INTER-AMERICAN DEVELOPMENT BANK

DOMINICAN REPUBLIC

SAN PEDRO DE MACORÍS

DR-0133

ENVIRONMENTAL AND SOCIAL IMPACT REPORT

April 1999

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1.0 INTRODUCTION

1.1 The Dominican Republic has limited and costly local energy resources, which compounded by an inadequate institutional framework and inefficient generation, transformation and end-use of energy, have resulted in continuous power shortages. The state owned utility company *Corporación Dominicana de Electricidad* (CDE) has been historically unable to provide sufficient and reliable electricity to consumers. As a result, there has been a substantial growth of private generators and self-generators, reaching a total capacity almost equal to that operated by CDE (i.e., approximately 1100 MW). Electricity demand is expected to increase at a rate of about 5% per year during the next decade, with new capacity requirements estimated at about 750 MW by 2001. Meeting the current and future requirements is further hampered by existing limitations on the investment capacity of the public sector.

1.2 The Government is currently pursuing a power policy with two main objectives. First, improving operating and investment efficiency by introducing competition in generation and distribution, and privatizing the management of the transmission grid. Second, reducing the financial burden on the Government of the Dominican Republic (GODR) by transferring control of the distribution activities to the private sector and attracting private investment for new generation capacity. These policies are reflected in a new Electricity Law currently being discussed in Congress. In the interim, until the new law is enacted, the proposed project's Implementation Agreement, between the project company (Compañía de electricidad de San Pedro de Macorís) and the GODR, provides a framework for the investment establishing several obligations for the parties which would traditionally be part of the regulatory mechanisms.

1.3 The proposed San Pedro de Macoris Power Plant project will be one of the largest power projects undertaken by an independent producer in the Dominican Republic, and it is the first one to be awarded under competitive bidding. The IDB played a major role during the preparation phase of the bidding process. The project consists of a 294.6 MW thermal power plant to be developed under a 20-year contract Build-Own-Operate (BOO) scheme awarded to an international consortium formed by Cogentrix (US) and Scotia Energy (UK). The project is part of the GODR's strategy to reduce power shortages and fits with the country's preference for thermal power plants (e.g., use of diesel fuels). The project agreements call for a fully operational plant to be commissioned by the second half of 2000. The consortium proposed a tariff of US¢5.459 per kWh, at 65% load factor and 1997 prices, which is below the generation long-run marginal cost for the Dominican system currently estimated at US¢6.5 to 7.0 per kWh.

1.4 The IDB has been requested to provide a partial risk guarantee for the project of approximately 130 million U.S. Dollars for transferability and convertibility and early termination of the PPA.

2.0 PROJECT DESCRIPTION

2.1 The Project

2.1 The proposed San Pedro de Macorís Thermal Power Plant will be constructed approximately 5 km northwest of the city of San Pedro de Macorís, in a 4 ha site (see Annex 1 for a map). The Project will be a highly efficient facility, consisting of a 294.6 (MW) oil-fired (fuel oil), combined-cycle generating facility. The project will provide electricity to the existing CDE transmission grid through a new substation to be constructed by CDE, adjacent to the project site. The proposed project will require the construction and operation of an underground high voltage cable to connect to the adjacent CDE substation.

2.2 The project will also involve the construction of a fuel supply system consisting of a mooring and unloading point for the ship transported fuel oil, located approximately 600 to 1000 meters offshore; a fuel bunkering facility located approximately 2.5 km north of the shoreline in a 5 ha site; and a pipeline extending from the mooring to the bunkering facility and to the power plant, totaling approximately 9.5 km.

2.2 Thermal Power Plant

2.3 The project will consist of three Siemens Model V64.3A low NOx combustion turbine sets, three heat recovery steam generators (HRSGs), three steam turbine sets, a cooling tower, and associated ancillary facilities. The total output will be 294.6 MW. The units will be fired using No.2 distillate fuel oil. Estimated air emission rates of the proposed facility are 134 mg/Nm^3 for NO_x, 644 mg/Nm^3 for SO_2, and 38.9 mg/Nm^3 for particulate matter.

2.4 The main thermal power plant components will consist of: Combustion turbine Model V64.3A with an internally air-cooled compressor and turbine common rotor; 24 hybrid burners forming a continuous ring flame that acts to minimize NOx formation. Water is injected for NOx control when firing distillate fuel oil. An air intake system provides filtered air to the combustion compressors required for operating the turbine. The air inlet will contain several absorbent bafflers (silencers) for noise reduction. A single common generator will be provided for each combustion turbine and steam turbine set. The gas turbines will release exhaust gases into the horizontal HRSGs that will generate steam at two pressure levels for supply to the steam turbine. The HRSGs use natural circulation with each pressure stage using a separate drum. Exhaust gases leaving the HRSGs are routed through the stack. The extraction from the steam turbines will be used for preheating of the condensate from the condensers prior to its admission to HRSGs. Low pressure steam from the HRSGs is admitted to the steam turbines to maximize the steam cycle efficiency.

2.5 A 49 meter high carbon steel stack will release the combustion gases from each HRSG. Un-insulated and free standing, it will be connected to the HRSG by ducts. A 1- or 2- pass steam surface condenser will condense the steam exhaust from each steam turbine. The condenser will be used with a wet cooling tower, and will be designed in accordance with the HEI standards for steam surface condensers. A cooling tower will minimize thermal impacts to the receiving water from condenser cooling water through the release of thermal energy to the atmosphere prior to discharge. A single mechanical induced draft, counterflow cooling tower will cool the circulating water. The cooling tower will be constructed out of steel, wood or concrete. Fill and drift eliminators will be made of PVC. A single speed fan will be installed in each cell with multi-blade propellers.

2.3 Water Supply and Treatment

2.6 Onsite wells will supply water for the project. Maximum water demand will be approximately 2, 100 gallons per minute (gpm) per day. The water treatment system will consist of make-up water treatment, potable water treatment and a demineralizer system. The wastewater collection system has three components: a sanitary waste system, a stormwater drainage system and a process wastewater system. Sanitary wastes will be treated in an onsite package plant or leach field. Stormwater runoff from non-curbed areas will flow directly to the river. Stormwater from curbed areas will be treated for oil removal in an oil/water separator (OWS) and then discharged into the river. The process water collection and treatment system will consist of in-plant sumps, a boiler blowdown, a cooling tower blowdown, demineralizer wastes and chemical drains. The wastes requiring pH adjustment will flow to the neutralization tank before they are discharged into the river. The discharge to the Higuamo River will be 724 gpm, of which 588 gpm will consist of cooling tower blowdown.

2.4 Fuel System

2.7 Fuel oil (No. 2 distillate fuel oil with maximum by weight sulfur and ash content of 1.0 and 0.03 %, respectively) will be transported to the Dominican Republic by ship (approximately one ship per month). The total estimated volume of fuel oil to be shipped to the fuel unloading and transportation facility will be 288,000 barrels per month, or 3,012,000 barrels per year. An offshore mooring and fuel unloading terminal, onshore bunkering facility and associated pipelines will be constructed as part of the San Pedro de Macorís Power Project.

2.8 The mooring and unloading point is planned as a conventional buoy mooring system. It will utilize anchor buoys and the ships bow anchors to moor the vessel. A line handling boat will take the mooring lines from the ship to each anchor buoy.

2.9 A 3.5 km pipeline will connect the mooring unloading facility to storage tanks located at the on shore fuel oil bunkering site. The pipeline end manifold, anchored on the sea floor adjacent to the ship in the moored position, will include an elbow with flanged connection to a hose. The other end of the hose will include a butterfly valve, a blind flange to be installed when not in service and a cam lock coupling to a spool piece which mates to the ship's manifold. The hose will be chained to a marker buoy and will be tugged by the line boat to the moored ship for lifting.

2.10 The on shore fuel bunkering facility will consist of two 150,000 barrel fuel oil storage tanks and associated facilities. The dimensions of the tanks to be constructed are 12.2 meters tall and 55 meters in diameter. The bunkering facility will cover an area of approximate 5 Ha and will be enclosed by a 2.1 meter high chain link fence. The facility will have security 24 hours/day.

2.11 The offshore section of the pipeline from the offshore mooring and unloading buoy will likely be constructed of carbon steel with an epoxy or concrete coating to prevent corrosion and to provide additional protection from damage. This section will be anchored to the sea floor and it may be necessary to bury or cover the pipeline in the shallower depths. The onshore portion of the pipeline will be also constructed of steel and will be buried with at least 0.6 meter of soil on top of the pipeline. The section of the pipeline from the shore line to the fuel bunkering facility, crossing an area of mixed vegetation, will not be buried.

2.12 At the power plant site, the fuel oil system will consist of two steel day-tanks that will provide a storage capacity equal to 15 days (22,710 cubic meters) consumption at the plant. The fuel oil tanks will be provided with secondary containment. All areas with the potential for contamination with oil will be curbed and provided with an impervious surface. All runoff from these areas will be directed to an oil water separator.

2.5 Project Schedule and Costs

2.13 The San Pedro de Macorís Power Plant construction is scheduled to begin in late 1999, with commercial operation scheduled for mid/late 2001. Total Project costs are estimated at US$282 million.

2.6 Project Alternative Analysis

2.14 CDE defined San Pedro de Macorís as a 250 MW combined cycle project to be operated as a fully dispatched power plant with a 92 % availability. The location was selected after conducting a siting evaluation designed to identify suitable development sites based on engineering, environmental, land use and system reliability considerations. Locating the Power Plant elsewhere would not result in the optimal development based on CDE's needs. The site was also selected to

take advantage of the new substation and newly completed simple cycle plant, located immediately adjacent to the proposed project site.

2.15 The existing docking facilities at the City of the San Pedro de Macorís can not adequately handle the volume of fuel oil or the sizes of ships required for the proposed project. The option of using natural gas as a fuel was eliminated due to an inadequate supply of gas on the island. The selected fuel transportation option does not require the construction of additional jetties, docks or other major marine structures.

2.16 The technology selected for the project represents an efficient energy generation system, in addition to using very cost effective and low polluting technologies. An analysis of alternative water sources was conducted, considering options of using sea water, river water or either on-site or off-site groundwater. Sea water was rejected because of engineering and cost considerations, including saline resistant materials, need for long pipelines, high treatment costs, and high energy costs for pumping. Analysis of river water showed high salinity, which would present many of the same constraints associated with the use of sea water. Results of on-site hydrogeologic and groundwater quality testing demonstrated that dependable aquifer yields of reasonable quality water can be obtained without significant impacts. This option has the benefit of having the fewest environmental impacts due to the non-potable nature of the aquifer.

2.17 Discharge options considered both riverine and open ocean disposal. The open ocean disposal was discarded because of the high cost of installation and operation and the general lack of environmental benefit. The river discharge option was selected based on the proximity to the project site, results of the thermodynamic modeling which demonstrated minimal impacts to the river, and a significant advantage in regard to operational requirements.

2.18 Two options were considered for condenser cooling: once through cooling and a cooling tower. The last option was selected because of the lower volume of water to be used and the lower overall temperature of the thermal discharge.

3.0 INSTITUTIONAL AND LEGAL FRAMEWORK

3.1 Institutional

3.1.1 Energy Sector

3.1 The electric power generation, transmission and distribution infrastructure of the DR is owned and administered by CDE, an autonomous public service company whose sole shareholder is the Dominican State. CDE operates pursuant to its Organic Law (*Ley Orgánica de la Corporación*

Dominicana de Electricidad) of April 1955. Pursuant to its Organic Law, CDE has comprehensive authority to produce and distribute electricity and to administer and regulate the electricity sector under its authority. CDE's broad authority is subject to the legislation of the DR and to the directions of the President.

