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Termopernambuco Power Project
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ENVIRONMENTAL AND SOCIAL IMPACT REPORT
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ACRONYMS

ABNT	Brazilian Technical Standards Association
ANEEL	National Electrical Power Agency
ANP	National Oil Agency
BOD	Biological Oxygen Demand
CELPE	State Power Distribution Company
CIPS	Industrial Port Complex of Suape
CLT	Brazilian Consolidated Labor Legislation
CNPE	National Energy Policy Council
COMPESA	State of Pernambuco Water Company
CONAMA	National Environment Council
CONSEMA	State of Pernambuco Environmental Council
CPRH	State of Pernambuco Environmental Agency
DNPM	National Department of Mineral Production
DO	dissolved oxygen
DRT	Regional State-based offices
EIA	Environmental Impact Assessment
EPC	Engineering, Procurement, and Construction Contractor
ESDR	Environmental and Social Due Diligence Report
GCOI	Interconnected Operations Coordinating Group
GE	General Electric
GT	gas-fired turbines
HRSG	Heat Recovery Steam Generators
IBAMA	Brazilian Institute for Environment and Renewable Resources
IDB	Inter-American Development Bank
LI	Installation License
LNG	liquefied natural gas
LO	Operating License
LP	Preliminary License
MAE	Wholesale Electricity Market Exchange
MMA	Ministry of the Environment, Water Resources and the Amazon Region
MME	Ministry of Mines and Energy
MTPS	Ministry of Labor and Social Security
NBR	Brazilian Norms (Standards)
NGO	Non-Governmental Organization
NO_2	nitrogen dioxide
NR	Regulatory Norms
NTU	Nephelometric Turbidity Unit
ONS	National System Operator
PCB	polychlorinated biphenyls
PMI	Ipojuca Municipal Authority
PRI	Private Sector Department
SECTMA	State of Pernambuco Science, Technology and Environmental Department
SO_2	Sulfur dioxide
SPC	Special Purpose Company
TSP	total suspended particles
ZPC	Zone of Cultural Preservation

I. INTRODUCTION

1.1 The Brazilian energy shortage, the result of a combination of economic growth and water scarcity in the reservoirs used by hydroelectric plants, led the federal government to accelerate the implementation of the Thermoelectric Priority Program established by Federal Decree 3.371/2000. The decree estimates that over the next 10 years, the generation of thermal power in Brazil will increase from 7 percent to 20 percent of the total energy produced in the country, expanding the Brazilian power supply by approximately 15,000 MW through the installation of 49 thermal power plants in 18 states.

1.2 The Termopernambuco Power Project (the "Project") comprises the development, design, construction, and operation and maintenance of a natural gas-fired 520-megawatt (MW) combined-cycle thermoelectric power plant at the Suape industrial port complex in the State of Pernambuco, Brazil. In addition to the power plant, the Project includes 27 kilometers (km) of 230-kilovolt (kV) transmission lines that will transport energy from the plant to the national grid power system via the Pirapama II Power Substation in the City of Cabo de Santo Agostinho. This facility will supply 60 percent of the Pernambuco Power Company – CELPE's market share, enough energy to supply current demand and expanded economic growth within the state of Pernambuco, with the possibility of a surplus to export energy to other states in the Northeastern Region of Brazil.

1.3 The Project will be developed by Termopernambuco S.A., a Brazilian company wholly-owned by *Companhia Energética de Pernambuco* ("CELPE"), a Brazilian company. CELPE is owned 86 percent by *Guaraniana, S.A.*, a consortium comprising *Iberdrola Energia, S.A.* (Spain), *BB Banco de Investimento S.A.* (Brazil), *Previ* (Brazil) and other Brazilian Pension and investment fund. Termopernambuco S.A was incorporated on April 25, 2000, as a Special Purpose Company (SPC) to implement the project. The Termopernambuco project is part of the emergency program put forward in early 2000 by the Government of Brazil to facilitate investment in electricity generation and to overcome the difficulties encountered by private of generation plants during the transition to the new electricity market model.

1.4 The Engineering, Procurement, and construction (EPC) contractor for the Project will be a consortium formed by Construtora Norberto Odebrecht, Promon Engenharia, and Inepar. Constructora Norberto Odebrecht (Odebrecht) will be the primary EPC for the Termopernambuco project, Promon will provide design services and Inepar will provide tools for the implementation of quality assurance, communication, and health and safety and environmental plans. The operation and maintenance of the plant will be contracted between Termopernambuco S.A. and IBERDROLA Generación S.A.

1.5 Termopernambuco SA has approached the IADB for a loan to finance the Project via an A Loan of approximately US$42.4 million and a B Loan of approximately US$150 million.

II. PROJECT DESCRIPTION

A. Site Location

2.1 The Project will be located at the Industrial Port Zone (*ZIP*, in Portuguese) of the Suape Industrial Port Complex (*CIPS – Complexo Industrial Portuário de Suape*), 40 km south of the City of Recife, the capital of the State of Pernambuco (see Figures 2-1 and 2-2). The Project site is approximately 15.5 hectares, located within a 30-hectare reclamation area allocated for the expansion of the ZIP at the margin of the Ipojuca estuary. The reclamation area has been identified by Suape for the expansion of industrial and port facilities although specific installations have not previously been identified. The proposed power plant is consistent with the general intent of Suape for the development of industrial facilities within the reclamation area. The reclamation area will be filled by dredging of the adjacent Ipojuca estuary. The Project will be filled to an elevation of about 4.2 meters above sea level.

2.2 The Project is limited to the south by the estuary of the Ipojuca River, to the east by a natural rock reef barrier that separates the site from the Atlantic Ocean, to the west by the remaining area of the aforesaid reclamation area (currently below sea level), and to the North by an oil storage area operated by PETROBRAS (Brazil's state oil company). Other petrochemical and container terminals of the internal and external Port of Suape are located beyond the PETROBRAS oil storage area. A Liquefied Natural Gas (LNG) terminal is proposed to be constructed north of the Project site. Another proposed project in close proximity to the Project site is a Liquid Petroleum Gas (LPG) terminal.

2.3 There are no human settlements in the immediate vicinity of the power plant site since it will be built within an existing industrial complex zoned to accommodate large industries. The major urban areas within a 15-km range of the Project are the City of Cabo de Santo Agostinho (125,000 inhabitants), 14 km northwest and the City of Ipojuca (30,000 inhabitants), 10 km southwest. Smaller villages that are nearby include Nossa Senhora do Ó, 6.2 km south, Vila Nazaré 6.9 km north and Vila Europa 11.5 km. There are some beach residential areas and tourist resorts to the south and north are found along the coast, including Muro Alto (2 km), Cupe (5.8 km), Porto Galinhas (9 km), Blue Tree Park Hotel (5 km), Gaibu (7.5 km) and Itapoama (13 km).

B. Project Components and Facilities

Power Plant

2.4 The Termopernambuco natural gas-fired 520-megawatt (MW) combined-cycle plant will be developed in a conventional combined-cycle gas turbine (CCGT) configuration, using two GE Frame 7FA natural gas-fired turbines (GT) and a steam turbine (ST). Back-up fuel will not be used as part of the project. The GE 7FA gas turbines will have a nominal capacity of 174 MW (ISO) and will be designed for continuous operation, 24 hours a day, 7 days a week. The combustion turbines will use dry low NO_X technology for the control of nitrogen oxides. Both gas turbines drive dedicated electrical generators. Waste heat in the flue gas from the turbines will be captured in two Heat Recovery Steam Generators (HRSG), one for each gas turbine, which will produce steam at three pressure levels for the ST. The ST will have a nominal capacity of 211 MW and will be designed for continuous operation, as well. It will have three phases—high, intermediate, and low-pressure—reheating steam between the high and intermediate-pressure phases. The three phases will be arranged in a tandem layout, with a horizontal axis and an axial steam flow. Supplemental firing in the HRSG will be provided. The steam from both HRSGs will

drive a single steam turbine, also with its own electrical generator. After it has passed through the steam turbine, the steam is cooled within the condenser before being returned to the HRSGs as feedwater to repeat the cycle. Waste heat from the condenser is discharged to the Atlantic Ocean via a once-through cooling water system. Air emissions will be discharged from two 43.2-meter-high steel stacks located adjacent to the HRSGs.

2.5 Water Supply. Water for the power plant will be obtained from two sources: cooling water from the ocean and freshwater for steam cycle makeup, general services, and potable water to be supplied to the site by COMPESA.

2.6 Cooling water will be pumped from the ocean at the rate of 10 m^3/second. The water intake system will consist of a raw water reservoir and three intake pipes that will be buried below the ocean floor. Thee intake pipes will be fitted with screens at the end to prevent macro-organisms from being drawn into the pipes. The use of three intake pipes will reduce the overall inlet velocity to 0.2 meters per second and thus minimize impact to aquatic organisms. Cooling water will be treated with chlorine to control the growth of biofowling organisms in the condenser cooling system.

2.7 Process water (fresh water) for the steam cycle makeup will be purchased from COMPESA (the State of Pernambuco Water Company) and will be supplied from the existing Bita and Utinga Reservoirs within the bounds of Suape, which were built to guarantee water supply to the CIPS industries and the port. The water to be used for the process water makeup will be transported to the site via a pipeline to be constructed, owned, and operated by COMPESA. The potential alignment of the water pipeline will likely follow an existing water pipeline from the reservoirs to the port facility. COMPESA will be responsible for obtaining all of the required environmental permits for the fresh water pipeline. The water pipeline is not part of the Termopernambuco Project.

2.8 Water Discharge. The Plant waste water discharge will consist of four discharge pipes that will parallel the intake pipes to the point where the intake pipes terminate. The discharge pipes then turn to the north at a 45-degree angle and extend beyond the end of the intake pipes. The discharge pipe will be at least 1000 meters with diffusers along the last 100 meters. The discharge pipes terminate in a stepwise manner distributing the thermal effluent over an area of approximately 600 meters. The cooling water discharge will be less than 10m^3/second and the quality will meet the applicable Brazilian standards and World Bank guidelines for New Power Thermal Plants (Pollution Prevention and Abatement Handbook, 1998) without the need for additional treatment and therefore, no treatment is proposed for the cooling discharge.

2.9 Fresh water will be treated to three levels at the power plant site. Water for steam cycle makeup will be treated to the highest level of purity using reverse osmosis at a rate of 15 m^3/hr. Wastes from the reverse osmosis process will be 5 m^3/hr and will be neutralized prior to discharge. Other incidental freshwater uses including general service water and potable water will undergo filtration, flocculation, and decantation. Potable water will be further treated with chlorination.

2.10 An onsite septic tank will be used for treatment of sanitary wastes at a rate of approximately 5.6 m^3/day. Other plant facilities will include fire suppression equipment, administrative buildings, control system, pumps, storage facilities, parking spaces, and tanks. Wastes from the water treatment system will consist of sludges (organic matter and fine materials). Final treatment of the wastes from the water treatment system will consist of dewatering of the sludge and recycling the water fraction while the semidry solids are removed for offsite disposal at a landfill.

2.11 Storm water runoff that has the potential to come in contact with oils and petroleum products will be routed through an oil water separator prior to final discharge. Based on similar facilities in the area, the expected volume of water to be treated through the oil water separator is approximately 1,750 m^3/year.

2.12 Fuel Supply. Natural gas will be supplied by COPERGAS, Pernambuco State Gas Company, and GASPETRO at the rate of 2.0 million cubic meters per day (Mm^3/day) through a new 5-km-long 12-inch pipeline that will branch out from the existing Pilar-Cabo gas duct. The alignment for the natural gas pipeline will be determined by COPERGAS and GASPETRO, and has not been finalized. Natural gas will be piped from the Industrial City Gate to the Pressure Regulation and Measuring Station on the Project site, and from there, to the power plant site. COPERGAS and GASPETRO will construct, own, and operate the pipeline.

2.13 Land Preparation. Land preparation activities include construction of the breakwater around the Project site, dredging of fill material from the Ipojuca estuary, soil stabilization, site grading and earthwork necessary to facilitate construction. Dredging activities are expected to start during the fourth quarter of 2001 and will last 4 to 6 months. Dredging will be carried out using hydraulic dredging technologies typically used for this purpose. The dredged material (primarily sand and water) will be piped to the Project site and placed landward of the rock embankment constructed to retain the fill material. Water associated with the sediment will be allowed to flow back into the estuary in a controlled manner. The volume of fill material to be used for the site will be 720,000 cubic meters. Grain-size analysis of the fill material indicates medium-size sand (0.4 mm). Less than 5 percent of the dredged matter will be fine material that could be lost during the dredging and filling process. The maximum depth of the dredging will be 6 meters below the existing bottom level. Dredging will be accomplished through the use of hydraulic dredges. Temporary and final slopes of the Project site will ensure proper drainage. Land-clearing activities for the transmission line will require removing brushy vegetation and stabilizing the soil for the structure foundations.

