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Sendou 125 MW Coal Power Plant

Senegal

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LIST OF ABBREVIATIONS

ESIA :	Environmental and Social Impact Assessment
MEPN :	Ministère de l'Environnement et de la Protection de la Nature (Ministry of Environment and Nature Protection)
DEEC :	Direction de l'Environnement et des Etablissements Classés (Directorate of Environment and Classified Establishments)
CQAD :	Direction de l'Environnement et des Etablissements Classés (Air Quality Monitoring Centre of Dakar)
DPC :	Direction de la Protection Civile (Civil Protection Directorate)
DE :	Direction de l'énergie (Energy Directorate)
CRSE :	Commission de régulation du secteur de l'électricité du Sénégal (Electricity Sector Regulatory Commission of Senegal)
UCAD :	Cheikh Anta DIOP University
CRODT :	Centre de recherches Océanographique DAKAR-THIAROYE (DAKAR-THIAROYE Oceanographic Research Centre)
SDE :	Société Sénégalaise des Eaux (Senegal Water Authority)
SENELEC :	Société National d'Electricité du Sénégal (National Electricity Board of Senegal)
ONAS :	Office National d'Assainissement du Sénégal (National Sanitation Agency of Senegal)
CES :	Compagnie d'Electricité du Sénégal (Senegal Electricity Corporation)
IsDB :	Islamic Development Bank
ADB :	African Development Bank Group
BOAD :	Banque Ouest Africaine de Développement (West African Development Bank)
PAD :	Port autonome de Dakar (Dakar Port Authority)
PBW:	Public Buildings and Works
WHO :	World Health Organization
ESP :	Electrostatic Precipitator
NS 05-061 :	Senegalese Standard on Wastewater
NS 05-062 :	Senegalese Standard on Air Pollution
ESMP :	Environmental and Social Management Plan
NA :	Not Applicable

Name of project	**:**	**Project for the construction of a 125 MW coal power plant in the village of Bargny Minam**
Country	**:**	**Republic of Senegal**
Project Number	**:**	**P-SN –F00-004**

I. Introduction

In a bid to face the growing electricity demand in Senegal, the National Electricity Board (SENELEC), in keeping with its industrial development plan and the Government of Senegal's intention to develop the coal industry for the generation of electric power[1], commissioned NYKOMB SYNERGETICS DEVELOPMENT AB Group, based in Sweden, acting on behalf of the Electricity Corporation of Senegal S.A. (CES S.A.) for the construction of a 1 x125 MGW power plant using coal as the basic fuel, through a "Build, Own, Operate (BOO)" arrangement. The power plant will be located near Bargny Minam village, 32 km from the city of Dakar.

CES, SENELEC, the Government of Senegal and their partners are convinced that economic development in a deteriorated environment cannot be sustainable development. This explains the priority they give to the application of the laws and rules governing environmental protection under the project. This view also led to prior consultation of all the administrative authorities involved in the preparation of an environmental and social impact assessment (ESIA). This study was entrusted to QUARTZ-Afrique, a consulting firm based in Senegal and duly accredited to carry out such a mission. The ESIA identified and quantified the environmental and societal effects of the project, formulated mitigation measures and produced an environmental management plan.

This report contains a non-technical summary of the ESIA focusing on the following points: (i) description and justification of the project; (ii) policy, legal and administrative framework ; (iii) description of the project environment; (iv) Alternative solutions for the project; (v) potential impacts and mitigating and improvement measures; (vi) environmental risk management; (vii) monitoring programme; (viii) public consultations and information dissemination; (ix) supplementary initiatives; (x) conclusion and (xi) references and contacts.

II. Project Description and Rationale

2.1 Project Context and Justification

Net electricity demand on the SENELEC interconnected network is estimated at 2,489.57 GWh for a projected capacity of 2,484 GWh, representing a shortfall of 5,514 MWh. Despite efforts to rehabilitate current plants and construct new ones, generation capacities still cannot meet demand.

The project, once implemented, will help diversify electric energy sources in Senegal and ensure adequate supply to meet the demand growing at an estimated 7.89 % annually for the 2005-2025 period. It will help raise SENELEC's generation capacity by supplying an additional 925 GWh per annum to the interconnected grid to bring the plant to 91.8% capacity. Thus, the proposed plant will cover about 12% of the annual power consumption projected for 2052, estimated at 8443 GWh[2]. The first of its kind in Senegal, the coal-fired plant will also contribute to North-South technology and skills transfer.

2.2 Summary Project Description

The project site is located in the Bargny District (see map in annexes). The 125MW coal power plant entailing an investment of CFAF 118 billion, will be constructed on a total land area of 29 hectares, near the village of Minam, and a few villas and a small fishing wharf. The plant installations will be located on a site at a minimum distance of 500m from dwellings, buildings usually occupied by persons unrelated to the project, public buildings and areas designated for residential development, a watercourse, a lake, a transit route and a water collection point, pursuant to Article L13 of Law n°2001 – 01 of 15 January 2001 on the environment code.

The site is about 32 km from the Dakar Port and is accessed from the north by Highway N°1, the only road link with the Bargny District from Dakar. The location is 600 to 700m from the Atlantic Ocean, which is a considerable advantage in terms of sources of cooling water for the plant. Two inhabited areas are located near the site, namely a fishing village 600 metres to the south and the town of Bargny 2 km north-west.

[1] **Source :** Point 88 of Energy Sector Development Policy Letter (February 2008)
[2] **Source :** Tender document for 1 X1 125 MW BOO Coal Power Plant Project; April 2007

The coal power plant will consist of (see layout in annex): (i) a coal depot and a coal preparation station (conveyor belt, silo, crusher, a coal hopper, etc.); (ii) a boiler island with its auxiliary installations; (iii) an electrostatic precipitator to reduce dust particle emissions and a stack to evacuate exhaust gases; (iv) a machine room consisting of a steam turbine and an alternator; and (v) transformers to convert the voltage to the level of the SENELEC grid.

In addition to these installations which directly contribute to electricity generation, related equipment will comprise:

- A 5,000 m3 potable water tank to be connected to the SDE pipelines to supply the water plant. The water will be used to meet the dematerialized water needs of the boiler and equipment cooling system, for drinking and washing, makeup water for cooling ash, coal handling (dust removal), cooling of continuous and discontinuous cleaning system, cooling water for furnace ash (clinker), cleaning of electrostatic precipitator, plant service water (for washing and spraying), etc. ;
- a storage place for diesel oil used to start-up the boiler;
- a boiler water demineralization station;
- a area for compressors and air dryers;
- a 600 m3 silo for collecting fly ash;
- an open circuit cooling system delivering 15,000 m3/h of sea water to the intake of the condenser through underground piping;
- a bulk clinker storage platform;
- a closed fire-control water system consisting of piping and fire-hoses covering the entire plant, including storage and coal preparation facilities;
- a treatment unit for the waste water produced by the power plant and, lastly, an 800 kvA standby generator.

The infrastructure connected to the plant is: (i) a 225 kV (1.5 km) power line to convey the energy produced to the SENELEC high tension grid (SENELEC is currently conducting an initial environmental assessment of the line); (ii) access roads to the site; (iv) and a coal weighing depot.

During the plant construction phase, site preparation works will include: tree-felling, clearing, excavation, digging and backfilling. There will be no blasting. A temporary camp will be set up consisting of offices, a meeting room; a bathroom facilities and canteen and dormitories for workers. A storage area and three other warehouses will be provided and temporary roads and unloading tracks will be constructed. The coal storage area will be used for temporary storage of site equipment and construction materials.

In the operating phase the plant will operate as follows:

(i) the main fuel, namely coal, will be imported by sea by the supplier, COMPTOIR BALLAND BRUGNEAUX (CBB), a Swiss company. Unloading and transfer to the plant storage site will be under the responsibility of SDV, the forwarding agent of Senegal Electricity Corporation (CES). The coal will be conveyed from the Dakar Port to the storage facility by covered trucks. Following storage, handling and preparation, the coal will be burnt in the boiler after mixing with air; this chemical reaction releases thermal energy (heat) in the combustion gases;
(ii) the combustion gases release most of their heat into the boiler water in the tubes in interconnected screen panels; this water is transformed into steam at high pressure and high temperature;
(iii) the steam turns a turbine; the resultant mechanical energy drives the power generator called the alternator;
(iv) The mechanical energy is thus converted into electric energy within the alternator.

III. Policy, Legal and Administrative Framework

3.1 Energy Sector

The Senegalese energy sector took a new policy direction in 2008 set out in a policy letter that focused on three major objectives: (i) sufficient supply of energy to the country, with optimal conditions in terms of quality and sustainability and at the least cost; (ii) widen the population's access to modern energy services; (iii) reduce the country's vulnerability to external contingencies notably relating to the world oil market. The vision underpinning these objectives is consistent with the Poverty Reduction Strategic Paper (PRSP II), specifically: to provide the country with the infrastructure to guarantee urban and rural households access to basic social services including energy services by 2012.

At the institutional level, three main stakeholders are the key players in the energy sector. These are: (i) the Ministry in charge of Energy which is responsible for implementing the Government's energy policy. It is the only entity mandated to grant licences and concessions that determine the right of operators to generate, distribute or sell electricity in the country; (ii) the Electricity Sector Regulatory Commission (CRSE) responsible for regulating generation, transmission, distribution and sale of electric energy in Senegal; (iii) the Ministry for Bio-fuels, Renewable Energies and Scientific Research, responsible for providing new opportunities for research and application of scientific and technological research findings for social well-being in a controlled environment, which would be a reflection of a controlled energy sector.

