid systems and equipment in proper quantities and numbers in coordination with the Ministry of Health, Civil Defense Directorate and the competent regularity unit.
5. The emergency plan shall be set for facing any expected accidents during production, storage, transport or handling operations of such materials provided; competent regularity unit shall approve such plan.
6. The staff of hazardous wastes handling parties shall be subject to periodical medical check-up provided the results of such medical checkup shall be kept in the file of each person and provided they shall be treated from all occupational diseases under the U.A.E. applied laws, rules and regulations.

Article 14 - The owners of installations generating hazardous wastes under the provisions of this Law shall maintain a record for such wastes including:

- A full description of the waste including physical and chemical characteristics and hazards;
- Quantities;
- Sources;
- Collection rates and periods;
- Transport and treatment methods;
- Name of the waste contractor to which these wastes are delivered

The regulation also contains provisions for handling/disposal of medical wastes. Any handling of hazardous materials and wastes throughout the construction and operation of the project need to adhere to this regulation, with all responsible parties undertaking appropriate practice.

4.2. UAE REGIONAL STANDARDS

Environmental agencies of different emirates of UAE have issued regulations/ guidelines and standards for EIA study as well as allowable pollutant levels. Given below is a list of guidelines/regulations available within the UAE that referred to this report:

- Sharjah Municipality guidelines and standards
- Abu Dhabi Environmental Agency (EAD) guidelines for EIA
- Dubai Municipality - Technical guidelines for EIA, 2017
- EHS guidelines and guidelines of Ports, Customs and Free Zone Corporation (PCFC)-Trakhees, Government of Dubai.

4.2.1. EMIRATE OF SHARJAH - ENVIRONMENTAL STANDARDS AND ALLOWABLE LIMITS OF POLLUTANTS

All concerned parties, agencies and establishments operating in Sharjah Emirate are required to comply with environmental standards mentioned below:

Table 21 – Specification & Standard of Effluent Water for Land Irrigation and to Dispose into Sea

S. No.	Parameters	Units	Maximum Allowable Limits for Discharge to		
			Sludge to Land (mg/kg)	Land Irrigation	Sea Disposal
1.	pH		--	6 - 9	6 - 9
2.	Suspended Solids		--	15	30
3.	Biochemical Oxygen Demand (5 Days)	mg/l	--	15	30
4.	Turbidity	NTU	--	--	75
5.	Chemical Oxygen Demand	mg/l	--	100	150
6.	Oil & Grease (Non-soluble)	mg/l	--	5.0	10.0
7.	Phenols	mg/l	--	1.0	0.5
8.	Ammonia as NH_3-N	mg/l	--	5.0	5.0
9.	Aluminium (Al)	mg/l		5.0	--
10.	Arsenic (As)	mg/l	--	0.2	0.05
11.	Beryllium (Be)	mg/l	--	2.0	--
12.	Barium (Ba)	mg/l	--	0.3	--
13.	Boron (B)	mg/l	--	2.0	--
14.	Cadmium (Cd)	mg/l	30	0.03	0.05
15.	Chromium (Cr)	mg/l	1000	0.50	0.50
16.	Cobalt (Co)	mg/l	100	0.5	0.50
17.	Copper (Cu)	mg/l	1000	0.5	0.50
18.	Iron (Fe)	mg/l	--	5	2.0
19.	Lead (Pb)	mg/l	1000	0.1	0.1
20.	Lithium (Li)	mg/l	--	10.0	--
21.	Manganese (Mn)	mg/l	--	1.0	--
22.	Mercury (Hg)	mg/l	10.0	0.001	0.001
23.	Nickel (Ni)	mg/l	200	0.5	0.1
24.	Zinc (Zn)	mg/l	1000	0.5	0.1
25.	Total Coliforms	MPN/ 100 ml	--	20	100

Table 22 – Recommended Water Quality Criteria of Industrial Effluent Acceptable to Sewage Treatment Works

S. No.	Parameters	Units	Max. Allowable Limits	Comments
1.	Temperature	°C	45	After balancing
2.	Color	--	Wastewater containing dyes shall be discharged if decolorization in the wastewater treatment plant is ensured.	
3.	Total Dissolved Solids (TDS)	mg/l	3000	--
4.	Total Suspended Solids (TSS)	mg/l	500	--
5.	pH	--	6 - 10	--
6.	Chemical Oxygen Demand (COD)	mg/l	*1000 - 3000	*For small industries limit typically
7.	Biochemical Oxygen Demand (BOD)	mg/l	1000	--
8.	Total Hydrocarbons	mg/l	20	--
9.	Phenols	mg/l	10	--
10.	Fat & Grease	mg/l	100	--
11.	Oil & Grease (Non-soluble)	mg/l	50	--
12.	Detergent	mg/l	30	--
13.	Active Chlorine (Cl)	mg/l	0.5 – 3.0	--
14.	Active Bromine (Br_3)	mg/l	1- 3	--
15.	Ammonia Nitrogen (NH_3-N)	mg/l	75	--
16.	Total Kjeldahl Nitrogen (N)	mg/l	125	--
17.	Chlorine Dioxide (ClO_2)	mg/l	0.5 – 3.0	--
18.	Chlorides	mg/l	600	--
19.	Fluorides (F)	mg/l	10	--
20.	Nitrates (NO_3)	mg/l		As low as possible
21.	Nitrites (NO_2)	mg/l	10	--
22.	Sulphates (SO_4)	mg/l	500	--
23.	Sulphide(S^{2-})	mg/l	10	--
24.	Aluminium (Al)	mg/l	20	--
25.	Arsenic (As)	mg/l	0.1	--
26.	Boron (B)	mg/l	1.0	--
27.	Cadmium (Cd)	mg/l	0.1	--
28.	Chromium (Cr^{+3})	mg/l	2.0	Lower levels for major discharges
29.	Chromium (Cr^{+4})	mg/l	0.5	
30.	Cobalt (Co)	mg/l	0.5	--
31.	Copper (Cu)	mg/l	1.0	Lower levels for major discharges
32.	Lead (Pb)	mg/l	1.0	--
33.	Mercury (Hg)	mg/l	0.01	--
34.	Nickel (Ni)	mg/l	2.0	Lower levels for major discharges
35.	Silver (Ag)	mg/l	0.01	--

S. No.	Parameters	Units	Max. Allowable Limits	Comments
36.	Tin (Su)	mg/l	2.0	--
37.	Zinc (Zn)	mg/l	2.0	--

4.2.2. DUBAI MUNICIPALITY - ENVIRONMENTAL STANDARDS AND ALLOWABLE LIMITS OF POLLUTANTS ON LAND, WATER AND AIR ENVIRONMENT, 2003

The bulletin features quick reference of the various environmental standards issued by the Dubai Municipality - Environment Protection and Safety Section (EPSS) of the Environment Department. The below tables indicate the allowable and objective values with supplementary notes. All concerned parties, agencies and establishments operating in Dubai are required to comply with these environmental standards.

Table 23 – Dubai Wastewater Discharge Limits

S. No.	Indicators	Units	Maximum Allowable Limits for Discharge to		
			Sewerage System	Land as for Irrigation	
				Drip	Spray
1.	Biochemical Oxygen Demand	mg/l	1,000	20	10
2.	Chemical Oxygen Demand	mg/l	3,000	100	50
3.	Chlorides	mg/l	--	500	350
4.	Chlorine – residual	mg/l	10	Not less than 0.5 mg/l after 30 min contact time	
5.	Cyanides as CN	mg/l	1	0.5	0.5
6.	Detergents	mg/l	30	--	--
7.	Fluorides	mg/l	--	1	1
8.	Nitrogen,	mg/l	40	5	1
9.	Nitrogen, ammoniacal	mg/l	--	10	5
10.	Nitrogen, organic	mg/l	--	50	30
11.	Oil total	mg/l	150	--	--
12.	Oil	mg/l	50	5	5
13.	pH (range)		6 - 10	6 - 8	6 - 8
14.	Pesticides, non-chlorinated	mg/l	5	--	--
15.	Phenols	mg/l	50	0.1	0.1
16.	Phosphorous (P)	mg/l	30	20	20
17.	Sulfates, total	mg/l	500	200	200
18.	Sulfides as S	mg/l	10	0.05	0.05
19.	Suspended Solids	mg/l	500	50	10
20.	Temperature	°C	45 or <5 of ambient	--	--

S. No.	Indicators	Units	Maximum Allowable Limits for Discharge to		
			Sewerage System	Land as for Irrigation	
				Drip	Spray
21.	Total Dissolved Solids	mg/l	3,000	1,500	1,000
22.	Total Metals	mg/l	10	--	--
23.	Aluminium (Al)	mg/l		2	2
24.	Arsenic (As)	mg/l	0.5	0.05	0.05
25.	Barium (Ba)	mg/l	--	1	1
26.	Beryllium (Be)	mg/l	--	0.1	0.1
27.	Boron (B)	mg/l	2	2	2
28.	Cadmium (Cd)	mg/l	0.3	0.01	0.01
29.	Chromium (Cr)	mg/l	1	0.1	0.1
30.	Cobalt (Co)	mg/l	--	0.1	0.1
31.	Copper (Cu)	mg/l	1	0.2	0.2
32.	Iron (Fe)	mg/l	--	2	2
33.	Lead (Pb)	mg/l	1	0.5	0.5
34.	Magnesium (Mg)	mg/l	--	100	100
35.	Manganese (Mn)	mg/l	1	0.2	0.2
36.	Mercury (Hg)	mg/l	0.01	0.001	0.001
37.	Molybdenum (Mo)	mg/l	--	0.01	0.01
38.	Nickel (Ni)	mg/l	1	0.2	0.2
39.	Selenium (Se)	mg/l	--	0.02	0.02
40.	Silver (Ag)	mg/l	1		
41.	Sodium (Na)	mg/l	--	500	200
42.	Zinc (Zn)	mg/l	2	0.5	0.2
43.	Faecal Coliforms	MPN/ 100 ml	500	20	--