Transmission Line

2.14 A new 27.4-km, 230-kV double-circuit power lines will cross several zones of the CIPS to reach the Pirapama II Power Substation in the City of Cabo de Santo Agostinho, running parallel to other existing lines and roads for the majority of the alignment (Figure 2-2). The power line starts at the Termopernambuco Power Plant, crossing the land reclamation area including an area of mangroves for approximately 400 meters until it reaches the railroad (approximately 1,800 meters), then follows parallel to the railroad for about 1,400 meters and enters a rural area, where subsistence agriculture and vegetation predominate, until it reaches the area designated for the Iron and Steel Products Center (*Central de Produtos Siderúrgicos*) (approximately 1,400 meters). The mangrove area crossed has been previously approved by the government of Brazil as part of the port expansion area. From this point, the power line crosses sugarcane fields (approximately 5,300 meters) and several areas occupied by different types of agriculture, including forestation projects, sugarcane fields, and subsistence agriculture, until it reaches the Pirapama II Power Substation.

2.15 The ROW for the transmission line will be 20 meters within the port and 30 meters for the rest of the alignment. Termopernambuco will be responsible for construction and operation of the transmission line. Construction of the transmission line will involve the clearing of the right-of-way (ROW), construction of structure foundations, erection of the towers and stringing of the conductors

C. Project Workforce, Schedule, and Costs

2.16 The average number of workers in the construction phase (power plant and transmission line) will be 500, with an estimated maximum of about 750 workers. During the operation phase, an estimated number of 50 employees (most of them Termopernambuco staff) will be required. Construction workers will come from surrounding communities. Transportation will be provided for the workers by the EPC contractor.

2.17 The overall project construction phase will last approximately 30 months. Construction of the Project is expected to start during the fourth quarter of 2001. The supply of combustion turbines, HRSGs, and Continuous Emissions Monitoring Systems as well as other specialized equipment has been contracted with GE, which has guaranteed to complete its delivery in early 2003. Construction of the transmission line will be scheduled to be completed concurrent with the power plant facility. Start of commercial operations is scheduled for late 2003.

2.18 Total costs for the Project are estimated at US$403.5 million.

D. Analysis of Alternatives

2.19 Location. The current Project location within the industrial area was selected as a result of the alternative analysis for the Project location, and performed as part of the Project Environmental Impact Assessment (EIA). The original proposed site was east of the internal port of Suape, between the Ipojuca and Tatuoca Rivers. The original site was identified to facilitate water intake and discharge from the cooling system; however, it was determined that this alternative would have significant and irreversible impacts on the biota of these shallow and warm riverine systems. The current power plant location has the additional advantages of being free from protected vegetation and fauna and farther away from populated areas. Part of this expanded port area had already been allocated for the construction in a future of an LNG regasification plant.

2.20 Transmission Lines. The current location of the power line corridor resulted from the environmental and social analysis performed during the EIA, and prevents interference with mangroves and protected areas. To achieve this project enhancement, the total length of the transmission lines was increased from 22,870 to 27,400 meters. In addition, the spacing between structures was increased whenever possible to minimize impacts to vegetation.

2.21 Generation Technology. According to CELPE's privatization process, Guaraniana had the obligation by contract to build a thermal power plant of at least 240 MW by January 31, 2005, in the general area of Suape. The advantages and disadvantages of various technologies for thermal power plants were assessed and supported the decision to adopt natural gas-fired combined-cycle as the chosen technology. Main advantages of natural gas-fired power plants include: the possibility of situating plants close to the consumer areas; the reduction of environmental air pollutants, since natural gas is less polluting than coal and diesel; and the shorter period of planning and construction. The use of combined-cycle technology provides a significant increase in the thermal efficiency of the power plant by capturing heat energy in the HRSG that would otherwise be wasted.

III. INSTITUTIONAL AND LEGAL FRAMEWORKS

A. Institutional Framework

Energy Sector

3.1 The National Energy Policy Council (CNPE) has the responsibility to propose national oil and gas policies to the federal government, periodically review the national energy matrix, protect the environment, promote the use, and establish specific guidelines for the use of natural gas (Federal Law No. 9,478/1997 and Federal Decree No. 2,457/1998). The Ministry of Mines and Energy (MME) is in charge of executing Brazilian energy policy, approving the exploration and development of natural energy resources, and auditing the operation of decentralized industry-related entities.

3.2 The National Oil Agency (ANP) is responsible for the implementation of the federal oil and gas policy contained in the Federal Law No. 9,478/1997, and regulation and enforcement of oil and gas activities. The National Electrical Power Agency (ANEEL) is responsible for the regulation and enforcement of production, transmission, distribution, and commercialization of electric energy in accordance to federal guidelines and policies (Federal Law No. 9,427/1996 and Federal Decree No. 2,335/1997).

3.3 The National System Operator (ONS) was set up to coordinate and control the operation of electricity generation and transmission in the interconnected systems with a view to optimizing these activities, previously performed by the Interconnected Operations Coordinating Group (GCOI).

3.4 The Wholesale Electricity Market Exchange (MAE), when fully established, will operate all power purchase and sale transactions, either through bilateral contracts or in the short-term market. The Market Rules were passed in the ANEEL Order 290/2000, regulating all transactions made on the Wholesale Electricity Market.

Environmental Sector

3.5 At the national level, the Ministry of the Environment, Water Resources and the Amazon Region (MMA) is responsible for the coordination of the National Environmental Policy (*Política Nacional de Meio Ambiente*). The National Environment Council (CONAMA) is a consulting and deliberating body responsible for defining general environmental regulations and basic criteria and guidelines to implement the National Environmental Policy, such as environmental and emission standards for ambient quality and pollutants. In addition, CONAMA establishes the general requirements for environmental licensing and for the environmental impact assessment process. The Brazilian Institute for Environment and Renewable Resources (IBAMA) is the federal agency responsible for executing and enforcing the environmental regulations and standards at the federal jurisdiction, and for issuing the environmental permit in the cases defined by law.

3.6 Federal and State Attorney General Offices oversee the environmental practices of government agencies and the private sector, serving an “ombudsman” function. They have investigative and prosecuting powers and may bring civil and criminal actions against polluters and those who infringe environmental legislation. They have a constitutional mandate to protect the public and the environment.

3.7 At the state level, in terms of the Termopernambuco Project, the environmental responsibility for the enforcement of environmental legislation and issuance of major environmental licenses falls under the jurisdiction of the State of Pernambuco environmental agency (*"Companhia Pernambucana do Recursos Hídricos" or* CPRH), while the State of Pernambuco Science, Technology and Environmental Department (*"Secretaria de Ciência, Tecnologia e Meio Ambiente"* or SECTMA) has the policy-making responsibilities. The State of Pernambuco Environmental Council (*"Conselho Estadual do Meio Ambiente"* or CONSEMA) is a consultative and deliberative body comprised of members from the government, private sector, and non-governmental organizations. CONSEMA is consulted during the environmental permit process.

3.8 At the municipal level, Ipojuca Municipal Authority (PMI) is responsible for land-use planning and for municipal policies and legislation. Nevertheless, municipal legislation and regulations cannot be less stringent than federal and state standards. Although local governments usually exert strong land-use controls, in the case of the Termopernambuco Project, the CIPS Administration will apply its own zoning and land-use regulation to the project, given that it will be constructed within the industrial port area for which there is a state decree that defines land-use and zoning.

Health and Safety

3.9 The responsibility for developing and enforcing the health and safety regulations is assigned to the Ministry of Labor and Social Security (*"Ministério do Trabalho e Previdência Social"* or MTPS) and its regional state-based offices (*"Delegacia Regional do Trabalho"* DRT). Stiff penalties, including a construction embargo, may apply for noncompliance. State and municipal authorities have no jurisdiction over labor matters.

B. Legal Framework

Energy Sector

3.10 The reform of the Brazilian power sector began in 1995 with the privatization of government-owned electricity utilities and with Constitutional amendments allowing private investment in the electricity sector. In 1996, the GOB undertook regulatory reform by setting rules of a new and competitive electricity market. The new market model opened generation and trading businesses to competition, while transmission and distribution continued as regulated activities. The regulation of the public provision of electricity is mainly centered in Articles 175 and 121 of the Federal Constitution, which establish among some federal responsibilities rendering of electric public services, either directly or under regime of concession or permit, always by means of public bidding.

Environment

3.11 As granted by the 1988 Federal Constitution, environmental legislation and regulations in Brazil are enacted at the federal, state, and municipal levels. The federal agency establishes general requirements of broad applicability, while specific standards of enforcement are left to the state agency, either by regulation or by administrative orders. The states and municipalities may also issue standards of equal or more stringent requirements than the federal ones. In addition, the Brazilian Technical Standards Association (ABNT) issues technical norms and standards dealing with specific environmental matters. The content of these standards is in general considered as best management practice; however, they can also be considered legal requirements when recommended by any piece of legislation.

3.12 At the federal level, the most relevant piece of environmental legislation is Federal Law 6,938/81, which created the National Environmental Policy (*Política Nacional do Meio Ambiente – PNMA*). It established the basis for environmental protection in Brazil, by putting in place the appropriate institutional framework and defining the main instruments for environmental management.

3.13 The Brazilian environmental permitting process requires that three licenses (permits) be obtained by potentially pollutant activities: Preliminary License (*Licença Prévia or LP*), Installation License (*Licença de Instalação or LI*), and Operating License (*Licença de Operação or LO*). For projects listed in CONAMA 001/86 (including power plants with nominal capacity above 10 MW), an Environmental Impact Assessment (EIA) is required. The CONAMA Resolution 001/86 defines the basic content of the EIA and establishes the public participation requirements. CONAMA Resolution 09/87 regulates the public hearing process associated with the EIA process. The LP is granted based upon governmental approval of the Project EIA and the RIMA (*Relatório de Impacto Ambiental*), which is a summary of the EIA. The LI is granted based upon government approval of a project-specific Environmental and Social Management Plan ESMP (*Projeto Básico Ambiental or PBA*) and represents the governmental authorization to start the construction of the proposed project. The LI also establishes specific requirements regarding the mitigation and monitoring or environmental and social impacts. The LO must be obtained prior to project operation.

3.14 Air Quality. CONAMA Resolution No. 03 of July 28, 1990 establishes air quality standards for facilities that use fossil fuels. Emission standards in Brazil are established by CONAMA Resolution No. 08 of December 6, 1990, which sets emission standards for particulate matter and sulfur dioxide for facilities that burn coal and fuel oil. Brazilian emission standards do not mention the emission from natural gas-fired facilities. Air emissions limits for the Project are included in the Guidelines for New Power Plants (Table 3-1) included in the World Bank Pollution Prevention and Abatement Handbook, 1998.

3.15 Waste Management. Several CONAMA resolutions deal with waste management and regulate requirements for a complete waste inventory (including storage, transportation and final disposal methods), submittal of inventory forms to the state environmental agency, classification of used lubricant oil as hazardous waste, and procedures for its storage, treatment, and disposal. The ABNT has also issued a number of standards that relate to waste management, such as waste classification and characterization. There are also standards addressing the final disposal of wastes. Criteria for design, construction, and operation of a hazardous waste (Class 1) landfill are defined under NBRs 8418 and 10157. The option of disposal through incineration is becoming more widely available and performance criteria for hazardous waste incinerators are established under NBR 11175 (formerly NB 1265). CONAMA Resolution 006/88 requires the submission of an inventory of any PCB (polychlorinated biphenyls) and/or PCB-containing materials to the state environmental regulatory agency. Federal legislation also establishes procedures for handling, storage, and transportation of PCB or PCB-containing materials (and reference ABNT NBR 8371 for technical aspects).

3.16 Water Management. The most important piece of legislation is CONAMA Resolution 20/86, which establishes standards for quality of superficial water bodies and requirements and limits for wastewater and/or effluent discharges. Most recently, Federal Law 9,433/97 establishes the Water Resources National Policy and creates the National System of Water Resources Management. Ordinance 36/90, by the Ministry of Health, establishes standards for drinking water use. Water

quality standards for Class 6 waters applicable to the proposed Project are presented in Table 3-2. World Bank effluent Guidelines for New Thermal Power Plants are presented in Table 3-3.

3.17 Fauna and Flora and Forest Management. The most relevant legislation at the federal level is Federal Law 4,771/65 (Forestry Code), which defines as permanent preservation areas forests and other forms of natural vegetation along the rivers and around lakes and other natural or artificial reservoirs. It sets provisions to authorize the clearing of these forests if previously authorized or when absolutely necessary for the implementation of public interest projects. Procedures to manage native forests and requirements to cutting and transporting forest resources are defined at the state level. Further regulation at the federal level defined the minimum width of "ciliary belts." In the case of artificial reservoirs and rivers wider than 50 meters, ciliary belts should have a minimum width of 100 meters. CONAMA Resolution 04/85 also requires the establishment of a permanent preservation area of 100 meters around the reservoir of an HPP. Federal Law 3,824/60 establishes the requirements for deforestation and clearing of the areas to be flooded.

3.18 Mineral Resources. Under the Brazilian Mining Code, established by Federal Law 227/67, the extraction of stones and slate (quarry) (Class II mineral resources) to serve as raw material for construction require an specific authorization from the local administration authority and from the National Department of Mineral Production (DNPM). CONAMA Resolution 010/90 determines that the quarry to serve at Class II mineral resources is subject to the environmental permitting procedures.

3.19 Environmental Education. Federal Law 9,795 of April 27, 1999, creates the National Policy for Environmental Education.