3.2 The GODR enacted the General Law for the Reform of Public Enterprises (Ley General de Reforma de la Empresa Pública)) (LREP) on June 24, 1997, which codifies the GODR's commitment to the introduction of private sector participation in the electricity sector. The LREP establishes an agency of the government, the Commission for the Reform of Public Enterprises (Comisión de Reforma de la Empresa Pública) (CREP) which, under the direction and authority of the President, has been granted jurisdiction over the restructuring and capitalization of government enterprises.

3.3 Pending approval and implementation of the Electricity Law, the President issued Presidential Decree no. 118-98 of March 16, 1998 creating the Superintendency of Electricity as a regulatory body of the electric sector within the Ministry of Industry and Commerce (MIC). Among its functions, the Superintendency of Electricity shall supervise and enforce compliance of the sector regulations, shall define tariffs and shall verify the continuous supply of electricity. Under Decree 118, the responsibility for regulating the capitalized electricity sector falls to the MIC through the newly created Superintendency. Accordingly, the MIC issued Resolution no. 45-98 of March 18, 1998 establishing a regulatory framework to administer electric utilities and the electricity sector.

3.1.2 Environment

3.4 The National Commission for the Environment (CONAMA) was established on March 28, 1987, under Presidential Decree no. 15587. The Commission's task was to synthesize and harmonize the various existing laws and enforcement authorities into a far-reaching environmental law applicable to all geographic and economic sectors. CONAMA's current jurisdiction focuses on developing an integrated legal framework for environmental protection and does not include the development or enforcement of specific environmental regulations.

3.5 The draft Environmental Protection and Quality Law draft currently being considered by the Dominican Republic legislature is intended to consolidate all environmental protection legislation. The Environmental Protection and Quality of Life Law proposes the creation of the National Institute for Environmental Protection (Instituto Nacional de Protección Ambiental - INPRA). INPRA, which is currently under formation, will be the regulatory agency in the country.

3.6 According to the draft national law, CONAMA would remain in charge of developing national standards for environmental quality, regulations and related recommendations. Further, CONAMA would create and manage the national Environmental Social Impact Evaluation (EIAS) system, and

would issue construction and operation permits. An EIAS would be required for most projects in the power sector. In addition, according to the draft law, CONAMA would be required to review and comment upon Environmental Impact Assessments related to projects in the Dominican Republic performed for international lending institutions.

3.1.3 Health and Safety

3.7 Decree 2784, dated October 6, 1981, created a National Emergency Plan Commission referenced in the draft environmental law. This Commission oversees the electric power sector, including earthquake protection, flood protection, electrical system failure and prevention, and maintenance of emergency communication systems.

3.2 Legal

3.2.1 Environment

3.8 Given that the Environmental Protection and Quality of Life Law has not been enacted, there is a disperse and incomplete set of regulations establishing requirements for water uses, for forestry conservation, forestry cutting and for activities in coastal areas. For example, there are no specific legal requirements for the project related to the preparation and approval of an Environmental Impact Assessment (EIA), air emission or ambient air quality criteria, or permits for waste production, handling or disposal.

3.9 Table 3-1 presents a list of various laws and regulations that are potentially applicable to the project. Table 3-2 presents the GODR waste water effluent limits that can be applied to the project.

3.2.2 Health and Safety

3.10 The project related health and safety requirements are presented in the Dominican Republic Public Health Law (1956) and in the Dominican Republic Industrial Safety and Hygiene Law 807 (1976).

3.2.3 Other Requirements

3.11 The project will comply with the World Bank guidelines for new thermal power plants (Pollution Prevention and Abatement Handbook, September 1997)(see Table 3-3). In addition related to health and safety, the project will comply with the applicable guidelines in the World Bank Power Plants, Coal and Fuel Oil: Occupational Safety and Health Guidelines.

3.3 Project status

3.12 A preliminary Environmental Impact Assessment for the project was completed in April 1998 and included: a detailed description of the proposed project; the applicable environmental legislation, regulations, and policies; a description of the baseline environmental and social conditions, including results from field activities; a description of the proposed environmental and social impacts; and the associated proposed mitigation measures and monitoring programs. This preliminary EIA was made available to the public in April 1998 (see section 7 for details).

3.13 Subsequently additional field investigations were performed, including a detailed ground water survey and pump test and additional water quality monitoring.

3.14 A public meeting was held in November 1998 in San Pedro de Macorís to allow the local population to better understand the project, potential environmental impacts and proposed mitigation measures and controls, and to present any questions or concerns (see section 7 for details). No significant issues were raised during the meeting.

3.15 Based upon the additional data and information collected, public comments, and final design aspects, a final EIA was completed in December 1998 and submitted to various governmental entities for comment (note: under the present regulatory system these entities have apparently no direct requirement for the approval of the EIA).

3.16 At the request of IDB, the project sponsors have performed additional multi-source air emission modeling, additional temperature discharge modeling, and have requested various governmental entities for a letter of "no objection". The sponsors have received letters of no objection from the following governmental entities: Oficina Nacional de Planifacacion, Autoridad Portuaria, Govierno Civil Provincial, Instituto Nacional de Aguas Potables, Marina Guera, Dirrecion Forestal, and Instituto Nacional de Recursos Hidraulicos.

3.17 Table 3-4 presents a list of applicable permits and authorizations required for the San Pedro de Macorís Power Project from the Government of the Dominican Republic and their status.

4.0 ENVIRONMENTAL AND SOCIAL CONDITIONS

4.1 Environmental

4.1 The project site is located approximately 5 km northwest of the city of San Pedro de Macorís (see map Annex 1). The site is presently undeveloped with a mixed vegetation that was previously used for cattle grazing. The area immediately surrounding the property consists of undeveloped open

fields used for livestock grazing (north and south), the new CDE 68 MW oil fired simple cycle power plant (west), and the Higuamo River (east).

4.1.1 Climate and Air Quality

4.2 The Dominican Republic is located on the island of Hispaniola in the Caribbean Sea. The island is oriented in a general east-to-west direction, extending approximately from 68.3º W to 72.0º W longitude and 17.6º N to 20.0º N latitude. Because of its relative isolation from other landmasses and its relatively small area, trade winds, orographic features, and maritime influences primarily control the general climate of the island.

4.3 Local climatic regimes, ranging from arid to wet, are determined by the insularity and heterogeneous topography of the island. Rainfall varies throughout the country, and is seasonal. Exposure to northeasterly trade winds for more than half of the year results in abundant orographic rainfall in northern sections of the Dominican Republic. Data shows that June is typically the driest month and December the wettest. The average annual minimum and maximum temperatures range from 20.9º C to 30.6º C, and the average annual is 25.7º C. Average wind velocities measured in Santo Domingo range from 10.2 km/h during October to 12.7 km/h in March, with average annual wind speed is 11.5 km/h. Winds are predominantly from the north, and with less frequency from the northeast and south to southeast.

4.4 Although there is no available ambient air quality data, air quality in the general vicinity of the proposed project site is considered to be relatively good as a result of the consistent flow of the trade winds and the small number and magnitude of emission sources. Air quality is affected locally by emissions from the newly constructed CDE 68 mw power plant located immediately next to the site. There are four other existing stationary air emission sources in the regional area: the Mitsubishi power plant, a soap factory, the Ingenio Cristóbal Colón sugar mill, and a cement factory.

4.1.2 Noise

4.5 Site noise levels are affected slightly by newly completed CDE simple cycle generating facility, which commenced operation during the summer of 1998. Adjacent land is primarily undeveloped agricultural and pasture land with few noise sources. The distance to the nearest residence is about 4 km.

4.1.3 Land Form and Geology

4.6 The project site is located within the geomorphological region known as the Caribbean Coastal Plain. The region is characterized by calcareous marine coastal rocks, marl, sandstone, and

oligonitic and oligogenic conglomerates. The topography in the project area is uniform and altitude varies from sea level at the mouth of the Higuamo River, to approximately 25 meters above mean sea level (msl) at the proposed site. The site topography is flat with a slope/incline on the western edge of the property going down to the Higuamo River.

4.7 The local geology consists primarily of sands and gravels, weakly cemented sandstones and limestones. The lithology at the power plant site consists of a series of clays, silty sand, fine to coarse sands and gravels, calcium carbonate cemented sands, and Limestone.

4.1.4 Surface Hydrology

4.8 The Higuamo River originates in the mountains on the eastern side of the island and discharges to the Caribbean Sea to the south. The total drainage area for the Higuamo basin is approximately 1,042 square kilometers (km^2). The main stem of the river begins about 20 km north of the confluence with the Caribbean Sea at the confluence of the Casuí and Maguá Rivers. The flow data shows a distinct wet/dry system flow regime. The estimated average daily river flow for the record is about 19.2 m^3/s (median 8.9 m^3/s), and the daily maximum flow is 947 m^3/s.

4.9 In the project site vicinity, the river channel is very well defined and has eroded itself into the underlying limestone formations. The Higuamo River does not pose a flooding threat to the project site. The Higuamo River near the project site is predominately saline. Observed water salinity values at the surface were typically 4 parts per thousand (ppt); at a depth of approximately 1 meter, salinity values were typically more than 27 ppt. Sampling conducted at a station located approximately 5 km north of the project site indicated surface salinity of about 2 ppt; at 1 meter depth to the bottom salinity was approximately 17 ppt. This data indicates that salt water intrusion into the river is a long term, stable phenomenon.

4.10 Historical data for the Higuamo River suggest that industrial and domestic wastewater discharges significantly impact river water quality. These existing impacts have a noticeable effect on the dissolved oxygen (DO), color, and suspended solids concentrations. For example, samples showed the river to be typically DO hypersaturated at the surface during the day, typically exceeding 20 milligrams per liter (mg/l). Below these hypersaturated surface lenses, DO concentrations fluctuated highly and approached anoxic conditions for much of the water column.

4.11 The significant differences between the salinity and temperature within the two separate lenses suggest the existing stratification would be very difficult to destabilize. The extreme variability observed in the DO observations suggests that large volumes of oxygen consuming compounds are present in the river.

4.1.5 Groundwater

4.12 The groundwater resources present in the San Pedro de Macorís region are not extensively developed. The groundwater used in the region comes from the potable portions of the local aquifer systems as opposed to the non-potable portions proposed for this project. Several industries in the vicinity of the proposed power plant use privately developed wells for potable, process, and/or cooling purposes.

4.13 A regional hydrogeology study conducted by the Instituto Nacional de Recursos Hidraulicos (INDRHI) in the mid-1980's shows no "research" wells within 7-km of the project site. INDRHI considers the groundwater underlying the site to be non-potable in nature (i.e. total dissolved solids (TDS) concentrations are greater than 1,000 mg/l). INDRHI reports indicate this aquifer can support well pumping rates up to 126 l/s. Nominal potentiometric elevation of the aquifer is 0.7 m above mean sea level, suggesting that increased pumping rates may result in lowered groundwater quality.

4.14 An on-site aquifer performance test was initiated on September 18, 1998. Results of the test boring and pump tests indicated rapid potentiometric elevation stabilization that suggested that pumping rates as high as 60 l/s can be maintained. However, these are long-term concerns related to saltwater interference from upconing, which might prohibit these suction rates. In the limestone aquifer underlying the project site, a layer of relatively fresh water overlies denser saltwater. The aquifer contains slightly brackish water (TDS 1, 000 to 2, 000 mg/l) to a depth of about 40 meters. Water quality becomes poorer with depth. Saltwater with TDS above 10, 000 is present at depths below 45 meters. The scenario using four on-site wells (32 l/s) one located at each of the four corners of the project site, was found to provide the necessary 126 l/s with an estimated water quality of 2,500 to 3,000 mg/l TDS, while not resulting in long term impacts.