** Discharge limits to marine environment will be determined on the case basis and through a mathematical modeling study. Based on the result of the modeling study, the EPSS would issue Disposal Permit specifying the allowable limits which, in no case, shall compromise the Marine Water Quality Objectives as given below.*

Table 24 – Marine Water Quality Objectives

S. No.	Indicators	Unit	Sea and Coastal Zone	Dubai Creek
1.	Biochemical Oxygen Demand	mg/l	20	10
2.	Chlorine – Total residual	mg/l	0.01	0.01
3.	Dissolved Oxygen	mg/l	Not less than 5 mg/l or 90% saturation	
4.	Nitrogen - ammonia (NH_3-N)	mg/l	0.1	0.1
5.	Nitrogen – Nitrate	mg/l	0.5	0.5
6.	Nitrogen – Total	mg/l	2.0	2.0
7.	Petroleum Hydrocarbons	mg/l	0.001 (Aromatic fraction)	0.001 (Aromatic fraction)

S. No.	Indicators	Unit	Sea and Coastal Zone	Dubai Creek
8.	pH	mg/l	1 pH unit from ambient levels	
9.	Phosphate - Phosphorous	mg/l	0.05	0.05
10.	Temperature	°C	2°C from the background level	
11.	Total Dissolved Solids (TDS)	mg/l	2% from the background level	
12.	Turbidity/Color	NTU	75 NTU or none that reduce light penetration by more than 20% from the background level	
13.	Surfactants	mg/l	0.02	0.02
14.	Suspended Solids	mg/l	10 – Mean 25 - Maximum	10 – Mean 15 - Maximum
15.	Aluminium (Al)	mg/l	0.2	0.2
16.	Arsenic (As)	mg/l	0.01	0.01
17.	Cadmium (Cd)	mg/l	0.003	0.003
18.	Chromium (Cr)	mg/l	0.01	0.01
19.	Copper (Cu)	mg/l	0.005	0.005
20.	Iron (Fe)	mg/l	0.2	0.2
21.	Mercury (Hg)	mg/l	0.001	0.001
22.	Zinc (Zn)	mg/l	0.02	0.02
23.	E. Coli	Nos./ 100 ml	200	200

Table 25 – Land Contamination Indicator Levels

S. No.	Indicator	Unit	Concentration
1.	Arsenic	mg/kg	50
2.	Barium	mg/kg	400
3.	Cadmium	mg/kg	5
4.	Chromium	mg/kg	250
5.	Copper	mg/kg	100
6.	Lead	mg/kg	200
7.	Manganese	mg/kg	700
8.	Mercury	mg/kg	2
9.	Selenium	mg/kg	2
10.	Zinc	mg/kg	500
11.	Pesticides(total)	mg/kg	2
12.	Cyanide	mg/kg	10
13.	Fluoride	mg/kg	500
14.	Phenol	mg/kg	1
15.	Benzene	mg/kg	1
16.	BTEX (total)	mg/kg	100
17.	Chlorinated Hydrocarbons	mg/kg	1
18.	Polychlorinated Biphenyls	mg/kg	0.5
19.	Total Petroleum Hydrocarbons		
	<C9	mg/kg	1,000
	>C9	mg/kg	10,000

4.2.3. REGULATION BUREAU OF ABU DHABI EMIRATE – WATER QUALITY REGULATIONS

Water Quality Regulations was issued in July 2013 and came into force on 1 January 2014. The Regulations are intended to provide for the supply of wholesome drinking water to consumers throughout the Emirate of Abu Dhabi and reflect the current guidance by the World Health Organization (WHO) and Gulf Cooperation Council (GCC).

Table 26 - Drinking Water Quality Guidelines of Regulation Bureau of Abu Dhabi

S. No.	Parameter	Unit	Guideline value
1.	Temperature	°C	**--**
2.	pH	-	7.0 - 9.2
3.	Colour	pt/Co scale	15.0
4.	Turbidity	NTU	4.0
5.	Total Suspended Solids (TSS)	mg/l	--
6.	Total Dissolved Solids (TDS)	mg/l	100 - 1000
7.	Total Hardness	mg/l	300
8.	Total Alkalinity	mg/l	--
9.	Sodium	mg/l	150
10.	Potassium	mg/l	12.0
11.	Calcium as Calcium Hardness	mg/l	200
12.	Magnesium	mg/l	30
13.	Chloride	mg/l	250
14.	Sulphate	mg/l	250
15.	Fluoride	mg/l	1.5
16.	Total Phosphorous	mg/l	2.2
17.	Nitrate	mg/l	50
18.	Nitrite	mg/l	3.0
19.	Ammonia	mg/l	0.5
20.	Arsenic	mg/l	0.01
21.	Barium	mg/l	0.7
22.	Boron	mg/l	2.4
23.	Cadmium	mg/l	0.003
24.	Chromium	mg/l	0.05
25.	Copper	mg/l	1.0
26.	Cyanide	mg/l	--
27.	Iron	mg/l	0.2
28.	Lead	mg/l	0.01
29.	Manganese	mg/l	0.4
30.	Mercury	mg/l	0.003
31.	Nickel	mg/l	0.07
32.	Selenium	mg/l	0.04
33.	Zinc	mg/l	5.0
34.	Total Organic Carbon	mg/l	1.0

S. No.	Parameter	Unit	Guideline value
35.	Phenols	mg/l	0.5
36.	Residual Chlorine	mg/l	0.2 - 0.5
37.	Total Coliforms	mg/l	0

4.3. INTERNATIONAL CONVENTIONS AND STANDARD

According to UAE - State of environment report (2015) published by MoCCaE, UAE join the world in recognizing environmental problems by signing and ratifying environmental agreements such as:

- Vienna Convention for the protection of the Ozone layer and the Montreal Protocol on substances that deplete the ozone Layer
- Basel Convention on the control of trans-boundary movements of hazardous wastes and their disposal
- United Nations convention to combat desertification,
- Rotterdam convention on hazardous pesticides and hazardous chemicals in International trade
- Convention on biological diversity and Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES)
- Stockholm convention on persistent organic pollutants
- United Nations framework convention on climate change and the Kyoto Protocol
- Ramsar convention on wetlands of International importance
- Convention on the conservation of migratory species of wild animals
- Kuwait Regional Convention for cooperation and protection of the marine environment from pollution and its protocols
- International Convention for the prevention of pollution from ships (1973G.) as amended by protocol MARPOL (1978G).

4.4. INTERNATIONAL REQUIREMENTS

The ESIA study conducted in line with The Equator Principles III (EPs), which in turn require adherence to the World Bank Group - International Finance Corporation (IFC) Policies and Standards. The EPs are based on the International Finance Corporation Performance Standards of social and environmental sustainability and relevant World Bank Group/IFC Environmental, Health and Safety Guidelines (EHS Guidelines). The lender of the project is **Japan Bank for International Cooperation (JBIC)**, and it has a set of 'Guidelines for Confirmation of Environmental and Social Considerations' which they use to determine compliance of projects and their eligibility to receive funding for development. The requirements for ESIA study are hereunder briefly described.

4.4.1. THE EQUATOR PRINCIPLES

International finance institutions including the World Bank and other lending institutions require adherence to environmental and social principles and environmental impact assessments to be carried out before a project can proceed. The World Bank and the International Finance Corporation (IFC) follow the IFC's Environment, Health and Safety guidelines which were developed over an extended period, with significant collaboration between the World Bank and IFC. The Equator Principles are a financial industry benchmark for determining, assessing and managing environmental and social risk in projects. Equator Principles Financial Institutions (EPFIs) have adopted the Equator Principles to ensure that the Projects seek finance and advise on are developed in a manner that is socially responsible and reflects sound environmental management practices. EPFIs recognize the importance of climate change, biodiversity, and human rights, and believe negative impacts on project-affected ecosystems, communities, and the climate should be avoided where possible. If these impacts are unavoidable, they should be minimized, mitigated, or offset. The principles are hereunder summarized.

Principle 1: Review and Categorization - The project categorizes it based on the magnitude of its potential environmental and social risks and impacts. Such screening is based on the environmental and social categorization process of the International Finance Corporation (IFC), and it will be categorized as A, B and C. The categorization of the proposed project based on IFC and JBIC is hereunder discussed.

IFC's Policy on Environmental and Social Sustainability, 2012 requires initial screening and categorization of the proposed project to determine the appropriate extent and type of environmental assessment needed. The resulting category also specifies IFC's institutional requirements for disclosure following with IFC's access to information policy. Projects can be placed into one of three categories, depending on the type, location, sensitivity, and scale of the project, as well as the nature and magnitude of its potential environmental impacts. JBIC has a similar procedure for the project, and they determine the extent of assessment required using the same labels as IFC. The different categories and descriptions for both IFC and JBIC are presented in **Table 66**.