3.20 Noise. CONAMA Resolution 001/90 establishes criteria for noise emissions from any industrial, commercial, social, or leisure activities. It also addresses the contents of NBR 10151 as the suitable noise evaluation method and NBR 10152 as the applicable noise levels for areas of different use (residential, commercial, and industrial). Tables 3-4 through 3-6 present the noise levels at the federal level (NBR 10151) and from Article 25 of the State Decree No. 8,447/83 for the State of Pernambuco. Table 3-7 refers the noise limits in the Guidelines for New Thermal Power Plant included in the Pollution Prevention and Abatement Handbook (1998).

3.21 Historic and Archeological Heritage. The main regulation addressing the issues related to the protection of the historic, artistic, aesthetic, cultural, and archeological heritage/patrimony is Federal Law 3,924/61, which determines that any site in which positive vestiges of occupation by paleoamerindians or of temporary settlements of the ceramic period is defined as historic or archeological monuments. The legislation also establishes the general requirements for the excavation procedures.

3.22 Expropriation. The expropriation process, regulated by the Law-Decree No. 3,365 of June 21, 1941, occurs in two stages. In the declaratory stage, ANEEL, the organization responsible for the regulation of the electricity concessionaires, publishes a Resolution determining the area to be expropriated for public utility. In the expropriation stage, the concessionaire is allowed to acquire and compensate the affected properties in the areas to be expropriated.

3.23 Environmental Crimes. Recent Federal Law 9,605/98, regulated by Federal Decree 3,179/99, establishes punishments for environmental crimes, including environmental damages provoked by human actions. At the state level, the State of Pernambuco has specific provisions concerning environmental licensing. CPRH, the state environmental agency, has the authority to issue all environmental licenses (LP, LI, and LO) as required by State Law No. 11,516/1997 and Decree

No. 20,586/1998. When an EIA is required, it must be presented prior to issuing a Preliminary License. The State is also responsible for the Industrial Port Complex of Suape (CIPS). Land use and environmental protection in the area of CIPS is governed by State Decree No. 8,447/1983. Annex II of this decree establishes a set of pollution control requirements that the Project must comply with to operate within CIPS. CIPS has an environmental office to oversee environmental matters within the area of the industrial complex.

3.24 Noise. CONAMA Resolutions No. 1 and 2, March 8, 1990, regulate noise pollution in Brazil. Resolution No. 1 establishes that the noises levels above those provided in the Brazilian Technical Norm NBR 10151 from ABNT are damaging to human health and to the peace of public places. Resolution No. 2/90 establishes the "Silence Program," which is coordinated by IBAMA with participation of state and municipal environmental agencies, as necessary. Regulatory agencies (federal, state, and municipal) regulate noise ordinances and noise emission from any source and of any nature, taking into consideration the place and time where these occur to protect human health and the wellbeing of the general public.

3.25 CONAMA Resolution 002/96 determines that projects with significant environmental impact shall establish an environmental conservation area/unit, and that a minimum of 0.5 percent of the total Project cost be spent exclusively for the acquisition of the necessary areas. Excess funds (e.g., when areas cost less that the established percentage) can be used in infrastructure and monitoring activities within the area, at the discretion of the state environmental regulatory agency.

Health and safety

3.26 The Brazilian federal legislation establishes the set of general requirements and details the federal health and safety requirements through Regulatory Norms (NR). However, complementary health and safety and industrial hygiene requirements are established through Technical Rules and Standards issued by the ABNT. As for the transportation, handling, and temporary storage of explosives for mineral extraction purposes, Federal Decree 2,998/99 requires that a specific authorization (Certificado de Registro) be granted by the Ministry of Army for each activity. Technical requirements for the storage facilities are also established by the Decree.

3.27 The 1988 Federal Constitution provided for the reduction of labor risks through health, hygiene, and safety measures (Article 7, XXII). Chapter V of the Brazilian Consolidated Labor Legislation (CLT) contains numerous sections and provisions to guarantee this objective, including the use of personal protective equipment (PPE or EPI in Portuguese).

3.28 Federal law No. 6,514/1977 is the primary instrument governing occupational health and safety standards. Subsequently, the Ministry of Labor issued Administrative Rule No. 3,214/1978 with detailed provisions in these matters, known as NRs – Normas Regulamentadoras. Programs for medical control of occupational health (Administrative Rule No. 8/1996) ought to take the NR provisions under consideration.

3.29 The main legislation regarding occupational health and safety follow: a) Workers Code (*Consolidação das Leis do Trabalho -CLT*) and its regulations (*Normas Regulamentadoras - NR*); and b) International Conventions of the International Labor Organization – ILO. NR 05 and Article 163 of the CLT define that every company must create and operate an Internal Accident Prevention Commission (*CIPA - Comissão Interna de Prevenção de Acidentes*). NR 07 and 09, respectively, define requirements for the Workers Health and Medical Program (*Programa de*

Controle Médico e Saúde Ocupacional - PCMSO) and the Environmental Risks Prevention Program (*Programa de Prevenção de Riscos Ambientais – PPRA*).

C. Project Compliance Status

3.30 The Project EIA (including the power station, natural gas pipeline, and the power line) was finalized in December 2000 and presented to CPRH for its review. Public disclosure of the EIA was on December 28, 2000. In January 2001, CPRH delivered copies of the EIA to IBAMA (the national environmental agency) and to the municipal districts of Ipojuca and Cabo de Santo Agostinho.

3.31 Given that no public hearing was requested, CPRH issued the Preliminary License on March 19, 2001 (LP 0033/01). This license (LP) includes the thermoelectric power plant and its corresponding gas pipeline and power lines. Subsequently, the LI for the thermoelectric power plant was issued on June 14, 2001 (LI 0637/01). When the Operation License is requested, the company must present:

- Detailed design of modifications made to the cooling water intake and discharge system,
- Details of the treatment of industrial effluents,
- Details of the treatment of sanitary wastes,
- Plans for the drainage system for the whole facility,
- Plans for environmental monitoring, including the management of solid, liquid and gaseous wastes, and
- Monitoring plans for the marine environment for areas that will be affected by cooling water intake and discharge systems.

3.32 The transmission line LI was issued on October 25, 2001. . Conditions of the LI include a requirement of 0.5% of Project investment be used for mitigation measures. The installation license for the natural gas pipeline as well as design and construction of this facility is the responsibility of COPERGAS and GASPETRO. The installation license and waste of the water pipeline is the responsibility of COMPESA.

3.33 The Project dredging and filling has been previously authorized to Suape by the State of Pernambuco Environmental Agency (*CPRH*), license No. 0974/00, and is renewed on an annual basis. The Project will fill part of the reclamation area (15.5 hectares of a total approved area of 30 hectares) by dredging of the adjacent Ipojuca estuary under the previously authorized permit (License No. 0974/00). Termopernambuco S.A. will conduct the dredging activities under the terms and conditions stated in the original Installation License issued to Suape. No additional permits are required for these activities.

IV. ENVIRONMENTAL AND SOCIAL CONDITIONS

A. Environmental Conditions

4.1 The Project site is located approximately 40 km south of the City of Recife, inside the industrial zone of the Industrial Port Complex of Suape. The CIPS total area of 13,600 hectares overlaps the municipal districts of Ipojuca and Cabo de Santo Agostinho. There are 46 active industries within the various industrial zones of the CIPS and 10 industries under construction as of September 1999. Although there are residents living within the overall boundaries of Suape, no human

settlements are present in the immediate vicinity of the power plant site, since it will be built within an existing industrial complex zoned to accommodate large industries.

4.2 The power plant site itself is adjacent to the Atlantic Ocean and is currently below sea level. The site will be filled to an elevation of approximately 4.25 meters above sea level by the placement of dredged fill material (predominantly sand) from the adjacent Ipojuca River and estuary.

4.3 Meteorology. Climate in the CIPS area is warm and humid. The annual average temperature is 25.5°C. The average temperature is 22°C during the rainy season (March to August) and 29°C during the dry season (September to February, summer). Evaporation is highest in the month of December, reaching 145.5 millimeters (mm), and lowest in May, dropping to 70.2 mm. Over the last 15 years, the average annual precipitation in the Suape region has been 2,214 mm. Maximum rainfall occurs in June and July, reaching peaks of 380 mm/month.

4.4 Wind conditions in the general area of the Project are influenced by the Atlantic Ocean and other factors. Wind speed conditions vary from the southeast quadrant in the months of March to September to east/northeast in the months of October to February at an annual average speed of 2.9 meters per second (m/s). Wind speed varies from 0 to 13 m/s with highest speeds in the month of August. The velocity is slower during the night, when the wind direction flows from the continent to the ocean.

4.5 The northeast coast of Brazil, including the Project site, is not subject to adverse weather conditions such as hurricanes and other severe storms. Periods of heavy rain do occur but are not typically accompanied by high winds typical of tropical storms.

4.6 Air Quality. Air quality in the metropolitan area of Recife, which includes the municipal districts of Cabo de Santo Agostinho and Ipojuca, is monitored by CPRH. Although there are no ambient air quality monitoring stations in the immediate vicinity of the Project power plant site, CPRH does maintain a monitoring station in the City of Cabo, 14 km northwest of the Project site. Air quality in the vicinity of the monitoring station at Cabo is impacted by existing industrial and transportation sources not present at the Project site. Monitoring results for the years 1996 to 1998 suggest a downward trend in the annual concentrations of SO_2, although there is an overall increase in the concentrations of NO_2. While the NO_2 concentrations are below the Brazilian and World Bank annual standard of 100 $\mu g/m^3$, ambient concentrations are approaching these limits. The concentration of TSP does not show a strong trend, with only a small overall increase between 1996 and 1998. To monitor parameters for daily standards, CPRH used manual methods that collect data for 24 hours. Thus, these results of the 24-hour measurements cannot be compared to the World Bank 1-hour standard for NO_2. However, because of the general absence of significant sources of air emissions near the power plant site and the prevailing coastal winds, it is anticipated that the concentrations of air pollutants near Cabo are higher than those at the Project site. It is generally believed that the air quality at the power plant site is less impacted by industrial and transportation sources and is of better quality than represented by the data from Cabo.

4.7 Estuarine and Coastal Hydrology. The proposed Project power plant site is located landward of the natural rock reef that parallels much of the coastline near the proposed project. The power plant will be constructed on an area to be filled within the Ipojuca estuary immediately west of a natural rock reef. East of the natural reef is the open Atlantic Ocean. To the south and west is the Ipojuca River and estuary.

4.8 The tidal regime at the Port of Suape follows a 12.4-hour cycle. The average high tide is 2.0 meters, and low tide is 0.9 meters. Equinoctial tides may reach 2.6 meters. The height of coastal waves varies from 3.0 meters to 4.5 meters for 10 seconds. Inside Suape inner harbor, wave heights reach 0.6 meters for 4.4 seconds. Circulation patterns were measured at nine stations, of which Stations 1 and 2 were located inside the Ipojuca River estuary. Outside the reef area (open ocean) in front of the Project site, surface currents are predominantly south-north with velocities of 0.04 to 2.0 meters/sec during the dry season and 0.4 to 1.2 meters/sec during the wet season. Depth currents are usually 70 percent weaker than surface currents and parallel to the reefs, in the same direction as surface currents. At the Ipojuca estuary, the most intense currents were measured during ebb tide. In any case, surface and depth currents are synchronized and have low velocities with average speeds of 0.03 to 0.28 meters/sec (dry season) and 0.04 to 0.38 meters/sec (wet season). The preferential direction of current is parallel to the axis of the river.

4.9 In the area of Stations 8 and 9 (outside the reef near the proposed cooling water discharge point), the water column is approximately 16 to 17 meters deep. The water column is homogeneous in terms of temperature and salinity. The temperature along the water column varies from 28.9 to 28.7°C, and the salinity varies from 37.5 to 37.2 percent, in the dry to and rainy seasons, respectively. With regard to suspended materials, the water column is not homogenous, with suspended materials concentrations increasing toward the bottom. The total suspended materials near the bottom varied between 40 to 110 Nephelometric Turbidity Unit (NTU) (dry season) and from 11 to 350 NTU (wet season). Near the surface, total suspended materials were recorded as less than 10 NTU (dry season) and less than 25 NTU (wet season).

4.10 In the estuary, salinity levels decrease westward and inland, as expected because of freshwater influx. Water temperatures in the Ipojuca estuary range from 28.6°C to 32.6°C during the dry season and from 27.2°C to 28.5°C during the rainy season. The higher temperatures in the dry season result from a combination of a low water column and higher solar radiation. With regard to suspended solids, the water column is relatively homogeneous and the overall values for suspended materials are relatively stable and low, less than 100 NTU even when the currents are more intense.

4.11 Additional oceanographic studies have been conducted in the area of the intake and discharge structures. Parameters addressed include temperature, salinity, conductivity, visibility and total suspended solids. Samples were collected form June to September 2001. Sediments have also been collected and currents and tides were measured. The information is being used for the final design of the intake and discharge structures and will be used as precise input data for the dispersion model once the intake and discharge structures final design is approved by the EPC.