3.2 Environment Sector

Senegal's environmental management policy is shaped by a number of policy papers and strategic planning frameworks geared to sustainable development. The policy documents include: (i) a *letter of environmental sector policy*, adopted in 2004 ; (ii) *National environmental action plan (PNAE) formulated in* 1997; (iii) *Biodiversity conservation strategy*; and (vi) *National climate change strategy (SNMO)*. The strategy aims to establish a harmonious framework for managing climate change programmes.

The environmental management legislative and regulatory framework again underwent reform in 2001 with the passing of Law n° 2001-01 of 15 January 2001 on the Environment Code (LCE) and its implementing decree n° 2001- 282 of 12 April 2001.The LCE deals with general environmental provisions, pollution prevention and control, protection and development of receiving water bodies, as well as various sanctions and arrangements.

With regard to environmental assessment, the provisions of Heading II, Chapter IV of the LCE institutes an environmental assessment for any project or activity that could harm the environment, as well as policies, plans, programmes and regional and sectoral studies and programmes. On the basis of the LCE implementing decree and its Annex 1 relating to the classification of projects submitted for environmental and social assessment, the project is classified as **Category 1** and therefore subject to an environmental and social impact assessment (ESIA). The present assessment is a follow up to the submission of the terms of reference (TOR) at the Directorate of Environment and Classified Establishments (DEEC), on 6 March 2008, and the issuance by the DEEC of a letter validating the TOR on 8 April 2008. The provisional ESIA report was finalized in July 2008, and sent to the DEEC for validation by the Technical Committee. Following the technical committee meeting held on Thursday 21 August 2008, the amended provisional report was submitted again to the DEEC which approved it by a letter dated Saturday 4 November 2008. It was after the public meeting held at the Bargny local community building that the final ESIA report was submitted to the DEEC including the observations by the technical committee and members of the public concerned.

Furthermore, there are environmental standards on air quality protection and wastewater discharge. The need for measures to reduce the risks of pollution in water bodies and the atmosphere led to the adoption of a mechanism for regulating wastewater discharge (NS 05-061 standard) and atmospheric emissions (NS 05-062 standard).

With regard to atmospheric emissions, the coal plant will apply the standards set by the World Bank[3] for any pollutant released. The use of the World Bank's guidelines is fully justified by the fact that the electricity tariff agreement between SENELEC and CES is based on World Bank standards and that, by a letter[4] dated and signed by the Minister in charge of the environment, the Government exceptionally authorized SENELEC to apply the World Bank's air quality guidelines for the strategic reasons mentioned in **Paragraph 2.1.** Table 3.1 below provides a summary of emission levels of the power plant compared to the thresholds set by the World Bank.

Table 3.1 : Emission levels of the coal plant compared with standard thresholds

Polluant	**125 MW Coal Plant (382 MWth)**	**World Bank Thresholds**
SO_2 (sulphur content: 0.55 – 0.80 %)	1.700 mg/Nm^3	2.000 mg/Nm^3
NO_x	750 mg/Nm^3	750 mg/Nm^3
CO	200 mg/Nm^3	-
Dust (PM10)	50 mg/Nm^3	50 mg/Nm^3

[3] **Source :** Section "Thermal Power" of "The Environmental, Health, and Safety (EHS) Guidelines" World Bank, July 1998

[4] **Source :** Letter N°00053/MEPNBRLA/CT.CM to Minister of State, Ministry in Charge of Energy

With regard to noise control, there are no specific regulating standards, but the environmental code stipulates that "*the maximum thresholds that should not be exceeded are fifty-five (55) to sixty (60) decibels by day and forty (40) decibels by night".*

At the institutional level, the coal plant construction and operation plan are the concerns of two key actors of environmental management: the Ministry of Environment and the rural districts/communities located in the project area.

The chief mission of the Ministry of Environment is to promote rational management of natural resources and strive to improve the living conditions of the communities within the framework of sustainable development and poverty reduction. The mission has been reaffirmed through a sector policy letter and a decree defining the responsibilities of the said Ministry. Specifically, this entails the formulation and enforcement of the environmental policy involving other stakeholders. To fulfil its mission, the Ministry works through a number of entities viz.: *the Directorate for Environment and Classified Establishments (DEEC); The Technical Committee* **instituted** by ministerial decision N° 009469 of 28 November 2001; *Directorate of Water, Forestry, Hunting and Soil Conservation.*

The rural districts and communities are responsible for managing the environment and natural resources, in accordance with responsibilities devolved to them. They are to oversee all the measures required for an ecologically rational management of the environment. To this end, they must be informed of projects to be located in their areas and some aspects must be negotiated with them prior to the effective commencement of works in order to avoid conflicts. The rural administrations involved in this project are: the Regional Council of Dakar, the District of Bargny and the Yène Rural Community.

3.3 Environmental and Social Procedures of Lenders

The main funders of the project are: the ADB Group, ADB and BOAD. All these parties have common environmental procedures similar to those of the World Bank. These are based on the 11 July 2006 version of the 10 "Equator Principles – (EPII). They constitute a set of measures for sound management of social and environmental problems related to project financing. In the case of signatory financial establishments, the objective of the EPs is to ensure that the projects they finance in the countries, particularly emerging countries and markets, meet established social and environmental criteria. To this end, the EPs fall in line with the environmental and social standards of the International Financial Corporation (IFC)" a member of the World Bank Group responsible for private sector operations.

The project has been designed to comply with the relevant environmental and social requirements of the World Bank on which the EPs are based. Additionally, the ESIA has already been the subject of a due diligence review by the American firm K & M Engineering, mandated by the aforementioned donors.

IV. Description of Project Environment

The project area is located on the coastal strip extending from Bargny to Yène. The area is administered by the Department of Rufisque, located in the southern approach to the Dakar Region to which it belongs. It is bounded on the north and the south by the Atlantic Ocean, on the west by the Department of Pikine, on the east by the Department of Thiès and on the south-west by the Department of Mbour.

Access to the site is from the Sendou intersection, through a 1.5 km earth road linking it to National Highway N°1. The environmental impacts of the project on the physical, biological and human (social, cultural and economic settings) have been assessed.

4.1 Physical Environment

Climate:

The project area has a Sahelo-Sudanese type of climate. Two basic seasons may be distinguished: a rainy season from June to October and a dry season for the rest of the year. The climate is relatively mild compared to the hinterland, due to the geographic position of the area and oceanic influences that account for its peculiar character.

Temperatures are generally low with an annual average of 23, 8°C. The September-October period is generally hotter (average of 27 to 28°C). The lowest temperatures are recorded during the January-March period. Thermal amplitude varies between 6 °C and 8 °C.

The rains generally fall between June and October, peaking in August. These rains are moderate, hardly exceeding 500 mm annually in the Dakar Region. From a pluviometric perspective, the Bargny area and its environs fall within the 400 and 600 mm isohypses.

The project area is under the influence of 3 air masses: (i) a fresh and moist tropical sea wind from an easterly (N-NW) direction[5] blowing from November to June. It originates in the Azores Anticyclone and crosses the ocean before reaching the peninsula; (ii) continental easterly (Harmattan), a hot and dry wind blowing from March to June. It reaches the coast after a weakening of the maritime easterly; (iii) the monsoon brings rains. It blows from the St. Helena Anticyclone in the South Atlantic from June to October. The wind system is relatively uniform and stable over time. Dominant winds essentially from the north will play a key role in dispersing pollutants from the power plant. Average wind velocity in the area does not exceed 6 m/s, but is higher than 4 m/s.

Relative humidity is high, sometimes nearing 100%. Annual mean relative humidity is about 75%. The highest levels occur during the rainy season (August-September) and the lowest occur in December-January.

Air quality and noise environment

There is little knowledge about the quality of air in the project area and even on a regional scale, in view of the lack of measuring stations. A project to put in place a network of air quality monitoring throughout Dakar is ongoing. However, the *Norwegian Institute for Air Research (October - December 2005 and January 2006)* conducted an assessment of the state of air pollution for the Dakar Urban Transport Executive Council (CETUD). The study shows that in the Mbao area, about 7 km from the project site, average monthly concentrations measured do not reach 20 µg/m3 for NOx and SO2. These concentrations are below the annual thresholds fixed by the NS 05-062 standard and the World Health Organization (WHO), which are 40 µg/m3 and 50 µg/m3 for NOx and SO2 respectively. Within a radius of 1 km from the site, air quality degradation could be related to extractive activities in the North.

The surroundings of the project area are calm in terms of ambient sound level.

Geology, geomorphology, soil resources and sedimentology

The project site is located on the lower portion of the Bargny Plateau, sloping slightly from the north (50 m) to the south (less than 4 m) and giving a relatively flat relief to the power plant land. This area is characterized by the presence of limestone marl, highly clayey black or dark brown hydromorphous soil.

Site investigation conducted by MSI LAB in April 2006, and based on 30 penetrometric samplings indicated the existence of a hard layer of rock in the fringe constituting the refusal area, with depths ranging between 0.70 and 4.50 m.

Sandstone outcrops are found all over the coast between Bargny and Sendou; this rock buried under the sand bar appears between the coast and the Ypresian marl outcrops. It forms large piled structures all over the beach in Bargny – Ngoud, Bargny – Minam and Sendou. The slabs lie scattered on the marl and show traces of karstification, which is more significant on the mainland, behind the off-shore bar where the rocks appear as outcrops over long distances. This is particularly the case in Sendou, where, thick slabs (1m to1.50 m) slope down to the sea over a 700 m by 100 m area.

