Chapter 8 Environmental and Social Considerations

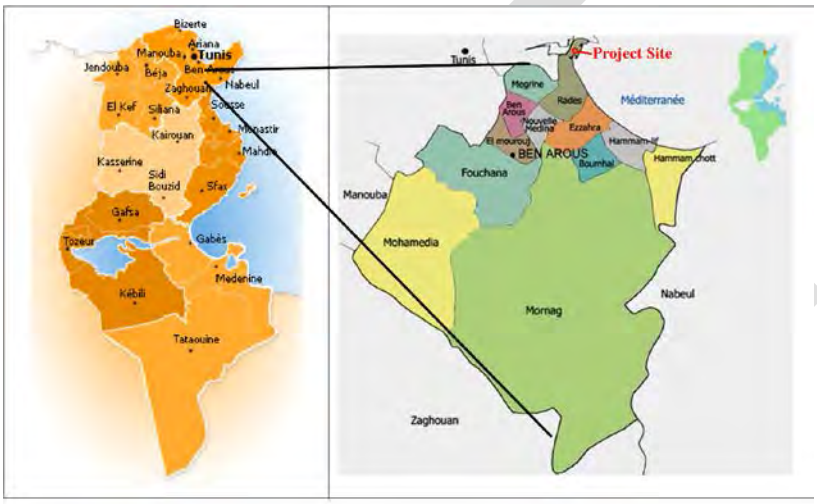
Table of Contents

Chapter 8 Environmental and Social Considerations

8.1 Environmental Status

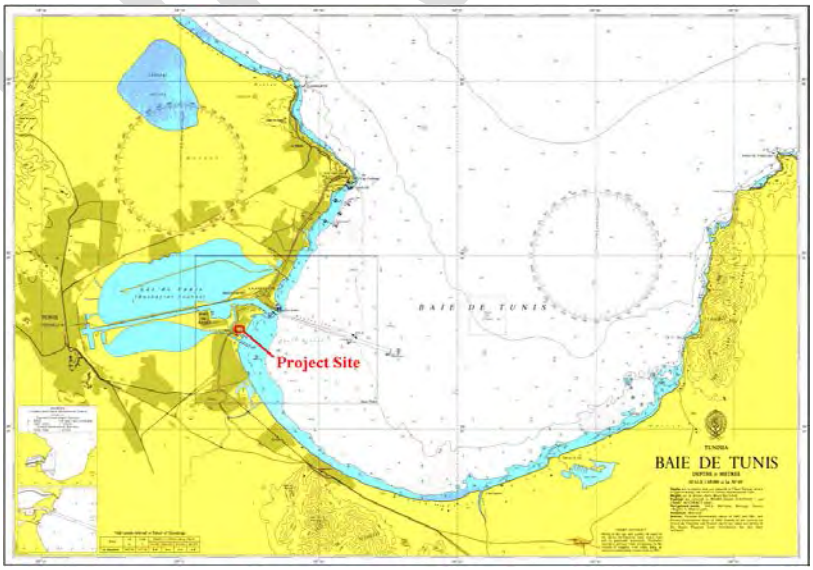
8.1.1 Location of the Site Design Conditions

Rades C Power Plant of the Project is constructed within the site of Rades Power Plant Group (Radès A&B Power Plants owned by STEG (the project proponent) and Rades II owned by Carthage Power Company, an IPP enterprise, are in operation) located in Rades County, Ben Arous Governorates 10km away from the capital city of Tunis Figure 8.1-1, Figure 8.1-2, Figure 8.1-3). Radès C Power Plant occupies 5.4ha of the total area of 25.4ha of Radès A&B Power Plants and the related facilities.



Source: EIA Report for Rades C Project

Figure 8.1-1 Location of Ben Arous Governorates



Source: JICA Study Team

Figure 8.1-2 Location of the Project Site

Source: EIA Report for Rades C Project

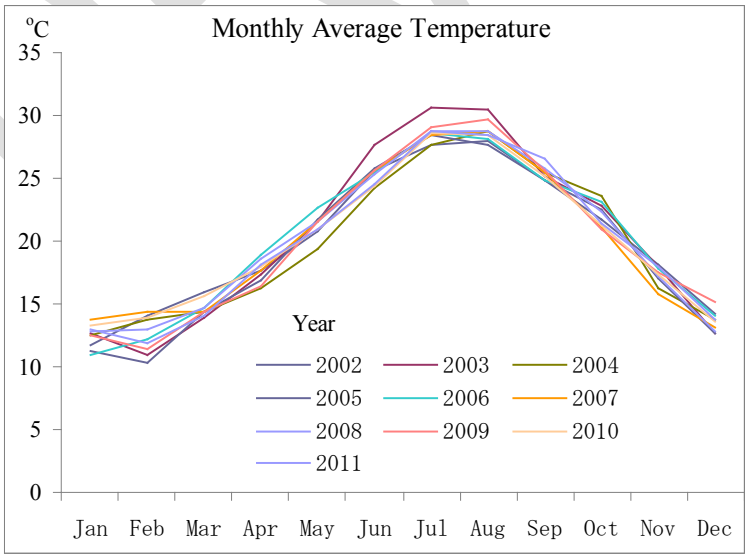
Figure 8.1-3 Scenery around the Project Site

8.1.2 Natural Environment

(1) Climate

1) Temperature

Figure 8.1-4 describes the monthly average atmospheric temperatures measured from 2002 to 2011 at the Carthago meteorological station located approximately 15 km from the project site. The average temperature tends to become high in July and August and decrease from September.

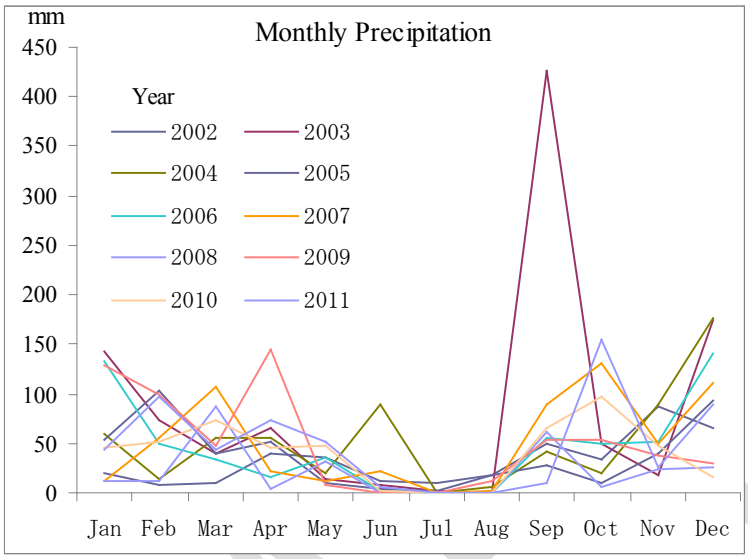


Source: Prepared by the JICA Survey Team based on documentation from STEG

Figure 8.1-4 Monthly Average Temperatures at the Carthago Meteorological Station

2) Precipitation

Figure 8.1-5 describes the monthly precipitation measured from 2002 to 2011. The yearly precipitation varies widely every year, from 265.4 mm to 1,011.6 mm. Monthly averages also vary every year, but they tend to decrease from January to June, with the minimum precipitation occurring from June to August, and starts to rise from September.

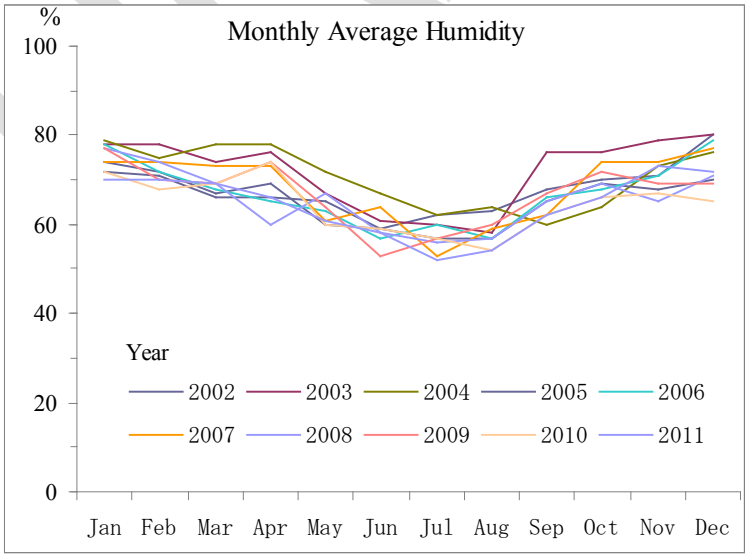


Source: Prepared by the JICA Survey Team based on documentation from STEG

Figure 8.1-5 Monthly Precipitation at the Carthago Meteorological Station

3) Humidity

Figure 8.1-6 describes the monthly average humidity measured from 2002 to 2011 at the Carthago meteorological station. The monthly average humidity in this period was 52~80%. The monthly average varies in conjunction with the monthly precipitation, and tends to become the lowest in June and August and rise from September.

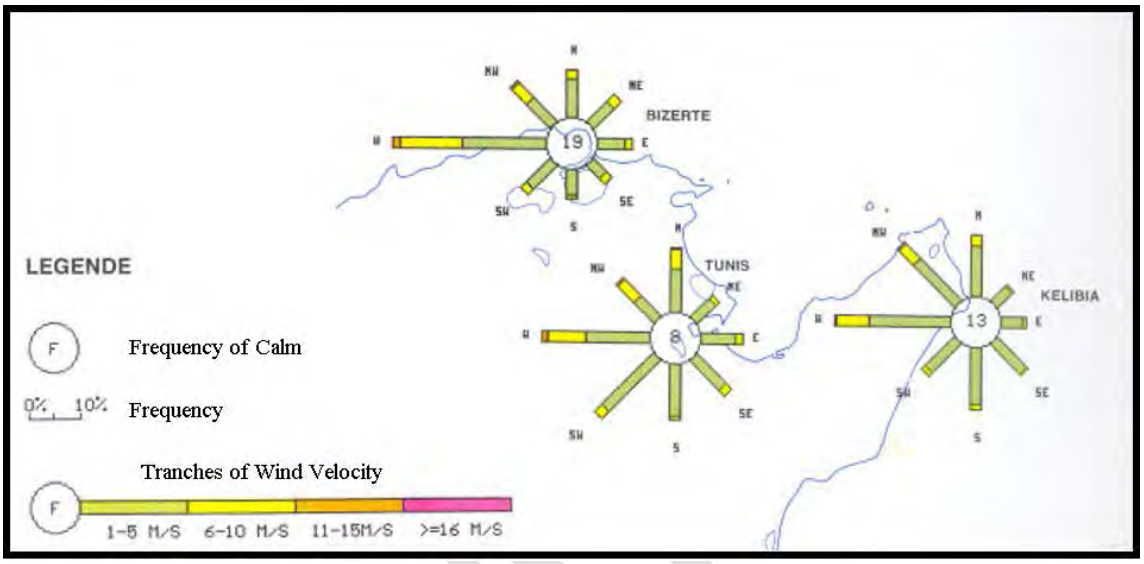


Source: Prepared by the JICA Survey Team based on documentation from STEG

Figure 8.1-6 Monthly Average Humidity at the Carthago Meteorological Station

4) Wind direction/wind speed

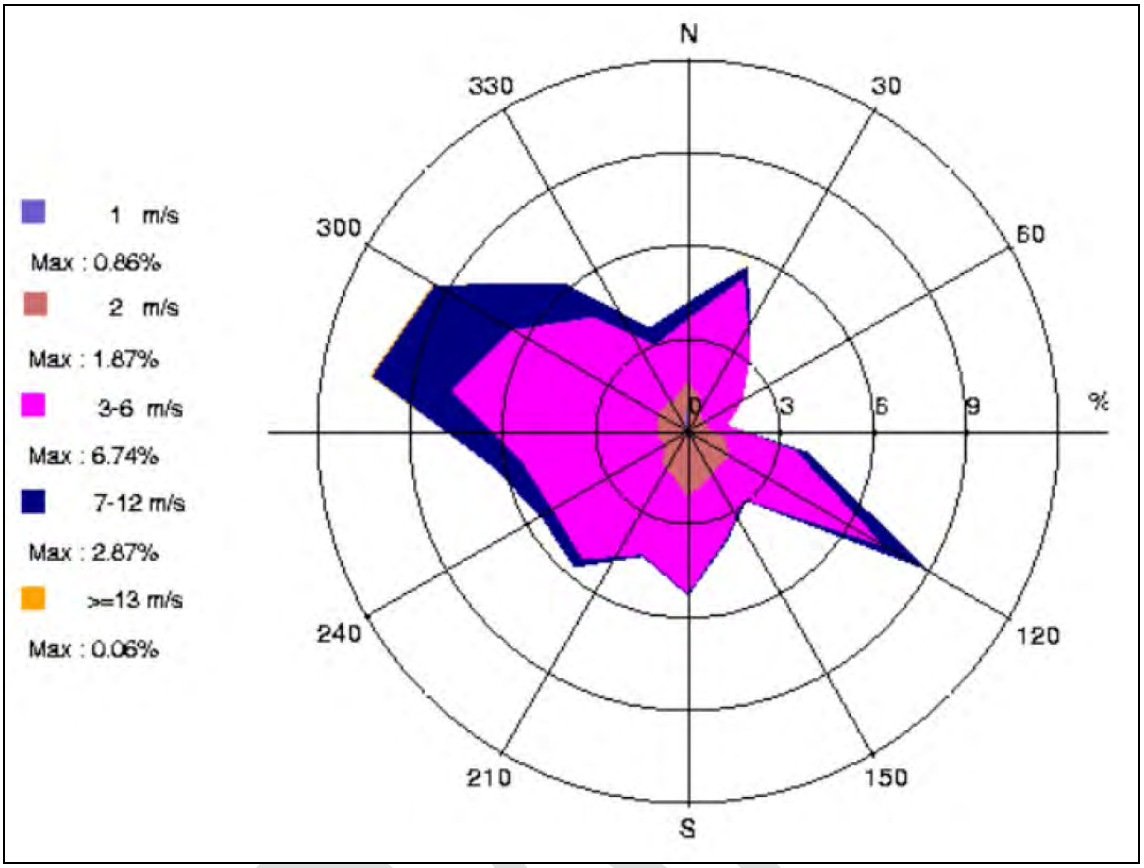
Figure 8.1-7 describes the wind rose including wind direction and wind speed at the meteorological station at Bizerte, Tunis-Carthage and Kelibia in the Gulf of Tunis. The observation was conducted at 10m ground height every 3 hours (8 times a day). The data from 1970 to 1990 indicates that west wind is dominant with the average wind speed of approximately 7m/s.



Source: EIA Report for Rades C Project

Figure 8.1-7 Annual Wind Rose in the Gulf of Tunis (1970 - 1990)

Figure 8.1-8 shows the wind roses in Tunis-Carthage from 2010 to 2012. The data indicates that wind direction from WNW to west is dominant and the wind speed is high.



Source: EIA Report for Rades C Project

Figure 8.1-8 Wind Rose in Tunis-Carthage (2010 - 2012)

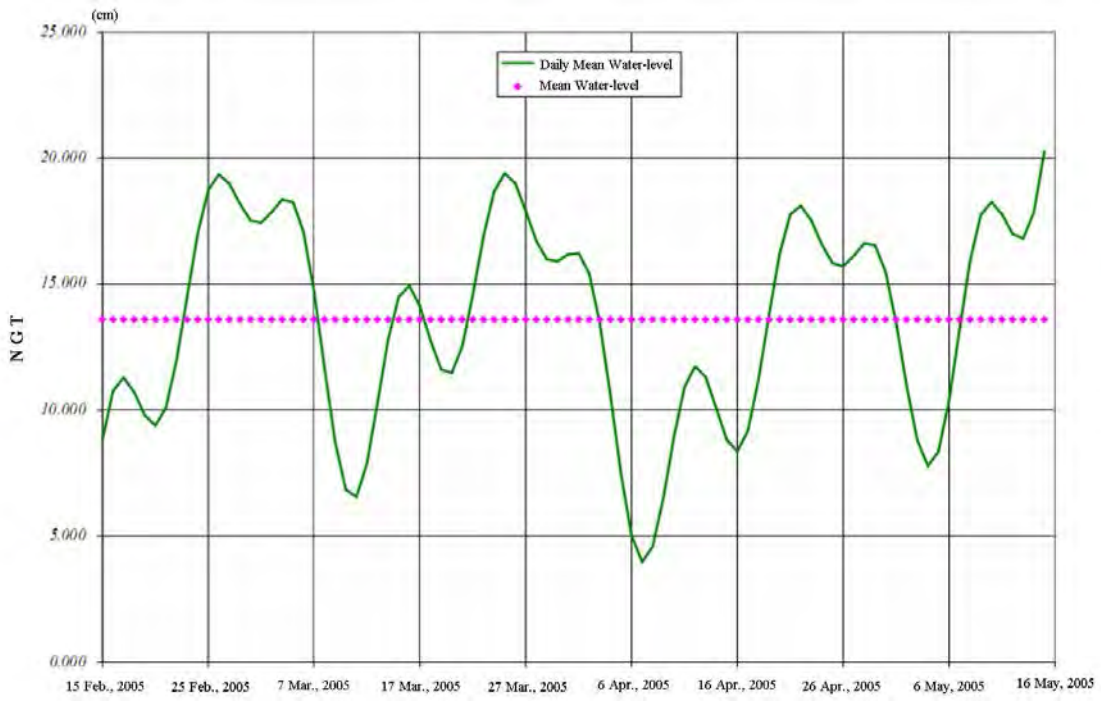
(2) Oceanographic Features

1) Tidal

Tidal level at the Gulf of Tunis fluctuates between NGT = 0m (the Zero Leveling General of Tunisia) and NGT = +0.41m. The result of the observation of tidal level conducted from February 15 to May 15 of 2005 at La Goulette Port near the project site indicates the following characteristics:

- Average tidal level at the La Goulette port was NGT = +20cm
- Tidal range in neap tide was very small.
- Tidal range in spring tide was approximately 30cm
- Tidal range in equinoxes was exceptionally high (36.3cm).

The Change in the daily mean water-level (NGT) in the Port of La Goulette is shown in Figure 8.1-9.



Source: EIA Report for Rades C Project

Figure 8.1-9 Change in the Daily Mean Water-level (NGT) in the Port of La Goulette

2) Current

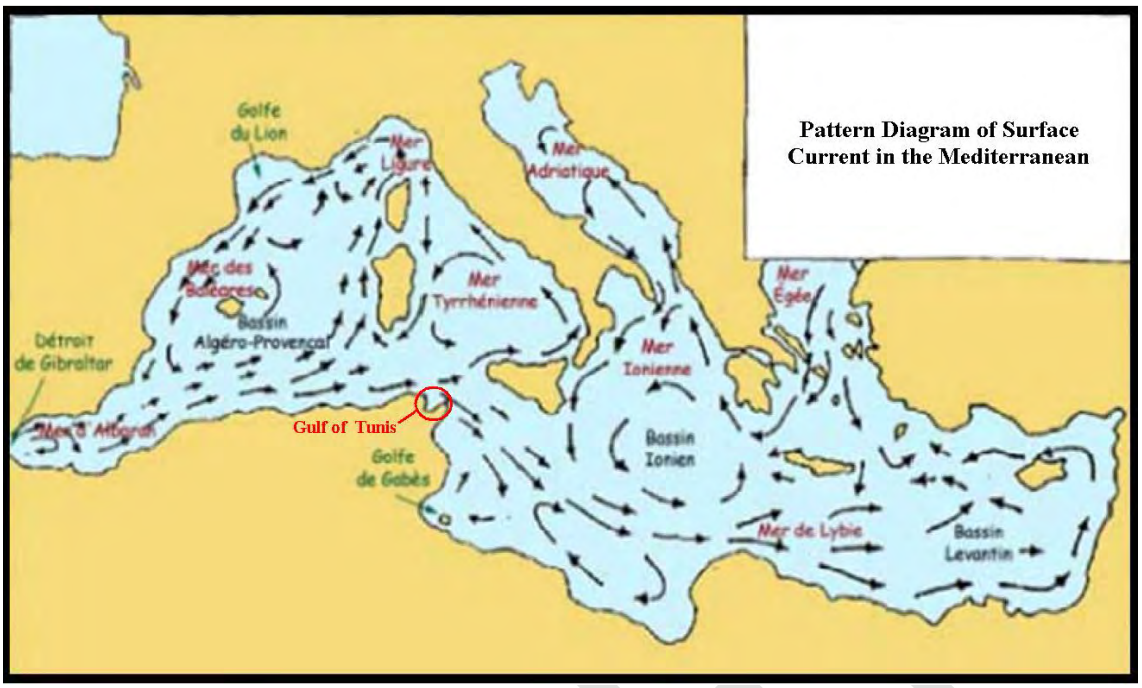
Currents are categorized into 4 types.

- Surface Current
- Current Due to Wind
- Tidal Current
- Current Wave

The current in the coastal area of Tunisia is low in the maximum speed (0.10 m/sec) and has narrow area of current wave. Accordingly, surface current and current due to wind will cause major influence on thermal effluent diffusion.

a. Surface Current

The Mediterranean connects to the Atlantic only through Straits of Gibraltar, and as quantity of evaporation from the sea surface is quite large, it has high salinity and low tidal level. The eastern part of the Mediterranean has higher rate of evaporation quantity, resulting in lower sea level and higher salinity. Low-salinity sea water from the Atlantic flows into the eastern area of Mediterranean, pushing high-salinity sea water of the eastern area westward back into the Atlantic through Straits of Gibraltar. In this manner, low-salinity water, which is comparatively light, flows eastward near the sea surface, whereas deep current consists of heavier high-salinity sea water flowing westward.



Source: EIA Report for Rades C Project

Figure 8.1-10 Pattern Diagram of Surface Current in the Mediterranean

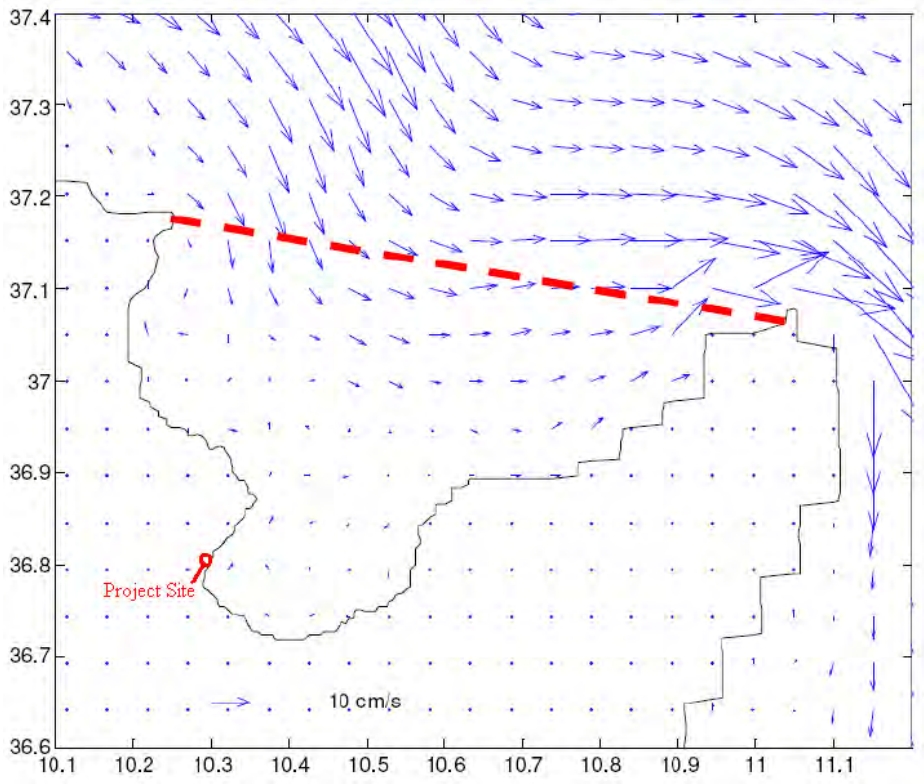
b. Current Due to Wind

When wind blows on the sea surface, sea surface water moves downwind by the pressure of wind and current due to wind occurs. Through Figure 8.1-11 to Figure 8.1-13 describes the simulation of current of sea water in the Gulf of Tunis in each wind direction.

Under calm condition with no influence of wind, the surface current of the Mediterranean flowing from west to east causes inflow of sea water from the western coast of Gulf of Tunis, but reaching only near the center of the gulf (Figure 8.1-11).

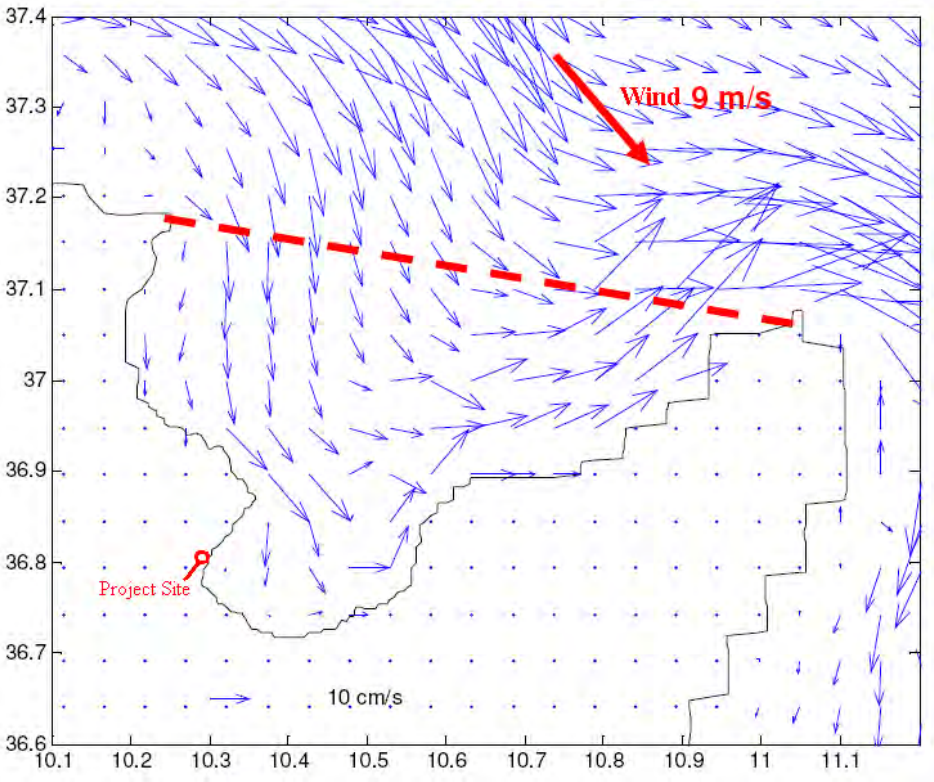
In case of north-western wind, this sea current is enhanced and the clockwise inflow of seawater reaches deep into the Gulf of Tunis, then flows out from the eastern coast of the gulf into the Mediterranean (Figure 8.1-12).

In case of eastern wind, the surface current does not flow into the Gulf of Tunis and the current in the gulf flow counterclockwise (Figure 8.1-13).



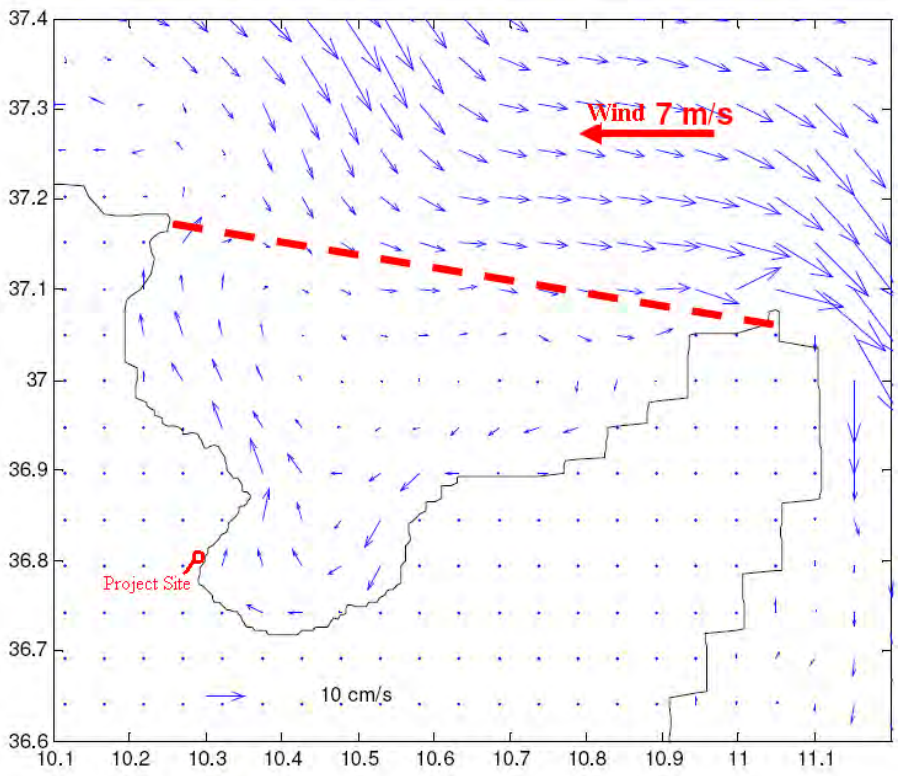
Source: EIA Report for Rades C Project

Figure 8.1-11 Mean Circulation in the Gulf of Tunis Generated by Calm (less than 1m/s)



Source: EIA Report for Rades C Project

Figure 8.1-12 Mean Circulation in the Gulf of Tunis Generated by NW Wind (9m/s)



Source: EIA Report for Rades C Project

Figure 8.1-13 Mean Circulation in the Gulf of Tunis Generated by East Wind (7m/s)

(3) Natural Environment

1) Situations around the project site

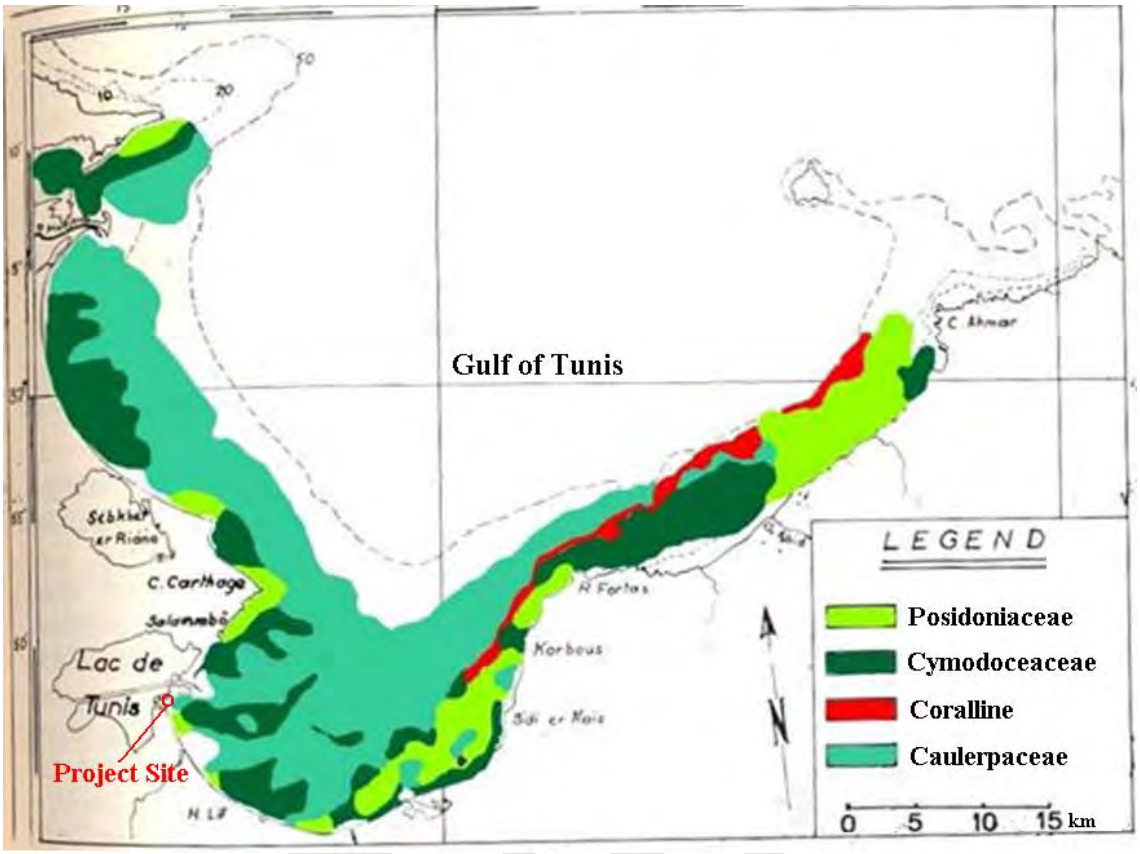
The area around the project site is, as shown in Figure 8.1-14, The remain of a labor camp and material storage site from the time of construction of Rades B TPP are still standing on the site, and well-developed area and no forest is seen. Little vegetation grows except some grass plants and trees planted in the green belt in the site. There are no primary forests, natural forests and mangrove wetlands around the site. The outlet of waste water faces shoaling beach, with no tidal flat or coral reef.

Source: Prepared by the JICA Survey Team based on a Google earth

Figure 8.1-14 Situations around the Project Site

2) Seagrass and Algae Habitat in the Gulf of Tunis

Figure 8.1-15 shows the distribution of seaweed bed in the Gulf of Tunis in 1972. Seaweed bed spread in the whole shallow sea area of the gulf at that time, but the area has decreased since then due to decreased water clarity and eutrophication.