4.12 Marine Environment. Site-specific surveys of the biotic communities in the Project area are underway. It is anticipated that the Project site and the area to be dredged are inhabited by various species typical of these habitats, including benthic invertebrates such as mollusks, shrimp, and crabs; algae; zooplankton; and fish. A wide variety of algae, mollusks, fish, shrimp, and crabs are found in the estuary of the Ipojuca River. Heavy-metal concentrations have been detected in some species. A study conducted in 1999 (Estudos Ecotoxicológicos na Área do Complexo Industrial Portuário de Suape, PE, 1999) identified some level of contamination with heavy metals. Aquatic species such as zinc in the mangrove oysters, (*Crassostrea rhizophorae)* and chromium in the shellfish, (*Anomalocardia brasiliana*) and of the sediments in the areas around Suape present levels of heavy metals above the Health Minister Standards. Although the study did not analyze for other contaminants, it is believed that the water, sediment, and some aquatic species may be contaminated with other contaminants such as petroleum products, herbicides, and pesticides.

4.13 There is no live coral at the Project site. The reef line that borders the Project site consists of calcareous rock. Its natural condition has been significantly altered by the landfill and construction executed over the last three decades for the implementation of the port. Ocean flora and fauna in the area of the port are not as diverse and abundant as estuarine wildlife in the surrounding areas.

4.14 Fresh Water Hydrology. The Project site is located at the margin of the Ipojuca River estuary. The Ipojuca River Basin occupies an area of 3,600 km^2 and crosses 24 municipal districts. In addition to the Ipojuca River, four other rivers, the Tatuoca, Massangana, Pirapama, and Jaboatão, converge to the CIPS area, but are not directly or indirectly affected by the Project. In addition, the Merepe River also serves as a tributary to the Ipojuca estuary. The Tatuoca, Ipojuca, and Massangana estuaries have been significantly altered by the internal port of Suape through dredging of canals and building of port docks. Further north, the Pirapama and Jaboatão estuaries present well-preserved mangroves.

4.15 The Ipojuca is the major river in the area of influence of the Termopernambuco Project, and the only one directly affected. The Ipojuca River extends 250 km and runs through several municipalities in Pernambuco. Even though this river is classified as a Class II River (fresh waters designated for domestic supply after conventional treatment, protection of aquatic communities, recreation, irrigation, and fisheries), it receives untreated discharges from a variety of sources (agricultural areas, industrial facilities, municipal sources, and flour houses). Untreated discharges contribute to contamination of the water, sediment, and some aquatic species in the river and at its estuary. Water quality results reported in the EIA indicate that biochemical parameters exceed Brazilian standards for BOD, DO, and fecal coliforms.

4.16 Near Suape, there are two reservoirs that were constructed to guarantee uninterrupted water supply to CIPS. The Bita and the Utinga Reservoirs form a water supply system that supplies an annual average of 49.6 x 106 m^3 of water. The capacities of the Bita and Utinga maximum reservoirs are 2,710,000 m^3 and 10,270,000 m^3 of water, respectively, which is usually reached during the rainy season. From the reservoirs, the water is piped to a water treatment plant at the CIPS for local distribution. Water quality data are not available for the reservoirs.

4.17 The groundwater aquifers within the area of interest of the Termopernambuco Project are classified as fissure, interstitial, and alluvial. The fissure aquifer is located in the area of Cabo de Santo Agostinho. The average depth of wells in this aquifer is approximately 39 meters, with average flow capacity of 3.70 m^3/hour. The principal interstitial aquifer in the area of influence of the Project is found within the Cabo Formation. The average depth of wells in this aquifer is 110 meters, with yield capacity varying from 7.0 to 50 m^3/hour. In the port area, water extraction rates of 7 to 50 m^3/hour were obtained at depth of 110 meters. Maximum extraction allowed by the State Water Resources Department is 100 m^3/day.

4.18 Geology and Geomorphology. The Project site is located at the southern section of the State of Pernambuco coastal plain. This coastal area is characterized by two main features: the Precambrian crystalline basement and a mid-Cenozoic sequence of sediments. The area of CIPS is located within a Cretaceous volcanic-sedimentary sequence. This entire sequence of volcanic-sedimentary groups is known as the Cabo Sedimentary Basin. The Cabo Basin consists of conglomerates of arkose sandstones interbedded with thinly stratified micaceous siltstones. Potentially, the Cabo Basin constitutes a confined aquifer, which supplies water to the southern region of Recife metropolitan area. Currently, the coastal area of Brazil is neither volcanically nor seismically active.

4.19 At the CIPS site, extensive dredging and filling activities have occurred that have greatly altered the local surface geomorphology. During initial construction of the port, the natural channel of the Ipojuca estuary was diverged when the area was filled with dredged material to create the port. During this project, a portion of the natural rock reef barrier was cut in some areas to allow the estuary to flow to the ocean and closed in other areas where the port needed to fill to create more land. As a result, the implementation of the port changed the natural dynamics of the estuary and reshaped the local coastal landscape.

4.20 Along the coast, a natural rock reef barrier parallels the coast. This rock reef barrier is fundamental to the local coastal morphology and controls erosion processes. The reef, which is composed of rock and not coral, dissipates and controls wave energy into the estuary and is responsible for shaping the transition to the continent, thereby maintaining its equilibrium. The Project site has historically been part of the Ipojuca estuary and is located immediately adjacent and landward of the rock reef.

4.21 Soil and Subsoil. The Termopernambuco Project will be located within a general area with a wide variety of soils. A geotechnical investigation was conducted in 1996 in an area located west of the Termopernambuco site. This investigation encountered two main types of soils. Type 1 soils are inorganic clays with low-to-moderate plasticity, which may consist of sandy clays, silty clays, and clays. Type 2 soils are inorganic silts and fine sands, which consist of sandy silts or clayey silts with very low plasticity. Theses soils are representatives of the residual soils found in hills within CIPS.

4.22 The project, however, will be built on a reclaimed area that will be filled with sand dredged from the adjacent Ipojuca River and estuary. Studies are currently under way to characterize the chemical composition of the sediment (potential for petroleum and other chemical contaminants) as well as grain-size analysis. Preliminary results indicate that the sands from the proposed dredging areas are of good quality, and consist of medium- to coarse-grained quartz sands.

4.23 Flora and Fauna. No protected vegetation or wildlife exist on the Project site and in the immediate vicinity. Similarly, no known protected vegetation or wildlife occurs along the power lines routing. The transmission line will cross a small area that currently supports mangrove trees. This area has been previously approved for clearing as part of the port expansion and reclamation project to be conducted by Suape. Mangrove swamps remain in the Ipojuca estuary and in the estuaries of the Tatuoca and Massangana rivers that flow into the internal port of Suape. Farther inland, coconut, sugarcane, and tropical fruit trees are present as remnants from the plantations that once existed prior to the acquisition of the area for the development of the industrial port complex. Reptiles, rodents, and birds are common there. In the CIPS itself, several areas have been zoned for Atlantic rain forest and mangrove preservation. In these areas, the vegetation and fauna diversity is significant and will not be impacted by the power plant or associated transmission line.

4.24 Cultural Resources. The only area designated as the Zone of Cultural Preservation (ZPC) within CIPS is located approximately 6 km north of the proposed site, in the area of the Farol Igreja de Nazaré and Parque Metropolitano Armando Holanda Cavalcanti. Based on the results of the 2000 cultural resources study, there are no cultural resources at the power plant site nor along the proposed alignment of the transmission line.

B. Socioeconomic Conditions

4.25 Demography. The metropolitan area of Recife has a population of approximately 3 million. The total population of Cabo de Santo Agostinho is approximately 140,000, and Ipojuca has 50,000 inhabitants. Both Cabo de Santo Agostinho and Ipojuca have undergone significant urbanization since the 1960s. Urban populations grew from 16,000 to 125,000 in Cabo de Santo Agostinho and from 7,500 to 30,500 in Ipojuca between 1960 and 1996. The rural population, meanwhile, declined significantly, during the same period. Today, 82 percent of the population lives in the urban areas of these municipalities.

4.26 Before the implementation of the CIPS, sugarcane production was the prevalent activity in the area. In the 1970s, 1,073 peasants continued to live in the CIPS area after its acquisition by the State of Pernambuco for the development of the industrial port complex. Agrarian reform, furtive land occupation and population growth since then are responsible for a resident population of 8,800 in the areas within the CIPS that have not been occupied by the port and industries. All land within the CIPS is owned by the state; no private land ownership by the current residents is allowed. There are no residents on or adjacent to the power plant site. Six families, however, will be relocated to allow for construction of the transmission line.

4.27 Land Use Economic Activities. Suape itself consists of the CIPS, residential areas, other industrial zones, agricultural areas, and areas of ecological and historical preservation. The CIPS has a total area of 13,600 hectares with 46 active industries. Agriculture is still the primary occupation for those who occupy CIPS lands. The main crops are sugarcane, vegetables, and root crops. Occupations also include animal farming and the fisheries business. Families generally live in isolated homes or in small clusters, at a subsistence level, without treated water or sewage. Electricity is often obtained from illegal connections made to existing power lines. Residences typically consist of one-room houses constructed of clay, straw, leftover plastic or wood, and hold up to 15 people. While there has been steady growth in the CIPS, the area is still very much in the developmental process. Growth projects for the industrial port zone call for significant increases in shipping, port activities and industrial projects.

4.28 Outside the CIPS, the population in the urban areas of Ipojuca and Cabo de Santo Agostinho typically works for local industries and commerce. The coastal areas of these municipalities have been developed into condominiums and beach homes for urban dwellers, usually from Recife, and into hotels and resorts. Many of those who once worked in sugarcane fields and in fisheries have been absorbed by the service sector of the new economy.

4.29 CIPS Infrastructure and Access Roads. The CIPS is well served by roads and railroads. The federal coastal highway BR-101 connects the capital city of Recife with the district of Cabo de Santo Agostinho, and from there, state road PE-60 leads to the CIPS. Internally, several well-paved roads will reach several zones of the CIPS, including the industrial port. Energy is provided by CELPE, the Electricity Company of Pernambuco. Gas is supplied by the 204-km Pilar-Cabo main pipeline. Fresh water is obtained from the Bita and Utinga Reservoirs located within the CIPS area. After being treated by COMPESA, the water is supplied to industrial users. Sewage is treated in septic tanks by the industries according to CPRH guidelines and monitoring. Currently, there is no solid waste disposal facility in Suape, but a industrial/municipal landfill has been projected and is undergoing environmental licensing. This plant was projected to receive solid industrial and residential wastes from Ipojuca, Cabo de Santo Agostinho, Recife, and the CIPS.

4.30 Tourism. has become a significant economic factor in the general area outside of the CIPS. There are numerous beach resorts located in the municipality of Ipojuca and other communities along the coastal area of Pernambuco. The majority of tourist activity in these areas is associated with coastal recreation including boating and other beach activities.

V. ENVIRONMENTAL AND SOCIAL IMPACTS

A. Construction Phase

Environmental Impacts

5.1 Marine Environment. Impacts to biota associated with construction of the power plant facility will be limited to aquatic communities in the Ipojuca estuary and the open ocean in the general area of the intake and discharge structures. Impacts on the biota and quality and the Ipojuca estuary will be primarily associated with the dredging and filling of the Project site, and construction of the cooling water intake, and discharge pipes.

5.2 Dredging activities in the Ipojuca estuary will result in the loss of some aquatic organisms. It is likely that the loss of these organisms will not result in a significant long-term impact to the estuary due to recruitment of organisms from nonimpacted areas. The time required for recovery of the biotic communities in the estuary is not known, but is expected to be on the order of approximately 1 year or less. Filling of the Project site will result in the permanent loss of up to about 12 hectares of sand bottom and tidal aquatic habitat. This habitat is not unique and has been previously approved for filling by the Government of Brazil.

5.3 Prior to dredging, a survey was conducted and 38 sediment cores were obtained for the area. Spot sites with large argil/silt concentration will be avoided. Considering that the material present in the area target to be dredged and to be used for site filling is constituted by sand (mean D60 = 0,4mm) it is not anticipated the formation on extensive or high fine concentrations plumes. No damage to mangroves or other vegetation is expected since they are not present close to the dredging/filling areas.

5.4 The construction of the cooling water intake and discharge structures is planned to cross beneath the natural rock reef and the ocean floor by way of directional drilling. Construction of the intake and discharge structures in the Atlantic Ocean will impact the biotic communities in the immediate areas of the construction activities. Because of the use of horizontal drilling, these impacts will likely be minimal and of relatively short duration and limited primarily to the immediate construction area. It is likely that much of the bottom is sandy with the possibility of some hard bottom communities.

5.5 Estuarine and Coastal Hydrology and Quality. In addition to the direct loss of organisms through dredging, increased turbidity, and the possible resuspension of heavy metals and other contaminants into the water column will result in an adverse impact to the estuary. This impact will likely be minor and of short duration, primarily during the active dredging process (4 to 6 months). The Bank has requested a comprehensive analysis of the sediments in the estuary to assess the likelihood of contamination in the estuary and design adequate mitigation measures if warranted. ,A previous study conducted for Suape identified elevated levels of some heavy metals in sediments and organisms from the Ipojuca estuary. The placement of potentially

contaminated fill on the Project site as well as the resuspension of potentially contaminated sediments into the marine environment could pose a significant impact.

5.6 Dredging activities will result in a channel ranging up to 6 meters in depth. However, since the natural hydrology of the area has been significantly altered with implementation of the port itself, the overall effects of the dredging on the current estuary system are anticipated to be relatively minor and of short duration.