Water resources

The Bargny limestone plateau has deep notches in the south-eastern portion where the power plant site is located and aerial photographs show a dense and ramified river system with streams trickling down to the coast. Some of these dry up part of the year (Bargny, Pantior etc…); although the flow channel can conserve water throughout the year in small ponds. The streams build up into watercourses during the rainy season, flooding the southern portion of the plateau; they can flow into the sea after breaking over the coastal sandy bars that re-emerge with the long shore current. Thus, the peculiar features of this river system and the lack of drainage are bound to affect sanitation and development in the region.

[5] N-NW : Nord-Nord Ouest

The Hydrology of the continental plateau is characterized by high spatial, seasonal and inter-annual variability. The structure of water bodies indicates 3 types of water: cold saline water, tropical water (warm and salty) and Guinean water (warm and desalted).

The hydrogeology is characterized by a single type of aquifer lying beneath the project area; this consists of shallow (3-10 m) marl and limestone marl of the Eocene (Tertiary) era. Given its clayey consistency, the upper Eocene strata is not very deep (3-10 m)

Oceanography

The Senegalese coast virtually remains under the influence of a relatively strong northwesterly surge. This produces a swelling and scouring effect on the sandy floors. Furthermore, a longshore (coastal) current shapes the beaches through sedimentation and coastal erosion processes. The region is affected by shore erosion especially along the strip from Rufisque to Bargny and Sendou up to Toubab Dialiaw. The consequences of these phenomena are the constant and gradual dwindling of beaches and a receding coastline. The estimated rate of coastal erosion is between 0.5 and 1.5 m/yr[6], depending on the area of the Rufisque coast. On the northern coast, the current takes a north-south direction with an estimated average speed of 4 Km/h.

The semi-diurnal tides from the south are made up of two high tides and two low tides per day. The tidal fall varies between 1.3 m in low fresh water to 0.5 m in dead water. The average level of the water can increase by 0.30 m during the rainy season.

The temperature of sea water off the project areas can rise from 17°C in the cold season to over 28°C in the hot season. Salinity data was not collected in the study area, however, nutrient salt contents show highly marked natural variations: 16 µmol/l of nitrates and 1.2 µmol/l of phosphates between February and March and less than 3 µmol/l of nitrates and 0.5 µmol/l of phosphates between June and November. The only available sea water analysis in the project area was carried out in Sendou in 2002 under the Artisanal Fishing Support Programme (PAPA). The results show that the sea water has high organic pollution levels, but limited microbiological pollution (coliform content below swimming limitations).

4.2 Biological Environment

Terrestrial flora and fauna

Notwithstanding the presence of high water retention soil, there are no major wooded areas at Bargny. The vegetation is essentially made up of shrubs, spiniferous plants, a few scattered baobabs and fig trees.

The study area does not have much terrestrial fauna. The relatively poor vegetation and the presence of large human populations have caused large animals to disappear, leaving only rodents and small reptiles. Birdlife is relatively varied and abundant, without any exceptional wealth or rare or endangered species.

Marine ecosystems

The coastal water bodies are characterized by pelagic species: *Sardinella, Trachurus et Decapterus type,* whereas the deep water bodies are essentially dominated by tunnies (*albacore, patudo, listao*) and related species (swordfish*, sailfish, spearfish, etc.*).

The coastal demersal resources generally consist of high market value elements: *shellfish* (shrimps, lobsters and crabs), *cephalopods* (octopus, cuttlefish and squid) and *fish* (grouper, bream, red mullet, sole, Nile perch, surmullet, barracudas). Mainly intended for export, these resources are fraught with social, economic and political challenges in view of the relatively high incomes they generate to the fishing communities and industry. Overfishing, degradation of their natural habitats and the attendant erosion of the marine biodiversity constitute a threat to the continuity and economic viability of fishing activities.

4.3 Human Environment

In the Bargny district (direct impact area of the project), men account for 49.59 % of the population (18,139 inhabitants), compared to 50.41 % for women, (18,439 persons). The average number of persons per household is 10.1 which is well above the national average of 8.9. Projections by the DPS indicate 44,179 inhabitants by 2010 and 49,041 by 2015.

[6] According to Niang and Diop

The villages of Minam and Sendou are homogenous settlements with the majority of the population made up of Lebous. The traditional villages comprise a compact nucleus with congested and makeshift housing units that do not observe various limitations and urban standards and practices. The streets are narrow and dwellings are very basic. The attachment of the local populations to the original nucleus (traditional village) will make their displacement to the North difficult, but the advancing the sea will compel them to move to the mainland.

Traditional village settlements in the project area are made up of huts and some private houses belonging to Senegalese citizens or Western investors. These buildings foster development of local tourism. Between the coastal strip dominated by luxurious vacation homes and the dwellings further north, there are unoccupied flood-prone areas.

A bounded area allocated to MIFERSO has been indentified but the implementation of the project has been delayed. There is also the port infrastructure of the MITTAL project in the Bargny Sendou area. This is a 250 ha mineral port near the village of Minam. There is a fish processing area between Bargny and Minam used by hundreds of women.

There is no significant farming or livestock rearing in the area in view of the salty soil that does not allow for the development of farming activities. The project area is essentially an artisanal fishing area, as attested by the presence of canoes, artisanal landing wharfs and fishermen.

In general, both in the district itself and in villages attached to it (Minam, Sendou), the supply of drinking water is poor. The village of Minam has a single primary school and a day nursery built recently. Regarding cultural amenities, there is an artisanal gallery and an open theatre, but nothing in the villages of Sendou, Yéne Todd or Minam. The health facilities of Bargny make the project area a pole of attraction. Villages in the area do not have major health facilities. Minam does not have a health post, and the inhabitants go to Bargny for health care.

Given the lack of rainwater and waste water sanitation systems, many forms of environmental pollution and inconveniences are rife, particularly in the rainy season. During that season, the Minam–Sendou–Yéne Todd road links are cut off due to floods.

The road network of the project area is essentially unpaved and in a poor state. It covers a 20,750 m at Kipp Carrière, 1,600 m at Ndaldaly, 1,400 m at Marnane and Ndiayéne, 4,500 m for Minam amd 500 m for Sendou.

The dominant activity in the area is fishing, mainly at Bargny, Minam, and Sendou. However, this activity is becoming increasingly artisanal in view of environmental constraints on the Senegalese coast. In the project area, most commercial activities relate to fish products, off-season farm produce (okra) and the retailing of food products, textiles, etc.

Industrial activities in the project area are essentially in the mining and quarry sector. The Bargny area only has extractive industries, consisting of limestone and sandstone quarry operations. Tourism is not developed in the project area despite the proximity to the sea. However, for a number of years, the Petite Côte de Mbodjène in Sendou (a village to the south of Bargny) has witnessed the development of a special kind of tourism mainly targeting local customers and leading to construction of houses along the coast for weekend tourists.

No archaeological site has been identified in the project area. Only the cemetery of Minam is considered a culturally inalienable site. The local Lebou population attaches special importance to it, however, it does not fall within the 500 m buffer zone.

V. Project Alternative Solutions

The first alternative solution is the “without project” option. This option is to be rejected because, even though it helps avoid negative impacts related to the construction and operation of the coal plant, the economic, health and social consequences stemming from low energy supply to households, industry and all the other sector activities will persist and worsen.

The second alternative solution relates to the choice of the site. Indeed, the major factors that influenced the choice of the coal plant’s location in this area are:

(i) Proximity to Dakar for the transportation of coal over about 32 km by Highway N°1 and the possibility of using a toll motorway (of which the first section Malick Sy – Pikine recently opened; the second section, i.e. Pikine – Diamniadio will probably open in 2011) ;

(ii) Possibility of developing and constructing installations on the high seas for unloading ships in the future;
(iii) A very short connection to the SENELEC grid ranging between 1.5 and 2 km and therefore easily envisaged and not unduly expensive;
(iv) Emergence of a development pole in Diamniadio, close to the MIFERSO site and development of an integrated economic zone in the area which will create high energy demand.

Establishing the power plant at any other location in Senegal would render the transportation of coal difficult and require the development of additional infrastructure, not to mention the inherent environmental impacts.

The third alternative relates to the mode of transportation of the coal to the site (see Annex). It consists in constructing and operating a short pier equipped with cranes and a conveyor belt. Anchored barges would be loaded by the ships' cranes or a floating crane. The pier cranes would offload the coal from the conveyor belt, for supply to the coal storage yard. This alternative is being reviewed by CES and its partners and will require another ESIA prior to construction and commissioning.

From a technological perspective, preference was given to the coal power plant instead of heavy fuel-oil for the strategic reasons outlined, and in view of the availability of coal on the international market and its low cost compared to other fossil fuels. Furthermore, the technology to be used (pulverized coal system) has some advantages over traditional thermal plants: (i) high fuel adaptability making it possible to use alternative fuels such as biomass; (ii) reduced NOx and SOx emissions; (iii) high fuel efficiency; (iv) economy of space and improved maintenance capacity.

VI. Potential Impacts and Mitigating and Improvement Measures

The impacts of the project on the physical, biological and human environment (social, cultural and economic) have been assessed.

6.1 Biophysical Environment

Table 6.1 provides a summary of the major negative impacts on the biophysical environment identified during the preparatory phase for the installation of the site and construction of the plant. The table also includes mitigating measures for the negative impacts.