Source: EIA Report for Rades C Project

Figure 8.1-15 Seagrass and Algae Habitat in the Gulf of Tunis (1972)

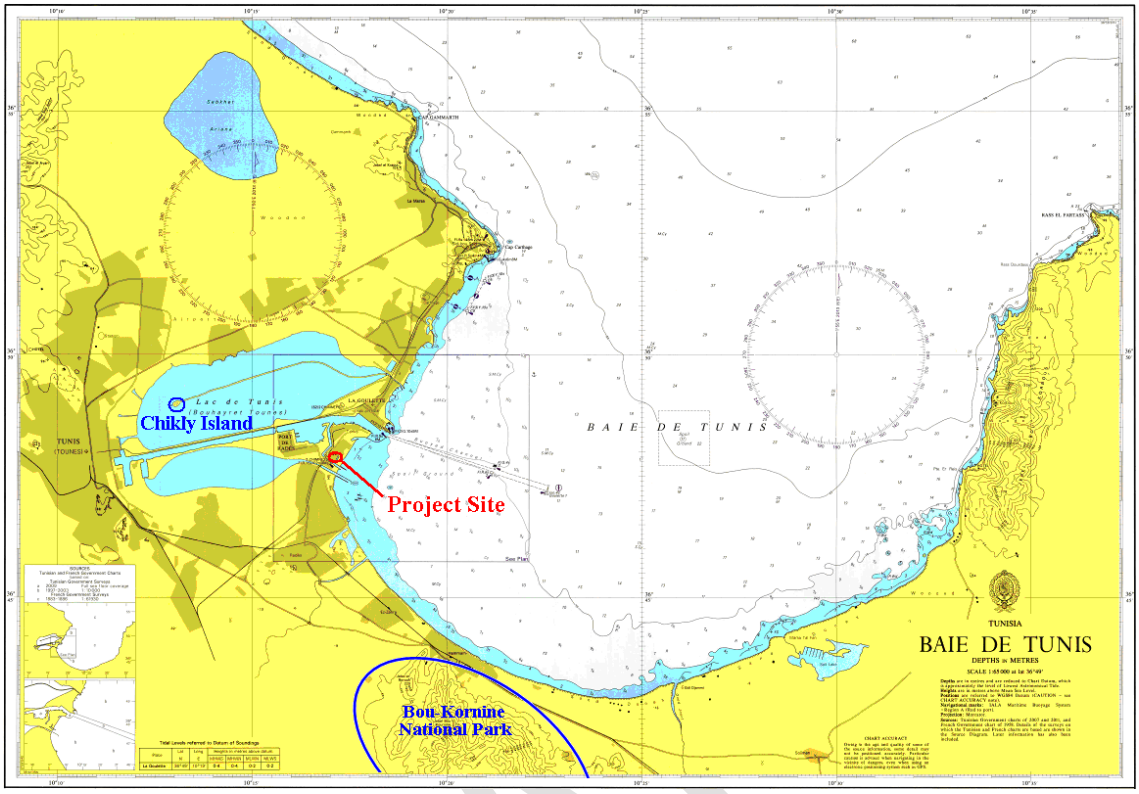
3) Nature Reserve and National Park

Figure 8.1-16 shows the Nature Reserve and National Park around the project site. The nearest nature reserve from the site is Chikly Island located in Lake of Tunis 6km west of the project site. This area is forbidden of development due to archaeological monument, and is also a protected area of water bird (Figure 8.1-17). In 8km southeast of the project site is Bou-Kornine Natinal Park (Figure 8.1-18) which is the protected area for the habitat of Barbary Sheep.

Nature reserve is stipulated by Forest Code Law No.88-20: "by natural reserve is meant a little-extended natural site whose aim is preserving animals' or plants' individual or group species natural life, as well as their habitat, and the conservation of migrant fauna species of national or global importance"[1].

National Park is stipulated by the same law: "by national park is meant a relatively extended land parcel with one or many ecosystems a little or not transformed by human exploitation and occupation where vegetal and animal species, geomorphologic sites and habitats offer special interest from scientific, educational and recreational stands, or which include natural landscapes of great aesthetic value"[1].

[1] www.cbd.int/database/attachment/?id=1170



Souce: JICA Study Team

Figure 8.1-16 Location of Protected Area and National Park near the Project Site

Source: http://commons.wikimedia.org/wiki/File:IleChikliLacTunis.jpg

Figure 8.1-17 Scenery of Chikly Island

Source: http://en.m.wikipedia.org/wiki/File:Gulf_of_Tunis_with_Mount_Bou_Kornine.jpg
Figure 8.1-18 Scenery of Bou-Kornine Mountain

8.1.3 Social Environment

(1) Land Use

The Project Site is located in Rades County, one of twelve counties in Ben Arous Governorate, with 1,955 ha and 47,910 inhabitants (2010). It is only 10 km from the center of the Capital Tunis and to the east of Tunis. The northern part of Rades County is occupied by Rades Port, its warehouses and related facilities. Rades port is the biggest commercial port in Tunisia with approximately 6 million tons of treatment annually. There is also an industrial zone in the north-west of the county with more than 40 industries. Residential area is spread mainly along the seashore and in the center of the county. One residential area is, however, located 300 m from STEG Rades administration building and around 600m from the project site. This area is called “Mallaha” area, with an estimated population of 4,000 inhabitants according to the people living there (Figure 8.1-19). To the south and aouth-west of the county, there is a large forest area.

Source: http://193.95.122.123/atlas/en/node/644

Figure 8.1-19 Land Use in Rades County

(2) Social Feature near the Project Site

The social features of Rades County and Ben Arous Governorate are shown in Table 8.1-1. Rades County is mostly an industrial area and there is no rural area. The population density is higher than the average in Ben Arous Governorate, as well as the density of housings. Social Infrastructure development such as portable water, electricity, and sewage is also in a high level in Ben Arous Governorate.

Table 8.1-1 Social Feature of Rades County and Ben Arous Governotrate

Indicators	Rades County	Ben Arous Governorate	Observations
Area (km^2)	19.93	666.75	-
Population	47,910	571,464 [1)]	2010
Annual Growth Rate	2.31%	3.13% [1)]	1994/2004
Urban Population	37,910	517,242 [10)]	2010
Rural Population	-	54,222 [10)]	2010
Population Density (inhab/km^2)	2,404	857	2010
Number of Households	11,295	117,901 [2)]	2004
Average Household Size	3.69	4.00 [2)]	2004
Activity Rate	49.0%	49.0% [4)]	2004
Unemployment Rate	11.0%	13.0% [4)]	2004
Number of Dwellings	13,465	136,064 [5)]	2004
Housing Density (houseing/ha)	6.83	2.04 [6)]	2004
Main Urban Center	Rades	Ben Arous	-
Rate of Drinking Water Supply	99.9%	97.9% [3)]	2004
Electrification Rate	99.9%	98.9% [3)]	2004
Rate of Connection to the Sewerae System	95.4%	86.2% [3)]	2004
Number of Pimary Schools	13	151 [7)]	2008
Number of Colleges – Secondary Schools	5	58 [7)]	2008
Number of Basic Health Centers	4	46 [8)]	2008
Number of Post Office	4	30 [9)]	2008

Source: http://193.95.122.123/atlas/en/node/664
1) http://193.95.122.123/atlas/en/node/498
2) http://193.95.122.123/atlas/en/node/504
3) http://193.95.122.123/atlas/en/node/508
4) http://193.95.122.123/atlas/en/node/518
5) http://193.95.122.123/atlas/en/node/564
6) http://193.95.122.123/atlas/en/node/581
7) http://193.95.122.123/atlas/en/node/586
8) http://193.95.122.123/atlas/en/node/594
9) http://193.95.122.123/atlas/en/node/601
10)http://www.ins.nat.tn/demog/population/fr/tab4_fr_evolution.xls

The nearest residential area of Mallaha is composed of several story apartment buildings and is a rather isolated area in the middle of industrial zone. There are stores for daily life and some restaurants. One elementary school is also located. Many people living there are mainly working for industrial factories nearby and some of them are even working for STEG.

(3) Industry

Ben Arous Governorate had 585 companies with over 10 employees including around 50% of textile and clothing industries, mechanical and electrical (2007). In 2008, Industry in Ben Arous Governoraet provides some 55,190 jobs nearly 40% (20,033 jobs) are offered by the branch Mechanical / electrical and more than 10% for the textile clothing (11,978 jobs). The food industry provides nearly 10% of industrial jobs with more than 6,000 jobs.

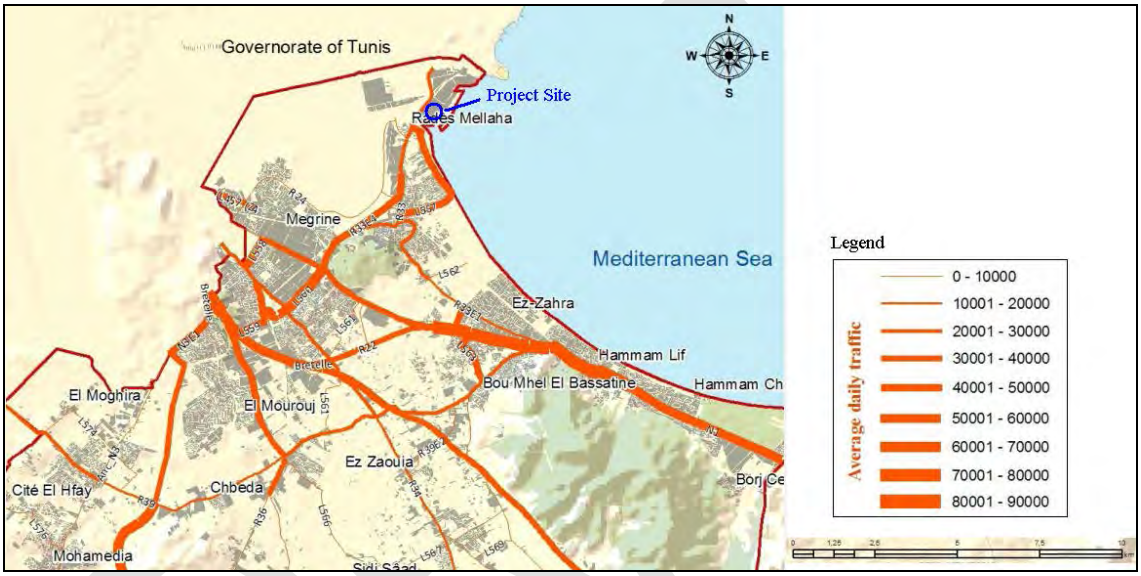
Table 8.1-2 Structure of Industry in Rades County and BenArous Governorate

Area	Rades County	Ben Arous Governorate	Observations
Number of Companies [1)]	43	558	2007
Number of Employees by Industrial Sector [2)]	3,594	55,190	2008

Source: 1) http://193.95.122.123/atlas/en/node/547
2) http://193.95.122.123/atlas/en/node/549

(4) Road Traffic

According to the 2007 census, the main roads in the governorate registered a traffic of 284,192 vehicles/day on a main road N1. Section R33 registered 176,527 vehicles/day including 27,546 heavy vehicles or 15.6%.



Source: http://193.95.122.123/atlas/en/node/606

Figure 8.1-20 Road Traffic near the Project Site

8.2 Environmental Impact Assessment and Other Legal System

8.2.1 Overview of Environmental Administration

Environmental administration in Tunisia started with the establishment of the National Agency for Environment Protection (Agence Nationale de Protection de l'Environnement, ANPE) by virtue of Law No.88-91 in 1988. Prior to that date, however, a certain number of ministries had started to set up some regulations or standards under respective authority.

The first ministry with the name "Environment" was the Ministry of Environment and Territorial Exploitation (Ministère de l'Environnement et de l'Aménagement du Territoire), created by decree No.92-1098 dated June 9, 1992. The direction in charge of environment of the said ministry was transferred in September 2002 to the Ministry of Agriculture, Environment and Water Resources (Ministère de l'Agriculture, de 'Environnement et des Ressources Hydrauliques). An independent ministry in terms of environment was finally created later in November 2004 as the Ministry of Environment and Sustainable Development (Minstère de l'Environnement et du Développement Durable, MEDD). This ministry, however, was reintegrated in January 2011 to the Ministry of Agriculture.

After a short period of independence as the Ministry of Environment since December 2011, the ministry was again merged with ministry of equipment in March 2013, to become the current Ministry of Equipement and Environment (Minsitère de l'Equipement et de l'Environnement, MEE). Currently, therefore, a substantial part of policy issues for the environment are under MEE's authority, leaving certain areas to other ministries, like fauna and flora related issues to the Ministry of Agriculture and Water Resources.

A certain number of national agencies are working closely with and under MEE. Since its establishment, ANPE has assumed an important role as an agency in charge of evaluating Environmental Impact Assessments (EIA). The National Agency for Waste Management (Agence Nationale de Gestion des déchets, ANGED), created in 2005 by decree No. 2005-2317, controls all kinds of waste in Tunisia. Moreover, since the Project is located nearby the seashore, the Agency for Littoral Protection and Exploitation (Agence de Protection et d'Aménagement du Littoral, APAL) is also concerned with water discharge into public sea areas.

8.2.2 Environment Related Legal Framework

(1) Main Laws and Regulations Concerning Environment
Below are the main laws and regulations concerning environmental issues in Tunisia and closely related to the Project.

- Law No.66-27 promulgating Labor Code (April, 1966)
- Law No.75-16 promulgating Water Code (March, 1975)
- Decree No. 84-1556 of 29 on the regulation of industrial estates relating to the noise level (December 1984)
- Law No.86-35 related to protection of archeologic assets, historical monuments and natural and urban sites (May, 1986)
- Law No.88-20 promulgating Forest Code (April, 1988)
- Law No.88-91 related to the creation of the National Agency for Environment Protection (August, 1988)
- Tunisian Standard No.106-02 related to Effluent (July, 1989)
- Decree No.90-2273 related to the status of controllers of the National Agency for Environment Protection (December, 1990)
- Decree No.91-362 related to Environmental Impact Assessments (March, 1991)
- Law No.92-115 simplifying administrative procedures of the National Agency for Environment Protection (November, 1992)
- Decree No.93-303 detemining the attributions of the Ministry of Environment and Territorial Expoitation (February, 1993)
- Law No.94-16 related to exploitation and maintenance of Industrial Zones (January 1994)
- Tunisian Standard No.106-04 related to Air (December, 1994)
- Decree No.95-72 related to the creation of the Agency for Coastal Protection and Development (July, 1995)
- Law No.96-29 introducing an urgent national intervention plan against marine pollution (April, 1996)
- Law No.96-41 related to Solid Waste, its Management and Disposal (June, 1996)
- Decree No.2000-2339 determining a list of Hazardous Waste (October, 2000)
- Decree No.2005-2317 related to the creation of the National Agency for Waste Management (August 2005)
- Decree No.2005-2933 detemining the attributions of the Ministry of Environment and Sustainable Development (November 2005)

- Decision of Ministry of Agriculture and Water Resources dated July 19, 2006 determining the list of rare fauna and flora having risk of extinction
- Decree No.2010-2519 fixing upper limits of polluted air from stationary sources (September, 2010)

(2) Main Regulation Standards

We enumerate the main standards in Tunisia for air, water, and noise, etc., in connection with thermal power projects.

1) Air Quality

Air quality standards (No.106-04; December, 1994) are shown in Table 8.2.1. There are two reference values. "Standards" values are allowed, to some extent, to exceed a certain frequency (allowable frequency). "Guidelines" values are targeted to be applied with the objective of long term environmental and health effects.

Note that in Table 8.2.1, IFC/ EHS guidelines (General 2007) are shown as reference values. The guideline value of the ambient air quality standards will be the reference value for the monitoring results of the Project, considering the cumulative impact of other pollution sources, such as vessels and cars.

Table 8.2-1 Ambient Air Quality Standards

(Unit: μg/m^3, (ppm))

Parameter	Averaging time	Allowable frequency	Tunisian Standards related to Air (No. 106-04)		IFC/EHS guidelines (General; 2007)
			Standards	Guidelines	
CO	8 hrs	Twice/ 30 days	10,000 (9)	10,000 (9)	-
	1 hr	Twice/ 30 days	40 (35)	30 (26)	-
NO_2	Year	-	200 (0.106)	150 (0.080)	40
	1 hr	Once/ 30 days	660 (0.350)	400 (0.212)	200
O_3	8 hrs	-	-	-	160
	1 hr	Once/ 30 days	235 (0.12)	150 - 200 (0.077 - 0.102)	-
PM_{10}	Year	-	80	40 - 60	70
	24 hrs	-	-	-	150
	1 hr	Once/ 12 months	260	120	-
SO_2	Year	-	80 (0.030)	50 (0.019)	-
	24 hrs	Once/ 12 months	365 (0.12)	125 (0.041)	125
	3 hrs	Once/ 12 months	1,300 (0.50)	-	-
	10 min	-	-	-	500
Pb	Year	-	2	0.5 - 1	-
H_2S	1 hr	Once/ 12 months	200	-	-

Source: Tunisian Standards related to Air (No. 106-04), IFC/EHS guidelines (General; 2007)

2) Emission Gas Standards

Standards for exhaust gas emissions from a stationary source (2010-2519 September 2010) are shown in Table 8.2.2. In this Project, the fixed source of exhaust gas is a gas turbine and fuel is natural gas. In addition, emergency fuel (5 days expected per year) is a diesel oil.

Note that in Table 8.2.2, IFC / EHS guidelines (Thermal Power Plant 2008) are shown as reference values. The emission gas standards are applied for the Project.

Table 8.2-2 Emission Gas Standards of Gas Turbines

(Unit: mg/m^3 ,(ppm))

Parameter	Fixing Upper Limit of Polluted Air from Stationary Source (2010-2519)		IFC/EHS guidelines (Thermal; 2008)	
	Natural gas	Diesel oil	Natural gas	Diesel oil
SO_2	10 (3)	120 (41)	-	Use of 1% or less S fuel[*1] Use of 0.5% or less S fuel[*2]
NO_2 (20 <MW <50)	80 (39)	120 (58)	51 (25)	152 (74)
(MW >50)	50 (24)	120 (58)		
Dust	10	20	-	-
PM_{10}	-	-	-	50[*1] 30[*2]

Notes: The values are converted into 15% of O_2 concentration.
*1: Non-degraded airshed
*2: Degraded airshed: Airshed should be considered as being degraded if nationally legislated air quality standards are exceeded or in their absence.
Source: Fixing upper limit of polluted air from stationary source (2010-2519), IFC/EHS guidelines (Thermal; 2008).

3) Water Quality

a. Ambient Water Quality Standards

There are no standards in Tunisia concerning water quality and environmental standards. Only emission conditions of industrial and domestic wastewater are only defined.

b. Discharged Wastewater Standards

Discharged wastewater standards (Tunisian standard No.106-02 July, 1989) are shown in Table 8.2-3. Reference values vary depending on the place where the water is discharged, however water will be discharged into the sea in this Project.

Note that in Table 8.2-3, industrial wastewater values as well as domestic wastewater values of IFC / EHS guidelines are shown for reference (Thermal Power Plant 2008 and 2007 General, respectively). The discharged wastewater standards are applied for the Project.

Table 8.2-3 Discharged Wastewater Standards

Parameter	Unit	Tunisian Standard related to Effluent (No.106-02)			IFC/EHS guidelines	
		Discharge into sea	Discharge into continental water	Discharge into sewage network	Industry wastewater (Thermal Power Plant; 2008)	Sanitary sewage (General; 2007)
Temperature	°C	35	25	35	- *	-
pH	-	6.5 - 8.5	6.5 - 8.5	6.5 – 9	6 – 9	6 – 9
Suspended Solid	mg/L	30	30	400	50	50
Settled Solid	mg/L	0.3	0.3	-	-	-
COD	mg/L	90 (Excepting bathing water and aquaculture)	90	1,000	-	125
BOD_5	mg/L	30	30	400	-	30
Cl	mg/L	-	600	700	-	-
Cl_2	mgCl_2/L	0.05	0.05	1	-	-
ClO_2	mg/L	0.05	0.05	0.5	-	-
Chlorine residual	mg/L	-	-	-	0.2	-
SO_4	mg/L	1,000	600	400	-	-
Magnesium (Mg)	mg/L	2,000	200	300	-	-
Potassium (K)	mg/L	1,000	50	50	-	-
Sodium (Na)	mg/L	-	300	1,000	-	-
Calcium (Ca)	mg/L	-	500	-	-	-
Aluminium (Al)	mg/L	5	5	10	-	-
Color scale platinum cobalt	mg/L	100	70	-	-	-
Sulfide	mg/L	2	0.1	3	-	-
Fluoride	mg/L	5	3	3	-	-
NO_3-N	mg/L	90	50	90	-	-
NO_2-N	mg/L	5	0.5	10	-	-
NH_3-N	mg/L	30	1	100	-	-
T-N	mg/L	-	-	-	-	10
PO_4-P	mg/L	0.1	0.05	10	-	-
T-P	mg/L	-	-	-	-	2
Phenols	mg/L	0.05	0.002	1	-	-
Oills saponifibles	mg/L	20	10	30	-	-
Tolat aliphatic hydrocarbons (Oil, grease, tar)	mg/L	10	2	10	10	10
Chloride solvents	mg/L	0.05	0	0.1	-	-
Anionic detergents (ABS)	mg/L	2	0.5	5	-	-
Boron (B)	mg/L	20	2	2	-	-
Iron (Fe)	mg/L	1	1	5	1.0	-
Copper (Cu)	mg/L	1.5	0.5	1	0.5	-
Tin (Sn)	mg/L	2	2	2	-	-
Manganese (Mn)	mg/L	1	0.5	1	-	-

Parameter	Unit	Tunisian Standard related to Effluent (No.106-02)			IFC/EHS guidelines	
		Discharge into sea	Discharge into continental water	Discharge into sewage network	Industry wastewater (Thermal Power Plant; 2008)	Sanitary sewage (General; 2007)
Zinc (Zn)	mg/L	10	5	5	1.0	-
Molybdenum (Mo)	mg/L	5	0.05	5	-	-
Cobalt (Co)	mg/L	0.5	0.1	0.5	-	-
Bromine active Br_2	mg/L	0.1	0.05	1	-	-
Barium (Ba)	mg/L	10	0.5	10	-	-
Silver (Ag)	mg/L	0.1	0.05	0.1	-	-
Arsenic (As)	mg/L	0.1	0.05	0.1	0.5	-
Berylium (Be)	mg/L	0.05	0.01	0.05	-	-
Cadmium (Cd)	mg/L	0.005	0.005	0.1	0.1	-
Cyanogen (CN^-)	mg/L	0.05	0.05	0.5	-	-
Hexavalent chromium (Cr^{6+})	mg/L	0.5	0.01	0.5	0.5 (T-Cr)	-
Trivalent chromium (Cr^{3+})	mg/L	2	0.5	2	-	-
Antimony (Sb)	mg/L	0.1	0.1	0.2	-	-
Nickel (Ni)	mg/L	2	0.2	2	-	-
Selenium (Se)	mg/L	0.5	0.05	1	-	-
Mercury (Hg)	mg/L	0.001	0.001	0.01	0.005	-
Lead (Pb)	mg/L	0.5	0.1	1	0.5	-
Titanium (Ti)	mg/L	0.001	0.001	0.01	-	-
Pesticides - Insecticides - Organic phosphorous compounds - Carbamate compounds - Chemical herbicides - Fungicides - PCB & PCT	mg/L	0.005	0.001	0.01	-	-
Fecal coliform bacterium	MPN/ 100 mL	2,000	2,000	-	-	400
Fecal streptococci	MPN/ 100 mL	1,000	1,000	-	-	-
Salmonella	MPN/ 500 mL	Absence	Absence	-	-	-
Vibrio cholerae	MPN/ 100 mL	Absence	Absence	-	-	-

Notes: *: Elevated temperature areas should be minimized by adjusting intake and outfall design though the project specific EIA depending on the sensitive aquatic ecosystems around the discharge point.

Source: Tunisian Standard related to Effluent (No.106-02), IFC/EHS guidelines (General; 2007) and (Thermal; 2008).

4) Noise

Decree No. 84-1556 of 29 December 1984 on the regulation of industrial estates. Under Article 26 of this Decree, the noise level generated by a business day shall not exceed 50 decibels, measured at the facade of the closest house from the noise source For reference, IFC/ EHS guidelines (General 2007) are shown in Table 8.2-4. IFC/EHS guideline requires should not exceed the levels in the Table, or result in a maximum increase in background levels of 3 dB at the nearest receptor location off-site. The decree of the noise level is applied for the Project.

Table 8.2-4 Noise Level Values of IFC/EHS Guidelines

Receptor	One hour LAeq (dBA)	
	Daytime 07:00-22:00	Nighttime 22:00-07:00
Residential, Institutional, and Educational	55	45
Industrial and Commercial	70	70

Source: IFC/EHS guidelines (General; 2007)

5) Solid waste

The law concerning management and disposal of solid waste (Law No. 96-14) stipulates criteria for the classification of solid wastes and disposal methods for each classified solid waste. Solid waste is classified mainly as follows. Household waste, hazardous waste, stabilized waste (such as scrap metal and waste plastic), packaging materials, and special waste (such as sludge of wastewater treatment plants and medical waste). The collection of solid waste is under the responsibility of local governments, and disposal is carried out by the national agency for waste management and disposal (ANGED).

Regulation on hazardous waste (Regulation No. 2339-2000) stipulates 20 types of hazardous waste (Table 8.2-5). Detailed items are shown for thermal power plants.

Table 8.2-5 List of Hazardous Waste

Code	Designation
01	**Radioactive waste**
0101	Medical waste
0102	Non-medical waste
0103	Waste from consumable products containing radioactive agents
0104	Nuclear reactors' waste
02	**Waste from medical or veterinary centers and from associated research**
0201	Waste maternity, diagnosis, treatment or human disease prevention units
0202	Waste from research, diagnosis, treatment or animal-disease prevention
03	**Waste from primary production (agriculture, horticulture, hunting, fishing, aquaculture and food processing production)**
0301	Waste from primary production
0302	Waste from fruit, vegetables, cereals, food oil processing; and from canned food and tobacco production
04	**Waste from mine exploration and exploitation, and from ore processing**
0401	Waste from metallic minerals physical and chemical processing
0402	Waste from non-metallic minerals physical and chemical processing
0403	Drilling and other waste muds

Code	Designation
05	**Waste from wood, paper, card-board, panels and furniture processing**
0501	Waste from wood protection products
0502	Waste from paper, card-board and paper paste processing
06	**Waste from leather and textile industries**
0601	Leather industry waste
0602	Textile industry waste
07	Waste from oil refining, natural gas purification and carbon pyrolitc treatment
0701	Muds and solid waste containing hydrocarbons
0702	Used filtration clays
0703	Waste from coal pyrolitic treatment
0704	Waste from natural gas purification
0705	Waste from oil regeneration
08	**Waste from mineral chemistry processes**
0801	Acid solutions waste
0802	Alcaline solutions waste
0803	Salt waste and their solutions
0804	Waste containing metals
0805	Waste from in situ waste
0806	Waste from sulfur chemistry and desulfuration processes
0807	Waste from halons chemistry
0808	Waste from phosphates chemistry
0809	Waste from mineral chemistry
09	**Waste from organic chemistry processes**
0901	Waste from basic organic products making, formulation, distribution and use (MFDU)
0902	Waste from basic organic products MFDU
0903	Waste from organic dyes and pigments MFDU
0904	Waste from organic pesticides MFDU
0905	Waste from pharmaceutical products MFDU
0906	Waste from grease, soaps, detergents, disinfectants and cosmetic substances
0907	Waste from MFDU of chemical products resulting from fine chemistry and of chemical products not mentioned elsewhere
10	**Waste from MFDU coating products (polish, vitreous (glass) enamels), putty (fillers) and printing inks**
1001	Waste from paints and polish
1002	Waste from MFDU printing inks
1003	Waste from MFDU glues and fillers (putty) including sealing (water-proofing) products
11	**Waste from photographic industry**
1101	Waste from photographic industry
12	**Waste from thermic processes**
1201	Waste from electric power plants and other combustion plants
120101	Fly ash
120102	Sulfuric acid
1203	Pyrometallurgy aluminum waste
1204	Waste from lead pyrometallurgy
1205	Waste from zinc pyrometallurgy
1206	Waste from copper pyrometallurgy
1207	Waste from cement (concrete), lime and plaster manufacture and by-products
13	**Inorganic waste containing metals from metals treatment and coating, and from non-irony metals hydrometallurgy**

Code	Designation
1301	Liquid and mud waste from metals (for example, galvanic processes, zinc coating, stripping, engraving, phosphatisation, alkaline cleaning and degreasing
1302	Mud and solids from non-irony hydrometallurgic metals
1303	Mud and solids from waste tempering processes
14	**Waste from shaping and surface mechanical treatment metals and plastic materials**
1401	Waste from shaping (ironing, soldering, pressing, stretching, turnmilling/ turning, cutting and filing)
1402	Waste from hydraulic and steam degreasing
15	**Used oils except food oils**
1501	Used brake hydraulic and liquid oils
1502	Used engine, gear-box and lubricating oils
1503	Used isolating, heat-transfer and other fluids
1504	Bilge oils hydrocarbons (fuels)
1505	Content of hydraulic/ hydrocarbon separators
1506	Used oils non-specified elsewhere
16	**Waste from organic substances used as solvents**
1601	Waste from metals degreasing and machine maintenance
1602	Waste from textile cleaning and natural products degreasing
1603	Waste from electronic industries
1604	Coolants and aerosol and moss propellers
1605	Waste from solvents and coolants recovery (distillation caps/ waste)
17	**Construction and demolition waste**
1701	Isolating materials
18	**Waste from waste-treatment plants, sanitation and used-water plants, and water industry**
1801	Waste from waste burning or municipal pyrolyse and like wastes from small businesses, industries and administration offices
1802	Waste from specific physico-chemical industrial wastes (e.g., dechroming, decyanuring and neutralization)
1803	Vitrified waste and waste from vitrification
1804	Discharge leachates (= *toxic liquids from waste in waste landfills*)
1805	Waste from used-water treatment plants non-specified elsewhere
19	Household and like waste from small businesses, industries and offices, including the parts collected separately
1901	Separately collected parts
20	**Wastes non-specified elsewhere**
2001	End-of-life vehicles
2002	Discarded equipment and shredding waste
2003	Explosives waste
2004	Batteries and accumulators
2005	Waste from the cleaning of transport and storage tanks

Source: List of Hazardous Waste (Regulation No.2000-2339)

(3) International Conventions and Treaties

Below are the main international conventions and treaties relating to environmental protect which Tunisia has ratified.

- Convention on International Trade in Endangered Species of Wild Fauna and Flora

(Washington Convention)
- African Convention on the Conservation of Nature and Natural Resources
- Agreements for protection of trans-boundary movements of Migratory Birds
- Convention on Wetlands of International Importance especially as Waterfowl Habitat (Ramsar Convention)
- Convention on Biological Diversity
- United Nations Convention to Combat Desertification in Those Countries Experiencing Serious Drought and/or Desertification, Particularly in Africa
- Bern Convention on the Conservation of European Wildlife and Natural Habitats
- International Convention for the Prevention of Pollution from Ships, 1973, as modified by the Protocol of 1978 relating thereto (MARPOL 73/78 Convention)
- Stockholm Convention on Persistent Organic Pollutants
- United Nations Framework Convention on Climate Change

8.2.3 Overview of Environmental Impact Assessments

(1) Procedures of Environmental Impact Assessments (EIAs)

Procedures for EIAs have been established by decree No.91-362 in 1991, and some modifications have been made by decree No.2005-1991 dated July 11, 2005. The Annex-I of the decree, lists up 26 projects as category A and 24 projects as category B. Category A is deemed to be equivalent to category B and Category B equivalent to category A respectively under the "Japan International Cooperation Agency (JICA) Guidelines for Environmental and Social Considerations (April 2010)". Establishment of an EIA is mandatory for projects classified as category A and category B. In addition, 18 projects are listed in Annex-II of the said decree. These projects are not required to conduct an EIA, but the implementing agency is required to take measures as stipulated in the ordinance of the respective ministry responsible for the project (Table 8.2-6).

Since power plants of 300 MW or more are classified as category B, this Project belongs to category B by Tunisian regulations.

Table 8.2-6(1) Projects of Category A (Annex-I)

No.	Project
1	Management facility of domestic waste with treatment capacity not over 20t/day
2	Treatment/manufacturing facility for construction material, glass and ceramics
3	Drugs and medicines manufacturing facility
4	Non-ferrous metalworking facility
5	Metalworking/surface treatment facility
6	Oil/natural gas exploring/test-drilling project
7	Soil and sand-drilling and collecting site/metal mining site producing not over 300 thousand tons/year.
8	Sugar/yeast producing facility
9	Dyeing facility, knitting product washing facility
10	Development of industrial complex not over 15 ha
11	Urbanization project of 5 ha to 20 ha
12	Tourist area development project of 10 ha to 30 ha
13	Mineral fiber manufacturing facility
14	Food manufacturing/processing/storing facility

No.	Project
15	Meat processing facility
16	Vehicle (part) manufacturing/assembling factory
17	Dockyard
18	Airplane manufacturing/maintaining facility
19	Shellfish culture facility
20	Desalination facility in a factory or tourist facility
21	Sea-bathing/spa facility
22	Hotels of more than 300 beds
23	Paper/cardboard manufacturing facility
24	Elastomer/peroxide manufacturing facility

Source: Decree No. 2005-1991 related to Environmental Impact Assessment.

Table 8.2-6(2) Projects of Category B (Annex-I)

No.	Project
1	Oil refining plant, gasification/liquefaction facility with coal/oil shale treatment capacity of more than 500t/day
2	Power generation facility of more than 300 MW
3	Management facility of domestic waste with treatment capacity over 20t/day
4	Hazardous waste management facility
5	Cement/lime/plaster manufacturing facility
6	Manufacturing facility of chemicals, pesticide, paint, abrasive, and bleach generally considered as hazardous, unwelcome facility having bad effect on health.
7	Iron/steel manufacturing facility
8	Project concerning soil-drilling and natural resource development producing over 300 thousand tons/year.
9	Pulp-manufacturing and cellulose-processing facility
10	Project concerning construction of railways, main roads, highways, bridges and interchanges.
11	Project concerning construction of airport with runway of over 2100 m long.
12	Project concerning commercial port, fishing port and leisure port
13	Project concerning development of industrial area over 5ha.
14	Urbanization project with the area of over 20 ha
15	Tourist area development project of over 30 ha
16	Transportation facility for crude oil and gas
17	Municipal effluent treatment facility
18	Centralized treatment facility for industrial effluent
19	Tanner
20	Irrigation plant using treated water for agriculture
21	Large-scaled dam project
22	Agricultural project not listed in Annex-II
23	Desalination facility for drink water supply to urban areas
24	Hotels of more than 1000 beds
25	Extraction, treatment and washing facility for metals/non-metals
26	Phosphorus and its byproduct treatment facility

Source: Decree No. 2005-1991 related to Environmental Impact Assessment.