Table 27 – Description about project categorization

Category	IFC Description	JBIC Description
A	Projects with potential significant adverse environmental and social risks and/or impacts are diverse, irreversible or unprecedented;	A proposed project is likely to have a significant adverse impact on the environment and/or with complicated impact or impact which is difficult to assess due to lack of precedence. The impact of the project may affect an area broader

Category	IFC Description	JBIC Description
		than the sites or facilities and includes projects in sensitive sectors or with sensitive characteristics, and projects located in or near sensitive areas.
B	Projects with potential limited adverse environmental and social risks and/or impacts that are few, generally site-specific, largely reversible and readily addressed through mitigation measures; and	The potential adverse environmental impact of the proposed project is less adverse than that of Category A. Typically, its impacts are site-specific, few if any are irreversible, and mitigation measures are more readily available.
C	Projects with minimal or no adverse environmental and social risks and/or impacts.	The proposed project is likely to have minimal or no adverse environmental impact, including projects for which JBIC's share is less than Special Drawing Rights equals (SDR) 10 million; sectors or projects in which no particular environmental impact is normally expected; cases in which JBIC's involvement is minor.

The proposed project has the potential to cause adverse impacts on the environment and the adjacent community. It may impact on sensitive areas and receptors and has the potential to have diverse types of impacts. However, this project is considered to be a "Category B project" under both IFC and JBIC categorization criteria. The impacts are not expected to be unprecedented in their nature, and it is considered feasible to mitigate and manage the majority of impacts associated with the project through appropriate, readily available, and commercially proven environmental and social management techniques, together with the monitoring to be specified in the Environmental and Social Management Plan and related plans that are in the outcome of this ESIA process.

Principle 2: Environmental and Social Assessment - For all Category A and Category B Projects, the EPFI requires the project proponent to conduct an Assessment process to address the relevant environmental and social risks and impacts of the proposed Project. The Assessment Documentation should propose measures to minimize, mitigate, and offset adverse impacts in a manner relevant and appropriate to the nature and scale of the proposed Project.

Principle 3: Applicable Environmental and Social Standards - The EPFI requires that the assessment process evaluates compliance with the applicable standards. For projects

located in Non-Designated countries, the assessment process evaluates compliance with the then applicable IFC Performance Standards on Environmental and Social Sustainability (Performance Standards) and the World Bank Group Environmental, Health and Safety Guidelines (EHS Guidelines).

United Arab Emirates (UAE) is a non-designated country, and as such, the assessment process for the Project must evaluate compliance with the applicable IFC PS on Environmental and Social Sustainability.

Principle 4: Environmental and Social Management System and Equator Principles Action Plan - For all Category A and Category B Projects, the EPFI requires the project proponent to develop or maintain an Environmental and Social Management System (ESMS). Further, an Environmental and Social Management Plan (ESMP) shall be prepared by the project proponent to address issues raised in the Assessment process and incorporate actions required to comply with the applicable standards. Where the applicable standards are not met to the EPFI's satisfaction, the Project Proponent and the EPFI agree an Equator Principles Action Plan (AP). The Equator Principles is intended to outline gaps and commitments to meet EPFI requirements in line with the applicable standards.

Principle 5: Stakeholder Engagement - For all Category A and Category B Projects, the EPFI requires the project proponent to demonstrate active stakeholder engagement as an ongoing process in a structured and culturally appropriate manner with Affected Communities and, where relevant, other Stakeholders.

Principle 6: Grievance Mechanism - For Category A and as appropriate Category B Projects, the EPFI requires the project proponent, as part of the ESMS, to establish a grievance mechanism designed to receive and facilitate resolution of concerns and grievances about the Project's environmental and social performance. The grievance mechanism is required to be scaled to the risks and impacts of the project and has affected communities as its primary user.

Principle 7: Independent Review - For all Category A and as appropriate Category B Projects, an Independent Environmental and Social Consultant, not directly associated with the project proponent carry out an Independent Review of the Assessment Documentation including the ESMPs, the ESMS, and the Stakeholder Engagement process documentation in order to assist the EPFI's due diligence, and assess Equator Principles compliance.

Principle 8: Covenants - An essential strength of the Equator Principles is the incorporation of covenants linked to compliance. For all projects, the project proponent covenants in the financing documentation to comply with all relevant host country

environmental and social laws, regulations and permits in all material respects. Furthermore, for all category A and category B projects, the project proponent covenants the financial documentation:

- To comply with the ESMPs and Equator Principles (where applicable) during the construction and operation of the project in all material respects;
- To provide periodic reports in a format agreed with the EPFI (with the frequency of these reports proportionate to the severity of impacts, or as required by law, but not less than annually), that:
    - Document compliance with the ESMPs and Equator Principles (where applicable)
    - Provide the representation of compliance with relevant local, state and host country environmental and social laws, regulations and permits and
- To decommission the facilities, where applicable and appropriate, following an agreed decommissioning plan.

Principle 9: Independent Monitoring and Reporting - EPFI requires for the appointment of an Independent E&S Consultant, or the project proponent retains qualified and experienced external experts to assess the project compliance with the Equator Principles and ongoing monitoring and reporting after financial close and over the life of the loan.

Principle 10: Reporting and Transparency - For all category A and as appropriate category B Projects, project proponent will ensure that, at a minimum, a summary of the ESIA is accessible and available online. The Project Proponent will publicly report GHG emission levels (combined Scope 1 and Scope 2 Emissions) during the operational phase for Projects emitting over 100,000 tonnes of CO_2 equivalent annually.

4.4.2. WORLD BANK GROUP – INTERNATIONAL FINANCIAL CORPORATION (IFC) – POLICIES AND STANDARDS

4.4.2.1. Environmental and Social Performance Standards

The World Bank procedures for EA study cover policies, guidelines and good practices. Such guidelines, therefore, follow the national best practices in undertaking any development project in Bangladesh. The environment safeguards policies applicable to the proposed project are the following:

***Environmental Assessment (EA) (OP 4.01/BP/GP 4.01)*:** An Environmental Assessment is conducted to ensure that IFC-financed projects are environmentally sound and

sustainable, and that decision-making is improved through appropriate analysis of actions and of their likely environmental impacts. Any IFC-funded project that is likely to have potential adverse environmental risks and impacts in its area of influence requires an EA indicating the potential risks, mitigation measures and environmental management framework or plan.

***Natural Habitats (OP/BP 4.04)*:** Natural habitats are land and water areas where most of the original native plant and animal species are still present. Natural habitats comprise many types of terrestrial, freshwater, coastal, and marine ecosystems. They include areas lightly modified by human activities, but retaining their ecological functions and native species. The Natural habitats policy is triggered by any project (including any subproject under aspect or investment or intermediary financial loan) with the potential to cause significant conversion (loss) or degradation of natural habitats, whether directly (through construction) or indirectly (through human activities induced by the project). The policy has separate requirements for critical (either legally or proposed to be protected or high ecological value) and non-critical natural habitats. World Bank's interpretation of "significant conversion or degradation" is on a case-by-case basis for each project, based on the information obtained through the EA.

***Forestry (OP/GP 4.36)*:** Forest sector activities trigger this policy, and World Bank sponsored other interventions, which have the potential to impact significantly upon forested areas. The World Bank does not finance commercial logging operations but aims to reduce deforestation, enhance the environmental contribution of forested areas, promote afforestation, reduce poverty and encourage economic development.

***Cultural Property (OPN 4.11)*:** Physical, cultural resources are defined as movable or immovable objects, sites, structures, groups of structures, natural features and landscapes that have archaeological, paleontological, historical, architectural, religious, aesthetic, or other cultural significance. Physical, cultural resources may be located in urban or rural settings, and may be above ground, underground, or underwater. The Bank seeks to assist countries to manage the physical, cultural resources and to avoid or the mitigate adverse impact of development projects on these resources. This policy is triggered for any project that requires an EA.

***Policy on Disclosure of Information, 2002*:** There are disclosure requirements at every part of the project preparation and implementation process. Consultation with affected groups and local community should take place during scoping and before Terms of references (ToRs) are prepared; when the draft EA is prepared; and throughout project implementation as necessary. The Borrower makes the draft EA and any separate EA report available in the country in a local language and at a public place accessible to project-affected groups and the local community before appraisal. Besides, IFC has set

out 8 (eight) performance standards in respect of various parameters of the proposed project. These eight performance standards of IFC with their corresponding parameters as under:

- Performance Standard 1: Social and Environmental Assessment and Management System
- Performance Standard 2: Labour and Working Conditions
- Performance Standard 3: Pollution Prevention and Abatement
- Performance Standard 4: Community Health, Safety and Security
- Performance Standard 5: Land Acquisition and Involuntary Resettlement
- Performance Standard 6: Biodiversity Conservation and Sustainable Natural Resource Management
- Performance Standard 7: Indigenous Peoples
- Performance Standard 8: Cultural Heritage.