4.1.6 Terrestrial Ecology

4.15 The majority of the power plant site is a grassed pasture with scattered trees, which are common species found throughout the Dominican Republic. The dominant tree species observed during the field review included guacima, tcha tcha, jabilla, almacigo, higuero, and caimito. Scattered citrus and mature mango trees were observed at isolated locations on the property, along the edge of the Higuamo River. Many of the almacigo trees are present along the fence and appeared to have been frequently trimmed for use as fence posts. Dominant shrubs and herbaceous species include Rabo de gato, *Paspalum notatum, Sida cordifolia, Lanatana involucrata, Amaranthus spinosus,* and *Acacia tortuosa.* Similar types of vegetation are located at the fuel storage facility.

4.16 Wetlands within the general area of the proposed power plant site are confined to the river floodplain. There are no wetlands within the 4-hectare power plant site.

4.17 The entire coastline between the mouth of the river and Playita de las Cabuyas consists of a rock and limestone formation on which very little vegetation is present. There is a small mangrove community located inland and immediately north of the Playita de las Cabuyas embayment. This isolated mangrove community will not be impacted by the construction of the pipeline connecting the unloading facility with the storage area. Further inland, approximately 30 meters, this coastal area is dominated by coastal scrub vegetation and a forested community, with a width of 500-1000 meters. Typical species in this region include seagrape, coconut palm, ficus citrifolia, torchwood, jabilla, almacigo, higuero, and caimito.

4.1.7 Aquatic Ecology

4.18 The Higuamo River has been subjected to uncontrolled effluent discharges from industrial facilities located both upstream and downstream of the proposed project site. Frequent fish kills in the river have been documented by the Instituto Nacional de Recursos Hidraulicos (INDRHI) and reported by local fisherman. According to local fishermen, fish populations have severely declined within the river during the last decade. The river is not considered productive for catching fish, and most fishing is done offshore in the Caribbean Sea. Local fishermen have observed spawning runs by the false pilchard, during which fish kills occur near the existing industrial outfalls.

4.19 Results of the aquatic survey, performed for the Project, on the Higuamo River show that the system is heavily impacted as evidenced by a limited benthic invertebrate community. Because of their sedentary nature, benthic invertebrates serve as good indicators of water quality on both a temporal and spatial basis. The impact of low DO and existing industrial discharges has significantly reduced the biological diversity and productivity of the Higuamo River.

4.20 The aquatic environment along the Caribbean coast consists mainly of rocky coastline and deepwater habitat. The offshore mooring and unloading terminal is located downstream of the prevailing longshore current and under the constant influence of the Higuamo River discharge and the untreated wastewater discharges from the city of San Pedro de Macorís. The general poor water quality suggests that the presence of viable coral communities in the proposed offshore mooring area is highly unlikely. Interviews with local fisherman conducted during field surveys provided additional evidence that no coral is present within the area from the mouth of the river to the Playita de las Cabuyas embayment.

4.21 The primary driving force for water flow in the Caribbean Sea along the southern coast of the Dominican Republic is wind. Wind induced currents typically exhibit a velocity equal to 3% to 5% of the ambient wind speed. Wind speeds in the project area average 11.5 km/h (3.2 m/sec) producing currents of between 10 and 16 cm/sec. Tidal ranges along the coast of typically <0.15-meters and there is only nominal current induced by tides (i.e., <1 cm/sec).

4.1.8 Endangered Species

4.22 A list of endangered, threatened, vulnerable and rare species that occur on the Island of Hispaniola was obtained from the Department of Agriculture. No listed species were observed during the field survey of the power plant site, Higuamo River or coastal areas near the proposed offshore mooring and unloading terminal and bunkering facility study.

4.2 Social-Economic

4.2.1 Land Use

4.23 Land use in and adjacent to the proposed power plant site has historically been agricultural, specifically for livestock and sugar production. The site is located on the west bank of the Higuamo River approximately 5 km northwest of the city of San Pedro de Macorís. With the exception of CDE's recently completed simple cycle power plant adjacent to the proposed project site, land use in the surrounding area has retained its agricultural nature. The Ingenio Cristobal Colón sugar mill is located 4 km to the south and a cement factory is located approximately 1.5 km due north of the power plant project site. The land use within the 4 km of the project site, excluding the two industrial facilities noted above, is agricultural. There are no villages or other residential communities within 4 km of the site, with the exception of a worker's colony located on the Ingenio Cristóbal Colón sugar mill property (located to the south).

4.24 The area crossed by the pipeline between the shoreline and the bunkering facility is characterized as improved pasture habitat interspersed with trees. The proposed mooring and fuel unloading area for the project is located immediately south of Playita de las Cabuyas. The shoreline from the Higuamo river westward for 4 km (i.e., including Playita de las Cabuyas) consist of steep limestone cliffs with heights of 1 to 10 meters. There are no sandy beaches in the area and, with the exception of the Playita de las Cabuyas embayment, no direct access to the Caribbean sea. Installation of the fuel unloading pipeline from the Playita de las Cabuyas embayment to the bunkering facility will not impact existing agricultural uses nor will it preclude future non-agricultural development in the area.

4.25 The fuel bunkering facility area consists of improved pasture/agricultural land with no habitable structures located within a 1 km radius of the site.

4.26 The fuel oil pipeline between the bunkering facility and the power plant will be located adjacent to the existing highway ROW. The area is characterized as having a terrestrial habitat consisting primarily of shrubs and herbaceous plants. No existing habitable or commercial infrastructures are located within the ROW. Installation of a buried pipeline within the ROW will not impact adjacent land uses and will not require the resettlement of residents or commercial or industrial facilities.

4.2.2 Population

4.27 A 1997 demographic study conducted by the Secretaría Ejecutiva de la Comisión Presidencial para la Reforma y Modernización del Estado, shows a population of 212,886 in the province of San Pedro de Macorís. The province covers 1,255 km^2 and is composed of three municipalities and two municipal districts, one of which is San Pedro de Macorís. A 1995 Oficina Nacional de Planificación (ONAPLAN) study cites a population density of 176(inhabitant/km^2) in 1993. The proposed power plant site is located within the province of San Pedro de Macorís and within the municipality having the same name. A 1997 population estimate for this municipality is 146,628. Annual per capita income for the province is $219 U.S.

4.2.3 Economy

4.28 The economy of the region relies heavily on agriculture, primarily the sugar and livestock industries. As of 1995, the province contained 5 sugar mills, four of which were state owned and one privately held. Sugar production has suffered in recent years as a consequence of low international prices and a lack of diversification and management problems within the sugar industry.

4.29 Another dominant economic factor developing in the province within the last decade has been manufacturing industries. As of 1992, the province contained 72 industries, including textile, shoe, electronics and leather manufacturing, which generate employment for approximately 26,672 citizens.

4.30 With 39 hotels comprising more than 2,800 rooms, tourism also plays an important role in the province's economy. In addition to the beaches of Guayacanes, Juan Dolio, Villas del Mar, Sandina and Cumayasa, provincial Victorian architecture attracts many tourists.

4.2.4 Infrastructure

4.31 The infrastructure (i.e. housing, roads, and schools) in nearby San Pedro is sufficient to support the required workforce. It is anticipated that sufficient housing will be available without the need to supplement the local infrastructure.

4.2.5 Archeological, Historical, and, Culturally Sensitive Resources

4.32 As one of the first settled provinces in the country, the province of San Pedro de Macorís contains many resources of historical and cultural significance. Indigenous populations were the only inhabitants in this province until their extinction in 1800. In 1822, the settlement of San Pedro de

Macorís was established with the migration of citizens from the capital. According to interviews with anthropologists and historians at the Museo del Hombre Dominicano, there were numerous indigenous settlements along the Higuamo River. However, the proposed power plant site is not on one of the known settlement areas. There are no known historical or archeological areas at or near the San Pedro de Macorís Power Project site.

5.0 ENVIRONMENTAL AND SOCIAL IMPACTS

5.1 Construction Phase

5.1.1 Environment

5.1 As construction impacts are considered similar in nature this section deals with the impacts of the construction of the power plant, fuel unloading and transport system in conjunction. Specific differences, worth noting, are mentioned.

5.2 Air quality impacts during construction will result from fugitive dust emissions associated with earth moving activities and emissions from construction equipment. The presence of the trade winds will effectively mitigate the impact of the short-term air quality impacts associated with the construction activities. These emissions will be of short-term and sporadic duration, confined primarily to daylight hours.

5.3 Noise sources during construction will include heavy equipment such as trucks, cranes, graders and other earth moving equipment for all power plants, fuel unloading and transport system activities, and confined primarily to daylight hours. Noise impacts during construction will be sporadic and of short duration. Noise levels during construction will not exceed 55 dB(A) (daytime) and 45 dB(A) (night time) at the nearest residential area.

5.4 Construction of the Power Plant will require only limited site grading and excavation. The power plant and bunkering facility sites are relatively flat and will likely require only limited amounts of fill to bring the sites up to grade. Grading will be required for construction of the containment dikes around the fuel oil storage tanks. Offsite fill, if required, will be obtained from approved sources. The route for the pipeline is similarly level. The pipeline will be located adjacent to the existing highway ROW in upland areas and will be attached to the sea floor in the offshore portion.

5.5 The potential hydrologic and water quality impacts include increased site surface water runoff volumes resulting from paving and compaction of the site's existing pervious surfaces. Impact to the Higuamo River will be minimal given that the works will be limited to four hectares in a drainage basin greater than 1,000 km^2. Local ponding of storm water may occur on site. Site

construction activities will not be affected by nor will they have a significant effect on Higuamo River flooding. Site runoff estimates yield a peak storm water flow rate of 0.25 m^3/s for existing conditions and 1 m^3/s during construction. The main area of the project site is located over 250 meters from the Higuamo river, thus minimizing the potential for direct runoff into the river during construction. Potential water quality impacts during construction of the power plant will be effectively mitigated and will be of short duration. Potential hydrologic and water quality impacts associated with construction of the bunkering facility will be of short duration and minimal as there are no surface water bodies located near the site.

5.6 Construction of the offshore mooring facility will not require dredging and will be accomplished through the use of surface ships and on-shore support. The offshore segment of the pipeline, approximately 600 to 1,000 meters in length, will be attached to the sea floor. Since dredging will not be required for placement of the pipeline, limited additional turbidity will be generated during the pipeline installation and it will be confined to the immediate area surrounding the pipeline. The general area where the fuel unloading and offshore pipeline facilities will be constructed have historically been subject to high levels of turbidity and siltation due to the influence of the Higuamo river.

5.7 Potential impacts to groundwater quantity due to construction of the proposed facilities are minimal. Fuel oil or lubricant leaks from construction equipment, improper handling and disposal of chemicals and waste materials and sanitary effluent infiltration could be a potential groundwater impact. The trench for the pipeline will not extend into the groundwater table and the need for draining is not anticipated.

5.8 In terms of flora, the construction will result in the removal of much of the existing vegetation on the site, some of which will be replaced following completion of construction activities. Minimal impacts to the mangrove wetlands are expected from the construction of the discharge structure. Mitigation for the displacement of mangrove habitat will be provided if appropriate on a one-to-one basis (one unit of displaced habitat equals one habitat unit of created, restored or enhanced habitat). Because of the nature of the existing conditions at the project site (i.e. disturbed pasture land and the construction of another power plant by CDE adjacent to this project) the proposed project will not impact protected and sensitive species.