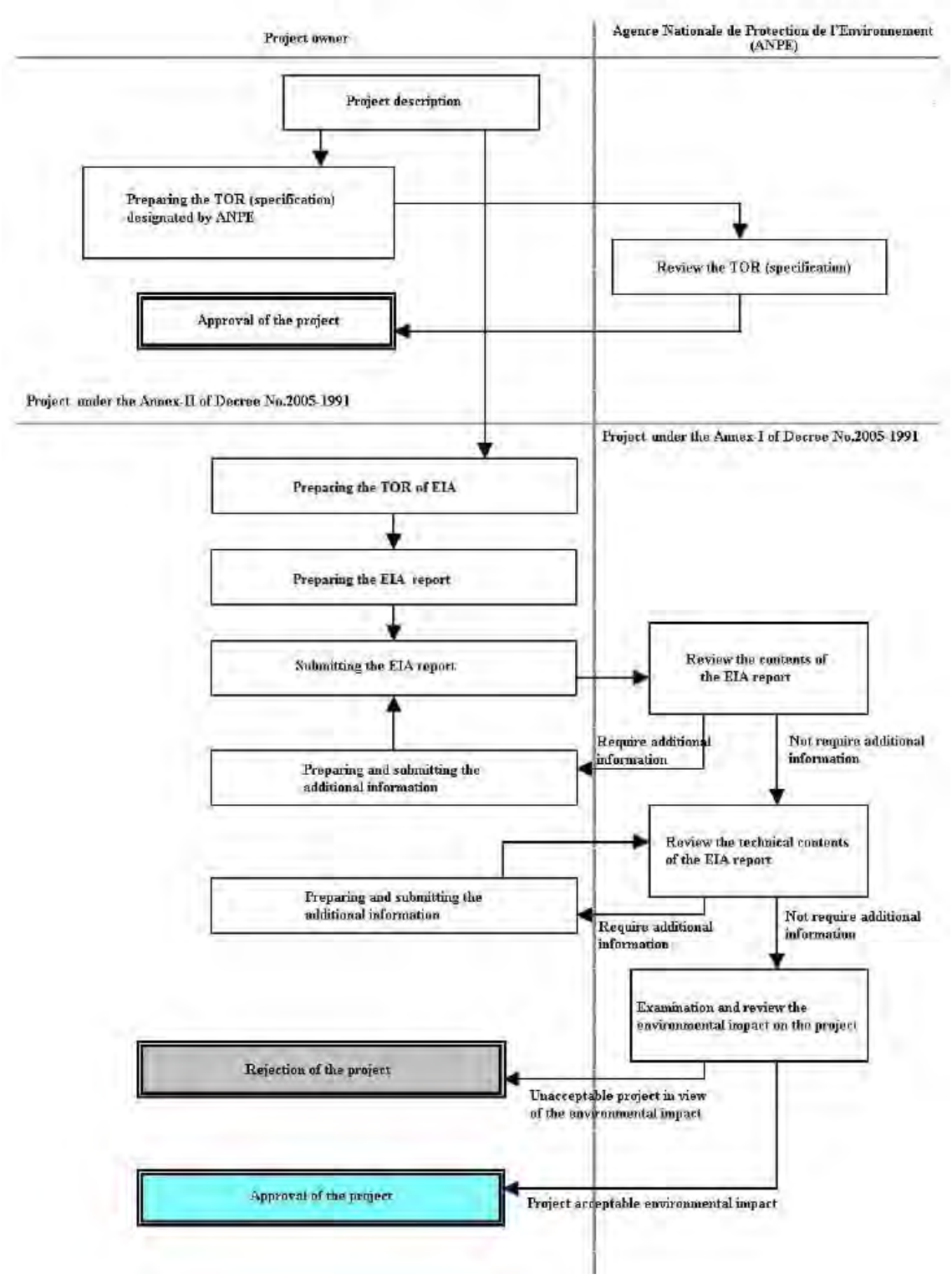
Table 8.2-6(3) Projects Listed in Annex-II

No.	Project
1	Urbanization project with an area of less than 5 ha; Touristic area development project of less than 10 ha
2	Project concerning construction of schools or educational facility
3	Pipeline installation project for water supply
4	Transmission line installation project not listed in Annex-I and not passing through a (legally-protected) vulnerable area.
5	Coastal area development project not cited in Annex-I
6	Olive oil extraction facility
7	Vegetable/animal oil extraction facility
8	Livestock farming facility
9	Textile industry not listed in Annex-I.
10	Large metal parts press/cutting facility
11	Hydrocarbon transport/storing facility, vehicle washing facility
12	Starch food manufacturing facility
13	Conventional rock quarry
14	Gas/chemical substances storage facility
15	Boiler/reservoir construction project, sheet metal plant
16	Laundry industry using water
717	Small-scaled water storage facility
18	Manufacturing facility for nutritional supplement and others

Source: Decree No.2005-1991 related to Environmental Impact Assessment.

For projects belonging to Annex-2, for which an EIA is not required, the implementing agency must submit to ANPE some necessary specification (design) documents and upon the evaluation/approval of ANPE, the project will be approved.

On the other hand, for projects belonging to category A or B, an EIA must be examined by ANPE for its content and technical justification. Within 21 working days after the submission of an EIA report for Category A projects and within three months for Category B projects, ANPE is supposed to issue its comments on the EIA. If no comments are received from ANPE, the project is deemed to be approved. In the case where ANPE's comments require further investigation, further time is required before receiving approval (Figure 9.1). In addition, an EIA is supposed to be executed not by the implementing agency itself but by an external professional organization (consulting firm or professional expert in environmental issues).



Source: Japan Bank for International Cooperation (JBIC) "Environmental profile of Tunisia" (2006) and JICA Study Team.

Figure 8.2-1 Flow of EIA Procedure

For the EIA of this project, STEG, through its bidding procedures, selected a Tunisian consulting firm TPE (Tunisia Protection of Environment). Starting from July 15, 2013, TPE is currently carrying out necessary investigations, targeting to finalize the EIA by mid-November 2013 with a view to obtaining final approval from ANPE by mid-February 2014.

(2) Contents of an EIA report

Decree No.2005-1991 stipulates that an EIA report shall include at least the following items.

a. A detailed overview of the project
b. Current situation of the project site and analysis of natural resources and other items that may be affected by the implementation of the project
c. Analysis of impacts the project can have on natural resources, flora and fauna, protected areas including forests, historical sites, protected breeds and national parks, etc.
d. Possible avoidance, reduction or measures together with their cost estimates that the implementing agency could take against estimated negative impacts to be caused by the implementation of the project
e. Detailed environmental management plan

(3) Gaps between the EIA Report and JICA Guideline

Table 8.2.7 shows the gaps between the items treated by the EIA report for Rades C and the items required by the JICA guidelines.

Table 8.2-7 Discrepancies between the EIA Report and the Contents required by the JICA Guidelines for Environmental and Social Considerations

Content	JICA Guidelines for Environmental and Social Considerations	Draft Final EIA Report	Gap and Action to be taken
Executive Summary	Concisely discusses significant findings and recommended actions.	N/A	There is a gap. The JICA Study Team will state it in the Team's final report.
Policy, Legal, and Administrative Framework	The framework within which the EIA report is to be carried out.	Chapter III	There is no gap.
Project Description	Describes the proposed project and its geographic, ecological, social and temporal context, including any off-site investments that may be required (e.g., dedicated pipelines, access roads, power plants, water supply, housing, or raw material and product storage facilities). It also indicates the need for any resettlement or social development plan. It normally includes a map showing the project site and the area affected by the project.	Chapter VI	There is no gap.
Baseline Data	Assesses the dimensions of the study area and describes relevant physical, biological, and socio-economic conditions, including all changes expected to occur before the project commences. Additionally, it takes into account	Chapter VIII	There is a lack of some baseline data. The JICA Study Team

Content	JICA Guidelines for Environmental and Social Considerations	Draft Final EIA Report	Gap and Action to be taken
	current and proposed development activities within the project area but not directly connected to the project. Data should be relevant to decisions about project site, design, operation, or mitigation measures, and it is necessary to indicate the accuracy, reliability, and sources of the data.		will state them in the Team's final report.
Environmental Impacts	Predicts and assesses the project's likely positive and negative impacts in quantitative terms, to the extent possible. It identifies mitigation measures and any negative environmental impacts that cannot be mitigated, and explores opportunities for environmental enhancement. It identifies and estimates the extent and quality of available data, essential data gaps and uncertainties associated with predictions, and it specifies topics that do not require further attention.	Chapter IX	There is no gap.
Analysis of Alternatives	Systematically compares feasible alternatives to the proposed project site, technology, design, and operation including the "zero option (without project)" situation in terms of the following: the potential environmental impacts; the feasibility of mitigating these impacts; the capital and recurrent costs; the suitability under local conditions; and the institutional, training, and monitoring requirements. For each of the alternatives, it quantifies the environmental impacts to the extent possible, and attaches economic values where feasible. It also states the basis for selecting the particular proposed project design, and offers justification for recommended emission levels and approaches to pollution prevention and abatement.	Chapter VII There is no case of "zero option"	There is no case of "zero option". The JICA Study Team will state them in the Team's final report.
Environmental Management Plan	Describes mitigation, monitoring, and institutional measures to be taken during construction and operation in order to eliminate adverse impacts, offset them, or reduce them to acceptable levels.	Chapter X, XI There is no "Environmental Monitoring Plan"	There is no "Environmental Monitoring Plan". The JICA Study Team discuss an "Environmental Monitoring Plan" with STEG and state it in the Team's final report.
Community Consultation	Includes a record of consultation meetings (date, venue, participants, procedures, opinions	N/A	The JICA Study Team

Content	JICA Guidelines for Environmental and Social Considerations	Draft Final EIA Report	Gap and Action to be taken
	of major local stakeholders and responses to them, and other items), including consultations for obtaining the informed views of the affected people, local nongovernmental organizations (NGOs), and regulatory agencies.		has supported to hold stakeholder meetings.
Annexes	World Bank safeguard policy OP 4.01 Annex B (i) List of EIA report contributors - individuals and organizations. (ii) References - written materials both published and unpublished, used in the study preparation. (iii) Record of interagency and consultation meetings, including consultations for obtaining the informed views of the affected people and local NGOs. The record specifies any means other than consultations (e.g., surveys) that were used to obtain the views of affected groups and local NGOs. (iv) Tables presenting the relevant data referred to or summarized in the main text. (v) List of associated reports (e.g., resettlement plan or indigenous people development plan).	N/A	JICA Guidelines make reference to some of these requirements under World Bank safeguard policy in accordance with the necessity for each respective project.

Source: JICA Study Team.

8.2.4 Protected Species in Tunisia

Protected species lists of flora and fauna in Tunisia (19 July, 2006) are shown in Table 8.2-8 and Table 8.2-9 respectively. Capturing and picking of these species are prohibited and for certain number of species their natural habitat is designated as part of national park etc. for protection purpose. Species listed as red list category under IUCN (International Union for Conservation of Nature and Natural Resources) and species regulated for international transactions under CITES (Convention on International Trade in Endangered Species of Wild Fauna and Flora) are marked for reference together with category and rank.

Table 8.2-8 Proteced Species of Flora in Tunisia (19 July, 2006)

Class	Order	Family	Scientific Name	English Name	Conservation Sites	
					IUCN [1] 2013/Jan	CITES [2] 2013/Jun
Magnoliopsida	Fagales	Fagaceae	*Castanea sativa*	Chestnut	-	-
Magnoliopsida	Fagales	Fagaceae	*Quercus afares*	Oak	-	-
Pinopsida	Pinales	Pinaceae	*Cedrus atlantica*	Atlas Cedar	EN	-
Pinopsida	Pinales	Cupressaceae	*Cupressus simperverens*	Mediterranean Cypress	-	-
Magnoliopsida	Sapindales	Aceraceae	*Acer monspessulanurm*	Maple	-	-
Magnoliopsida	Rosales	Rosaceae	*Prunus avium*	Wild Cherry	-	-
Magnoliopsida	Rosales	Cannabaceae	*Celtis australis*	European Nettle Tree	-	-
Magnoliopsida	Rosales	Ulmaceae	*Ulmus compestris*	Field Elm	-	-
Magnoliopsida	Sapindales	Anacardiaceae	*Pistacia atlantica*	Mt. Atlas mastic	-	-

Class	Order	Family	Scientific Name	English Name	Conservation Sites	
					IUCN [1] 2013/Jan	CITES [2] 2013/Jun
				tree		
Magnoliopsida	Fabales	Leguminosea	*Acacia radiana*	-	-	-
Magnoliopsida	Polygonales	Polygonaceae	*Calligonum azel*	-	-	-
Magnoliopsida	Polygonales	Polygonaceae	*Calligonum arich*	-	-	-
Magnoliopsida	Rosales	Rosaceae	*Cotoneaster racemiflora*	-	-	-
Magnoliopsida	Fabales	Leguminosea	*Genista saharae*	-	-	-
Magnoliopsida	Lamiales	Lamiaceae	*Marrubium deserti*	-	-	-
Magnoliopsida	Gentianales	Asclepiadaeae	*Periploca laevigata*	-	-	-
Magnoliopsida	Rosales	Rosaceae	*Poterium spinosum*	-	-	-
Magnoliopsida	Rosales	Rosaceae	*Prunus syriaca*	Mirabelle Prune	-	-
Magnoliopsida	Rosales	Rosaceae	*Sorbus aria*	Whitebeam	-	-
Magnoliopsida	Solanales	Solanacea	*Withania frutescens*	-	-	-
Magnoliopsida	Fabales	Leguminosea	*Anthyllis barba jovis*	Beard of Jupiter	-	-
Magnoliopsida	Fabales	Leguminosea	*Anthyllis sericea*	-	-	-
Magnoliopsida	Caryophyllales	Chenopodia-ceae	*Atriplex mollis*	-	-	-
Magnoliopsida	Polygonales	Polygonaceae	*Calligonum comosum*	-	-	-
Magnoliopsida	Rosales	Rhamnaceae	*Rharmnus frangula*	-	-	-
Magnoliopsida	Brassicales	Brassicaceae	*Oudneya africana*	-	-	-
Magnoliopsida	Fabales	Leguminosea	*Prosopis stephaniana*	-	-	-
Magnoliopsida	Rhamnales	Rhamnaceae	*Ziziphus spinachus*	-	-	-
Magnoliopsida	Sapindales	Anacardiaceae	*Rhus tripartitum*	-	-	-
Liliopsida	Cyperales	Gramineae	*Aristida pulmosa*	-	-	-
Liliopsida	Cyperales	Gramineae	*Aristida ciliate*	-	-	-
Liliopsida	Cyperales	Gramineae	*Aristida obtuse*	-	-	-
Liliopsida	Cyperales	Gramineae	*Cymbopogon schoenantus*	-	-	-
Liliopsida	Cyperales	Gramineae	*Dactylis glomerata*	-	-	-
Liliopsida	Cyperales	Gramineae	*Digitaria commutata*	-	-	-
Liliopsida	Cyperales	Gramineae	*Pennisetum dichotomum*	-	-	-
Liliopsida	Cyperales	Gramineae	*Pennisetum elatum*	-	-	-
Liliopsida	Cyperales	Gramineae	*Pennisetum Sotaceum*	-	-	-
Liliopsida	Poales	Poaceae	*Cecnchrus ciliaris*	African Foxtail Grass	-	-
Liliopsida	Poales	Poaceae	*Tricholaena lanerife*			
Liliopsida	Cyperales	Gramineae	*Panicum turgidum*	-	-	-
Liliopsida	Cyperales	Gramineae	*Stipa fontasii*	-	-	-
Liliopsida	Liliales	Asphodela-Ceae	*Asphodelus acaulis*	-	-	-
Magnoliopsida	Scrophulariales	Scophularia-ceae	*Anarrhinum brevifolium*	-	-	-
Liliopsida	Liliales	Colchicaceae	*Colchicum autonnale*	Autumn Crocus	-	-
Gnetopsida	Ephedrales	Ephwdraceae	*Ephedra alata alenda*	-	LC	-
Magnoliopsida	Malvales	Cistaceae	*Helianthermum confertum*	-	-	-
Liliopsida	Cyperales	Gramineae	*Sporobolus marginatus*	-	-	-
Magnoliopsida	Rosales	Rosaceae	Rosaceae	Rose	-	-
Magnoliopsida	Violales	Violaceae	*Viola* spp.	-	-	-
Liliopsida	Orchidales	Orchidaceae	*Orchis* spp.	Orchid	-	II
Liliopsida	Liliales	Liliaceae	Liliaceae	Tulip	-	-
Magnoliopsida	Primulales	Primulaceae	*Cyclamen* spp.	Cyclamen	-	II

Class	Order	Family	Scientific Name	English Name	Conservation Sites	
					IUCN [1] 2013/Jan	CITES [2] 2013/Jun
Liliopsida	Liliales	Iridaceae	*Iris* spp.	-	-	-

Notes: Categoly of IUCN; **LC** (Least Concern), **NT** (Near Threatened), **VU** (Vulnerable), **EN** (Endangered), **CR** (Critically Endangered), **EW** (Extinct in the Wild)
Categoly of CITES; **I** (Appendices I), **II** (Appendices II), **III** (Appendices III)
Source; 1) http://www.iucnredlist.org/search
2) http://www.cites.org/eng/resources/species.html

Table 8.2-9 Proteced Species of Faune in Tunisia

Class	Order	Family	Scientific Name	English Name	Conservation Sites	
					IUCN [1] 2013/Jan	CITES [2] 2013/Jun
Mammalia	Artiodactyla	Bovidae	*Bubalus bubalis*	Water buffalo	-	-
Mammalia	Cetartiodatyla	Cervidae	*Cervus elaphus barbarus*	Red Deer	LC	III
Mammalia	Artiodactyla	Bovidae	*Addax nasomaculatus*	Addax	CR	I
Mammalia	Artiodactyla	Bovidae	*Oryx dammah*	Scimitar-horned Oryx	EW	I
Mammalia	Artiodactyla	Bovidae	*Gazella dorcas*	Dorcas Gazelle	VU	III
Mammalia	Artiodactyla	Bovidae	*Gazella dama mhorr*	Dama Gazelle	CR	I
Mammalia	Artiodactyla	Bovidae	*Gazella leptoceros*	Slender-horned Gazelle	EN	I
Mammalia	Artiodactyla	Bovidae	*Gazella cuvieri*	Cuvier's Gazelle	EN	I
Mammalia	Artiodactyla	Bovidae	*Ammotragus lervia*	Barbary Sheep	VU	II
Mammalia	Carnivora	Felidae	*Acinonyx jubatus*	Cheetah	VU	I
Mammalia	Carnivora	Mustelidae	*Lutra lutra*	Eurasian Otter	NT	I
Mammalia	Carnivora	Phocidae	*Monachus monachus*	Mediterranean Monk Seal	CR	I
Mammalia	Carnivora	Canidae	*Fennecus zerda*	Fennec Fox	LC	II
Mammalia	Carnivora	Hyaenidae	*Hyaena hyaena*	Striped Hyaena	NT	-
Mammalia	Carnivora	Mustelidae	*Mustela nivalis*	Least Weasel	LC	-
Mammalia	Carnivora	Felidae	*Leptailurus serval*	Serval	LC	II
Mammalia	Carnivora	Felidae	*Lynx caracal caracal*	Desert Lynx	LC	II
Mammalia	Eulipotyphla	Soricidae	*Crocidura russula*	White-toothed Shrew	LC	-
Mammalia	Rodentia	Hystricidae	*Hystrix cristata*	Crested Porcupine	LC	-
Mammalia	Rodentia	Ctenodactyli-dae	*Ctenodactylus gundi*	North African Gundi	LC	-
Mammalia	Chiroptera	-	All species of Chiroptera	Bat	LC - NT	II
Mammalia	Carnivora	Felidae	*Felis silvestris*	Wildcat	LC	II
Aves	Falconiformes	-	Falconiformes	Raptors	LC - EN	I – II
Aves	Strigiformes	Strigidae	All species of Strigidae	Owls	LC	II
Aves	Charadriiformes	Recurvirostri-Dae	*Recurvirostra avosetta*	Pied Avocet	LC	-
Aves	Charadriiformes	Scolopacidae	*Calidris* spp.	Sandpiper	LC	-
Aves	Charadriiformes	Scolopacidae	*Tringa* spp.	Redshank	LC	-
Aves	Charadriiformes	Glareolidae	*Cursorius* spp.	Courser	LC	-
Aves	Charadriiformes	Scolopacidae	*Glareola* spp.	Pratincole	LC	-
Aves	Charadriiformes	Charadriidae	*Charadrius* spp.	Plover	LC	-
Aves	Charadriiformes	Recurvirostri-	*Himantopus* spp.	Stilt	LC	-

Class	Order	Family	Scientific Name	English Name	Conservation Sites	
					IUCN [1] 2013/Jan	CITES [2] 2013/Jun
		Dae				
Aves	Anseriformes	Anatidae	*Anas strepera*	Gadwall	LC	-
Aves	Anseriformes	Anatidae	*Tadorna Tadorna*	Common Shelduck	LC	-
Aves	Anseriformes	Anatidae	*Anas platyrhynchos*	Mallard	LC	-
Aves	Anseriformes	Anatidae	*Cygnus* spp.	Swan	LC	-
Aves	Anseriformes	Anatidae	*Oxyura leucocephala*	White-headed Duck	EN	II
Aves	Charadriiformes	Laridae	Laridae	Gull	LC - NT	-
Aves	Podicipediformes	Podicipedi-Dae	Podicipedidae	Grebes	LC	II
Aves	Anseriformes	Anatidae	*Mergus* spp.	Smew	LC	-
Aves	Gruiformes	Rallidae	*Aenigmatolimnas marginalis*	Striped Crake	LC	-
Aves	Gruiformes	Rallidae	*Rallus* spp.	Rail	LC	-
Aves	Gruiformes	Rallidae	*Sterna* spp.	Tern	LC	-
Aves	Pelecaniformes	Pelecanidae	*Pelecanus* spp.	Pelican	LC	-
Aves	Procellariiformes	Hydrobatidae	*Hydrobates pelagicus*	European Storm-petrel	LC	-
Aves	Procellariiformes	Procellariidae	*Puffinus puffinus*	Manx Shearwater	LC	-
Aves	Procellariiformes	Sulidae	*Morus bassanus*	Northern Gannet	LC	-
Aves	Ciconiiformes	Ardeidae	*Egretta garzetta*	Little Egret	LC	-
Aves	Ciconiiformes	Ciconiidae	*Ciconia ciconia*	White Stork	LC	-
Aves	Phoenicopteriformes	Phoenicopteridae	*Phoenicopterus ruber*	American Flamingo	LC	II
Aves	Gruiformes	Gruidae	*Grus grus*	Common Crane	LC	II
Aves	Ciconiiformes	Threskiornithi-Dae	*Platalea leucorodia*	Eurasian Spoonbill	LC	II
Aves	Struthioniformes	Struthionidae	*Struthio camelus camelus*	Ostrich	LC	-
Aves	Gruiformes	Otididae	*Outarde houbara*	Houbara Bustard	VU	-
Aves	Passeriformes	-	Except bird pests in agriculture listed in the order of hunting	-	-	-
Amphibia	Caudata	Salamandridae	*Pleurodeles poireti*	Edough Ribbed Newt	EN	-
Amphibia	Caudata	-	Terrestrial salamanders	-	-	-
Amphibia	Anura	Bufonidae	All species of Bufonidae	True Toads	LC	-
Amphibia	Anura	Hylidae	*Hyla meriodionalis*	Mediterranean Tee Fog	-	-
Reptilia	Testudines	-	Tortues marines	Sea turtles	VU - CR	I
Reptilia	Testudines	Testudinidae	*Testudo gracea gracea*	Common Tortoise	VU	II
Reptilia	Testudines	Emydidae	*Emys orbicularis*	European Pond Turtle	NT	-
Reptilia	Testudines	Geoemydidae	*Mauremys leprosa*	Mediterranean Turtle	VU	-

Class	Order	Family	Scientific Name	English Name	Conservation Sites	
					IUCN [1] 2013/Jan	CITES [2] 2013/Jun
Reptilia	Squamata	Gekkonidae	Gekkonidae	Geckos	LC	-
Reptilia	Squamata	Agamidae	Agamidae	Agamas	LC	-
Reptilia	Squamata	Chamaeleoni-dae	*Chamaeleo chamaeleon*	Mediterranean Chameleon	LC	II
Reptilia	Squamata	Lacertidae	Lacertidae	Lezards	LC - CR	-
Reptilia	Squamata	Scincidae	Scincidae	Scinques	LC	-
Reptilia	Squamata	Viperidae	Viperidae	Viper	LC - VU	-
Reptilia	Squamata	Elapidae	*Naja arabica*	-	LC	II
Reptilia	Squamata	Boidae	*Eryx jaculus*	-	-	II
Insecta	Mantodea	-	Mantodea	Mantis	-	-
Insecta	Phasmatodea	Phasmatidae	Phasmatidae	Phasma	-	-
Insecta	Lepidoptera	Papilionidae	*Papilio* spp.	Swallowtail	-	-
Insecta	Coleoptera	Lucanidae	*Lucanus* spp.	-	-	-
Insecta	Coleoptera	Scarabaeidae	*Scarabaeus* spp.	Scarabee	-	-

Notes: Categoly of IUCN; **LC** (Least Concern), **NT** (Near Threatened), **VU** (Vulnerable),
EN (Endangered), **CR** (Critically Endangered), **EW** (Extinct in the Wild)
Categoly of CITES; **I** (Appendices I), **II** (Appendices II), **III** (Appendices III)
Source; 1) http://www.iucnredlist.org/search
2) http://www.cites.org/eng/resources/species.html

Table 8.2-10 shows relation between the international conventions and Tunisian laws relating to protect wildlife.

Table 8.2-10 Relationship between the International Conventions and Tunisian Laws

International sonventions	Tunisian Laws
Convention on Wetlands of International Importance especially as Waterfowl Habitat (Ramsar Convention)	Law No.86-64
Convention on International Trade in Endangered Species of Wild Fauna and Flora (Washington Convention)	Law No.74-12
Agreements for protection of trans-boundary movements of Migratory Birds	Law No.86-63
Convention on Biological Diversity	Law No.93-45
Bern Convention on the Conservation of European Wildlife and Natural Habitats	Law No.95-75

Source: Japan Bank for International Cooperation (JBIC) "Environmental profile of Tunisia" (2006)

8.3 Comparison of Alternatives Including Zero Option

8.3.1 Zero option (the case where the project is not implemented)

In case the project is not implemented, the predicted problem of power supply shortage will not be so solved (Table 8.3-1).

Table 8.3-1 Comparison with the Zero Option

Items	Project implementation	Zero option
Technical aspects	- Construction of the power plant within the existing plant site	N/A
Economic aspects	- The project, in spite of construction cost, will contribute	- Although no construction cost is needed, shortage of electric

Items	Project implementation	Zero option
	to the promotion of economic growth of Tunisia. - Contribution to the regional economic vitalization is also expected, including employment of local people, utilization of local materials, etc.	supply will interfere with the economic growth of Tunisia. - There will be no contribution to the local economy as well, including job opportunities for local people.
Environmental-social consideration	- Certain environmental impact is predicted, although this project is an additional installation to the existing facility. Appropriate environmental protection measures shall be taken.	- Maintaining the status-quo (certain environmental impact from the existing facility is predicted).

Source: JICA Study Team

8.3.2 Comparison with Renewable Energy

The government of the Republic of Tunisia has been trying to promote renewable enery, wind power through STEG and solar photovoltaic, through the National Agency for Energy Management (Agence Nationale de Maîtrise d'Energy; ANME). However, realized generating capacity remains still very limited (Wind power 245 MW, Solar photovoltaic 6 MW etc. at the end of 2012). Constraints of appropriate location for installation, necessity for constructing new massive transmission lines, needs to construct an additional power plant during night time in case of solar panels, still high cost for installation are some of the reasons for not being able to replace the proposed project by renewable enrgy (Table 8.3-2).

Table 8.3-2 Comparison with Renewable Energy

Item	Proposed combined cycle project	Renewable energy
Technical aspects	- The new power plant can cope with the projected electricity demande increase in 2017, because the site has already been preparated. - Construction on existing site of Rades does not require any additional infrastructure such as road, gas pipeline.	- Given the past record and no preparation made until now, it is quite difficult to install necessary generation capacity within the required time. - Additional power plant is also needed during night time in case of solar panels. - Once project sites are selected, study for transmission lines is needed and new road construction may be required depending on sites.
Economic aspects	- High efficiency in power generation and lower cost per power generation unit (US$ 0.09/kWh).	- Still high cost for installation of facilities. In case of solar panels, a total surface of 400 ha (0.8ha/MW) is needed with an estimated cost of 700 Million US$ for installment (US$ 1,400/kW) to get an equivalent capacity of 500 MW, without taking account of low

Item	Proposed combined cycle project	Renewable energy
		operation rate of solar panels. - Power generation cost is estimated US$ 0.2-0.4/kWh. - Additional construction cost of transmission lines or new roads, as well as an additional power plant for the night time is also needed.
Environmental-social consideration	- CO_2 is produced by the project operation. - The project relates to the expansion of the existing power plant within the site, and is not supposed to cause additional significant impact on the natural environment. - Rades A Power Plant started operation in 1985, Rades B PP in 1998 and Rades II PP in 2002. The existing power plants have about 30 years of history within the local community through operation and expansion. The project relates to the expansion of the existing power plant within the site, and significant impact on the local community can be avoided.	- Practically no CO_2 emission, but an additional power plant, whice is needed during night time, will produce CO_2, if a thermal power plant is required. - Since huge land is necessary for installation, some impact may occur to natural environment. - Resettlement may be necessary depending on the location of transmission lines or new roads. - Since a new project (s) is to be launched, local community may suffer from some changes.

Source: JICA Study Team.

8.3.3 Consideration of an Alternative Site

According to the results of the consideration of a balance between electrical power supply and demand in the survey regarding transmission network enhancement, it was concluded that northern Tunisia would be the most efficient location selection for introducing a new power plant. However, the initial planned site at Kalaat El Andalous involves land acquisition. The process of land acquisition requires a long period of time, leading to the extension of the project implementation period, and considering that there is no candidate site immediately available northern Tunisia, STEG selected the vacant area of Rades TPPs site as the alternative site for the project (Table 8.3-3).

Table 8.3-3 Consideration of an Alternative site

Items	The project site	Kalaat El Andalous
Technical aspects	- There are already surrounding roads constructed, improved and ready for transportation of materials.	- Construction and improvement of the surrounding roads is essential for transportation of materials.
Economic aspects	- The land for the project is already available and acquisition of new land is not necessary.	- Acquisition of new land is necessary.

Items	The project site	Kalaat El Andalous
Environmental-social consideration	- The project relates to the installation of a new power plant in an existing power plant site, and environmental impact related to the new facility is insignificant. - Additionally, the existing power plant is integrated into the local society and significant impact on the local society can be avoided.	- New acquisitions of land will significant affect the local society.

Source: JICA Study Team.

8.3.4 Consideration of Fuel

Rades TPP is already equipped with a gas station connected to the domestic gas supply network of Tunisia. In view of a stable gas supply and low environmental effects compared to other fuel, natural gas will be chosen as the fuel to be used in the Project (Table 8.3-4).

Table 8.3-4 Consideration of Fuel

Items	Natural gas	Oil	Coal
Technical aspects	- Fuel can be supplied only by building a pipeline between the site and the existing gas station.	- There is only a light fuel oil tank for auxiliary use. In order to use oil as the main fuel, a new jetty with fuel discharge facility needs to be constructed.	- Construction of a new jetty equipped with a coal discharge facility is needed. - A coal storage site and ash disposal site must be constructed as well.
Economic aspects	- Fuel costs are expensive, but construction costs for fuel supply facilities are very low, because there is the existing gas station by the project site.	- High fuel costs are expected, as well as high construction costs for fuel supply facility.	- Although fuel costs are low, construction costs of fuel supply facility will be high. - In addition, construction of a new coal storage site and ash disposal site requires land acquisition.
Environmental-social consideration	- As natural gas contains almost no ash and sulfur, dust and SOx will not be generated. - Amout of CO_2 emissions per thermal unit in the combustion natural gas is about 75% compared to oil combustion and about 60% compared	- Ash and sulfur will be generated and dust collector and de-sulfurization equipment will be needed. - Amout of CO_2 emissions per thermal unit in the combustion oil is about 130% compared to natural gas combustion and	- Coal generates ash and dust collecting equipment will be needed. - De-sulfurization equipment will also be necessary depending on the sulfur contents of coal. - Land acquisition is also necessary and it is expected that this

Items	Natural gas	Oil	Coal
	to coal combustion[2].	about 75% compared to coal combustion[2].	will have a significant impact on the local society. - Amout of CO_2 emissions per thermal unit in the combustion coal is about 170% compared to natural gas combustion and about 130% compared to oil combustion[2].

Source: JICA Study Team.

8.3.5 Consideration of Power Generation Method

In the case of using natural gas as fuel, a combined cycle system would be adopted for its advantage in high efficiency compared to other power generation methods and economic performance (Table 8.3-5).

Table 8.3-5 Consideration of Power Generation Method

Item	Combined Cycle	Conventional Thermal Power Generation
Technical aspects	- Power generation with only gas turbine would also be possible, while with relatively smaller generation power, resulting in a shorter construction period before starting operation.	- The plant could not start operation before all the facilities were completed, resulting in a longer construction period.
Economic aspects	- High efficiency in power generation and lower cost per power generation unit.	- Lower power generation efficiency compared to the combined cycle, resulting in higher cost per power generation unit.
Environmental-social consideration	- High power generation efficiency and lower CO_2 generation per power generation unit. - Amount of CO_2 emissions are estimated to be 0.519 ton/ MWh[3].	- Lower power generation efficiency compared to the combined cycle, resulting in higher CO_2 generation per power generation unit. - Amount of CO_2 emissions are estimated to be 0.608 ton/ MWh[3].

