



MACAÉ MERCHANT THERMAL POWER PLANT

ENVIRONMENTAL IMPACT REPORT

R I M A

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ENVIRONMENTAL REPORT - RIMA

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INTRODUCTION

This Environmental Report - RIMA addresses the primary environmental aspects liable to be changed due to the construction and operation of Macaé Merchant Thermal Power Plant in Macaé, Rio de Janeiro State.

The RIMA presents the main findings of the studies performed in order to assess the environmental impacts (EIA) due to the implementation and operation of the plant, but providing this information on an accessible, simplified way, since it is addressed to nonprofessional readers.

Macaé Merchant TPP is a power-generation, gas natural-fired plant. Its design includes the construction of a dedicated gas-supply pipeline, whose impacts are also identified and assessed in this document.

THE PROJECT

1. WHAT IS MACAÉ MERCHANT PLANT?

The plant is a 700 MW thermal power plant that fires gas natural from Campos basin. The plant will be implemented and operated by the company EL PASO RIO CLARO LTDA.

The gas pipeline that will supply the plant will be also implemented by EL PASO RIO CLARO LTDA. but probably operated by CEG RIO or PETROBRÁS, depending on the completion of negotiations that are presently being developed.

Macaé Merchant TPP will use water collected at Macaé river and dispose the process effluents onto the same water body, upstream the water intake of the plant.

2. WHO IS RESPONSIBLE FOR MACAÉ MERCHANT THERMAL POWER PLANT?

The responsible for the design, implementation and operation of Macaé Merchant TPP is the company EL PASO RIO CLARO LTDA that is part of the group EL PASO ENERGY INTERNATIONAL. The company will be also responsible for the implementation of the dedicated gas pipeline, whose operation, though, will be a responsibility of CEG RIO or PETROBRÁS, depending on the completion of negotiations that are presently being developed.

The fuel gas will be supplied by Petrobrás station, in Cabiúnas, which processes the gas produced at Campos basin.

EL PASO ENERGY INTERNATIONAL is a worldwide leading company in power infrastructure projects. The multiple experience on different of power generation lines has been making of EL PASO ENERGY INTERNATIONAL one of the largest international investors of the natural gas industry, participating on 28 energetic projects located in all five continents, including 7.252km of gas pipelines and over 7.000MW of generated power.

EL PASO ENERGY INTERNATIONAL group has been working in Brazil for six years, after signing an interest agreement with PETROBRÁS for the consortium of the Bolivia-Brazil gas pipeline, also known as Grupo BTB.

Consequently, as the leader company of Grupo BTB, EL PASO ENERGY acquired a considerable knowledge on the Brazilian power system, primarily on the Brazilian gas sector.

3. WHY IMPLEMENTING MACAÉ MERCHANT TPP ?

BETTER SELF-SUFFICIENCY OF RIO DE JANEIRO STATE AND BETTER RELIABILITY ON THE POWER SUPPLY OF THE NORTH REGION OF THE STATE

Rio de Janeiro state imports most of its consumed energy from other states. The main concessionaires of the state, CERJ and Light, generate less than 900 MW together. CERJ generates only 3% of the power distributed by the company within its concession area, while LIGHT, whose concession area includes most of the metropolitan region of the state, generates only 17% of the power distributed by the company.

Therefore, although supplied by the South/Southeast/Middle West Interconnected system, the state occupies a disadvantageous position in the power supply self-sufficiency ranking. This picture is even more critical in the north region of the state which depends on a single supply branch of the interconnected system, which brings power from other regions in order to supply the area. Therefore, in case of failures of the interconnected system, the North region of the state is one of the most impaired ones, since it cannot be supplied by any rearrangement of the power transmission system.

Therefore, the implementation of Macaé Merchant TPP meets not only the self-sufficiency needs of the state but also the supply improvement requirements of the north region of the state, due to its geographic location.

INCREASE ON THE POWER OFFERING OF THE INTERCONNECTED SYSTEM

In addition to supporting the self-sufficiency of both Rio de Janeiro state and its north region, the implementation of Macaé Merchant TPP would also benefit other regions.

The plant will also benefit the south region of Espírito Santo state, which undergoes the same problems of the north region of Rio de Janeiro state, since it is supplied by the same transmission branch. Therefore, the plant will benefit both regions by ensuring a more stable power supply, without frequency and voltage oscillations and less likely subject to outages. The implementation of Macaé Merchant TPP will also allow that 700MW to be released to the Interconnected System, increasing the supplying flexibility of the system, especially in case of a deficit of the generation park, benefiting the region as a whole.

IF THE PROJECT IS NOT IMPLEMENTED

The non-implementation of Macaé Merchant TPP means keeping the uncertainty scenario of power supply for the region supplied by the interconnected system, while missing an important opportunity toward the power self-sufficiency of both Rio de Janeiro state and its north region.

It also means submitting the involved population to the risk of deficits or to a lack of reliability on the power supply, while also discouraging the installation of new projects, required for the economical and social growth of the region.

4. WOULD NOT BE BETTER INSTALLING A HYDROELECTRIC PLANT?

Although the hydroelectric generation mode prevails in Brazil, due to the large amount of available water resources of the country, Rio de Janeiro state is not provided with a large number of areas where this mode could be used. On the other hand, the state is remarkable for its large production of natural gas from Campos Basin, most specifically from the North region, which is considered as the largest gas producer of the country.

In addition to these aspects, it must be considered that hydroelectric plants require large flooded areas for the power-generating reservoirs, which takes to the loss of cultivable lands, the need for removing affected populations and the loss of natural environments. These are the commonest problems associated to the implementation of hydroelectric plants, to which long-term implementation periods should be added, required by the large works associated to these projects.

Natural gas power plants does not require large implementation works and can be implemented within short periods, approximately two years, which is extremely faster than the average 6-10 years required for constructing hydroelectric plants. Thermal power plants are specially advantageous in Macaé region, since they would be close to the fuel supply sources, reducing the need for constructing long gas pipelines. Besides, these plants are associated to low-magnitude environmental impacts, especially if clean-generation technologies are adopted in the plant design.

It must also be added that thermal power plants require lower investments and can be installed closer to consumer centers, which is very hard to meet in case of hydroelectric plants, since they require adequate areas for constructing the dam .

5. WHY THE URGENCY OF CONSTRUCTING THE PLANT?

There is a considerable difference between what was planned by the Brazilian Power Sector in regard of the needs for increasing the generation capacity and what has been really implemented in the last decades. This scenario is worsened by the accelerated expansion of the power consumption due to the increase on the acquisitive power of a considerable portion of the population. This assumption is confirmed by the increase on consumption levels by household appliances and other electronic devices, which have been tracked by the commercial sector. In addition to this, since the power consumed in Brazil is mostly generated by the hydroelectric mode, the long-lasting dry season observed for the Southeast region has been lowered the levels of the reservoirs of the South-Southeast-Mid West interconnected system to critical conditions.

Therefore, as it has been widely announced, the possibilities of power rationing have been increasing on a daily basis while the increasing demands have become more

repressed, whether by the risk of outages or by the low quality of the supply under deficit conditions.

This scenario and the risk of rationing trend to grow fast in the next years if urgent measures are not taken, in order to increase the power generation capacity.

Therefore, the need for a fast and expressive increase on the generation capacity makes of thermal power projects, such as Macaé Merchant plant, the most adequate ones in terms of an emergency program.

The expressive impact of this project on the installed generation capacity of Rio de Janeiro state is easily observed when the total present capacity of the state, from both LIGHT and CERJ, totalizes 892MW, when Macaé Merchant power plant would be adding, alone and within a short term, 700MW to this total.

6. WHAT ARE THE AVAILABLE TECHNOLOGICAL ALTERNATIVES?

Well-known generation technologies comprise those driven by hydric sources, those related to the combustion of different materials, those driven by the force of winds and those that make use of photovoltaic cells for transforming solar radiant energy into mechanical energy.

The so-called alternative sources, such as solar and eolian ones, as well as ocean, geothermal and vegetable biomass sources, can only be considered under specific circumstances, whether under technical or economical standpoints, which is not the case of the targeted region. Therefore, the inexistence of significant level differences between the ebb and flow tides, which would allow the application of ocean power generation, or the lack of alternative materials to be fired on economically feasible quantities, do not make of these sources feasible alternatives in order to supply large consumption centers and when compared to conventional modes, such as hydroelectric and thermal modes.

Therefore, the options presently feasible in terms of a significant generation capacity are restricted to thermal power plants (gas, coal or oil) and nuclear plants, since the hydroelectric sources are practically depleted.

As already mentioned, the hydroelectric generation is not a feasible alternative when considered against the urgency scenario of the region where the plant is intended to be implemented. Therefore, the only analysis that can be developed here is related to the different alternatives of thermal generation processes.

This analysis is valid, since thermal power plants can utilize a number of fuels, such as oil, coal and nuclear sources.

The world energetic matrix is strongly based on thermal power generation, where coal-fired plants are responsible for over 40% of the power production, followed by oil-fired units, with over 20% of the total generation. However, it must be considered here that

the coal is not a competitive alternative fuel in Brazil due to the non-availability of this material within feasible distances from important consumption areas. On the other hand, the fuel oil is also not interesting since it is still reasonably subordinate to importation.

Even taking into account the existence of efficient technologies addressed to the reduction of the pollution levels associated to firing these fuels, high control levels result in high capital costs for equipment acquisition and process environmental control adequacy, which makes the natural gas an advantageous alternative when compared to those fuels. This advantage is especially remarkable for the present project, when the availability of the gas is considered in the area due to its proximity to Campos basin, where the fuel is produced.

The only experience of the country related to nuclear thermal generation is related to nuclear plants Angra I and II, located in Rio de Janeiro state, in the municipality of Angra dos Reis. The several different difficulties associated to the implementation of these projects are well known. The present uncertainties related to the Brazilian Nuclear Program allow assuming that, except for Angra III, no new projects of this type are likely to be developed. Also, the power generation costs of nuclear plants are significantly greater than the costs associated to thermal power plants, which must be taken in account in addition to the worldwide concerns about the risks associated to the nuclear process.

Therefore, it seems to be clear that the nuclear generation is not a feasible alternative for the considered project.

According to these considerations, it can be understood that the thermal power generation is the best alternative for the existing setting, offering several advantages over other options under technical, economical and environmental standpoints. It must be emphasized that the considered alternative will also consume part of the natural gas produced at Campos basin, whose surplus is presently flared without any socioeconomic benefits.

At last, it is worth mentioning that the natural gas, single cycle power generation proposed for Macaé Merchant TPP is especially adequate to the emergency circumstances associated to the program of thermal power plants of Rio de Janeiro, since this process will allow to add 700MW to the regional generation capacity within a term as short as 12 months.

As for the gas supply pipeline, two technological options were considered: a straight interconnection to Cabiúnas station and a branch from GASDUC pipeline. The first alternative was selected, despite the longer length of the line, due to its better reliability in terms of the gas supply pressure and to lower operational risks. In addition to these aspects, the first alternative will not require the compression of the delivered gas at the plant inlet.

7. WHERE MACAÉ MERCHANT TPP WILL BE LOCATED?

Three sites were studied for the location of the Plant, as depicted at Figure 2.3-1: one close to PETROBRÁS industrial area, in Cabiúnas; a second one next to BR-101 road and close to Macaé river, in the locality of Severina, and a third one in the city of Campos dos Goytacazes, close to Campos substation.

The site selection process took in account the following aspects:

1. Year-round availability of water in sufficient quantity and acceptable quality;
2. The sensitiveness of the areas to changes on air quality standards;
3. Distance to existing electric transmission line(s) and substation(s), as well as environmental interferences/sensitiveness along the interconnection;
4. Ability of existing transmission and substations to accept and distribute the added electric load requirement;
5. Distance to the gas supply source – Cabiúnas station;
6. Low likelihood of site flooding based on topography and historical information;
7. Suitable geotechnical conditions;
8. Location of residential or other sensitive areas such as historical sites, military installations archaeological sites, endangered species or protected ecological areas and parks with respect to the site;
9. Compliance of the intended use with the use planned for the area by the municipal administration;
10. Ease of access of heavy vehicles to the site ;
11. Availability of and proximity to required operational and support needs such as fuel, landfill, maintenance, etc. ;
12. Required infrastructure additions external to potential site ;
13. Community acceptance of the project.

The listed alternatives were assessed based on these criteria.

It is important to mention that EL PASO already had Sítio Cabiúnas land, an area with approximately 60ha and good technical conditions for implementing the plant, especially due to its proximity to PETROBRÁS facilities, from where the fuel gas will be supplied. This land, located within an industrial area of Macaé, was acquired in 1997, i.e., one year before the creation of the National Park of Restinga de Jurubatiba, which is located about 2 km far from the site. However, this new condition required a new analysis of the implementation of the plant in the aforementioned site, due to the new sensitiveness scenario related to the proximity to the National Park.

Therefore, EL PASO re-evaluated the site location feasibility in this study, after acquiring another area, with approximately 100ha, also located in Macaé and denominated Sítio Severina, which became a new alternative for locating the targeted project.

In addition to these options, the site selection also took in account another area, located in Sítio Campos, close to the local substation.

The areas were screened, based on the aforementioned criteria and on the following studies or measures:

- ↪ Initial analysis of Cabiúnas site, based on IBGE charts, land use legislation and conservation units legislation;
- ↪ Field survey in Cabiúnas site, for a preliminary analysis of the area and precise location of the site regarding the National Park of Restinga de Jurubatiba;
- ↪ Overflights for checking over possible alternatives to Cabiúnas site, when Severina site was identified;
- ↪ Field survey in Cabiúnas, Severina and Campos sites, addressing locational aspects of all three alternatives;
- ↪ Contact with local communities for perceiving their expectations and feelings about the location of the plant.

The table presented next summarizes the results of the analysis of the studied sites.

Assessment of Alternative Sites for the Implementation of Macaé Merchant TPP

ASPECT	SÍTIO CABIÚNAS	SÍTIO SEVERINA	SÍTIO CAMPOS
ACCESS	Amaral Peixoto Road (RJ-106)	BR-101 Road	Campos – Itaperuna Road
EARTHWORKS	Less required	More required	Less required
GEOTECHNICAL ASPECTS	No geotechnical problems	No geotechnical problems	Requires geotechnical surveys
FLOODING AREAS	Above the flooding level	Above the flooding level	Above the flooding level
WATER SOURCE	Macaé River - 15km; Ground water: under evaluation	Macaé river - 0,5km	Paraíba do Sul river
TRANSMISSION LINE: Distance to TL 345kV FURNAS Transmission capacity	10 - 12km YES	0,3km YES	Less than 1km YES
NATURAL GAS: Length of the supply pipeline	0,8 - 1,0km	11km	Longer than 90km
CONSERVATION UNITS: Proximity to.	National Park of Restinga de Jurubatiba (2 km)	None	None
GAS PIPELINE ROUTE	The pipeline would cross an industrial are and run within the area of Cabiúnas Station, of S, and within the site land.	The pipeline would start at the valve yard of PETROBRÁS and run through 2km along RJ-168 road, crossing pasture areas along its entire length, far from urban areas.	The pipelines would interconnect Cabiúnas to Campos (approximately 90 km)
AIR QUALITY STANDARDS	Res. CONAMA 13 /89, defines the maintenance of the air quality on conservation units (Class I conditions).	Res. CONAMA 03/90	Res. CONAMA 03/90
AIR EMISSIONS: Existing industrial units	Cabiúnas station Recharge of gas bottles	No industrial units in the area	Campos Thermal Power Plant
AIR EMISSIONS: Industrial units planned for the area	Expansion of Cabiúnas station; Thermal Power Plant (already licensed); Thermal Power Plant (under licensing); Future industrial facilities.	Thermal Power Plant (under licensing);.	No plans for new industrial units.
LAND ZONING (Municipal Law 1.683/96)	Industrial Zone	Rural Zone	Urban Zone
LAND USE AND VEGETATION Sites	Anthropic area (human-changed site), covered by pastures	Anthropic area (human-changed site), covered by pastures	Urban area with expansion areas por residential areas in the vicinities.

LOCATIONAL ASPECT	SÍTIO CABIÚNAS	SÍTIO SEVERINA	SÍTIO CAMPOS
LAND USE AND VEGETATION Vicinity of the sites	Industrial use area in the periphery of Macaé, approximately 1,5 km far from residential building areas. 2 km far from the National Park of Restinga de Jurubatiba; Close to the coastal forest (restinga) of Cabiúnas.	Rural area, characterized by large pastures.	SE Campos. Urban land plots.
URBAN AREAS: Proximity to	Approximately 1,5km far from the nearest urban area.	Approximately 11 km far from the nearest urban area.	Within an urban area
LIQUID EFFLUENTS Disposal area	Onto Jurumirim channel, a left tributary of Macaé river, located at about 3,5km far from the site; the disposal onto the sea or lakes/lagoons will not be considered.	Onto Macaé river, upstream the water intake.	Onto Paraíba do Sul river (left margin), upstream CEDAE water intake.
POSSIBLE LOCAL IMPACTS	Cumulative effects of air emissions could impact the National Park of Jurubatiba; in addition to the expansion of the urban area close to the site. Possible interferences with lagoon systems if groundwater is used.	Cumulative effects of air emissions due to Macaé Merchant TPP, but not affecting conservation units or urban areas.	Cumulative effects of air emissions due to Campos TPP could affect urban areas.
AVAILABILITY OF AREAS FOR THE PROJECT IMPLEMENTATION	The available areas are large, allowing the facilities to be isolated and, therefore, easily managed in terms of noise levels and risks.	The available areas are large, allowing the facilities to be isolated and, therefore, easily managed in terms of noise levels and risks.	The available areas are limited, increasing the risks in case of accidents and requiring major measures in terms of noise control.
COMMUNITY ACCEPTANCE	Possible rejection due to the existence of a conservation unit	Lower likelihood of rejection, since the site is located within a rural area.	Higher likelihood of rejection, since the site is located within an urban area.

SELECTED ALTERNATIVE

The lower complexity of the environmental sensitiveness aspects associated to Sítio Severina took to the selection of this alternative as the best one, according to the criteria used in the site selection process.

In regard of engineering aspects related to the project, it was verified that Sítio Severina site presents a number of advantages when compared to Sítio Cabiúnas in terms of the proximity to both the transmission lines of FURNAS and Macaé river. This proximity implies on a significant reduction on the costs associated to the interconnection with the transmission line and on the construction of the water supply line. Additionally, the final disposal of liquid effluents is also simple and less expensive for Sítio Severina site, since Cabiúnas alternative would require a pumping system and an outfall for the basin reversion. On the other hand, the low slopes of Cabiúnas site require less earthworks for preparing the area, while Cabiúnas site requires a shorter gas pipelines, also reducing the costs associated to the implementation of the gas supply system.

These aspects, when compared again s the characteristics of Campos site, becomes very clear, especially when the total length of the gas pipeline required for this option are taken in account (90 km). Besides, the construction of a thermal power plant within an urban area should consider its location within the city expansion area, involving higher risks when compared to the implementation of the same plant in a rural or industrial area.

Therefore, the main aspects that took to the selection of Sítio Severina site are summarized next.

ACCESS

The site is easily accessed, since it is located close to BR-101 road;

WATER

The water would be supplied to the plant from Macaé river, located less than 1 km far from the site and whose flow rates are enough to ensure the water supply of the plant.

GAS

The fuel gas would be also supplied from a gas pipelines between Cabiúnas station, of PETROBRÁS. For Sítio Severina alternative, the pipeline would be longer than the one required for Cabiúnas site and shorter than the one required for Campos site.

TRANSMISSION LINE

There is a transmission line located at less than 500m from the area selected for implementing the plant.

ENVIRONMENTAL STATUS

The site is located on a hill, 40 m above the flooding area of Macaé river, 10 km far from the nearest urban area and away from any natural area protected by any environmental legislation, such as Conservation Units (parks, reserves, etc.). No significant land clearing is required in terms of native vegetation and there are only four residences (rural employees) in the vicinities of the site.

8. WHICH ROUTE THE GAS PIPELINE WILL FOLLOW?

Three routes were studied for the gas pipeline interconnecting PETROBRÁS station, in Cabiúnas, to Macaé Merchant TPP. These alternatives are summarized and characterized next.