5.9 At the bunkering facility site, some tree clearing will be needed for the storage tank and access road construction, but impacts will be kept to a minimum. Construction of the pipeline along existing linear corridors will minimize impacts to terrestrial biota. The pipeline will be routed onshore in a portion of the Playita de las Cabuyas embayment with no vegetation. The pipeline route from there to the bunkering facility will be above grade and will be routed to minimize displacement of upland tree specimens and avoid the isolated, inland mangrove community. From the bunkering facility to the power plant, the pipeline will be below grade and located in or adjacent to road ROW, the

shrubby species that can be found on that area exhibit rapid recovery periods. It is important to note that most of this area is currently being cleared for road widening.

5.10 Construction activities will result in the generation of noise that may result in some wildlife and bird species avoiding the immediate area. The displacement will be temporary and will be limited to the immediate area. Given that CDE has recently completed construction of a power plant adjacent to the proposed facility, it is likely that the proposed construction will have minimal additional impacts on terrestrial species.

5.11 Potential encroachment into aquatic habitat on the power plant site will occur immediately adjacent to the Higuamo river during construction of the cooling water discharge structure. The area of activity will be limited to less than 100 m^2 so as to minimize impacts. Construction of the discharge structure will not require dredging of the river, and only limited disturbance to the aquatic environment is anticipated.

5.12 During offshore construction activities a localized increase in turbidity can be expected. Given that the area already receives a significant silt load from the Higuamo river, the impact is not expected to be significant. Data from several sources support the conclusion that no significant coral communities exist in the immediate vicinity of the proposed offshore mooring facility. Based on interviews with local fishermen and observations made during February 1998 field studies, no viable coral communities are known to occur within the area west of the mouth of the Higuamo river to the Playita de las Cabuyas. Thus, the construction of an offshore mooring and unloading facility and associated pipeline to the shore is not expected to impact reef communities.

5.13 Although marine turtles occur in the Caribbean sea, there are no beaches in the fuel unloading study area, and impacts are unlikely. Offshore construction will include about 100 m^2 of mooring structures and a pipeline with a 3 meters wide right of way extending about 600 to 1000 meters to the shore. The total offshore area affected by the construction will likely be less than 3,000 m^2 . Because of the location of the bunkering facility and on-shore pipelines in upland areas, impacts to aquatic systems are not anticipated to occur.

5.14 Land use impacts during construction will be limited to the 4 ha project site. The site is adjacent to a newly completed CDE simple cycle power plant and is thus compatible with the adjacent land use. There are no residential uses within 4 km. Land use impacts during construction of the bunkering facility will be limited to the 5 ha facility site. The current land use in this area is a mix of agricultural and undeveloped land, and there are no residential facilities in the vicinity. The fuel oil pipeline will be located primarily within or adjacent to existing highway ROW. Pipeline will be buried, with exception of a short distance as the pipeline transitions from offshore to onshore, aside from use restrictions during construction there are no other impacts expected.

5.1.2 Social-Economic

5.15 There are no relocation impacts associated with the development of the proposed power plant. There are no businesses or other commercial enterprises, except for the newly completed CDE power plant, in the immediate vicinity of the proposed site for the power plant and bunkering facility. There are no anticipated negative socioeconomic impacts involved with the development of the proposed power plant and fuel supply associated facilities. During the peak of construction, an average of approximately 200 construction personnel will work onsite. It is anticipated that sufficient housing will be available without need to supplement the local infrastructure.

5.16 The construction jobs should be filled primarily by workers located within 30 miles of the site. Construction jobs and, to a lesser extent, permanent plant personnel, may produce some support jobs (i.e. grocery stores, restaurants and other area businesses). The plant, however, is not expected to foster significant commercial growth in the immediate area.

5.17 No impacts to historical, archaeological or cultural resources are anticipated. There are no identified historical or archaeological impacts related to developing the power plant site, bunkering facility and pipeline route. Sites of historical significance located along the Higuamo river will also not be affected by the installation of the proposed facility. If during construction historical or culturally significant sites are identified, work in the area will be halted and appropriate authorities notified, and subsequently appropriate mitigation measures will be drafted.

5.2 Operation Phase

5.2.1 Air Quality

5.18 Air emissions levels from the proposed power plant will comply with World Bank Guidelines (Pollution Prevention and Abatement Handbook, 1998)(see Table 3-3). In order to assess potential ambient air quality impacts due to the project both a single source air quality modeling analysis was performed to estimate only the project's potential air quality impacts and a multi-source modeling was used to estimate the overall impact on the air quality of the region.

5.19 The latest version of the Industrial Source Complex Short Term Dispersion Model (ISCST3) was used in the air quality modeling analysis to evaluate pollutant concentrations. ISCST3 was run with the following options (as recommended in the USEPA Guideline on Air Quality Models): 10 meter anemometer high, actual receptors elevations, and complex/intermediate terrain algorithms. The following regulatory default options were used: final plume rise, stack tip downwash, buoyancy induced dispersion, default wind profile exponents, and default temperature gradients. The HRSG was selected and oriented to produce worst case potential downwash effects. The building was estimated to have a maximum cross section width of 25 meters and a height of 21.8

meters, based on the information provided by the EPC contractor. Since more than 50 percent of the land use within the modeling area is rural, the ISCST3 model was run using the rural dispersion coefficients. The input data were:

PARAMETER	VALUE
Stack height, meters	49
Stack diameter, meters	3.6
Stack exit temperature (K)	418.5
Stack volumetric flow rate (acfm)	474,566
Exit velocity (m/s)	22.0
Building height (meters)	21.8
Building cross-sectional width (meters)	25
Emission rates (g/s)	
CO	4.35
NO_2	34.5
VOC	1.55
PM	5.55
SO_2	96.9

5.20 Meteorological data collected at Puerto Plata and Santo Domingo is incomplete and cannot be used for air dispersion modeling purposes. Given the lack of reliable meteorological information, data collected from San Juan, Puerto Rico was used, after evaluating its representativeness to the proposed site. San Juan is located on the coast of Puerto Rico, which is approximately 500 km east of project site. Hourly surface and twice-daily upper air data is collected at the Isla Verde Airport. This data is reported to and compiled by the U.S. National Climatic Data Center (NCDC). Based on relative location within the island, conditions in San Juan are reasonably representative of conditions at the proposed project site.

5.21 One complete year (1991) of hourly surface meteorological and mixing height data (measured twice daily) were obtained from the National Weather Service station at San Juan, Puerto Rico (station no. 11641). A receptor grid of 10 by 12 km was defined, with a 200 meter spacing within 4 km of the plant and a 400 meter spacing further out. Receptors were also placed along the property boundary, with approximately 50 meters of spacing between them.

5.22 Based upon the modeling results, the emissions for the plant will not result in exceedence of the World Bank Guidelines for ambient air quality (see Table below). The modeling results show that the proposed plant emissions will result in a maximum ambient air quality level significantly less than the allowable limits for all pollutants (i.e., see single source modeling results). The sensitive receptors are located primarily in and near the City of San Pedro de Macorís located southeast of

the proposed facility, while the trade winds blow consistently toward the southwest. A map of the area showing the modeled SO_2 isopleths is presented in the Annex 2.

Pollutant	Averaging Period	Ambient Air Quality Guidelines (mg/m^3)*	Single Source Modeling Maximum Impact (mg/m^3)	Multiple Source Model Maximum Impact Without Plant (mg/m^3)	Multiple Source Model Maximum Impact With Plant (mg/m^3)
CO	1 hour		12.45	19.5	20.7
	8 hour		6.20	9.9	11.1
NO_2	24 hour	150	23.91	53.5	53.5
	Annual	100	4.56	14.2	14.2
VOC	1 hour	-	4.44		NA
SO_2	24 hour	150	67.15	381.7[1]	381.7[1]
	Annual	80	12.82	102.0[1]	102.0[1]
TSP	24 hour	230	3.85	25.5	25.5
	Annual	80	0.73	6.8	6.8
PM10	24 hour	150	3.85	25.5	25.5
	Annual	50	0.73	6.8	6.8

* World Bank Group. Ambient air quality standards based on Pollution Prevention and Abatement, Towards cleaner Production Handbook. September, 1997

1.Although guidelines are exceeded contribution by plant is 0.

5.23 Multi-source modeling was also conducted to include all major air emission sources (e.g., sugar cane mill, Mitsubishi, Rum distillery, CDE, Cement plant) within the air shed of the San Pedro project. One set of coordinates was used for each facility. If a facility had more than one stack, all stacks were co-located to a common point. The input data used for the modeling of the emissions from the other industrial activities were obtained from literature based on the characteristics of the other plants and are not based on actual monitoring data. Thus, the inputs were selected to represent conservative or likely worst case scenarios. The modeling results presented in the Table above demonstrate that the proposed project's air emissions should not increase the ambient air quality levels resulting from air emissions by other sources. For example, the contribution from the Project is zero percent for the estimated maximum model ambient air concentrations (see results for multiple source model maximum impact from plant). The multiple source modeling results did identify that SO_2 levels may exceed ambient air quality levels in limited conditions; specifically the model estimated 12 times for the 24 hour value and once for the annual value.). The primary air emission sources that resulted in these levels were the local rum plant (which is now out-of-commission due to the recent hurricane, and it is unclear whether the plant will be rehabilitated) and the cement plant. The proposed Project does not contribute to these exeeedences given the

Project plant characteristics (i.e., location in relation to other sources, meteorological conditions associated with the specific times of estimated exceedences).

5.24 The emission of CO_2 based on 8,760 hours per year of operation (worst-case) is calculated to be 1,568,040 tons per year. It should be noted that gas turbine combined cycle technology is the most efficient manner to generate electricity from burning fuel oil.

5.25 It is expected that the ozone formation on the shore areas of the Dominican Republic is minimal due to the presence of the persistent easterly winds in addition to the sea breezes. The fuel oil handling system will be designed and constructed to minimize VOC emissions. Therefore, VOC emissions from the fuel oil system will be limited to fugitive emissions. The predicted fugitive VOC emissions from both the fuel bunkering facility and the two onsite day tanks are 720 kg per year.

5.2.2 Noise

5.26 Noise levels will be: 65 dB(A) at a distance of 120 meters from the outermost points of power plant installations; and 90 dB(A) at a distance of 1 meter and at a height of 1.5 meters from the exterior walls of the turbine houses. Noise levels at the fence line of the bunkering facility will meet with industrial noise level of 70 dB(A). During normal operation regime, noise levels will not exceed 55 dB(A) (daytime) and 45 dB(A) (night time) at the nearest residential area, which is greater than 4 km from the power plant site and 1 km from the fuel oil bunkering facility site.

5.2.3 Landform

5.27 Potential landform impacts will consist primarily of small alterations to the land surface elevation to accommodate necessary project structures. Operation of the proposed facilities will not significantly affect landform features. The structures, primarily the stack, although visible from a certain distance, conform to the landscape.

5.2.4 Surface Hydrology

5.2.4.1 Thermal impact

5.28 The dominant wastewater discharged from the proposed facility in terms of volume will be cooling tower blowdown. Using a freshwater cooling tower with three concentration cycles, the blowdown flow rate is estimated at about 724 gpm (0.05 m^3/s), with a conservative water temperature of 5º C above ambient river temperature.

5.29 An extreme low river flow condition was assumed to be the flow that is exceeded 95% of the time. Using the log-normal flow distribution for the Higuamo River, the extreme low flow can be estimated at 1.0 m^3/sec. An estimate of average month river temperatures was made using a mathematical model of the heat budget. The results show minimum monthly average river temperatures of 28.3°C in January and maximum average monthly river temperature of 34.7°C in August and September.