Source: JICA Study Team.

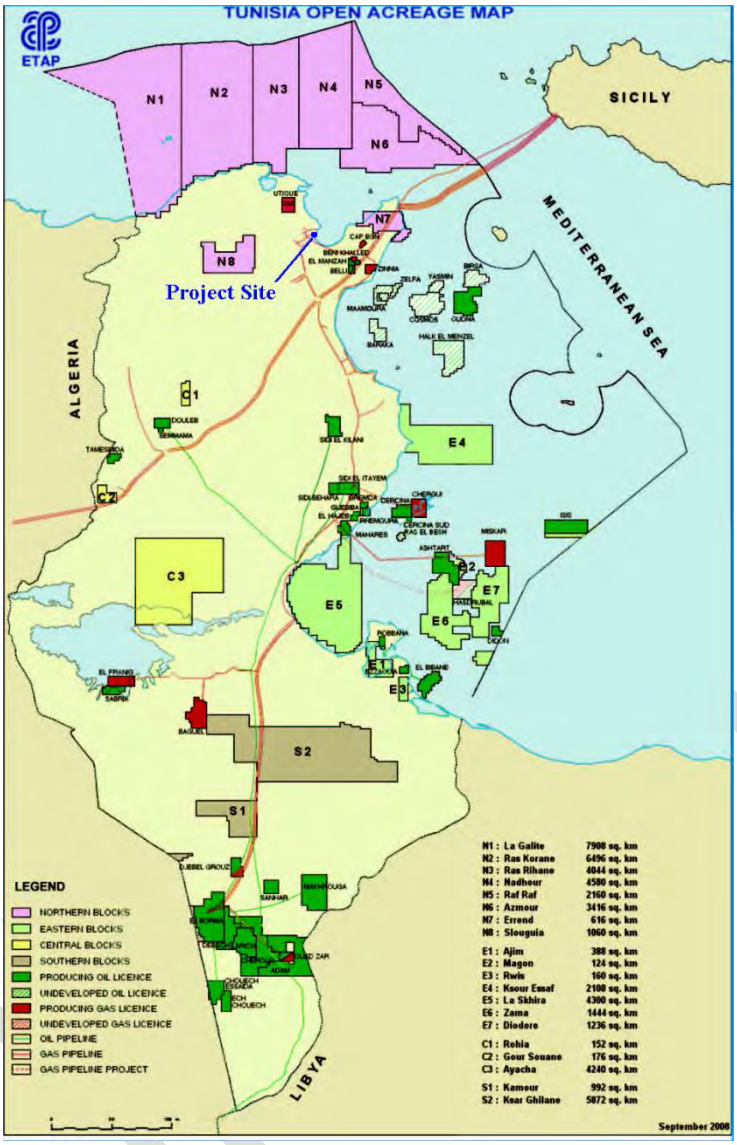
[2] IPCC (2006); Guidelines for Natural Gas Inventories.
[3] Central Research Institute of Electric Power Industry (2009); Evaluation of Power Generation Technologies based on Life Cycle CO_2 Emissions.

8.4 Consideration of Associated Facilities

The facilities associated to the power plant which is the main body of the project includes gas pipeline for fuel transportation and transmission line facilities. No other associated operation is planned as far as is understood. In this survey, JICA Study Team considered the gas pipelines and the transmission facility as “associated facilities”. Rades III switchyard was ascribed “associated facilities”, and Rades III switchyard was added the scope of the EIA study.

8.4.1 Gas Pipelines

Rades A&B Power Plant and Rades II Power Plant are supplied with natural gas from the national gas supply network, which connect with south part of Tunisia, Algeria, and Sicily (Figure 8.4-1). Rades C Power Plant will also obtain its natural gas supply from the adjacent station of the same gas supply network. Installation of a gas pipeline connecting Rades C Power Plant to the gas supply network has been integrated in the planning of the Project, and the main pipeline has been in use prior to the construction of Rades C Power Plant. In this regard, the gas pipeline between the national gas supply network and the adjacent station is not considered to be an associated facility of the project.



Source: http://www.docstoc.com/docs/50696250/TUNISIA-CONCESSION-MAP

Figure 8.4-1 National Gas Supply Network in Tunisia

8.4.2 Electric Transmission Facilities

(1) Rades III Swichyard

Rades C Power Plant will be connected to the national grid through the Rades III switchyard and existing Rades II sub-station within the plant site. This Rades III switchyard is used by only Rades C Power Plant and proposed by STEG to be constructed separately from Rades C Power Plant and with another source of funding. Rades C Power Plant not being able to function without this switchyard, the Rades III switchyard is considered to be an associated facility, necessitating the evaluation of its environmental impacts during construction phase and operation phase. EIA shows that there is no significant negative impact in both phases.

(2) Other transmission facilities

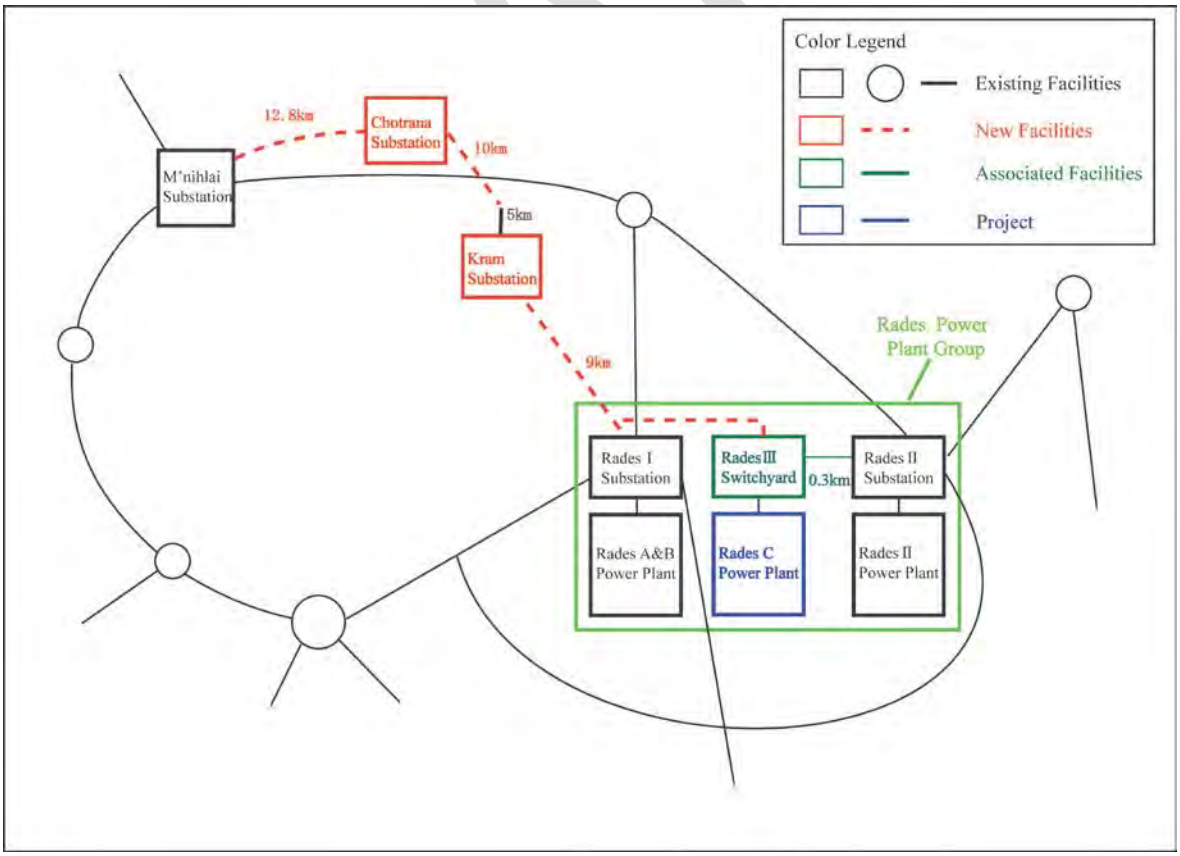
Current grid system in the great Tunis area is forming a cycle, making it prepared for an eventual transmission line accident. Our power system analysis shows that this double transmission line in the form of cycle has sufficient capacity to absorb additional electricity

from Rades C Power Plant. Therefore, even without the new substations and the underground transmission line which are described below, electricity generated by Rades C Power Plant can be transferred to customers through existing grid.

The 12th national grid enhancement plan developed by STEG includes the installation of a third transmission line in order to better prepare for a transmission line accident as well as to serve areas where electric demande is growing. The construction of new substations and transmission line is also designed in the context of the plan, and Rades C Power Plant will be also connected to the national grid through this new route (Figure 8.4-2).

In the 11th national grid enhancement plan developed by STEG, construction of Kram Substation and an underground transmission line connecting the project site to the substation have almost been completed with a loan from EIB (European Investment Bank). The new planned transmission route includes construction of Chotrana Substation 15 km from Kram Substation and an underground transmission line connecting to the existing Mnihla Substation, also with a new loan from EIB. Chotrana Substation is located on government-owned land acquired by STEG, and there will be no resettlement of local inhabitants. The underground transmission line will be buried in a new trench 0.65 m wide and 1.5 m deep dug along the existing main road and highway, and acquisition of land is not necessary.

Consequently, the new substations and the underground transmission line will be used to transmit electricity from the three power plants and not only from Rades C Power Plant, and they are not considered to be associated facilities of the Project.



Source: JICA Study Team

Figure 8.4-2 Schematic View of the Rades Area and Transmission Network

8.5 Scoping and Terms of Reference (TOR) for the Survey on Natural and Social Environment

8.5.1 Expected Environmental Impacts

Table 8.5-1 shows the scoping results of the expected environmental impacts of the survey, which was conducted in accordance with the JICA Guideline on Environmental Social Consideration.

Table 8.5-1 Scoping results

Item	No.	Impact Source	Rating		Predicted Impact
			Pre- / construction Phase	Operation Phase	
Pollution Control	1	Air Quality	B-	B-	**Construction phase:** - Production of dust is expected by land preparation and other construction work, but the impact will be temporary. - Generation of air pollutants (SOx, NOx, etc.) is predicted from the operation of heavy machinery and trucks, but the impact will be limited to only the surrounding area. **Operation phase:** - Natural gas is used as fuel and almost no SOx and dust will be generated. However, NOx is generated in the gas turbine operation.
	2	Water Quality	B-	B-	**Construction phase:** - Water turbidity is anticipated by excavation work, but the impact will be temporary. - It is expected that the impact of concrete wastewater and oil-containing wastewater is anticipated. **Operation phase:** - The impact of oil-containing wastewater, domestic wastewater, high salinity waste water, thermal wastewater, and other wastewater from the plant are expected by the plant operation.
	3	Wastes	B-	B-	**Construction phase:** - General waste and hazardous waste will be generated by the construction work. **Operation phase:** - General waste and hazardous waste will be generated
	4	Noise and Vibration	B-	B-	**Construction phase:** - Impact of noise and vibration is predicted caused by the operation of heavy machinery and trucks, but will be limited to the surrounding area. **Operation phase:** - Noise and vibration will be generated by the project operation. However, the nearest residential area is around 600m away, and STEG approves only the equipment satisfying the noise standard stipulated in Labor Law, and the environmental impact will be

Item	No.	Impact Source	Rating		Predicted Impact
			Pre- / construction Phase	Operation Phase	
					insignificant. - STEG approves only the use of equipment compliant to the noise generated standards, and the environmental impact of noise and vibration is not predicted within and around the project site.
	5	Subsidence	D	D	**Construction phase:** - Use of ground water is not in the plan. **Operation phase:** - Desalinated water will be used in the power plant.
	6	Odor	B-	B-	**Construction and Operation phases:** - If domestic waste from the workers' camp is not appropriately treated, foul odors may emanate from the rotten waste.
Natural Environment	7	Protected Areas	C-	C-	**Construction and Operation phases:** - The nearest protected area from the site is Chikly Island in Lake of Tunis located 6km east of the project site. There is also Bou kornin National Park 8km south-west of the site. As waste water is not discharged into Lake of Tunis, air pollution is the only possible environmental impact.
	8	Ecosystem	C-	C-	**Construction phase:** - The project relates to the installation of the additional power plantin the prepared vacant site which is not forest or marsh. There are no primary forests, natural forests and mangrove wetlands around the site. - The outlet of waste water faces shoaling beach, with no tidal flat or coral reef. - Zostera bed, which is commonly seen in Tunisia, constitutes a nursing ground for marine organisms. If there is Zostera bed located near the project site, it may be potentially affected by the water discharge from the construction work. - The existence of precious species around the project site is not identified, and if there are, potential impact of the construction work is predicted. **Operation phase:** - If there is Zostera bed located near the project site, it may be potentially affected by the increased thermal effluent. - By cooling water intake, the intake of organisms, and potential impact of plant effluent and oil-containing effluent on aqua organisms is predicted. Although high-salinity effluent from sea water desalination system will be discharged, it is mixed with large quantity of circulation water at the discharge canal and impact on aqua organisms is not predicted.
Social Environment	9	Resettlement	D	D	**Pre-construction phase:** - Land acquisition and relocation of the affected people

Item	No.	Impact Source	Rating		Predicted Impact
			Pre- / construction Phase	Operation Phase	
					by the project implementation is not predicted.
	10	Poor People	D	D	**Construction and Operation phases:** - Rades A Power Plant started operation in 1985, Rades B PP in 1998 and Rades II PP in 2002. The existing power plants have about 30 years of history within the local community through operation and expansion. The project relates to the expansion of the existing power plant within the site, and significant impact on the local community is not avoided. Consequently, the life of poor people in the region, if any, will not be significantly affected.
	11	Ethnic Minority Groups and Indigenous People	D	D	**Construction and Operation phases:** - As described above, the project can avoid significant change on the local society. Consequently, the life of ethnic minority groups and indigenous people in the region, if any, will not be significantly affected.
	12	Local Economy such as Employment and Livelihood Means	B+/B-	B+/B-	**Construction phase:** - Construction work may produce increased job opportunity for the local people and increased purchase of local materials. - Local economy, especially fisheries, may be affected by the turbid water discharged from the construction site. **Operation phase:** - The operation of the power plant may produce increased job opportunity for the local people and increased purchase of local materials. - Local economy, especially fisheries, may be affected by the discharged wastewater from the power plant into the sea.
	13	Land Use and Utilization of Local Resources	D	D	**Construction and Operation phases:** - The project relates to an installation of an additional power plant in the vacant are of the existing project site. The site of the existing power plant is not used as a local resource and the operation of the project will not affect the use of the local land and resources.
	14	Water Usage, Water Rights, etc	D	D	**Construction and Operation phase:** - There is no water source for agricultural water, industrial water, and drinking water in and srounding the site and the operation of the project will not affect the water use and water rights.
	15	Existing Social Infrastructure and Services	B-	B-	**Construction phase:** - Marine and land traffic will be increased, because of material and equipment transportation, so that the traffic may disturb the existing local traffic and marine traffic. **Operation phase:** - Commuting of power plant workers will increase the traffic volume of the surrounding roads, possibly leading to traffic jams.

Item	No.	Impact Source	Rating		Predicted Impact
			Pre- / construction Phase	Operation Phase	
	16	Social Institutions such as Social Infrastructure and Local Decision-making Institutions	D	D	**Construction and Operation phases:** - The project does not involve land acquisition and no damage of relation with the local decision-making institutions and other social institutions. - As described above, the project can avoid significant change on the local society. Consequently, any adverse effect on the relationship with the social institutions is not expected.
	17	Misdistribution of Benefits and Loss	B-	B-	**Construction and Operation phases:** - If unfair employment and subcontracting occur between the local people, this may lead to misdistribution of benefits and loss.
	18	Local Conflicts of Interest	B-	B-	**Construction and Operation phases:** - If unfair employment and subcontracting occur between the local people, this may lead to misdistribution of benefits and loss. - Conflicts between local residence and construction workers and power plant staff may occur because of changes in local customs if the construction workers and the power plant staff cannot understand local customs.
	19	Cultural Heritage	D	D	- Historical, cultural and/or archaeological property and heritage does not exist around the site.
	20	Landscape	D	D	- The existing power plant is already integrated into the local scenery, and the project will not affect the local landscape. There is no scenic area around the project site.
	21	Gender	D	D	**Construction and Operation phases:** - As described above, the project can avoid significant change on the local society. Consequently, any adverse effect on the gender is not expected.
	22	Children's Rights	D	D	**Construction and Operation phases:** - As described above, the project can avoid significant change on the local society. Consequently, any adverse effect on children's right is not expected. - No child labor has been conducted in STEG, and will never be admitted in the future as well.
	23	Infectious Diseases such as HIV/AIDS	B-	D	**Construction phase:** - A temporary influx of migrant labor during the construction period may increase the risk of sexual transmitted diseases, etc.
	24	Work Environment (Including Work Safety)	B-	B-	**Construction phase:** - High risk rate of accidents is predicted in construction work. **Operation phase:** - Work accidents of workers may occur.
Others	25	Accidents	B-	B-	**Construction phase:** - Without the implementation of an appropriate traffic safety training, accidents in water traffic and land

Item	No.	Impact Source	Rating		Predicted Impact
			Pre- / construction Phase	Operation Phase	
					traffic may happen. **Operation phase:** - Without the implementation of appropriate traffic safety training, accidents in land traffic may happen. - There is a risk of potential oil seepage from the light oil tanks.
	26	Cross-boundary Impact and Climate Change	B-	B-	**Construction phase:** - CO_2 will be produced by the construction work. However, since the construction volume is limited, the environmental impact, such as cross-boundary pollution, is predicted to be insignificant. **Operation phase:** - CO_2 will be produced by the project operation. However, since the output of the power plant is not large, the environmental impact, such as cross-boundary pollution, is predicted to be insignificant.

Notes; A+/-: Significant positive/negative impact is expected.
B+/-: Positive/negative impact is expected to some extent.
C+/-: Extent of positive/negative impact is unknown. (Further examination is needed, and the impact may be clarified as the study progresses.)
D: No impact is expected.
Source: JICA Study Team

8.5.2 TOR of the EIA Study

According to the scoping results, Table 8.5-2 shows the TOR which will be needed for the EIA study.

Table 8.5-2 TOR of the EIA Study

Environmental Items	Survey Items	Survey Method	Possible Countermeasures
Air Quality	- Relevant environmental standards - Meteorology - Current status of air quality	- Obtaining ambient air quality standards and emission gas standards. - Obtaining meteorological data (temperatures, moisture, wind directions, wind speeds, etc.) from the nearby weather centers. - Obtaining information of air pollutants (SO_2, NO_2, PM_{10}, etc.) - Predicting atmosphere diffusion by using simulation models and confirming that they meet air quality standards - Atmospheric diffusion simulations are calculated for the following 5 cases.	**Construction phase** - Taking preventive measures against air pollution. **Operation phase** - Pollution-control equipment will be installed to meet the gas emission standard.

Environmental Items	Survey Items	Survey Method	Possible Countermeasures
		〈In gas combustion〉 * Open-cycle system in Rades C * Combined-cycle system in Rades C * Polymerization of Rades A&B and Rades II 〈In diesel-oil combustion〉 * Open-cycle system in Rades C * Combined-cycle system in Rades C - Atmospheric diffusion simulation under unusual climate phenomenon, such as inversion layers and down drafts that may occur depending on the facility design and climate conditions, are also calculated in the above-described 5 cases.	
Water Quality	- Relevant environmental standards - Bathymetric feature of the sea bottom - Current status of tidal current - Current status of water quality	- Obtaining water quality standards and effluent standards. - Obtaining information of the bottom topography - Obtaining information of tidal currents (tidal direction, current speed). - Obtaining information of marine water quality (temperatures, salinity, COD, nutrients) - Predicting thermal effluent diffusion by using simulation models and confirming the range of the diffusion. - Thermal effluent diffusion simulation is calculated with the following 6 cases (3 different tides x 2 situations) <Tidal hour> - Flood tide (12 hrs) - Ebb tide (12 hrs) - Slack tide (based on current information) <Situation> - Only Rades C - Cumulative impacts of Rades A&B and Rades II	**Construction phase** - Taking preventive measures against water pollution **Operation phase** - Satisfying effluent standards by installing a wastewater treatment facility for domestic and other types of water.
Wastes	- Relevant environmental standards	- Obtain waste handling standards/ manuals/ guidelines.	**Construction phase** - Establishing a disposal plan for industrial, domestic and hazardous waste **Operation phase** - The same as above
Noise and Vibration	- Relevant environmental	- Obtain noise level standards - Obtain the information of noise	**Construction phase** - Taking preventive measures for

Environmental Items	Survey Items	Survey Method	Possible Countermeasures
	standards - Current status of noise and vibration	and vibration levels	noise and vibration **Operation phase** - Taking preventive measures for noise and vibration
Subsidence	- None	- None	- None
Odor	- Relevant environmental standards	- Obtain environmental standards for smell sources (odor).	**Construction phase** - Taking preventive measures for handling domestic waste **Operation phase** - The same as above
Protected Areas	- Location of protected areas	- Obtaining information regarding protected areas	**Construction and Operation phases** - Estimating the degree of the impact on protected areas, and taking preventive measures if significant impact on the areas is expected
Ecosystem	- Current habitat status of ecologically valuable habitat (Zostera bed) - Current habitat status of flora, mammals, birds, reptiles, amphibians, fish, and precious species	- Obtaining distribution information of Zostera bed - Obtaining distribution information of flora and fauna	**Construction phase** - Estimating the degree of the impact on ecologically important habitat (Zostera bed), and taking preventive measures if any impact on the habitat is expected. - In case any precious species are observed within the construction area or the affected area, appropriate mitigation measures will be developed and implemented. **Operation phase** - Estimating the degree of the impact on ecologically important habitat (Zostera bed), and taking preventive measures if any impact on the habitat is expected. - In case any precious species are observed within the project-affected area with air pollution, water turbidity, or thermal effluent diffusion, the degree of the impact will be estimated and preventive measures shall be taken if any impact on the habitat is expected.
Resettlement	- None	- None	- None
Poor People	- None	- None	- None
Ethnic Minority Groups and Indigenous People	- None	- None	- None
Local Economy such as	- Employment plan - Condition of fishery	- Check employment plan - Obtaining information regarding	**Construction phase** - A fair and transparent

Environmental Items	Survey Items	Survey Method	Possible Countermeasures
Employment and Livelihood Means		fishery	employment plan shall be developed. - Fair standards for subcontract and material purchases shall be developed. - The same as those addressed in "Water Quality" - Estimating the degree of the impact on fishery **Operation phase** - The same as above
Land Use and Utilization of Local Resources	- None	- None	- None
Water Usage, Water Rights, etc	- None	- None	- None
Existing Social Infrastructure and Services	- Current traffic volume	- Obtain the information of the traffic volume	**Construction phase** - Taking measures for reducing the traffic volume **Operation phase** - The same as above
Social Institutions such as Social Infrastructure and Local Decision-making Institutions	- None	- None	- None
Misdistribution of Benefits and Loss	- Employment plan	- Check employment plan	**Construction phase** - Taking fair employment plan - Local material shall be purchased and used to the possible extent through fair method such as bidding system. **Operation phase** - The same as above
Local Conflicts of Interest	- None	- None	- The same as those addressed in "Misdistribution of Benefits and Compensation"
Cultural Heritage	- None	- None	- None
Landscape	- None	- None	- None
Gender	- None	- None	- None
Children's Rights	- None	- None	- None
Infectious Diseases such as HIV/AIDS	- None	- None	**Construction phase** - Taking mitigation measures for public health
Work Environment (Including Work Safety)	- None	- None	**Construction phase** - Taking mitigation measures for work safety **Operation phase** - The same as those addressed in "Construction phase"

Environmental Items	Survey Items	Survey Method	Possible Countermeasures
Accident	- None	- None	**Construction phase** - Taking preventive measures for traffic accident **Operation phase** - The same as those addressed in "Construction phase" - Oil-seepage prevention measures shall be taken.
Cross-boundary Impact and Climate Change	- CO_2 will be generated from the existing power plants (1-2 stations) with the old facilities in the area	- The amount of reduced CO_2 amount will be calculated with the JICA Climate-FIT (Mitigation) calculation method	**Construction phase** - Taking measures for reducing the volume of CO_2 emissions **Operation phase** - Amount of CO_2 generation will be monitored

Source: JICA Study Team

8.6 Results of the Survey on Natural and Social Environment

8.6.1 Pollution Control

(1) Air Quality

According to the EIA Report for Rades II CCPP, the Ministry of Environment and Land Management measured the air quality in September 1995 in the surrounding area of the project site as part of the study entitled "Study of the Quality of the Air and Atmospheric Pollution in Tunisia" (Table 8.6-1). For reference, the "Tunisian Ambient Air Quality Standards" and the "IFC/EHS Guideline Value" (Genneral; 2007) is provided.

Compared with the standards of 1-hour average, the value of NO_2 and particulate matter does not exceed the standards at any locations. The air quality can be clean at that time, although Rades A Power Plant had already started operation in 1995. However, there was certain measure point where the value of NO_2 concentration was significantly higher than the average value.

Table 8.6-1 Summary of Ambient Air Quality (September, 1995)

(Unit: $\mu g/m^3$)

Parameter	Range (Average) (24hr averaging time)	Tunisian Ambient Air Quality Standards		IFC/EHS Guideline (General; 2007)
		Limit Value	Guide Value	
NO_2	2.7 - 92.9 (24.8)	600 (1hr)	400 (1hr)	200 (1hr)
SO_2	4.7 - 27.4 (14.9)	365	125	125
Particulate Matter	5 – 12 (8.6)	260 (1hr)	120 (1hr)	150 (PM_{10})

Source: EIA Report for Rades II CCPP

(2) Water Quality

The EIA Report for Rades II CCPP provides the measurement results of sea water quality in the surrounding area of the project site (Table 8.6-2). As described above, ambient water quality standards have not been prescribed in Tunisia. Therefore, the ambient water quality standards in Japan (human health, environmental protection) are shown in the table, for your reference.

The values of COD and TSS shown in the table are extremely high. These data might be an abnormal value in the measurement.

Table 8.6-2 Summary of Sea Water Quality (1993-1997)

Parameter	Unit	Results	Japanese Ambient Water Quality Standards (Human Health, Environmental Protection)
Temperature	°C	11.6 - 27.1	-
pH	-	7.65 - 8.42	7.8 - 8.3
Conductivity	μS/cm	37,700 - 63,000	-
COD	mg/L	1,080	< 2
TSS	mg/L	40,052 - 41186	< 7.5
DO	mg/L	5.5	-
Grease & Oil	mg/L	0.38	-
Chloride	mg/L	21,000 - 23,000	-
Sulfate	mg/L	2,558 - 5,206	-
Nitrate	mg/L	3.2	-
Fluoride	mg/L	0.74 - 0.9	< 0.8

Source: EIA Report for Rades II CCPP

(3) Noise

In the Rades II CCPP Project, the level of noise was measured on March 27 and 28, 1998, at the boundary of Rades II Power Plant (Table 8.6-3). As described above, Noise level standards for off-site has not been prescribed in Tunisia. Therefore, the guideline values for noise of the IFC/EHS Guidelines is shown, for your reference.

The project site is on the premise of Rades A&B Power Plant, which is adjacent to Rades II Power Plant, and it is not in a residential area. The noise level did not exceed the IFC/EHS guideline values when being compared to those for the industrial zone.

The residential area is approximately 600m away from the project site. Noise level reduces around 55dB on the residence area from the noise source in the project site due to distance decay effect.

Table 8.6-3 Summary of Noise Mesurement

Noise Level (dBA)	IFC/EHS Guideline (General; 2007)	
	Residential; Institutional; Educational	Industrial; Commercial
54.0 - 67.0	Day Time (07:00-22:00): 55	Day Time; 70
	Night Time (22:00-07:00): 45	Night Time: 70

Source: EIA Report for Rades II CCPP

8.6.2 Natural Environment

(1) Terrestrial Wildlife

According to the EIA Report for Rades II CCPP, The Rades II site was mainly unvegetated. The vegetation surrounding area was characterized by halophilic flora, the dominant species of which is salicorne arabica.

In addition, any precious faunas have not been recorded in the surrounding area of the Rades II site, excepting birds. Meanwhile, the following species of birds have been confirmed at the Lake of Tunis (Table 8.6-4).

These birds are mainly migrant birds, which are typically observed on the coastal line of Tunisia. However, nesting has not been confirmed in the surrounding area of the Rades II site.

Table 8.6-4 Aves Identified in the Lake of Tunis

English Name in the	Appropriate Species in Tunisia listed in	Conservation Sites

EIA Report	Avebase [1)]	National List	IUCN [2)] 2013/Jan
Heron	*Botaurus stellaris*		LC
	Ixobrychus minutus		LC
	Ardea cinerea		LC
	Ardea purpurea		LC
	Ardea alba		-
	Egretta garzetta	O	LC
	Egretta gularis		LC
	Bubulcus ibis		LC
	Ardeola ralloides		LC
	Nycticorax nycticorax		LC
Duck	*Tadorna ferruginea*		LC
	Tadorna tadorna		LC
	Anas strepera	O	LC
	Anas penelope		LC
	Anas platyrhynchos	O	LC
	Anas discors		LC
	Anas clypeata		LC
	Anas acuta		LC
	Anas querquedula		LC
	Anas crecca		LC
	Marmaronetta angustirostris		VU
	Netta rufina		LC
	Aythya ferina		LC
	Aythya nyroca		NT
	Aythya fuligula		LC
	Aythya marila		LC
	Somateria mollissima		LC
	Melanitta nigra		LC
	Clangula hyemalis		VU
	Bucephala clangula		LC
	Mergellus albellus		LC
	Mergus merganser	O	LC
	Mergus serrator	O	LC
	Oxyura leucocephala	O	EN
Lark	*Alaemon alaudipes*		LC
	Chersophilus duponti		NT
	Ammomanes cinctura		LC
	Ammomanes deserti		LC
	Ramphocoris clotbey		LC
	Melanocorypha calandra		LC
	Calandrella brachydactyla		LC
	Calandrella rufescens		LC
	Galerida cristata		LC
	Galerida theklae		-
	Alauda arvensis		LC
	Lullula arborea		LC
	Eremophila bilopha		LC
Gull	*Larus ichthyaetus*	O	LC
	Larus melanocephalus	O	LC

English Name in the EIA Report	Appropriate Species in Tunisia listed in Avebase [1)]	Conservation Sites	
		National List	IUCN [2)] 2013/Jan
	Larus minutus	O	LC
	Larus cirrocephalus	O	LC
	Larus ridibundus	O	LC
	Larus genei	O	LC
	Larus audouinii	O	NT
	Larus canus	O	LC
	Larus fuscus	O	LC
	Larus argentatus	O	LC
	Larus cachinnans	O	LC
	Larus hyperboreus	O	LC
	Larus marinus	O	LC
	Rissa tridactyla	O	LC
Cormoran	*Phalacrocorax carbo*		LC
	Phalacrocorax aristotelis		LC
	Phalacrocorax pygmaeus		LC
Flamingo	*Phoenicopterus ruber*	O	LC
Avocet	*Himantopus himantopus*	O	LC
	Recurvirostra avosetta		LC
Curlew	*Numenius phaeopus*		LC
	Numenius tenuirostris		CR
	Numenius arquata		NT
Spoonbill	*Plegadis falcinellus*		LC
	Platalea leucorodia	O	LC
Egret	Same Family as “Heron”		
Harrier	*Circus aeruginosus*	O	LC
	Circus cyaneus	O	LC
	Circus macrourus	O	VU
	Circus pygargus	O	LC
Plover	*Pluvialis squatarola*		LC
	Pluvialis apricaria		LC
	Pluvialis dominica		LC
	Pluvialis fulva		LC
	Vanellus vanellus		LC
	Vanellus gregarius		CR
	Vanellus leucurus		LC
	Charadrius leschenaultii	O	LC
	Charadrius alexandrinus	O	LC
	Charadrius hiaticula	O	LC
	Charadrius dubius	O	LC
	Charadrius morinellus	O	-
Grebe	*Tachybaptus ruficollis*	O	LC
	Podiceps auritus	O	LC
	Podiceps grisegena	O	LC
	Podiceps cristatus	O	LC
	Podiceps nigricollis	O	LC
Osprey	*Pandion haliaetus*		LC
Coot	*Crex crex*		LC
	Rallus aquaticus	O	LC

English Name in the EIA Report	Appropriate Species in Tunisia listed in Avebase [1)]	Conservation Sites	
		National List	IUCN [2)] 2013/Jan
	Porzana parva		LC
	Porzana pusilla		LC
	Porzana porzana		LC
	Porphyrio porphyrio		-
	Porphyrio alleni		-
	Gallinula chloropus		LC
	Fulica cristata		LC
	Fulica atra		LC
Sandpiper	*Xenus cinereus*		LC
	Actitis hypoleucos		LC
	Tringa ochropus	O	LC
	Tringa erythropus	O	LC
	Tringa nebularia	O	LC
	Tringa stagnatilis	O	LC
	Tringa glareola	O	LC
	Tringa totanus	O	LC
	Limosa limosa		NT
	Limosa lapponica		LC
	Arenaria interpres		LC
	Calidris canutus	O	LC
	Calidris pugnax	O	-
	Calidris falcinellus	O	-
	Calidris himantopus	O	LC
	Calidris ferruginea	O	LC
	Calidris temminckii	O	LC
	Calidris ruficollis	O	LC
	Calidris alba	O	LC
	Calidris alpina	O	LC
	Calidris minuta	O	LC
	Calidris subruficollis	O	-
	Lymnocryptes minimus		LC
	Gallinago media		NT
	Gallinago gallinago		LC
	Gallinago stenura		LC
	Scolopax rusticola		LC
	Phalaropus lobatus		LC
	Phalaropus fulicariu		LC
Tern	*Chlidonias niger*	O	LC
	Chlidonias leucopterus	O	LC
	Chlidonias hybrida	O	LC
	Sterna albifrons	O	LC
	Sterna bengalensis	O	LC
	Sterna caspia	O	LC
	Sterna dougallii	O	LC
	Sterna fuscata	O	LC
	Sterna hirundo	O	LC
	Sterna nilotica	O	LC
	Sterna sandvicensis	O	LC

Notes: Categoly of IUCN; **LC** (Least Concern), **NT** (Near Threatened), **VU** (Vulnerable), **EN** (Endangered), **CR** (Critically Endangered)
Source: EIA Report for Rades II CCPP
1) http://avibase.bsc-eoc.org/checklist.jsp?region=tn&list=clements
2) http://www.iucnredlist.org/search

(2) Marine Organism

On September 27, 2013, the water temperature was measured at 12 points () as shown in Figure 8.6-1. At 8 points, i.e. St.4 to St.12 except for St.7, benthos was collected. The collection procedures were as follows: divers collected bottom mud to the depth of 5cm using a square-shaped frame sized 30cm by 30cm, and the collected mud was strained with a 2mm-mesh screen. The speed of current was so fast at St.7 that the divers couldn't go under the water to collect mud (which resulted in missing data).