Table 6.1: Potential Impacts of the Project on the Biophysical Environment During Site Development and Construction Phase

Environmental Component	Potential Impacts of project	Mitigating and improvement measures
Geology, geomorphology, soil resources and sedimentology	Contamination of soil by discharge of hydrocarbons and other chemical products	- Recovery of dead oil and reduction of spillage to the strict minimum ; - Water tightness of fixed areas for handing fuels and lubricants - Contractors compliance with requirements of World Bank and Senegal relating to environmental good practices - Sensitization of site workers on environmental protection
Water resources	Contamination of surface and underground water	- Recovery of dead oil and reduction of spillage to strict minimum - Construction of site sanitary facilities (with cesspools) - Water tightness of fixed areas for handing fuels and lubricants - Sensitization of site workers on environmental protection - Sensitization of site teams on emergency measures in the event of the incidental release of hazardous products
	Disruption of the runoff flow system	- Construction of a runoff evacuation system - Avoid obstructing natural water flow channels as much as possible
Air Quality and human health	alteration of local air quality due to dust and exhaust gas emissions from some site equipment	- Use of dust control liquid - Use of certified mobile machines in line with current international standards - Regular maintenance of the engines of machinery and vehicles to minimize exhaust gas emissions;

		- Spraying of areas exposed to wind during dry and windy periods, particularly between November and May; - Limitation of speed of mobile equipment and lorries; - reduction of open air storage of materials to the extent possible.
Living environment	Social conflict arising from non acceptance of the project by some sections of the population	- Information and awareness of the populations - Consultation with all stakeholders - Support to specific development initiatives initiated by the local communities
	Noise pollution produced by site equipment and lorries carrying equipment and materials, etc.	- Regularly inform residents of surrounding villages about the noisy phases of the site works particularly times, duration, etc. - Raise works contractors' awareness of the need to adopt less noisy behaviour or practices notably prevent equipment from falling, avoid shouting, ensure conformity of site machines with standards, etc. - Organize the works site such that access or traffic roads are not located close to the village of Minam where the population is relatively dense
	generation of waste made up of rubble and backfill, used oil, packaging materials, metals, etc.	- Use waste materials (e.g. rubble and backfill) to form earth banks around the work site. These can reduce background noise considerably - Wastes comprising packaging materials and metals must be sent to their intended recipients or sold by local dealers according to the prescribed regulations - Prior to start of works, CES will prepare an organizational plan for the sorting, selective collection and elimination of waste according to the size of the site. In the absence of recycling arrangements for most of the waste, CES should eliminate non recyclable wastes in a landfill near the site. A landfill (CET) is under construction at Bargny) - Used oil will be collected on the site (one 8 m3 tank for storage) and recycled in a local cement factory; - Provide an area for cleaning machines or lorries before they enter Highway N°1, especially during rainy periods.
Terrestrial flora and fauna	Disturbance of natural ecosystems and loss of fauna habitat through deforestation	- Conservation of specific trees located on the project right-of -way - Seek approval from relevant authorities prior to any tree felling operation - Hand over of wood products to local communities - Plant rows of trees (local species) around the power plant
		-

Table 6.2 provides a summary of the major negative impacts identified in the biophysical environment during the operation of the plant. The table also includes measures for mitigating the negative impacts.

Table 6.2: Potential Biophysical Impacts of the Project During Operation of the Plant

Environmental Component	Potential Impacts of project	Mitigating and improvement measures
Soil and water resources	Contamination of soil and underground water from the seeping of water into fuel storage areas (coal and diesel oil)	- Watertight of fuel storage points
	Water pollution due evacuation of wastewater from the plant	- The wastewater will be collected through a clean channel in a neutralization pit and treated in order to restore its physical and chemical characteristics in line with Senegalese wastewater standard
	Thermal pollution of the sea through release of hot water from the power plant	- Construction of an underground discharge pipeline to ensure adequate dispersal of thermal plume

Air quality and human health	Alteration of the air quality due to hazardous pollutants (NOx, SO2, CO) and dust emissions during the generation of electric energy **Health impacts:** In view of the proximity of densely urbanized areas (village of Bargny Minam), a health risk assessment was carried out. The pollutants included in the model (SO2 and NOx) are all considered to be non-carcinogenic. The assessment indicates that the ratio of hazards, viz the ratio between exposure attributable to the stack and the toxicological baseline (WHO or EU values) is far less than 1 for each of the target organs. This means that, in theory there is no major health risk for the population in the area but does not inform on the probability of emergence of secondary disorders. In conclusion, none of the VTRs was exceeded for any of the target organs.	- Design a power plant that will comply with the following emission criteria: (i) height of stack: 100 m ; (ii) temperature of gases: 135 ° C ; (iii) speed of gas emission: 15 m/s ; (iv) gas flow rate: 130.6 Nm3/s - Set up station for the continuous measuring of SO2 emissions and concentration in the area, taking into account the wind direction and proximity of inhabited areas. This system could be electronically connected to the power plant's control room - In the event of exceeding of limits due to severe wind conditions, similar to the scenario in the model with a low a occurrence rate (5.2 days / year), an arrangement could be made with SENELEC to reduce the plant operating capacity in order to cushion the impact
Climate	Contribution to climate change through GHG emissions (CO2 in particular). The plant will consume on average 400,000 tonnes of coal annually. This could have a significant effect on the country's current GHG emission level. Net annual GHG emissions from the coal plant are estimated at 964.554 tonnes of CO2 equivalent. This represents 27 % of total GHG emissions of Senegal in 1995 (about 3.572 million de tonnes of CO2 equivalent). However, although Senegal has ratified two legal instruments on climate – the United Nations Climate Change Framework in 1994 and the Kyoto protocol in 2001 – it has not made any constraining commitment on the reduction of these GHS emissions, as is case for countries in Annex B of the Kyoto Protocol. However, it must endeavor to participate in the global effort to combat climate change.	CES, in agreement with SENELEC and the Government of Senegal, should adopt a set of actions to reduce GHG emissions in the electricity sector. The priority actions include: - replace old power plants with new and more efficient ones that moreover use cleaner energy sources - substitute a portion of the coal with natural gas or alternative fuels and, consequently use a burner that is appropriate for these kinds of fuel - improve the energy efficiency of the plant by replacing the coal furnace with a circulating fluidized bed furnace that emits less CO2 - To the extent possible, apply the Clean Development Mechanism (CDM) by using the ash for the local manufacture of cement or tree planting on the communal land in order to contain the GHGs to be emitted by the plant - promote savings in energy consumption through sensitization, training and support in the choice of low energy consuming equipment.
Oceanography	In order to quantify the effects of hot water in the operation of the power plant condenser, a French-based company, *FLUIDYN,* was commissioned to undertake a simulation of the dispersal of thermal plume. *FLUIDYN* used a specific software ***fluidyn-FLOWPOL*** derived from the ***fluidyn-FLOWCOAST specifically for*** aquatic environment, to carry out the simulations. The modeling results show that hot water released from the plant will disrupt local effluents (near the discharged hot water) due to the difference between the weak ocean current and the high velocity of the discharge. The disruption will induce the accumulation of stagnant water to the east of the discharge point over a distance of about 200 m from the coast.	- To the extent possible reduce the velocity of the hot water discharge
Living environment	Noise pollution stemming from noise generated by carbon preparation and handling and operation of equipment. The main villages, dwellings and schools in the study area as well as their respective distances from the plant are: - village of Bargny Minam at 800 m to 1 km to the north-west of the plant, - fishing village 600, m and an elementary school 520 m to the south of the site,	- The plant will be located in a remote site, with a minimum radius of 500 m from dwellings, also representing the buffer zone; - The proposed facilities will be in accordance with international regulations on noise and vibrations; - Coal crushing and screening are conducted at the same post which is entirely contained in a structure with a metal section to reduce the overall noise level. - Use of silencers in the fans, safety valves, stack, etc. ; - Installation of the steam turbine inside an acoustic enclosure;

	- Yenne village at 800 m to the south-west of the plant.	- Distribute and maintain ear muffs, at no cost to the workers, and ensure that these are worn by all workers at noisy points such as machine room, coal crushing post, etc.; - Conduct property limit noise measurements. The results can be used to better assess the impact of noise emitted by the plant on the environs and ensure that maximum noise levels set in environment code are not exceeded.
	Production of different types of household waste, special industrial waste and inert waste (clinker and fly ash)	- Household waste will be collected by the suppliers or sent to the nearest landfill (CET) is under construction at Bargny); - CES should ensure that the sludge is sent to treatment centre at Cambéréne; - Used oil and grease should be recycled in a local cement factory; - Ion exchange resins as well as sludge from oil separation unit and neutralization pit should be exported outside Senegal in accordance with the Basel convention on cross border movement of hazardous waste and its elimination; - Clinker and fly ash will be recycled as raw materials in a factory for the production of bricks, paving stones, etc. to this end, CES is negotiating with "Central Power Research Institute (CPRI)" based in India, which specializes in the production of fuel by-products. This project which is similar to the current one will be fully financed by ADB.
Marine Ecosystems	Entrainment of small fish and mollusc resulting from the operation of the sea-water intake for the cooling system;	- The water intake will start from underground piping and a pumping station at the end of pipeline instead of concrete channels that capture more small fish; - Prevent the entrainment of small fish through a lighting system using submarine lamps over a distance of 150 m;
	The modeling results show that hot water released from the plant will disrupt local effluents (around the evacuation point) due to the difference between the weak ocean current and the high velocity of the discharge. The disruption will induce accumulation of stagnant water to the east of the discharge point over a distance of about 200 m form the coast.	- To the extent possible, reduce the flow speed of hot effluents in order to safeguard other uses of water resources (e.g. fishing) and aquatic biodiversity
	Thermal sea pollution caused by discharge of hot water from the plant. This kind of pollution can induce direct effects on phytoplankton, by lowering primary production and with regard to the zooplankton, through the mortality of some fragile organisms. There are even potential cumulative effects with the development of the new Bargny mineral harbour.	- Water intake will start from an underground pipeline linking a pumping station - Steps will be taken to ensure that in cooling the condenser, the temperature of the sea water discharge does not ever exceed the ocean temperature by 3°C. To that end, the CES will undertake regular and adequate maintenance of the cooling system and constant sensitization of the operators