5.7 Flora. The transmission line will cross areas of natural vegetation, disturbed areas, and areas of agricultural use. The transmission line will cross a small area of approximately 400 meters that currently supports mangrove trees. This area has been previously approved for clearing as part of the port expansion and reclamation Project to be conducted by Suape. The transmission line will cross other areas of native vegetation as well as sugarcane fields. Impacts to vegetation associated with the transmission line will be limited to the right-of-way that will be between 20 to 30 meters wide and will continue for the duration of the operation of the line. Some low growing vegetation will be allowed within the transmission line right-of-way. Impacts to natural vegetation will be very limited in extent and, therefore, minor but of long duration, impacts to disturbed areas and areas of agriculture will be limited to the width if the ROW and will therefore be minor and of long duration. No known protected vegetation occurs along the power lines route.

5.8 Terrestrial Fauna. No protected wildlife exist on the Project site or in the immediate vicinity. Similarly, no known protected wildlife occurs along the transmission line ROW.

5.9 Fresh and Ground Water. Impacts to fresh water hydrology and quality associated with construction of the transmission line will be minimal and of short duration. Potential impacts to these resources relating to possible erosion and sedimentation during construction will be limited to the areas of the structures, which are typically small and are sited outside of any surface waters. In fact, the alignment for the transmission line was revised specifically to minimize disturbances to surface waters and native vegetation.

5.10 Other potential hydrologic impacts include increased site surface water runoff resulting from paving and compaction of the site's impervious surfaces. If not adequately managed, construction activities such as dredging, site grading, and excavation could generate sedimentation and temporarily affect the estuary of the Ipojuca River. Oil and lubricants spills, as well as inadequate waste disposal could also affect the estuary of the Ipojuca River.

5.11 Geology and Geomorphology. Construction of the proposed power plant will alter the geomorphology of the Project site through the filling of this area. The final elevation of the Project site will be 4.25 meters above sea level and will be consistent with the immediate surrounding area. The filling of the Project area will be compatible with other previous development activities at the CIPS and will not significantly impact the geology or geomorphology of the surrounding area.

5.12 The height of the natural rock reef will be elevated by approximately three to four meters through the placement of additional rock to provide additional protection and support for the Project fill. This activity is not considered to be a significant impact to the local geomorphology. Construction of the cooling water intake and discharge structures beneath the natural rock root will minimize impacts.

5.13 Soils and Subsoil. The power plant facility will be built on reclaimed area that will be filled with sand dredged from the adjacent Ipojuca estuary. Studies are currently under way to characterize the chemical composition of the sediment (potential for petroleum and other chemical

contaminants) as well as grain-size analysis. Preliminary results indicate that the sands from the proposed dredging areas are of good quality consisting of medium- to coarse-grained quartz sands. In the event the sediment in the estuary is found to contain high levels of contaminants, the filling of the Project site with those sediments will have the potential to adversely impact soils on the Project site. The significance of this potential impact will be dependent upon the concentrations found in the sediments. As part of the due diligence evaluation, the IADB has requested that a field investigation be conducted at the area to be dredged to define adequate mitigation measures in the event of contamination in sediments. Sediment sampling, both at the proposed site and the area to be dredged, water quality and biotic community in the estuarine area are under development and results are forthcoming at this time.

5.14 Baseline site conditions will be obtained prior beginning of dredging activities and includes:

- Collection of sediment samples (top 30 cm) at sites A-H for analysis of the following elements: (a) Priority pollutant metals (As, Cd, Cr, Cu, Pb, Hg, Ni, Ag and Zn); (b) Total and free Cyanide; (c) IRPH; (d) SVOCs including phenols and PAHs; (e) VOCs including BIEX; (f) Pesticides; (g) Herbicides; (h) PCBs and (i) HC. Samples analysis are being conducted by the CEIMIC Analises Ambientais LIDA at São Paulo, Brazil that uses EPA analyses methodologies.

- Collection of water samples during low and high water at sites EFG and H at míd depth for analysis of the following elements: (a) DO; (b) BOD5; (c) pH; (d) Alkalinity; (e) Total hardness; (f) TSS; (g) Nutrients (N, P and TOC); (h) HC; (1) Total dissolved metals (As, Cd, Cr, Ou, Pb, Hg, Ni, Ag and Zn); (j) Total and free Cyanide; (k) TRPH; (d) SVOCs including phenols and PAHs; (l) VOCs including BTEX; (m) Pesticides; (n) Herbicides; (o) PCBs and (p) HC. Samples analysis are being conducted by the CPRH, the Pernambuco State Environmental Company, and by the CEIMIC Analises Ambientais LIDA at São Paulo, Brazil that uses EPA analyses methodologies.

- A survey in the filling area (A-C) and dredging (D-H) sites in order to obtain information on the conditions and stocks of fishes, crustaceous and mollusks. Information includes: (a) An inventory of the eatable specie and their participation in the subsistence fisheries; (b) biometric characteristics (total length, total weight and tissue weight); (c) organisms density (ind/m2); (d) proportion of specimens with commercial length; (e) commercial quality (%tissue/total weight); (f) Adequacy to human consumption (concentration of heavy metal and fecal coliforms) and (g) Estimation of the population size and production.

5.15 Air Quality. Air quality impacts associated with construction activities will result from fugitive emissions associated with site grading, exhaust emissions, stockpiling, and spillage from vehicles. Air quality impacts associated with construction of the transmission line will be minimal and will be limited in aerial extent and in time. The presence of the coastal winds and absence of receptors will effectively minimize the short-term air quality impacts associated with construction activities. These impacts will be relatively minor and confined primarily to daylight hours. Fugitive emissions, i.e., particulate matter released into the atmosphere through non-combustion sources at the facility will be the major air quality impact during construction. These emissions do not emanate continuously from clearly defined point sources, but are usually short-term and sporadic depending upon construction activities and meteorological conditions. Specifically, dust and other particulates from truck movement, wind erosion of soil surfaces, construction activities, and the movement of waste during plant operations are all possible fugitive emission sources.

5.16 Cultural Resources. Based on the results of the 2000 cultural resources study, there are no cultural resources at the power plant site nor along the proposed alignment of the transmission line; therefore, impacts during construction are not anticipated.

5.17 Noise. The power plant site is bordered to the north and west by industrial facilities, to the east by the Atlantic Ocean, and to the south by the Ipojuca estuary. Existing noise levels at the Project site are typical of industrial areas. The closest residence is more than 4 km from the Project site. Although noise levels during construction will increase over existing ambient levels, these impacts will be minor and of relatively short duration and will not impact offsite residential areas.

5.18 Noise levels associated with construction of the transmission line will be of short duration and limited primarily to the immediate area surrounding the construction activities. Construction in any single area should not extend beyond 1 to 2 months Construction activities for the transmission line will be primarily limited to daylight hours. Noise impacts associated with construction of the transmission line may be moderate but limited to the working hours and the immediate area surrounding the work area. These impacts will be of short duration.

Social Impacts

5.19 Resettlement. Six families will be relocated to accommodate construction of the transmission line. The land on which the families currently reside is owned by Suape and the residents generally understand that they are living illegally at the Industrial Port Zone and that they may be required to relocate at some time. Because the Project site is a reclamation area, where no human settlements exist, no indemnification or resettlement will be required for the power plant.

5.20 Demography. The Project construction, involving a maximum of about 750 workers during the peak construction period, will not lead to a large mobilization of people or an increased demand on the existing infrastructure. The Project construction workforce will largely be recruited from residents in the municipal districts of Ipojuca and Cabo, which have a large supply of skilled construction labor and therefore no campsites and temporary will be necessary. The existing public transportation combined with transportation provided by the EPC contractor will facilitate the daily commute to the site. Demographic and social impacts related with large construction, such as social conflicts and increased infrastructure demand, will not occur.

5.21 Land Use. The transmission line will be located primarily within the boundaries of Suape and will cross seaport, industrial, agricultural, and commercial land uses. The transmission line will cross some areas of sugarcane cultivation and will result in the loss of active farmland. However, this impact will be restricted to the width of the ROW (20 - 30 meters) and will be minor with regard to the overall acreage of agricultural land in the general region.

5.22 The power plant site is zoned for industrial development and is designated as a reclamation area. The site is currently unused, and the proposed power plant facility will be constructed to be compatible with surrounding land uses, including port facilities and bulk petroleum storage terminals.

5.23 Aesthetics. The Termopernambuco Power Plant will be built in an area that has been significantly altered by other industrial and port facilities including the Port of Suape, oil storage facilities, oil and gas pipelines, and large bulk and container ships. The power plant will generally be compatible with existing visual resources at the port. However, because of their height, i.e. 43.2 meters above ground level, the two stacks will be higher than most other facilities at the port and will be visible for some distance in all directions, especially from the coastal area south of the Ipojuca estuary. While this area is not currently developed for tourism, it is possible that future

development of this nature may take place. Impacts to the existing aesthetics and landscape of the area surrounding the port will be restricted primarily to the stacks, which will be most visible from the area immediately south of the Project site. Overall visual impacts are therefore expected to be minor but of long duration.

5.24 The transmission line will be located within the area of Suape with the exception of a short distance where the line will cross private property. Currently, a number of transmission and distribution lines exist within Suape. This general area has been designated in part for the development of industrial and port facilities. Although the transmission line will be visible, it will not have a significant impact on the overall visual resources of the area.

5.25 Infrastructure and Roads. The Project is located in an industrial area where the access and internal roads are already designed for heavy traffic. Much of the necessary infrastructure for construction of the power plant and transmission lines, including port facilities, highways, and rail roads are in place. Access and transportation services for construction workers are available. Construction of the Project will have a minimal adverse impact on the existing infrastructure and will be of relatively short duration.

5.26 There is currently no solid waste disposal facility in Suape; however, an industrial/municipal landfill has been projected and is undergoing environmental licensing. This facility is projected to receive solid industrial and residential wastes from Ipojuca, Cabo de Santo Agostinho, Recife, and the CIPS.

Health and Safety

5.27 Occupational hazards expected during the construction phase of the Project are typical of medium-scale construction work. Health and safety concerns during construction include transportation of equipment and materials to and within the site; handling and storage of materials onsite; use of cranes and other heavy equipment; work on scaffolding, platforms, and other work at heights; welding; excavations and trenching; confined work space; electrical and other energized work; hydraulic work; fire, explosion, spill, and other emergencies; and hygiene and general sanitary conditions. Health and safety impacts are anticipated to be relatively minor and of short duration

B. Operation Phase

Environmental

5.28 Air Quality. The operation of the Project power plant using natural gas will result in gas emissions including primarily nitrogen oxides (NO_X) and to a lesser extent sulfur dioxide (SO_2), particulate matter (PM), and carbon monoxide (CO). Air emissions from the Project will comply with the applicable Brazilian standards and the IDB requirements for the Project. Sulfur dioxide and particulate matter will be controlled through the use of natural gas as the only fuel source. Natural gas is naturally very low in sulfur while the combustion of natural gas, which consists primarily of methane, results in low emissions of particulate matter.

5.29 Air quality impacts from the proposed Termopernambuco plant were assessed with the USEPA SCREEN3 model (version 96043). SCREEN3 is the U.S. Environmental Protection Agency's (USEPA) most versatile screening model. SCREEN3 uses pre-set meteorological data to determine the worst-case concentrations that might result from a given emissions source. This single-source model accommodates flat as well as elevated terrain. The source modeled with

SCREEN3 may be a point, flare, area, or volume source. Emissions were modeled from the two proposed combustion turbines as a single composite source. Table 5-1 presents the source parameters used to model the composite source. A distance of 50 meters from the composite stack was used to establish the starting point for a simple terrain receptor grid for SCREEN3. The automated distance array option was used to complete the simple terrain grid to a distance of 5,000 meters. Building downwash was accounted for by using the expected height of the HRSG structure (25 meters) as the height of the dominant building downwash structure. Typical values for the length and width of a HRSG structure (15 meters by 20 meters) were used as the minimum and maximum horizontal building dimensions. Impacts from distant high-terrain points were also assessed with SCREEN3, but were found to be of a much lower magnitude than impacts due to nearby simple terrain.

5.30 Modeling results were compared to air quality standards established by Brazil and the World Bank. The SCREEN3 model was used to predict the maximum 1-hour impact from the facility, and then applied appropriate scaling factors for longer averaging periods. The highest impacts predicted occurred near the facility at a distance of 75 meters from the composite source at a simple terrain receptor that was influenced by building downwash effects.

5.31 The results of the modeling are summarized in table 5-2. NO_x emission will exceed both the Brazilian 1-hour NO_2 standard and the World Bank 24-hour NO_2 standard if the 48 ppm manufacturer's performance guarantee is used as an input to SCREEN3 model. The 48 ppm guaranteed emission is a very unlikely scenario for this type of equipment. The manufacturer's performance guarantee for NO_x emissions (48 ppm) is higher than usually achieved for the type of combustion turbines proposed for the project. Average performance guarantees for NO_x emissions range in the order of 25 to 9 ppm. The predicted exceedances could be reduced to levels below the standards if a lower NO_x emissions guarantee for the turbines could be obtained from the EPC. Specifically, a NO_x emission rate of 27 ppmvd at 15 percent O_2 for each of the two proposed units would allow for acceptable air quality impacts. Otherwise, if the NO_x emission rate remains at 48 ppmvd at 15 percent O_2 for each machine, an increase in stack height from 43.2 meters to 48.8 meters would allow for acceptable impacts.