The survey result of temperature is shown in Table 8.6-5 and the one of benthos is shown in Table 8.6-6. At most of the measuring points, the bottom was made up of sand and silt. The vegetation of *Cymodocea nodosa* as "Zostera bed", which is a species of sea glass, was found only at St. 5 and St. 6 (Figure 8.6-2).

Source: EIA Report for Rades C Project

Figure 8.6-1 Loaction of Survey Point

Table 8.6-5 Depth and Water Temperature on the Survey Points

Station	Depth (m)	Temperature (°C)	
		Surface	Bottom
St.1	4.9	30.1	-
St.2	2.5	32.0	-
St.3	1.9	30.0	-
St.4	2.5	30.0	29.0
St.5	3.1	30.0	27.0
St.6	4.2	30.1	29.0
St.7	3.4	32.0	31.5
St.8	0.5	30.0	-
St.9	3.6	32.0	28.0
St.10	2.5	30.0	28.5
St.11	4.3	30.0	28.5
St.12	3.2	30.0	27.4

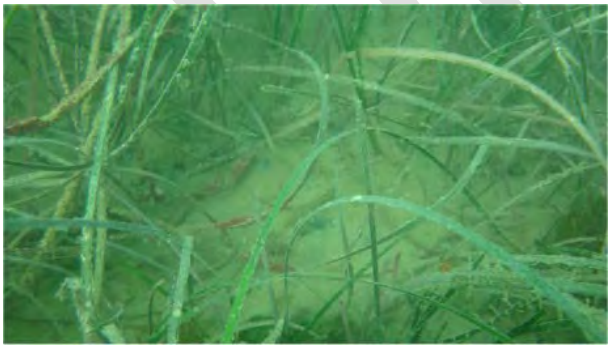
Source: EIA Report for Rades C Project

Table 8.6-6 List of Species on Each Survey Point

Station	Depth (m)	Species	Remarks
St.4	2.5	**[Flora]** None **[Fauna]** Polychaeta: *Myxicola* sp. Bivalvia: *Callista chione* *Venerupis pullastra*	*Myxicola* sp. is indicative of sheltered muddy areas
St.5	3.1	**[Flora]** Spermatophyta: *Cymodocea nodosa* **[Fauna]** Bivalvia: *Cerastoderma glaucum* *Kellia* sp. *Arca noe* *Mytilus galloprovincialis* *Pecten glaber* *Venerupis pullastra* *Ruditapes decussatus* *Loripes lacteus* Gastropoda: *Turitella turbona*	Although *Cymodocea nodosa* indicates facies without freshening (normal state of biocenose) the presence of *Cerasmoderma glaucum* rather mean intakes because of desalinated water also characterizes euryhaline and eurythermal biocenosis lagoon, facing it in the presence of *Loripes lacteus*.
St.6	4.2	**[Flora]** Spermatophyta: *Cymodocea nodosa* **[Fauna]** Crustacea: *Carcinus aestuarii* Bivalvia: *Ruditapes decussatus* *Arca noe*	*Carcinus aesturii* indicate the presence of polluted water but also enjoying a relatively larger than the other stations in hydrodynamics.
St.8	0.5	**[Flora]** None **[Fauna]** Polychaeta: *Heteromastus filiformis* Bivalvia: *Callista chione* *Loripes lacteus* *Ruditapes decussates* *Venerupis pullastra*	The presence of *Heteromastus filiformis*, which is a species which it contains important hemoglobin allows it to oxygenate, and indicates the presence of a large muddy fraction, indicating the containment medium (*Loripes lacteus*, *Cerithium vulgatum*).

Station	Depth (m)	Species	Remarks
		Turitella turbona	
St.9	3.6	**[Flora]** None **[Fauna]** Polychaeta: *Heteromastus filiformis* Bivalvia: *Kellia corbuloides* *Ruditapes* sp. *Venerupis* sp. Gastropoda: *Littorina punctata*	*Heteromastus filiformis* indicates a strong medium silt, the presence of *Kellia corbuloides* indicates that we are in the presence of a silt habitat quiet mode (calm waters protected)
St.10	2.5	**[Flora]** None **[Fauna]** Polychaeta: *Heteromastus filiformis* Bivalvia: *Ruditapes decustatus* *Ensis minor* Gastropoda: *Cerithium vulgatum*	Confined characterized by the presence of *Heteromsatus filiformis* and *Cerithium vulgatum.*
St.11	4.3	**[Flora]** None **[Fauna]** Polychaeta: *Paradonereis lyra* *Heteromastus filiformis* Bivalvia: *Ruditapes decustatus* *Venerupis pullastra* *Donax trunculus*	*Heteromastus filiformis* indicates a strong medium silt. The presence of *Donax trunculus* and *Ruditapes decustatus* indiqueraientt important contributions tropics
St.12	3.2	**[Flora]** None **[Fauna]** Polychaeta: *Paradonereis lyra* *Heteromastus filiformis* Bivalvia: *Donax trunculus* Gastropoda: *Cerithium vulgatum*	Despite the large muddy fraction *Heteromastus filiuformis*, which is a species hemoglobin is important, allowing it to oxygenate

Source: EIA Report for Rades C Project



St.5

St.6

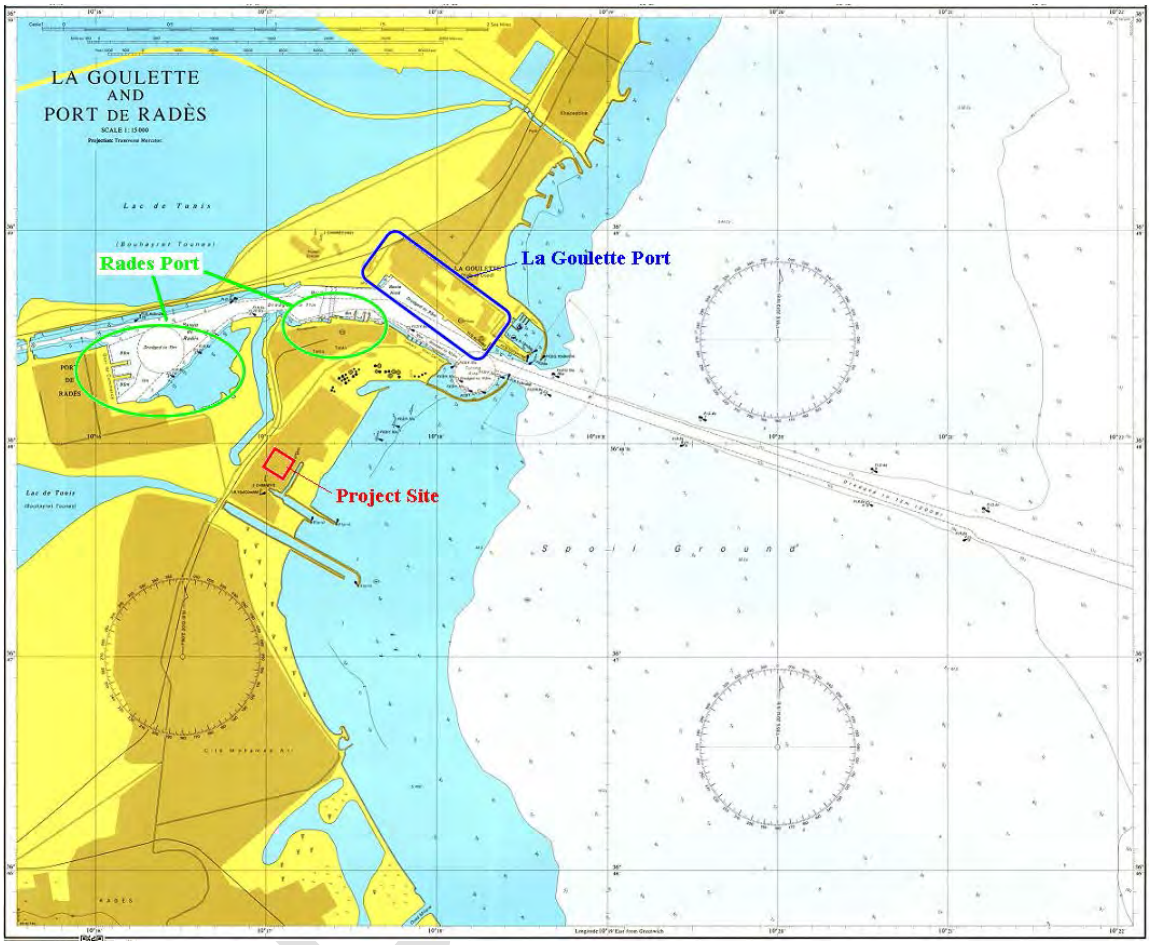
Source: EIA Report for Rades C Project

Figure 8.6-2 Scenery of Seaglass Vegetation

8.6.3 Social Environment

(1) Marine Traffic

Rades port is the largest marine port in Tunisia with seven container berths, one oil berth, one dry bulk berth and one berth for general cargo, all separated in two main piers. La Goulette port, just opposite to Rades port, is mainly used for passengers, car ferry and cruise tourists (Figure 8.6-3). Due to the depth of sea, maximum tonnage of vessels accessible to these two ports is 30,000 tons. In recent years, a total number of approximately 3,000 vessels per year are using these two ports (Table 8.6-7). Annual volume of treated cargo by Rades port alone is around 6 million of tons. According to the Port Authority (Office de la Marine Marchande et des Ports), about 1,600 container trucks are working per day, to which tank lorries for oil and many trucks for dry cargo or general cargo should be added.



Source: JICA Study Team

Figure 8.6-3 Location of Rades Port and La Goulette Port

Table 8.6-7 Evolution of ships traffic

(Unit: Vessels)

Year	Rades Port	La Goulette Port
1990	980	799
1991	1,023	705
1992	1,221	792
1993	1,388	773
1994	1,273	776
1995	1,321	861
1996	1,367	896

Year	Rades Port	La Goulette Port
1997	1,361	1,016
1998	1,417	940
1999	1,475	1,140
2000	1,672	1,179
2001	1,735	1,240
2002	1,727	1,277
2003	1,501	1,273
2004	1,567	1,358
2005	1,582	1,434
2006	1,531	1,466
2007	1,583	1,483
2008	1,540	1,405
2009	1,689	1,278
2010	1,560	1,342
2011*	1,276	1,036

Source: http://www.ommp.nat.tn/page.php?code_menu=10&code_page=26
* Office de la Marine Marchande et des Ports; Annual Report 2011

(2) Fishery

According to the Union Tunisienee de l'Agriculture et de la Peche (UTAP), there is no fishery operators engaged in fishery in the sea area in front of the Rades Power Plant group, because they cannot obtain income to cover fishing cost. There are approximately 2,000 fishermen in La Goulette, 80% of which operate grill net using a small boat. Remaining 20% are engaged in trawl net. The amount of catches is approximately 2,700 tons per year for trawl net, while that of for grill net is only 117 tons per year. Since trawl net in water shallower than 50m is restricted, the coastal area doesn't operate as a fishing ground. On the other hand, grill net is done on the coastal area to the north of La Marss (Figure 8.6-4). Target species of the gill net are shown in Table 8.6-8.

Source: Prepared by the JICA Survey Team based on a Google earth
Figure 8.6-4 Fishing Zone of Gill Net

Table 8.6-8 Target Species of the Gill Net

Einglish Name	Family	Einglish Name	Family
Fish		Meagre	Sciaenidae
Ell	Anguillidae	Picarel	Centracanthidae
Conger	Congridae	Wrasse	Labriade
Sardin	Clupeidae	Stargazer	Uranoscopidae
Lizarfish	Synodontidae	weever	Trachinidae
Hake	Merlucciidae	Blenny	Blenniidae
Cod	Gadidae	Barracuda	Sphyraenidae
Mullet	Mugilidae	Scabbard fish	Trichiuridae
Smelt	Atherinidae	Flatfish	Bothidae, Paralichthyidae
Garfish	Belonidae	Sole	Soleidae
Scorpionfish	Scorpaenidae	Cephalopoda	
Gurnard	Triglidae	Cuttlefish	Sepiidae
Seabass	Moronidae	Squid	Loliginidae, Ommastrephidae
Amberjack	Carangidae	Octopus	Octopodidae
Grunt	Haemulidae	Crustacea	
Seabream	Sparidae	Shrimp	Crangonidae
Goatfish	Mullidae	Prawn	Penaeidae

Source: Union Tunisienee de l'Agriculture et de la Peche

8.7 Environmental and Social Impact Evaluation

8.7.1 Construction Phase

(1) Pollution Control

1) Air Quality

Generation of dust is expected by land preparation, and generation of air pollutants (SOx and NOx, etc.) is predicted from the operation of heavy machinery and trucks, but the impact will be temporary.

Watering the construction site and using cover sheets on trucks for the transportation of soil will be undertaken to reduce dust generation.

Periodic maintenance and management of all the construction machinery and vehicles will be conducted to reduce exhaust gas discharged from construction machinery and vehicles.

2) Water Quality

There is water turbidity anticipated by land preparation, but the impact will be temporary. The impact of domestic wastewater, oil-containing wastewater, and chemical materials from construction activity is also expected.

Channels, ditches and a temporary settling pond will be dug and excavated around the construction area.

A wastewater treatment facility for workers, such as a septic tank and an oil separator for oily run-off water, will be installed in the construction area. Oil and chemical materials will be stored in an appropriate storage site to prevent permeation into the ground.

These measures will minimize the impact of contamination of sea water.

3) Waste

Waste generated from the construction work will include metal chips, waste plastic, wood shavings, waste glass and waste oil. Furthermore, household waste discarded from the workers will include cans, bottles and garbage. If such waste is inadequately handled, sea water may be contaminated, and sanitation problems may arise.

Segregating waste at collection, recycling and reusing waste will be promoted and non-recyclable waste will be disposed at appropriate sites according to related regulations.

To reduce the amount of solid waste discharged from the workers during the construction work, efforts will be taken to employ local workers wherever possible not to prepare worker's camp, so that the amount of household waste at the construction site will be minimized. These measures will be taken to ensure that water pollution or sanitary problems resulting from waste will not arise.

Hazardous wastes, such as waste oil and batteries, will be treated by SOTULUB (Société Tunisienne de Lubrifiant) and ASSAD (L'accumulateur Tunisian ASSAD)

4) Noise and Vibration

a. Noise

Noise and vibration occurs due to the operation of heavy machinery and trucks associated with the construction work. Table 8.7-1 shows the level of noise that occurs from major construction machinery. In order to reduce the noise generation, low-noise/low-vibration machinery will be used and the construction machinery and vehicles will be regularly maintained.

The distance to the nearest residential area (Mallaha) from the project site is approximately 600m and the noise level is decreased by approximately 55dB compared to the site (ex. 107 dB -> 52 dB). Moreover, since there is a fance around the Rades Power Plant Group, the noise is decreased by exsiting the fance. Therefore, the noise

level doesn't exceed the value of the Decree No. 84-1556 relating to the noise level, when single heavy machinery is operated. However, it may surpass these values when multiple units of heavy machinery are operated intensively. Therefore, the level of noise associated with the construction work can be reduced by avoiding intensive operations of construction machinery, not conducting construction work during the night and introducing low-noise type new machines. However, monitoring of noise level is necessary.

The source of noise is that vehicles will be used during equipment and material mobilization. When the vehicles drive near Mallaha residence area, it is necessary to take preventive measures, such as limiting truck speed.

Table 8.7-1 Noise Level of Major Construction Machinery

Machine	Unit Power (kW)	Noise Power level (dB)
Backhoe	P<55	99
	55<P<103	104
	103<P	106
Truck crane Crawler crane	P<55	100
	55<P<103	103
	103<P	107
Pile Driver	-	107
Concrete pump	P<55	100
	55<P<103	103
	103<P	107
Concrete Crusher	P<55	99
	55<P<103	103
	103<P<206	106
	203<P	107
Concrete Cutter	-	106
Engine Compressor	P<55	101
	55<P	105
Truck	P<150	89
	150<P	92

Source: Japan Construction Mechanization Association (2001): Noise and Vibration Handbook measures associated with construction work

b. Vibration

The operation of heavy machinery and trucks create vibration. However, schedule management will be performed to maintain constant amounts of construction work and to ensure that low vibration equipment will be used as much as possible. Construction work will be performed during daytime, especially piling work.

5) Odor

In case domestic waste from the workers is not appropriately treated, the rotting waste may produce a foul odor. Before starting the construction work, workers will be instructed to classify and collect garbage and illegal waste disposal will be prohibited. Garbage will be disposed on a periodic basis to ensure that odor by putrefaction is not produced. These measures will be taken to minimize the generation of odor.

(2) Natural Environment

1) Protected Area

As waste water is not discharged into Lake of Tunis, Chikly Island where is the nearest

protected area from the project site is not affected by waste water.
Since the air pollution due to the construction work is limited to the surrounding area of the construction site, it is assumed that there aren't any effects on Chikly Island and Bou kornin National Park, which are 6km and 8km distant from the project site respectively.

2) Ecosystem

The project is not forest or marsh. There is no primary forests, natural forests and mangrove wetlands around the site. According to Rades II EIA report, no fauna of significance, excepting birds, have been noted on the Rades II Power Plant site. Although migration birds are likely to fly to the coastline, the impact of the construction work on migration birds is minor, as there is no plan for changing the coastline. Therefore, the impact on the terrestrial ecosystem is minor. However due to protect individual, workers will prohibit disturbance, harassment, and hunting.
The water outlet faces shoaling beach, with no tidal land or coral reef. Zostera bed, which is commonly seen in Tunisia, was found in the north side of the sea area in front of the project site. Since the countermeasures against water contamination will be taken, the impact on the Zostera bed will be reduced.
If precious species are observed, construction work will be stopped and the mitigation measure will be discussed in consultation with the expert.

(3) Social Environment

1) Local Economy

a. Fishery

According to UTAP (Union Tunisienne de l'Agriculture et de la Pêche), there is no fisherman operating in front of the project site on the bay of Tunis. The reason thereof is that, due to shallow sea, no commercially valuable fish is available in that area. Therefore, no negative impact is expected to fishery activities by the construction activity.

b. Local Employment

Positive impacts are expected by employment of local people for the construction as well as sales increase of the stores and restaurants in the Mallaha area nearby by people working for the construction. Since a large cement plant is located in Ben Arous Governorate, purchase of certain quantity of cement for the construction will stimulate the local economy. Other construction materials if procured locally will also stimulate the local economy.

2) Social Infrastructure

All materials, equipment and machinery to be imported to Tunisia for the Rades C project are estimated to be around 10,000 tons. As mentioned above, this represents less than 0.2 % of total volume treated by Rades port (6 million tons). Therefore, there should be no serious issue in terms of marine transportation. As for the land transportation, we need to examine three elements; materials and equipment from Rades port, materials to be purchased in Tunisia and increased number of workers during the construction period. Since Rades power plant site is located only 2 km from Rades port and the volume to be transported from port is equivalent to less than 1 day of annual volume treated by Rades port, no additional congestion of land transportation is foreseen for this category of materials and equipment.
Construction of a power plant needs a placing of considerable volume of concrete. It is up to the decision of final contractor to set up a concrete plant in the site and transport cement bags from outside or to use concrete mixer trucks coming from cement factory nearby. Impacts on the current land transportation are larger in the latter case. However, maximum

number of concrete mixer trucks per hour being not more than five at the peak time of concrete placing, no serious problem expected to the current land transportation which accounts more than 200 heavy trucks per hour during day time.
Finally, vehicles transporting commuting workers may cause increased traffic and traffic jams around the project area.
In this regard, bus use will be promoted to reduce the increased number of vehicles on the roads. Construction companies will consult the bus schedules with related organizations.

3) Misdistribution of Benefits and Loss
Since the construction of the project will not create any disappearance of existing job on one hand and all contractors or subcontractors will act in accordance with market mechanism on the other hand, no misdistribution of benefits and loss is expected.

4) Local Conflicts of Interest
Local people should be employed for the construction work to the maximum extent possible, and external workers should be taught to respect local customs in order to facilitate good relationships with local people and should promote communication to local people (e.g., join in local events).
All contractors or subcontractors will act in accordance with market mechanism, and no misdistribution of benefits and loss is expected.

5) Infectious Diseases such as HIV/AIDS
A temporary influx of migrant labor during the construction period may increase the risk of sexual transmitted diseases, etc. Local people should be recruited as much as possible so to minimize the risk of infectious diseases being transmitted from external workers. Pre-employment and periodic medical check-ups should be conducted for external workers (technical workers, etc). Construction companies will conduct an education and training on health care of workers.

6) Work Environment (Including Work Safety)
A high risk rate of accidents is predicted for the construction work. Construction companies should establish work safety plans and submit them to STEG to obtain approval. Work safety plans should stipulate mitigation measures on soft aspects (safety training, etc.) and hard aspects (provide workers with appropriate protective equipment such as helmets masks, ear plugs, and, insulation protection equipments etc.).
In order to prevent health problems of workers, construction companies should observe related working environment standards and provide workers with appropriate equipment, such as masks, ear plugs, etc..

7) Accidents
Land traffic accidents during construction work may occur. As prevention measures for land traffic accidents, observation of traffic regulations, and training and education on safe driving to the driver will be implemented by construction companies. People in the surrounding residence area shall be informed of the bus schedules.

8) Cross-boundary Impact and Climate Change
CO_2 will be produced by the construction machinery and vehicles. Periodic maintenance and management of all construction machinery and vehicles will be conducted.

8.7.2 Operation Phase

(1) Pollution Control

1) Air Quality

Prediction on environmental impact in Tunisia is supposed to be conducted by simulating the worst case scenario, even under the condition of natural gas containing sulfur. However, the result will be extremely over estimated and there is considered to have big gap between the estimated value and actual value.

JICA Study Team has conducted exhaust gas dispersion simulation for the case of short term (1 hour) instead, though it is not the same program of calculation as STEG because of lack of meteorological data.

Due to the limitation of the program of the simulation software, the culcration put the case that all emission sources were at the center of the project site. The result will also be considered over estimated, even with this method.

a. Method

Prediction method

Whether or not simulating exhaust gas dispersion models under special metrological conditions, such as inversion layers and downdrafts, was considered, in addition to the dispersion model under normal metrological condition.

Inversion Layers

In case that an inversion layer of the temperature occurred temporarily above the stack of the power plant, exhaust gas would stay under the inversion layer, possibly causing the concentration of pollutants becoming high. Here, the dispersion model was simulated with the worst case estimated.

Consideration according to the occurrence of downwash and down draft

Based on the Briggs formula[4], when gas emissions speed is lower than 1.5 times of the wind speed of stack height, downwash may occur (Figure 8.7-1). In this project, the gas emission speed is 20.4m/s, so that downwash will occur when wind speed at the stack outlet level is more than 30m/s. The gas emission speed of the existing Rades A Power Plant, Rades B Power Plant and Rades II Power Plant, on the other hand, is 11.5 - 14.5m/s, so downwash will not occur under the wind speed of 16m/s or more at stack outlet level. According to Figure 8.1-7, it is not frequent for the wind speed to become more than 16m/s, and the wind is usually west wind towards the ocean. Therefore, downwash was not considered to have occurred, and a dispersion model under downwash conditions was not simulated.

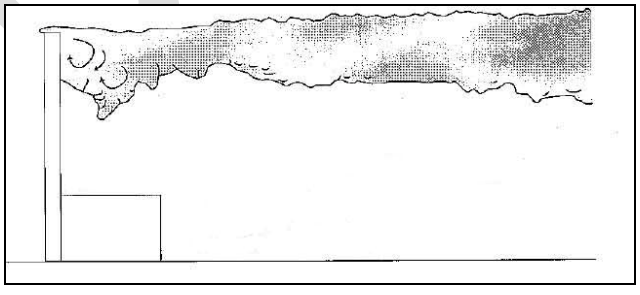


Figure 8.7-1 Outlook of the Downwash

[4] Briggs, G.A.（1970): Some recent analyses of plume rise obeservation, International Clean Air Cong. Washington, D.C., 1970

Based on the Huber formula[5], when stack height is lower than 2.5 times of building height, downdraft may occur (Figure 8.7-2). In this project, stack height is 85 m. The building height in the vicinity of the stack for downdraft to occur would have to be more than 34 m. Since the height of all the proposed buildings will be under around 30m, downdraft will not occur.

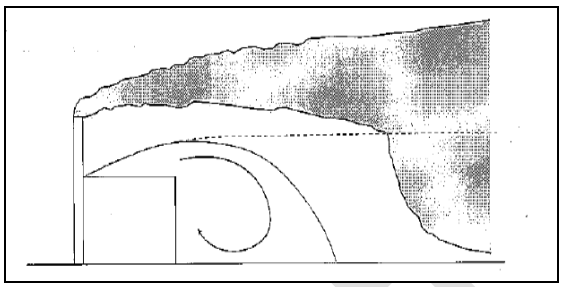


Figure 8.7-2 Outlook of the Down Draft

Dispersion Model of Exhaust Gas

Using the following Gaussian diffusion model, prediction of 1-hour value was calculated according to the time scale in conformity with the environmental standards of Tunisia and the IFC/EHS guidelines (General ,2008)..

Normal Meteorological Condition

$$C = \frac{Q_p}{2\pi\ \sigma_y \sigma_z u} \cdot \exp(-2\frac{y_2}{2\sigma_{y\,2}}) \exp\left\{-\frac{(z-He)^2}{2\,\sigma_z^{\,2}}\right\} + \exp\left\{-\frac{(z+He)^2}{2\,\sigma_z^{\,2}}\right\}$$

where

C: Above-ground concentration at a leeward distance R (m)
Q_p: Emission volume
σ_y: Parameter in the horizontal direction (m)
σ_z: Parameter in the vertical direction (m)
u: Wind speed (m/s)
R: Horizontal distance between smoke source and calculated point (m)
z: Above-ground height
He: Effective stack height (m)

$He = H + \Delta H$

H: Stack height (m)
ΔH: Elevation height (m)

Occurrence of Inversion Layer

The occurrence of an inversion layer as a temporary metrological phenomenon, the dispersion model on a 1-hour value was simulated, using the Gaussian Model shown below.

[5] Huber, A.H. (1984): Evaluation of a method for estimating pollution concentation downwind of inlfluencing buildings. Atmos. Environ., 18, 11., 2313-2338.

$$C(x) = \frac{Q_p}{2\pi \cdot \sigma_y \cdot \sigma_z \cdot u} \cdot \sum_{n=-3}^{3} \left[\exp\left\{ -\frac{(He + 2n \cdot L)^2}{2\sigma_z^2} \right\} + \exp\left\{ -\frac{(-He + 2n \cdot L)^2}{2\sigma_z^2} \right\} \right]$$

Where;
Qp : Emission amount (g/s)
σy : Parameter of horizontal direction (m)
σz : Parameter of vertical direction (m)
u : Wind speed (m/s)
He : Effective stack height (m)
L : Height of mixing layer (m) (set as L=He, which is the worst case)
n : Reflection times (set as ±3)

b. Emission specifications

Natural gas, which is used as fuel, does not normally contain sulfur and ash; therefore, SOx and Particulate Matter were not calculated here. Table 8.7-2 shows the exhaust volume, temperature, speed, and emissions of the NOx on the Rades A Power Plant, Rades B Power Plant, Rades II Power Plant, and Rades C Power Plant. All the nitrogen oxide from the stack is assumed to become NO_2. Concentration of pollutants in emission gas will meet emission gas standards by adopting low-NOx combustion methods

Table 8.7-2 Emission Specifications

Parameter	Unit	Rades A	Rades B	Rades II	Rades C
Emission Volume (wet)	Nm^3/s	303.0	318.9	631.2	576.0
Exhaust Temperature	ºC	95.0	95.0	98.0	90.3
Exhaust Speed	m/s	11.5	12.1	14.5	20.4
Actual Stack Height	M	100	100	70	85
Diameter of Stack Outlet	M	5.8	5.8	5.258 x 2	6.0
Nox	kg/h	58.0	283.5	162.0	33.9

Source: JICA Study Team

c. Results

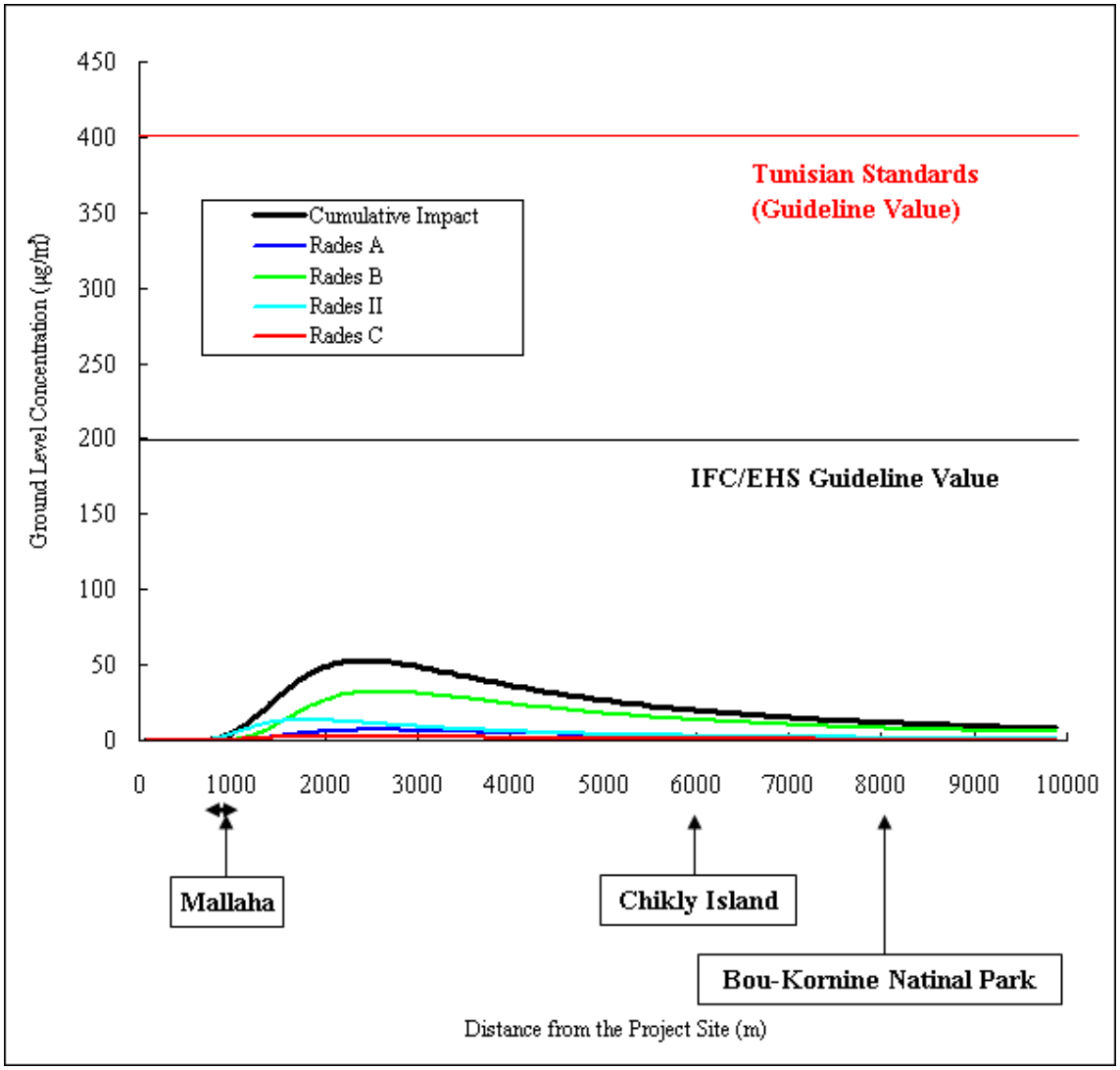
Figure 8.7-3 shows the results of exhaust gas dispersion simulation on the 4 power plants and cumulative impact, showing the maximum ground concentrations based on the calculation under the condition of atmospheric stability B to F by wind speed. Tunisian Standards and IFC/EHS Guideline Value are also shown in the figure as reference. This result indicates that the impact caused by this project, Rades C Power Plant, is the lowest, whereas, the impact by the existing power plant, Rades B, is the highest.

Cumulative impact of all the 4 power plants is shown the black line in Figure 8.7-3. Mallaha (residential area), Chikly Island (protected area) and Bou- Kornine National Park are indicated at corresponded place from the project site in the figure. According to the figure, the maximum ground concentration is approximately 50μg/m^3 at about 2.300m from the project site. Although Mallaha (residential area) is located near the point of maximum ground concentration, the concentration value is still much below Tunisian Standards (Guideline Value) and IFC/EHS Guideline value. Also, there will be no air pollution impact on Chikly Island, 6km away from the project site, and Bou-Kornine National Park, 8km away from the project site.