Alternatives Studied for the Route of the Dedicated Gas Pipeline

ASPECT	ALTERNATIVE 1	ALTERNATIVE 2	ALTERNATIVE 3
Length	~30km	~20km	~25km
Route	A 20" dedicated gas pipelines leaving Cabiúnas, crossing Jurumirim channel up to the junction with RJ-25 and running along this road up to the crossroads with BR-101. From this point, the route runs along the road, crossing the rivers São Pedro and Macaé, reaching the TPP site.	A 20" dedicated gas pipeline leaving Cabiúnas, following the raw-water pipeline of S, along the old riverbed of Macaé river up to Macaé Merchant TPP site.	A 20" dedicated gas running along GASDUC (14km) up to the junction with the raw water line of S and running along the right-of-way of this line up to Macaé Merchant TPP (11km)
Impacts – Physical Settings	Interferences with watercourses (Macaé, São Pedro and other rivers) and flooding areas.	Interferences with watercourses (Macaé and other rivers) and flooding areas.	Interferences with water courses (Macaé and other rivers)
Impacts – Biological Settings	The route crosses flooding areas of Macaé river	The route crosses flooding areas of Macaé river	The route crosses flooding areas of Macaé river. The route crosses an area close to a remaining forest.
Impacts – Socioeconomic settings (right-of-way)	Most of the proposed route makes use of existing right-of-ways of roads.	Negotiations are required with land users, use restrictions along the route. Close to an INCRA settlement.	The area is already used by a water line and a gas pipelines of PETROBRÁS .
Crossing of water courses and existing infrastructures	The route crosses RJ-25 road, São Pedro river and Macaé river (buried) as well as Jurumirim channel	The route crosses RJ-25; Macaé river (through an area without infrastructures), flooded areas and Jurumirim channel	The route crosses RJ-25 road. Macaé river (buried and in the same area crossed by GASDUC pipelines) and Jurumirim channel.
Topography	The route crosses plain and flooding areas, getting close to S. Manuel ridge along RJ-25 road.	The route crosses plain and flooding areas.	The route crosses plain and small hills.

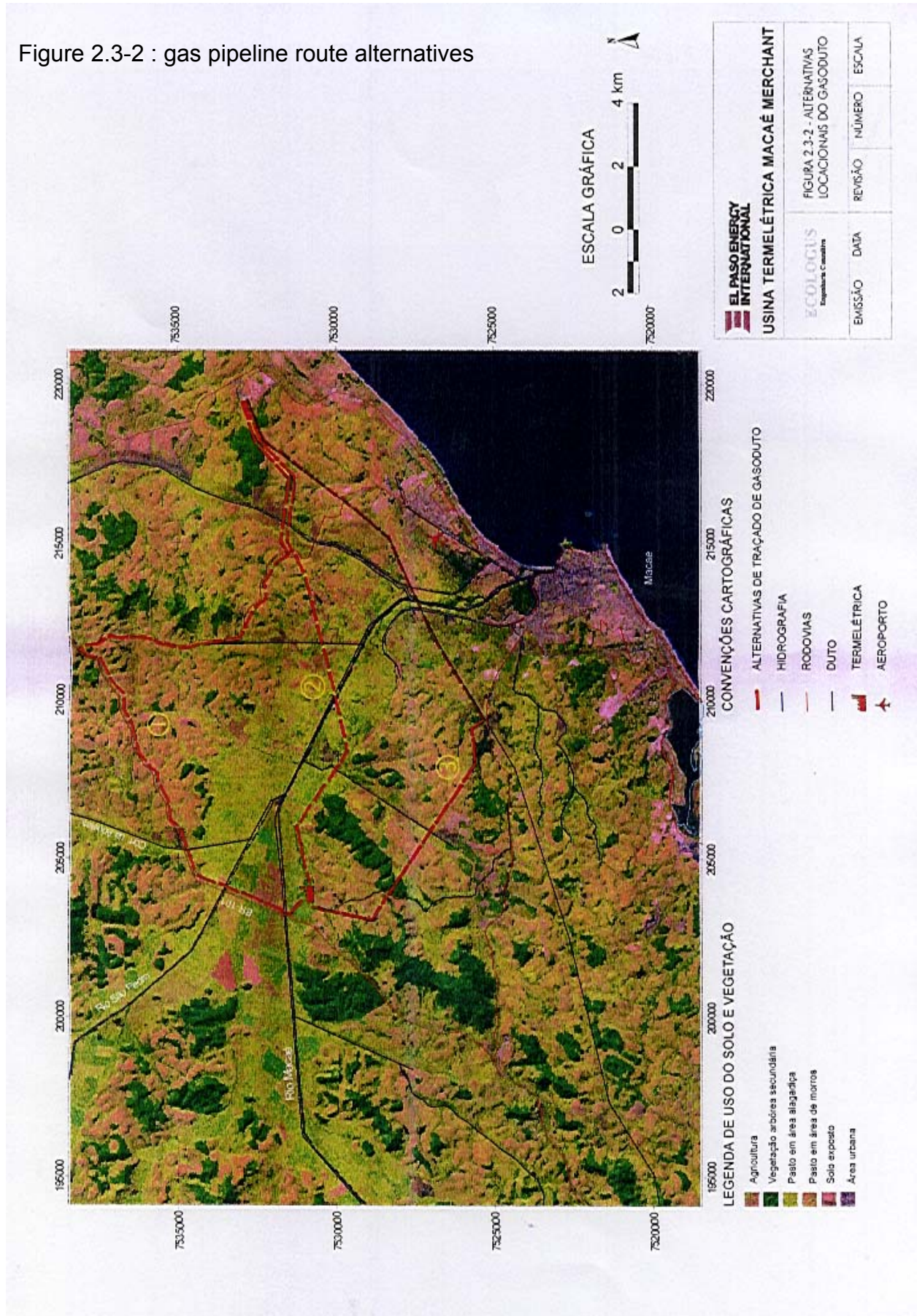
Selected Route for the Gas Pipeline

The lower environmental impacts associated to third alternative proposed for the gas pipeline route took to the selection of this alternative as the best one, according to the criteria used in the site selection process, as follows:

- Distance to urban or occupied areas;
- Distance to areas with preserved vegetation;
- Minimization of water bodies crossings;
- Utilization of existing right-of-ways.

Although Alternative 2 was very similar to Alternative 3, it was not selected due to the existence of a human settlement close to the pipeline route, as well as to disadvantageous geotechnical conditions.

Figure 2.3-2 : gas pipeline route alternatives



9. HOW MACAÉ MERCHANT TPP WILL OPERATE ?

Macaé Merchant TPP will be a single-cycle plant with a maximum rated capacity of 700MW, composed by 16 GTG's comprising gas turbines with unit power of 43MW designed for firing natural gas, each one coupled to a air-cooled generator. The terminals of all 16 generators will be interconnected to 8 main step-up transformers, one for each pair of generators.

Macaé Merchant TPP will use combustion turbines, where ambient air is compressed before being admitted into the combustor, where it is mixed to the fuel and burned. The combustion products, at high temperature and pressure, are sent through the turbine, generating mechanical energy and driving the generator.

The recent improvements on combustion turbines' technologies has increased the efficiency of these equipment to a range of values between 30% to 35%, close to the values observed for steam turbines. This type of process is denominated a single-cycle, usually used for peak operations or as a stand-by.

For Macaé Merchant TPP, which will fire natural gas, a GE LM6000 turbine was selected, which present the best efficiency for the considered power range (40 to 70 MW), as depicted next.

Two alternatives can be used for releasing the heat cycle: the open cooling system and the closed one, using cooling towers. For several years, the open system was widely used. However, increasing restrictions to thermal discharges into water bodies and the need for large amounts of water for the cooling systems have been increasing the selection of closed systems as the best alternative for this type of process. This system requires less water and the associated thermal impacts are significantly reduced, since most of the thermal energy is dissipated through the water evaporation.

Pursuant to this technology, Macaé Merchant TPP will adopt a closed system composed by cooling towers operating at a maximum water intake flow rate of 86 l/s and supplied by Macaé river, whose minimum flow rate (7 days) is 4,870 l/s, as informed at the "Plano Diretor da CEDAE para Abastecimento de Água da Região dos Lagos, Macaé e Casimiro de Abreu". The water balance considers 4 l/s of treated effluents and 8 l/s of water from the cooling system returning to the river, totaling 12 l/s.

10. WHAT IS REQUIRED FOR CONSTRUCTING MACAÉ MERCHANT TPP?

EARTHWORKS

The general layout of Macaé Merchant TPP is depicted at Figure 2.4-6, next, also indicating the plant planned to be installed in a neighbor land.

The plant implementation plateau will be prepared by cutting the land and lowering the natural elevation of the site from 50 to 20m. The material removed by this operation will be used for expanding the plateau and disposed along the south-slope of the elevation. This procedure will minimize the need of borrowed/disposed materials.

STRUCTURES

The main structures planned for the plant are the Pressure Control Unit, the Water treatment Unit, the Office Building, the GTG Yards and the substation.

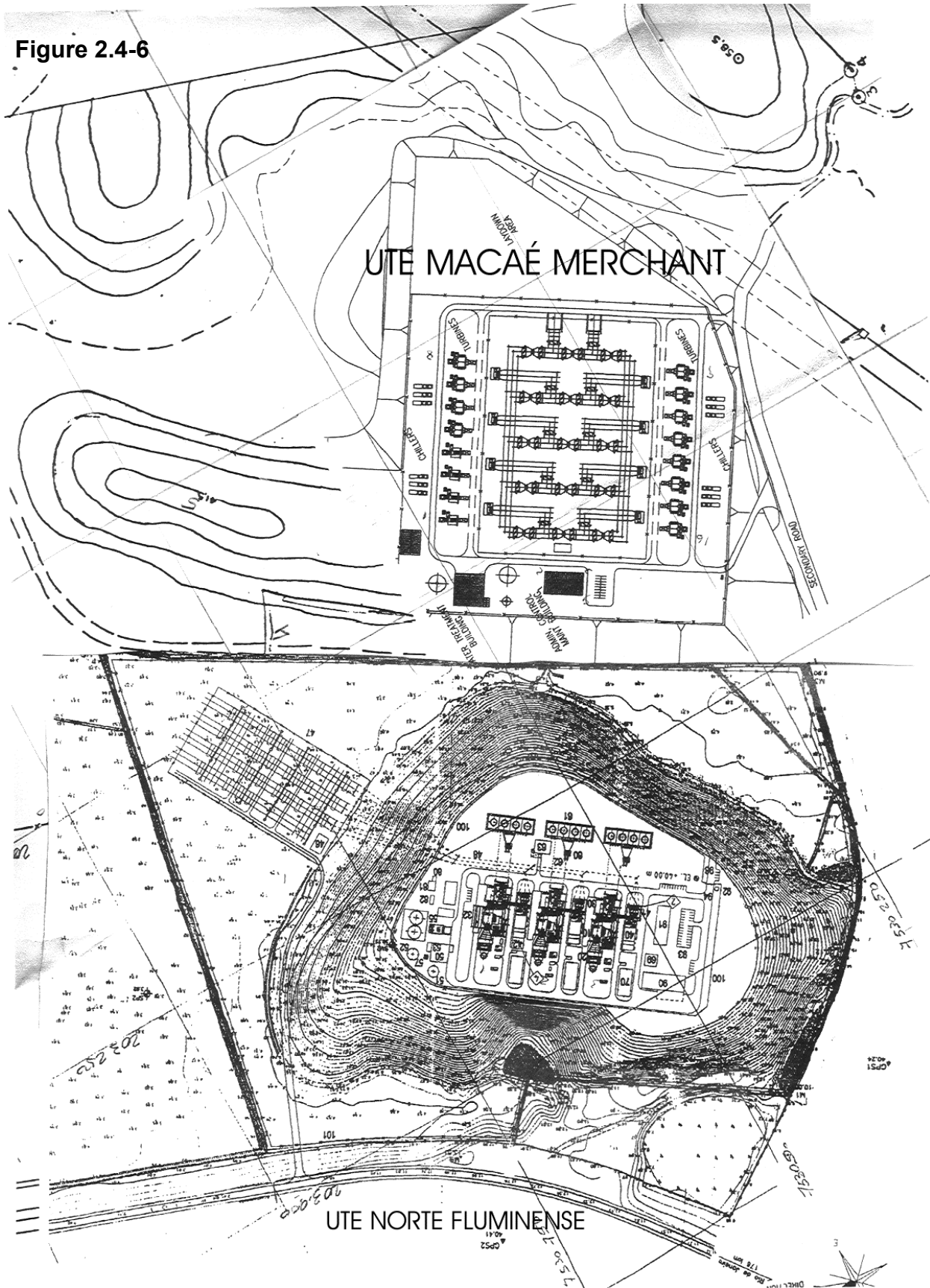
The plant implementation will be performed through three steps, totaling 12 months and comprising earthworks, civil construction and assemblage/pre-operation tests.

REQUIRED MANPOWER

A total number of 500 people is planned to be used during the peak period of Macaé Merchant TPP construction. Considering that Macaé is provided with a considerable number of construction and assemblage companies due to its industrial park, local companies will be preferably contracted. This strategy aims at minimizing the mobilization periods of the works and the migration of workers from other regions.

The operational phase of the project will allocate a maximum number of 40 people, including qualified people that might come from other cities or even from other countries. Nevertheless, a training program is planned to be developed in a partnership with local institutions (SESI/SENAI Macaé) in order to qualify local manpower.

Figure 2.4-6



IMPLEMENTATION TIMETABLE

DESCRIPTION	MONTHS											
	1	2	3	4	5	6	7	8	9	10	11	12
CONSTRUCTION												
Land preparation	■	■										
Construction of GTG's bases		■	■	■	■	■	■					
Construction of Remaining structures			■	■								
Assemblage of GTGs				■	■	■	■	■	■	■	■	
Construction of Transformers Switchyard			■	■	■	■						
Installation of the Water Treatment System						■	■					
Construction of the Control Building							■	■				
Installation of the Dedicated Gas Pipeline	■	■	■	■	■	■	■					
Installation of the Water Main Line	■	■	■	■	■							
COMMISSIONING AND START UP												
Start up of the water system							■					
Gas commissioning							■	■				
Start up of the GTGs								■	■	■	■	■
Synchronization with the Power Network											■	■

11. WHAT IS REQUIRED FOR OPERATING MACAÉ MERCHANT PLANT?

Raw Materials

In addition to ambient air, the plant will also require 3 million of m³/day of natural gas and 86 liter/second of to be collected at river.

The gas will be supplied to the plant by means of a dedicated gas pipeline, which will interconnect PETROBRÁS station, in Cabiúnas, to Macaé Merchant TPP. This pipeline will be implemented by EL PASO RIO CLARO.

The water intake will be located close to BR-101 bridge and interconnected to the plant by means of a water main line that will cross lands owned by third parties.

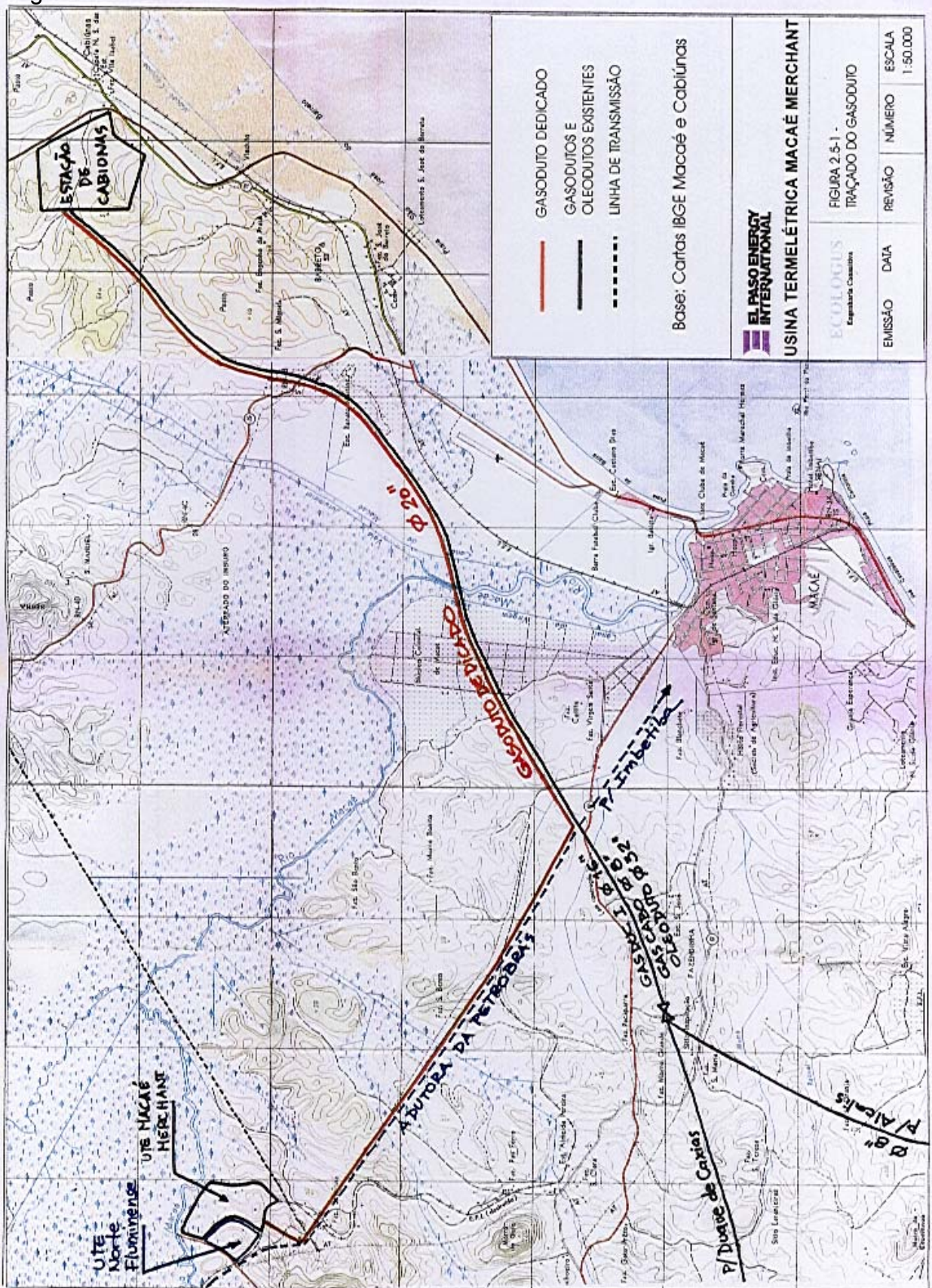
MANPOWER

The operational phase of the project will allocate a maximum number of 40 people, including qualified people that might come from other cities or even from other countries. Nevertheless, a training program is planned to be developed in a partnership with local institutions (SESI/SENAI Macaé) in order to qualify local manpower.

12. WHAT ARE THE CHARACTERISTICS OF THE GAS PIPELINE THAT WILL SUPPLY THE PLANT?

The natural gas will be supplied to Macaé Merchant TPP by means of a 25-km long dedicated pipeline that will be specifically constructed for this purpose, as depicted at Figure 2.5-1, next.

Figure 2.5-1



ENVIRONMENTAL LEGISLATION APPLICABLE TO THIS MATTER

1. WHICH ARE THE LAWS APPLICABLE TO THE PROJECT?

The legal aspects significantly related to environmental issues associated to the implementation of Macaé Merchant TPP are listed next:

- ↪ The National Environmental Policy (PNMA), established in 1981, by Law 6.938 and received by the Federal Constitution and all other federal instruments applicable to the proposed project and to the areas where it will be implemented;
- ↪ The needs of the project in regard of water resources and associated infrastructure (gas pipeline, transmission line and roads);
- ↪ The juridical-institutional framework addressed to environmental in Rio de Janeiro state, emphasizing pollution control regulations, which are a duty of FEEMA;
- ↪ The municipal legislation of Macaé, primarily the aspects related to land use of the Organic Law of the municipality, enacted on 04.05.90, and its Directing Plan;
- ↪ The recent creation of a Intermunicipal Consortium for the Environmental Management of the Basins of Macaé, Macabu, Lagoa Feia rivers and Adjacent Coastal Zones.

Considering the different subject, only the most important laws and legal instruments were selected and discussed here, according to the natural resource to be used or to the use intended for Macaé Merchant TPP.

The analysis of the existing environmental legislation allows to identify the existing obstacles to the project implementation or to the obtention of the required previous license, while supporting the proposal of action measures and programs addressed to minimizing the environmental impacts identified by the study

THE ENVIRONMENTAL LICENSING AND THE CONSTITUTIONAL STRUCTURE OF DUTIES

General aspects of the Federal Constitution

The Environmental chapter of the Federal Constitution (1988), establishes several duties to the Public Administration, (art. 225): such as

- I – preserve and restore essential ecological processes and provide the ecological handling of species and ecosystems;*
- II – preserve the diversity and integrity of the genetic patrimony of the country;*
- III – define territorial spaces to be specially protected within all federation units and where any suppression is allowed only by law, being prohibited the utilization of any features that justify their protection;*
- IV – legally require an environmental impact assessment for any facility or activity that might potentially take to significant degradation of the environment;*
- V – control the production, commercialization and utilization of techniques, methods or substance that might take to risks to life, life quality and to the environment.*
- VI – provide environmental education addressed to all schooling levels and also to the public conscience related to the environment preservation.*
- VII – protect flora and fauna, forbidding all practices that might take their ecological roles into risks, as well as those that might take to their extinction or that submit animals to cruelty.*

When it comes to responsibilities, the constitution established a concurrent jurisdiction between the Union, States and Federal District, so that the duties of the Union are restricted to general rules that might be applied to the whole territory due to their characteristics. General rules, therefore, are not supposed to superpose to regional, state or local specific aspects.