Of the above eight performance standards set by IFC, the Performance Standard 1 envisages establishing the importance of (i) integrated assessment to identify the social and environmental impacts, risks and opportunities; (ii) active community engagement through disclosure of project-related information and consultation with local communities on matters that directly affect them; and (iii) the project proponent's management of social and environmental impacts throughout the life of the project. The rest seven of the performance standards, i.e., Performance Standards 2 through 8 seek to ascertain establishing requirements to avoid, reduce, mitigate or compensate the impacts on people and the environment, and to improve conditions where appropriate.

4.4.2.2. General Environment, Health and Safety Guidelines

The Environmental, Health, and Safety (EHS) Guidelines are technical reference documents with general and industry-specific examples of Good International Industry Practice (GIIP). 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. Application of the EHS Guidelines to existing facilities may involve the establishment of site-specific targets, with an appropriate timetable for achieving them. The applicability of the EHS Guidelines should be tailored to the hazards and risks established for each project by 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.

4.4.2.2.1. Ambient Air Quality

Projects with significant sources of air emissions and potential for significant impacts to ambient air quality should prevent or minimize impacts by ensuring that:

- Emissions do not result in pollutant concentrations that reach or exceed relevant ambient quality guidelines and standards by applying national legislated standards, or in their absence, the current WHO Air Quality Guidelines or other internationally recognized sources

- Emissions do not contribute a significant portion to the attainment of relevant ambient air quality guidelines or standards. As a general rule, this Guideline suggests per cent of the applicable air quality standards to allow additional, future sustainable development in the same air-shed.

Table 28 –WHO Ambient Air Quality Guidelines

S. No.	Indicators	Averaging Period	Guideline value in µg/m^3
1.	Sulphur dioxide (SO_2)	24-hour 10 minute	125 (Interim target 1) 50 (Interim target 2) 20 (guideline) 500 (guideline)
2.	Nitrogen dioxide (NO_2)	1-year 1-hour	40 (guideline) 200 (guideline)
3.	Particulate matter – PM_{10}	1-year 24-hour	70 (Interim target 1) 50 (Interim target 2) 30 (Interim target 3) 20 (Guideline) 150 (Interim target 1) 100 (Interim target 2) 75 (Interim target 3) 50 (guideline)
4.	Particulate matter – $PM_{2.5}$	1-year 24-hour	35 (Interim target 1) 25 (Interim target 2) 15 (Interim target 3) 10 (Guideline) 75 (Interim target 1) 50 (Interim target 2) 37.5 (Interim target 3) 25 (guideline)
5.	Ozone	8-hour daily Maximum	160 (Interim target 1) 100 (guideline)

Point sources are characterized by the release of air pollutants typically associated with the combustion of fossil fuels, such as nitrogen oxides (NOx), sulfur dioxide (SO_2), carbon monoxide (CO), and particulate matter (PM), as well as other air pollutants including certain volatile organic compounds (VOCs) and metals that may also be associated with a wide range of industrial activities. Emissions from point sources should be avoided and controlled according to good international industry practice (GIIP) applicable to the relevant industry sector, depending on ambient conditions, through the combined application of process modifications and emissions controls.

4.4.2.2.2. Good International Industry Practice (GIIP) Stack Height

Stack heights shall be designed according to Good International Industry Practice (GIIP) to avoid excessive ground level concentrations and minimize impacts, including the acid deposition. It is based on United States 40 CFR, part 51.100 (ii) by the following formula.

$$H_G = H + 1.5L \quad \text{..... (1)}$$

Where,

H_G = GEP stack height measured from the ground level elevation at the base of the stack

H = Height of nearby structure(s) above the base of the stack.

L = Lesser dimension, height (h) or width (w), of nearby structures ("Nearby structures" = Structures within/touching a radius of 5L but less than 800 m).

4.4.2.2.3. Noise Level Guideline

Noise impacts should not exceed the levels presented in **Table 29** or result in a maximum increase in background levels of 3 dB at the nearest receptor location off-site.

Table 29 – Noise Level Guidelines

S. No.	Receptor	One hour L_{Aeq} (dBA)	
		Daytime 07:00 – 22:00	Nighttime 22:00 – 07:00
1.	Residential; institutional; educational	55	45
2.	Industrial; commercial	70	70

4.4.2.2.4. General Effluent Water Quality – Discharge to Surface water

Discharge of process wastewater, sanitary wastewater, wastewater from utility operations or storm water or surface water should not result in contaminant concentrations more than local ambient water quality criteria or, in the absence of local criteria, other sources

of ambient water quality (Eg. US EPA National Recommended Water Quality Criteria). Additional considerations that should be included in the setting of project-specific performance levels for wastewater effluents include:

- Process wastewater treatment standards consistent with applicable industry sector EHS guidelines. Projects for which there are no industry-specific guideline should reference the effluent quality guidelines of an industry sector with suitably analogous processes and effluents;
- Compliance with national or local standards for sanitary wastewater discharges or, in their absence, the indicative guideline values applicable to sanitary wastewater prescribed by IFC general EHS guidelines.
- The temperature of wastewater before discharge does not increase greater than 3°C of ambient temperature at the edge of a scientifically established mixing zone which takes into account ambient water quality, receiving water use and assimilative capacity among other considerations.

4.4.2.3. Environmental, Health and Safety (EHS) guidelines for thermal power plants

The development of an environmental assessment (EA) for a thermal power project should take into account any government energy and/or environmental policy or strategy including strategic aspects such as energy efficiency improvements in existing power generation, transmission, and distribution systems, demand-side management, project siting, fuel choice, technology choice, and environmental performance.

4.4.2.3.1. Effluents – Thermal Discharge

Thermal power plants with steam-powered generators and once-through cooling systems use significant volume of water to cool and condense the steam for the return to the boiler. The heated water is typically discharged back to the source water or the nearest surface water body. In general thermal discharge should be designed to ensure that discharge water temperature does not result in exceeding relevant ambient water quality temperature standards outside a scientifically established mixing zone. The mixing zone is typically defined as the zone where initial dilution of a discharge takes place within which relevant water quality temperature standards are allowed to exceed and takes into account cumulative impact of seasonal variations, ambient water quality, receiving water use, potential receptors and assimilative capacity among other considerations. Establishment of such a mixing zone is project specific and may be established by local regulatory agencies and confirmed or updated through the project's environmental assessment process. Thermal discharges should be designed to prevent adverse impacts to the receiving water taking into account the following criteria:

- The elevated temperature areas because of thermal discharge from the project should not impair the integrity of the water body as a whole or endanger sensitive areas (such as recreational areas, breeding grounds, or areas with sensitive biota);
- There should be no lethality or significant impact to breeding and feeding habits of organisms passing through the elevated temperature areas; and
- There should be no significant risk to human health or residual levels of water treatment chemicals.

4.4.2.3.2. Performance Indicators and Monitoring – Emissions and Effluent Guidelines

Effluent guidelines are described in **Table 30**. Effluent guidelines are applicable for direct discharges of treated effluents to surface waters for general use. Site-specific discharge levels may be established based on the availability and conditions in the use of publicly operated sewage collection and treatment systems or, if discharged directly to surface waters, on the receiving water use classification as described in general EHS guidelines.

Table 30 – Effluent Guidelines

S. No.	Parameter	Unit - mg/L except pH and Temperature
1.	pH	6 - 9
2.	TSS	50
3.	Oil and Grease	10
4.	Total residual chlorine	0.2
5.	Chromium – Total (Cr)	0.5
6.	Copper (Cu)	0.5
7.	Iron (Fe)	1.0
8.	Zinc (Zn)	1.0
9.	Lead (Pb)	0.5
10.	Cadmium (Cd)	0.1
11.	Mercury (Hg)	0.005
12.	Arsenic (As)	0.5
13.	Temperature increase by thermal discharge from the cooling system	• Site-specific requirement to be established by the Environmental Assessment (EA) • Elevated temperature areas due to the 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 the intake and outfall design through the project-specific EA depending on the sensitive aquatic ecosystems around the discharge point.

4.4.3. JAPAN BANK FOR INTERNATIONAL COOPERATION (JBIC) GUIDELINES FOR CONFIRMATION OF ENVIRONMENTAL AND SOCIAL CONSIDERATION

The guidelines have the objective of contributing to the sound development of the international economy and society through environmental and social considerations in all projects subject to lending, equity participation, and guaranteed by JBIC. Environmental and social considerations refer not only to the natural environment but also to social issues such as involuntary resettlement and respect for the human rights of indigenous peoples. JBIC confirms, through various measures, that project proponents undertake appropriate environmental and social considerations to prevent or minimize the impact on the environment and local communities, and not bring about unacceptable impacts which may be caused by the projects for which JBIC provides funding. Basic principles regarding confirmation of environmental and social considerations are as follows:

(1) Parties Responsible for Environmental and Social Considerations - It is the project proponents that are responsible for environmental and social considerations for the project, and JBIC confirms such considerations in light of the Guidelines;

(2) Confirmation of Environmental and Social Considerations by JBIC - For confirmation of environmental and social considerations, JBIC undertakes:

a) **Screening**

b) **Categorization –** It is discussed in **Section 4.4.1 of the report**.

c) **Environmental Reviews for each category -** After the screening process, JBIC carries out environmental reviews according to the following procedures for each category. The environmental reviews for Category B projects are similar to those of Category A projects in that JBIC examines the potential negative and positive environmental impact of the projects, and evaluate measures necessary to prevent, minimize, mitigate, or compensate for the potential negative impact. As part of the review process, JBIC also conducts measures to improve the environment if any such measures are available. JBIC undertakes its environmental reviews based on information provided by borrowers and related parties. Where an environmental impact assessment procedure has been conducted, JBIC may refer to the ESIA reports and permit certificates. However, this is not a mandatory requirement.