The simulation result indicating the maximum ground concentration shown in the figure

was obtained under the condition of atmospheric stability B with 1.0 -3.0 m/s of wind speed. According to Figure 8.1-8, the occurrence frequency of north or northeasterly wind, blowing towards Mallaha from the project site is about 10%. Therefore, predicting the long term impact by the 4 power plants, the maximum ground concentration will not likely exceed even yearly standards of Tunisian Standards (Guideline Value), which is 150μg/m^3.

As reported in Chapter 8.6.1 of Rades II EIA, however, NO_2 concentration is abnormally high in some part of this area, so that environmental monitoring will be needed.



Source: JICA Study Team

Figure 8.7-3 Cumulative Impact on the 4 Power Plants

2) Water Quality

a. Thermal Effluents

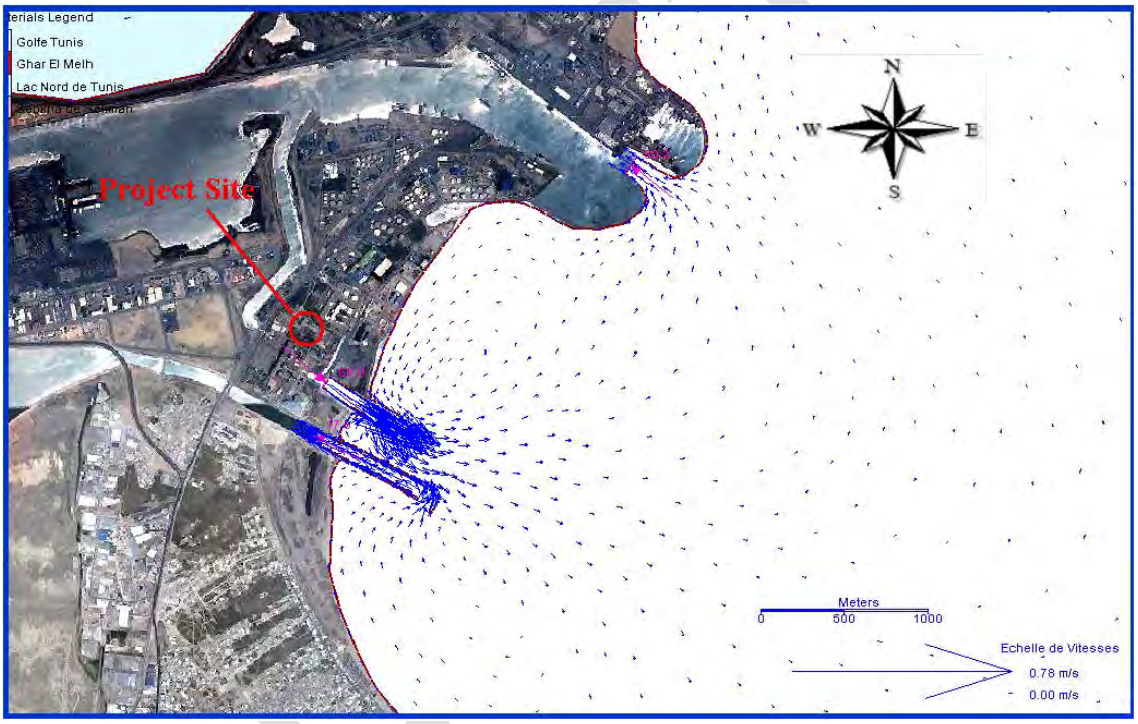
(a) Water Flow in front of the Project Site

As describeed above, different flows of seawater occur in the Gulf of Tunis due to the impact of wind on the base surface current that is specific to Mediterranean Sea. Through Figure 8.7-5 to Figure 8.7-7 show the results of simulation of the flows of

seawater for each wind direction in front of the project site. Taking the wind conditions in Tunis into consideration, simulation was conducted for the following three cases: Calm, East Wind with the wind speed of 6 m/sec, and West Wind with the wind speed of 9 m/sec.

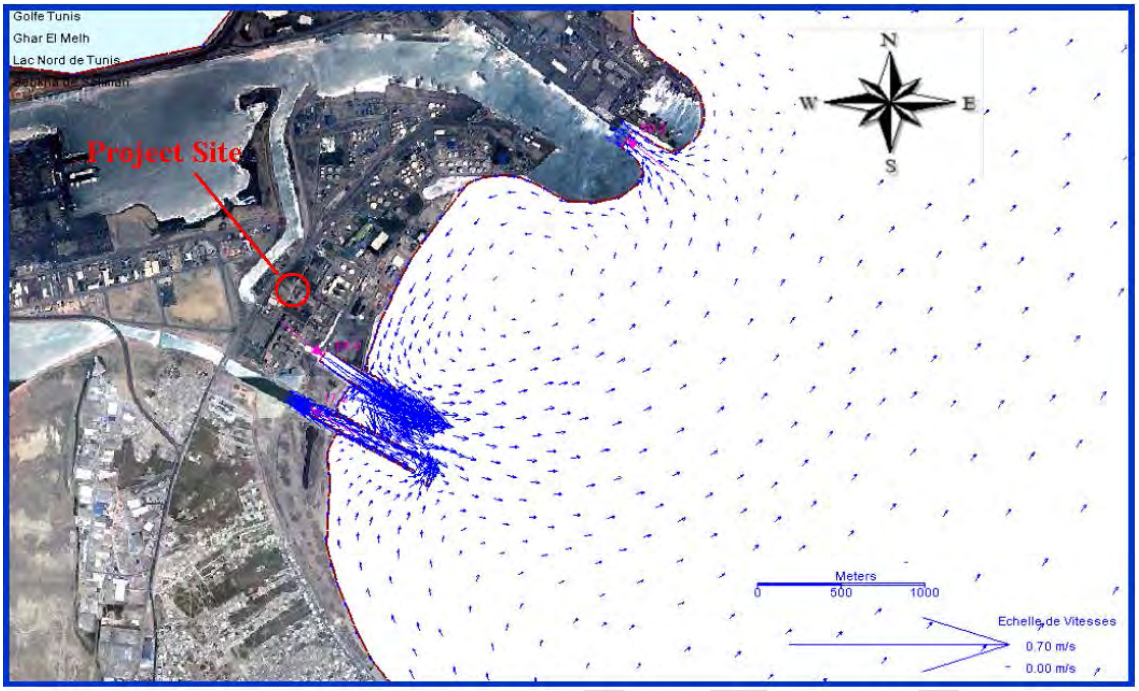
In the case of "Calm," the flow of seawater in front of the project site goes from north to south, and then heads out to sea after hitting the wash port.
Also in the case of "East Wind (6 m/sec)," there is an anticlockwise flow of seawater that flows from north to south in front of the project site.
In the case of "West Wind (9 m/sec)," the seawater in front of the project site flows from south to north, which is the reverse direction of those of the above two cases.

Since the project site is located in a short distance back from Gulf of Tunis, directions of seawater flows become complicated. As a result, the wind direction and the direction of seawater flow don't seem to coincide.



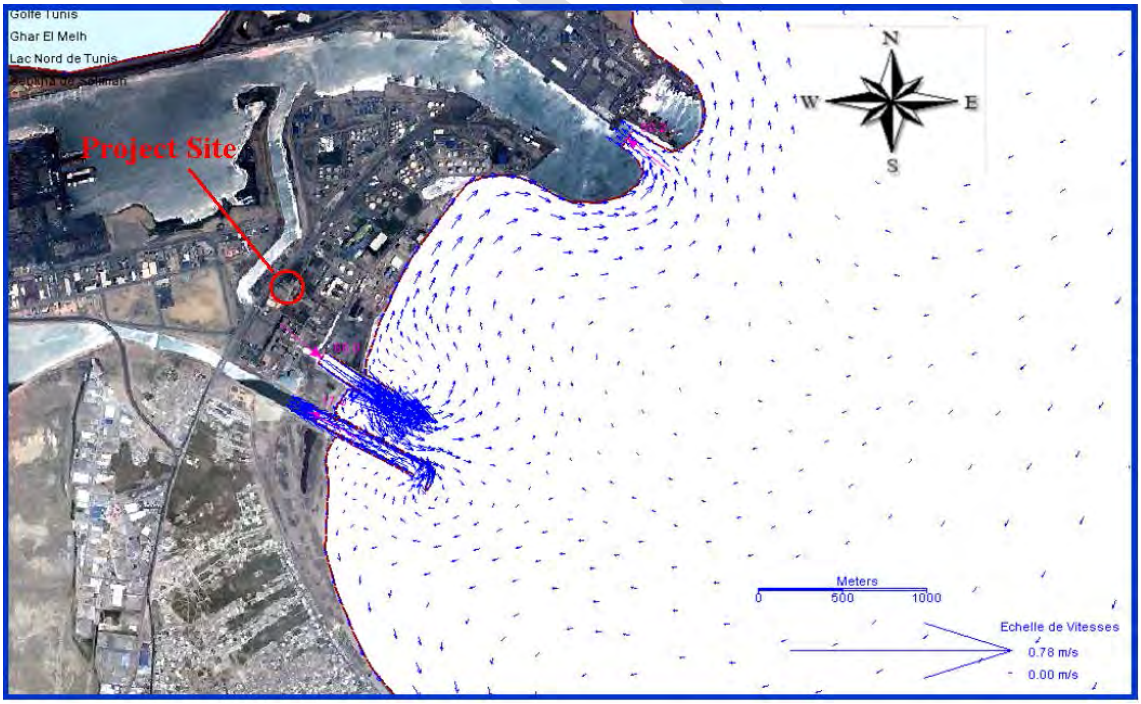
Source: EIA Report for Rades C Project

Figure 8.7-5 Water Flow in front of the Project Site (Calm)



Source: EIA Report for Rades C Project

Figure 8.7-6 Water Flow in front of the Project Site (East Wind: 6m/s)



Source: EIA Report for Rades C Project

Figure 8.7-7 Water Flow in front of the Project Site (West Wind: 9m/s)

(b) Simulation of Thermal Effluents Diffusion

a) Specifications of Thermal Effluents

According to the EIA report for Rades C project, since the outlet of thermal

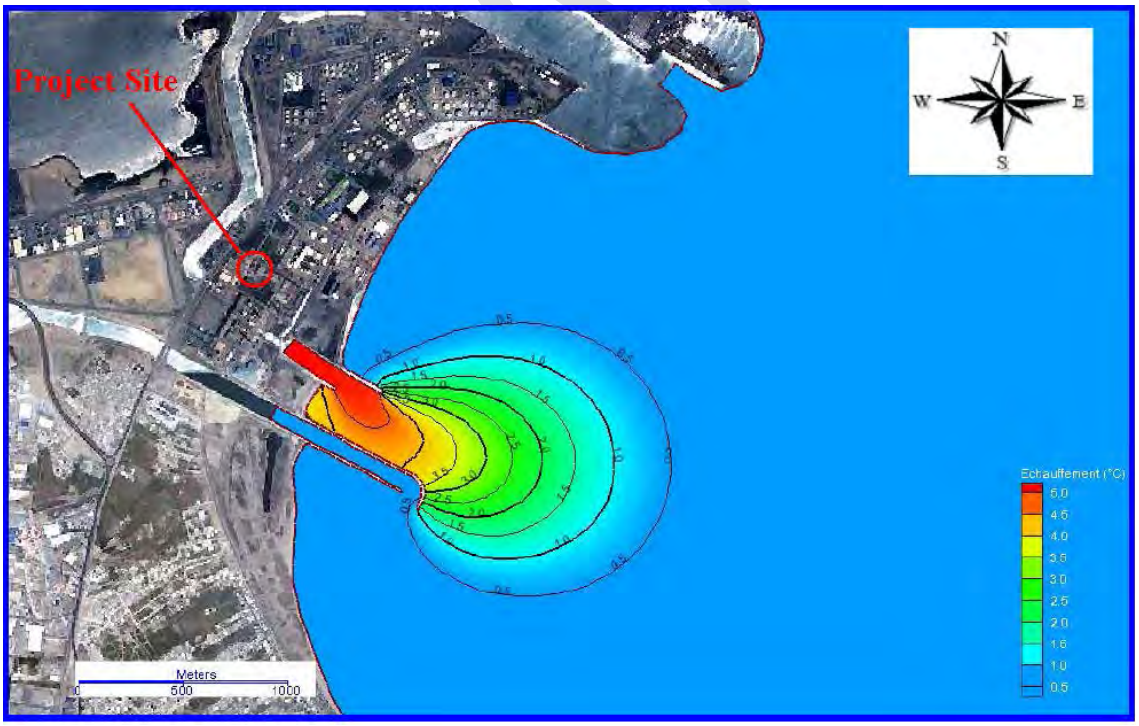
effluents is placed in one location, the simulation was conducted based on the two scenarios: Scenario 1 is the case in which Rades A&B Power Plant and Rades II Power Plant are in operation, and Scenario 2 is the case in which Rades C Power Plant of this project is operated in addition to the above two plants. The results of the simulation were calculated using "2 Dimension Diffusion Model".
The specifications of thermal effluents in the simulation of the EIA report are as shown in Table 8.7-3.

Table 8.7-3 Specifications of Thermal Effluents

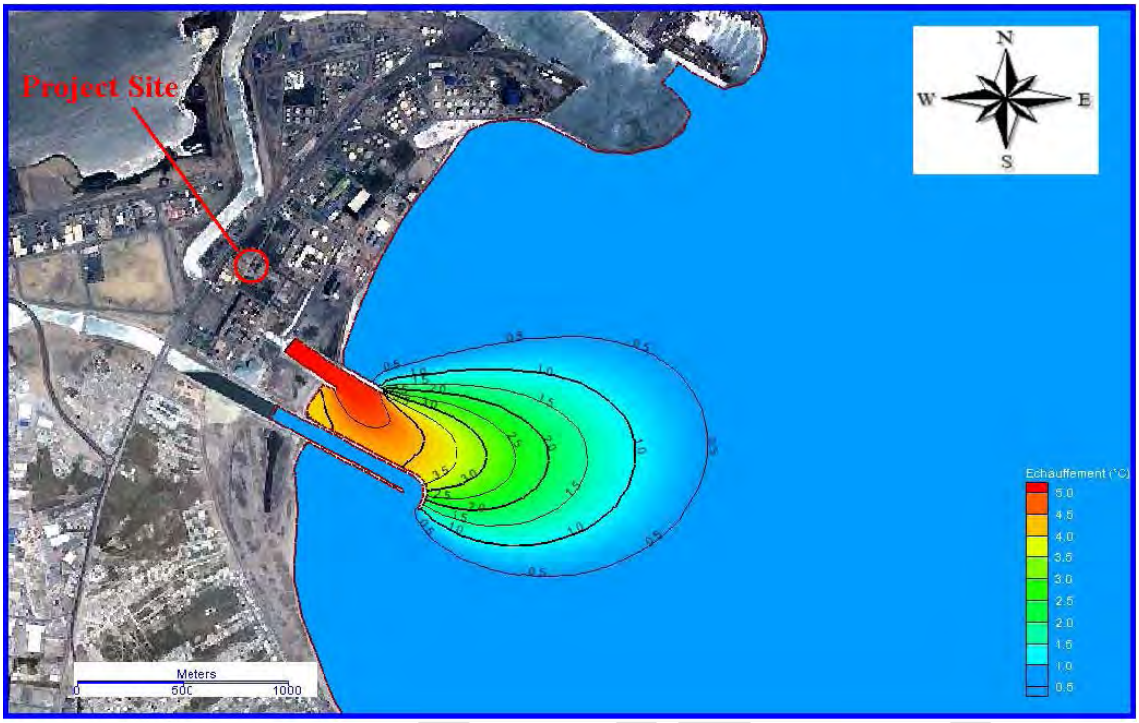
Parameter	Rades A&B	Rades II	Sinario 1	Rades C	Sinario 2
Maximam Discharge volume	33.3 m^3/sec	24.5 m^3/sec	56.8 m^3/sec	10.0 m^3/sec	68.8 m^3/sec
Rising Temperature from Intake Water Temperature	+5 °C	+5 °C	+5 °C	+5 °C	+5 °C

Source: EIA Report for Rades C Project

b) Results
The results of Scenario 2 in the EIA report are shown in through Figure 8.7-8 to Figure 8.7-10. As the thermal effluents disperse with the flow of seawater, they spread concentrically from the wash port in the cases of "Calm" and "East Wind (6 m/sec)." To the contrast, the thermal effluents are flowed to the shore while dispersing in the case of "West Wind (9 m/sec)."

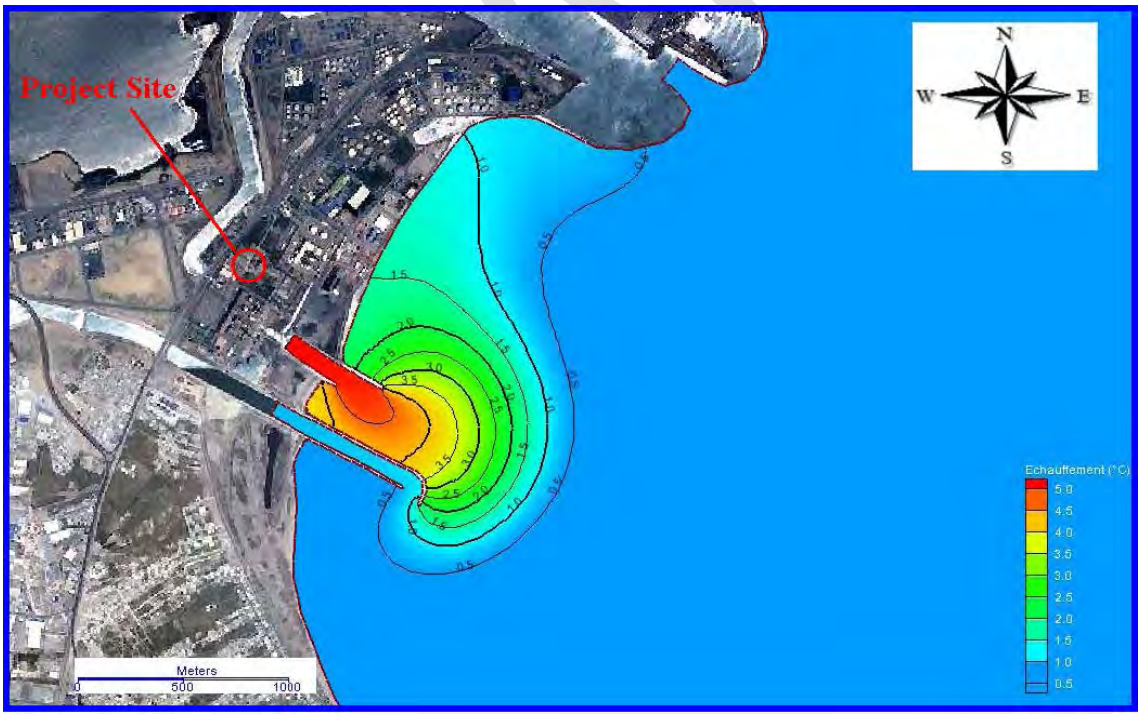


Source: EIA Report for Rades C Project
Figure 8.7-8 Contour of Rising Temperature Range (Sinario 2: Calm)



Source: EIA Report for Rades C Project

Figure 8.7-9 Contour of Rising Temperature Range (Sinario 2: East Wind 6m/sec)



Source: EIA Report for Rades C Project

Figure 8.7-10 Contour of Rising Temperature Range (Sinario 2: West Wind 9m/sec)

The sizes of the Rising Temperature Area under Scenario 2 are as shown in Table 8.7-4. The dispersing scope of thermal effluents is the largest in the case of West Wind. It showed the tendency to even disperse toward the coast where the

seaweed bed was located.

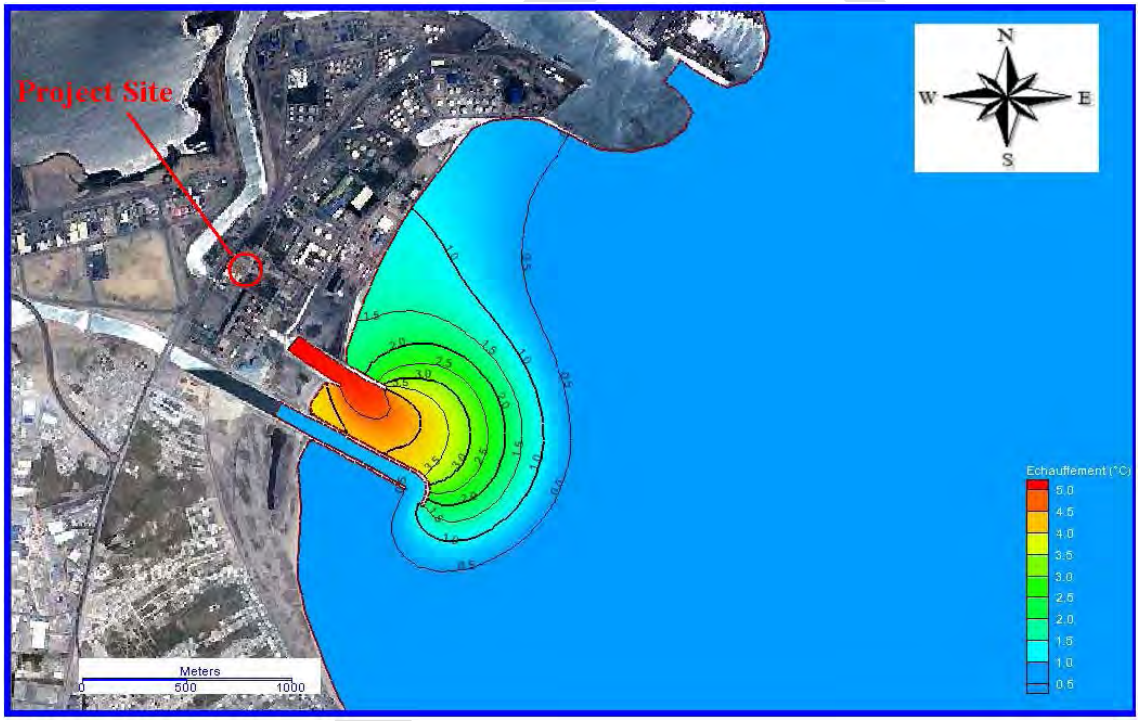
Table 8.7-4 Size of Rising Temperature Area (Sinario 2)

(Unit: ha)

Rising Temperature	Calm	East Wind	West wind
+4 °C	18	15	18
+3 °C	28	27	34
+2 °C	51	40	54
+1 °C	93	87	110

Source: EIA Report for Rades C Project

In the end, two results of Scenario 1 and Scenario 2 in the case of West Wind was compared that has an impact on the coast. Also in Scenario 1, the thermal effluents are observed to be flowed to the shore while dispersing (Figure 8.7-11). In addition, the diffusion area of thermal effluents was 100 ha when the rising temperature was +1 °C (Table 8.7-5). Therefore, the diffusion area of thermal effluents expanded by 10% only even under Scenario 2.



Source: EIA Report for Rades C Project

Figure 8.7-11 Contour of Rising Temperature Range (Sinario 1: West Wind 9m/sec)

Table 8.7-5 Size of Rising Temperature Area (West Wind)

(Unit: ha)

Rising Temperature	Sinario 1	Sinario 2
+4 °C	18	18
+3 °C	30	34
+2 °C	51	54
+1 °C	100	110

Source: EIA Report for Rades C Project

c) Evaluation

With the start of the operation of Rades C Power Plant in addition to the current power plants, the dispersing scope of thermal effluents is expected to increase by 10% under Scenario 2. As a result, St.5 and St.6, where the Zostera bed has been found, may fall within the scope of the temperature rise of 1 ^{o}C. However, the dispersing scope is estimated to be larger in this simulation, as the calculation was made with the "2 Dimension Model", in which thermal effluents are assumed to disperse only on the surface. In addition, the impact on the Zostera bed that is located in the sea bottom is not assumed even if the thermal effluents disperse to the inside of the Zostera bed, because the thermal effluents will diffused on the surface layer of the sea as their density is smaller than the surrounding seawater.

For the input data this time, the rising temperature is 5 ^{o}C. Considering the fact that the thermal effluents mix with the seawater in the sea at the wash port, the rising temperature is approximately 2 ^{o}C based on the results of the water temperature survey in the EIA report for Rades C project. Therefore, this simulation result is considered overestimate.

b. Plant wastewater, oil-containing wastewater, and domestic wastewater

The operation of the power plant will produce wastewater from its facilities. Wastewater from each facility will collect in the central wastewater treatment system. The wastewater treatment system will consist of neutralization, coagulating sedimentation, and a filtration and oil separator. Wastewater will be managed and treated appropriately to comply with water quality of Tunisian regulations and IFC/EHS Guideline values for thermal power plants. Treated wastewater will be mixed and diluted with a large volume of thermal effluents.

The impact on water quality by the power plant operation is considered to be insignificant, because the impact intensity, duration and coverage area will be low, long term and limited, respectively.

3) Waste

Currently, Rades A&B are producing three kinds of solid wastes; used grease, batteries and seaweeds collected by the intake of cooling water (Figure 8.7-12). These solid wastes are treated, in conformity with Tunisian regulations, as follows.

- Waste Oil: Tunisian company, named SOTULUB (Société Tunisienne de Lubrifiant), takes over all waste oil of STEG at Rades and reclaims it at its factory in order to resell it as new oil. SOTULUB is an accredited company by ANGED.
- Battery: Tunisian company, named ASSAD (L'accumulateur Tunisian ASSAD) under the Agency for the Promotion of Industry and Innovation, takes all old used batteries at Rades and regenerates them in order to sell them as a reclaimed battery. ASSAD is also an accredited company by ANGED.
- Sea weeds: STEG dries collected seaweeds in the site of Rades. Rades city comes to collect them and transports them as raw material to a bio-related plant which was financed by the World Bank and is under operation by ANGED.

All these solide wastes are treated, therefore, by the organizations accredited by ANGED. ANGED is acting mainly as a public accreditation body but also supervising regularly daily operations of theses accredited organizations.

Rades C will produce the same kinds of solid wastes as Rades A&B. Solid wastes produced by Rades C will be treated in the same manner in the operation phase.

Source: Source: EIA Report for Rades C Project

Figure 8.7-12 Sediment, Algae etc.. Retained in the Gates of the Pumping Station

4) Noise and Vibration

a. Noise

Machinery or equipment that generates large noise level in the plant operation is gas compressor, circulation water pump and water supply pump. Table 8.7-6 shows the specific noise level generated by machineries. As described in Chapter 8.7.1, the nearest residential area (Mallaha) from the project site is about 600 m away from the project site, and noise level is attenuated by about 55dB over 600m (ex. 100 dB -> 45 dB). However, all the machinery in the power plant will be operated over night, and it is still necessary to take appropriate mitigation measures to reduce noise level such as installing machinery and equipment in adequate enclosure, installing low noise/ low vibration type equipment and mainitaing the equipment regularly.

Table 8.7-6 Noise Level of Power Generation Facility

Machine Type	Noise Source Level(dB)
HRSG	75.0
Water Supply Pump	91.6
Stack	80.4
Circulation Water Pump	98.9
Gas Turbine	80.3
Steam Turbine	80.0
Gas Compressor	99.3

Note: Gas turbine and steam turbine are equipped with a cover.
Source: JICA Study Team

On the other hand, noise and vibration occurs due to the operation of vehicles. Vehicles for tranpotation of the workers will be regularly maintained.

b. Vibration

The impact of vibration is predicted to be caused by plant operation. Maintenance of equipment will be conducted, and low vibration type equipment and adequate enclosures will be installed.

5) Odor

In case domestic waste from the workers is not appropriately treated, bad odors from rotten waste may occur. Before starting plant operation, workers will be instructed to classify and collect garbage and illegal waste disposal will be prohibited. Garbage will be disposed on a periodic basis to ensure that odor by putrefaction is not produces. These measures will be taken to minimize the generation of odor.

(2) Natural Environment

1) Protected Area

As waste water is not discharged into Lake of Tunis, Chikly Island, which is the nearest protected area from the project site, is not affected by waste water.

In addition, impact to Chikly Island and Bou- Kornine National Park by this project is not anticipated since simulation result on the exhaust gas dispersion model indicates no impact on those protected areas by air pollutants emitted from the power plants.

2) Ecosystem

Simulation on thermal wastewater diffusion model indicates no impact on the existing Zostera bed. In addition, other industrial wastewater will be discharged from the power plant after appropriate treatment so that the impact on Zostera bed will be reduced.

Although migration birds are likely to fly to the coastline, the impact of the power plant operation on migration birds is minor, as there is no plan for changing the coastline. However due to protect individual, workers will prohibit disturbance, harassment, and hunting. If precious species are observed, the mitigation measure will be discussed in consultation with the expert.

(3) Social Environment

1) Local Economy

a. Fishery

As described above, there is no fisherman operating in front of the project site on the bay of Tunis. Therefore, no negative impact is expected to fishery activities by the operation of the Rades C Power Plant.

b. Local Employment

STEG has a clear policy that as for the technitians requiring certain qualification, recruitment will be carried out on national level, but as for unqualified personnel, priority will be granted to people living nearby the site. Since Rades C will need certain number of unqualified personnel for its daily operation, positive impact on local economy can be expected.

2) Social Infrastructure

After the completion of the project, approximately 90 additional workers will be working at the Rades C Power Plant. This number is not quite important compared with the number of 3+sedan cars or buses passing in front of Rades power plant site. However, if needed, bus

use will be promoted to reduce the increased number of vehicles on the roads. The bus schedules may be managed in consultation with related organizations

3) Misdistribution of Benefits and Loss
With a certain number of people recruited locally and no disappearance of existing job, as well as with certain purchase increase of the same materials as for the existing power plants, there will be no misdistribution of benefits and loss.

4) Local Conflicts of Interest
Local conflicts of interest may occur between employers and local residence. Local people should be employed at the power plant to the maximum extent possible, and external workers should be taught to respect local customs in order to facilitate good relationships with the local people and should promote communication to local people (e.g., join in local events).

5) Work Environment (Including Work Safety)
Work accidents involving workers may occur at the power plant site. STEG shall establish a work safety plan. The work safety plan shall stipulate mitigation measures on soft aspects (safety training, etc.) and on hard aspects (such as helmets masks, ear plugs, and, insulation protection equipments etc.).).
In order to prevent health problems of workers, "Control/Instrument Group", which may take responsibility in the implementation of the environmental management plan, should observe related working environment standards and provide workers with appropriate equipment, such as masks, ear plugs, etc..

6) Accidents
Observation of traffic regulations, installation of traffic signs, and training and education on safe driving to drivers shall be conducted for land traffic vehicles by "Control/Instrument Group".
Fire prevention measures shall be conducted such as installation of fire protection equipment in the power plant and organization of fire-fighting team and fire-fighting training.
For oil leakage from oil tanks, it is necessary to establish a counter measures, such as cover the bottom of the tank-installation area with cement and installation of oil-separation tank in the drainage around the tank-installation area.

7) Cross-boundary Impact and Climate Change
CO_2 will be produced by the operation of the power plant. Combined Cycle technology will be adopted at the power plant, producing less CO_2 of approximately 486 thousand tons/year compared to a exsiting thermal power plant.