National Environmental Policy

This policy was established by Federal Law 6.938 (08/31/81), aiming at the preservation, improvement and recovery of the environmental quality propitious to life, in order to assure conditions for social-economical development in the country, as well as national safety interests and the protection to human being dignity. It also considers that the government action addressed to the maintenance of the ecological equilibrium must consider the environment as a public patrimony to be necessarily guaranteed and protected considering its collective utilization.

The politics is performed by means or rules and plans the guide the actions of all government levels (Union, states, municipalities and the Federal District) related to environmental conservation matters as well as public and private business activities. The law also created the National Environment System - SISNAMA:

CONAMA (the national environmental council), the consulting and deliberative board of SISNAMA, is composed by representatives of federal and state government agencies, workers, entrepreneurs and environmental non-government organization representatives. It is presided by the Minister of Environment and its duties are related to support, study and propose government politics guidelines addressed to the environment and natural resources, as well as deliberate on rules and standards compatible with an ecologically equilibrated environment, essential to a sound life quality.

Environmental Licensing

The most important instrument of the national environmental politics is the environmental impact assessment and the licensing of activities effectively or potentially pollutants. These instruments allow the state environmental agencies to authorize, induce, modify or even reject the implementation of projects and public/private activities aimed at the utilization of natural resources.

Therefore, the corresponding law establishes that the implementation and operation of those activities, as well as of any others that might take to environmental degradation, will depend on a previous license granted by the corresponding state agency belonging to SISNAMA and supplementary by IBAMA, regardless any other required licenses."

Three licenses can be granted by both the state environmental agencies and IBAMA:

I - Previous license (LP), during the preliminary planning step of the project, including all basic requirements to be followed during the site selection, installation and operation steps, considering all municipal, state or federal plans related to the land use..

II - Installation License (LI), authorizing the start of the implementation step, according to the specifications at the approved detailed project; and,

III - Operation License (LO), authorizing the activity start-up and the operation of the associated pollution control equipment, according to the conditionings at both Previous and Installation Licenses.

All licenses require the previous environmental impact evaluations, which comprise a set of procedures addressed to systematically check all environmental impacts related to a certain proposed activity and its alternatives. The results of this evaluation should be properly addressed to both the public and the responsible by the decisions to be taken, so that the required information can be properly considered before that.

The instruments addressed to these evaluations are the Environmental Impact Assessment (EIA) and its respective Environmental Report (RIMA), both established by the Decree 88.351/83 (art. 18), replaced by the Decree 99.274/90.

The licensing of potentially pollutant activities, on the other hand, is a duty of CONAMA, responsible for establishing general rules and criteria for these licensing.

Therefore, CONAMA issued Resolution 001 (01/23) defining environmental impact as any changes on physical, chemical and biological properties of the environment caused by any form of energy or matter resulting from human activities and which can directly or indirectly affect the health, safety and welfare of the population, social and economical activities, the biota, the esthetical and sanitary conditions of the environment or the quality of the environmental resources.

Resolution CONAMA 237 (12/19/97) detailed the basic criteria required for the development of both EIA and RIMA.

Resolution 237 (12/19/97) detailed the basic criteria required for the development of both EIA and RIMA. Based on these documents, the EIA must follow several requirements, such as: consider all localization and technological alternatives for the project, comparing them to the non-implementation hypothesis; systematically identify and evaluate all environmental impacts due to the implementation and operation steps of the project; define the limits of the geographical area to be directly or indirectly affected by the impacts, here named project influence area but considering, for all cases, the hydrographic basin where the site is localized; consider all government plans and programs proposed and/or under implementation within the influence area.

On the other hand, the RIMA must be an objective report, adequately prepared in order to provide its proper understanding, so that all public agencies and the population can manifest their interests and doubts.

Resolution 237/97 established that expenses related to the development of the studies are a duty of the project responsible, including: data/information collection and acquisition, field surveys and works, laboratory analysis, technical or scientific studies, supervision and monitoring of the impacts, development of the RIMA (including at least the issue of 5 copies of the report).

According to Resolution no 237/97, the implementation of a project such as Macaé Merchant Thermal Power Plant depends on an environmental licensing.

The licensing requests, their renewal or the respective grant must be published at the official State newspaper, as well as at a representative local or regional newspaper.

It is a duty of CONAMA to establish the grant terms for the licenses, according to the nature of the technical activity, considering up to 6 months for processes that do not require public audiences and up to one year for those that require it.

One of the new aspects established by CONAMA 237 is the more significant role, played by the Municipalities. According to article 6 of the mentioned Resolution, the environmental municipal agencies are responsible for the licensing of local impacting projects or activities as well as of those ones designed by the State. For the present case, the licensing will be a duty of the State.

General issues of the State Constitution and of the State Environment Politics

The Rio de Janeiro State Constitution (10/05//89) follows de Federal Constitution presenting a specific chapter addressed to environmental matters, establishing principles or even rules regarding the management of the environment or its resources.

On the other hand, the State Politic for Environmental Control (Decree 134, 07/17/75) comprises a set of administrative directives and techniques aimed at the rational utilization of the environment, focusing the preservation and control of all environmental pollution methods.

The execution of this politics is performed by means of its most important instrument, the so-called SLAP or Licensing System for Pollutant Activities. The system was created by the Decree 1.633/77, aimed at disciplining the implementation of any activity considered as pollutant or potentially pollutant, as well as of any pollution control equipment. The system has been regulated and improved by several decrees and deliberations of CECA (the state commission of environmental control).

The Environment Secretariat – SEMA, was established by Decree 21.258 (1995). The decreed linked the following agencies/institutions to SEMA:

- ↗ Fundação Estadual de Engenharia do Meio Ambiente – FEEMA (State environmental agency)
- ↗ Fundação Instituto Estadual de Floresta – IEF (forest matters)
- ↗ Fundação Superintendência Estadual de Rios e Lagoas – SERLA (rivers and lakes)
- ↗ Departamento de Recursos Minerais – DRM (mineral resources)
- ↗ Fundo de Controle Ambiental – FECAM (environmental control)
- ↗ Conselho de Defesa do Litoral – CODEL (coastal defense)
- ↗ Conselho Estadual para Controle de Agrotóxicos e outros Biocidas – CECAB (control of pesticides and biocides)
- ↗ Conselho Estadual de Meio Ambiente – CONEMA (environment state council)
- ↗ Comissão Estadual de Controle Ambiental - CECA (environmental control state commission)

The project here considered is closely related to FEEMA and SERLA.

FEEMA is the executing state agency regarding the environmental control politics. The main duties of this agency are: provide technical support to CECA, suggesting the necessary environmental protection and improvement control measures; license and supervise the compliance of pollution control standards on behalf of CECA; measure and control all modes of environmental pollution, implementing measures for managing this pollution; planning, coordination and execution of actions against the dissemination

of diseases and support and develop researches and technical studies on environmental protection matters.

SERLA is responsible for the water resources state management politics, which comprises the sanitation and recovery of fluvial and lacustrine basins, execution and maintenance of flooding and erosion control works, macro and micro-drainage works, evaluation and study of hydrographic basins and supervision of marginal areas of rivers.

In 1999, after a governmental changeover, several changes were applied to the State structure, including the creation of SEMADS – the Environment and Sustainable Development Secretariat, which kept practically the same duties of its prior agency. The most important change was related to the incorporation of DRM by the State Secretariat of Energy.

Environmental Licensing in Rio de Janeiro State

In a general way, the procedures related to the state licensing processes are similar to those described for federal rules being, in this case, established by Decree 1.633/77, which created the SLAP.

The SLAP licensing process, enacted before the Federal Law 6.938/81, is performed through three different steps, by granting the environmental licenses referred at Decree 1.633/77. The operation of SLAP is a duty of CECA and FEEMA.

The system has been regulated and improved by several decrees and deliberations of CECA.

State Law 1.356 (1988) is also another important licensing instrument related to the development, analysis and approval of EIA, but also establishing complimentary duties to the project responsible company.

The most important deliberations of CECA related to environmental impacts assessment issues are:

- ↪ Deliberation CECA 003/77 – Deals with the Licensing System for Pollutant Activities
- ↪ Deliberation CECA 1.078/87 – Guidelines for the implementation of the EIA and respective RIMA
- ↪ Deliberation CECA 1.173/87 – Participation and support to the community on the impact evaluation process.
- ↪ Deliberation CECA 1.344/88 – Regulates the development of public audiences as part of the licensing process for pollutant activities subject to the need of an EIA/RIMA.
- ↪ Deliberation CECA 2.117/90 – Guidelines for the development of an EIA/RIMA.

- ↪ CECA 2.117/90 - Guideline for the implementation of EIA/RIMA.

Jurisdiction of the Environmental Licensing of the Studied Project

The environmental licensing process of the project studied here is a jurisdiction of the Environmental and Sustainable Development Secretariat of Rio de Janeiro state, which assesses EIA/RIMA's of power concessionaires projects and grants the aforementioned licenses, pursuant to Decree 99.274/90 and Law n° 7.804/89 and in accordance with the aforementioned Resolutions CONAMA n° 006/87 and n° 237/97.

LAND USE AND OCCUPATION AND NATURAL RESOURCES

Water Resources and Aquatic Ecosystems

Aquatic ecosystems are legally protected by several instruments, as follows:

- ↪ Natural breeding areas are a property of the State and, since lagoons and lakes are well-known breeding areas of the aquatic fauna, their destruction is prohibited (Law 5.197/67);
- ↪ Effluents from any pollution source can only be disposed if in compliance with the conditions established by Resolution CONAMA 020/86 (as well as by NT – 202 R-10 of FEEMA – Criteria and Standards for the Disposal of Liquid Effluents).
- ↪ No oily effluents can be disposed into inland waters (Decree 50.887, 06/29/1961);
- ↪ The death of species of aquatic fauna due to effluents disposal or material dragged into rivers, lakes, dams, lagoons, bays or legal waters is a crime punishable by detention (Law n. 9.605/98, art. 33);
- ↪ Water intakes for industrial uses must be always performed downstream effluent disposal areas of the same industrial unit (State Constitution, art. 261);
- ↪ The State Constitution consider as permanent preservation areas: lakes, lagoons and estuaries, as well as the marginal protection areas f surface waters (art. 265, I e II).

In regard of water quality, Resolution CONAMA n° 20 classifies fresh, brackish and salt water, according to their prevailing uses, into nine classes, defining the maximum allowable limits for the evaluated parameters for each class. Resolution CONAMA 20/86 also defines possible characteristics of effluent streams in terms of their disposal from any pollutant source (art.21).

In Rio de Janeiro state, NT-202-R-10 rule (SEMA), classified Macaé river as a class 2 river, i.e., a river whose waters are destined to domestic supply, after conventional treatment, to the protection of aquatic communities, to primary-contact leisure, to the irrigation of arboreous, cereal and foraging cultures and as drinkable water for animals.

This same rule, approved by Resolution CECA nº 1.007/86, defines the maximum allowable limits of certain parameters in effluents to be disposed onto water bodies.

However, the water uses must be regulated by creating Hydrographic Basins Committees for the entire state of Rio de Janeiro, as required by Federal Law nº 9.433/97, that created the National Water Resources Policy, establishing a National Management System for Water Resources, whose duties include proposing criteria for granting rights to the use of water, as well for water taxation, according to pollution principles (“pollutant pays”).

It must also be mentioned here, the recent creation of the Intermunicipal Consortium for the Environmental Management of the Basins of Macaé, Macabú, Lagoa Feia rivers and Adjacent Coastal Zones, the so called MRA5 (June, 2000), which will be composed by the municipalities of Macaé, Rio das Ostras, Casimiro de Abreu, Trajano de Moraes, Nova Friburgo, Conceição de Macabú, Carapebús, Quissamã, Santa Maria Madalena, Campos dos Goytacazes and São João da Barra, as well as by Non-government organizations and private companies.

It must also be emphasized that, according to Directive nº 124 (08/20/80 of the Ministry of Internal Affairs, no potentially pollutant industries, as well as buildings or structures storing substances able to cause water pollution, can be installed within a distance of 200 meters far from water bodies.

Additionally, the State Constitution of Rio de Janeiro, pursuant to the National Water Resources Policy, defines that it is a duty of the public administration to promote the integrated management of water resources, based on the following principles:

- ↪ *Adoption of hydrographic basins and sub-basins as planning/execution units for plans, programs and projects;*
- ↪ Integration of water quality and quantity management;
- ↪ Compatibility between multiple, effective and potential uses;
- ↪ Participation of users on the water resources management and compulsory support to the recovery and maintenance of the water quality, according to type and intensity of the use;
- ↪ Emphasis on the development and utilization of biological methods and criteria for evaluating the water quality;
- ↪ Prohibition of the disposal of alcohol-distillation wastes and other wastes that could, even temporarily, make the water improper for consumption, normal use or the survival of species.

The same document also requires that all users of natural resources must perform monitoring programs, as defined by the respective environmental agencies. In terms of water collection, the constitution requires that the water intake for industrial purposes must be performed downstream the disposal of the liquid effluents of the plant. This condition is also requested by the Organic Law of Macaé

At last, it is important to mention the Self-Control Programs (PROCON) addressed to liquid effluents, such as:

- ↪ - Deliberation CECA 044 (02.01.79), which approved NT - 943 and established frequencies for measurements, sampling and analysis;
- ↪ - Deliberation CECA 1.079 (06.25.87) that defines guidelines addressed to the control of industrial liquid effluents;
- ↪ - Deliberation CECA 1.995 (10.10.90), that establishes guidelines addressed to the Self-control Program for Liquid Effluents.

Fauna, Flora and Conservation Units

The Forest Code, enacted in the mid 60's, supplemented by Laws nº 7.511 (07/07/86) and nº 7.803/8 and detailed by Resolution CONAMA nº 004/85, considers as permanent preservation areas, regardless any other legislation, forests and other forms of natural vegetation located:

“a) along rivers and any other water courses, within a marginal strip whose minimum width will be:

- 30 meters for rivers with width less than 10 meters;
- 50 meters for rivers with width between 10 and 50 meters;
- 100 meters for rivers with width between 50 and 200 meters;
- 200 meters for rivers with width between 200 and 600 meters; and,
- 500 meters for rivers with width higher than 600 meters.

b) around lakes, lagoons and water reservoirs, natural or artificial ones;

c) around springs or boils, regardless their topographic conditions, within a minimum radius of 50 m;

d) top of mounds, hills, mountains and ridges;

e) on slopes with declivities higher than 45°, or 100% at the highest declivity line;

f) in coastal forests, as dune fixation or mangrove stabilization elements;

g) at the edges of terraces and plateaus, from the relive break line and within a land strip never inferior to 100 m (horizontal projection);

h) at heights above 1,800 m, regardless the type of vegetation”

The Code still states that permanent preservation areas located within private lands can be forested or reforested by the Public Power, without expropriation, if the landowner refuses to do it.

Law nº 9.605/98 defined all types of aggressions to permanent preservation flora species or to the flora located within Conservation Units as crime, subject to detention (1-3 years) or fines ranging from R\$ 1,500.00 through R\$ 50,000.00 per hectare or fraction of hectare, pursuant to Decree 3.179/99.

As for the provisos of the Forest Code, granting the Executive power the right to declare other areas than the aforementioned ones as permanent preservation areas, it must be considered:

↳ the work of SERLA (supported by Law nº 650 of 01.11.83) that deals with the State Policy addressed to the defense and protection of fluvial and lacustrine basins of Rio de Janeiro and the Decree nº 2.330 of 01.08.79, which created the Protection System for Lakes and Water Courses - SIPROL. Among its instruments, the project addressed to marginal protection strips (*Faixa Marginal de Proteção* - FMP) must be highlighted, comprising the demarcation of such areas and the policy power of the agency over them

↳ The Organic Law of Macaé, which considers as permanent preservation areas:

I – the mangrove of Macaé river and its estuary ;

II – the coastal forest vegetation;

III – springs and marginal strips of surface waters; and

IV – vegetation of slopes subject to erosion and land sliding.

The partial or complete suppression of permanent preservation forests will be allowed only after the previous authorization of the Federal Executive Power and when required for allowing the development of public utility or social interest works, plans or activities (Law nº 4.771/65).

At last, it must be mentioned the possible applicability of Resolution CONAMA nº 002/96 which requires the application of 0,5% of the total value of the project on forest compensation projects. This resolution could be applied to the studied project considering the environmental impacts associated to the implementation of the gas pipeline.

In regard on fauna, Law nº 5.197 (01/03/1967, changed by Laws nº 7.584/87, nº 7.653/88 and nº 7.679/88 and regulated by the Decree 97.633/89), ensures the protection of any species of wildlife animals, as well as of their nests, shelters and natural breeding areas located within state lands, prohibiting the utilization, hunting, destruction or catching of these species.

Special attention must be given to Law 7.653/88, which considers any actions against the wildlife as non-bailable crimes; as well as to the Directive IBAMA nº 1.522 (12.12.89), which informs the official list of Brazilian threatened species.

At last, the recent Law on Environmental Crimes must also be mentioned here, since it expanded the ambit of the legal protection to the fauna.

The following Conservation Units within the region must be listed:

- ↪ Parque Nacional da Restinga de Jurubatiba (National park, created on 04/29/98, comprising the area of the municipalities of Macaé, Carapebus and Quissamã);
- ↪ Parque Municipal do Atalaia (created by the Municipal Law No. 150098 of 06-24-95, comprising areas of the municipality of Macaé);
- ↪ Reserva Biológica Fazenda União (Biological reserve, located in the basin of Macaé river, upstream the project site, in the municipality of Casemiro de Abreu. Created by the Decree No.76 of 04-22-98).

Air

The PRONAR (National Program on Air Quality Control) was established by CONAMA 005/89 in order to define strategies for controlling, preservation and recovery of air quality for the whole national territory, establishing definitions and guidelines for prevention and management.

Based on this program, Resolution CONAMA No. 003 (06/28/1990) was enacted, defining air quality standards, sampling and analysis methods for air pollutants and quality levels addressed to an Emergency Plan for Critical Episodes of Air Pollution, aiming at measures to be taken by state and municipal governments in order to prevent severe and imminent risks to the community health.

These monitoring activities are performed in Rio de Janeiro state by FEEMA, supported by entrepreneurs and taking in account the air pollution Self-control Programs created by CECA (Deliberation nº 021 of 03.15.78, which approved NT 603 (defining standards and periodicity) and nº 935 of 08.07.86, which approved DZ-545).

Basically, no enterprise must emit air pollutants at rates that could reach concentrations higher than the air quality standards in its vicinities.

Noise Level

Noise emissions are addressed at Resolution CONAMA 001 (03.08.90), which establishes that the noise levels due to industrial, commercial, social or other activities must follow the criteria and guidelines established at NBR 10.152 Code, which establishes acceptable noise levels, aiming at the community comfort and health protection.

The matter is additionally regulated in Rio de Janeiro state by Law 126 (05.10.77), that considers noise pollution harmful to the human population comfort and, therefore, liable to be punished, whenever the noise levels reach a value higher than 85 dB(A) outside the room/building where the source is located (measured according to MB-268 ABNT std.).

However, this law is restricted by the Directive n° 92 (06.19.80) of the Ministry of Interior Affairs, that considers as harmful to the human health all noise emissions that:

- *reach a noise level above 10 dB above the traffic-free background levels, outside the room/building where they were generated;*
- *reach over 70 dB (daytime) or 60 dB (nighttime) outside the room where they were generated, regardless the background level;*
- *reach levels higher than those considered acceptable by ABNT NB-96 standard within the room where they were generated.*

Therefore, there are two maximum standards to meet at the same time: an absolute value and a second one, related to background levels. Therefore, for an area with low background levels, the legal limits will be lower than those to be met in a noisy area.

Control of Industrial Wastes

The conditions for the treatment and disposal of solid wastes were established by the Directive 053 (March, 1979), indicating that projects specifically addressed to the treatment and disposal of solid wastes, as well as the supervision of their implementation, operation and maintenance, are subject to the approval of the state environmental agency.

Resolution CONAMA n° 006/88 (June, 1988), establishes that the licenses of companies is conditioned to an inventory of their industrial wastes, whether generated or stored in the country. The resolution does not specify if the targeted wastes are hazardous or not and defines a maximum term of 90 days for the companies to meet the proviso of the law.