6.2 Social, Cultural and Economic Environment

In general, the project will have relatively positive impacts on the social, cultural and economic environment:

Site preparation, Installation and construction phase

- Many jobs will be created during the construction of the plant, which will last 2 years. The local workforce will no doubt secure certain jobs, which will contribute to lowering the unemployment rate in the project area, together with induced positive effects (improvement in incomes and living conditions of local communities). During this phase an estimated 600 jobs will be created;
- The presence of workers on the work site will foster the development of trading activities in the project area, especially around the work site, food spots and petty trading. The benefits of catering activities will mainly be for women and young girls who are most active in this area.
- In the social organization of the country, even though authority is hardly given to women, they actively participate in household self-sufficiency efforts, for example, through commercial and farming activities. Our field visits confirmed the active role played by women in fish processing and trading.
- Overall, the project will contribute to improving the living conditions of the local population and reducing unemployment rate.

- The works implementation phase will generate revenue for local residents given the employment opportunities to be provided. The project will thus impact positively on incomes by contributing either to employment creation or increase, and development of related activities, especially for women.
- Thus, the notable gains the project could afford the communities will include youth employment during the works execution phase.

Operational phase

Most of the positive impacts of the project will occur during the operational phase of the plant. The expected outcomes are: (i) improved electricity service; (ii) employment creation; (iv) improved living conditions; (v) development of the project area and population inflow; (vi) visual aspects.

Other positive impacts

Other positive impacts of the project relate to: (i) improved productivity of industrial production units through improvement in electricity supply; (ii) a rise in the value of lands in the project area, notably during the operational phase, especially given the scarcity of land at Bargny; (iv) promotion of the local economy through the payment of taxes and levies; (v) integration of the local populations, particularly the youth, into income generating activities such as: coal transportation making bricks using clinker and fly ash etc.

VII. Environmental Risk Management

The hazard assessment by QUARTZ-Afrique shows that most of the risks from the activities of the plant will be acceptable; only the storage of diesel oil has been classified otherwise in accordance with the Senegalese methodological hazard assessment guide.

To reduce these risks to acceptable levels, preventive measures have been proposed to the promoter. These are organizational, operational and technical. Apart from measures to prevent incidental risks, protective measures to contain the effects of possible accidents have been envisaged by the promoter or by QUARTZ-Afrique. These are mainly: (i) emergency shutdown systems to protect the installations; (ii) catchpits to prevent contamination of soils or nearby water bodies in the event of accidental leakage of a hazardous product; (iii) fixed or mobile fire-fighting facilities; (iv) an Internal Organization Plan (POI) to respond to an emergency situation.

A review of possible breakdowns at the electric plant showed that the measures adopted or proposed would be adequate to maintain an acceptable level of protection of the installations

VIII. Environmental Management Plan

To ensure smooth implementation of the mitigative measures, an environmental management process will be incorporated into all the project stages. To this end, a monitoring and follow up programme has been put in place. The programme identifies changes in the affected areas in relation to their original status, compliance with legal and regulatory requirements in Senegal, World Bank guidelines and the environmental policy of the promoter. It will enable the promoter and stakeholders to follow up and harmoniously monitor: (i) the status of atmospheric emissions from the plant and quality of ambient air in the nearest villages; (ii) the condition of effluents from the plant, changes in surface hydrology close to the plant and local hydro-geology; (iii) possible alteration of sea water and effects on aquatic species owing to hot water discharge from the cooling system; (iv) changes in the living conditions of the communities owing to noise from within the plant site, and waste produced by the latter.

These steps will help report results and propose remedial actions in the event of significant changes to the areas. Various parameters that will be monitored and followed up at both the construction and operational stages are: (i) air quality; (ii) noise level and wastes; (iii) sea water (quality and current patterns); (iv) aquatic species.

Data collected under the programme (cf. table below) will be analyzed and incorporated into an electronic database directly linked to the plant Control Room. Where the regulatory limits are exceeded, measures will be taken immediately to reduce the emission level.

Environmental Monitoring and Follow Up of Air Quality and Living Conditions

Parameters	Method	Place	Frequency	Party Responsible
Construction Phase				
Dust fallout	Rounds	site vicinity	weekly	HSE [7] Service to be put in place by NYCOMB
Sound level	Integrating sound level meter	Plant's property limits	During site peak hours	CES HSE Dept
Construction waste (rubble, scrap, used oil, etc.)	By monitoring schedule	On site	monthly	CES HSE Dept
Operational phase				
Emissions (NOx, SO2, CO, O2)	Automatic analyzer	Boiler stack	Continuous	CES HSE Dept
Concentrations (NOx and SO2)	Automatic analyzer and diffusion tubes	In 1 to 2 areas where concentration limits have been exceeded (see modeling results)	Continuous	CES HSE Dept and CQAD[8]
Wind speed and direction	By a measuring station	In 1 to 2 areas where concentration limits have been exceeded (see modelling results)	At least twice annually (dry and rainy seasons)	CES HSE Dept and national weather report
Sound power of plant machines (station de crushing/screening, boiler, turbine generator, fan, stack, etc.)	By monitoring schedule	1 meter away from source – work areas	monthly	CES HSE Dept
Sound level within plant property limits	Measurement in the production facility	Power plant	annual	CES HSE Dept
Household waste (packaging materials, replacement maintenance parts, sludge, algae and molluscs, etc.)	Monitoring schedule	On site and dump site	monthly	CES HSE Dept
Special industrial waste (used oil and grease, oil filters, etc.)	Monitoring schedule	On site and disposal companies	monthly	CES HSE Dept
Clinker and fly ash	Monitoring schedule	On site and disposal companies	monthly	CES HSE Dept

[7] HSE : Hygiene Securite et Environnment (Health, Safety and Environment)
[8] CQAD:Air Quality Monitoring Centre in Dakar based at the Environmental Directorate and classified establishments (DEEC)

Environmental monitoring and follow up of liquid effluents from the plant, hydrology and hydro-geology

Parameters	Method	Place	Frequency	Responsible Party
Construction Phase				
Quality and drinkability of water from water table (pH, conductivity, Ca^{++}, Mg^{++}, Na, K^{+}, SO_4^{--}, Cl^{-}, NO_3^{-}, NO_2^{-}, total hydrocarbons)	Sample taking and periodic laboratory testing	Piezometers installed in line with established network based on spatial distribution of hydraulic structures in the villages of Bargny and Sébikotane	Once a year during high and low water periods	CES HSE Dept
Quality of Sendou lagoon water (pH, MEST, DBO5, DCO, total nitrogen, total phosphate, heavy metals, faecal coliforms, etc.)	Sample taking and periodic laboratory testing	A the mouth of Sendou Lagoon	Twice during wet season (November)	CES HSE Dept
Operational Phase				
Quality of demineralised boiler water	Sample taking and periodic laboratory testing	Boiler water tank	Routine	Operations units and CES HSE Dept
Quality of water released by the plant (pH, MEST, DBO5, DCO, total nitrogen, total phosphate, heavy metals, total hydrocarbons, temperature)	Sample taking and periodic laboratory testing	1500 m3 settling tank for collecting already treated waste water	3 times annually	CES HSE Dept
Quality of sea water discharged after use by condenser and possibly SO2 cleaner (pH, temperature, DBO5, DCO, faecal coliforms, sulphate and nitrate content)	Sample taking and periodic laboratory testing	Discharge point at Sendou beach	- Continuous for temperature - 3 times annually for other parameters	CES HSE Dept
Pluviometry, Insolation, Evapotranspiration (real and potential)	Establish a pluviometric post at the plant (1 nanometer, 1 heliograph 1 Sunken Colorado pan)	In the area	Continuous	CES HSE Dept and national weather report
Variation of thermal troughs on the Siendou lagoon	Installation Thalimède	At lagoon mouth	Once every season	CES HSE Dept
Quality of Sendou lagoon water (pH, MEST, DBO5, DCO, total nitrogen, total phosphate, heavy metals, faecal coliforms, etc.)	Sample taking and periodic laboratory testing	Thermal troughs	2 sample taking per year	CES HSE Dept and DEEC