8.7.3 Summary of Environmental and Social Impact Assessment

Table 8.7-7 Results of Environmental Impact Assessment

Item	No.	Impact	Assessment based Scoping		Assessment based Survey Results		Results
			Pre/ construction Phase	Operation Phase	Pre/ construction Phase	Operation Phase	
Pollution Control	1	Air Quality	B-	B-	B-	B-	**Construction phase:** - Watering the construction site and using cover sheets on

Item	No.	Impact	Assessment based Scoping		Assessment based Survey Results		Results
			Pre/ construction Phase	Operation Phase	Pre/ construction Phase	Operation Phase	
							trucks for the transportation of soil will be undertaken to reduce dust generation. - Maintenance of machinery will be conducted regularly, resulting in reducing exhaust gas emissions. **Operation phase:** - The results of NOx in the exhust gas dispersion simulation are much below the ambient air quality standards (Guideline Value). - There wil be no air pollution impact on Mallaha (residentioal area), Chikly Island, and Bou-Kornine National Park. - Concentration of pollutants in emission gas will meet emission gas standards by adopting low-NOx combustion methods - Duct will be provided with CEMS (Continuous Emission Monitoring System) with the supported infrastructure as required under the gas emission standards
	2	Water Quality	B-	B-	B-	B-	**Construction phase:** - Channels, ditches and a temporary settling pond will be dug and excavated around the construction area. - A wastewater treatment facility for workers, such as a septic tank and an oil separator for oily run-off water, will be installed in the construction area. - Oil and chemical materials will be stored in an appropriate storage site to prevent permeation into the ground. **Operation phase:** - The diffusion area of thermal effluents expanded by approximately 20% only. The diffusion of thermal effluents is occurred only in the surface of the sea. The impact on the Zostera bed that is located in the sea bottom is not assumed even if the thermal effluents disperse to the inside of the Zostera bed - Plant wastewater will be treated at a wastewater treatment facility in order for pollutants in the water to meet the discharged wastewater standards so that the impact on Zostera bed will be reduced.
	3	Waste	B-	B-	B-	B-	**Construction phase:** - Construction waste and general waste will be re-used, recycled or disposed following related regulations. - Hazardous wastes, such as waste oil and batteries, will be treated by the appropriate companies in Tunisia **Operation phase:** - Rades C will also produce the same kinds of wastes on Rades A&B. These wastes are treated, in conformity with Tunisian regulations. - Hazardous wastes, such as waste oil and batteries, will be treated by the appropriate companies in Tunisia

Item	No.	Impact	Assessment based Scoping		Assessment based Survey Results		Results
			Pre/ construction Phase	Operation Phase	Pre/ construction Phase	Operation Phase	
	4	Noise and Vibration	B-	B-	B-	B-	**Construction phase:** - Construction machinery and vehicles will be regularly maintained. - Performing construction work during daytime - Low-noise/ low-vibration machinery will be used. - The distance to the nearest residential area (Mallaha) from the project site is approximately 600m and the noise level is decreased by approximately 55dB compared to the site (ex. 107 dB -> 52 dB). Moreover, since there is a fance around the Rades Power Plant Group, the noise is decreased by exsiting the fance. Therefore, the noise level doesn‘t exceed the value of the Decree No. 84-1556 relating to the noise level, However, counter measuers, such as avoiding intensive operations of construction machinery, will be taken. - When the vehicles drive near Mallaha residence area, it is necessary to take preventive measures, such as limiting truck speed. **Operation phase:** - The distance to the nearest residential area (Mallaha) from the project site is approximately 600m and the noise level is decreased by approximately 55dB compared to the site (ex. 100 dB -> 45 dB). However, counter measure, such as installing machinery and equipment in adequate enclosure, will be taken. - Low-noise/ low-vibration machinery will be used. - Vehicles for tranpotation of the workers will be regularly maintained.
	5	Subsidence	D	D	D	D	**Construction phase:** - Use of ground water is not in the plan. **Operation phase:** - Desalinated water will be used in the power plant.
	6	Odor	B-	B-	B-	B-	**Construction and Operation phases:** - Before starting the construction work and power plant operation, workers will be instructed to classify and collect garbage and illegal waste disposal will be prohibited. - Garbage will be disposed on a periodic basis to ensure that odor by putrefaction is not produced.
Natural Environ -ment	7	Protected Areas	C-	C-	D	D	**Construction and Operation phases:** - The nearest protected area from the site is Chikly Island in Lake Tunis located 6km east of the project site. There is also Bou-Kornin National -Park 8km south-west of the site. As waste water is not discharged into Lake Tunis, there is not water pollution impact to Chikly Island. - As the results of exhaust gas dispersion simulation, there will be no air pollution impact on Chikly Island and Bou-Kornine National Park

Item	No.	Impact	Assessment based Scoping		Assessment based Survey Results		Results
			Pre/ construction Phase	Operation Phase	Pre/ construction Phase	Operation Phase	
	8	Ecosystem	C-	C-	B-	B-	**Construction phase:** - The project is not forest or marsh. There is no primary forests, natural forests and mangrove wetlands around the site. - No fauna of significance, excepting birds, have been noted on the Rades II Power Plant site. Although migration birds are likely to fly to the coastline, the impact of the construction work on migration birds is minor, as there is no plan for changing the coastline. - However due to protect individual, construction workers will prohibit disturbance, harassment, and hunting. - The water outlet faces shoaling beach, with no tidal land or coral reef. - Zostera bed, which is commonly seen in Tunisia, was found in the north side of the sea area in front of the project site. Therefore, since the countermeasures against water contamination will be taken, the impact on the Zostera bed will be reduced. - If precious species are observed, construction work will be stopped and the mitigation measure will be discussed in consultation with the expert. **Operation phase:** - Simulation on thermal wastewater diffusion model indicates no impact on the existing Zostera bed. In addition, other industrial wastewater will be discharged from the power plant after appropriate treatment so that the impact on Zostera bed will be reduced. - Although migration birds are likely to fly to the coastline, the impact of the power plant operation on migration birds is minor, as there is no plan for changing the coastline. - However due to protect individual, workers will prohibit disturbance, harassment, and hunting. - If precious species are observed, the mitigation measure will be discussed in consultation with the expert.
Social Environ-Ment	9	Resettlement	D	D	D	D	**Pre-construction phase:** - Land acquisition and relocation of the affected people by the project implementation is not predicted.
	10	Poor People	D	D	D	D	**Construction and Operation phases:** - Rades A Power Plant started operation in 1985, Rades B PP in 1998 and Rades II PP in 2002. The existing power plants have about 30 years of history within the local community through operation and expansion. The project relates to the expansion of the existing power plant within the site, and significant impact on the local community is not avoided. Consequently, the life of poor people in the region, if any, will not be significantly affected.
	11	Ethnic Minority	D	D	D	D	**Construction and Operation phases:**

Item	No.	Impact	Assessment based Scoping		Assessment based Survey Results		Results
			Pre/ construction Phase	Operation Phase	Pre/ construction Phase	Operation Phase	
		Groups and Indigenous People					- As described above, the project can avoid significant change on the local society. Consequently, the life of ethnic minority groups and indigenous people in the region, if any, will not be significantly affected.
	12	Local Economy such as Losses of Employment and Livelihood Means	B+/B-	B+/B+	B+	B+	**Construction phases:** - There is no fisherman operation in front of the project site on the Bay of Tunis. Therefore, no negative impact is expected to fishery activities by the construction activity. - Positive impacts are expected by employment of local people for the construction as well as sales increase of the stores and restaurants in the Mallaha area nearby by people working for the construction. **Operation phase:** - No negative impact is expected to fishery activities by the operation of the Rades C Power Plant. - Rades C will need certain number of unqualified personnel for its daily operation. Positive impact on local economy can be expected.
	13	Land Use and Utilization of Local Resources	D	D	D	D	**Construction and Operation phases:** - The project relates to an installation of an additional power plant in the vacant are of the existing project site. The site of the existing power plant is not used as a local resource and the operation of the project will not affect the use of the local land and resources.
	14	Water Usage, Water Rights, etc.	D	D	D	D	**Construction and Operation phase:** - There is no water source for agricultural water, industrial water, and drinking water in and srounding the site and the operation of the project will not affect the water use and water rights.
	15	Existing Social Infrastructure and Services	B-	B-	B-	B-	**Construction phase:** - All materials, equipment and machinery to be imported to Tunisia for the project are less than 0.2 % of total volume treated by Rades port. Therefore, there should be no serious issue in terms of marine transportation. - Vehicles transporting commuting workers may cause increased traffic and traffic jams around the project area. - For vehicles, bus use will be promoted to reduce increasing the number of vehicles used. Bus use will be promoted to reduce the increased number of vehicles on the roads. - The bus schedules shall be managed in consultation with related organizations. **Operation phase:** - After the completion of the project, approximately 90 additional workers will be working at the Rades C Power Plant. This number is not quite important compared with the number of sedan cars or buses passing in front of Rades power plant site.

Item	No.	Impact	Assessment based Scoping		Assessment based Survey Results		Results
			Pre/ construction Phase	Operation Phase	Pre/ construction Phase	Operation Phase	
							- However, if needed, bus use will be promoted to reduce the increased number of vehicles on the roads. - The bus schedules may be managed in consultation with related organizations
	16	Social Institutions such as Social Infrastructure and Local Decision-making Institutions	D	D	D	D	**Construction and Operation phases:** - The project does not involve land acquisition and no damage of relation with the local decision-making institutions and other social institutions. - As described above, the project can avoid significant change on the local society. Consequently, any adverse effect on the relationship with the social institutions is not expected.
	17	Misdistribution of Benefits and Loss	B-	B-	D	D	**Construction phase:** - All contractors or subcontractors will act in accordance with market mechanism, and no misdistribution of benefits and loss is expected. **Operation phase:** - With a certain number of people recruited locally and no disappearance of existing job, as well as with certain purchase increase of the same materials as for the existing power plants, there will be no misdistribution of benefits and loss.
	18	Local Conflicts of Interest	B-	B-	B-	B-	**Construction phase:** - Local people should be employed for the construction work to the maximum extent possible - All contractors or subcontractors will act in accordance with market mechanism, and no misdistribution of benefits and loss is expected. - External workers should be taught to respect local customs in order to facilitate good relationships with local people and should promote communication to local people (e.g., join in local event). **Operation phase:** - Local conflicts of interest may occur between employers and local residence. - Local people should be employed at the power plant to the maximum extent possible, and external workers should be taught to respect local customs in order to facilitate good relationships with the local people and promote communication to local people (eg., join in local events).
	19	Cultural Heritage	D	D	D	D	- Historical, cultural and/or archaeological property and heritage does not exist around the site.
	20	Landscape	D	D	D	D	- The existing power plant is already integrated into the local scenery, and the project will not affect the local landscape. There is no scenic area around the project site.
	21	Gender	D	D	D	D	**Construction and Operation phases:** - As described above, the project can avoid significant

Item	No.	Impact	Assessment based Scoping		Assessment based Survey Results		Results
			Pre/ construction Phase	Operation Phase	Pre/ construction Phase	Operation Phase	
							change on the local society. Consequently, any adverse effect on the gender is not expected.
	22	Children's Rights	D	D	D	D	**Construction and Operation phases:** - As described above, the project can avoid significant change on the local society. Consequently, any adverse effect on children's right is not expected. - No child labor has been conducted in STEG, and will never be admitted in the future as well.
	23	Infectious Diseases such as HIV/AIDS	B-	D	B-	D	**Construction phase:** - A temporary influx of migrant labor during the construction period may increase the risk of sexual transmitted diseases, etc. - Local people shoul be recruited as much as possible. - Pre-employment and periodic medical check-ups should be conducted for external workers (technical wokers, etc.). - An education and training on health care of workers will be conducted.
	24	Work Environment (Including Work Safety)	B-	B-	B-	B-	**Construction phase:** - High risk rate of accidents is predicted in construction work. - Work safety plans and should be established and obtained the approval of STEG. - Work safety plans should stipulate mitigation measures on soft aspects (safety training, etc.) and hard aspects (provide workers with appropriate protective equipment such as helmets masks, ear plugs, and, insulation protection equipments etc.). - In order to prevent health problems of workers, construction companies should observe related working environment standards and provide workers with appropriate equipment, such as masks, ear plugs, etc.. **Operation phase:** - Work accidents involving workers may occur at the power plant site. STEG shall establish a work safety plan. - The work safety plan shall stipulate mitigation measures on soft aspects (safety training, etc.) and on hard aspects (such as helmets masks, ear plugs, and, insulation protection equipments etc.).). - In order to prevent health problems of workers, StEG should observe related working environment standards and provide workers with appropriate equipment, such as masks, ear plugs, etc..
Other	25	Accidents	B-	B-	B-	B-	**Construction phase:** - Land traffic accidents during construction work may occur. As prevention measures for land traffic accidents, observation of traffic regulations, and training and education on safe driving to the driver will be implemented

Item	No.	Impact	Assessment based Scoping		Assessment based Survey Results		Results
			Pre/ construction Phase	Operation Phase	Pre/ construction Phase	Operation Phase	
							by construction companies. - People in the surrounding residence area shall be informed of the bus schedule **Operation phase:** - Observation of traffic regulations, installation of traffic signs, and training and education on safe driving to drivers shall be conducted for land traffic vehicles. - Fire prevention measures shall be conducted such as installation of fire protection equipment in the power plant and organization of fire-fighting team and fire-fighting training. - Cover the bottom of the tank-installation area with cement - Installation of oil-separation tank in the drainage around the tank-installation area.
	26	Cross-boundary Impact and Climate Change	B-	B-	B-	B-	**Construction phase:** - CO_2 will be produced by the construction machinery and.vehicles. However, since the construction volume is limited, the environmental impact, such as cross-boundary pollution, is predicted to be insignificant. - To reduce CO_2 emission as much as possible, Periodic mentenance and management of all construction machinery and vehicles will be conducted. **Operation phase:** - CO_2 will be produced by the operation of the power plant. Combined Cycle technology will be adopted at the power plant, producing less CO_2 of approximately 486 thousand tons/year compared to a exsiting thermal power plant.

Notes: A+/-: Significant positive/negative impact is expected.
B+/-: Positive/negative impact is expected to some extent.
C+/-: Extent of positive/negative impact is unknown. (Further examination is needed, and the impact may be clarified as the study progresses.)
D: No impact is expected.

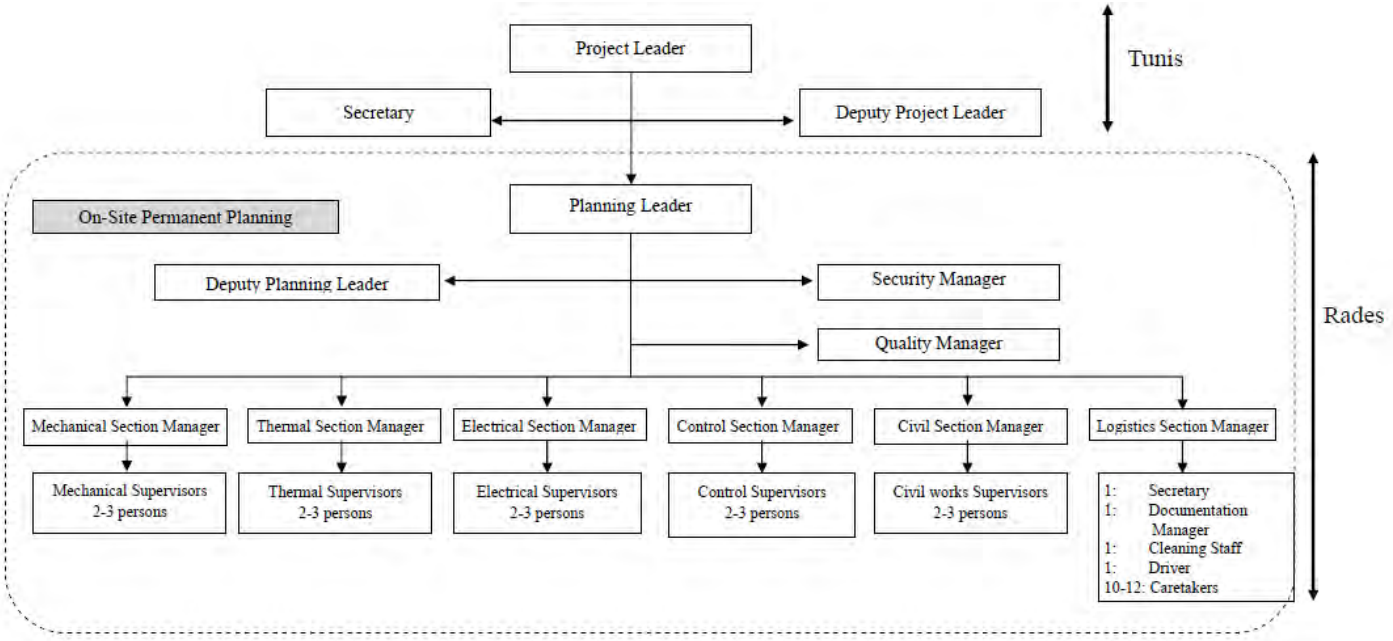
(Source: JICA Study Team)

8.8 Environmental Management Plan

8.8.1 Implementation System

(1) Construction Phase

Figure 8.8-1 shows the diagram of organizational framework during construction period of Rades C Power Plant. It is expected that "Control Section manager" take responsibility in the implementation of the environmental management plan.

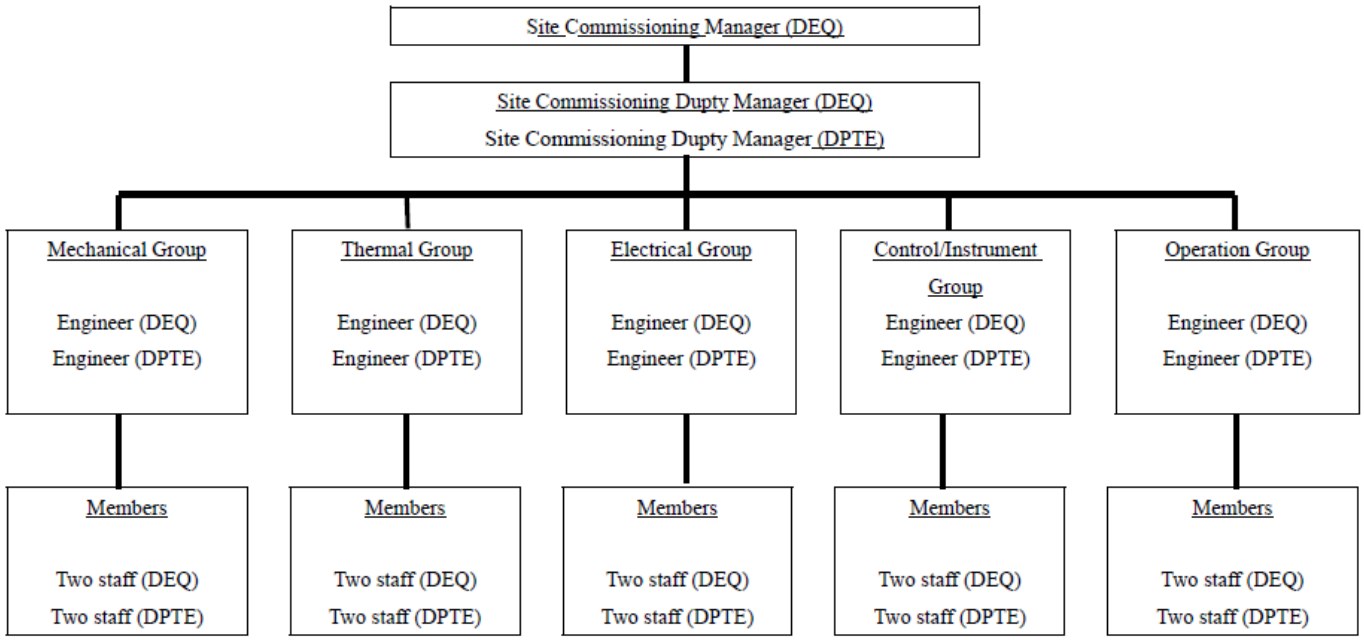


Source: Rades C Power Plant in STEG

Figure 8.8-1 Diagram of Organizational Framework during Construction Phase

(2) Operation Phase

Figure 8.8-2 shows the diagram of organizational framework during operation phase of Rades C Power Plant. It is expected that "Control/Instrument Group" takes responsibility in the implementation of the environmental management plan.



Notes: DEQ (Direction de l'Équipement)

DPTE (Direction de Production et Transport de l'Électricité)

Source: Rades C Power Plant in STEG

Figure 8.8-1 Diagram of Organizational Framework during Operation Phase

8.8.2 Environmental Management Plan

Table 8.8-1 describes the environmental management plan proposed by JICA survey team to STEG and the consultant preparing EIA (TPE). The review by STEG and TPE is currently in progress. For the environmental management plan, final consultations will be conducted in JICA's appraisal mission.

Table 8.8-1 Environmental Management Plan (Draft)

No	Potential Impact to be Managed	Sources of Potential Impact	Standard of Impact	Objectives	Management Effort	Management Location	Period of Management	Management Institution	Cost
Construction phase									
1	Air Quality	1) Dust resulting from construction work 2) Exhaust gas from construction machinery and vehicles used for mobilization of equipment	1), 2) - Guideline values in Tunisian Standards related to Air (No. 106-04)	1), 2) - Prevention of air pollution in the surrounding area	1) Dust prevention - Watering the construction site and using cover sheets on trucks for the transportation of soil will be undertaken to reduce dust generation. 2) Gas emission prevention - Periodic maintenance and management of all the construction machinery and vehicles	1), 2) - Construction area	1), 2) - During construction phase	- Implementation: Contractor/ Environmental Consultant - Supervisor: STEG/ Supervision Consultant	Expenses included in contract cost by Contractor
2	Water Quality	1) Run off water from construction area 2) Domestic wastewater of workers 3) Leakage oil and chemical materials from construction activity	1) – 3) - "Discharge to sea" in Tunisian Standard related to Effluent (No.106-02)	1) – 3) - Prevention of water pollution in the surrounding area	1) Run off water - Excavate channels, ditches and temporary settling pond around construction area - Install oil separator for treatment of oily wastewater - Construct silt basin 2) Domestic wastewater - Install wastewater treatment facility for workers such as septic tanks 3) Oil and chemical materials leakage - Storage of oil and chemical	1) – 3) - Construction area	1) – 3) - During construction phase	- Implementation: Contractor/ Environmental Consultant - Supervisor: STEG/ Supervision Consultant	Expenses included in contract cost by Contractor

No	Potential Impact to be Managed	Sources of Potential Impact	Standard of Impact	Objectives	Management Effort	Management Location	Period of Management	Management Institution	Cost
					materials in an appropriate storage site and appropriate method to prevent permeation into ground				
3	Waste	1) Construction waste from construction work 2) Domestic waste from workers 3) Hazardous waste such as dry batteries, etc.	1) - 3) - Law No. 96-14 (concerning management and disposal of solid waste)	1) - 3) - Prevention of inappropriate waste disposal	1), 2) Construction and domestic waste - Construction waste and general waste will be re-used, recycled or disposed following related regulations. 3) Hazardous waste - Hazardous waste should be treated by appropriate companies in Tunisia	1) - 3) - Construction area	1) - 3) - During construction phase	- Implementation: Contractor/ Environmental Consultant - Supervisor: STEG/ Supervision Consultant	Expenses included in contract cost by Contractor
4	Noise and Vibration	1) Noise and vibration caused by construction machinery 2) Noise caused by vehicles used for mobilization of equipment and workers	1), 2) - Decree No. 84-1556 on the regulation of industrial estates relating to the noise level	1), 2) - Reduction of noise levels from construction activities	1) Construction machinery - Construction machinery and vehicles will be regularly maintained. - Performing construction work during daytime - Using low-noise/ low vibration equipment 2) Mobilization - When the vehicles drive near Mallaha residence area, it is necessary to take preventive measures, such as limiting truck speed.	1), 2) - Construction area	1), 2) - During construction phase	- Implementation: Contractor/ Environmental Consultant - Supervisor: STEG/ Supervision Consultant	Expenses included in contract cost by Contractor
5	Odor	- Domestic waste from workers	-----	- Prevention of generating odor	- Before starting the construction work, workers will be instructed	- Construction area	- During construction phase	- Implementation: Contractor/ Environmental	Expenses included in contract cost by Contractor

No	Potential Impact to be Managed	Sources of Potential Impact	Standard of Impact	Objectives	Management Effort	Management Location	Period of Management	Management Institution	Cost
					to classify and collect garbage and illegal waste disposal will be prohibited. - Garbage will be disposed on a periodic basis to ensure that odor by putrefaction is not produced.			Consultant - Supervisor: STEG/ Supervision Consultant	
6	Ecosystem	- Existence of plant and animal	- Protected Species Lists of Flora and Fauna in Tunisia (19 July, 2006)	- Protection of endangered species	- Prohibit disturbance, harassment, and hunting - If precious species are observed, construction work will be stopped and the mitigation measure will be discussed in consultation with the expert.	- Construction area	- During construction phase	- Implementation: Contractor/ Environmental Consultant - Supervisor: STEG/ Supervision Consultant	Expenses included in contract cost by Contractor
		- Adverse impact due to water pollution	-----	- Prevention of water pollution	- Same as those addressed in "Water quality"				
7	Existing Social Infrastructure and Services	- Traffic jams caused by increased number of vehicles	-----	- Mitigation of traffic disturbance	- Vehicles transporting commuting workers may cause increased traffic and traffic jams around the project area. - For vehicles, bus use will be promoted to reduce increasing the number of vehicles used. Bus use will be promoted to reduce the increased number of	- Roads near the construction area	- During construction phase	- Implementation: Contractor/ Environmental Consultant - Supervisor: STEG/ Supervision Consultant	Expenses included in contract cost by Contractor

No	Potential Impact to be Managed	Sources of Potential Impact	Standard of Impact	Objectives	Management Effort	Management Location	Period of Management	Management Institution	Cost
					vehicles on the roads. - The bus schedules shall be managed in consultation with related organizations.				
8	Local Conflicts of Interest	1) Increase employment, subcontracting, the purchase of materials 2) Conflicts between local residents and external workers	-----	1), 2) - Consideration of the attitudes of local residents to the project	1) Employment - Local people should be employed for the construction work to the maximum extent possible - All contractors or subcontractors will act in accordance with market mechanism, and no misdistribution of benefits and loss is expected. 2) Conflicts - External workers should be taught to respect local customs in order to facilitate good relationships with local people and should promote communication to local people (e.g., join in local event).	- Community around the site	- During construction phase	- Implementation: Contractor/ Environmental Consultant - Supervisor: STEG/ Supervision Consultant	Expenses included in contract cost by Contractor
9	Infectious Diseases such as HIV/AIDS	- Temporary influx of migrant labor during construction may increase risk of infection	-----	- Consideration for sanitation for local residents	- A temporary influx of migrant labor during the construction period may increase the risk of sexual transmitted diseases, etc. - Local people shoul be recruited as much as	- Construction area	- During construction phase	- Implementation: Contractor/ Environmental Consultant - Supervisor: STEG/ Supervision Consultant	Expenses included in contract cost by Contractor - Medical checkups: $???/ Person - Health education:

No	Potential Impact to be Managed	Sources of Potential Impact	Standard of Impact	Objectives	Management Effort	Management Location	Period of Management	Management Institution	Cost
					possible. - Pre-employment and periodic medical check-ups should be conducted for external workers (technical wokers, etc.). - An education and training on health care of workers will be conducted.				$???/ Person
10	Work environment (including work safety)	1) Labor accidents 2) Diseases caused by air pollutants, water pollutants, and noise by construction work	-----	1), 2) - Prevention of labor accidents and health problems	1) Labor accidents - Work safety plans and should be established and obtained the approval of STEG. - Work safety plans should stipulate mitigation measures on soft aspects (safety training, etc.) and hard aspects (provide workers with appropriate protective equipment such as helmets masks, ear plugs, and, insulation protection equipments etc.). 2) Working environment - In order to prevent health problems of workers, construction companies should observe related working environment standards and provide workers with appropriate	1), 2) - Construction area	1), 2) - During construction phase	- Implementation: Contractor/ Environmental Consultant - Supervisor: STEG/ Supervision Consultant	Expenses included in contract cost by Contractor - Protective equipment: $???/Set

No	Potential Impact to be Managed	Sources of Potential Impact	Standard of Impact	Objectives	Management Effort	Management Location	Period of Management	Management Institution	Cost
					equipment, such as masks, ear plugs, etc..				
11	Accidents	- Traffic accidents	-----	- Prevention of traffic accidents	- As prevention measures for land traffic accidents, observation of traffic regulations, and training and education on safe driving to the driver will be implemented by construction companies. - People in the surrounding residence area shall be informed of the bus schedule	- Roads near the construction area	- During construction phase	- Implementation: Contractor/ Environmental Consultant - Supervisor: STEG/ Supervision Consultant	Expenses included in contract cost by Contractor - Safety training: $???/ Person
12	Cross-boundary impact and climate change	- CO_2 will be produced by construction machinery and vehicles	-----	- Reduce CO_2 emissions as much as possible	- To reduce CO_2 emission as much as possible, Periodic mentenance and management of all construction machinery and vehicles will be conducted	- Construction area	- During construction phase	- Implementation: Contractor/ Environmental Consultant - Supervisor: STEG/ Supervision Consultant	Expenses included in contract cost by Contractor
Operation phase									
1	Air Quality	- Exhaust gas from the stacks	- Fixing Upper Limit of Polluted Air from Stationary Source (2010-2519) - Guideline values in Tunisian Standards related to Air	- Prevention of air pollution in the surrounding area	- To reduce NO_2 emissions, firing system will use low combust technology - Duct will be provided with CEMS (Continuous Emission Monitoring System) with the supported infrastructure as required under the gas emission standards	- Stack	- During operation of power plant	STEG/ Environmental Consultant	- Installing CEMS: $??? (Expenses included in contract cost by Contractor)

No	Potential Impact to be Managed	Sources of Potential Impact	Standard of Impact	Objectives	Management Effort	Management Location	Period of Management	Management Institution	Cost
			(No. 106-04)						
2	Water Quality	- Oil-containing wastewater, domestic wastewater, high salinity wastewater, and other wastewater due to plant operation	- "Discharge to sea" in Tunisian Standard related to Effluent (No.106-02)	- Prevention of sea water pollution	- Installation of wastewater treatment system by neutralization, settling and oil separation so any wastewater produced complies with wastewater standards	- Power plant, especially at discharge of thermal effluents and wastewater treatment system	- During operation of power plant	STEG/ Environmental Consultant	- Wastewater treatment system: (Expenses included in contract cost by Contractor)
3	Waste	1) Sludge from wastewater treatment and waste oil from equipment, etc. 2) Sewage and garbage from workers	1), 2) - Law No. 96-14 (concerning management and disposal of solid waste)	1), 2) - Management of waste, especially hazardous waste - Prevention of inappropriate waste disposal	1), 2) - Wastes are treated, in conformity with Tunisian regulations. - Hazardous wastes, such as waste oil and batteries, will be treated by the appropriate companies in Tunisia	1), 2) - Power plant	1), 2) - During operation of power plant	STEG/ Environmental Consultant	STEG
4	Noise and vibration	1) Noise and vibration from steam turbines, generators, and pumps, etc. 2) Noise caused by vehicles used for mobilization of equipment and workers	1), 2) - Decree No. 84-1556 on the regulation of industrial estates relating to the noise level	1), 2) - Mitigation of noise generated by the power plant	1), 2) - Installation of low noise/ low vibration type equipment - Vehicles for transportation of the workers will be regularly maintained	1), 2) - Power plant	1), 2) - During operation of power plant	STEG/ Environmental Consultant	- Buildings housing boiler and turbine generator (Expenses included in contract cost by Contractor)
5	Odor	- Domestic waste from workers	-----	- Prevention of generating odor	- Before starting the power plant operation, workers will be instructed to	- Power plant	- During operation of power plant	STEG/ Environmental Consultant	STEG

No	Potential Impact to be Managed	Sources of Potential Impact	Standard of Impact	Objectives	Management Effort	Management Location	Period of Management	Management Institution	Cost
					classify and collect garbage and illegal waste disposal will be prohibited. - Garbage will be disposed on a periodic basis to ensure that odor by putrefaction is not produced.				
6	Ecosystem	- Existence of animal	- Protected Species Lists of Flora and Fauna in Tunisia (19 July, 2006)	- Protection of endangered species	- Prohibit disturbance, harassment, and hunting - If any precious species are observed, the mitigation measure will be discussed in consultation with the expert.	- Power plant	- During operation of power plant	STEG/ Environmental Consultant	STEG
		- Adverse impact due to water pollution	-----	- Prevention of water pollution	- Same as those addressed in "Water quality"	- Power plant			
7	Existing Social Infrastructure and Services	- Traffic jams caused by increased vehicles	-----	- Mitigation of traffic disturbance	- If needed, bus use will be promoted to reduce the increased number of vehicles on the roads. - The bus schedules may be managed in consultation with related organizations	- Community around the power plant	- During operation of power plant	STEG	STEG
8	Local Conflicts of Interest	1) Increase employment, subcontracting, the purchase of materials 2) Conflicts	-----	1), 2) - Consideration of the attitudes of local residents to the project	1) Employment - Local people should be employed for the construction work to the maximum extent possible 2) Conflicts	1), 2) - Community around the power plant	1), 2) - During operation of power plant	STEG/ Environmental Consultant	STEG

No	Potential Impact to be Managed	Sources of Potential Impact	Standard of Impact	Objectives	Management Effort	Management Location	Period of Management	Management Institution	Cost
		between local residents and external workers			- External workers should be taught to respect local customs in order to facilitate good relationships with local people and should promote communication to local people (e.g., join in local event).				
9	Work environment (including work safety)	1) Labor accidents 2) Diseases caused by air pollutants, water pollutants, and noise by power plant operation	-----	1), 2) - Prevention of labor accidents and health problems	1) Labor accidents - Work accidents involving workers may occur at the power plant site. STEG shall establish a work safety plan. - The work safety plan shall stipulate mitigation measures on soft aspects (safety training, etc.) and on hard aspects (such as helmets masks, ear plugs, and, insulation protection equipments etc.). 2) Working environment - In order to prevent health problems of workers, StEG should observe related working environment standards and provide workers with appropriate equipment, such as masks, ear plugs, etc.	1), 2) - Power plant	1), 2) - During operation of power plant	STEG/ Environmental Consultant	STEG - Protective equipment: $???/set

No	Potential Impact to be Managed	Sources of Potential Impact	Standard of Impact	Objectives	Management Effort	Management Location	Period of Management	Management Institution	Cost
10	Accidents	1) Traffic accidents 2) Fire 3) Oil leakage from oil tanks	-----	1) Prevention of traffic accidents 2) Fire prevention measures 3) Oil leakage measures	1) Traffic accidents - Observation of traffic regulations, installation of traffic signs, and training and education on safe driving to drivers shall be conducted for land traffic vehicles. 2) Fire - Fire prevention measures shall be conducted such as installation of fire protection equipment in the power plant and organization of fire-fighting team and fire-fighting training. 3) Oil tanks - Cover the bottom of the tank-installation area with cement. - Installation of oil-separation tank in the drainage around the tank-installation area.	1) Community around the power plant 2), 3) Power plant	1) - 3) - During operation of power plant	STEG/ Environmental Consultant	STEG - Fire fighting facilities: $??? - Concrete: $??? - Oil separation tank: $??? (Expenses included in contract cost by Contractor) - Safety training: $???/ PErson - Training of fire fighting team: $???/ Team
11	Cross-boundary impact and climate change	- Emissions of CO_2	-----	- Reduce CO_2 emissions per electric generate (kW)	- Adoption of high-efficiency CCPP.	- Power plant	- During operation of power plant	STEG	STEG

Source: JICA Study Team

8.9 Environmental Monitoring Plan

Table 8.9-1 describes the environmental monitoring plan proposed by JICA survey team to STEG and the consultant preparing EIA (TPE). The review by STEG and TPE is currently in progress. For the environmental monitoring plan, final consultations will be conducted in JICA's appraisal mission.