5.30 The extreme maximum plant discharge temperature was estimated using the engineering design assumption that a cooling tower's "cold" side will be less than 5°F (2.6°C) higher than the instantaneous wet bulb air temperature. Under average air temperature conditions, the cooling tower discharge will always be slightly lower than the ambient river temperature. Under the maximum air temperature conditions, the cooling discharge will have the greatest temperature differential with the Higuamo River during the month of February (i.e., 5.5°C). The estimated maximum cooling discharge temperature exceeds the average Higuamo River ambient temperature by more than 1°C only 25% of the time.

5.31 A mixing zone analysis using the Fischer methodology showed that under the extreme low flow and extreme high thermal conditions, the discharge is cooled to within 1°C of ambient temperature within 60-meters of the point of discharge. A condition of discharging at the maximum tower temperature into a perfectly stagnant river was performed and showed that the thermal discharge is cooled to within 1°C of ambient in a maximum mixing zone of 1-hectare (2.2-acres).

5.2.4.2 Physico-Chemical impact to the Higuamo River

5.32 The initial cleaning of the HRSG, steam lines, and other components in the plant's water systems will be accomplished using steam, dilute mineral acid, dilute organic acid, and dilute detergents. The materials used are rated "non-toxic" according to US EPA regulations. The liquid wastewaters created during the commissioning will be routed to a temporary storage tank used to settle solids (e.g., metal burrs and filing debris) and neutralize pH prior to discharge. Wastewater batches that pass the water quality test will be discharged to the Higuamo River after mixing with cooling tower blowdown. Wastewater batches that require additional treatment will either be treated using skid mounted treatment processes or will be drummed for off-site treatment and disposal.

5.33 The estimated effluent stream characterization during normal operation conditions is presented in Table 5-1. As seen in the table, the effluent has higher Chloride and Total Dissolved Solids concentrations than listed in the draft of the Dominican Republic criteria for industrial water discharges. However, these guidelines were developed for discharges into fresh water rivers, whereas the Higuamo river is a saltwater river. Chloride and TDS concentrations in the effluent stream are considerable lower than ambient Higuamo river conditions and do not represent an

adverse environmental impact. The power plant's combined effluent discharge meets the standards for trace metals and other parameters included in the Dominican Republic effluent limitations.

5.34 Operation of the fuel oil bunkering facility will not adversely impact surface water quality. A Spill Prevention Control and Countermeasures plan (SPCC) will address measures to avoid and minimize oil spills. The on-shore portion of the fuel oil pipeline will be located within or adjacent to the existing highway ROW. This portion of the pipeline will be buried and will not significantly impact aquatic ecology during operation. The pipeline ROW will be maintained in a manner that facilitates visual inspection of the line to detect encroachments, erosion or soil or other actions requiring maintenance of the line. Emergency shut-off valves will be provided along the pipeline to minimize the potential loss of product in the event of an emergency.

5.2.4.3 Impact to the sea water

5.35 Potential impacts to surface water quality caused by operation of the mooring and fuel unloading facility include: accidental releases of fuel oil, improper handling of ship traffic, and unauthorized discharges to the marine environment. The fuel will be delivered in 250,000 barrel tankers at a frequency of about one per month. The fuel tankers will be operated in accordance with international conventions that prohibit the discharge of bilge and other oily wastewaters into marine environments while operating outside of international waters. Oil spills from bulk fuel tankers are comparatively rare events and, a major oil spill is defined as an event where more than 50-barrels are released. The Dominican Republic has not reported a major oil spill event since reliable international records have been kept (i.e., since 1962). This project expects to annually off-load oil from about 12 tankers with 32,000-tone capacity, or about 3% of the estimated annual fuel unloading events in the Dominican Republic. The on-shore bunkering tanks will be inspected using non-invasive techniques that preclude the need for tank draining and/or cleaning.

5.36 The project sponsor and the fuel supplier will perform the fuel unloading activities. To minimize the potential for the accidental release of fuel oil, all mooring and unloading operations will be conducted according to operational procedures established in the operational management plan for the fuel delivery system.

5.2.5 Groundwater Quality and Quantity

5.37 Pumping tests showed that upconing of the saltwater occurs at pumping rates exceeding 60 l/s. Avoiding upconing is therefore critical to maintaining adequate water quality. Based upon on-site aquifer testing, a four-well system has been designed to avoid impacts. The on-site well field will be located in a portion of the regional aquifer that is already designated as non-potable. Furthermore, an on-site well field will serve as a drawdown barrier, reducing the potential for salt water upconing west of the project site (i.e., the potable portions of the regional aquifer). Finally,

the regional groundwater flow is toward the Higuamo river and there are no other existing or potential groundwater users between the project site and the river.

5.38 Potential impacts to groundwater hydrology and/or water quality from operating the fuel unloading and transport system are limited to accidental leaks and spills. For this reason the fuel bunkering facility and all associated pipelines will be constructed in the non-potable regions of the aquifer.

5.2.6 Terrestrial Ecology

5.39 Operation of the power plant will not cause any additional impacts to the flora and fauna, either on or adjacent to the project site. Given the limited extent of the thermal plume in the river, operation of the discharge structure and its associated power plant discharge will not adversely impact wetlands.

5.40 Operation of the fuel oil bunkering facility will not adversely impact terrestrial ecology. All operational activities will be restricted to the 5 ha fenced facility. The onshore portion of the pipeline will be located within or adjacent to the existing highway ROW. This portion of the pipeline will be buried and will not significantly impact the flora and fauna during operation.

5.2.7 Aquatic Ecology

5.42 Ecological impacts of waste water discharges, consisting of primarily cooling tower blowdown, will be minimal based on the results of the thermal mixing analysis. The thermal mixing zone will not extend more than 8.5 meters across the river channel width and will be indistinguishable from background conditions within 25 meters, producing no effects on the species present in the Higuamo. Based on the small size of the mixing zone, no significant impacts are anticipated within the Higuamo River.

5.43 The proposed facility has been designated to minimize the potential for the accidental release of fuel oil into the environment. The day tanks on site will be provided with adequate secondary containment. All areas around oil pipes, pumps and other related equipment with the potential to receive oil contamination will be provided with an impermeable surface. Runoff from these areas will be routed to the on-site oil water separator to prevent the release of oil and grease to the environment. With the design features described above, the potential for release of fuel oil into the environment is minimal. In addition, the operational emergency plan for implementation in the proposed facility will address specific actions to be taken in the unlikely event of an emergency.

5.44 Operation of the offshore mooring and unloading facility and associated submarine pipeline will not adversely impact reef communities or other sensitive marine communities. No turtle nesting habitat was observed at the Playita de las Cabuyas. The well proven technology of the mooring and fuel

unloading equipment and the fact that well trained and experienced operators will install and operate the unloading and transport facilities, minimizes the risk of accidental releases.

5.2.8 Land Use

5.45 The operation of the project will not effect land uses surrounding the power plant since the project is located on a 4 ha project site within a 20 ha parcel of land designated for electrical generation. The land use within the 5 km of the project site is agricultural, with the exception of the Ingenio Cristóbal Colón sugar mill and a cement factory. There are no villages or other residential communities within 5 km of the site, with the exception of a worker's colony located on the Ingenio Cristóbal Colón sugar mill property.

5.46 The area crossed by the pipeline between the shoreline and the bunkering facility is characterized as improved pasture habitat interspersed with trees. The proposed mooring and fuel unloading area for the project is located immediately south of Playita de las Cabuyas. The shoreline from the Higuamo river westward for 4 km (i.e., including Playita de las Cabuyas) consist of steep limestone cliffs with heights of 1 to 10 meters. There are no sandy beaches in the area and, with the exception of the Playita de las Cabuyas embayment, no direct access to the Caribbean sea. Installation of the fuel unloading pipeline from the Playita de las Cabuyas embayment to the bunkering facility will not impact existing agricultural uses nor will it preclude future non-agricultural development in the area.

5.47 The fuel bunkering facility area consists of improved pasture agricultural lands with no habitable structures located within a 1 km radius of the site. The fuel oil pipeline between the bunkering facility and the power plant will be located adjacent to the existing highway ROW. Installation of a buried pipeline within the ROW will not impact adjacent land uses and will not require the resettlement of residents or commercial or industrial facilities.

5.2.9 Social-Economic

5.48 Associated with the operation of the proposed facilities, there are no anticipated socioeconomic impacts. Impacts to existing infrastructure resulting from the San Pedro de Macorís Power Project will be minor. Water for the project, including both industrial and potable will be provided through the treatment of groundwater from on-site wells. Fire suppression and fighting equipment will be maintained on site at the power plant and fuel oil bunkering facilities. Adequate roads exist for the transportation of workers and equipment to the various sites. The projected work force during operation of the project will not require additional infrastructure support.

5.3 Positive Impacts/Benefits

5.49 The project provides employment opportunities both during construction and operational phases. The proposed power project will also positively impact on the area's quality of life and economic viability by providing a reliable source of electric energy. This impact will promote further economic development in the surrounding area and economic opportunities for the general public. Socioeconomic impacts in the form of direct employment opportunities and through the availability of reliable source of electricity will continue for the life of the project.

6.0 ENVIRONMENTAL AND SOCIAL MITIGATION AND MONITORING MEASURES

6.1 Mitigation Measures

6.1 The project Environmental Impact Assessment has identified various mitigation measures for the construction and operation phases of the project. These measures are presented in Tables 6-1 and 6-2, respectively, and briefly expanded below. The tables also identify the estimated cost and responsibility for each measure. In addition, an Environmental Management Plan is presently being finalized which presents the detail description on the implementation of these mitigation measures (see Section 6.4).

6.2 The following summarizes some of the key proposed construction mitigation measures (see also Table 6-1).

- The fugitive dust emissions will be controlled by using good management practices such as sodding and/or re-seeding open areas after construction activities are completed and periodically spraying water over high traffic areas for dust suppression.

- To minimize noise generation construction equipment and techniques will conform to applicable international guidelines for construction projects. Project staff will use personal ear protection devices at appropriate times during construction.

- Sediments will be controlled by a combination of BMPs (Best Management Practices) including stormwater detention ponds, installation of silt barriers (i.e. hay bales) and re-planting disturbed soils as soon as possible.

- The placement of anchors and offshore buoys will not require dredging and will be accomplished through the use of surface ships and on shore support. Appropriate BMP measures will be employed to minimize the potential for water quality impacts through the release of materials from the ships as well as unnecessary disturbances to the sea floor.

- The EPC contractor during the scheduling process will, as part of the construction BMP's employed, identify the management strategy for solid and/or hazardous waste management prior to such waste generation. Hazardous or potentially hazardous wastes will be managed and inventoried to facilitate onsite and offsite waste tracking. Any hazardous wastes stored onsite will be kept in a segregated area with full appropriate containment, roofing and spill collection systems.

- Construction BMP will determine the need for third party (i.e. contract) waste haulers for solid waste disposal. A waste documentation and tracking procedure will be established prior to the offsite shipment of wastes. Simple land disposals will be permitted only for construction and other non-hazardous type debris. Licensed, local solid waste management contractors will dispose hazardous materials.

- Sensitive areas surrounding the development site, such as the mangrove fringe along the river, will be protected during construction. BMP's that may be used to mitigate potential impacts include stormwater detention ponds, installation of silt barriers (e.g., hay bales) and re-planting disturbed soils as soon as practical.

- Excavation and earth moving BMP's will include training the equipment operators how to identify potential historical or archaeological resources. In the event discovery occurs, appropriate government personnel will be notified and the artifacts will be preserved and relinquished to the appropriate governmental agency.