Monitoring For category A and B projects - JBIC in principle confirms through the borrower the results of monitoring undertaken by the project proponents on the items which have a significant environmental impact over a specified period.

5. PROJECT DESCRIPTION

5.1. LOCATION OF PROJECT SITE

The proposed project will be facilitated in the existing Layyah Power Station of SEWA located at Layyah, Sharjah – UAE. The location of the project site is represented in **Figure 1.** The environmental settings of the project are given in **Table 31.**

Table 31 - Environmental settings of the project site

S. No.	Particulars	Details	
1	Location	Layyah, Sharjah - UAE	
2	**Site GPS Co-ordinates**	**Latitude**	**Longitude**
	Corner A	25°21'27.03"N	55°22'4.27"E
	Corner B	25°21'20.80"N	55°22'7.52"E
	Corner C	25°21'27.17"N	55°22'12.68"E
	Corner D	25°21'21.75"N	55°22'23.13"E
	Corner E	25°21'14.47"N	55°22'21.39"E
	Corner F	25°21'6.46"N	55°22'15.94"E
	Corner G	25°21'5.81"N	55°22'14.31"E
	Corner H	25°21'11.10"N	55°22'4.04"E
	Corner I	25°21'25.86"N	55°22'2.50"E
	Corner J	25°27'39" N	55°28'27" E
3	Site Elevation above MSL	Approx. 0 - 6 m	
4	Nearest Habitation	Al Layyah – 0.45 km (S) Al Marijah – 0.70 km (E)	
5	Nearest Airport	Dubai International Airport – 9.5 km (SSW) Sharjah International airport – 12.5 km (E)	
6	Nearest Port	Sharjah Khalid Port – Adjacent	

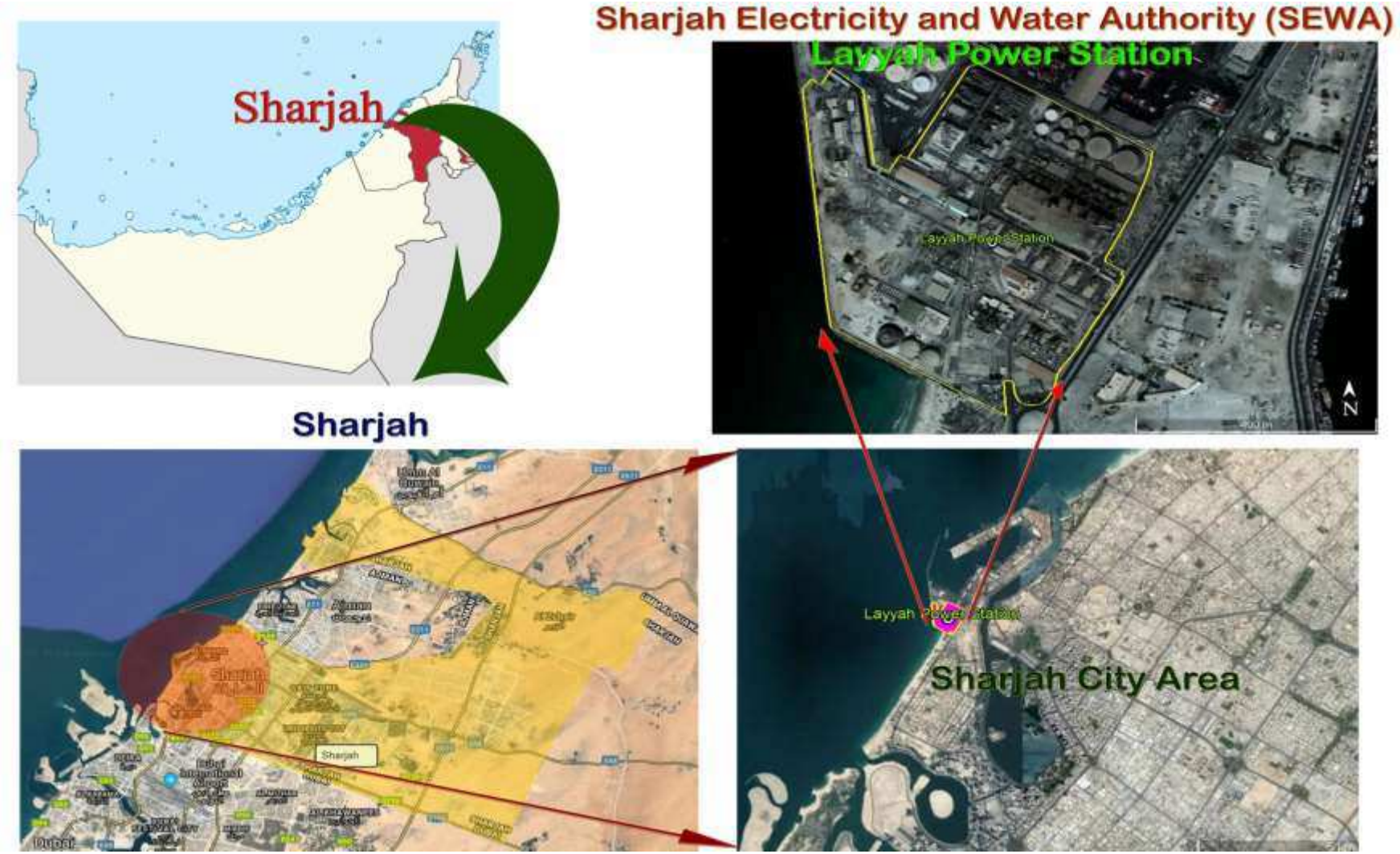


Figure 1 - General Location map of the project site

Figure 2 - Google Image showing the project site

Figure 3 - Google Image showing the project site with proposed development with tentative intake and outfall locations

5.2. TYPE AND MAGNITUDE OF THE PROJECT

The proposed project will be developed for producing electric power which will be distributed in the Emirate of Sharjah. It is designed to produce 1,100 MW electric power. The Man power required for the operation of the power plant will be approximately 45-55 number, working in 3 shifts.

Salient features of the project are given in **Table 32**.

Table 32 – Salient features of the proposed project

S. No.	Description	Details
1	Total plot area	250,000.00 m^2 (Approx.)
2	Plot area of the proposed project	35,0000 m^2 (Approx.)
3	**Proposed Activity**	
	Proposed Activity	Power generation by Combined Cycle Power Plant (CCPP)
5	**The Magnitude of the project**	
	Name of the product	**Capacity of Generation**
	Electric Power	1,100 MW
6	**Manpower details**	
	No. of manpower	45 - 55
	Working shifts	3 shifts (8 hours/shift)

5.3. FACILITY DESCRIPTION

The proposed project, of Combined Cycle Power Plant (CCPP) is planned in the existing Layyah Power Station (LPS) of SEWA. Total plot area of LPS is approximately 250,000 m^2, in which 35,000 m^2 areas will be utilized for the proposed project. Layyah Power Station is one of the major power and water source of Sharjah. LPS has power station as well as desalination plants . Site setting layout plan showing existing facilities and proposed facilities is presented in **Figure 4**.