5.32 Marine environment. Potential impacts to aquatic organisms during operation of the Project are primarily associated with the intake and discharge of the cooling water. Water from the cooling water system will be withdrawn and returned to the ocean at the same rate of 10 m^3/second. The cooling water intake system will impact aquatic organisms including plankton, macroinvertebrates, and fish through impingement and entrainment. Small organisms that can pass through the intake screens will be entrained into the cooling water system, many of which will be killed or injured by mechanical and thermal stress. Larger organisms such as fish can be impinged or trapped on the intake screens, many of which will likely die.

5.33 The other major potential impact to aquatic organisms is from the discharge of the thermal effluent from the cooling system. At the point of discharge, the thermal effluent will be approximately 8°C above ambient temperature, which ranges from 28.9°C to 28.7°C through the water column. Temperatures will decrease with distance from the point of discharge. Some aquatic organisms within the mixing zone will likely be stressed by these temperatures and will typically avoid the immediate area. The overall impact of the thermal discharge will depend upon the extent of the mixing zone. There may be some loss of biotic activity within the mixing zone, and those organisms that are not very mobile, such as some benthic invertebrates, may die. The overall impact of the thermal discharge on aquatic organisms will be limited to the area of the mixing zone, within which a number of thermally sensitive species will be excluded. With the

exception of additional thermal load and slightly higher chlorine concentrations, the cooling water discharge should be essentially unchanged in quality from the intake water.

5.34 The results of thermal plume modeling were based on a preliminary discharge design which consisted of a single 3-meter-wide pipe with no diffuser. As per the IDB request, the discharge structure has been re-design and now includes the use of two smaller-diameter pipes of at least 1000 meters with diffusers along the last 100 meters. While updated thermal plume dispersion modeling results have not been provided to date, it is anticipated that the refined discharge structure design will increase mixing and decrease the overall thermal mixing zone and associated impacts on aquatic organisms. The use of the diffuser will allow compliance with the World Bank effluent guidelines for thermal power plants included in the Pollution Prevention and Abatement Handbook. The World Bank Guidelines establishes a maximum temperature increase of no more than 3°C at the edge of the zone where initial mixing and dilution takes place (defined as 100 meters from the point of discharge). Additional scenarios with the use of the proposed diffusers have been recently conducted. Model runs have been performed to identify the dispersion and boundaries of the 29°C plume (3°C above ambient temperature). The 3°C increase isopleths exceed the 100m boundary for 500m during winter conditions. Results of the revised water dispersion modeling for winter and summer conditions will be reviewed to assess impacts once the final design of the discharge structure is available.

5.35 Estuarine and Coastal Hydrology and Quality. Potential impacts to estuarine and coastal hydrology and quality are associated with the various discharges to the Atlantic Ocean from the plant, and potential spills and other releases of oils, chemicals, and discharge storm water runoff to the Ipojuca estuary.

5.36 Potential impacts to water quality in the Ipojuca estuary during operation of the power plant include spills and releases of oils and chemicals and the discharge of contaminated storm water runoff. Since the power plant will be fired with natural gas only, onsite oils and lubricants will be limited in quantities and should be maintained in areas with secondary containment.

5.37 Fresh Water Hydrology and Quality. Operation of the power plant and transmission line will not directly impact any fresh surface water resources since there are no fresh water bodies. Fresh water for steam cycle makeup and other uses, including fire suppression water and washdown water, will be obtained from the existing Bita and Utinga Reservoirs within the bounds of Suape. The use of this water has been approved by CPRH and will have no adverse impact on fresh water hydrology or quality.

5.38 Terrestrial Flora and Fauna. Nearly all of the Termopernambuco Project site is currently under water and located within an industrial zone The power plant site is covered by either beach sand or seawater, and contains no terrestrial flora or fauna. Therefore, there will be no adverse impacts on the local terrestrial flora and fauna associated with the operation of the power plant. Operation of the transmission line will require the maintenance of low-growing vegetation within the ROW. All large vegetation will be cleared during construction of the transmission line. Overall impacts to terrestrial flora and fauna resulting from the operation of the transmission line will be minimal and of long duration.

5.39 Cultural Resources. Operation of the power plant and transmission line will not adversely impact cultural resources.

5.40 Noise. Based on attenuation of sound over distance and the design of the facility, the EIA states that the noise levels from the power plant will meet the appropriate Brazilian daytime 70 dB(A) and nightime levels of 60 dB(A) at the plant boundary for predominantly industrial area.

5.41 Solid wastes. Natural gas-fired thermoelectric power plants generate only small amounts of solid wastes, mainly office and organic wastes, and sludge from the wastewater treatment plant. Approximately 1 kg/person/day (approximately 50 employees) originate from administrative activities and 50 kg/day of industrial wastes from the routine plant operation and maintenance (oils, lubricants, and several materials contaminated with chemical products), which will be disposed of according to the requirements of Brazilian environmental legislation. CIPS currently has no licensed landfill to dispose of industrial or domestic wastes. Some facilities located in the port practice improper disposal of solid waste within Suape. This improper practice of waste disposal may impact the scenery, soil, surface water, groundwater, and air quality.

B. Social

5.42 Land Use. Operation of the Project will not adversely impact land use. The power plant site is zoned for industrial development. The transmission line will be located primarily within the boundaries of Suape and will not adversely impact land use during facility operation. The ROW for the transmission line will be purchased or an easement obtained. Land uses such as dwellings, commercial, and some agricultural activities will not be permitted with the ROW.

5.43 Aesthetics. Operation of the Termopernambuco power plant will not adversely impact the aesthetics of the adjoining landscape. The Project will operate in an area that has been significantly altered by other industrial and port facilities including the Port of Suape, oil storage facilities, oil and gas pipelines, and large bulk and container ships. The power plant will be compatible with existing visual resources, and no significant impacts to the current aesthetics and landscape are anticipated.

Health and Safety

5.44 The nature of health and safety concerns in the operation phase include indoor occupational hazards, such as appropriate lighting and ventilation, noise levels, and fire prevention, among others. The proposed technology (i.e., natural gas-fired combustion turbines) has a good safety record. Operation of the pipeline will be the responsibility of COPERGAS. The transmission line will be designed and operated to maintain a safe distance (25 feet or more) between the conductors and people. Health and safety impacts will be minimal.

C. Positive Impacts/Benefits

5.45 The proposed Project will improve the quality of life and economic viability of the area by providing a reliable source of electric energy. This will be compatible with the mission of Suape and will foster economic development of the surrounding areas and economic opportunities of the general public. This facility will supply 60 percent of the Pernambuco Power Company – CELPE's market share, enough energy to meet current and future demand in the State of Pernambuco, with a possible surplus of energy available for export to other states in the northeastern region of Brazil. This power supply is especially important to the economy of the entire state of Pernambuco in view of the significant electric power shortages currently being experienced in many regions of Brazil.

5.46 Significant positive impacts will result from the employment opportunities created during construction of the proposed project. Additional economic benefits will be provided to the local economy of the area through the purchase of goods and services. At the local scale, the Project is expected to provide an average of 500 jobs during the construction phase, reaching a peak of 750 jobs, for a period of approximately 2 years, thereby generating income for numerous families and boosting the local economy (local commerce and other economic activities). At the regional level, the Project will have a positive impact on the economy through the creation of indirect jobs and demand for services and equipment that might be provided by local or regional suppliers, as well as generating increased tax revenues.

VI. ENVIRONMENTAL, SOCIAL, AND HEALTH AND SAFETY MITIGATION AND MONITORING MEASURES

6.1 The original Project was altered in location and technology to mitigate the negative effects on estuarine and coastal flora and fauna. The prevention and mitigation measures established for each of the identified environmental impacts will be consolidated in an Environmental and Social Management Plan (ESMP) for both the construction and the operation phases. Trained personnel will be responsible for verifying and supervising compliance with the preventive and mitigation measures established for each stage of the project.

A. Environmental and Social Mitigation Measures

Construction Phase

6.2 Marine Environment and Estuarine and Coastal Hydrology and Quality. The selection of the cutter section dredging technology will generate minimal impacts due to turbidity. Appropriate mitigation measures, including a temporary halt to dredging activities, will be implemented if the results of the monitoring indicate exceedance of turbidity standards.

6.3 Weekly monitoring will include measurements of vertical profiles of OBS (Optical backscatterance) signals with a Sea-Bird SBEI9 CTD with a OBS-3 A & D Instrument sensor along radials centered in the dredge/limits of the filling areas and else where a plume can visually be identified, in order to attain instantaneous and detailed information on the extension and concentration of suspended particles within this plume. Simultaneously to those measurements, water samples will also be conducted at various occasions for measurements of the TSS concentration and concentrations of silt. This will permit the construction of a correlation curve among the 3 parameters and that will be used for comparison purposes. Water samples will also be collected at selected sites (higher concentration of suspended particles) for heavy metals concentrations analysis, in order to monitor transfer of those contaminants to the water column. An alert limit has been established based on a persistent concentration of silt particles above 0,25 mg/l in points more than 100 m away from the point of dredging/plume formation. This value was based on the fact that concentrations of silt greater than 0,25 mg/l are lethal to eggs and larvae of some aquatic organisms; that dredging efforts will take place from oct/2001 to jan/2002 and that the peak of oysters offspring here in the State of Pernambuco occurs in October. These controls aim to protect the oysters stock renew in the area.

6.4 In the eventuality of that limit being reached, dredging responsible will be immediately notified and measures taken in order to reduce silt concentrations in the water column. This will be

attained by a combination of reducing/stopping dredging activities for a period and/or moving the dredges to a different site, and monitoring intensified (daily basis), until acceptable conditions is reestablished.

6.5 The installation of the water intake and discharge pipelines using horizontal drilling as proposed by Termoparnambuco Project will help mitigate impacts to water quality during construction of these facilities. Furthermore, installation of the intake and discharge pipes under the natural rock reef will prevent impacts to the reef structure. The water intake will be done with several horizontal drilling-pipe beneath the seabed. During the installation the main work will be done on the seashore. Divers will do the connection between the pipes flanges and the metallic flanges of the filters. Discharge pipes will be settled down onto the seabed using divers to place it in their right positions. Before starting this work the Consortium will analyze the required area to evaluate the impact of these pipes on the fauna and the flora. This work will be done within the scope of the biotic characterization.

6.6 During construction of the facility, control measures such as grading, soil compaction, and siltation fences should be employed to prevent excessive runoff from entering the adjacent surface waters including the estuary and ocean.

6.7 Soils and Subsoil. The Project proposes to implement a surface water management system to control surface runoff and soil erosion.

6.8 Air Quality. During construction, the EPC contractor will apply conventional mitigation measures such as watering areas to be excavated or filled and access roads; trucks will be covered to prevent the dispersion of the material; excavation materials will be reused as much as possible in filling and grading activities; all stockpiled excavation material will be adequately disposed of to avoid dispersion by wind or rain; and vehicles used to transport material and equipment, as well as the equipment with internal combustion motors, will comply with Brazilian standards to control the amount of air emissions generated.

6.9 Terrestrial Flora. The current transmission line alignment was revised from an earlier alignment to minimize impacts to mangrove areas and residences. The original transmission line alignment has been altered to avoid mangroves as well as other types of forests, residential areas, industrial uses, and other infrastructure within the CIPS. The distances between the transmission line towers will be designed to provide the maximum spacing possible to minimize impacts to the impacted areas.

6.10 Cultural Resources. If cultural artifacts are found, appropriate actions to preserve the findings will be undertaken.

6.11 Noise. The following measures will be instituted: vehicles will operate with exhaust systems and at low speeds while driving on access roads or on the site; and all vehicles, including motorcycles and motorized tricycles, will meet Brazilian regulations regarding maximum permissible noise emission limits. Workers will be provided with adequate equipment for hearing protection, where necessary. If plant personnel are required to work near the heavy equipment, they should wear proper hearing protection devices.

6.12 Solid Waste. Collection, classification, packing, labeling, and temporary storage and disposal programs will be implemented to avoid the physical-chemical contamination of the soil and water resources by wastes generated during construction. Domestic wastes will be sent to the municipal landfills for final disposal. To avoid soil and water pollution, the areas where the fuels and

lubricating oils are stored will be designed with secondary containment; chemical containers and other hazardous wastes will be treated according to Brazilian regulations.

6.13 Social. Given the number of construction workers required and the existing availability of manpower in neighboring towns, the Project will not provide onsite housing during construction. Workers will be transported daily to and from the work site. The Project ESMP will include requirements to give preference to the local workforce from neighboring communities, and to provide transportation for workers. Special care will be given to phasing out construction employment progressively so that the local economy can absorb the reduction of the workforce from the average 500 employees during construction to 50 during operation, many of whom will be highly specialized.

6.14 Resettlement. Prior to the construction of the transmission line, approximately six families will need to be resettled. Some of these families have resided within CIPS for decades. Suape maintains records of the families, and they will be contacted to inform them of the upcoming Project and the need for relocations. Most residents work in sugarcane plantations or within SUAPE. Most have little formal education and limited work skills. CIPS standard procedure for relocation involves assessing the value of improvement made on the property (size of house, pasture, flour house, wells, etc.) and natural resources (fruit trees). Families are compensated according to an established formula and evaluation of the families assets, and asked to leave the land. The relocation process provides money to the families, but does not provide land or home ownership. Most will move to nearby towns. The Project company is presently working with CIPS to ensure that the resettlement activities will comply with the IADB policy OP-710.