6.3 The following summarizes some of the key proposed operation control and mitigation measures (see also Table 6-2).

- Air emissions will be controlled through the use of water injection for nitrogen oxides and low sulfur fuel oil with less than or equal to 1 percent by weight for sulfur. Fuel oil was selected as the proposed fuel because adequate supplies of natural gas are not available in the Dominican Republic. The use of No. 2 fuel oil with less than 0.03 percent ash content will minimize particulate matter production.

- Noise controls will be incorporated to ensure compliance with applicable World Bank Guidelines at the nearest residential receptor.

- The impacts associated with groundwater withdrawal and wastewater discharges are not expected to be of a magnitude to warrant mitigation in addition to those that have been incorporated into the project design. Specific mitigation that has been included as part of the basic project design includes: use of non-potable groundwater as a makeup water resource with an extraction/pumping system designed to prevent upcoming of saltwater; use of cooling towers to reduce the overall volume of water consumed and to lower the volume and

temperature of thermal discharge into the Higuamo river; installation of secondary containment around the fuel handling facilities; installation of impermeable areas around all areas with the potential to be impacted by fuel oil and other lubricants and chemicals; and installation of oil water separators.

- The fuel unloading facility will be equipped with oil spill containment equipment. In the unlikely event of a fuel spill at the offshore unloading platform, the bunkering facility, or along the pipeline, spill containment equipment will be deployed to control, contain and retrieve the spilled materials. The storage of such equipment for emergency situations will allow for a timely response in the event of an accident or oil spill. The fuel terminal's management team will develop an oil spill contingency plan. As part of the plan, standard operating procedures (SOP's) pertaining to fuel handling and storage will be developed. Training staff for fuel handling and transport will be emphasized and conducted on a continuing basis.

- Third party contractors will be used for solid waste disposal. A documentation and tracking process will be established prior to shipment of wastes offsite. Efforts will be made to reduce the overall amount of solid generated at the proposed facility. Hazardous or potentially hazardous waste will be managed and accounted for in such a way that tracking of these wastes, both onsite and off of the site is possible. Any hazardous wastes will be stored in appropriate containers in an appropriate storage area appropriate containment and spill collection system.

6.2 Monitoring Programs

6.4 Tables 6-3 and 6-4 present the proposed construction and operational monitoring programs, with aspects of the operational monitoring program summarized below. The project Environmental Management Plan, presently being finalized, will provide a detailed description of the implementation of these programs. All data will be collected and maintained in a manner to facilitate the ongoing monitoring of the project with regards to applicable standards and guidelines. A determination will be made with the appropriate in-country organizations concerning the content and timing of environmental monitoring reports for the proposed project. All environmental monitoring reports will be made available to the public in some manner either through the Mayor's Office, the CDE, or INPRA.

6.5 The facility's air emissions will be monitored by computing air emission rates based on fuel oil sulfur content, firing temperatures, water injection rates and air flow rates. Initial stack testing will be conducted as part of the performance testing to establish emission rates for the combustion turbines. Compliance with NOx and SO_2 guidelines will be monitored on a continuing basis through the implementation of procedures established in 40 CFR, Part 60, Subpart GG, § 60.334 (Monitoring of operation) through § 60.335 (Test methods and procedures).

6.6 NOx emissions will be monitored through the installation and operation of a continuous monitoring system to monitor and record the fuel consumption and the ratio of water to fuel being fired in the turbine. This system will be accurate to within ±5.0 percent. As part of this process, sulfur content and nitrogen content of the fuel being fired in the turbine will be monitored. The frequency of this monitoring will be on each occasion that fuel is transferred from the ships to the fuel oil bunkering facility.

6.7 Noise monitoring will be conducted prior to start of operation to establish pre-operational noise levels at the power plant and fuel oil bunkering facilities. Noise monitoring will also be conducted during operation of the power plant and fuel oil bunkering facility to ensure compliance with applicable World Bank guidelines. Occupational noise will be monitored once the facility is in operation. Monitoring will be conducted by facility staff and will be considered as part of the cost of operation.

6.8 Ground water wells that supply the facility's water supply system will be equipped with flow recorders and conductivity meters. Records of water use will be maintained on a continuous basis.

6.9 Waste water discharges to surface waters from the wastewater treatment system, including the cooling tower blowdown, will be monitored on a continuing basis for temperature and pH. Once the power plant is in operation, a thermodynamic study of the river in the area will be conducted to confirm the aerial extent and temperature range in the thermal plume.

6.3 Health and Safety

6.10 Construction activities will be conducted in accordance with local and internationally applicable health and safety guidelines. Workers will be required to wear head, ear, eye and foot protection at all times during construction. Workers will be required to wear appropriate respiratory equipment while engaged in tasks where air quality maybe compromised. Implementation of these measures will be responsibility of the EPC contractor and will be addressed in the environmental management plan for construction activities. The cost for these activities is included in the EPC Contractor's budget and is not an additional project cost.

6.11 Worker health and safety during operation will be assured by facility compliance with Dominican Law 807 and applicable World Bank guidelines. Training of the power plant staff will be a recurring and continuous activity. Power plant management personnel will develop and implement standard operating procedures (SOP's) to ensure worker compliance with safe working conditions. The responsibility and cost of development and implementation of the SOP's as well as continuous safety training will be the responsibility of the project proponent. These activities will be part of the plant's normal operating budget and does not represent an additional project cost.

6.12 Air quality and temperature will be monitored as required in confined work spaces. Workers will be notified of potentially hazardous working conditions so that appropriate protective gear can be worn. Records will be maintained of any reported on the job accidents or illnesses. A training program will be established to help ensure the safe operation of the proposed project facilities. Employee training will include the proper use of respiratory protection, safety practices, recognition of hazards and properties of toxic materials that may be encountered during execution of their duties. Training will be provided by a health and safety professional with experience in the power sector. All new employees will be trained at initial placement with updates provided on an annual basis. All training will be documented with a written record of topics covered, employees trained, dates of training and hours of training. All training will be the responsibility of the project proponent. The cost of training will be the responsibility of the project proponent and will be part of the cost of operation.

6.4 Environmental, Health and Safety Management

6.13 A series of environmental, health and safety plans will be developed, including an Environmental Management Plan, Health and Safety Plan, Contingency Plan, and Spill Prevention Plan. Table 6-5 presents a summary of these plans, including their objectives and schedule for development. The tables of contents for these plans are presented in Annex 3.

6.14 Specifically related to potential risks due to oil spills, the sponsors are preparing operational Contingency Plans and Spill Prevention Plans, as mentioned above. These plans are being developed based upon an assessment of potential oil spill risks and their associated likely impacts via the use of mathematical models/calculations of oil spill fate and transport.

7.0 PUBLIC CONSULTATION

7.1 The public consultation associated with the San Pedro de Macorís project has included the following:

- Various meetings with local, provincial and federal officials related to environmental aspects of the project.

- Public disclosure of the preliminary Environmental Impact Assessment (EIA) to the local public The availability was publicized through notices in several newspapers on April 16, 1998.

- A public meeting, specifically at the request of the IDB, was held on November 4, 1998 at the local Chamber of Commerce and Industry meeting hall. The objective of this meeting was to inform the public about the project, its environmental impacts and mitigation and to gain

feedback on the plant design in its relation to the impacts on the environment. The sponsors specifically contacted five local NGOs to inform them of the meeting. In total, approximately 75 persons attended the public meeting. During the public meeting various materials were used in the meeting to enhance the information exchange including: project pamphlet with a rendering of the project and project developer descriptions, a project description, color project location map and a color schematic of the gas turbine combined cycle process; Executive Summary of the EIA; and color overheads and story boards were used in the presentation of the project, potential environmental impacts and mitigation. No significant concerns or issues were presented by the public during the public meeting, in fact various positive comments were made regarding the openness and exempletory nature of the public consultation process performed by the sponsors.

- The final EIA was made available to the public in December 1998 in a similar fashion as the preliminary EIA.

- Continual public outreach through meetings with governmental officials and the opening of a local office in which public can obtain information about the project.

8.0 RECOMMENDATIONS

8.1 The IDB (Bank) will require, as part of the Guarantee Contract, that the Company comply with the following: (i) all applicable environmental, health and safety Dominican Republic regulatory requirements, (ii) all requirements associated with any environmental, health and safety related permits, authorizations or licenses that apply to Project, (iii) all environmental, health and safety aspects of the Power Purchase Agreement, (iv) all mitigation measures and monitoring programs in the project Environmental Impact Assessment, (iv) implementation of all actions and requirements in any project related environmental, health and safety plans and procedures, contingency/emergency plan, and spill prevention plan; (v) all applicable requirements in the World Bank Pollution Prevention Handbook (September 1997); and (vi) all applicable requirements in World Bank occupational and safety guidelines.

8.2 Prior to the signature of the Guarantee Contract, the Company must fulfill the following conditions:

1. Submit the finalized Environmental and Social Management Plan (ESMP), subject to IDB approval, which details the proposed mitigation measures and monitoring programs, including without limitation, enhancements to the proposed operational monitoring programs for stack emissions, ambient air quality, waste water discharges, noise, and ground water.

2. Present sufficient information, in form and content acceptable to IDB, related to potential impacts from an oil spill/release associated with oil unloading activities from ships, including quantification of potential impacts (e.g., direction of flow, magnitude, etc.).

3. Present the project construction phase Health and Safety Plan, Contingency Plan, and Spill Prevention Plan and any other construction related environmental, health and safety plans. In addition, present specific information to demonstrate that these plans will be fully implemented.

4. Present a proposed Project Supervision Plan, subject to IDB approval, which will include the specific methods (e.g., use of independent environmental consultants, environmental health and safety audits and inspections) to be implemented to ensure all environmental and social measures and programs for the Project are completely and properly implemented by all responsible parties.

8.3 Three months prior to initiation of commercial operation of the power plant, the Company must present to the Bank, subject to Bank approval, the operational related environmental, health and safety plans, including the Environmental Management Plan, the Health and Safety Plan, the Contingency Plan, and the Spill Prevention and any other operational environmental, health and safety plan. In addition, specific information must be presented to demonstrate that these plans will be fully implemented.

8.4 After beginning of the commercial operation, and no later than 90 days, the Company shall submit a Final Report on the Construction Component of Environmental and Social Mitigation and Monitoring Measures, including the following:

1. Certification by the Company that the project has successfully implemented and complied with all environmental and social requirements;

2. Any material deviation from the original construction plan, including a brief technical description and major reasons for such changes, as well as any adjustment to the relevant environmental and social measures that have been taken;

3. Description of any existing or anticipated environmental or social liability, risk or non-compliance; and

4. Copies of any major environmental or social report or document prepared in order to satisfy regulatory requirements, except those already submitted with the reports during construction period.

8.5 During the life of the Guarantee Contract, the Company must prepare and submit an Annual Environmental and Social Compliance Report, which will be due 60 days after the close of each Fiscal Year. The report must include, at a minimum, the following:

1. Certification that the Company is complying with all environmental and social loan requirements;

2. Description of any material non-compliance with any environmental and social loan requirement that occurred and a description of measures taken to correct the non-compliance.

3. Description of any changes in the company's operations which may have a material environmental or social effect, the reasons for such changes and any actions taken to mitigate the impact of such change.

4. Description of any material environmental or social problem (such as accident, unplanned event, etc.) and a description of the actions taken to resolve the problem and the measures taken to prevent the event from occurring in the future.

5. Description of any contact by a third party (including governmental agency, public, non-governmental organization, company employee, etc.) regarding environmental, social or health and safety issue.

6. Description of planned environmental and social related activities to be performed during the next year, including estimated cost, schedule, and responsibility, including any environmental impact assessment to be developed.

7. Summary of results of all environmental monitoring programs performed during the prior year.

8. Copy of any environmental and social document or report written to comply with any governmental regulatory requirements.