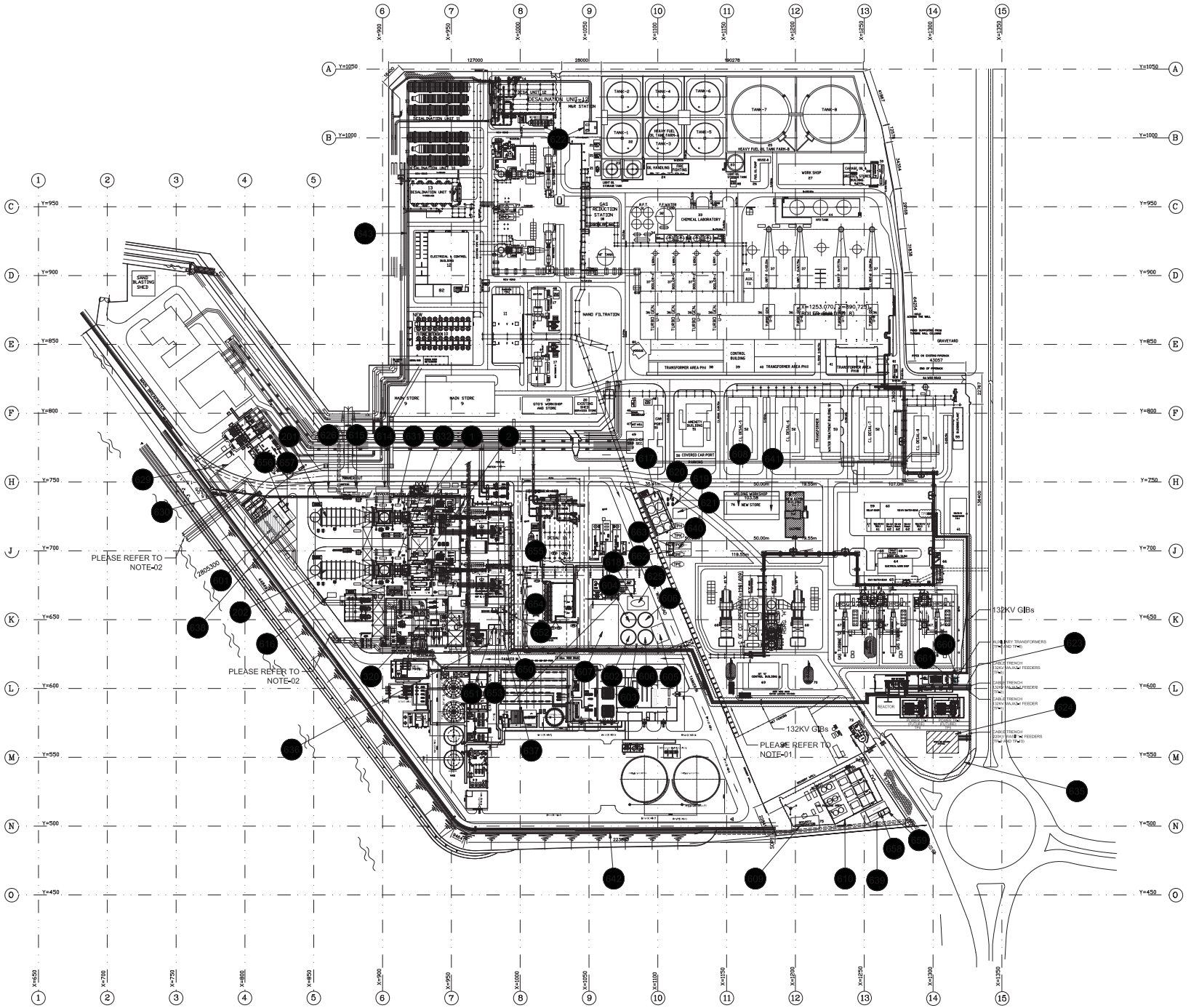
The proposed land area for the project is already reclamed during the time of LPS previous developments and there is no need for additonal land developed for the proposed project. The proposed land is sandy without any vegetation and currently left barren which is used for temporary storage. In addition to the existing intake pipeline

and Outfall channel, offshore Intake and outfall HDPE pipelines will be installed for this project. . The details of the proposed facility and its area statement are given in **Table 33**.

Table 33 – Proposed Facility details and its area statement

S. No.	Details	Area in Sq.m (Approximate)
1	Combined cycle power plant (including internal road, miscellaneous facilities etc.,)	18,000.00
2	Central Control Building and 132 KV Gas Insulated Substation (GIS)	2,000.00
3	Fuel Gas Treatment and Fuel Gas Compressor	1,500.00
4	Water Treatment plant, wastewater treatment plant and associated facilities	1,500.00
	Total build-up Area for the proposed facility	**23,000.00**

Figure 4 – Site setting layout plan of the project



NOTES:

1. SWITCHYARD AND GIS CONNECTING BETWEEN GENERATOR STEP UP TRANSFORMER AND SWITCHYARD ARE ON HOLD AND EXCLUDED FROM EPCC'S TECHNICAL AND COMMERCIAL OFFER UPON FURTHER INFORMATION FROM SEWA/EDF.
2. OFFSHORE STRUCTURE (INTAKE AND OUTFALL) CONCEPT DESIGN WILL BE DETAILED AFTER FURTHER INVESTIGATION.

LEGEND:

No.	EQUIPMENT LIST
1	NO.1 GAS TURBINE
2	NO.2 GAS TURBINE
201	NO.1 HEAT RECOVERY STEAM GENERATOR
202	NO.2 HEAT RECOVERY STEAM GENERATOR
320	CONDENSER
601	PUMPING STATION BUILDING
602	OSMOTIZED WATER TANK
603	OSMOTIZED WATER PUMPS (2x100%)
604	DEMI WATER TANK
605	FIRE FIGHTING CONTAINER
606	SERVICE AND FIRE FIGHTING WATER TANK (2x50%)
607	WATER TREATMENT PLANT
608	WORKSHOP / STORE
609	FUEL GAS TREATMENT
610	FUEL GAS COMPRESSORS (3x100%)
614	CO2 TANKS
615	H2 MANIFOLDS
616	N2 MANIFOLDS
617	GT FIN FAN COOLER
618	NEUTRALIZATION PIT
619	GT CLOSED COOLING PUMPS (2x100%)
620	ST CLOSED COOLING PUMPS (2x100%)
621	ST HEAT EXCHANGER CCW
622	FUEL OIL TRANSFER PUMPS / FUEL OIL TREATMENT PLANT
623	132KV GIS-CONTROL BUILDING
624	220KV GIS-CONTROL BUILDING (FUTURE)
625	OIL SEPARATOR
626	CEMS
629	CHLORINATION BUILDING
630	INTAKE
631	ELECTRICAL HEATER NO.1 GAS TURBINE (1x100%)
632	ELECTRICAL HEATER NO.2 GAS TURBINE (1x100%)
635	BOUNDARY WALL (NEW)
636	EMERGENCY DIESEL GENERATOR CONTAINER
637	EMERGENCY DIESEL GENERATOR TANK
638	CIRCULATING WATER - ELECTRICAL BUILDING
639	GAS COMPRESSOR - ELECTRICAL BUILDING
640	WATER TREATMENT - ELECTRICAL BUILDING
641	STORE
642	FUEL GAS PIPE LINE
643	FUEL OIL LINE
650	10BFT10 MV-LV TRANSFORMER COMMON SERVICES 1
651	10BFT20 MV-LV TRANSFORMER COMMON SERVICES 2
652	10BFT71 MV-LV TRANSFORMER COMMON SERVICES 1
653	10BFT81 MV-LV TRANSFORMER COMMON SERVICES 2
654	11BFT10 MV-LV TRANSFORMER GT1
655	12BFT20 MV-LV TRANSFORMER GT2
656	10BFT31 MV-LV TRANSFORMER CCRT 1
657	10BFT41 MV-LV TRANSFORMER CCRT 2
658	10BFT51 MV-LV TRANSFORMER FUEL GAS 1
659	10BFT61 MV-LV TRANSFORMER FUEL GAS 2
660	10BFT52 MV-LV TRANSFORMER SUBSTATION 1
661	10BFT62 MV-LV TRANSFORMER SUBSTATION 2
662	10BFT13 MV-LV TRANSFORMER WATER TREATMENT 1
663	10BFT23 MV-LV TRANSFORMER WATER TREATMENT 2

SCALE 1:1000 0 50 100 200 300m

Project: Layyah Power Station

Sharjah Electricity and Water Authority
Layyah Power Station
Sharjah U.A.E

Designed: EDF

Contractor: ELSEWEDY POWER

Drawing Title: OVERALL PLANT LAYOUT

5.3.1. MAJOR COMPONENTS OF POWER GENERATION

The scheme of the power generation process comprises the following major components:

- Two Gas Turbine (GT) units.
- Two heat recovery steam generators (HRSGs).
- One condensing steam turbine (ST) unit.
- Two Gas Turbine Generator (GTGs)
- One Steam Turbine Generator (STG)

5.3.1.1. Gas Turbine System

The M701F gas turbine is a large utility frame machine. The gas turbine consists of three main components: high-efficiency compressor, combustor and a high-efficiency turbine. Air is drawn through the inlet into the compressor where it is pressurized and fed into the combustors. The compressed air mix with fuel, and ignites in the combustors. The high-temperature mixture of thus formed combustion products then expands through the turbine, dropping in pressure and temperature as the heat energy is absorbed and converted into mechanical work. A portion of the power thus developed by the turbine is used for driving the compressor, and the balance of the power is used to drive the generator. Dry Low NOx (DLN) burner system is provided for the gas turbine system which controls nitrogen oxide emissions.

5.3.1.2. Heat Recovery Steam Generators (HRSGs)

Two (2) outdoor type HRSGs will be installed to generate the steam by the heat of the exhaust gas from each MHPS 701F gas turbine. Hot exhaust gas discharged from the gas turbine is channeled through a HRSG in order to heat incoming feed water and subsequently generate saturated and superheated steam. The exhaust gas exits the HRSG through an exhaust stack via damper and silencer located in HRSG stack. HRSGs contain an array of equipment, including interconnected banks of tubes, steam drums, headers, connecting pipes, and other components.

The tube banks within the HRSG are arranged in a particular order to optimize the heat exchange process. The various tube banks included in an HRSG are preheaters, economizers, evaporators, super-heaters and re-heaters. The steam production process starts with water entering the HRSG from condensate system via condensate pumps. The condensate water enters preheater tube bank and sent to external de-aerator. Preheater recirculation pumps are installed to recirculate preheater outlet water to preheater inlet

so that preheater inlet water temperature can be controlled to avoid low-temperature corrosion.

In the de-aerator, preheated condensate water is mixed with returned water from steam extraction where dissolved oxygen in the returned water from steam extraction is separated. The de-aerated feed water then enters Low Pressure (LP), Intermediate Pressure (IP) and High Pressure (HP) economizer tube banks via HP BFP/IP BFP/LP BFP which take suction from the external de-aerator. The economizer heats the water to a temperature slightly below the saturated temperature.