One of the difficulties observed about industrial wastes is related to their classification. Both the Basilea convention method and the *Recovery Conservation Resource Act* (RCRA, 1984, EUA) are used for this purpose.

There is also a Brazilian technical standard (NBR n° 10.004) that can be used for the same purpose. This standard dates from 1987, before Basilea convention, and is very similar to RCRA standard.

Some ambiguous definitions can be also observed between CONAMA and ABNT: while the first one defines a Class III waste as non-inert, NBR n° 10.004 standard considers those wastes as Class II.

The criteria addressed to the management of spent lube oils are defined at Resolution CONAMA 009/91, which states that all contaminated and/or spent oils must be recovered and properly disposed. The resolution prohibits the disposal of these wastes onto the soil, surface or groundwater, onto the ocean and any other drainage system.

The licensing system of Rio de Janeiro state, SLAP, defined a specific system addressed to the control of solid wastes, from their origin to the final destination. The system was implemented by FEEMA (Guideline DZ-1.310, Deliberation CECA n° 673, - June 27, 1985) and involves the generator, the transportation company and the final receiver of industrial wastes. The system is intended to prevent the wastes to be sent to unauthorized facilities for treating or final disposal purposes.

Both hazardous and common industrial wastes are covered by this state system.

This guideline defines hazardous industrial wastes as solid, semi-solid or liquid wastes resulting from industrial activities (including the treatment of liquid or gas effluents), which can not undergo conventional treatment processes and whose characteristics are associated to effective or potential hazards to the human health and the environment, thus requiring special cares regarding their storage, recovery, transportation, treatment and final disposal. The guideline also defines common industrial wastes as all solid or semi-solid wastes similar to urban solid wastes.

The final disposal of industrial wastes is regulated by Guideline DZ-1.311 (Deliberation CECA n° 3.327, November 29, 1994), which established the licensing processes addressed to the final destination of solid, semi-solid and liquid wastes from any pollution source that can not undergo conventional treatment processes.

It is important to consider here that the transferal of industrial wastes from a less critical hydrographic basin to a critical one, aiming at the disposal of these wastes into the ground, is not allowed. Likewise, the uncontrolled disposal of solid wastes into the ground is generally prohibited, even in flooding areas, aquifer-recharge areas, protected areas and fragile ecosystems.

The responsables for activities that somehow took to the disposal of wastes in unauthorized areas, in the past, without the awareness of FEEMA, must inform the quantities and the quality of those wastes, as well as the area and the date of this disposal.

Inert, non-recyclable wastes (Class III) can be disposed in sanitary landfills, including paper, cardboard, glass, office and cafeteria wastes. Sludge wastewater treatment plants can be also disposed likewise, as long as properly authorized by FEEMA and with a humidity content lower than 70%.

Most of the solid wastes generated by Macaé Merchant TPP must come from the water treatment plant. Therefore, the sludge generated by this process is considered as a non-hazardous, Class II wastes, in accordance with NBR 10.004 and can be properly disposed within the site, after dewatered. This waste will contain traces of chemicals used in the process, namely aluminum sulfate. The final destination of this waste must be informed to FEEMA, according to Guideline FEEMA DZ-1310. The remaining wastes generated by the plant operation will comprise office wastes and non-hazardous or inter wastes, that can be sent to the municipal sanitary landfill of Macaé, licensed by FEEMA.

Territorial Arrangement of Macaé

The municipal urban legislation comprises the provisos of the Parceling Laws and Land Use, Occupation and Zoning, as well as the Organic Law. The Urban Directing Plan, based on a comprehensive diagnosis of the urban problems and trends, defines a conception for the municipal growth and occupation, addressed to the arrangement of the land occupation and to the improvement of the life quality of the population. The guidelines of this Plan support the public administration on establishing urban policies, resulting on the definition of the form, type and location of land use interventions.

The municipal zoning of Macaé defines the area of Macaé Merchant will be implemented as a rural area and, therefore, the plant implementation is subject to the municipal approval.

**THE REGION WHERE THE PLANT WILL BE
IMPLEMENTED**

1. WHICH ARE THE PHYSICAL CHARACTERISTICS OF THE REGION ?

Macaé Merchant TPP will be installed within an area located close to BR 101 road, in the locality of Severina. A brief description of the region where the plant will be implemented is presented next.

Relief

Macaé river basin shapes large alluviums that cross old lands and comprise the main features of the regional physical settings.

The region is mostly composed by hillocks and mounds, but hills, mountains and ridges also occur, the most remarkable of them represented by Serra das Pedrinhas, NE-oriented. Alluviums are shaped from the upper and medium flow of these rivers, while flooded areas are shaped from the lower Macaé to its mouth.

Macaé river shapes a large alluvial plain, filled with sediments, mainly gravel, sand and unconsolidated silt.

Recent alluviums shape the coastal plains, which comprise fluvial valleys of large plains and beach ridges. Crystalline rocks excavated by the drainage compose the Coastal Hills and Massifs.

The most important tributaries of Macaé river basin are Purgatório river, Pedrinhas' channel and Imboacica river at the right bank and São Pedro river, at the left one. Several channels, including the one that drains Macaé river, cross alluviums and flooded lands, comprising an important human intervention to the natural drainage system. A summary of the geological and geomorphologic characteristics of the region is depicted at Figures 5.2.4-1 and 5.2.4-2.

Soils

The soils of the region also mirror the course of Macaé river. Organic soils occur from the medium course of the river and up to its mouth, characterized by a variable content of organic matter in fluvio-lacustrine sediments. The poor drainage of these soils is characterized by phreatic basins. Alluvial soils prevail at the spring and along the upper course of the river, allowing a diversified agricultural utilization, including rice,oleraceous and pastures. Yellow and Red Latosols and Podzols prevail in crystalline rock areas, both used as pastures. Figure 5.2.5-1 displays the types of soils existing in the studied region.

Water Resources and Water Quality

The most important fluvial system of the region comprises Macaé river basin, a 1,765 km² basin bounded to the north by part of Macabu river, an affluent of Lagoa

Feia; to the south by the basin of São João river; to the west by the basin of Macacu river and to the east by the Atlantic Ocean.

Figures 5.2.4-1 Geology

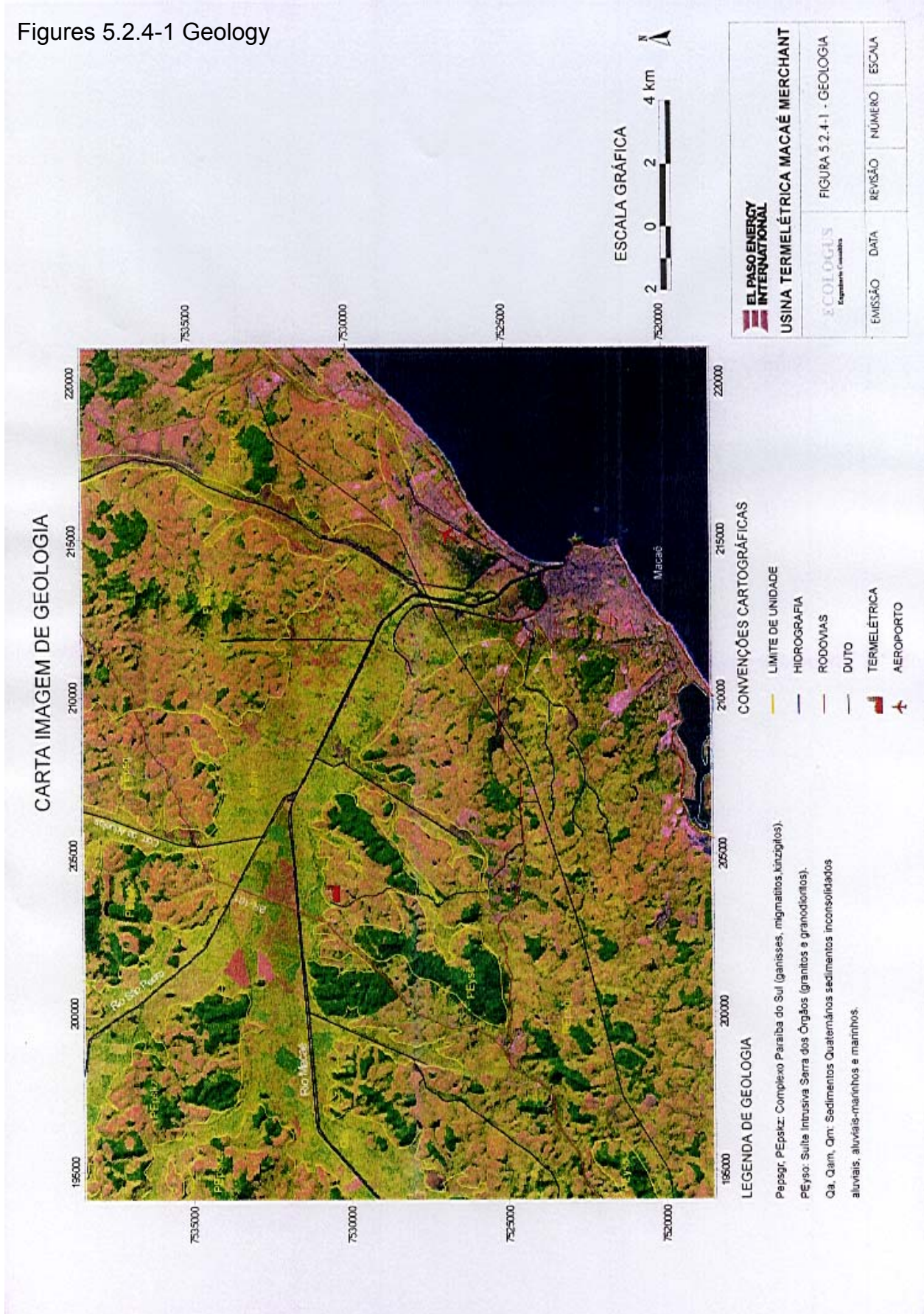
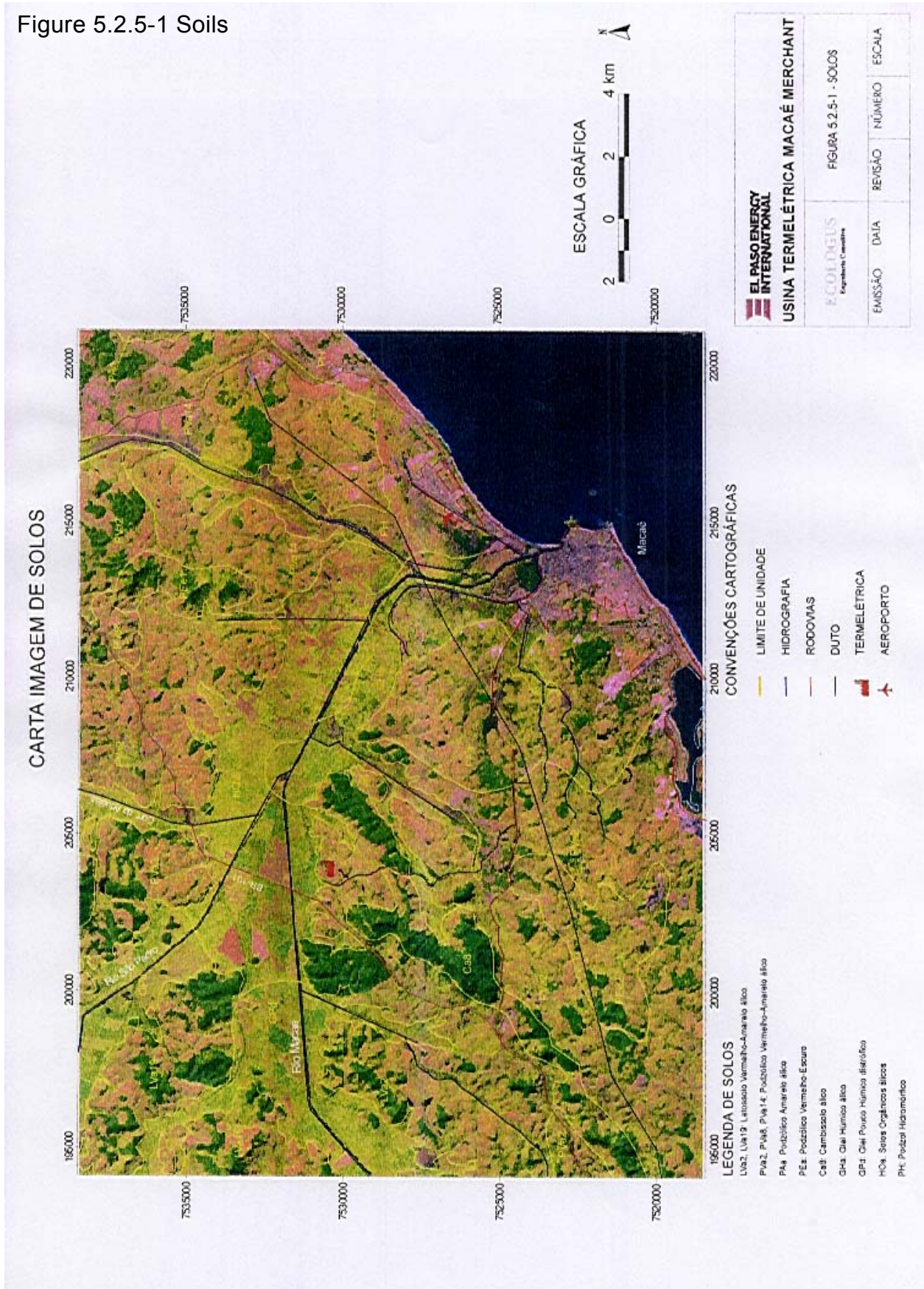


Figure 5.2.4-2. Geomorphology



Figure 5.2.5-1 Soils



The basin covers a large portion of Macaé and part of the municipalities of Nova Friburgo, where the springs are located, and Casimiro de Abreu, Rio das Ostras, Conceição de Macabu and Carapebus. Close to 82 % of the basin area is located in the municipality of Macaé.

Former Bagres river, Macaé river springs at Macaé ridge, close to Tinguá peak (height: 1,560m), in Nova Friburgo, flowing for 136 km before reaching the sea, near Macaé city. The main tributaries of the river are, at the right margin, Bonito, Purgatório and Pedrinhas rivers; Abacaxi and Carão creeks; Teimoso river, Roça Velha and Belarmino creeks and Três Pontes river and, at the left margin, Sana, Atalaia, São Domingos, Santa Bárbara, Ouro Macaé, São Pedro and Jurumirim rivers and Genipapo, Guanandirana and Sabiá creeks.

DNOS has trained 25km of the lower Macaé and some of its tributaries, such as São Pedro river and others (SEMADS, 2000).

Macaé river basin, Lagoa Feia basin and the adjacent Coastal Zone comprise the Macro Environmental Region No. 5 – MRA5 of Rio de Janeiro state, located at the southeast region of the state and bounded by the following basins: Paraíba do Sul river basin to north and west; São João river basin to south and the Atlantic Ocean to east (Figure 5.2.6-1).

Macaé river is the water supply source of the municipal seats of Macaé and Rio das Ostras, as well as of the locality of Barra de São João. The river also supplies water for industrial uses, such as for S and, in the future, for the thermal power plants planned for Macaé.

Both domestic sewage and industrial effluents are disposed onto Macaé river, especially from agricultural activities , emphasizing sugar cane cultures, and cattle raising.

As for the water quality, no evidences indicate the pollution of Macaé river by special contaminants, other than coliform bacteria.

Mineral Resources

The most important resource of the region is the petroleum explored at Campos Basin, which concentrates 82.65% of proven reserves of oil and 40.89% of the gas reserves of the country. Oil exploration activities are important in the entire north region of the state, but especially representative in the municipalities of Campos de Goytacazes and Macaé.

Climate

The climate of Macaé is classified as sub-tropical, with moderate humidity, dry winter and wet summer.

Figure 5.2.6-1 Macaé river basin

The site is located in the coastal area, 15 km far from the shoreline but still under a strong marine influence. The regional relief is predominantly flat and the small hills observed in the area are not able to produce orographic effects to the local rainfalls. The topography of the studied region is displayed at Figure 4.2.

The pattern of the main climatic elements is moderated by the proximity to the large mass of water represented by the Ocean.

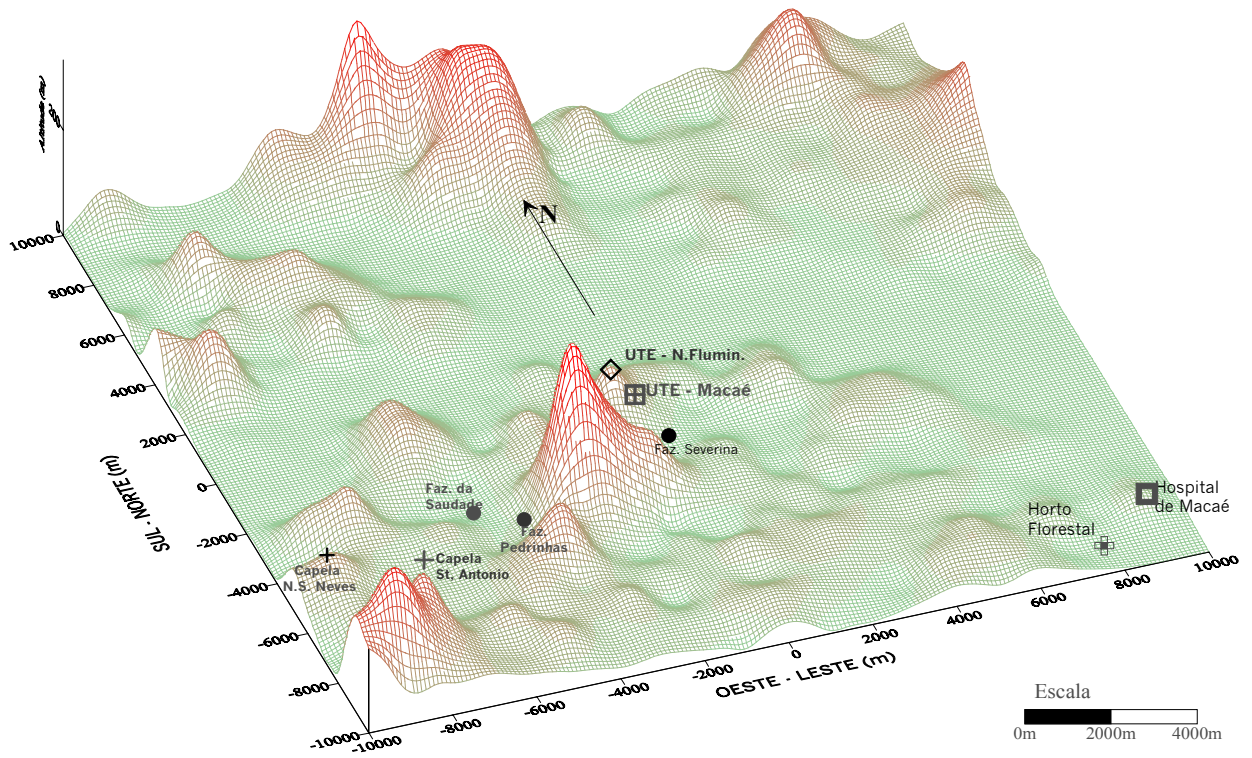
The annual mean rainfall index is 1,177.6 mm (mean value for the period 1961-1990) and the dry season comprises the months from May through September, while the wet season is observed between November and January.

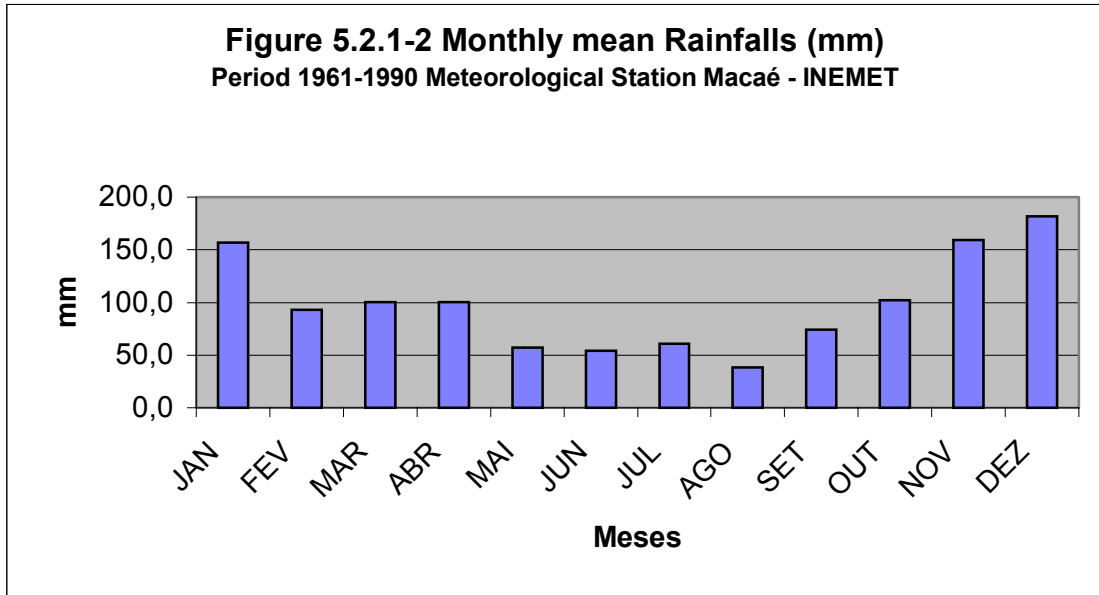
The annual average number of rainy days (indexes higher than 0.1 mm) is 122 days for Macaé, ranging from 6 days/month (August) through 14 days/month (December).