Table 8.9-1 Environmental Monitoring Plan (Draft)

No	Significant Impact to be Monitored	Source of Significant Impact	Monitored Parameter	Purpose of the Monitoring	Monitoring Method			Responsible Organization	Cost
					Method of Collecting and Analyzing Data	Location	Duration and Frequency		
Construction Phase									
1	Air Quality	1) Dust resulting from construction work 2) Exhaust gas from construction machinery and vehicles used for mobilization of equipment 3) Air pollution arising from incineration of construction materials and waste	1) - 3) **PM_{10}** - Tunisian Standards related to Air (No. 106-04) **Meteorological Condition (Temperature, Moisture, Wind)**	1) - 3) - Evaluation of effect of the mitigation measures towards air pollution	1) - 3) - Collecting samples and analyzing at a lab - Measuring meteorological data	1) - 3) - **3 points** Residential area around the power plant	1) - 3) - Once every three months	- Implementation Contractor/ Environmental Consultant - Supervisor: STEG/ Supervision Consultant	Expenses included in contract cost by Contractor - Sampling: D./ sample - Analyzing: D./ sample
2	Water Quality	1) Run off water from construction area 2) Domestic wastewater of workers 3) Leakages of oil and chemical materials from construction activity	1) - 3) **Refer to "Monitoring Form"** - Tunisian Standard related to Effluent (No.106-02)	1) - 3) - Evaluation of effect of the mitigation measures towards water pollution	1) - 3) - Collecting samples and analyzing at a lab	1) - 3) - **1 point:** Foreside of the drain outlet - **5 points:** Sea water near the construction area	1) - 3) - Once every three months	- Implementation Contractor/ Environmental Consultant - Supervisor: STEG/ Supervision Consultant	Expenses included in contract cost by Contractor - Sampling: D./ sampling - Analyzing: D./ sample
3	Wastes (Odor)	1) Construction waste from construction work 2) Domestic waste from workers 3) Hazardous waste such as dry batteries, etc.	1) - 3) **Kinds and quantity of waste, and the disposal method** - Law No. 96-14 (concerning management and disposal of solid	1) - 3) - Evaluation of effect of the mitigation measures for waste	1) - 3) - Record of kinds and quantity of waste, and the disposal method	1) - 3) - Contractor's office	1) - 4) - Once a year	- Implementation Contractor/ Environmental Consultant - Supervisor: STEG/ Supervision Consultant	Expenses included in contract cost by Contractor

No	Significant Impact to be Monitored	Source of Significant Impact	Monitored Parameter	Purpose of the Monitoring	Monitoring Method			Responsible Organization	Cost
					Method of Collecting and Analyzing Data	Location	Duration and Frequency		
			waste)						
4	Noise and Vibration	1) Noise and vibration caused by construction machinery 2) Noise caused by vehicles used for mobilization of equipment and workers	1), 2) **Noise level** - Decree No. 84-1556 on the regulation of industrial estates relating to the noise level	1), 2) - Evaluation of effect of the mitigation measures towards noise levels	1), 2) - Measurement using noise level meter	1), 2) - **2 points:** Boundary of the power plant - **1 point:** Boundary of the closest house	1), 2) - Once every three months	- Implementation Contractor/ Environmental Consultant - Supervisor: STEG/ Supervision Consultant	Expenses included in contract cost by Contractor - Measurement: D./ session
5	Ecosystem (Endangered Species)	- Existence of migration birds	**Species, Number** - Protected Species Lists of Flora and Fauna in Tunisia (19 July, 2006)	- Evaluation of existence of migration birds	- Observation	**1 point** - Construction area	- Once a week in migration season	- Implementation Contractor/ Environmental Consultant - Supervisor: STEG/ Supervision Consultant	Expenses included in contract cost by Contractor - Observation: D./ researcher・year
	Ecosystem (Marine Biota)	- Potential impact due to the degradation of water quality caused by civil engineering work	**Species, Cover degree** - Zostera bed	- Evaluation of effect of the mitigation measures towards water pollution	- Observation	**5 points** - Sea area in front of construction area	- Twice a year		- Observation: D. / researcher
6	Existing Social Infrastructure and Services	- Increase in the number of cars	- Number of vehicles used by construction	- Evaluation of effect of construction schedule	- Record of numbers of cars being used	- Contractor's office	- Once every 3 months	- Implementation Contractor/ Environmental Consultant - Supervisor: STEG/ Supervision Consultant	Expenses included in contract cost by Contractor
7	Local Conflicts of Interest	- Conflict between local residents and external	- Change in local customs	- Confirmation of the attitudes of local	- Number and contents of	- Contractor's office	- Once every 3 months	- Implementation Contractor/	Expenses included in

No	Significant Impact to be Monitored	Source of Significant Impact	Monitored Parameter	Purpose of the Monitoring	Monitoring Method			Responsible Organization	Cost
					Method of Collecting and Analyzing Data	Location	Duration and Frequency		
		workers		residents to the project	received grievance and the response			Environmental Consultant - Supervisor: STEG/ Supervision Consultant	contract cost by Contractor
8	Infectious Diseases such as HIV/AIDS	- Temporary influx of migrant labor during construction may increase risk of infection	- Health of labors	- Evaluation of sanitation for labor	- Labor health records	- Related institutions	- Once every 3 months	- Implementation Contractor/ Environmental Consultant - Supervisor: STEG/ Supervision Consultant	Expenses included in contract cost by Contractor
9	Work Environment (Including Work Safety)	- Labor accidents	- Record of accidents	- Evaluation of effect of the work safety plan	- Record of accidents	- Contractor's office	- Once every 3 months	- Implementation Contractor/ Environmental Consultant - Supervisor: STEG/ Supervision Consultant	Expenses included in contract cost by Contractor
10	Accidents	- Traffic accidents	- Record of accidents	- Evaluation of effect of traffic schedules	- Record of accidents	- Contractor's office	- Once every 3 months	- Implementation Contractor/ Environmental Consultant - Supervisor: STEG/ Supervision Consultant	Expenses included in contract cost by Contractor
11	Cross-boundary	- CO_2 will be produced	-----	- Efforts to reduce CO_2	- Record of	- Contractor's	- Once every 3	- Implementation	Expenses

No	Significant Impact to be Monitored	Source of Significant Impact	Monitored Parameter	Purpose of the Monitoring	Monitoring Method			Responsible Organization	Cost
					Method of Collecting and Analyzing Data	Location	Duration and Frequency		
	Impact and Climate Change	by construction work			machinery maintenance	office	months	Contractor/ Environmental Consultant - Supervisor: STEG/ Supervision Consultant	included in contract cost by Contractor
Operation Stage									
1	Air Quality	1) Exhaust gas from the stacks 2) Exhaust gas from vehicles used for mobilization of equipment and workers	1), 2) **SO_2, NO_2, PM_{10}** - Fixing Upper Limit of Polluted Air from Stationary Source (2010-2519) - Tunisian Standards related to Air (No. 106-04) **Meteorological Condition (Temperature, Moisture, Wind)**	1), 2) - Evaluation of effect of the mitigation measures towards air pollution	1) Stacks - CEMS (Continuous Emission Monitoring System) 1), 2) - Collecting samples at the site, analyzing at a lab - Measuring the meteorological data	1) Stack outlet 1), 2) - **3 points:** Residential area around the power plant	1) Continuous measure-ment 1), 2) - Once every 3 months	- STEG/ Environmental Consultant	- CEMS (Expenses included in contract cost by Contractor) Expenses by STEG - Sampling: D./ staff - Analyzing: D./ sample
2	Water Quality	- Oil-containing wastewater, domestic wastewater, high salinity wastewater, and other wastewater due to plant operation	1) - 4) **Refer to "Monitoring Form"** - Tunisian Standard related to Effluent (No.106-02)	1) - 4) - Evaluation of effect of the mitigation measure towards water pollution	1) Thermal effluents - Measuring vertical sea water temperature profile with CTD meter 2) - 4) - Collecting samples at the site, analyzing at a lab - Continuous	1), 4) - **5 points:** Sea area around thermal water discharge point 2), 3) - **2 points:** Drain outlet of the wastewater treatment facility	1), 4) - Once every 3 months 2), 3) - **SS, Oil, BOD, Heavy metal etc.**: Sampling and analyzing (as necessary)	- STEG/ Environmental Consultant	- Continuous sensor (Expenses included in contract cost by Contractor) Expenses by STEG

No	Significant Impact to be Monitored	Source of Significant Impact	Monitored Parameter	Purpose of the Monitoring	Monitoring Method			Responsible Organization	Cost
					Method of Collecting and Analyzing Data	Location	Duration and Frequency		
					measurement using a sensor		- **pH**: Continuous measure-Ment		- CTD: 20,000 US$ - Sampling: D./ staff - Analyzing: D./ sample
3	Waste (Odor)	1) Sludge from wastewater treatment and waste oil from equipment, etc. 2) Sewage and garbage from workers	1), 2) **Kinds and quantity of waste, and the disposal method** - Law No. 96-14 (concerning management and disposal of solid waste)	1), 2) - Evaluation of effect of the handling of sludge and garbage	1), 2) - Record of the amount of sludge and garbage	1), 2) - Power plant office	1), 2 - Once a year	- STEG/ Environmental Consultant	Expenses by STEG
4	Noise and Vibration	1) Noise and vibration from steam turbines, generators, and pumps, etc. 2) Noise caused by vehicles used for mobilization of equipment and workers	1), 2) **Noise level** - Decree No. 84-1556 on the regulation of industrial estates relating to the noise level	1), 2) - Evaluation of effect of the mitigation measures towards noise levels	1), 2) - Measurement using noise level meter	1), 2) - **2 points:** Boundary of the power plant - **1 point:** Boundary of the closest house	1), 2) - Once every 3 months	- STEG/ Environmental Consultant	Expenses by STEG - Measurement: D./ session
5	Ecosystem (Endangered Species)	- Existence of migration bird	**Species, Number** - Protected Species Lists of Flora and Fauna in Tunisia (19 July, 2006)	- Evaluation of existence of migration bird	- Observation	**1 point** - around the site	- Once a week in migration season	- STEG/ Environmental Consultant	Expenses by STEG - Observation: D. / researcher
	Ecosystem (Marine Biota)	- Degradation of water quality caused by operation of power	**Species, Cover degree** - Zostera bed	- Evaluation of effect of the mitigation measure towards	- Observation	- **5 points:** Sea area in front of the site	- Twice a year		Expenses by STEG

No	Significant Impact to be Monitored	Source of Significant Impact	Monitored Parameter	Purpose of the Monitoring	Monitoring Method			Responsible Organization	Cost
					Method of Collecting and Analyzing Data	Location	Duration and Frequency		
		plant		water pollution					- Observation: D. / researcher
6	Existing Social Infrastructure and Services	- Increase in the number of cars	- Number of vehicles related to the power plant	- Evaluation of effect of traffic schedules	- Record of numbers of cars being used	- Power plant office	- Once every 3 months	- STEG	Expenses by STEG
7	Local Conflicts of Interest	- Conflict between local residents and workers	- Local residents' feelings	- Confirmation of local residents' feelings	- Number and contents of received grievance and the response	- Power plant office	- Once every 3 months	- STEG/ Environmental Consultant	Expenses by STEG - Interview: D. / researcher
8	Work Environment (Including Work Safety)	- Labor accidents	- Record of accidents	- Evaluation of effect of the work safety plan	- Record of accidents	- Power plant office	- Once every 3 months	- STEG/ Environmental Consultant	Expenses by STEG
9	Accidents	1) Traffic accidents 2) Fire 3) Oil leakage	1) Record of traffic accidents 2) Record of fire 3) Record of oil leakage	1) - 3) - Evaluation of effect of the work safety plan	1) - 3) - Record of traffic accidents, fire, and oil leakage	1) - 3) - Power plant office	- Once every 3 months	- STEG/ Environmental Consultant	Expenses by STEG
10	Cross-boundary Impact and Climate Change	- Emissions of CO_2	- Amount of CO_2 emissions	- Efforts to reduce CO_2	- Calculate the CO_2 emissions from fuel consumption	- Power plant office	- Once every 3 months	- STEG/ Environmental Consultant	Expenses by STEG

Source: JICA Study Team

8.10 Stakeholders` Meeting

In Tunisia, a public consultation is not mandatory during the process of the EIA. For the Project of Rades C CCPP, STEG requested, in the contract, Tunisie Protec Environnement (TPE: a local contracting consultant) in charge of EIA implementation to carry out once a public consultation, but not before starting the EIA on the subject of the scoping of the EIA.
In consultation with STEG and TPE, a first stakeholders` meeting was organized on September 20, 2013 in order to explain the outline of the project to the people concerned and to obtain their opinions on the proposed scoping as well as on the terms of reference (TOR) of the EIA. A second stakeholders` consultation to hear their opinions on the draft final report of the EIA was organized on November 13, 2013, but due to some reasons explained below, this second stakeholders` consultation was not successful. The third stakeholder meeting was decided to be held upon the request from the participants of the second stakeholder meeting.
By organizing the two stakeholders` meeting as above, this is expected to be consistent with the JICA's Guidelines for Environmental and Social Considerations.

8.10.1 1st stakeholders` meeting

(1) Participants
For those who requested to be able to participate in the stakeholders` meeting, an invitation letter was sent in advance. In addition to STEG and the consulting firm in charge of the EIA, representatives from various organizations participated in the discussions. The participants were as follows (Figure 8.10.1).

- Administration authorities (i.e., the Ministry of Agriculture, National Agency for Environmental Protection (ANPE)
- Agency for Coastal Protection and Development (APAL),
- Ben Arous Prefecture and Rades City
- Local economic organizations (i.e., Tunisian Union of Agriculture and Fishery (UTAP), Ben Arous Prefecture industrial and commercial association, Rades City industrial and commercial association and the Rades City petroleum association)
- Non Governmental Organizations (NGOs) (i.e., Association de sauvegarde de l'Urbanisme et de l'Environnement (ASUE))
- Residents from the vicinity of the proposed power plant
- A female architect living in the vicinity of the proposed power plant

Source: JICA Study Team

Figure 8.10-1 Scenery of the 1st Stakeholder Meeting

(2) Summary of the meeting

Prior to the meeting, the governor of the Ben Arous Prefecture came to the venue and had discussions with various participants.

Summary of proceedings is as follows.

Date and time:	September 20, 2013 (Friday), 10:00 to 12:00.
Location:	Prefectural government facility of Ben Arous.
Number of participants:	34 people in total (as detailed above).
Used Language	Mainly Arabic mixed with French

Proceedings:

a. Welcome speech and description of the project (STEG)
b. Explanation of scoping and TOR of the EIA study (TPE)
c. Questions and answers session (STEG and TPE answered the questions)
d. Explanation on the expected date for the completion of the EIA draft final report and programmed date for the second stakeholders` meeting as well as expressing gratitude to the participants (STEG)

The main questions were as follows.

- Estimated volume of emission of CO_2, NOx, and SOx, and possible impacts on the neighborhood (local NGO)
- Estimated volume of warm water effluent and possible impacts on the sea, coast and fisheries (local NGO)
- Necessity of APAL approval for warm water effluent into the public sea (APAL)
- Landscape issues around the power plant (local architect)
- Adverse effect on local and national economy in case of the zero option (Rades city industrial and commercial association)
- Relationship between environmental standards and emission levels for air and water (multiple participants)
- Combined effects when considering Rades C and the currently operating Rades II A&B, together with IPP (multiple participants)

To these questions, STEG and TPE answered wherever possible and promised to give answers, based on the results of the EIA study, on the occasion of the next stakeholders` meeting in November.

8.10.2 2nd stakeholders` meeting

(1) Participants

An invitation letter was sent in advance to those people and organizations who were invited in the first stakeholders' meeting. In addition, taking into account the advice of JICA's advisory committee for environmental and social considerations, a women's association (AFTURD: Association des Femmes Tunisiennes pour la Recherche sur le Développement) was invited and several notices were put in the nearest residential area of Mallaha (Figure 8.10-2). Due to very bad weather in the morning of the meeting day, however, less number of participants than the first meeting was unfortunately registered. In addition to STEG, TPE, JICA and TEPSCO, representatives of Ministry of Industry, APAL, Ben Arous Governorate, Rades County, UTAP, UTICA were in the meeting (Figure 8.10-3).

Société Tunisienne de l'Electricité et du Gaz
الشركة التونسية للكهرباء والغاز

دعوة للعموم

في إطار مشروع إنجاز محطة جديدة لإنتاج الكهرباء برادس تعتزم الشركة التونسية للكهرباء و الغاز (STEG) تنظيم استشارة عمومية مع الأطراف المتدخلة لهذا المشروع بحضور ممثلي الهياكل و المؤسسات المجاورة و ذلك يوم الاربعاء 13 نوفمبر 2013 بقاعة الأفراح التابعة لبلدية مقرين على الساعة التاسعة و نصف صباحا.

و في هذا الإطار فإن الدعوة مفتوحة للعموم لحضور هذا الاجتماع و ذلك لإبداء الرأي و الاقتراحات حول هذا المشروع التنموي الهام.

Source: STEG

Figure 8.10-2 Bill of SHM Held Announcement

Source: JICA Study Team

Figure 8.10-3 Scenery of the 2nd Stakeholder Meeting

(2) Summary of the meeting

Prior to the meeting, ex-ambassador of the republic of Tunisia to Japan came to the venue and had discussions with various participants.

Summary of proceedings is as follows.

Date and time:	November 13, 2013 (Wednesday), 10:00 to 11:45.
Location:	Prefectural government facility of Ben Arous.
Number of participants:	26 people in total.
Used Language	Mainly Arabic mixed with French

Proceedings:

a. Welcome speech (STEG)
b. Explanation of main results of the EIA study (TPE)
c. Discussions

The main points discussed were as follows.

- Since the draft final EIA report was not distributed before meeting, we can not formulate our comments. In other projects, draft report is made available sufficiently in advance and we can check it in detail before attending the meeting (APAL).
- Invitation letter was not sent to our site office. I came here today by the order of my head-office which received STEG's letter only at the beginning of this week. The invitation should be reached at least one week before and should be addressed to Rades site office (UTAP).
- The meeting should be held in Rades city, nearer than here to the project site (a resident in Rades city).
- We should invite Media and make our discussions open to those people who could not attend the meeting (UTICA Ben Arous).
- Considering above discussions without mentioning at all the contents of EIA draft report, STEG decided to organize another stakeholders' meeting in about two weeks and announced it to participants making it also clear that comments made today will be taken into account. Participants agreed with that idea and the meeting was adjourned.

8.10.3 3rd stakeholders` meeting

(1) Participants

An invitation letter together with EIA report was sent by STEG one week before the meeting and newspaper announcement (in French language) was made twice by STEG (Figure 8.10-4). Ben Arous Governorate on the other hand informed other organizations concerned as well as media people. The place of meeting was changed to the Rades city hall, nearer place to project site than two previous meetings. Therefore, all requests expressed by participants in the second stake holders' meeting were respected (Figure 8.10-5).

- Representatives from administration (Minstry of Industry, Minstry of Finance, ANGed, Ben Arous Governorate, Rades County)
- Media (two Arab newspaper and one French newspaper)
- One private maritime company (Société maritime GENMAR)
- Economic organizations (JCI=Jeune Chambre Internationale Rades, UTAP Ben Arous)
- NGO (ASUE, ATAE (Association Art et Envoronnement), Association Yassmin, Association BIATI, BTBFBMecasol)
- Two citizen of Rades County

JOURNAL
LA PRESSE
Du 25 Novembre 2013

Consultation publique du projet de construction de la Centrale électrique de radès

Dans le cadre du projet de la construction de la centrale électrique à cycle combiné de Radès étape C (430-500 MW), la Société tunisienne de l'électricité et du gaz (Steg) se propose d'organiser une réunion pour la consultation publique des parties prenantes affectées à ce projet en présence des représentants des différents organismes nationaux et entreprises avoisinantes du site d'implantation de la centrale le **mercredi 27 novembre 2013 à 09h00** à la municipalité de Radès.

A cette occasion, les habitants de Radès et principalement ceux avoisinant le centre de production d'électricité, sont invités à assister à cette réunion pour discuter et donner leurs avis et suggestions sur les aspects environnementaux et sociaux liés à la réalisation de ce projet de développement régional.

Source: STEG

Figure 8.10-4 Newspaper Advertisement of SHM Held Announcement

Source: STEG

Figure 8.10-5 Scenery of the 3rd Stakeholder Meeting

(2) Summary of the meeting

Summary of proceedings is as follows.

Date and time:	November 27, 2013 (Wednesday), 9:30 to 11:30.
Location:	City hall of Rades County.
Number of participants:	37 people in total.
Used Language	Mainly Arabic mixed with French

Proceedings:

a. Welcome speech (STEG)
b. Explanation of main results of the EIA study (TPE)
c. Discussions
d. Resolution

The main points explained by TPE about the results of the EIA study are as follows.

- On September 27, 2013, 12 points of Tunis bay nearby the Rades central were investigated. It was confirmed that some of these points got direct impacts from port activities but none of them got negative impact from Rades central.
- According to the simulation of hot water, most significant impact may occur with wind from west. Even under such conditions, however, area to be reached by water of one to five degrees hotter than sea will not be very large compared with current situation and hot water will not reach the intake area of cooling water.
- Simulation of air diffusion from chimneys shows that air quality, namely Nox and SO_2 will never exceed national or international standards. This is thanks to high chimenies and high speed of emission gaz.
- Main recommendation is to monitor the noise and vibration level and their possible impact in the neighboring area.

Then discussions started. Main opinions and answers expressed are as follows.

- Wind direction is very important to determine the hot water diffusion. Main cause of current Rades seashore pollution is Oued Méliène River. We need to investigate more on this issue. Tall chimney can be very aggressive from aesthetic point (ASUE).
- Recommendation is also made to carry out an overall study on the pollution of Rades seashore. It is recommended to develop solar electric generation (JCI de Rades).
- Representative of the association regretted not to be able to see anymore migrating birds including flamingoes in the bay of Tunis. He is convinced that this is closely related to the pollution of Rades seashore. He is also interested in the number of jobs to be created by the Project (Association Art et Environnement).
- (STEG and TPE) The pollution of Rades seashore never comes from STEG's electric central but from Oued Méliène River. Combined cycle power plant is very clean and efficient. STEG is making efforts in wind power (240 MW developed until today) as well as in solar power with a project of 50 MW. It is estimated to create 90 new jobs by the Project, without talking about many indirect jobs during the construction stage. By the air and hot water simulation, accumulated impacts by existing two plants and the new Rades C project are measured and the result does not exceed the standard. The project will carry out an architectural competition. ASUE can be associated in the selection of such competition.
- In order to reduce the dependence on conventional energy, we should promote PROSOL

project[6] and increase the portion of solar power (Association BIATI).

- (STEG) PROSOL project is also beneficial for STEG. The government of Tunisia is now preparing a law concerning electricity sales by small producers. STEG is willing to associate with the comprehensive study to determine the causes of the pollution of Oued Méliène River.
- Rades county should be engaged in that study (Association BIATI).
- (STEG) Rades county is willing to commit to identify the source of pollution and to reduce it. The pollution seems to come from the water evacuation of ONAS (Office Nationale d'Assainissement) into the Oued Méliène River. The county wishes to have more contributions from NGO to find out good solutions. It wishes also that STEG be engaged in that study.
- The solution will be the construction of water treatment plant in Séjoumi area and to stop water drainage into the Oued Méliène River (ASUE).
- (STEG) We need to have an approval of ANPE before starting the project. As for the comprehensive study, Rades county is kindly requested to make a formal request to the STEG president. Since we are participating to a similar study in Sousse region, we can certainly engage in such a study.
- We propose in a near future a symposium on the Rades region pollution (Association Art et Environnement).
- The gouvernorate approves the initiative of symposium and will propose it to the government of Tunisia. It regrets the absence of ANPE to the meeting, although ANPE was well invited (Representative of Ben Arous Gouvernorate).
- We propose to construct a green belt around Rades Power Plans Group (UTAP).
- (STEG) We can do it.
- Deputy Mayor of Rades county, seeing there remains no further question, asked whether the stakeholders approve the EIA and the project. All participants agreed to approve the EIA prepared by TPE and the Rades C project.

Resolution:

- Some corrections should be made, namely the height of chimney which will improve the result of impacts.
- EIA should be presented to ANPE as soon as possible, because the project will have positive effects on regional economy as well as on the Tunisian economy in general.

8.11 Others

8.11.1 Environmental Checklist

It will be stated in Final Report.

8.11.2 Monitoring Form

It will be stated in Final Report.

[6] Initiative taken by UNEP to subsidize Tunisian private banks in order to promote the installation of solar panels by citizens to get hot water. By the success of this project, the government of Tunisia decided to install 750,000 m^2 of solar panels in the period 2010 - 2014.

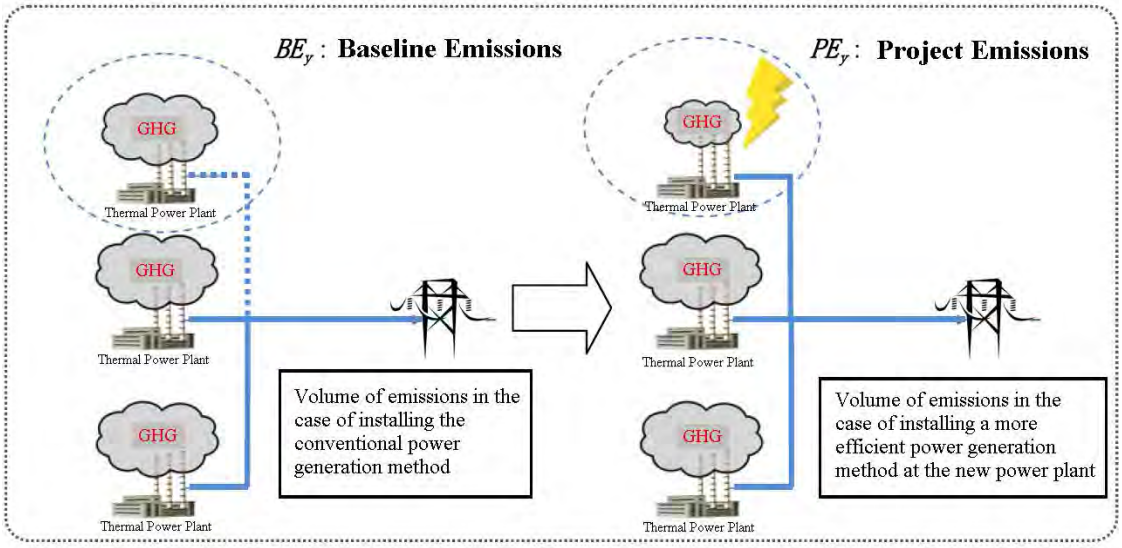
8.12 Estimation of Greenhouse Gas Reductions

8.12.1 Methodology

This project is identified as a climate change mitigation project, and its mitigation effect was calculated in reference to "JICA Climate-FIT (Mitigation) Climate Finance Impact Tool for Mitigation, 2011". The calculation method for greenhouse gas (GHG) emission reduction is shown below (Figure 8.12-1).

$$ER_y = BE_y - PEy$$

ER_y: GHG emission reduction in year y achieved by project (t-CO_2/y)
BE_y: GHG emission in year y with low-efficiency power generator (t-CO_2/y)
(Baseline emission)
PE_y: GHG emission in year y after efficiency improvement (t-CO_2/y)
(Project emission)



Source: JICA Climate-FIT (Mitigation) Climate Finance Impact Tool for Mitigation, 2011

Figure 8.12-1 Images of Emissions Reductions

(1) Baseline emission
Baseline emission shall be determined by multiplying the reduction of net power output by low-efficiency existing power plants and the CO_2 emission factor of electricity for the existing power plants.

Since the amount of power output in the grid before the start of the project is supposed not changed after the completion of the project, the power output reduced by the existing power plant shall be equivalent to the power out generated by the new power plant.

$$BE_y = EG_{BLy} \times EF_{BLy}$$

Where,
BEy: Baseline emission (GHG emission with low-efficiency existing power plants), (t-CO_2/y)

EG_{BLy}: Reduction of net electrical output by the existing power plants, which shall be equivalent to the power output of new power plant EG_{PJy}, (MWh/y)
EF_{BLy}: CO_2 emission factor of the electricity for the low-efficiency power plant, (t-CO_2/MWh)

Definition of baseline CO_2 emission factor of electricity EF_{BLy}

Baseline CO_2 emission factor of electricity is defined as the emission factor of typical, old power plants (at least 1 to 2 facilities) located in the said country or in a surrounding country.

If the emission factor is not available, it should be calculated using the net electrical output, fuel properties, net power generation efficiency, net calorific value, and CO_2 emission factor of fuel for the target power plant.

The power generation efficiency of the said power plant is adopted from the value referred in the interview with the electric power operation management organization and others in the said country or in a surrounding country.

$$EF_{BLy} = (COEFi / \eta_{BL,y}) \times 0.0036$$

Where,
EF_{BLy}: Baseline CO_2 emission factor of electricity (t-CO_2/MWh)
$COEF_i$: CO_2 emission factor of fuel "i" in lower calorific value basis (t-CO_2/TJ)
η_{PJy}: Electricity generating efficiency of the existing, old power plant in the said country or in a surrounding country (decimal)
0.0036: Energy conversion factor of MWh to TJ, (TJ/MWh)

(2) Project emission
Project emission shall be determined by multiplying the net power output produced by the new power plant and the CO_2 emission factor of electricity for the new power plants.

$$PE_y = EG_{PJy} \times EF_{PJy}$$

Where,
$PE_{PJ,y}$: Project emission (GHG emission after project activity (t-CO_2/y))
$EG_{PJ,y}$: Yearly electricity generating capacity after the project (transmission end efficiency) (MWh/y)
$EF_{PJ,y}$: CO_2 emission coefficient of electricity generation (t-CO_2/MWh)

Calculation of project CO_2 emission factor of electricity: EF_{PJy}

CO_2 emission coefficient of electricity for the new power plant is calculated using the planned data of CO_2 emission factor of fuel and generation efficiency and power output for the new power plant before the project starts, and the measured data shall be used after the project is completed.

CO_2 emission factor of fuel "i" shall be the same as of the baseline, since the fuel properties are the same for the both cases.

$EF_{PJ,y} = \{COEFi / (\eta_{PJ,y/100}) \} x\ 0.0036$

Where,
EF_{PJy}: Project CO_2 emission factor of electricity, (t-CO_2/MWh)
$COEF_i$: CO_2 emission coefficient of fuel "i" per calorific value, (t-CO_2/TJ)
$\eta_{PJ,y}$: Planned value of generation efficiency after improvement, (%)
0.0036: Conversion factor of electric energy (mega watt hour) to thermal energy (tera-jule), (TJ/MWh)

8.12.2 Estimation of effect of greenhouse gas emissions reductions

(1) Baseline emission
CO_2 emission coefficient of fuel i: COEFi can be calculated using the properties of fuel gas specified in Table 6.1.1-1 "Design Conditions and Specifications", and CO_2 emission coefficient of electricity generation $EF_{PJ,y}$ can be calculated using the generation efficiency of old power plants such as Rades A and Sousse A of which operations are planned to be stopped in 2016 and 2021 respectively. The details of the calculations are as shown in Table 8.12-1.

Table 8.12-1 Calculation of CO_2 emission coefficients for old power plant

Item	Unit	Value	Remarks
Kind of fuel	-	Natural gas	Note-1)
Higher heating value, HHV	kJ/kg	50,716	(ditto)
Lower heating value, LHV	kJ/kg	45,750	(ditto)
Carbon content in fuel, C%	weight%	70.37	(ditto)
CO_2 emission coefficient of fuel, COEFi	t-CO_2/TJ	56.36	Note-2)
Net generation efficiency of old power plant (LHV basis), $\eta_{PJ/y}$	%	39.81	Note-3)
Conversion factor of electric energy (mega watt hour) to thermal energy (tera-jule)	TJ/MWh	0.0036	
CO_2 emission coefficient of electricity generation, $EF_{PJ,y}$	t-CO_2/MWh	0.5084	Note-4)

Note:
1) the properties of fuel gas are cited from Table 6.1.1-1
2) CO_2 emission factor of fuel i,
COEFi = (C%/100) / LHV x (44.01/12.011) x 10^6
3) The net generation efficiency of old steam power plant such as Rades A TPP is 36.0% in higer heating value basis through the interview of STEG, and consequently the net generation efficiency in lower heating value basis is 39.81%.
4) CO_2 emission factor of electricity, $EF_{PJ,y}=\{COEFi / (\eta_{PJy} / 100)\} x\ 0.0036$

(2) Project emission
Regarding Rades C CCCP, the CO_2 emission factor of fuel i: COEFi and CO_2 emission factor of electricity: $EF_{PJ,y}$ can be calculated using the same equations as for the old power plants by only changing the figure of generation efficiency from Table 8.12-1. The results are as shown in Table 8.12-2.

Table 8.12-2 Calculation of CO_2 emission coefficients for Rades C Project

Item	Unit	Value	Remarks
Kind of fuel	-	Natural gas	Note-1)
Higher heating value, HHV	kJ/kg	50,716	(ditto)
Lower heating value, LHV	kJ/kg	45,750	(ditto)
Carbon content in fuel, C%	weight%	70.37	(ditto)
CO_2 emission coefficient of fuel, COEFi	t-CO_2/TJ	56.36	Note-2)
Net generation efficiency of old power plant, $\eta_{PJ/y}$	%	56.6	Note-3)
Conversion factor of electric energy (mega watt hour) to thermal energy (tera-jule)	TJ/MWh	0.0036	
CO_2 emission coefficient of electricity generation, $EF_{PJ,y}$	t-CO_2/MWh	0.3585	Note-4)

Note:
1) the properties of fuel gas are cited from Table 6.1.1-1
2) CO_2 emission factor of fuel i,
   $COEFi = (C\%/100) / LHV \times (44.01/12.011) \times 10^6$
3) The net generation efficiency of new power plant is cited from
4) CO_2 emission factor of electricity, $EF_{PJ,y}=\{COEFi / (\eta_{PJy} / 100)\} \times 0.0036$

(3) Trial calculation of GHG reduction

Table 8.12-3 shows the trial coalculation result of CO2 emission reduction of the project based on the expected performance data for the combined cycle plant of M701 F4 gas turbine. The baseline emission BEy is 1,646,800 t-CO_2/y, and the project mission PEy is 1,161,000 t-CO_2/y, and consequently the reduction of emission is 485,800 t-CO_2/y.

Table 8.12-3Production and CO_2 Emission by Rades C CCCP

Item	Unit	Value	Remarks
Gross power output of CCCP	MW	435.0	From Fig. 6.1.5-3
Gross thermal efficiency	%	56.6	(ditto)
Capacity factor	%	85	CF
Electricity generation	MWh	3,305,300	MWx8760x(CF/100)
Annual CO_2 emission	ton	1,158,900	Fx8760*(CF/100)x(C%/100)
Baseline CO_2 emission factor of electricity	ton/MWh	0.5084	ton/MHh
Project CO_2 emission factor of electricity	ton/MWh	0.3585	
Baseline emission, BEy	t-CO_2/y	1,646,800	
Project emission, PEy	t-CO_2/y	1,161,000	
Reduction of emission,	t-CO_2/y	485,800	