The water leaving the economizer enters a steam drum via the feedwater control valve. A portion of the water, which flows through the evaporator tube bank, is converted into steam (or evaporated). The resulting steam/water mixture exits the evaporator tubes and enters the steam drum via riser pipes. The steam drums are large diameter cylindrical vessels, which are located above the evaporator banks. In the super-heater, the steam is "superheated" above the saturated temperature and then leads to the steam turbine.

The tube banks located within an HRSG consist of fin tubes. The hot gas turbine exhaust at the inlet flows toward the HRSG outlet of the gas side, and heat transfer sections (tube banks) are arranged appropriately in the gas flow to absorb the heat effectively. Low-temperature fluid is fed from the HRSG outlet side of the gas flow toward the HRSG inlet side of gas flow.

The superheated steam from HP super-heater then expands through the HP steam turbine - turning it and the electrical generator to which it is connected, and in the process losing both pressure and temperature. A portion of the HP steam turbine exhaust steam is extracted to be sent to the external system. Rest of the exhaust steam flows back to the HRSG, and after mixed with IP super-heater outlet steam, it is reheated at an intermediate pressure by passing through re-heater tube banks. This "reheat" steam then returns to power a different part of the IP steam turbine. The exhaust steam from IP steam turbine then mixed with LP super-heater outlet steam and fed to LP steam turbine to further generate electricity. When the steam has completed its work in the steam turbine, the steam is turned back into water in the condenser following the steam turbine outlet and returned to the preheater section of the HRSG. This condensate is fed to HRSG by condensate water pumps.

A duct burner system for gas firing will be provided for supplementary firing, using excess oxygen in the gas turbine exhaust gas to burn natural gas, rising the exhaust gas temperature and increasing steam output.

5.3.1.3. Steam Turbine System

The proposed turbine generator unit is a "two cylinder tandem-compound double-exhaust, condensing reheat" type turbine, which consists of one combined High pressure-Intermediate pressure (HIP) turbine and one double flow Low Pressure (LP) turbine.

The HP steam from the combined main valve enters HP turbine through the inlet pipe. The steam flows through the HP blading producing power, decreasing its pressure and temperature, and leaves HP turbine through a HP exhaust opening, thence flows to re-heater. The steam from the re-heater enters IP turbine through combined reheat valve and inlet pipe. The steam flows through the IP blading producing power, decreasing its pressure and temperature, and leaves IP turbine through an IP exhaust opening, thence flows to cross-over pipe and enters LP turbine. The LP steam from the LP stop valve and LP control valve is mixed with the IP turbine exhaust steam at cross-over piping between HP-IP and LP turbine. LP turbine is a double exhaust flow type, and the steam enters LP turbine at the center of the blade path and flows through the LP blading toward an exhaust opening at each end, thence to a condenser. The low-pressure element incorporating high efficiency blading, and diffuser-type exhaust, and improved exhaust hood design has resulted in a significant improvement in turbine heat consumption

5.3.1.4. Gas Turbine Generator

The proposed gas turbine generator unit is enclosed, self-ventilated, forced lubricated, H_2 cooled, cylindrical rotor type, synchronous alternator. A hydrogen-cooled turbogenerator is a turbogenerator with gaseous hydrogen as a coolant (Stator winding is indirectly cooled by H_2 gas, and rotor winding is directly cooled by H_2 gas). Four (4) horizontal hydrogen coolers will be provided for cooling circulating hydrogen gas in the generator. Cold hydrogen cools stator windings, stator core, field windings and other parts in the generator.

Hydrogen-cooled turbo generators provide a low-drag atmosphere and cooling for combined-cycle applications. This is most common type due to the high thermal conductivity and other favourable properties of hydrogen gas.

Hydrogen-cooled turbo generators are designed to provide a low-drag atmosphere and cooling for single-shaft and combined-cycle applications in combination with the gas turbine with steam turbines. Because of the high thermal conductivity and other favorable properties of hydrogen gas, this is the most common type in its field.

5.3.1.5. Steam Turbine Generator

The proposed steam generator unit is enclosed, self-ventilated, forced lubricated, H_2 cooled, cylindrical rotor type, synchronous alternator. A hydrogen-cooled turbo generator is a turbogenerator with gaseous hydrogen as a coolant (Stator winding is indirectly cooled by H_2 gas, and rotor winding is directly cooled by H_2 gas). Four (4) horizontal hydrogen coolers will be provided for cooling circulating hydrogen gas in the generator. Cold hydrogen cools stator windings, stator core, field windings and other parts in the generator.

5.3.2. DETAILS OF EQUIPMENT/MACHINERY

The details of major equipment/machinery to be utilized for the proposed project are hereunder provided. Equipment layout for the proposed facility is enclosed as ANNEXURE 5.

Table 34 – Details of Equipment/ Machinery

S. No.	Description	Quantity to be installed (Nos.)
1.	Gas Turbine	2
2.	Gas Turbine Auxiliary Components	
	GT Main Lube Oil Pump Motor	
	GT Control Oil Pump Motor	
	GT Lube Oil Vapor Extractor Motor	
	GT Enclosure Ventilation Fan Motor	
	GT Exhaust Gas Damper System	
	HP Purge Air Compressor	
	GT Fuel Gas Calorie Meter	
	GT Control Oil Cleaning Unit	
	Evaporative Cooler	
	By-Pass Stack Aircraft Obstruction Lighting	
	GT CO_2 Fire Fighting	
	Temporary GT Closed Cooling Water Pumps	
	GT Main Fuel Oil Pump Motor	
	GT Water Injection Pump Motor	
3.	Steam Turbine	1
4.	Heat Recovery Steam Generators (HRSG) - Triple pressure, Reheat Type	2
5.	Steam Turbine and HRSG Auxiliary Components	
	ST Main lube Oil Pump Motor	
	ST Main Oil Tank Vapor Extractor Motor	
	ST Control Oil Pump Motor	
	ST lube Oil Purifier Circulation Pump	
	Gland Steam Condenser Exhauster Fan Motor	
	Duct Burner Scanner Cooling Air Blower	

S. No.	Description	Quantity to be installed (Nos.)
	Duct Burner Control Panel	
	Preheater Recirculation Pump Motor	
	Stack Aircraft Obstruction Light	
	HP/IP Feedwater Pumps	
	LP Feedwater Pumps	
	Condensate Pumps	
	ST Closed Cooling Water Pumps	
6.	Gas Turbine Generator (GTG)	2
7.	Steam Turbine Generator (STG)	1
8.	Generators Auxiliary Components	
	Generator Main Seal Oil pump for GTG	
	Generator Main Seal Oil pump for STG	
	H_2 GAS SUPERVISORY RACK for GTG	
	H_2 GAS SUPERVISORY RACK for STG	
	GCRP for GTG	
	GCRP for STG	
9.	Others Equipment	
	Gas Compressors	
	Chemical Dosing System	
	Compressed Air System	
	Fire Fighting System (Pumps)	
	HVAC System	
	Electro-chlorination Plant	
	Demineralized Water Plant	
	Fuel System Metering Station	
	CEMS	
	Sampling	
	Mechanical Intake Screening	
	Circulating Water Pumps	
	Circulating Water Priming Pumps	
	Demineralized Water Pumps	
	Demineralized Water GT injection Pumps (Fuel Oil)	
	Sewage Water Pumps	
	Flash Tank Pumps	
	Potable/Service Water Pumps	
	Vacuum pumps	
	Fuel oil forwarding pumps	
	Auxiliary cooling pumps	
	Sump pumps	
	Desalinated water booster pumps	
	Condensate return booster pumps	
	GT FFC	
	Fuel Oil electrical Heater	
	Heat Tracing fuel oil	
10	Main Transformer	

5.3.3. SUPPORT FACILITIES

The following facilities will be established as support facilities to enhance the power generation process and to manage environment, health and safety system.

5.3.3.1. Electro-Chlorination System

The raw feed intake water will be undergone for disinfection. Shock disinfection will be applied at suitable intervals in the intake water system to deal with marine growth in the system. The disinfectant used is sodium hypochlorite from an electro chlorination system.

Pressurized seawater will be delivered to the electro-chlorination system where it is strained to remove suspended solids larger than 0.5 mm. The de-strained seawater passes through the electrolyzer cells and exits as sodium hypochlorite solution with the byproduct, hydrogen gas. This two-phase solution is piped to a tank where hydrogen gas is removed from the solution. The hydrogen is typically diluted with air using a set of redundant blowers to a safe level (typically less than 1% by volume which is 25% of the explosive limit). Finally, the sodium hypochlorite solution is injected as shock-dose rates.

5.3.3.2. Brackish Water Reverse Osmosis (BWRO) plant

The received desalinated water will be softened/ osmotized by BWRO plant. The osmotized water will be further de-ionized by electro deionization system for obtaining de-ionized water.

5.3.3.3. Electro Deionization (EDI) plant

The process of EDI is combines semi-impermeable membrane technology with ion-exchange media to provide a high-efficiency demineralization. Electrical current and semi-permeable membrane will be used to reduce the ions based on the charge, electrical current and ability. An electrical potential generated through electrodialysis transports and segregates charged aqueous species. There is no need of periodical regeneration, and the electrical current can continuously regenerate the resin. The de-ionized water will be used for power generation process.