Rainfall indexes higher than 120 mm have occurred in Macaé for 24-h periods, even during winter months (130.9 mm in June and 124.8 mm in July), reaching a peak of 191.0 mm in April, which is higher than the monthly mean indexes observed for the period (181.6 mm in December). Figure 5.2.1-2, next, depicts the variation on the average rainfall indexes for the municipality.

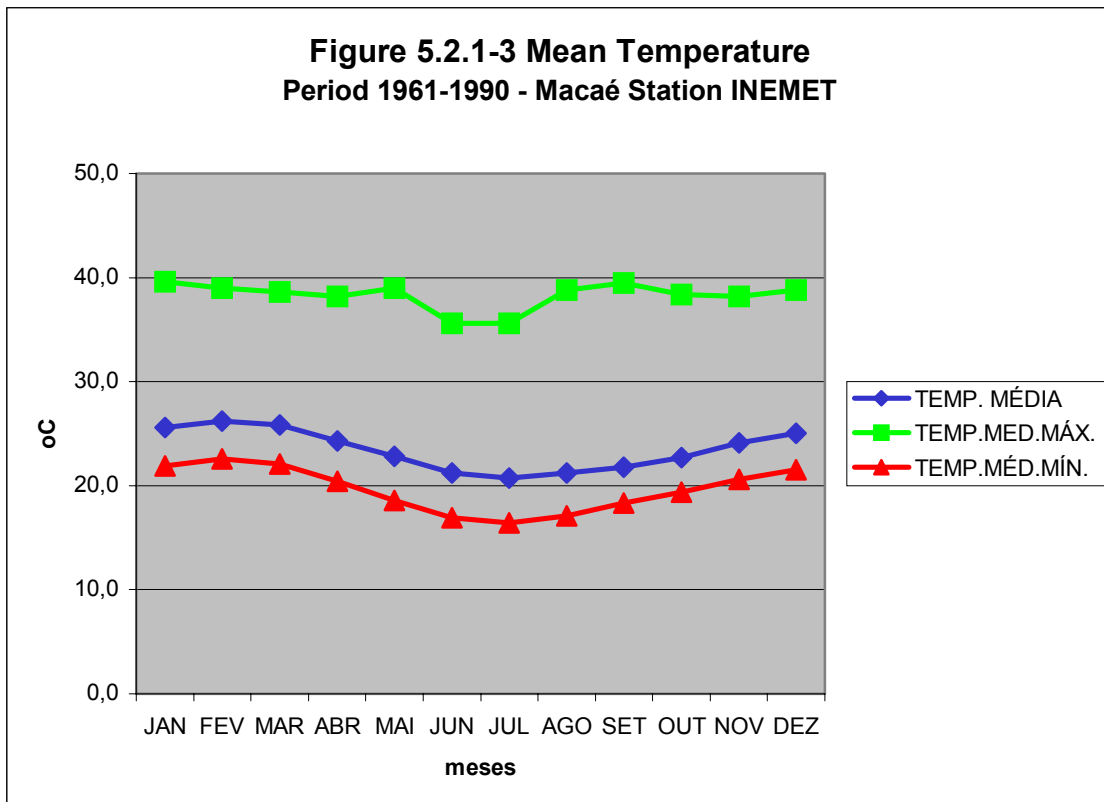
Figure 4.2

**PROJETO: USINA TERMOELÉTRICA - MACAE MERCHANT .
TOPOGRAFIA - TRECHO DA ÁREA DE INFLUÊNCIA
MUNICÍPIO DE MACAÉ - RJ**





Climate data provided by the Meteorological Station of Macaé (83749 - INEMET) for the period between 1961 and 1990 indicates that the mean temperature varied between 19,7 °C (coldest month) and 39,6 °C (warmest month). The annual mean temperature of the region is 23,5 °C. Figure 5.2.1-3 displays the monthly distribution of mean, maximum mean and minimum mean temperatures.



The winds are monitored in Macaé by DEPV/ INFRAERO. Although the available data are scarce, it is possible to observe that the winds predominantly blow to north-northeast for the surveyed period. The mean velocities of the winds for the same period were 9,3 km/h (March – July, 1997) and 14,8 km/h (August, 1997).

2. HOW ARE THE VEGETATION AND FAUNA OF THE STUDIED REGION?

Vegetation

Ecosystems of coastal plains are usually among the most impacted ones by human actions. The historical occupation process of the municipality of Macaé, stimulated by the easy access to low-sloped areas, took to a gradual extermination of most of the vegetal formations of these environments.

Macaé plains have undergone strong interferences of human activities since century XVII, initially represented by the sugar cane culture, later replaced by cattle raising activities. The original native vegetation, predominantly composed by forests, in some areas subject to periodical floods, was almost entirely replaced by pastures and sugar cane plantations .

Nowadays, the remainders of forest formations are scarce, mostly restricted to the slopes and tops of mountain ridges and isolated hills and usually represented by secondary-regeneration woods or by vegetation spots deeply changed in terms of their original structure and composition, resulting from the strong and continuous exploration of their native species.

Physiognomically, the vegetation that can be observed in the vicinities of the site can be classified as human fields/pastures and forests. The vegetation and the land use within the site area can be observed at Figure 5.3.2-1, indicating a predominance of pastures and fields, since the largest forests and secondary vegetation spots of the region are located in the north and northwest areas of the municipality, far from the site. Coastal forests can also be observed at the mouth of Macaé river.

Fields and Pastures

The fields are mostly represented by capim-braquiária associated to invading species, such as rabo-de-burro.

Vegetation Figure 5.3.2-1



Forests

Macaé river basin comprises two different types of forests: the Seasonal Semideciduous Forest, located on lowlands, closer to the coast, and the Dense Ombrophylous Forest, in addition to Pioneer Formations under Marine Influence (coastal forests or restingas).

The Dense Ombrophylous Forest (or Atlantic Rainforest) is related to climatic aspects, such as high temperatures (mean: 25°C) and high rainfalls, well distributed along the year (up to 60 dry days). This formation covers the slopes of the Serra do Mar (Macaé ridge) where the headwaters of Macaé river are located.

The Seasonal Semideciduous Forest is characterized by a double climatic seasonality: a tropical one, with strong rainfalls, followed by a dry season (longer than 60 days). The percentage of trees that loses the leaves during the dry season lies between 20 and 50%. Those formation occurs on hills and coastal massifs.

These formations are usually dense and composed by arboreous species, such as carobinha, cinco-folhas, mamona-do-mato, angelim-tento, sharing the spec with palm trees, such as iri, pindoba and jacitara. The human-changed spots usually display species such as the taquara, as well as shrubs and herbs, such as canxim-mirim, pixirica, pasto-de-anta and caiapiá, among others. Some bromeliaceae and cactaceae can also be observed.



Photo 1 – Spot of secondary vegetation within the Indirect Influence Area of the Project



Photo 2 - *Dichorisandra thyrsiflora*, *Pereskia aculeata* and *Streptocalyx floribundus*.

Coastal Forests

The bar of Macaé river is covered by remainders of flooded fields and coastal forests, with species varying from herbaceous to arboreal (forests), located on the quaternary plain to north-northwest of the Bar (partially protected by the National Park of Restinga de Jurubatiba).

Three communities occur along the sand ridges. Creeping formations are observed close to the seashore, composed by species commonly observed in all sandy beaches of the country, mostly represented by gramineous.

A dense, shrubby community can be found farther from the seashore, away from the flow tide but still tolerant of some sand, such as the aroeira.

The herbaceous formation is composed of species tolerant of a wide change on the soil humidity, from totally dry to soaked or even flooded.

A shrubby vegetation can also be found on some swale areas, most likely representing a transition step to the coastal forest.



Photo 3- Detail of the coastal forest in Macaé region.

Mangroves

The mangroves of Macaé are only found at the estuary of Macaé river, within the influence area of the tides, growing on muddy sediments. These communities have been undergoing a strong pressure due to the proximity to urban areas, especially represented by the installation of illicit land plots.

Fauna

Forests

The original fauna of the Atlantic Rainforest has been better studied in the last years, especially in the southeast region, by means of analysis of communities of different groups from preserved areas (parks, reserves or other conservation units).

The species historically registered for the region include some relicts, such as the lontra, mico leão dourado, onça, anta, bugio, suçuarana, gato do mato, jaguatirica and cachorro do mato vinagre.

The most important agent of the extinction processes identified in the region is the fragmentation of habitats and the suppression of unique forest formations. The devastation and impoverishment of the stability of climax ecosystems in the studied area and most specifically in the coastal region of Rio de Janeiro state is very effective and the region is changed along most of its extension.

The forest formations surveyed for this study are remarkable by the poor number of registered species. This scenario could result from hunting/catching activities performing in the region, which can lead to the extinction of some species when concentrated on small remaining spots of vegetation. It could also be an effect of the expansion of forest edges and a contraction of their inner portions. This effect generates an effective forest area but provided with a low support capacity in terms of a forest fauna.

Therefore, birds typically observed on plantations and open areas, such as anus, canário-da-terra, João-de-Barro and caboclinhos, are often found. The gavião-pegapinto and chimangos, on the other hand, are carnivorous species often found in these formations.

The presence of some fructiferous trees and small spots of shrubs allows some periquitos and insectivorous birds to be found in these areas, such as the choça.



Photo 4- *Myarchus ferox* and *Euphonia clorotica*

Fields and Pastures

The birds most often observed in the fields are the gavião-peneira; carrapateiro; quiriri; seriema; anu; anu-branco; saci; canarinhos, pica-pau-do-campo; João-de-barro; freirinha; guaracava; andorinha-grande-de-casa; sabiá-do-campo; maria-preta; tico-tico; tiziu and pardal.

Several species commonly observed in open formations, such as fields, are easily adjustable to pasture areas, such as the corujas-buraqueiras and urubus-caçadores.

Some carnivorous species can be also observed flying over the pasture areas of the region, such as the gavião peneira and the casaca de couro. Opportunist species, such as urubus, carcarás and gaviões-carrapateiros are also often found in these areas.

Mammals are less expressively observed in the area and the most common species are the gambá and several rodents, such as preá. Other mammals, such as the furão and the cachorro do mato are only occasionally observed.

The only specie of amphibians identified in the area was the sapo cururu. On the other hand, several reptiles were observed, widely distributed throughout the studied area, such as teiu, lagarto verde, calango, lagartixa, cobra de vidro, cobra capim and jararaca, among others.

The maricá is very common on wet, poor-drained lowland areas, forming thick shrubby groups, while the taboa prevails on marshy areas. The following birds were observed flying over marshes and channels: gavião-carijó, freirinha, bem-ti-vi, polícia-inglesa, biquinhos-de-lacre and bem-te-vi-de-penacho.

Drained areas were represented by species such as lavadeira, quero-quero, sanhaços, saíra-amarela, suiriri and garça-vaqueira.

Some species were also observed moving between these spots, such as saracura-sanã, garça-branca, maria-faceira, socozinho and jaçanãs. Feces and footprints of capivaras and mão-pelada were also registered.

Coastal forests

Most of the fauna of the coastal forests is represented by species observed in the Atlantic Rainforest. The only exception seems to be the sabiá-da-praia, often caught and kept captive for its ability on imitating several sounds.

The shrubby, thick formations existing in the studied area are characterized by species such as gavião-carijó; pomba galega; João-velho; pica-pau-anão; bico-chato-amarelado; miudinho; sebinho; and vi-vi.

On the other hand, the fields present a less rich fauna in terms of conservation. This environment can be characterized by species such as garça-vaqueira; gavião-caboclo; quero-quero; pica-pau-do-campo; joão-de-barro; bem-te-vi-vaqueiro; andorinha-do-campo; sabiá-do-campo; tiziu and canário-do-campo.

Mangroves

The mangrove areas of Macaé river are characterized by visiting marine groups, such as atobá-marrom, fragata, trinta-reis-de-bico-vermelho and trinta-reis-de-bico-amarelo, trinta-reis-ral, ostreiro, gaivotão and, occasionally, the gaivota rapineira.

Aquatic Ecosystems

The municipality of Macaé is almost entirely located within Macaé river basin, which comprises a dense drainage network located within a wet tropical region, as mentioned before.

The piabanha probably occurs in continental environments, as mentioned by inhabitants and fishermen, comprising a specie that is distributed throughout the entire state, from Itabapoana river to São João river. This specie must be highlighted, since it is mentioned in the list of threatened species of Rio de Janeiro state.

Some species can be also listed as the most common ones in backwater environments: barrigudinhos, acarás, mandis, some cascudos, traíras, bocarras, tuviras and jundiá.



Photo 5 - *Mimagoniates microlepis*, *Imparfinis minutus*, *Corydoras barbatus* of Macaé river basin.

The backwaters usually attract species that live on deposits, such as cascudos, curimatá and sairu. Since several of these groups are used as food for the population, these areas, namely the main riverbed of Macaé river, comprise important fishery areas.

Small bagres, lambaris, tamboatás, tuviras, cumbacas and mussuns can also be found in these systems.

The estuarine areas of Macaé river present a strongly unstable composition of fishes. Nevertheless, a typical arrangement can be described for these areas, very common to other estuarine areas of the state and composed by species such as carapebas and carapicus, barrigudinhos, robalos, acarás and peixes-rei.

Conservation Units

National Park of Restinga de Jurubatiba

This park was created on 04/29/98, comprising an area of 14,860 ha, located in the shore region of the state, in the municipalities of Carapebus, Macaé and Quissamã,

The park comprises a sandy quaternary plain, characterized by a smooth relief with maximum elevations of 12m and soils composed by quartzose marine sands intercalated by hydromorphic podzols. A number of aquatic and amphibian environments found in this area makes of this region one of the most important of the Brazilian coast in terms of diversity of ecosystems.

Photo 6 – Aerial view of the National Park of Restinga de Jurubatiba



The park is located 19 km far from the project site .

Biological Reserve Fazenda União

This reserve was created on April 22, 1998, aiming at ensuring the protection, conservation and recovery of remainders of the Atlantic Rainforest and associated formations and fauna, especially the mico-leão-dourado (*Leontopithecus rosalia*). The

reserve is managed by IBAMA and comprises a total area of 3,126 ha, 2/3 of them covered by a dense Atlantic Rainforest. The reserve is located 18 km far from the project site.



Photo 7 – Mico-leão-dourado at the Biological Reserve Fazenda União

Atalaia Municipal Park

This park was created by the Municipal Law No. 150098 on 06-24-95 and comprises a total area of 235 ha, addressed to the preservation of remainders of the Atlantic Rainforest, including areas of sub-mountain and lowland formations, these ones almost entirely decimated in the region. This park is located approximately 13 km far from the project site.



Photo 23 – liaceae in Atalaia Municipal Park

3. HOW ARE THE ECONOMY AND THE POPULATION OF MACAÉ ?

The Studied Area and the History of Its Occupation

In terms of socioeconomic aspects, the study area corresponds to the north region of Rio de Janeiro State, comprises by nine municipalities: Campos dos Goytacazes, Macaé, São Fidelis, São Francisco de Itabapoana, São João da Barra, Conceição de Macabu, Quissamã, Cardoso Moreira and Carapebus.

Out of these municipalities, two of them must be emphasized for their roles as economical poles: Campos dos Goytacazes, the center of commercial, industrial and service activities of the region; and Macaé, where the Plant will be located and where most of the industrial and service activities of the region are concentrated. Therefore, Macaé will especially be focused by this analysis.

The evolution of the North Region of Rio de Janeiro state has started in the century XVIII and undergone different periods of economical growth and stagnation, whether by the increase or the shortage of regional investments or by changes on government policies. The importance of the sugar cane culture was alternated by the predominance of a diversified culture and cattle raising activities.

From 1979 on, the national oil industry has started to grow fast, after the discovery of new oil fields in Campos Basin.

This economical growth changed, once again, the socioeconomic structure of the region due to the new demands of the municipalities, related to the implementation of activities directly or indirectly associated to the oil exploration. This new scenario was responsible for the migration of rural labor to the cities, in search of salaried jobs.

Nowadays, these municipalities have been trying to define new development structures addressed to the consolidation of the tourism in the region as an economical push to commercial and service activities.

The implementation of the government policy addressed to the expansion of the energetic matrix of the country, predominantly composed by the hydroelectric and oil-fired modes, new development possibilities become available to the region, associated to the implementation of natural gas thermal power plants, producing an environmentally clean, less impacting power, such as Macaé Merchant TPP.

Characterization of the Municipality of Macaé

Macaé is bounded by the municipalities of Conceição de Macabu, Carapebus, Rio das Ostras, Casimiro de Abreu, Nova Friburgo and Trajano de Moraes. The municipality was emancipated from Cabo Frio and Campos de Goytacazes on 01/25/1814 and presently occupies an area of 1,218.8 km² with a total population of 113,042 inhabitants (1998).

The first Development Plan of the municipality was performed in 1979, aiming at directing the municipal growth after the installation of Cabiúnas station (PETROBRAS). This plan comprised legal instruments addressed to the land use and occupation and aimed at supporting both the demographic growth and the expansion of oil-related activities in the municipality.

Three new plans were proposed or reviewed from 1980 through 1989, addressing issues related to the municipal zoning, to the demarcation of the urban perimeter, to the Soil Parceling Law and to impact assessment studies for the region. These issues were considered as a result of the uncontrolled urban expansion that had been causing severe changes on both urban and natural landscapes, under the pressure of increasing migration flows toward the municipality. These plans were never approved but comprised the basis of the Municipal Directing Plan of Macaé (1990) the only planning instrument presently used by the municipality.

For several years, the basis of the municipal economy was the culture of sugar cane. After the implementation of PETROBRÁS station and the start up of the activities related to those facilities, the economy of the municipality has turned to industrial, commercial and service activities.

The expansion of the oil activities has generated over 7,200 direct jobs and 14,000 indirect ones. Another important development agent of the local economy is represented by tax and royalties levies resulting from the oil exploration activities. According to data provided by the Finances Secretariat of Macaé, the ICM levies exceeded 100% in the municipality, between 1995 and 1999.

The investments expected for the municipality within the next 5 years are over R\$ 10 billions and must diversify the present demands for services and equipment, creating new economic activities in the region, such as lodging, catering, drilling companies, industrial assemblage, heavy-duty mechanical services, transportation services and supplies for offshore facilities and minor service providers.

These changes can be already observed for the tertiary sector that presently holds 41% of the municipal labor, while the secondary and primary sectors are represented only by 8% and 4%, respectively.

If the primary sector is less expressive in the municipality, when compared to the present industrial activities, it is really important in the state as a whole: cattle raising activities occupies, today, 40% of the municipal territory and the third position in the state ranking.

RELATED PLANS AND PROGRAMS

The characteristics of both the project and the region are related to three main planning areas:

- ↪ The federal one, in terms of the energetic planning, most specifically represented by the Expansion Decennial Plan 2000-2009, where the thermal power generation program is positioned;
- ↪ The state one, represented by the integrated environmental planning of the hydrographic basins, as the basis for the development of regional development and management policies in the area where the plant will be located (Macro Environmental Region MRA-5);
- ↪ The municipal one, represented by the definitions and guidelines of the territorial arrangement and management of the municipality.

The project is justified in the Decennial Plan, since it represents an expansion of the thermal park, which is one of the main short-term goals of the plan.

On March 14th, 2000, the Government of Rio de Janeiro stated divided the state territory into 7 Macro Environmental Regions (Decree N ° 26.058), as depicted at Figure 4.2.1.

These regions were formally created by a decree (03/14/2000) and comprise formal planning units in terms of the definition of environmental and sustainable development policies. They are defined according to the boundaries of hydrographic basins to which public environmental management structures are defined, pursuant to the environmental issues and sustainable development potentialities of each region.

The creation of these regions aims at inducing the establishment of regional management models, based on the interaction between the municipalities of each region. The Macro-Region MRA-5, where Macaé is located, comprises 11 municipalities totally or partially located in the basins of Macaé and Macabu/Lagoa Feia rivers and the adjacent coastal region (Figure 4.2.-2).