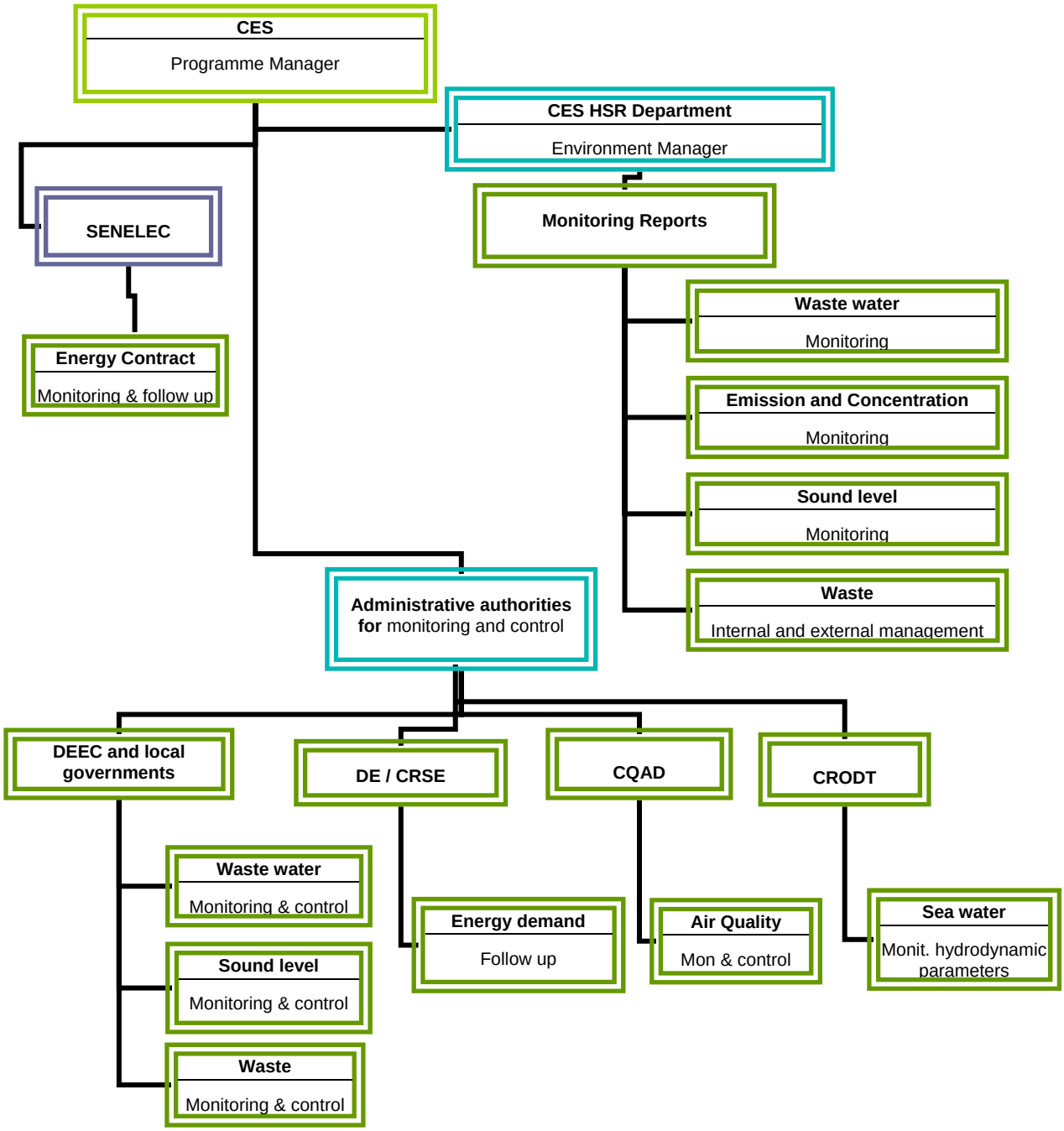
Parameters	Method	Place	Frequency	Responsible Party
Operational Phase				
Productivity of ground water table and development of hydraulic potentialities as well as direction of water flow	Organization of rounds followed by piezometric monitoring	Piezometers installed based on established network ,depending on the spatial distribution of hydraulic structures in the Bargny and Sébikotane villages	Once annually during high and low water periods	CES HSE Dept
Quality and drinkability of water table (pH, Conductivity, Ca^{++}, Mg^{++}, Na, K^{+}, SO_4^{--}, Cl^{-}, NO_3^{-}, NO_2^{-}, total hydrocarbons)	Sample taking and periodic laboratory testing	Piezometers installed based on established network depending on the spatial distribution of hydraulic structures in the Bargny and Sébikotane villages	Once annually during high and low water periods	CES HSE Dept and DEEC
- Recontamination and transfer of contaminants to ground water by water in wet areas. - Impacts of other temporary water courses on ground water.	- Install shallow and less costly PVC piezometers - From hydraulic structures or existing piezometers	Panthior : 4 piezometers, in a line perpendicular to the stream Close to plant: 2 piezometers	Once annually during high and low water periods	CES HSE Dept

Environmental monitoring and follow up of sea water (quality and current patterns) and aquatic species

Parameters	Method	Place	Frequency	Responsible Party
Operational Phase				
Quality of sea water (pH, temperature, DBO5, DCO, faecal coliforms, sulphate content, nitrate)	Sample taking and periodic laboratory testing	30 metres from hot water discharge	▪ Continuous for temperature ▪ 2 times annually for other parameters	CES HSE Dept
Velocity of currents	Current analysis	Pier location	Once a year	CES HSE Dept in conjunction with C.A.DIOP University (Department of Geology, FST) and CRODT[9]
Depth gauge	Depth guage	Pier location	Once a year	CES HSE Dept in conjunction with C.A.DIOP University (Department of Geology, FST) and CRODT
Swell conditions off and on project sites	Measurement of swell directions	Pier location	Once a year	CES HSE Dept in conjunction with C.A.DIOP University (Department of Geology, FST) and CRODT
Water temperature	Measurement of temperatures according to verticals (vertical profiles)	Pier location	Once every 6 months	CES HSE Dept in conjunction with C.A.DIOP University (Department of Geology, FST) and CRODT
Average chemical composition of sea water	Oxygen below pH Salinity	Pier location	Once every 6 months	CES HSE Dept in conjunction with C.A.DIOP University (Department of Geology, FST) and CRODT
Heavy metals, acids, alkaline products, ammonia and oil.	Measurements	Pier location	Once every 6 months	CES HSE Dept in conjunction with C.A.DIOP University (Department of Geology, FST) and CRODT
Zooplankton and phytoplankton	count	Pier location	Once every 6 months	CRODT

[9] CRODT : DAKAR-THIAROYE OCEANOGRAPHIC RESEARCH CENTRE

The environmental monitoring and follow up will be based on the following organization chart.



In this organization, the DEEC will play a key role. Through its classified establishments and in collaboration with the local authorities (Bargny, Sendou Rural Council, etc.), it will be responsible for ensuring that the power plant complies with property limit sound thresholds, NS 05-061 wastewater standards, provisions of the environmental code in respect of waste management and pressurized equipment, etc. It will be necessary to build the capacities of DEEC staff in view of the specific nature of the project (coal plant).

The estimated cost of the monitoring and follow up programme for the first year of plant operation is **208,721 Euros**.

Actions to be taken	Estimated costs in CFA F	
	Fixed	annual
1. Construction Phase (sum of 1.1 to 1.3)		***6 900 000***
1.1 noise measurements		6 000 000
1.2 monitoring drinkability of ground water		600 000
1.3 monitoring quality of Sendou lagoon water		300 000
2. Operational Phase (sum of 2.1 to 2.8)	***82 390 137***	***33 300 000***
2.1 Measuring boiler stack emissions		25 000 000
2.2 Installation of fixed station for monitoring air quality and meteorological parameters with automatic analyzers (excluding maintenance and supplies)	82 390 137	
2.3 Noise measurement		6 000 000
2.4 Monitoring quality of waste water released from the plant		700 000
2.5 Monitoring quality of sea water released		700 000
2.6 Monitoring temperature of sea water discharged		RAS
2.7 Monitoring drinkability of ground water		600 000
2.8 Monitoring quality of Sendou lagoon water		300 000
2.9 Monitoring quality of sea water (pH, temperature, DBO5, DCO, faecal coliforms, sulphate and nitrate content)		
2.10 Monitoring marine currents and salinity		NA
3. Operating costs of HSE Dept (salaries, meetings, waste management and other items)		***2 750 000***
4. Operating expenses of the Monitoring Committee (transportation to site, per diem, report preparation and other items)		***4 560 000***
TOTAL (1+2+3)	***82390137***	***54510000***

IX. Public Consultations and Information Dissemination

The participation by the public in the ESIA is pertinent for the integration of the project into its socioeconomic context. This has made it possible to: (i) include the views and observations by the various stakeholders, including those of the communities in the project area in an interactive manner, (ii) measure and take into account the impacts or effects of project implementation. In order to minimize or eliminate the negative aspects and improve the beneficial ones.

The public consultations, which began in March 2008, mainly concerned the local authorities and communities in the project area. Thus, a series of meetings was organized with the local authorities, the communities and resource persons from the targeted areas, namely Bargny District, Yéne, Sendou and Minam villages and the Yène rural community.

The main concerns and expectations of the populations emerging from the consultations are as follows: (i) The Bargny residents expressed fears about the negative effects of such a project. The inconveniences and discomfort (dust) they suffered from the SOCOCIM cement factory experience have made them apprehensive and skeptical, even though in the present circumstances they recognize the need for, and significance of a power station including the socioeconomic benefits for their locality; (ii) The communities wish to be reassured concerning the negative impacts and benefits of the project for rural communities; (iii) youth employment is key for the people. In their view, the project promoters should ensure that the youth from surrounding villages and Bargny district are given preference in the recruitment of workers for the construction and operation of the plant; (iv) They also expect improved electricity supply and a reduction of power rates; (v) they expressed high hopes that the project would follow environmental requirements outlined in the Environment Code during both the construction and operational phases; (vi) most of the persons interviewed would have preferred the siting of the project at MIFERSO in line with the ongoing projects in the area.