5.3.3.4. Neutralization Pit

The wastewater generated from BWRO plant, EDI, backwash, membrane clean in process, laboratory etc., will be collected in neutralization pit in which collected wastewater will be neutralized by acid/alkali dosing. Then, neutralized wastewater will be disposed to sea through outfall pipelines. A list of chemicals expected to be used in the proposed project is listed in **Table 35.**

Table 35 – Details of chemicals to be used for the proposed project

S. No.	Name of the Chemical	Nature	Purpose of usage	Storage
1	Sodium Hydroxide (NaOH) (50%)	Liquid	Neutralization and Membrane cleaning	Drums
2	Sulphuric Acid (H_2SO_4)	Liquid	Neutralization	Drums
3	EDTA disodium salt (0.8%)	Liquid	Membrane cleaning	Drums
4	Sodium Tripolyphosphate (STTP – 2.0%)	Liquid	Membrane cleaning	Drums
5	Citric Acid (2.0 %)	Liquid	Membrane cleaning	Drums
6	Sodium Bisulfite (1.0 %)	Liquid	Membrane cleaning	Drums

In the neutralization process, pH of wastewater to be generated from BWRO plant, EDI, backwash, membrane clean in process, laboratory will be neutralized (pH 6 - 8) in the neutralization process by alkali/acidic dosing.

5.4. PROCESS DESCRIPTION

The proposed power plant will generate power by the combined-cycle generation which is a configuration using both gas turbines and a steam generator. A combined cycle gas turbine is a gas turbine with a Heat Recovery Steam Generator (HRSG) applied at electric utility sites. In the combined-cycle gas turbine (CCGT), the hot exhaust gases of the gas turbines will be used to provide all, or a portion of, the heat source for the boiler, which produce steam for the steam turbine. This combination increases the thermal efficiency. The thermal efficiency of a combined cycle gas turbine is between 38% and 60%.Scheme of the production process is shown in the process flow diagram shown in **Figure 5.**

A gas turbine is an internal combustion engine that operates with rotary rather than reciprocating motion. The gas turbine drives an electric generator, and the steam from the HRSG drives a steam turbine which also drives an electric generator. Gas turbines are essentially composed of three major components: compressor, combustor, and power turbine. In the compressor section, air is drawn through the inlet into the compressor where it is pressurized and fed into the combustors. The compressed air mix with fuel, and ignites in the combustors. The combustion process in a gas turbine is lean premix staged combustion. In lean-premix combustors, fuel and air are thoroughly mixed in an initial stage resulting in a uniform, lean, unburned fuel/air mixture which is delivered to a secondary stage where the combustion reaction takes place. Gas turbines using staged combustion are also referred to as Dry Low NOx combustors. Dry Low NOx (DLN) burner

system will be used for gas turbine system which controls nitrogen oxide emissions *(US EPA, 2009[4])*.

Hot gases from combustor enter to the power turbine section. The high-temperature mixture of thus formed combustion products then expands through the turbine, dropping in pressure and temperature as the heat energy is absorbed and converted into mechanical work. A portion of the power thus developed by the turbine is used for driving the compressor, with the balance of the power used to drive the generator. Gas turbines have a shaft to transmit power among the inlet air compression turbine, the power turbine, and the exhaust turbine. The expanded gases are then exhausted into the HRSG for the bottoming cycle energy exchange. The heat content of the exhaust gases exiting the turbine will be recovered in a heat recovery steam generator to raise process steam, with supplementary firing (duct burner) (cogeneration) using excess oxygen in the gas turbine exhaust gas to burn natural gas to raise the exhaust gas temperature and increasing steam output, (Rankine cycle - combined cycle) *(US EPA, 2009)*.

[4] *U. S. Environmental Protection Agency-Compilation of Air Pollutant Emission Factors (AP 42 - Fifth Edition), 2009. Section 3.1 – Stationary gas turbines.*

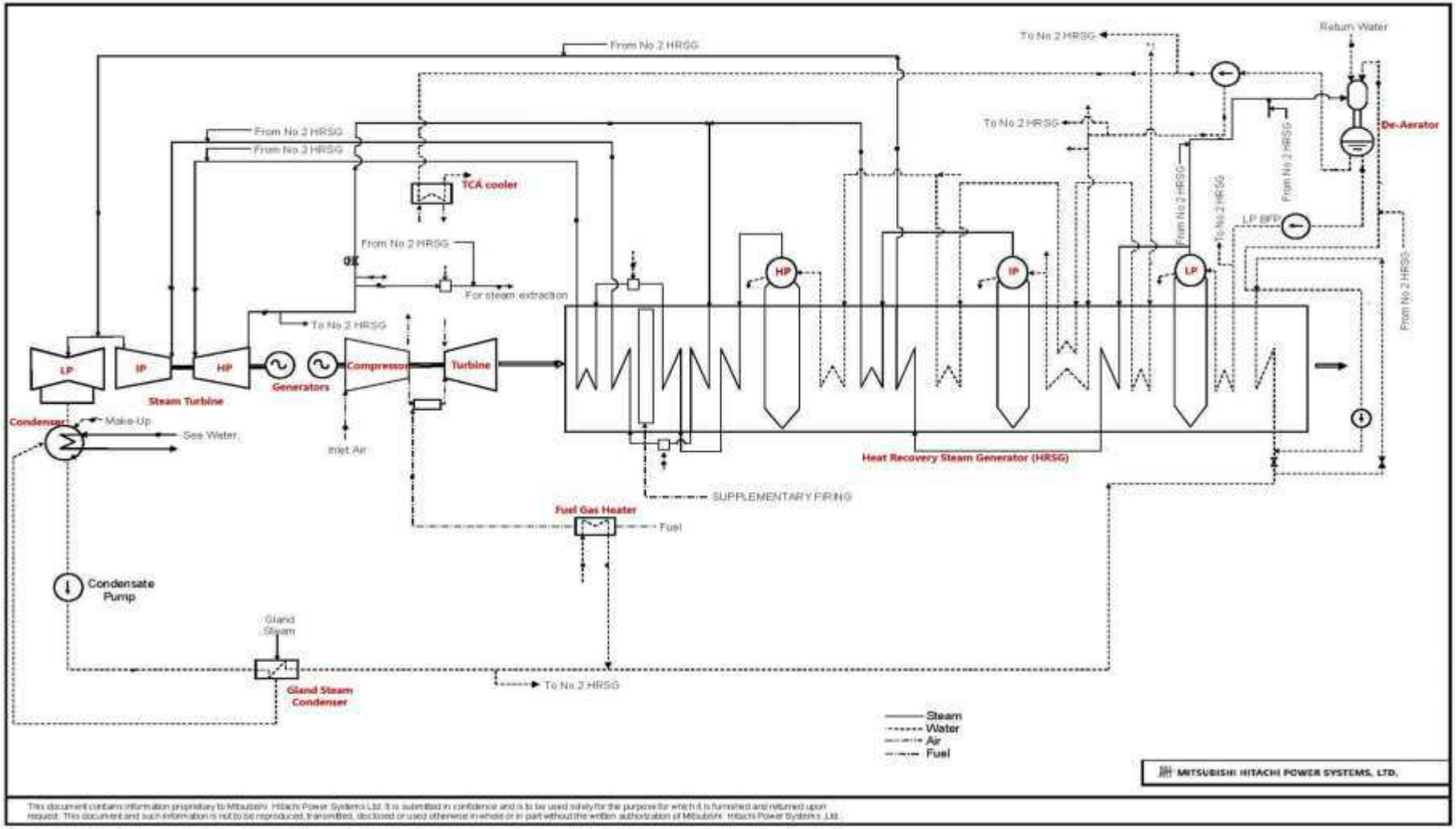


Figure 5 – Schematic Diagram of power generation process

5.5. RESOURCES, INFRASTRUCTURE AND UTILITIES

5.5.1. MAN POWER REQUIREMENT

The total manpower requirement for operating the facility will be around 45 - 55 employees including staff and labourers. The facility will be operated for 24 hours with 3 shift (8 hour each) basis.

5.5.2. POWER REQUIREMENT

The auxiliary power requirement for the proposed project will be 35 MW (approx.)

5.5.3. WATER SUPPLY AND REQUIREMENT

Seawater and desalinated water from existing desalination unit of LPS will be used for the operation of power plant. Sea water will be directly taken from sea (Arabian Gulf) through pipelines to be installed.

5.5.3.1. Water requirement

The water balance diagram of the project indicating water requirement and wastewater generation is presented in **Figure 6**. The required sea water for proposed project will be 1,873,225 m^3/day (78,050 m^3/hr).

5.5.3.2. Sea water intake structure

Sea water to be required for the proposed project will be directly taken from sea through pipelines (HDPE). The tentative location of intake tower and pipeline route is represented in Google image (**Figure 3**) and layout **(ANNEXURE 3).** The seawater drawn by pipeline will be pumped by onshore intake pumping station. The pumping station will have stop logs, band screen and bar screen. Screened sea water will be collected in the pumping chambers. Pumping station will also be equipped with pumps including standby. Each pump will be equipped with a variable speed drive (VSD) for flexibility purpose. Sea water in the pumping chamber will be pumped to pre-treatment system by pumps. Each pump has individual discharge pipe.