In terms of municipal plans, the main interface between the project and municipal programs and plans is represented by the guidelines of the Directing Plan of Macaé (1990).

Figure 4.2-1 MRA

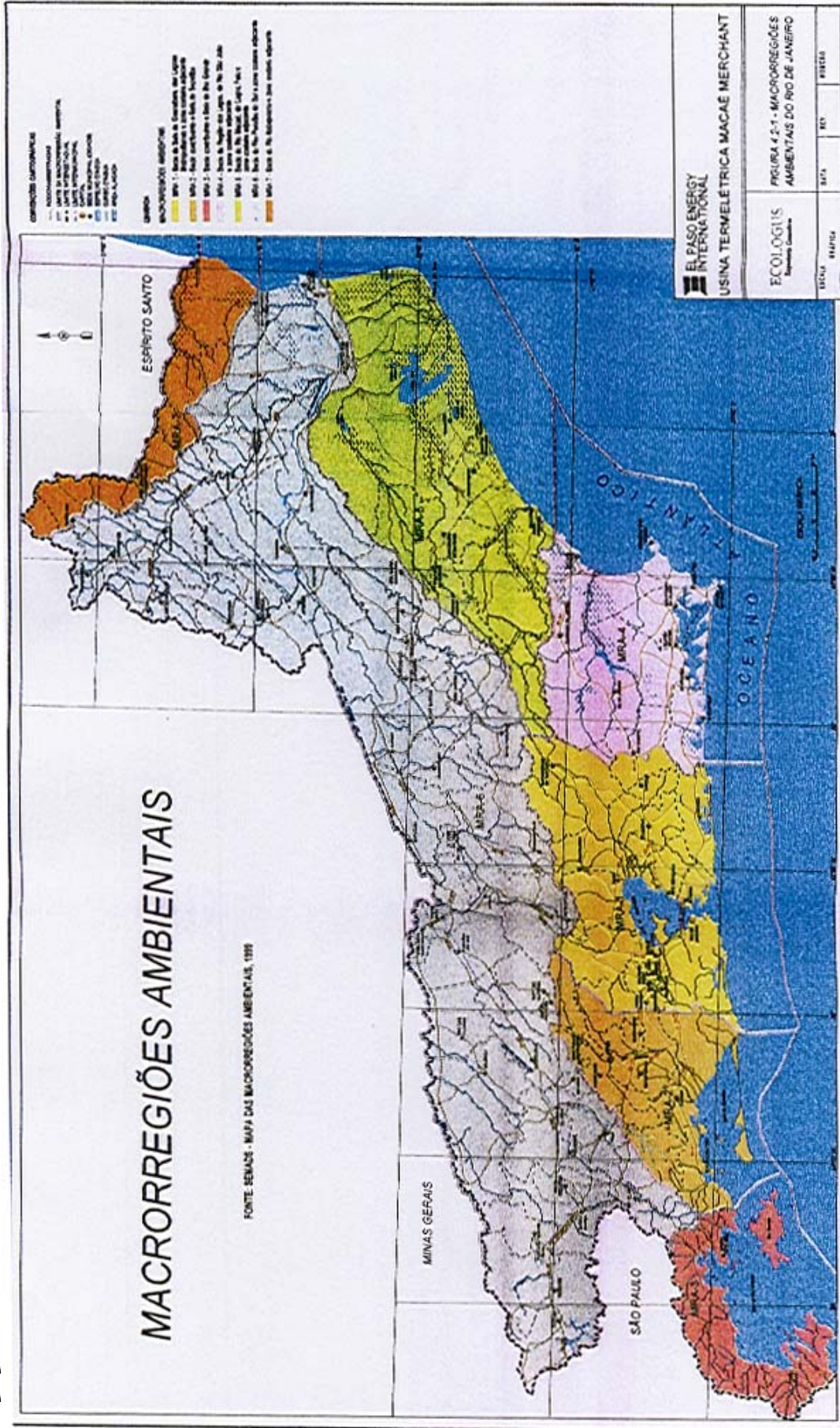
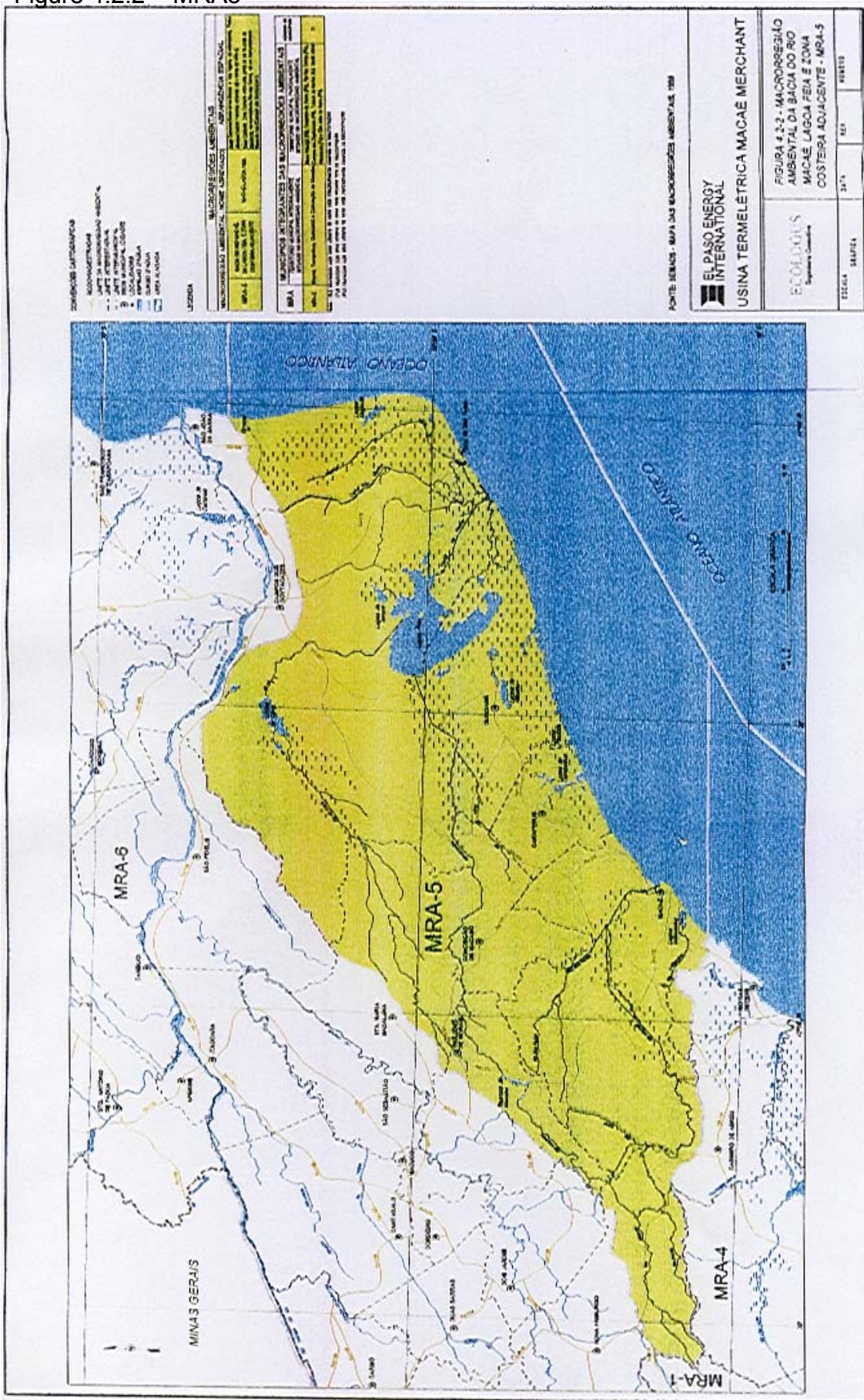


Figure 4.2.2 – MRA5



The Directing Plan of Macaé does not address a geographic planning of the land use, but considers that these definitions must arise from the macro zoning of the municipality, which has not been performed, yet. Nevertheless, according to the existing administrative definitions of the municipality, the plant site is located within a rural area, a region occupied by agricultural and cattle raising activities, subject to periodic floods of Macaé river and, therefore, not liable to the urban expansion of the municipality. It must be reminded here that the site is located above the flooding area of the river.

A study performed for a similar project (Norte Fluminense TPP), located in an area adjacent to the site of Macaé Merchant TPP, the Municipal Administration was formally consulted and did not express any objections against the implementation of the project in the selected area. As a matter of fact, the Environment and Work Secretariats of the municipality considered the intended use compatible with the land use guidelines planned for the area.

OTHER PROJECTS

In addition to Macaé Merchant TPP, other thermal power plants are being studied or licensed in Macaé, always using natural gas from Campos basin as the main fuel. They are:

- ↪ Norte Fluminense TPP (UTE Norte Fluminense S.A.), under environmental licensing. The environmental studies of this plant were recently presented to FEEMA;
- ↪ Cachoeira Dourada TPP (INDESA), located close to the National Park of Restinga de Jurubatiba. Both the Previous and Installation Licenses have been already granted to this project but its implementation has not started yet;
- ↪ Macaé TPP (a consortium of companies, including LIGHT and CERJ), under studies;
- ↪ Cabiúnas TPP (Group Cataguazes – Leopoldina), under studies.

In order to allow the expansion on the offer of natural gas in Campos Basin, agreements were signed with international financial institutions last March, addressed to the implementation of Cabiúnas Project, which aims at increasing the offer of the natural gas produced at the north region of Rio de Janeiro state.

THE IMPACTS OF THE PROJECT CONSTRUCTION

1. RELIEF AND AIR QUALITY

The effects of the implementation of the Plant and the dedicated gas pipeline on the air quality are mostly restricted to the emission of dust from excavation activities, earthworks and from the traffic of machines and trucks in the construction site. The earthworks will level the land at the elevation 20m providing a sufficient plain area for the plant construction. The gas pipeline will require a linear excavation along the entire length of its route (25 km).

The main component of these emissions is particulate matter, most specifically ground particles, which are inert and therefore not associated to the intoxication of occasional receivers but only to minor problems related to allergic persons

The effect of the emissions from the traffic of vehicles must not be measurable when compared to the existing traffic on BR-101 and, therefore, the associated impacts, in this case, can be considered neglectable.

2. BACKGROUND NOISE LEVELS

These impacts depend on the level of the noise emissions and to the distance between receivers and the noise sources within the targeted area.

The noise emissions during the implementation step of the plant will be temporary and mostly caused by earthworks, operations involving heavy-duty tractors, crushers, air compressors and by the assemblage of equipment. These impacts will be temporary, occurring only during the operation of the equipment and machines along the construction step of the plant.

3. SOILS AND WATER BODIES

Small, localized interventions will be required for implementing the water intake system and the effluent disposal system at Macaé river, as well as for implementing the gas pipeline across Macaé river and some minor water bodies.

On the other hand, earthworks, construction and assemblage activities might release sediments that would be carried to water bodies. However, the land between the construction site and Macaé river is fully covered by grass, which would act as a natural barrier against the transportation of these particles toward the river.

The risk of erosion processes will be increased if the soil is exposed for long periods of time, including the risk of linear erosion processes, associated to the massive flow of water on the exposed ground, generating furrows and ravines.

3. VEGETATION AND FAUNA

Suppression of Vegetation Species

Land clearing activities, even when directed by technical and environmental criteria, requires the suppression of the vegetation of the land or, at least, significant changes on the original characteristics of the original formations. However, the targeted area is mostly covered by gramineous species, with some shrubs and small trees scatter in the land.

Therefore, the impacts here considered are associated to the suppression of the vegetation in the areas destined to the implementation of the facilities. However, these formations are not native or not ecologically valuable, but represented by native species that presently support the adjusted fauna of the area.

The suppression of vegetation and the reduction of the habitat areas for the associated fauna can also occur during the installation of the construction site and disposal areas of the gas pipeline.

Although the gas pipeline will be implemented along existing right-of-ways, the implementation activities, in this case, will temporarily widen these areas in order to allow the development of the implementation works. These extended areas will comprise 15-m wide land strips along the pipeline route.

Therefore, the land clearing and the installation of construction sites and disposal areas will require the suppression of the vegetation, impacting the fauna species of these areas by reducing the available spaces required for their survival. Most of the fauna species will avoid these areas during the development of the works, as a consequence of human activities.

Effects of Noise Emissions and Human Activities over the Fauna

The implementation of both the site and the gas pipeline will require the movement and the work of heavy-duty vehicles and machines, whose noise emissions must chase fauna elements away from the area and its vicinities.

Since the area is typically rural and despite the human influence (close to BR 101 road), the fauna groups composed by diurnal species will naturally move to similar areas, which are very common throughout the direct and indirect influence areas, reducing the magnitude of the impact.

Interference of the gas pipeline implementation works with aquatic environments

The pipeline route will cross 14 small drainage channels and Macaé river. These crossings will be buried below the streambeds, thus eliminating any interferences after the implementation works.

Trenches will be excavated across these channels temporarily impacting their beds by revolving bottom sediments. These effects could impact the ichthyofauna, the phyto and zooplankton of these water bodies by increasing the turbidity of the waters and reducing the sunlight penetration into the water. However, the fishes would be able to avoid the area, swimming away from it.

The aquatic communities close to these areas will undergo the same effects of the increase on suspended materials and the reduction of sunlight levels but in a higher extent, due to the interrelationship with the substrate of the channel beds. Nevertheless, it must be considered that these channels, as well as Macaé river itself, are already characterized by a high content of suspended matters.

Increase on hunting activities

The new accesses opened for the implementation of the gas pipeline can stimulate the incursion of hunters in search of birds and mammals, creating a negative pressure over population stocks.

An aggravating aspect would be related to the workers involved with the implementation of the gas pipeline, which could also increase hunting activities in those areas. Likewise, general misinformation and fear about Cretans species of reptiles and snakes could take to an uncontrolled killing of animals that play an important role as biological controlling agents.

This scenario is only relevant in terms of the aforementioned changes to forest habitats, most specifically to the forest spot where a significant impoverishment of the fauna was observed, most likely due to hunting activities added to the degradation of the system integrity. Therefore, this area comprises an environment where new impacts could be very significant.

However, considering the short permanence of the implementation team in the area and the possible mitigation of the impact by simple measures, such as training programs and supervision, the hunting pressures can be reduced both in terms of magnitude and importance.

Creation of environments favorable to the development of disease vectors.

The accumulation of garbage in the construction site could attract synanthropic species, such as rodents, that also play the role of disease-vector. Despite its localized characteristics, this impact must be mitigated and controlled.

4. LOCAL POPULATION

Generation of jobs

The implementation of the thermal power plant will generate civil, mechanical and electrical manpower demands. These jobs will vary in terms of quantity, duration and distribution through these areas, reaching a peak number of 500 workers. The implementation of Macaé Merchant TPP will last one year.

The gas pipeline implementation will last 2 months and the tight timeframe will require a total number of 100 workers, both qualified and unqualified.

The region presents a diversified number of service providers for construction and assemblage activities based on local labor. These companies will be preferably considered for the plant implementation works and, therefore, no expressive labor from other regions is expected, minimizing the impacts on the local infrastructure and urban services. Additionally, the local jobs, although temporary, will also create opportunities to the unemployed workers of the region. No lodgings will be installed in the construction sites of the plant and of the pipeline.

The electromechanical assemblage works will be performed by highly qualified workers, probably hired in other areas of the country or even abroad.

Considering the socioeconomic profile of the region and, most specifically, of Macaé, the labor demands generated by the plant implementation will configure a positive impact, since they will be related to the industrial and service structures existing in the area. This process will help on intensifying the local offer of jobs, including additional indirect jobs.

Changes on the local landscape by the earthworks, the implementation of the plant structures and by the interconnection to the transmission lines

The plant site is located within a rural area, at elevations close to 50m in contrast with the lowlands of the river, located at 5 metros. The earthworks will devoid the present characteristics of the area, lowering the land elevation to 20m and adding industrial features to a predominantly rural area. However, these changes can be reasonably mitigated by an adequate landscaping and revegetation project.

Likewise, the interconnection between Macaé Merchant TPP and FURNAS transmission lines will cause a visual congestion by the accumulation of lines in the area, since the lines from Norte Fluminense TPP will be interconnected to the same transmission lines in the future.

Demarcation of the Right-of-way of the Interconnection Lines

The interconnection between Macaé Merchant TPP and FURNAS transmission lines will require the demarcation of a small right-of-way along the interconnection, requiring

negotiations addressed to the expropriation of crossed lands with the respective landowners. The land use on the right-of-way must be restricted both in terms of the construction of buildings and the culture of certain species.

Improvement and appreciation of local lands

The implementation of a large industrial plant could take to the appreciation of close lands due to urbanization and functionality improvements that ,might be induced in the locality of Severina by the presence of the plant.

This appreciation will help on strengthening the local economy, attracting new projects to the region and taking to regional and local commercial and tributary consequences.

Generation of business and incomes to local commercial and service activities

In addition to direct demands addressed to the construction and assemblage sectors of the region, the project implementation could also generate business and incomes to local commerce and service activities. These possibilities are associated to demands such as catering services, construction materials, lodging, transportation services and others, always representing an improvement to the local economy.

Likewise, the municipal levies should be also affected, although in a lesser extent.

Manpower demobilization

As already mentioned, the implementation of Macaé Merchant TPP will last one year requiring a maximum number of 500 employees during the peak period of the works. The pipeline implementation will take 2 months, requiring a maximum number of 50 workers.

As already discussed, local labor must be preferred, supplied by service providers, located in the region. The existing business structure of Macaé, based on the existence of several oil companies and other industrial sectors in the region, allow to conclude that no significant effects are expected from the demobilization of the manpower allocated to the implementation works, after their completion, considering the increasing number of demands that have been arising in the area.

Road crossings

Although the gas pipeline will be installed within the right-of-ways of an existing pipeline and a water main pipeline, some interferences must result while opening the trenches for laying down the pipeline. The pipeline must cross RJ 25 road and two minor roads, comprising the most important interferences of this type. No urban areas will be crossed

by the pipeline route. These crossings must temporarily interfere with the local traffic of these ways, during their execution .

Increase on the traffic of heavy-duty vehicles through regional and local ways.

Different materials will be transported to the construction site during the implementation works, especially pipelines. Since some of these parts are comprise heavy, large items, periodical disturbances are expected on the traffic of vehicles along BR 101, RJ 168 roads and on other access ways, as well as the wastage of these ways. The increase on the traffic could take to the increase on the average number of road accidents.

THE IMPACTS OF THE PROJECT OPERATION

1. AIR QUALITY

The plant operation will be associated to the emission of air pollutants, such as SO₂, NO_x, MP, HC and CO, resulting from the combustion of the fuel.

In order to assess the change son the air quality of the area due to the emission of these pollutants, an air dispersion study was performed for the plant.

The results of this study indicated that the concentration of the aforementioned pollutants would be below the maximum allowable standards regulated by law for the air quality.

The regional air quality is good, characterized by low concentrations of the considered pollutants and, therefore, the final air quality within the project influence area, considering the emissions from the plant operation, would not be compromised, ensuring the welfare and the health of neighbor communities, as well as the integrity of the flora, the fauna and materials.

The study also took in account the cumulative effects resulting from the emissions of both Macaé hant TPP and Norte Fluminense TPP, which should be installed in the future in an adjacent land.

The results of these cumulative effects are presented next.