X. Supplementary Initiatives

As part of the environmental assessment, CES held a meeting with the DEEC, SENELEC and MIFERSO. The agenda was as follows:

1) The option of transferring the Plant to the MIFERSO area proposed at the public meeting, and
2) Modalities for monitoring of implementation of the Environmental and Social Management Plan (ESMP) of the ESIA.

At the meeting it was stated that the transfer of the project to the MIFERSO site was not feasible. With regard to modalities for monitoring the implementation of the ESMP, the proposal for a tripartite memorandum of understanding (MOU) between DEEC, SENELEC and CES was deemed to be appropriate by SENELEC and the Energy Directorate. Thus, the Environment Director noted that the participation of SENELEC in the MoU is a guarantee of the success of the CES-DEEC collaboration.

The MoU, signed by the three parties on 13 May 2009 aims at:

1) Defining the roles and responsibilities of the two parties in reinforcing environmental regulations governing the 125 MW coal power plant project;
2) Establishing sound cooperation between CES and the DEEC, defining and using resources to effectively implement an environmental policy at CES,
3) Share useful information with the public to ensure transparency in addressing environmental and safety issues,
4) Monitor any new development that could improve the environmental policy as defined by the three parties,
5) Provide the wherewithal for achieving the objectives.

In view of the social nature of the project, the Promoter undertakes to support grassroots communities from the area (youth and women, cultural and sport associations, etc.) in environment and public health issues related to the implementation of the project, with a view to improving their living conditions. Two (2) key projects targeted by the Promoter are listed in the table below.

Project name	**Description**	**Environmental, social and health impacts**	**Project Cost / Beneficiary Population**	**Contributions by CES and its Partners**
Establishment of a brick-making factory, … using clinker and fly ash from the plant	- Comprehensive characterization of clinker and fly ash - Establishment of processing technology for construction materials (bricks, solid blocks, cobblestones, tiles, etc.). - Testing of processing technology by making products. - Training of operators (preference to local labour) - With 176 tonnes of ash per day, the following outputs are expected: 100,000 bricks, 6,000 heavy duty pavers, 1,000 cobble stones, 6,000 mosaic tiles	- Conservation of soil and underground resources by refraining from depositing ash outside the project site - Creation of employment in the area of influence of the plant - Improved air quality and consequently reduced health risks for the population caused by breathing of ash	An investment cost of US$ 660,000 excluding taxes; the beneficiary communities will be the youth and women of the area.	- The ADB hopes to fully finance the project - CES will assist the operator in establishing administrative documents and enhanced generation in line with environmental and safety standards set out by the ADB and the Government of Senegal
Modernization of the fish processing area between Bargny and Minam	The project will aim at: - putting in place15 warehouses, refurbishing a day nursery, electrification and backfilling of the area, building of shelters, marking out of the processing site. - training women for better fish drying in line with environmental and safety rules	- Conservation of soil and underground resources by refraining from drying fish directly on the ground - Creation of employment in the plant's area of influence - Improvement of hygiene and health of women by providing them personal protecting gear and medical care assistance	For an investment of CFAF 200 million, the beneficiary communities will be: 500 women from Bargny Minam, including 225 belonging to 15 Economic Interest Groups.	- Sizeable financial contribution by CES and its partners - Support to women's capacity development

XI. Conclusion

The findings of the study indicate that the project has significant positive impacts on the socioeconomic environment. Regrding the negative impacts, the most sensitive environmental components relate to air and the marine environment. But as the findings show, steps taken by the promoter to reduce some polluting emissions will bring the plant in line with relevant international standards. Also, the constructor has provided guarantees ensuring that emission levels will fall below the limits set by the World Bank. With regard to the marine environment, steps will be taken to choose the appropriate technology for sea water intake and the effluent canal to avoid adverse effects on marine ecosystems.

Consequently, it is critical to ensure that the Promoter's mitigation measures are systematically enforced as well as the supplementary measures proposed by QUARTZ-Afrique following this study. To this end, an active and effective partnership between the local authorities, DEEC, SENELEC, CES and other stakeholders constitutes a key factor for addressing all the environmental and social aspects of the project.

XII. References and Contact Persons

1. References:

Regulations

1) Ministry of Environment and Nature Protection (MEPN) – Directorate of Environment and Classified Establishments; Law N°2001 – 01 of 15 January 2001 on the Environment Code; 2001
2) Ministry of Environment and Nature Protection (MEPN) – Directorate of Environment and Classifed Establishments; regulatory instruments (orders and decrees) and standards (NS 05-061 and NS 05-062)
3) Letter of Energy Sector Development Policy (February 2008)
4) "The Environmental, Health, and Safety (EHS) Guidelines" – World Bank published in July 1998
5) EPII, July 2006

Miscellaneous

1) Tender documents for the 1X125 MW Coal Power BOO Project; April 2007
2) Technical specifications of coal power plant submitted by Promoter.
3) European Commission – Integrated Pollution Prevention and Control – Reference Document on Best Available Techniques for Large Combustion plants; July 2006
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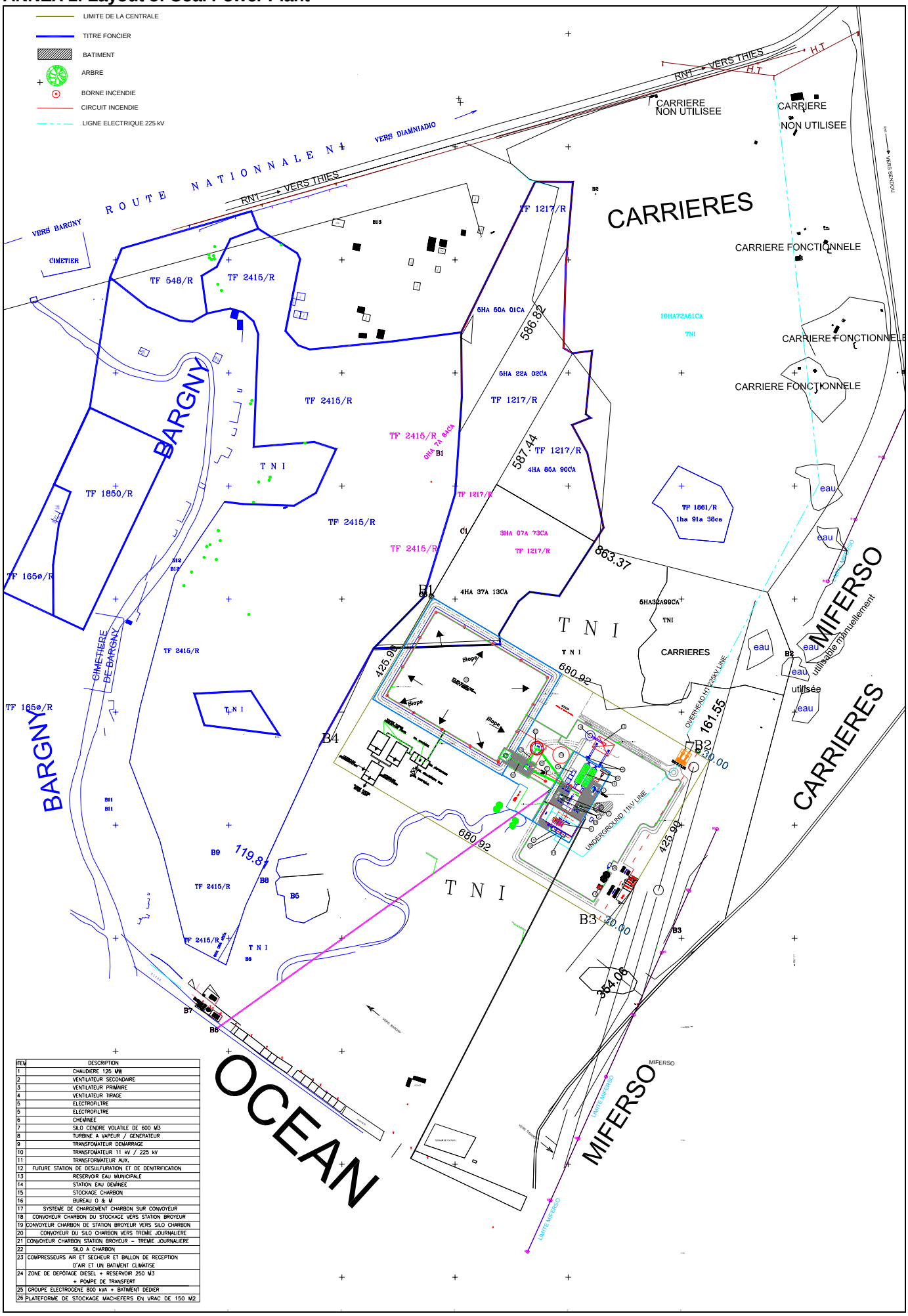
9) Site Research Study – Report on new bulk and mineral terminal in South Dakar, SOGREAH Consultants; December 2005

2. Contact Persons:

(i) Mr. Louis Claude Norland SUZOR, CES General Manager, Bregevagen 2, 182 64, Djursholm, Sweden ; Tel.: 0046705471304 – Email : nsuzor@swipnet.se