Operational Phase

6.15 Air Quality. The most significant single air quality mitigation is the selected technology and fuel. Natural gas is the cleanest fossil fuel source, and power plants using combustion turbine technology in combined-cycle configuration have significantly increased efficiencies over more conventional technologies. The increased efficiency translates to a reduction in the pounds of air pollutants emitted per megawatt of electricity produced. The Project use of natural gas with extremely low sulfur content guarantees low emissions of SO_2 and particulate matter. The use of natural gas as the only fuel source (as opposed to using fuel oil as backup) is an effective mitigation in reducing overall air emissions. Design and operation of the combustion turbines will be optimized to ensure the lowest possible emissions and the highest efficiency available with the proposed generating technology. The combustion turbines will have low NO_x burners for the control of nitrogen oxides. The mixture of air and fuel will be optimized to control the formation of both NO_x and CO.

6.16 The manufacturer's performance guarantee for NO_x emissions (48 ppm) is higher than usually achieved for the type of combustion turbines proposed for the project. Although the 48 ppm guarantee emissions is a very unlikely scenario for this type of equipment, the Project Company negotiate lower emissions guarantee for NO_x or will raise the stack height to 48.8 meters to achieve acceptable ambient air quality.

6.17 Continuous Emissions Monitors (CEMS) will be provided to monitor emissions from the HRSG stacks. Since the facility will burn only natural gas, the CEMS to be provided will monitor NO_X, CO, and O_2. Performance monitoring for atmospheric emissions will be implemented as part of the plant commissioning process. Data from the CEMS will be recorded by an automated data acquisition system, which reports continuous emissions.

6.18 Estuarine and Coastal Hydrology and Quality. The design of the intake and discharge structures has been refined to mitigate the extent of the thermal plume potential and associated impacts to aquatic organisms. In addition, a survey is being conducted to determine the least impacting area for the final location of the intake and discharge structures. Thermal plume modeling to define the extent of the thermal plume will be conducted once the final location of the discharge structure is determined.

6.19 Filters will be installed at the intake structure to fishes avoid capturing fishes. The intake structure has been designed to minimize the velocity of the water entering the pipelines. This approach can be effective in minimizing the impingement of larger fish.

6.20 Potential impacts to estuarine and coastal hydrology and quality will be mitigated through the implementation of adequate procedures for the safe storage and handling of petroleum and hazardous materials to prevent accidental spills and releases to this resource.

6.21 Fresh Water Hydrology and Quality. Siting of the power plant and transmission lines to avoid freshwater resources will serve as effective mitigation. Since the Project is not anticipated to impact freshwater resources, no additional mitigation is required.

6.22 Soils and Subsoils. Secondary containment will be used around fuel storage tank and chemical storage areas at the power plant. The drainage system at the power plant site will be designed to connect to the CIPS drainage system and will mitigate erosion of soils. Vegetation will be maintained in the transmission line ROW to mitigate potential soil erosion.

6.23 Noise. The Project is reported in the EIA to comply with Brazilian standards and the World Bank guidelines for new thermal power plants noise at industrial areas. If monitoring indicates any violation of these limits, the Company will implement additional corrective measures. The project's ESMP will also contain specific requirements regarding compliance with the Brazilian and State of Pernambuco's limits for noise at the working environment. To be compliant with the Brazilian health and safety requirements, hearing protection will be provided in areas identified as having high noise levels.

6.24 Solid Waste. The ESMP for the operational phase will include a collection, classification, packing, labeling, temporary storage, and disposition program for all the residues generated during the operation stage. Domestic wastes generated in the plant will be collected and sent to the municipal landfill. The sludge and residual solids from the treatment facilities that are not deemed hazardous will be disposed of at a site approved by the municipal authorities. Hazardous wastes (containers used for grease, oil, solvents, additives, lubricants, and flammable substances) will be managed according to the Brazilian regulations and state and municipal authorizations.

6.25 Social. No direct negative social impacts from the operational phase of the Project are anticipated; therefore, no mitigation measures were designed. The positive social impacts of this Project can be maximized if local and state governments invest in infrastructure (roads, sewage, water supply, communications, health, and education) improvements in adjacent municipalities (Ipojuca and Cabo de Santo Agostinho) to better accommodate the new urban and industrial growth demands that will result from the additional availability of power supply.

B. Environmental and Social Monitoring Programs

Construction

6.26 Marine Environment. Additional environmental studies and monitoring programs for the proposed cooling water discharge location are under development. These efforts include a baseline environmental study at the thermal discharge location prior to commencement of plant operations. An environmental baseline study will be conducted 13 months before plant start-up operations and will include the collection of the following:

- Physico-chemical parameters: bathymetry, current velocity and direction, D.O., temperature, salinity, pH, turbidity, and type of substrate (grain size, organic matter content, and area covered by the different types of benthic communities).
- Biological aspects, which will include phytoplankton, zooplankton, especially the meroplankton, nectonic and benthic macroinvertebrates, and fish. The results of the studies will provide the species present and their corresponding abundance, diversity, condition and stomach content.
- Ecotoxicological aspects: contamination by toxic substances (especially heavy metals and hydrocarbons). This will be accomplished by determination of heavy metals and hydrocarbons in the sediment, toxicity of the water and sediment and biotic contamination.
- Bioindicators in fish, which is accomplished through the study of young fish and adults. To assess stress bioindicators, the following will be observed:

6.27 During dredging at the Ipojuca estuary, turbidity will be monitored daily in the water column at selected locations in the area of the estuary and the nearby open ocean. The objective of the monitoring is to limit potential impacts associated with siltation and increased turbidity.

6.28 Air Quality. Personnel will visually observe fugitive dust during construction and, when appropriate, the construction surfaces will be wetted to control dust emissions from the site.

6.29 Social. Community relations, including the conduct of construction workers, will be monitored through routine contacts with local authorities in the adjoining communities. The status of the relocation efforts on behalf of the six families will be monitored to ensure that they are successful in securing new housing, employment, and services.

Operation

6.30 Air Quality. Continuous Emissions Monitors (CEMS) will be provided to monitor emissions from both HRSG stacks. Since the facility will burn only natural gas, the CEMS to be provided will monitor NO_x, CO, and O_2. Performance monitoring for atmospheric emissions will be implemented as part of the plant commissioning process. Data from the CEMS will be recorded by an automated data acquisition system, which reports continuous emissions. An ambient air quality monitoring station will monitor NO_x, SO_2 and PM in the Project area

6.31 Estuarine and Coastal Hydrology and Quality. Monitoring of the wastewater discharge of the Project will be conducted prior to their discharge into the ocean. It is assumed that the water at the point of discharge is classified as a Class 6 salt water body, used for navigational/commercial purposes. CONAMA Resolution No. 20 establishes a short list of water quality parameters that must be met. The water quality standards for Class 6 salt water bodies include oil and grease, turbidity, odor-producing products, dyes, coliforms, BOD5, DO, and pH.

6.32 Marine Environment. A 12-month study following the commencement of operations will be performed to assess the extent of water intake and discharge impacts. The studies will allow the evaluation of the proposed mitigation measures (lower water intake velocity and protective screens), the effect of the thermal plume on the aquatic community, the exclusion zones for the species studied in the environmental baseline study and the definition of a zone of recovery of the

species impacted by the thermal plume. The main areas for marine monitoring will include the area of influence of the intake and discharge of cooling water. The marine monitoring will be conducted through the execution of two phases. Phase I will be the quantification of aquatic organism mortality associated with the water intake structure and Phase II will be the evaluation of the impacts of the Thermal Plume on the Aquatic Communities. Within the thermal plume, the study will determine the extent and maximum duration of zones (zone of lethal impact, sub-lethal impact, fish exclusion, zone that can affect the fish's swimming velocity and zone where CONAMA standards are exceeded) that form as a result of increase in temperature and decrease in dissolved oxygen. The data collected prior to commencement and following commencement of operations will provide information and data that can be used to prepare a long-term monitoring plan to monitor the areas impacted by cooling water intake and discharge structures.

6.33 Terrestrial Fauna. The transmission line ROW will be monitored on a periodic basis to ensure that vegetation does not grow to a height that comes in contact with the conductors.

C. Health and Safety

6.34 The occupational health and safety requirements established under the Brazilian Labor Legislation require that the company (and the EPC contractor) create and operate an Internal Accident Prevention Commission (*CIPA – Comissão Interna de Prevenção de Acidentes*), implement a Workers' Health and Medical Program (*Programa de Controle Médico e Saúde Ocupacional – PCMSO),* and an Environmental Risks Prevention *Program (Programa de Prevenção de Riscos Ambientais – PPRA*). The EPC contractor will consolidate these requirements under a Health and Safety Plan for the construction phase. The EPC contractor will make an effort to ensure all workers are aware of the plan and understand the risks associated with their assigned activities and of those around them. A draft health and safety plan outline is presented in Exhibit 1.

D. Contingency Plan and Procedures

6.35 The Project company will develop a Contingency and Emergency Plan, which will be consistent with the existing Mutual Assistance Plan (PAM) of the CIPS, currently operated by PETROBRAS, and will include a Spill Prevention, Control and Counter-Measure Plan (SPCCP). The workers will be trained and informed about the content of the Contingency and Emergency Plans, since most cannot read or write.

E. Environmental, and Health and Safety Management

6.36 The Project will implement an Environmental, and Health and Safety (EHS) Management System to ensure effective implementation of the ESMP and other plans during both the construction and operation phases. During the construction phase, the implementation of the EHS system will be the responsibility of the EPC contractor. During operational phase, implementation of the EHS system will be the responsibility of the facility operator.

6.37 The EHS systems will include the following: a) the overall environmental, health and safety policies of the company; b) defined responsibilities of the Project environmental, and health and safety personnel; c) environmental, and health and safety training of all personnel; d) recordkeeping of environmental, and health and safety information; e) inspections and audits program; and f) noncompliance reporting and follow-up procedures. A cost, schedule, and responsibility document will be prepared that lists each of the monitoring and mitigation

requirements, including development and implementation of the ESMP and the HSP for both the construction and operation periods. These responsibilities will cover both the power plant and transmission line. The document should identify the specific items, the responsible party, the schedule for implementation, and the projected cost.

VII. PUBLIC CONSULTATION

7.1 The Project EIA was finalized in December 2000 and presented to CPRH for analysis. The EIA was published for public participation on December 28, 2000. In January 2001, copies of the EIA were delivered to IBAMA and to the municipal districts of Ipojuca and Cabo de Santo Agostinho.

7.2 On February 13, 2001, Termopernambuco made a formal presentation of the project and the results of the EIA to state environmental officials and CIPS representatives in Suape. Given that no public hearing was requested, CPRH issued the Preliminary License on March 19, 2001 (LP 0033/01) for the thermoelectric power plant and its corresponding gas pipeline and power lines. Subsequently, LI for the thermoelectric power plant and the LI for the transmission line were been issued.

7.3 The local press has given wide coverage to the project since CELPE's privatization, so the population at large is informed of its location and development. According to the press articles, the population in general perceives the project as relevant to the community. During the Bank's due diligence, both municipal and state authorities, including the Minister of Environment and the Minister of Tourism confirmed that the project has been disclosed extensively through various meetings throughout Eastern Pernambuco.

7.4 The proposed power plant is consistent with the general intent of the Suape Industrial Port Complex for the development of industrial facilities within the Port. Currently 46 active industries are located within the Suape Industrial Port Complex. Growth projects for the industrial port zone call for significant increases in shipping and port activities as well as growth in industrial projects such as the proposed Termopernambuco project. The Project is located in the far southeastern area of the CIPS, where there are no human settlements. The Project site is approximately 15.5 hectares within the 13,600 hectares of the CIPS area.

VIII. RECOMMENDATIONS

8.1 The Bank (IDB) proposes to require as part of the Loan Agreement that Termopernambuco (the Project Company) and all portions of the Project shall, at all times during the life of the Loan Agreement, comply with each of the following:

(a) All applicable environmental, health and safety Brazilian regulatory requirements, including all environmental, health and safety requirements of the Project contracts, and any subsequent modifications, and all requirements associated with any environmental, health and safety related permits, authorizations, or licenses that apply to the Project or the Company.

(b) All aspects and components of the various Project-related environmental, health and safety plans/documents.

(c) Applicable aspects of the World Bank Thermal Power Guidelines for New Plants (World Bank Pollution Prevention and Abatement Handbook, 1998), including air emissions, ambient air quality, ambient noise levels and waste water discharge limits.

(d) Applicable aspects of the World Bank General Environmental Guidelines (World Bank Pollution Prevention Handbook, July 1, 1998).

(e) Applicable aspects of the World Bank Monitoring Guidelines (World Bank Pollution Prevention Handbook, July 1, 1998).

(f) Applicable aspects of the International Finance Corporation General Health and Safety Guidelines (1998).

(g) Consult with IDB before approving or implementing any and all substantive changes to the Project or its timetable which could potentially have negative environmental, social, or health and safety effects.