8.6 During the life of the Guarantee Contract, the Company must comply with the following requirements:

1. Consult with the Bank before implementing any action, which will have a material environmental or social impact.

2. Provide written notification, within 30 days after the Company becomes aware, of any material non-compliance with environmental and social loan requirements, environmental health or safety material affect, environmental claim, or material complaint related to environment health or safety related to the Project or Properties, including a description of the situation (extent,

magnitude, impact, etc.), the cause, proposed corrective or remedial actions, actions taken, and proposed schedule for future actions.

3. Implement an Environmental Management System that is consistent with ISO 14001.

4. Ensure compliance by construction contractors with all environmental and social requirements.

5. Implement on-going public consultation related activities, including mechanisms to make relevant monitoring information available to the public.

6. Use of fuel oil with sulfur content less than or equal to 1.0 percent by weight and ash content of less than or equal to 0.03 percent by weight.

TABLE 3-1
PROJECT APPLICABLE REGULATORY REQUIREMENTS

REGULATION	INVOLVED INSTITUTION	REQUIREMENT
Law 5852, 1962	INDRHI	Regulates surface and ground water uses. INDRHI must issue authorization for use. The discharges should not harm human health, vegetation or wildlife reproduction. INDRHI can suspend the discharges until corrective measures are implemented.
Law 487, 1969		Establishes controls over the use of groundwater uses
Law 226, 1990		Prohibits industrial discharge of organics or chemicals into rivers and bans river contamination.
Decree 340	Comisión Cumbre de la Tierra	Created a National Commission for the pursuit of the Rio (Earth Summit) Environmental agreements
Law 305, 1968	Navy	Establishes a maritime zone extending landward 60 meters from the high tide line, within which project activities would require permission from the Dominican Navy
Law 3003 1951,	Navy	Requirements for port areas and coastlines
Decree 233, 1996		Establishes Higuamo river as a wildlife refuge for flora and fauna of impressive beauty
Decree 531, 1990	Forestry Department	Prohibits cutting, mutilating or destructing (by any method) coastal mangroves of all types in any estuary
Decree 303, 1987	Forestry Department (until 1998, Navy). In future INPRA will participate also in this mechanism	Declares protection and rehabilitation of existing mangroves in the national territory and adjacent islands. Mangrove cutting will only be authorized by the General Directorate of Forestry and the Directorate of National Parks for scientific interest or for tourism development, and only when cutting will be strictly necessary. These cases require EIA on potentially affected coastal zones (mangroves, wetlands, marine ecosystems, estuaries).
Decree 632, 1977	Forestry Department	Bans tree cutting at the upper end of rivers and creeks that feed the basins within a 0.5 km radius of the stream banks.
Law 807, 1976		Industrial Safety and Hygiene Law
Law 1728, 1948		Regulates tank construction

TABLE 3-2
PROJECT WASTE WATER CONCENTRATIONS AND DOMINICAN REPUBLIC LIMITS

Parameter	Units	Estimated Effluent Characterization[1]	Dominican Effluent Limitations
Total Dissolved Solids	Mg/L	7,574	1,200[2]
Alkalinity as $CaCO_3$	Mg/L	1,849	
Chloride	Mg/L	2,489	1,000[2]
Fluoride	Mg/L	3	
Sulfate	Mg/L	372	1,000
Total Nitrogen as N	Mg/L	17	100
Calcium	Mg/L	645	
Magnesium	Mg/L	181	500
Sodium	Mg/L	1,633	
Potassium	Mg/L	84	
Iron	Mg/L	0.60	10
Manganese	Mg/L	<0.01	10
Barium	Mg/L	0.3	
Silica	Mg/L	52	
Cyanide	Mg/L	<0.03	0.05
Aluminium	Mg/L	0.63	
Copper	µg/L	<6	1,000
Silver	µg/L	<7.5	100
Zinc	µg/L	141	10,000
Antimony	µg/L	<6	
Arsenic	µg/L	<20	500
Beryllium	µg/L	104	
Cadmium	µg/L	<3	100
Chromium	µg/L	<100	500
Lead	µg/L	<10	100
Mercury	µg/L	2.0	10
Nickel	µg/L	<6	2,000

[1] Based on using on-site groundwater for process and cooling demands and three cycles of concentration in the cooling tower

[2] The Dominican Republic effluent standards for TDS of 1,200 mg/L and for chloride of 1,000 mg/L are assumed to be applicable to freshwater receiving bodies. The salinity of the receiving body (Higuamo River) near the proposed project is highly saline, with a salinity of approximately 28,000 mg/L.

TABLE 3-3
WORLD BANK GUIDELINES

World Bank Stack Air Emission Guidelines for Thermal Power Plants and Project Emissions

Pollutant	Guideline[1]	Project Emissions
Particulate matter	50 mg/Nm^3 or 99.9% efficient	38.9 mg/Nm^3
Sulfur dioxide	0.2 TPD/MW, not to exceed 2000 mg/Nm^3	644 mg/Nm^3, 0.1 TPD/MW
Nitrogen oxides, as NO_2	300 mg/Nm^3	134 mg/Nm^3

mg/Nm^3	Milligrams per normal cubic meter
MW	Megawatt
TPD	Tons per day

[1] The World Bank Group, Pollution Prevention and Abatement Handbook, September, 1997

World Bank Noise Guidelines for Thermal Power Plants

Category of Noise Receptor	Guidelines[1] dB(A)	San Pedro Power Project dB(A)
Residential		
Day Time	55	<45[3]
Night Time	45	<45[3]
Commercial		
Day Time	70	70[2]
Night Time	70	70[2]
Industrial		
Day Time	70	70[2]
Night Time	70	70[2]

[1] Pollution Prevention and Abatement Handbook, World Bank Group, September 1997.

[2] Approximate dB(A) at fence line of project

[3] Approximate dB(A) at 4 km from project site

Waster Water World Bank Group Guidelines for New Thermal Power Plants and Project Discharges

Parameter	**Maximum Value[1]**	**Discharge Quality[3]**
PH	6-9	6-9
Total Suspended Solids	50 mg/L	<50 mg/L
Oil and Grease	10mg/L	<10 mg/L
Total Residual Chlorine	0.2 mg/L	<0.2 mg/L
Chromium (total)	0.5 mg/L	<0.1 mg/L
Copper	0.5 mg/L	<0.1 mg/L
Iron	1.0 mg/L	0.6 mg/L
Zinc	1.0 mg/L	0.14 mg/L
Temperature Increase [2]	Less than or equal to 3° C	<1°C at the edge of a 1-ha mixing zone

[1]Pollution Prevention and Abatement Handbook, World Bank Group, September 1997.

[2]Temperature increase at the edge of a designated mixing zone.

[3] Estimated project waste water discharges based

TABLE 3-4
PROJECT ENVIRONMENTAL PERMITS/AUTHORIZATIONS

Permit/Authorization	Agency	Status
Environmental Permit	ONAPLAN	ONAPLAN's environmental functions are being transferred into t and that agency has no "regulatory authority" at this time. Zoila C noted that his agency will likely not issue a Letter of No Objectio include office discussions during the weeks of September 14th, and
Review of Environmental Assessment (EA)	CDE	Preliminary EA submitted to CDE in April, 1998. Final EA submi 1998. Comments from CDE have been received and addressed.
Environmental Review of New Power Projects	Superintendency of Electricity	Approval not required. Function of Superintendency established b Electricity (January 7, 1997). Superintendency is in development November, 1998.
Regulation of effluents and protection of water quality	National Institute for Environmental Protection (INPRA)	Approval not required. Agency proposed in draft Environmental not yet passed and implemented. Based on draft law, INPRA is c and is not yet functioning.
Environmental Social Impact Evaluation System (EIAS)	National Commission for the Environment (CONAMA)	Approval not required. EIAS Proposed in draft Environmental Pr yet passed and implemented.
Consumptive use of water	INDRHI	INDRHI received a copy of the final EA and supplemental Hydro 1998). Ing. Razero with INDRHI has noted that the project desig issuing a Letter of No Objection. Contacts include office discussi October 12th and July 6th, 1998. Letter of no objection requested. obtained on July 9, 1998. A letter of no objection was obtained c
Regulation of liquid effluents	INDRHI	INDRHI received a copy of the final EA and supplemental Hydro 1998) Ing. Razero with INDRI has noted that the project design a issuing a Letter of No Objection. Contacts include office discussi October 12th and July 6th, 1998. A letter of no objection was obta
Potable Water	INAPA	INAPA received a copy of the Hydrogeologic Report (November, INAPA is charged with regulating public water supplies, not indu concerns would focus on assurance that the project would not aff Dolio well fields. He also noted that distances from the project sit likely preclude any potential impacts. Contacts include office disc September 14th and July 6th, 1998. A letter of no objection was re

Permit/Authorization	Agency	Status
Operation of Ship Unloading Facility	Port Authority	The Port Authority confirmed that their approval will be required terminal can be constructed. The Authority requires engineering i noted for the Navy; this information was submitted during the we Authority previously noted that it may require a nominal, annual c amount was discussed). Contacts include office discussions durin September 14th, and July 6th, 1998. A letter of no objection was o
Navigation and Coastal Protection	Department of the Navy	Capt. Gomez, Commandant of Ports, confirmed that the Navy ha environmental functions to the new environmental agency and tha authority" at this time. The Navy will need to approve the navigat project. Before the can issue a letter of no objection, they will nee and engineering schematics for the off-shore anchoring system, ur approaches from the water onto shore. Detailed location maps we during the week of October 12, 1998. Contacts include office dis October 12th and July 6th, 1998. Copy of final EIA was submitted of no objection was obtained on January 5, 1999.
Tree Cutting Permit	Department of Forestry	The Ministry has noted that the limited tree cutting warrants issui Ing. Abreu noted he would be filing a trip report of his field notes 19, 1998 and expected his superiors to act on it soon thereafter. S discussions during the week of October 12, 1998. Office discussi September 14 and July 6, 1998. A letter of no objection was obta
City Approval	City of San Pedro de Macorís	The mayor's office was presented with a copy of the preliminary final EA during November, 1998. Office contacts were made dur September 14th, and July 6th, 1998. A letter of no objection has be
Coral Protection	Ministry of Forestry	The Ministry noted that the limited offshore construction warrant Objection. Ing. Abreu noted he would be filing a trip report of his October 19, 1998 and expected his superiors to act on it soon the office discussions during the week of October 12, 1998. Office di September 14 and July 6, 1998. A letter of no objection was obta
Mangrove Fringe Protection	Ministry of Forestry	The Ministry has noted that the limited mangrove encroachment v Objection. Ing. Abreu noted he would be filing a trip report of his October 19, 1998 and expected his superiors to act on it soon the office discussions during the week of October 12, 1998. Office di September 14 and July 6, 1998. A letter of no objection was obta