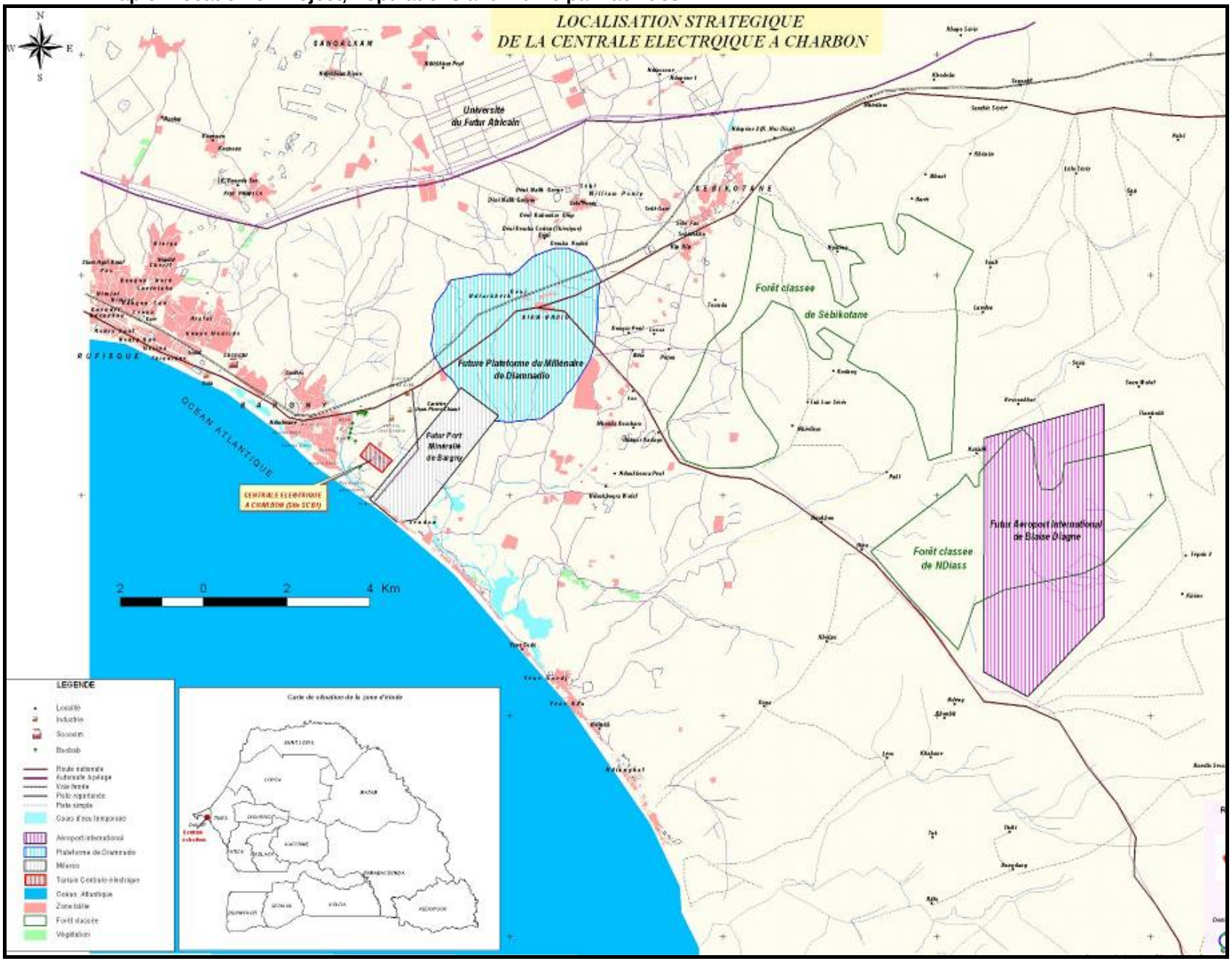
(ii) Mr. Mohamed DIAWARA, Director, QUARTZ-Afrique, Liberté 6 Extension, n° 8, BP : 10427 – TEL/FAX : 00221338279277 - EMAIL : quartz.afrique@sentoo.sn

ANNEX 1: Layout of Coal Power Plant

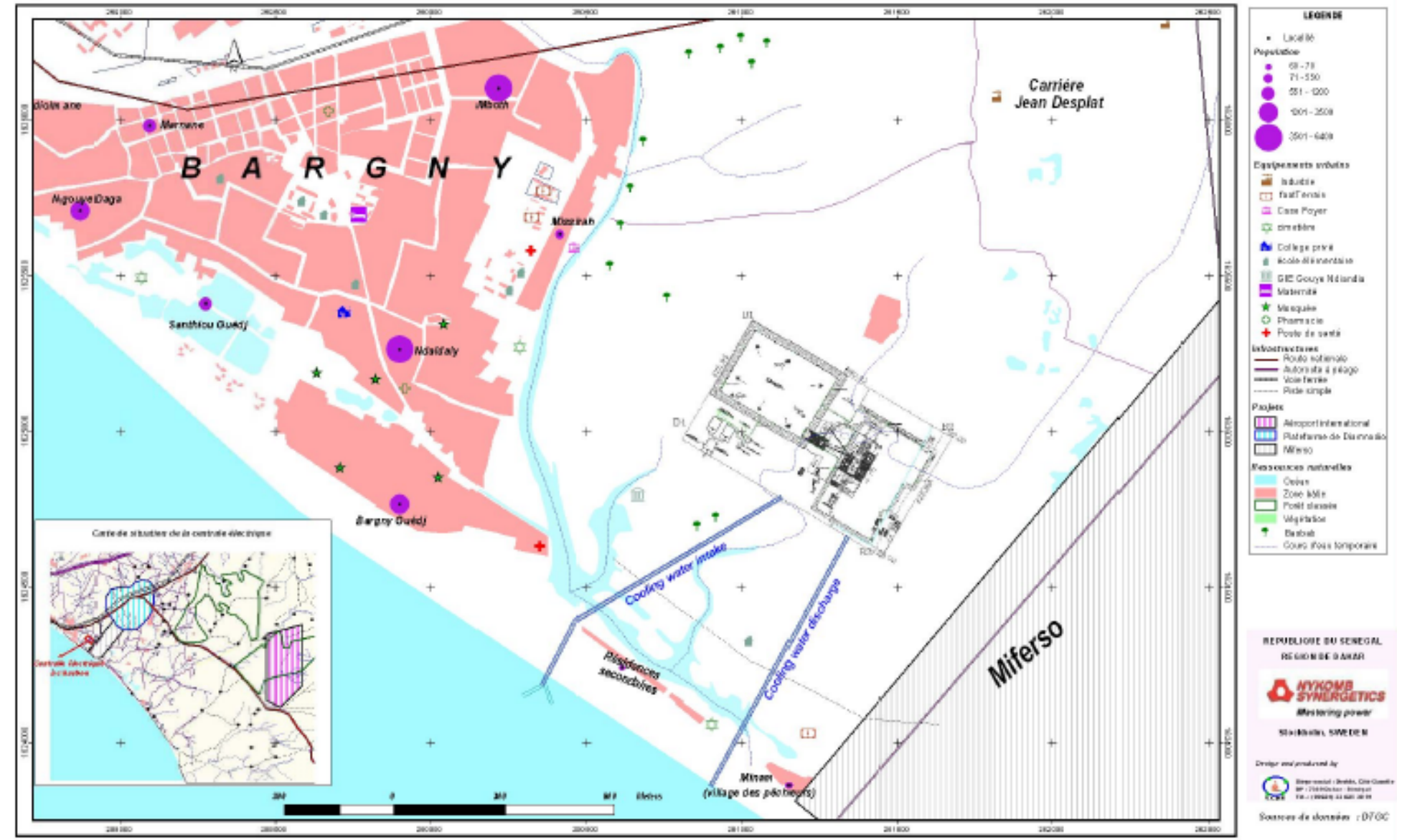


ITEM	DESCRIPTION
1	CHAUDIERE 125 MW
2	VENTILATEUR SECONDAIRE
3	VENTILATEUR PRIMAIRE
4	VENTILATEUR TIRAGE
5	ELECTROFILTRE
5	ELECTROFILTRE
6	CHEMINEE
7	SILO CENDRE VOLATILE DE 600 M3
8	TURBINE A VAPEUR / GENERATEUR
9	TRANSFOMATEUR DEMARRAGE
10	TRANSFOMATEUR 11 kV / 225 kV
11	TRANSFORMATEUR AUX.
12	FUTURE STATION DE DESULFURATION ET DE DENITRIFICATION
13	RESERVOIR EAU MUNICIPALE
14	STATION EAU DEMINEE
15	STOCKAGE CHARBON
16	BUREAU O & M
17	SYSTEME DE CHARGEMENT CHARBON SUR CONVOYEUR
18	CONVOYEUR CHARBON DU STOCKAGE VERS STATION BROYEUR
19	CONVOYEUR CHARBON DE STATION BROYEUR VERS SILO CHARBON
20	CONVOYEUR DU SILO CHARBON VERS TREMIE JOURNALIERE
21	CONVOYEUR CHARBON STATION BROYEUR – TREMIE JOURNALIERE
22	SILO A CHARBON
23	COMPRESSEURS AIR ET SECHEUR ET BALLON DE RECEPTION D'AIR ET UN BATIMENT CLIMATISE
24	ZONE DE DEPOTAGE DIESEL + RESERVOIR 250 M3 + POMPE DE TRANSFERT
25	GROUPE ELECTROGENE 800 kVA + BATIMENT DEDIER
26	PLATEFORME DE STOCKAGE MACHEFERS EN VRAC DE 150 M2

ANNEX 2 : Map of Location of Project, Populations and Municipal Facilities



Plan de masse
de la Centrale électrique à charbon



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