(h) Send written notice of any and all noncompliance with any environmental requirement of the Loan Agreement and any significant environmental, social, or health and safety accident, impact, event or environmental claim.

(i) Ensure that all companies contracted for construction or operation activities comply with the applicable environmental and social requirements of the Loan Agreement.

(j) Implement ongoing information disclosure and consultation activities related to environmental, social, and health and safety aspects of the project.

(k) Implement an environmental, health and safety management system that is consistent with ISO 14001 and BS 8800 (for environment and health and safety, respectively), for the construction and the operation phases.

8.2 Prior to the date of Financial Closure, the Company must present, in form and substance acceptable to the IDB:

(a) Present a finalized approach including all necessary support information to ensure the Termopernambuco power plant will comply with all applicable Brazilian and World Bank (Guidelines for New Thermal Power Plant (Pollution Prevention and Abatement Handbook, 1998) nitrogen dioxide standards and limits, and the final framework for ambient air quality monitoring during project operation.

(b) Present the finalized design of the intake and discharge structures, including mathematical basis and methodology used in the modeling to confirm that the Project will not increase the temperature in the ocean in no more than 3°C at the boundary of the mixing zone, as defined in the Guidelines for New Thermal Power Plant (Pollution Prevention and Abatement Handbook, 1998).

(c) Present a complete assessment of the likely impacts of the dredging activities on the Ipojuca estuary and river. The assessment should include the (a) hydrologic effects on the dredging on the river and estuary, (b) the results of the characterization conducted to assess potential contamination by dredging activities, including the results of the analysis of the sediments at the proposed site, water quality at the estuary, sediments in the area to be dredged and the biotic community in the estuarine area to be dredged, and (c) proposed mitigation measures.

(d) Present a resettlement approach for the six families living within the proposed ROW in CIPS consistent with the requirements of IDB policy OP-710.

8.3 Prior to First Disbursement of the Loan, the Company shall present, in form and substance acceptable to the IDB,

(a) Environmental and Social Management Plan (ESMP) for the construction phase;

(b) Health and Safety Plan for the construction phase,

(c) Contingency Plan and Spill Prevention and CounterControl Plan for the construction phase;

8.4 Prior to the initiation of operations and Technical Completion, the Company shall submit, in form and substance acceptable to the IDB, the:

(a) Environmental and Social Management Plan for the operational phase,

(b) Health and Safety Management Plan for the operational phase,

(c) Contingency Plan and Spill Prevention and CounterControl Plan for the operational phase, and

(d) Environmental, Health and Safety Management System for the operational phase.

8.5 Prior to each disbursement, the Company must certify compliance with all environmental, social, and health and safety requirements in the Loan Agreement.

8.6 During the life of the Loan Agreement, the Company must prepare and submit an Environmental and Social Compliance Report, in form, content and frequency as agreed between the IDB and the Company.

8.7 The Bank will monitor the project's environmental, social, and health and safety aspects via internal Bank supervision actions (e.g., site visits, review of documentation, etc.) and will contract an external independent environmental consultant to assist the Bank in supervision/monitoring of the Project. In addition, the Bank will have the right, as part of the Loan Agreement, to contract for the performance of an independent environmental, health, and safety audit, if needed.

TABLE 3-1
Air emissions - Comparison of World Bank Guidelines and Termopernambuco Emissions

Pollutant	World Bank Guidelines	Termopernambuco Emissions
NO_X	125 mg/N m^3 (60.9 ppm)	48 ppm
SO_2	0.2 TPD/MW, 2000 mg/N m^3, 500 TPD	0.17 TPD
PM	50 mg/N m^3	3.86 g/sec

TPD – Tons per day
From *World Bank Pollution Prevention and Abatement Handbook*, *Thermal Power: Guidelines for New Plants*, July 1998

TABLE 3-2
Class 6 Water Quality Standards

Parameters	Standards
Floating materials	Virtually absent
Oil and grease	Virtually absent
Substances that produce turbidity and odor	Virtually absent
Artificial dying materials	Virtually absent
Objectionable deposits	Virtually absent
Coliforms	4,000 coliforms/100 ml
BOD_5	10 mg/L
PH	Between 6.5 and 8.5 with no changes >0.2 units
Dissolved oxygen	Not less than 4.0 mg/L

TABLE 3-3

Effluent Guidelines – World Bank Group Guidelines for New Thermal Power Plants

Parameter	Maximum Value[1]
PH	6 to 9
Total suspended solids	50 mg/L
Oil and grease	10 mg/L
Total residual chlorine[2]	0.2 mg/L
Chromium (total)	0.5 mg/L
Copper	0.5 mg/L
Iron	1.0 mg/L
Zinc	1.0 mg/L
Temperature increase[3]	Less than or equal to 3°C

[1] From *Pollution Prevention and Abatement Handbook*, World Bank Group, July, 1998.
[2] Chlorine shocking may be preferable in certain circumstances. This involves using high chlorine levels for a few seconds rather than a continuous low-level release. The maximum value is 2 mg/L for up to 2 hours, not to be repeated more frequently than once in 24 hours, with a 24-hour average of 0.2 mg/L. (The same limits would apply to bromine and fluorine.)
[3] The effluent should result in a temperature increase of no more than 3°C at the edge of the zone where initial mixing and dilution take place. Where the zone is not defined, use 100 meters from the point of discharge when there are no sensitive aquatic ecosystems within this distance.

TABLE 3-4

Brazilian Land-Use Noise Levels

Land Use	Noise Level dB(A) (day time)	Noise Level dB(A) (night time)
Rural areas (farms)	40	35
Area strictly urban residential or hospital or schools	50	45
Mixed zone, predominantly residential	55	50
Mixed zone, commercial and business	60	55
Mixed zone, predominantly recreational	65	55
Area predominantly industrial	70	60

Source: NBR10151

TABLE 3-5

State of Pernambuco Noise Levels for External Areas in Industrial Zones

Time	Base value (dB(A)	Noise Level dB(A) Frequent Peak	Noise Level dB(A) Infrequent Peak
Day	70	80	85
Night	60	70	75

TABLE 3-6
State of Pernambuco Noise Levels for Internal Area at Industrial Zones

Place within the industrial facility	Base value dB(A)	Noise Level dB(A) Frequent Peak
Office	60	70
Shops	75	85

Source: Article 25 of the State Decree No. 8,447/83

TABLE 3-7
World Bank Ambient Noise Guidelines
Ambient Noise

	Maximum Allowable Level (hourly), in dB(A)	
Receptor	Daytime 7 am-10 pm	Nighttime 10 pm-7 am
Residential, institutional, and educational	55	45
Industrial and commercial	70	70

TABLE 5-1
Stack Parameters and Emission Rates for the Composite Source

Parameter	Composite Source for Termopernambuco Facility
Stack height (m)	43.2
Stack diameter (m)	5.64
Exhaust temperature (K)	358.5 (85.4°C)
Exit velocity (m/s)	18.05
NO_2 emission rate (g/s)	81.08
SO_2 emission rate (g/s)	1.97
VOC (ozone) emission rate (g/s)	6.22
PM_{10} emission rate (g/s)	3.86
CO emission rate (g/s)	741.67

TABLE 5-2

Comparison of Brazilian Ambient Air Quality Standards, World Bank Guidelines, and Termopernambuco Impacts (µg/ m^3)

Pollutant	Averaging Time	Project Modeling Results	Brazilian Primary Standard[1]	Brazilian Secondary Standard[2]	World Bank Guidelines[3]
PM_{10}	24-hour	10.6	150	150	150
	Annual Average	2.1	50	50	50
Particulate matter	24-hour	10.6	240	150	230
	Annual Average	2.1	80	60	80
Nitrogen dioxide	1-hour	555.8	320	190	ND
	24-hour	222.3	ND	ND	150
	Annual Average	44.5	100	100	100
Sulfur dioxide	24-hour	5.4	365	100	150
	Annual Average	1.1	80	40	80
Carbon MONOXIDE	1-hour	5,084.1	40,000	40,000	ND
	8 hour	3,558.9	10,000	10,000	ND
Ozone	1-hour	42.6	160	160	ND

[1]CONAMA Resolution 003/90; Primary standards are concentrations, which if exceeded, could impact human health.
[2]CONAMA Resolution 003/90; Secondary standards are concentrations, which if not exceeded, cause the minimum adverse impact on human health, flora and flora, materials, and the general environment.
[3]*World Bank Pollution Prevention and Abatement Handbook*, *Thermal Power: Guidelines for New Plants*, July 1998.
ND: Not defined

Figure 1

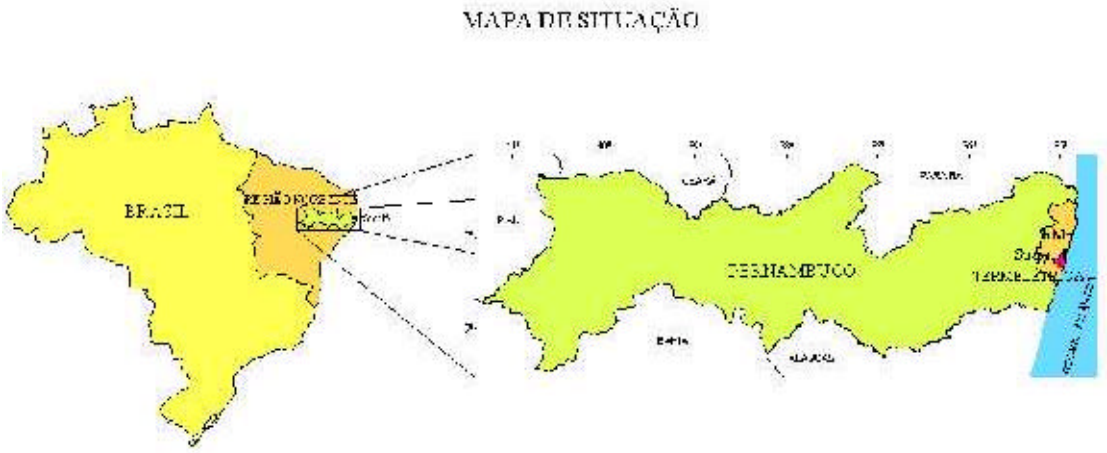

FIGURE 2
PROPOSED LOCATION WITHIN THE SUAPE INDUSTRIAL PORT COMPLEX

ANNEX 1

HSE Plan and Management System

1– HSE Management System Documentation

The basic set of documents that define the Company HSE Management System comprise the following specific parts:

2.1 - HSE Integrated Program Manual – PI - M

Contains the Company HSE Policy Statement and the elements that define the Program and the model for organizing a site specific Plan for HSE

2.2 - HSE Plan Preparation Procedure – PI – PRC - 01

Corporate procedure that establishes a guideline for preparation of site specific Plans

2.3 - HSE Risk and Impact Evaluation Procedure – PI – PRC - 02

Contains the guideline for evaluation of risks to safety, health and environment at the level of each group of activities in a job site. The basis for this evaluation is the identification of hazards and aspects in accordance with recommendations of ISO 14.001 and BS 8.800 Standards.

2.4 – Emergency Planning and Preparedness – PI – PRC - 03

This is a corporate procedure that orients the preparation of contingency plans to treat unplanned but foreseeable events that may impact HSE at the job site.

2.5 – Training and Capacity Building – PI – PRC - 04

Corporate procedure guiding the preparation and documentation relating job site training, competence assurance and capacity building.

2.6 – Continuous Improvement – PI – PRC - 05

Corporate procedure orienting the definition of HSE improvement goals in line with requisites of ISO 14.001 and BS 8.800.

2.7 – Internal Auditing Procedure – PI – PRC - 06

This is the last of the corporate procedures guiding the preparation and execution of internal HSE audits in all company job sites.

The occupational health section of the HSE Program has its specific corporate documents and guidelines prepared to meet legal requirements and other technical requisites of worker evaluation at specific tasks. They are:

2.8 – Respiratory Protection Program
Hearing Loss Prevention Program
Confined Space Worker Preparation and Health Clearing Procedure
Worker Health Requirements for Height-Related Activities
Group Health Protection Procedures

Clinical and Medical Examination of Workers
Ergonomic Evaluation of Worker Activities

All other HSE documents are specifically developed to meet job site requirements and do not integrate the group of corporate procedures. However, Odebrecht HSE System contains a large set of site procedures in a databank that serve as reference and guidance for preparation of each HSE System at a new site.

The Table of Contents of the Corporate Integrated Program HSE Manual is:

2 – HSE Management Organization

The HSE Program will be headed by a manager directly linked to the Project Manager. This HSE Manager will have under his responsibility safety and environmental inspectors, one medical doctor and health technicians working at the medical facilities on the fabrication site.

The HSE organization will be responsible for the supply and control of all personal protective equipment and the operation of the following medical facilities or equipment:

- emergency reception and treatment rooms
- clinical examination room
- medical supplies store room
- clinical stabilization room
- audiometric testing booth
- ambulance with first aid and emergency equipment

The construction and industrial fabrication site houses a wastewater treatment plant that will be operated under the HSE Organization. This is a compact activated sludge plant which will need some rehabilitation works before start up.

Potable water will be delivered on site by the existing municipal supply system of the area.

The HSE Organization will collect and deliver solid wastes to be transported to a landfill.