Pollutant	CONAMA STANDARD 03/90 OR AS INDICATED (µg/m ³)		
	HOUR		
	1	8	24 (annual)
Total suspended dust	-	-	240 and (80)* 34,72 and (4,32)*
SO₂ Sulfur dioxide			365 and (80)** 2,14 and 0,27**
NO₂ Nitrogen dioxide	320 148,01		(100) (2,86)
Carbon monoxide	40.000 117,58	10.000 42,54	
PM₁₀ Inhalant particulates			150 and 50** 34,72 and 4,32**
NMHC*** Non-methane hydrocarbons	160**** 21,66****		

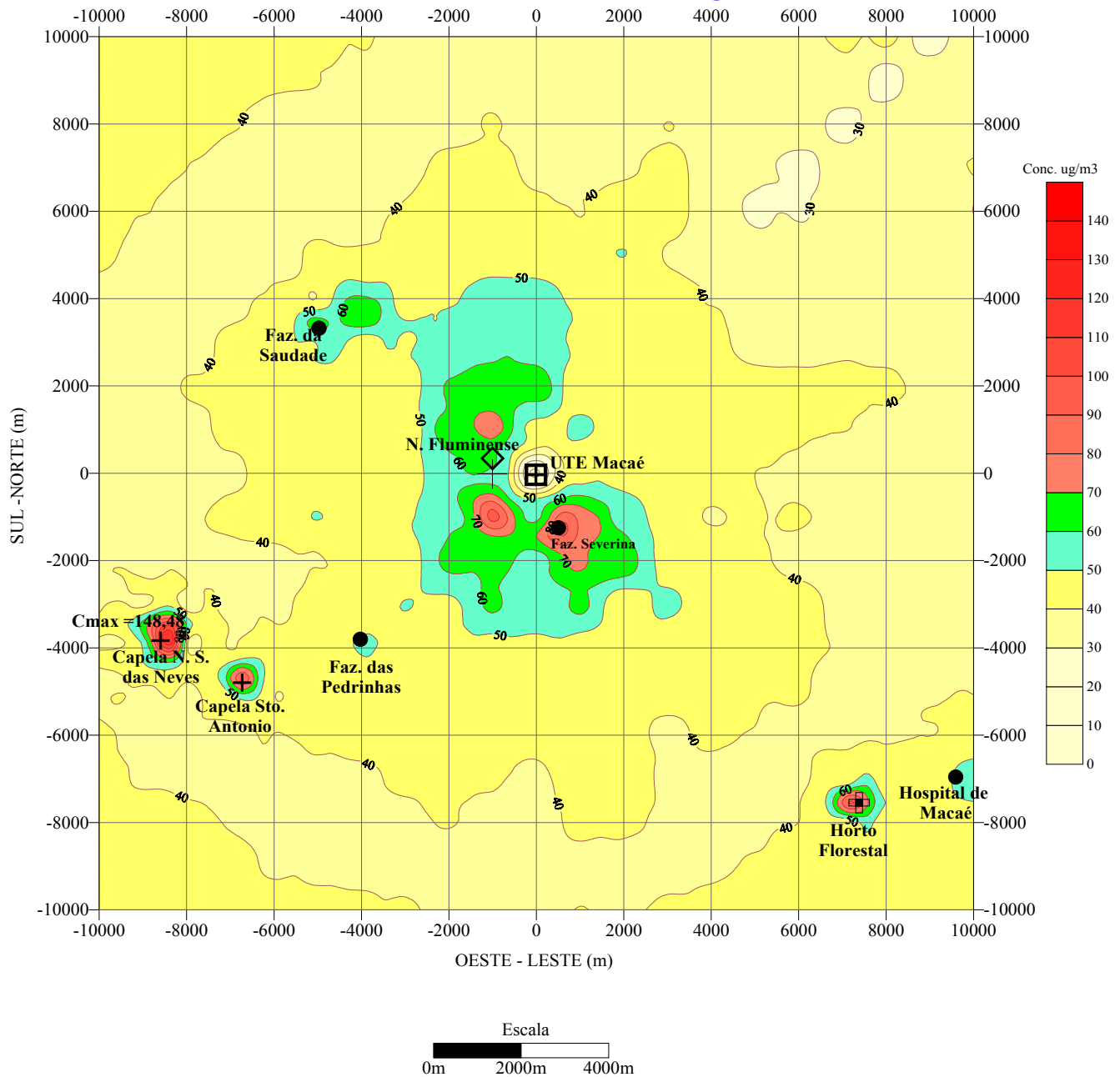
Keys * - Annual geometric mean; ** - Annual arithmetic mean; *** - USEPA – 1971. **** - 3h-mean

NOTE.: The figures in red correspond to the results of the model simulation considering the cumulative effects of both Thermal Power Plants

The figure presented next displays the results of the simulation for NO_x in the studied area.

Figure 6.2.3-2

PROJETO: USINA TERMOELÉTRICA - MACAÉ MERCHANT -
Concentração de NOx Integrada, a Norte Fluminense mais a Macaé Merchant
Conc. Máxima de NOx(1h) = 148,48 ug/m3
Padrão de Qualidade do Ar = 320,0 ug/m3



2. BACKGROUND NOISE LEVELS

Studies were also performed for simulating the noise levels of the area considering the operation of 16 turbines in the plant at noise emission rates of 85 dB(A) each, at 1 meters far from the sources. The noise generation rates of this equipment were associated to the background levels of the region, measured during the field surveys.

The environmental noise levels resulting from the plant operation are displayed at Figure 6.2.3-3.

Once again, the cumulative effects resulting from the operation of both Thermal Power Plants expected for the area (Macaé Merchant and Norte Fluminense TPPs) were simulated and associated. The results of this simulation are presented at Figure 6.2.3-4.

The analysis of both simulations allude to observe that the noise emissions from Macaé Merchant TPP will take to an increase of 15 dB(A) to the background levels (about 45 dB(A)) of the west portion of the plant, where 5 houses are presently located. This condition is aggravated when the simultaneous operation of both plants is taken in account, increasing the background levels to a value close to 70 dB(A).

Therefore, the changes on the background levels of the vicinities of the plant site are significant and receivers located out of the limits of the site, within the mapped vicinities, could undergo nuisances due to the noises generated by the operation of both plants.

As a result of these simulations and in addition to the acoustic isolation devices already supplied with the main equipment of the plant, El Paso has included additional acoustic protections the original design of the plant, in order to reduce the noise levels to limits that comply with both the state and federal legislation about this matter.

Figure 6.2.3-3. NOISE 1

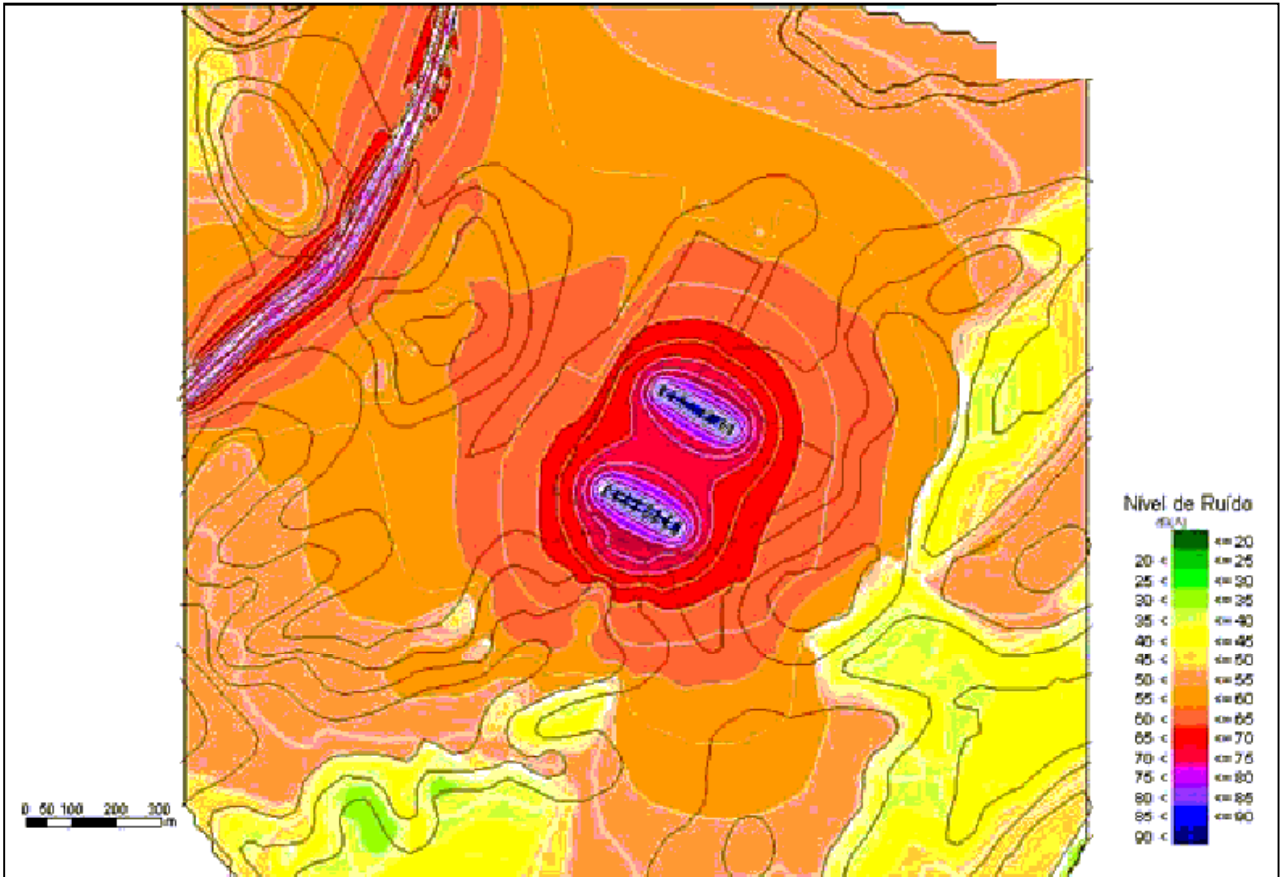
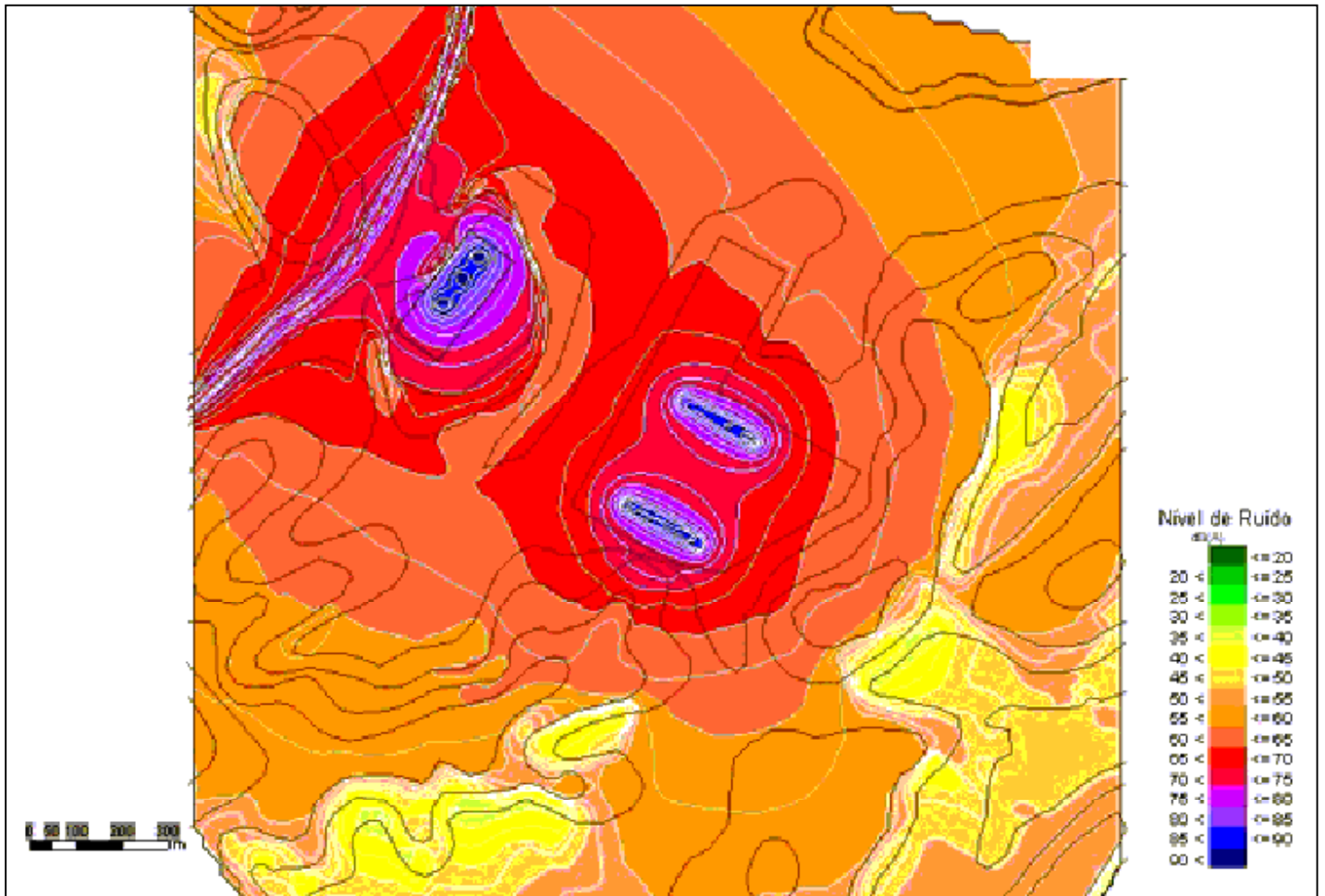


Figure 6.2.3-4. NOISE 2



3. WATER RESOURCES

Reduction on the water availability of Macaé river, downstream the water intake.

Macaé river basin supplies water to several users, such as CEDAE, which collects 600 l/s from the river for the public supply of the municipalities of Macaé, Rio das Ostras and Barra de São João, downstream the Thermal Power Plant site.

However, considering the flow rates to be collected by the plant (86 l/s), the existing conditions of the water availability of the basin will not be significantly changed. This flow rate represents about 1,7% of the local minimum availability (based on the minimum flow rate observed for Severina, Q7,10 - 4,87m³/s). Also, it must also be considered here that 14% of the collected water will be returned to the river, after treated. Therefore, the water intake of the plant must not be responsible for a significant change on the water availability of Macaé river.

Changes on the water quality of Macaé river, downstream the water intake

The disposal of the effluents generated by Macaé Merchant TPP will be performed upstream the plant water intake, as required by the Rio de Janeiro State Constitution.

The design flow rate of the effluents generated by the plant is 12 l/s (consumptive index: 86%), which means that 86% of the water collected from the river is used or lost in the industrial process and not returned to the river.

Considering a minimum flow rate of 4,87 m³/s for Macaé river, as mentioned above, the effluents returned to this water body corresponds to 0,2% of the river flow rate.

The implementation of an effluent treatment plant, associated to the operation of the thermal power plant and to the monitoring program addressed to the water quality of these effluents, must ensure that the effluents disposed onto Macaé river meet the criteria established by the valid environmental legislation about this matter. Therefore, the changes on the water quality of Macaé river due to the disposal of these effluents can be considered neglectable.

Changes on the quality of surface waters due to the maintenance of the gas pipeline

Likewise the implementation step, the maintenance works addressed to the gas pipeline and its right-of-way might change the water quality of nearby streams by the increase on suspended matters. Nevertheless, the frequency of this occurrence will be low.

4. SOILS AND WATERS

Generation and Disposal of Solid Wastes by the Operation of the Water Treatment Plant

The water treatment plant of Macaé Merchant TPP should treat up to 308 m³/h of water destined to the cooling system and other secondary uses. The operation of this plant will generate a sludge classified as a Class II solid waste (non-inert), according to ABNT standard, and, therefore, requiring the disposal in a licensed landfill. Close to 3 m³/day of sludge must be generated by the treatment plant.

The adequate disposal of this waste must prevent the impacts associated to the contamination of water and soils that could be expected of other practices accepted in the past were followed, such as returning the sludge to the river.

5. BIOLOGIC SETTINGS

Impacts on the vegetation due to the emission of air pollutants

The effect of air pollutants on the vegetation depend on a number of biotic and abiotic factors, the most important of them comprising the specie and genotypes of the specie, living form, age, development step, activity step and the general vigor of the plant, climatic and edaphic conditions, concentration of the pollutant and its chemical nature, exposure length and the time of the day when it occurred.

The long term influence of relatively low concentrations is the main reason of chronic damages to forest ecosystems, mirroring the negative effects on metabolic processes and on the slow accumulation of toxic agents in vegetal tissues.

On the other hand, high concentrations of pollutants might cause acute, visible damages in the vegetation, even in case of short-term exposures.

The most important pollutants in terms of impacts on the vegetation are the sulfur dioxide (SO₂), nitrogen oxides (NO_x), ozone (O₃) and acetyl nitrates (PAN).

The plant will only fire natural gas. The Thermal Power Plant operation might generate air emissions that could contain NO_x, SO_x, CO, CO₂, MP among other air pollutants.

However, considering the composition of the fuel gas to be supplied by PETROBRAS, with low contents of H₂S, measurable concentrations of SO₂ can also be expected in the flue gases. As for the remaining pollutants, the final concentrations were calculated

by means of dispersion models and the results indicated values below the standards established by the legislation in terms of the preservation of the fauna, flora, the health and welfare of the population. Therefore, no adverse effects from the plant operation are expected for the flora within the direct influence area of the plant.

Moreover, it must be considered that Macaé Merchant TPP will be located in an areas predominantly composed by fields and pastures and away from the remaining spots of Atlantic Rainforest existing in the region.

Impacts on the avifauna due to the emission of air pollutants

The pollutants emitted to the atmosphere can also affect birds. Studied performed for temperate areas of the Europe found that acid rains (resulting from the contact of SO₂ and NO_x with the steam in the atmosphere, forming sulfuric and nitric acids) are able to directly affect the eggs of birds, reducing the reproductive accomplishment and, consequently, the number of specimens.

However, considering the low concentrations of pollutants expected from the operation of Macaé Merchant TPP, as already discussed, no adverse effects are expected on the avifauna of the indirect influence area of the plant.

Restrictions to the development of arboreous vegetation on the right-of-way of the gas pipeline

The gas pipeline maintenance activities will prevent arboreous vegetation species to grow on the right-of-way. The pipeline route crosses a fragment of forest formations close to the site. However, the gas pipeline will be implemented along the right-of-ways of a water main line and a gas pipeline of PETROBRAS, thus reducing the need for creating a new cleared area across this forest spot.

6. SOCIOECONOMIC SETTINGS

Generation of jobs during the operation step

The plant operation must generate 50 permanent jobs. Therefore, the small representativeness of this number will generate a restrict impact under a socio-demographic standpoint.

Dynamization of the economy associated to the power generation

The implementation of the plant meets the expansion needs of the power supply capacity resulting from the deficit scenario of the Southeast electrical system.

The plant will bring energetic flexibility and autonomy to Rio de Janeiro state, stimulating new investments from the production sectors, with consequent socioeconomic results.

However, the plant will also bring local benefits to the north region of the state, despite its interconnection to the S/SE/MW system, which can be related to the unfavorable

conditions of this region, as well as of the south region of Espírito Santo state and Macaé in terms of the arrangement of the interconnected system (a single supply alternative, basically depending on imported power from other regions).

Therefore, the implementation of Macaé Merchant TPP within the proposed region is associated to an impact specifically applied to this region and represented by differentiated energetic benefits to the area, which is not usual in terms of generation plants that are implemented as part of the interconnected system.

The most comprehensive impact, therefore, is related to the economical enhancement potential of this project that could attract new industrial, commercial and service activities to the state.

Restriction to the land use along the right-of-ways of the gas pipeline and the transmission line

The land used along the right-of-ways of both the gas pipeline and the transmission line must be restricted, so no buildings, structures or any other intensive uses are allowed to these areas. As already emphasized, though, the dedicated gas pipeline will make use of existing right-of-ways, not requiring new areas for this purpose.

7. WHICH ARE THE LIKELY RISKS OF THE PROJECT?

The Risk Analysis Study performed for the plant identified and assessed the hazards associated to the implementation and operation of both the plant and the dedicated gas pipeline.

The risk calculation, though, was only performed for the gas pipeline, once, according to FEEMA Technical Instruction, since the damage distances to the plant do not exceed 500 m and there are no special population areas close to the site (such as schools, hospitals, prisons or nurseries:), the risk calculation of the plant, itself, is not required.

The main findings of the Risk Analysis are summarized next:

- The analysis of the database on worldwide accidents involving gas pipelines indicated that the most frequent causes of accidents are related to the action of third parties (close to 50% of the failures for Europeans gas pipelines).
- In case of a leakage of natural gas, associated to the existence of an ignition source, the most important types of consequent accidents would be a FireBall or a Fire Jet.
- The most hazardous facility of the TPP is the internal gas pipeline addressed to the gas supply of the turbines.

- Based on the inputs to the analysis, the **Societal Risk of the project can be considered neglectable.**
- According to the HSE acceptance criteria for individual risks, **the project is acceptable.**

These findings allow to consider the project as **acceptable** in terms of the Risk Analysis.

Nevertheless, residual risks must also be considered and an effective Emergency Plan must be performed in order to prevent these risks quickly and effectively .

It is necessary to remember that the fully elimination of all risks is an **impossible goal** for any industrial activity, regardless the emphasis addressed to this subject. However, the minimization of the risks associated to unsafe actions and operational conditions is feasible and can be required.

THE IMPACTS OF THE PROJECT DEACTIVATION

1. CHANGES ON THE QUALITY OF SURFACE WATERS

The termination of the maintenance processes on the gas pipeline right-of-way could allow erosion process to start, with the consequent changes on the water quality of nearby streams due to the increase on the quantity of suspended materials and possible aggradation of water bodies by carried sediments.