TABLE 5-1
COMPARISON OF WASTE WATER EFFLUENT, APPLICABLE GUIDELINES AND OBSERVED RIVER QUALITY

PARAMETER	UNITS	EFFLUENT VALUE	R.D. CRITERIA	WORLD BANK	HIGUAMO RIVER WATER QUALITY	
			(DRAFT)		(SW-1)	SW-2
BOD	mg/l				7.7	8.0
COD	mg/l				410	410
Water temperature	º C				29.8	29.8
PH	su			6-9	7.9	7.9
Oil and grease	mg/l			10		
Total Dissolved Solids	mg/l	7,574	1,200		3,460	3,760
Total Suspended Solids	mg/l			50	13.0	19.0
Alkalinity as $CaCO_3$	mg/l	1,849				
Chloride	mg/l	2,489	1,000		1,590	1,640
Fluoride	mg/l	3			0.31	0.3
Sulfate	mg/l	372	1,000		0.09	0.17
Total Nitrogen as N	mg/l	17	100			
Calcium	mg/l	645	700		4.06	3.72
Magnesium	mg/l	181	500		49.2	24.6
Sodium	mg/l	1,633			768	854
Potassium	mg/l	84			38.6	41.8
Iron	mg/l	0.6	10	1.0	ND	ND
Manganese	mg/l	<.01	10		ND	ND
Barium	mg/l	0.3			0.00129	0.00144
Silica	mg/l	52			15.7	14.6
Cyanide	mg/l	<.03	0.05		ND	ND
Aluminum	mg/l	0.63			ND	ND
Copper	µg/l	<6	1,000	500	4.19	4.74
Silver	µg/l	<7.5	100		ND	ND
Zinc	µg/l	141	10,000	1,000	16.5	27.6
Antimony	µg/l	<6			ND	ND
Arsenic	µg/l	<20	500		ND	ND
Beryllium	µg/l	104			ND	ND
Cadmium	µg/l	<3	100		ND	ND
Chromium	µg/l	<100	500	500	ND	ND
Lead	µg/l	<10	100		ND	ND
Mercury	µg/l	2.0	10		ND	ND
Nickel	µg/l	ND	2,000		ND	ND

SW1 and SW2 - Higuamo river water quality & biological sampling stations immediately upstream and downstream of the proposed discharge point

TABLE 6-1. CONSTRUCTION MITIGATION MEASURES

Action Items	Frequency of Mitigation	Estimated Cost
Control of Fugitive Dust– Production of excessive fugitive dust will be mitigated through the use of wetting exposed work areas and by revegetating exposed work areas.	As needed	$75,000
Best Management Practices (BMPs) – BMPs such as stormwater detention ponds, installation of silt barriers (i.e. hay bales and silt fences), and re-planting disturbed soils as soon as practical will be implemented to minimize stormwater runoff and erosion at the construction site. These measures will minimize impacts to water bodies.	Continuous during construction	$150,000
Proper Maintenance of all Equipment and Vehicles – Proper maintenance will help minimize exhaust emissions, and the potential for releases of oil and grease during construction.	Continuous during construction	Imbedded in EPC Cos
Noise – Potential noise impacts will be generated by a limited number of construction activities and/or equipment and the impacts will be limited to the immediate area. Project staff will use appropriate personal protection devices at all times during construction.	Continuous during construction	Imbedded in EPC Cos
Solid Waste Management– All solid waste generated during construction will be collected and stored on-site in a separate solid waste storage area. Any hazardous wastes generated will be stored onsite will be kept in a segregated area with full impermeable curbing, roofing, and potential spill collection systems. Licensed, local solid waste management contractors will be contracted to dispose all wastes generated during construction.	Continuous during construction	$100,000
Biological Resources– Sensitive areas surrounding the development site, such as the mangrove fringe along the river will be protected during construction. Sensitive area adjacent to the construction site, including the fuel handling facilities, will be marked and/or fenced off to ensure their protection.	Continuous during construction	Imbedded in EPC Cos

Action Items	Frequency of Mitigation	Estimated Cost
Cultural Resources– Excavation and earth moving BMP's will include training the equipment operators how to identify potential historical or archaeological resources discovery. In the event discovery occurs, appropriate government personnel will be notified and the artifacts will be preserved and relinquished to the appropriate governmental agency.	Continuous during construction	Imbedded in EPC Cos
Worker Health and Safety– Construction activities will be conducted in accordance with the project Environmental Health and Safety Plan as well as local and World Bank health and safety guidelines. Workers will be required to wear head, eye and foot protection at all times during construction. Workers will wear appropriate ear protection as required. Workers will be required to wear appropriate respiratory equipment while engaged in tasks where air quality maybe compromised.	Continuous during construction	Imbedded in EPC Cos
Landscaping– Appropriate landscaping will be planted at the completion of the construction phase of the project.	At completion of construction	$10,000

TABLE 6-2. OPERATIONAL MITIGATION MEASURES

Action Items	Frequency of Mitigation	Estimated Cost
Air Quality – Based on the project guaranteed emissions and the air quality impact analysis, maximum concentrations of SO_2, NO_2, and PM will comply with The World Bank guidelines for stack emissions and ambient air quality. Overall project air emissions will be mitigated/ controlled through the use of water injection for nitrogen oxides and low sulfur fuel oil with 1 percent by weight for sulfur dioxides and particulates. Fuel oil was selected as the proposed fuel because adequate supplies of natural gas are not available in the Dominican Republic. The construction of a 49-meter high stack will ensure effective dispersion of atmospheric emissions.	Continuous during operation	Imbedded in EPC contract
Noise – The noise impact analysis indicates that The World Bank guidelines will be met. Mitigation measures will be incorporated into the project design to ensure compliance with applicable World Bank Guidelines. The particular combination of noise suppression methods to be adopted will be based on a cost basis consistent with attaining an overall noise level consistent with the World Bank guidelines.	Continuous during operation	Imbedded in EPC contract
Local Work Force – The project will hire local staff and utilize merchants to the extent practicable.	Continuous	Imbedded in cost of operation

Action Items	Frequency of Mitigation	Estimated Cost
Water – The impacts associated with groundwater withdrawal and wastewater discharges are not expected to be of a magnitude to warrant mitigation in addition tothat which has been incorporated into the project design. Specific mitigation that is part of the basic project design includes: • Use of non-potable groundwater as a makeup water source • Use of cooling towers to reduce the overall volume of water consumed and to lower the volume and temperature of thermal discharge into the Higuamo River • Installation of secondary containment around the fuel handling facilities to minimize potential for contaminant release • Installation of impervious areas around all areas with the potential to be impacted by fuel oil and other lubricants and chemicals • Installation of oil water separators • Preparation and implementation of SPCC and Emergency Response Plans The fuel unloading facility will be equipped with oil spill containment and emergency response equipment. In the unlikely event of a fuel spill at the offshore unloading platform, the bunkering facility, or along the pipeline, spill containment equipment will be deployed to control, contain and retrieve the spill. The storage of such equipment for emergency situations will allow for a timely response in the event of an accident or oil spill. Training for fuel handling and transport staff will be emphasized and conducted on a continuing basis.	Continuous during operation	Imbedded in EPC contract

TABLE 6-3. CONSTRUCTION MONITORING PROGRAMS

Action Items	Frequency of Monitoring	Estimated Cost
Monitoring of Fugitive Dust– The production of excessive fugitive dust during construction will be monitored by visual observation.	On going during construction	$20,000
Implementation of Environmental Management Plan (EMP) – Compliance with the EMP will be monitored to ensure protection of the environment.	Daily	$80,000
Compliance with Environmental Health and Safety Plan (EHSP) – Compliance with the EHSP will be monitored to ensure the safety of workers and the public.	Daily	$80,000
Community Relations– Community relations, including the conduct of construction workers will be monitored through routine contacts with local authorities in San Pedro de Macorís.	Weekly or as appropriate	$20,000
Air Quality and Meteorology–Ambient air quality (NOx, SO2, PM, and ozone) will be monitored for a period of one year during the construction period. Meteorological data will also be collected concurrently with the ambient air quality data. The objective of the monitoring will be to establish site specific ambient air quality conditions and to provide meteorological data adequate for dispersion modeling.	Hourly for meteorological parameters, continuous for ambient air quality.	$150,000
Marine and Bathymetric Surveys of Offshore Construction Area– The offshore survey will be conducted to refine the exact location of the fuel unloading facility and submarine pipeline. The survey will address the presence of any sensitive marine habitats including corals.	Once prior to construction	$75,000

TABLE 6-4. OPERATIONAL MONITORING PROGRAMS

Action Items	Frequency of Monitoring	Estimated Cost
Air Quality – Initial performance monitoring will be conducted to establish the guarantee levels for the machines. Emission monitoring will be conducted every five years thereafter. Air emissions will be monitored on an on going basis through the use of surrogate performance monitoring as described in the World Bank Pollution Prevention and Abatement Handbook, 1997. Parameters to be monitored include NOx, SO2, and particulate matter	Initial performance testing to be followed by stack emission testing on a five year schedule. Surrogate monitoring will be on going.	$35,000 Annual
Water Quality Effluent (end of pipe)– Continuous effluent monitoring will be conducted for temperature, pH. Quarterly monitoring of the combined plant effluent will be conducted for oil and grease, BOD, Metals, Sulfates, Phosphates, Total residual Chlorine, and Solids (suspended and dissolved). The periodic monitoring will be conducted for one year. After that time, the necessity to continue with the entire parameter list will be evaluated and refined as appropriate.	Continuous for Temp & pH. Quarterly for oil and grease, BOD, Metals, Sulfates, Phosphates, Total residual Chlorine, and Solids (suspended and dissolved)	$35,000 Annual
Compliance with EMP, EHS– Compliance with all requirements of the EMP, SPCC, and EHS plans will be conducted on an on going basis.	Continuous	$10,000 Annual
O&G sampled from Oil-Water Separator– To ensure proper operation of the oil-water separator, discharge from the oil-water separator will be sampled for oil and grease following the first three storm events following start of full operation of the facility.	The sampling events	$500 Annual
Periodic inspection of all tanks and piping and valves and pipelines – All tanks, piping, valves, and pipelines will be inspected to minimize the potential for accidental release of fuel oil.	In-plant facilities will be inspected weekly, pipelines will be inspected quarterly.	$10,000 Annual
Landscaping – Viability and condition of on site landscaping will be conducted to ensure survival of on site planted vegetation.	Weekly	$1,000 Annual

Action Items	Frequency of Monitoring	Estimated Cost
Community Relations– Community relations, including the conduct of operational workers will be monitored through routine contacts with local authorities in San Pedro de Macorís.	Monthly	$5,000 Annual
Compliance with maritimeBMPs – Proper operation of fuel oil delivery ships will be monitored by project staff.	Monthly or when fuel is being delivered.	$5,000 Annual
Groundwater well monitoring– Continuous monitoring of temperature, pH, specific conductivity, and water levels in the onsite wells will be conducted.	Daily	$5,000 Annual

TABLE 6-5. PROJECT ENVIRONMENTAL, HEALTH AND SAFETY PLANS

Plan	Responsibility for Development		Responsibility for Implementation		Objective of Plans	
	Construction	**Operation**	**Construc-tion**	**Operation**	**Construction**	**Operation**
Environment Management Plan	EPC Contractor	Applicant	EPC Contractor	Applicant	Establish organizational responsibilities and protocols to ensure protection of the environment during construction	Establish organizational responsibilities and protocols to ensure protection of the environment during operation
Health and Safety	EPC Contractor	Applicant	EPC Contractor	Applicant	Establish organizational responsibilities and protocols to ensure the health and safety of workers and the public during construction	Establish organizational responsibilities and protocols to ensure the health and safety of workers and the public during operation
Contingency Plan	EPC Contractor	Applicant	EPC Contractor	Applicant	Establish organizational responsibilities and protocols to address emergency conditions during construction	Establish organizational responsibilities and protocols to address emergency conditions during operation
Spill Prevention Plan	EPC Contractor	Applicant	EPC Contractor	Applicant	Establish organizational responsibilities and protocols to prevent the accidental release of contaminants to the environment during construction	Establish organizational responsibilities and protocols to prevent the accidental release of contaminants to the environment during operation

ANNEX 1

PROJECT MAP

ANNEX 2

SO2 ISOPLETHS

ANNEX 3

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FOR

VARIOUS ENVIRONMENT, HEALTH AND SAFETY PLANS