2. RE-OCCUPATION OF THE RIGHT-OF-WAY BY NATURAL VEGETATION.

At the end of the gas pipeline lifetime, there will be no need on maintaining its right-of-way clear and free, so shrubby and arboreous species will spontaneously re-occupy this area. This process comprises a positive impact of the project deactivation and can be accelerated or enhanced by revegetating the area with adequate species.

However, it must be highlighted that, since the gas pipeline will make use of existing right-of-ways of other buried facilities that would not be necessarily deactivated at the same time, this impact would not exist.

3. DISRUPTION OF THE ICHTHYOFAUNA

The termination of the maintenance works along the gas pipeline route could change the water quality of nearby streams, as already mentioned, generating impacts on the ichthyofauna due to the increase on the amount of suspended matter in the water. However, this impact would not be significant.

4. BROADER POSSIBILITIES ON THE USE AND OCCUPATION OF THE GAS PIPELINE RIGHT-OF-WAY.

After the deactivation of the gas pipeline, land uses that were previously not allowed on the pipeline right-of-way can be resumed. However, the soil of this area cannot be handled by heavy equipment, such as tractors, or receive building foundations.

**CARES TO BE TAKEN DURING THE PROJECT
CONSTRUCTION AND OPERATION**

1. DURING THE PROJECT PLANNING

This set includes those measures related to impacts that can be mitigated by the environmental planning and management of the project. These measures must be implemented based on detailed studies addressed to the impacted elements and specific projects.

Social Communication Programs

In order to prevent negative social expectations, the entrepreneur must provide information about this project and its relationship with the local communities, including aspects related to the generation of jobs, in order to:

- ✓ Ensure an objective communication with the directly affected population, explaining the nature of the project and how the communities will be affected. For the specific case of the gas pipeline, the information must include explanations about the interferences with private rural lands crossed by PETROBRAS right-of-way, which will be used by the gas pipeline to be implemented;
- ✓ Develop negotiations with landowners, planning actions addressed to ensure minimum interferences with the properties in order to not disrupt the life of the land occupiers or the associated productions. Whenever changes are required to local land uses, even if temporarily (e.g. installation of construction sites or service areas), the best alternatives must be selected in order to not cause losses or reductions on the resources of the land users. If this approach turns out to be impossible, the landowners must be properly compensated.

Agreements with Landowners along the gas pipeline right-of-way

During the design step of the gas pipeline, the land use conditions along the right-of-way must be agreed with the landowners in terms of restrictions and forms of the uses to be allowed due to the pipeline operation and maintenance.

Air Emissions Control Systems (generation systems and stack design)

As already discussed, the plant will reduce the emissions of NO_x by controlling the combustion settings by means of water injection. This measure is considered as a mitigation measure already incorporated to the plant design, since it is related to the conception and selection of the best technological alternative .

Additionally, the design of the plant stacks is another important aspects in terms of the environmental performance of the plan, namely the height and diameter of the stacks, which are responsible for the outlet velocity of the flue gases.

These parameters were defined for Macaé TPP stacks based on the results of the air dispersion simulation model applied for the plant conditions. This model considered different stack geometry features, in order to check if the Brazilian legal standards would be met in terms of ground level concentrations of the pollutants, for the emission rates accepted by the World Bank. Once again, this measure comprises a mitigation aspects incorporated to the plant design.

Therefore, the measures required for reducing the impacts of the plant on the air quality have been already incorporated to the basic original design of Macaé Merchant TPP.

2. DURING THE PROJECT IMPLEMENTATION

This set of measures is basically addressed to the supervision of the different activities performed during the implementation step of the project.

Manpower Contracting and Demobilization Plan

Since a significant number of workers are expected to be hired during the implementation step of the project, a Manpower Contracting and Demobilization Program is proposed, in order to reduce the impacts associated to the massive mobilization of human resources, even if performed by third parties, during this period.

This plan considers explaining to the public powers the economical opportunities associated to the project, requiring the cooperation of those institutions whose municipal seats are located close to the site area in terms of supporting the companies selected for recruiting the manpower to be allocated for the civil construction works. The plan should also include guidelines to be provided to those companies, in order to preferably use workers living in Macaé, as long as properly qualified for the required services.

Adequate Disposal of Solid Wastes

The solid wastes generated by the implementation activities must be disposed into adequate, properly licensed areas. The suitable disposal of the wastes is an effective measure in terms of the reduction of areas favorable to the development of disease vectors as well as a measure for preventing the contamination of water bodies.

Adequate Disposal of Sewage

In order to prevent the interference between the construction site and the drainage network, the sewage generated during the implementation works must be disposed into septic tanks, located far enough from water bodies and wells.

Periodic Maintenance of Vehicles

All vehicles and machines utilized during the implementation works must undergo periodic maintenance, primarily aimed at adjustments addressed to the minimization of the emission of air pollutants.

Landscaping

In order to minimize the impacts associated to the implementation of an industrial plant in a rural area, a landscaping project will be developed (revegetation) and incorporated to the implementation project of the plant. This project will be implemented after the completion of the plant construction.

The plant landscaping must consider not only esthetical issues, but also the integration/harmonization of the project to the local scenery. This will be performed by creating a vegetal barrier around the entire site, composed by native species of region, with perennial leaves, ornamental characteristics and able to attract birds.

Implementation of Acoustical Barriers or Equipment Encasing

The design of Macaé Merchant TPP has already incorporated some devices addressed to equipment encasing and to the noise abatement of each GTG, so the maximum noise levels at 1 m far from these sources will be 85 dB(A). However, noise level simulations indicated that the simultaneous operation of all 16 GTG could add up to 20 dB(A) to the background levels of areas beyond the limits of the plant. Considering the existence of 5 houses close to the south border of the land, an acoustic barrier must be designed and implemented in order to ensure the required noise attenuation for these areas.

Another alternative that could be used for achieving the required noise levels out of the plant limits is improving the encasing level of the noise sources. The available alternatives must be studied and the selected one must be detailed during the development of the Basic Project of the plant.

Time Schedule of the Gas Pipeline Implementation according to Rainfall Indexes

In order to prevent the impacts of the gas pipeline implementation works to the water quality of nearby streams and to the soils, these works must be preferably performed during the dry season. If not possible, measures must be taken in order to prevent excavated soil to be scoured and erosion processes to start.

Adequate Location of the Construction Site

The construction sites and disposal areas of both the plant and the gas pipeline must not be located close to areas covered with forest formations. This measure aims at reducing the impacts related to the suppression of the vegetation and to the reduction of available habitats to the fauna.

Control of Incursions to Forest Areas close to the gas pipeline route

In order to prevent hunting activities in the forest area crossed by the gas pipeline, incursion of workers into these areas must be controlled and discouraged.

Revegetation and Stabilization of the Gas Pipeline Service Areas

The stabilization and/or revegetation of the service areas opened along the gas pipeline route must be performed after the completion of the associated implementation works, making use of gramineous native species or other types of vegetation. This measure will compensate the impacts related to the land clearing activities, while preventing the formation of erosion processes and consequent changes on the water quality of nearby streams.

Environmental Education

An environmental education program will be developed, addressed to the workers assigned to the construction sites and service areas along the pipeline route. This program aims at inducing adequate attitudes and habits in terms of environmental preservation, such as preventing the improper disposal of wastes (garbage and sewage), preventing uncontrolled hunting and fishing activities by means of objective instructions and preventing the unnecessary removal of trees.

3. DURING THE PROJECT OPERATION

The original conception of Macaé Merchant TPP has already incorporated several measures focusing the minimization of impacts typical of the operational step of such type of process. These measures comprise, therefore, mitigation measures already added to the project in order to ensure a better environmental performance of the plant operation. Moreover, these measures comprise technological aspects whose performance is monitored by dedicated systems along the entire lifetime of the plant and whose actions are described next.

The remaining mitigation aspects associated to the operational step of the plant basically comprise environmental management procedures and routines, also described here:

of the Disposal of Liquid Effluents

The liquid effluents generated by the plant will be treated and disposed onto Macaé river, upstream the water intake of the plant. The quality of these effluents will be ensured by the adequate operation of the treatment plant and controlled by a monitoring program, in order to make sure that the effluent parameters comply with the criteria established by the state and federal legislations (NT-202 FEEMA and Res. CONAMA 20/86 – art.21).

Adequate Storage and Handling of Consumption Products

The plant design will also consider storage systems for solid and liquid products, provided with suitable containment and drainage basins. IN addition to this, handling routines and procedures must be defined, addressing the proper utilization of these systems and products.

Adequate Disposal of Solid Wastes

Common solid wastes, such as those from the cafeteria, bathrooms and offices, will be disposed into the Sanitary Landfill of Macaé. The wastes will be transported to the landfill by trucks owned by the plant or by third parties.

Recyclable industrial wastes, such as paper, plastics, aluminum and scraps, will be sent to specialized waste recycling/commercialization companies. The sludge from the water treatment plant will be dewatered, temporarily stored (in accordance with the requirements for storing Class II wastes) and sent to a company licensed by FEEMA for providing its final disposal. The entire waste management system will be performed in accordance with the rules and procedures established and approved by FEEMA

Prioritization of the Use of Local Manpower

In order to maximize the benefits to the region, this report proposes that part of the labor required for the operation of the plan is hired in the region where the plant will be located.

A training program will be prepared, with the support of local labor institutions, such as SESI/SENAI- Macaé, prioritizing the local labor, whenever possible.

Time Schedule of the Gas Pipeline Implementation according to Rainfall Indexes

In order to prevent the impacts of the gas pipeline maintenance works to the water quality of nearby streams and to the soils, these works must be preferably performed during the dry season. If not possible, priority control measures must be taken in order to prevent these impacts during these services.

Gas Pipeline Signaling

The gas pipeline right-of-way must be clearly signaled, including the areas within private lands, in order to prevent damages or accidents caused by unaware actions of heavy machines, equipment or excavations performed by third parties close to the pipeline route.

4. DURING THE PROJECT DEACTIVATION

Directions to Landowners about the Land Use after the Gas Pipeline Deactivation

The landowners of the areas crossed by the gas pipeline must be informed about activities that can be performed on the pipeline right-of-way after the deactivation of the line. These uses include the introduction of new cultures on the area, in addition to those already existing, as well as the revegetation of the land, which would also minimize the impacts associated to the exposure of the soil to storms, which could compromise the water quality of water bodies.

**MEASURES TO BE TAKEN AIMING AT THE
MAINTENANCE OF THE ENVIRONMENTAL QUALITY**

1. SOCIAL COMMUNICATION PROGRAM

The social communication program aims at answering the questions of the population, public and private institutions about the project and associated impacts.

One of the basic guidelines of the programs comprises the creation of communication channels addressed to the different segments that represent the local community, including divulgation materials related to the pre-implementation activities and addressed to the general population and the press. This program should start immediately, in order to prevent the impacts expected for the planning and construction steps of the project.

2. NOISE LEVEL MONITORING PLAN

Noise level measurements should be performed during the plant operation, in order to:

- Ensure that the noise emissions will comply with both the federal and state legislation, i.e., below 85 dB(A) at 1 m far from the sources. This action can be considered as an environmental performance monitoring, and
- Ensure that the noise levels at the site boundaries meet federal requirements.

The measurements will be annually performed by noise metering devices and for both diurnal and nocturnal periods.

3. AIR EMISSIONS MONITORING PROGRAM

Emissions of NO_x, O₂ and CO should be measured at the stack, aiming at checking the environmental performance of the combustion process. The continuous measurement of the air pollutants levels and the periodic presentation of the monitoring results will meet both the corporate environmental management of the plant and the self-monitoring system of FEEMA. This program should start simultaneously to the power generation tests of the plant and continue throughout the entire operational lifetime of the plant.

4. AIR QUALITY MONITORING PROGRAM

Despite the good air quality and the good dispersion conditions of the region where the plant will be implemented, the area is not covered by systematic measurements addressing air quality parameters that could be used as a baseline to the monitoring of the same conditions after the plant implementation and associated effects. Therefore, in order to characterize the air quality before and during the plant operation, a monitoring program addressed to those parameters and covering the site vicinities is proposed here.

The considered air quality parameters must be regularly monitored from two sampling stations, located in areas yet to be defined, based on the air dispersion modeling. Four annual campaigns (quarterly) must be performed, considering 10 days/campaign.

In order to define a baseline addressed to the future comparison with the monitoring results, a background campaign must be performed before the start up of the implementation works.

Considering the typical emissions of thermal power plants and the existing air quality standards defined by the Brazilian legislation, the following parameters should be monitored:

- ↻ NO_x;
- ↻ SO_x;
- ↻ O₃;
- ↻ MP.

5. WATER QUALITY AND EFFLUENT MONITORING PROGRAM

The Water Quality Monitoring Program is justified by the need on checking the compliance of the effluents with valid legal standards, by checking the plant performance in terms of the changes on the water body at the disposal area of the effluents.

Since no water quality monitoring is presently performed at Macaé river, this program could also support the regional environmental management system associated to Macaé river basin.

Two collections will be performed, one during the dry season and one during the wet season. Water quality and flow rates parameters will be determined for both stations proposed here, in order to determine also the flow rate of Macaé river.

Samples of the plant effluents (sanitary effluents, effluents from the demineralization plant, blowdown of the cooling tower and combined liquid effluents) will be collected for checking the compliance with the limits established by Resolution CONAMA 20/86 and compared to the conditions verified for the water body downstream the discharge point..

The following parameters will be initially monitored by the sampling stations at Macaé river: turbidity, color, pH, temperature, conductivity, total filterable residues, non-filterable residues, dissolved oxygen, BOD, COD, carbonate, chloride, sulfate, nitrate, ammonia, Nitrogen Kjeldahl, silica, total phosphate, calcium, magnesium, sodium, potassium, lead, cyanide, copper, mercury, phenols, oils and greases and fecal coliforms. This list is based on the parameters previously analyzed by the environmental agency in the region, including parameters that are relevant for the operational control of the raw water treatment to be used by the process.

This list can be adjusted along the development of the program, if some of the targeted parameters turn out to remain reasonably constant and in compliance with the limits established at Res. CONAMA 20/86 for Class 2 water bodies.

The effluent parameters will be analyzed in accordance with both Resolution CONAMA 20/86 and NT-202/FEEMA, based on the prevailing characteristics of the water body and on the use and treatment of the water destined to the plant. The parameters to be analyzed are: pH, temperature, settleable matter, DO, BOD, COD, conductivity, ammonia, phosphorus, oils and greases, phenol, cyanide, copper, mercury and lead. The effluent flow rates must be continuously registered.

The detailed monitoring program for the plant effluents and water quality will be presented at the Basic Environmental Project.

6. LANDSCAPING PROJECT

The earthworks required to the project implementation, as well as the construction of an industrial unit in a rural use area will impact the local scenery. In order to recovery the local landscaping aspects while protecting the soil, a landscaping recovery program is here proposed but Macaé Merchant TPP area.

Moreover, a landscaping project also represents an improvement to the environmental quality in terms of vegetal covering, enhancing the ecological balance in the intervention area.

The following guidelines will be followed by this project:

- The remaining vegetation within the directly affected area of the project will be preserved;
- All free areas (i.e. without buildings or not used as accesses, parking lots, etc) will be planted;
- Native species of the regional flora will be used (especially flowery and fructiferous ones) in order to stimulate the attraction of birds;
- Green belts will be implemented around the site, in order to enhance the landscaping conditions of the area while acting as an acoustic barrier;

- Constant maintenance of the planted species, after the project implementation.

This project will be detailed as part of the constructive project of the plant.

7. MONITORING AND SUPERVISION OF REHABILITATION MEASURES

This program aims at monitoring and supervising the rehabilitation measures addressed to the areas degraded by the implementation works, ensuring the accomplishment of those measures. These measures comprise the following actions:

revegetation of areas degraded by the implementation works, such as borrow pits, disposal areas, construction sites, provisory accesses, etc.;

Offsetting revegetation measures (vegetation thickening or enrichment) along the right-of-way or at permanent preservation areas.

After the implementation of soil recovery measures and the revegetation of degraded areas, a supervision program will be initiated, in order to check the evolution of those measures. This supervision will emphasize the effectiveness of physical measures, revegetation activities and soil recovery measures. The areas will be monitored during the implementation step of the project.

8. ENVIRONMENTAL OFFSETTING PROGRAM AND REGIONAL INSERTION OF THE PROJECT

Along the development of the Basic Environmental Plan, El Paso will identify environmental offsetting and/or public interest lines, with the support of the environmental institutions and communities involved with the project.



CONCLUSIONS

WHICH ARE THE MAIN FINDINGS OF THE STUDIES ?

The most important aspects related to this RIMA are summarized next, focusing the national energetic conditions, as well as the technology and the area proposed for Macaé Merchant project:

1. The participation of hydroelectric generation in the Brazilian energetic matrix is higher than 90%. Although the location of large hydroelectric plants allows for low-priced power, these plants strongly depend on rainfall regimens and on expensive power transportation systems;
2. The power consumption has been increasing at rates higher than the economy growth. The present generation capacity is very close to the demands, requiring the implementation of new power generation sources, within short terms;
3. Based on an analysis of the available alternatives, the Federal Government defined that a higher participation of natural gas generation processes, by means solution to the problem in terms of timeframes, costs and environmental feasibility
4. The large national reserves of natural gas and the start up of the operation of Bolivia-Brazil Gas Pipeline ensure the supply of this fuel to the TPPs that must be implemented in the close future;
5. The natural gas is a fossil fuel used worldwide (corresponding to 23% of the world energetic matrix) based on: (a) its technical properties, such as the high heating value; (b) the large world reserves; (c) the low content of pollutants such as sulfur compounds, particulate matter and non-metallic hydrocarbons; (d) safe transportation and handling;
6. Rio de Janeiro state produces natural gas at Campos Basin while imports a large quantity of electric energy from other regions, what make of the state a strong candidate for hosting new natural gas TPPs;
7. The analysis of several location and capacity alternatives took to the selection of a 700 MW TPP to be implemented in the locality of Severina, in Macaé, within a 100 ha land acquired by Macaé Merchant and almost completely covered by pastures. The acquired land is adjacent to the area where the Norte Fluminense TPP will be located, another thermal plant presently under licensing process;
8. The selected area is located approximately 700 m far from BR 101 road and 1.000 m far from Macaé river, which will be used for supplying water to the plant. The power generated by Macaé Merchant TPP will be supplied to a 345 kV transmission line of FURNAS, located at 300m from the border of the plant site;
9. The natural gas will be supplied by PETROBRAS through a 20-km long gas pipeline starting at Cabiúnas station. The dedicated gas pipeline will be partially

constructed along right-of-ways of existing gas pipelines of PETROBRAS and of a raw water main line, also owned by PETROBRAS, which transports raw water from Macaé river to Cabiúnas station. Therefore, no interferences are expected with the land structure and private properties along the pipeline route;

10. Macaé Merchant TPP will be a single cycle plant, composed by 16 gas turbines;
11. The turbines of Macaé Merchant TPP will generate a noise level of 85 dB(A) at 1 m far from the sources, each. Simulations performed for the simultaneous operations of all 16 turbines of Macaé Merchant TPP and all 3 future turbines of Norte Fluminense TPP resulted on an increase on the background noise level beyond the plant boundaries of 20 dB(A) to the west of the plant, where five houses are located. Since these changes on the background noise level are significant and could cause nuisance effects on receivers located in the vicinities of the site, El Paso has been incorporating noise abatement measures to the original design of the plant, in order to comply the original noise levels of the plant operation with the standards allowed by the applicable legislation.
12. The turbines will be equipped with water-injection systems, addressed to reducing the NO_x content in the flue gases of the plant. This measure, associated to the characteristics of the natural gas, will provide an operation with low emissions of air pollutants;
13. The air quality and the dispersion capacity of the selected area indicate that the region provides a good support capacity, compatible with the emissions expected for the plant, including the simultaneous operations of both Macaé Merchant and Norte Fluminense TPPs, so it can be considered that the changes on the air quality will not damage neighbor communities, the flora, the fauna or materials;
14. The plant cooling system will be a closed type and the water required for the plant operation will be supplied by Macaé river, whose waters present both qualitative and quantitative aspects adequate to meet the project requirements, without compromising downstream uses;
15. The measures incorporated to the project, such as control of emissions, effluent treatment, suitable disposal of wastes, noise control and others are sufficient for resolving the issues associated to the environmental impacts of the project;
16. In terms of socioeconomic aspects, the project will generate only positive impacts, associated to the generation of direct and indirect jobs, to the significant increase on municipal levies and to the possible attraction of new business to the region;
17. The monitoring measures proposed in this study are sufficient to check is the project will cause undesirable environmental changes;
18. The risk analysis performed for the project indicated that the resulting societal risks comply with international standards or to standards defines by FEEMA as acceptable.

Therefore, the technical team that performed this RIMA concludes that the project is environmentally feasible so the state environmental agencies should decide for granting its environmental license.

TECHNICAL TEAM