Summary of the Environmental and Social Management Plan

Title of the project: Expansion of the Azito thermal plant (Phase 3)
Project number: P-CI-FA0-004
Country: Cote d'Ivoire
Department: OPSM
Division: OPSM3

1. Brief Description of the project and the main environmental and social components

a. The project

The Azito power station, as planned in the initial project from 1998, consisted of building, owning, operating and eventually transferring to the State a gas-fired power station with a total capacity of approximately 420 MW, to be implemented in three phases, each of around 140 MW.

The Azito thermal power plant is operated by Azito Operations and Management (O & M Azito), a subsidiary of Azito Holding. The shareholders of Azito Energy are Globeleq and Azito Energie Holding SA, a subsidiary of Industrial Promotion Services (IPS) and the Aga Khan Fund for Economic Development.

The project consists of upgrading the Azito thermal power commissioned in January 1999 by transforming the existing simple cycle power plant (two turbines, each with an installed capacity of 140-150 MW), to a combined cycle plant, by the addition of two heat recovery steam generators, a steam turbine generator with an installed power output capacity of 140 MW and one steam condenser with an associated closedloop, air-cooled cooling water system. This entails no creation of new sources of combustion and no incremental gas consumption. This is mainly to improve the efficiency of the plant, by recovering energy currently disposed off as heat in the turbine exhaust gases, bringing the installed capacity of the Azito plant from 280-290 MW to 420 MW, an increase of 50%. With this upgrade, the plant’s efficiency, about 29.5% currently (Phases I and II) will be increased to about 44% (for the same gas consumption).

The site is located near the village of Azito (300 m south), in the Yopougon district, about 6 km west of the port of Abidjan. The site is located alongside the western arm of the Ebrié lagoon, approximately 10 km from the inlet of the Vridi canal. Béago village is located 1km to the North-East of the Azito site.

Construction works began in July 1998, and the first phase (one turbine) was completed in January 1999. The second phase (similar to phase I) was commissioned in February 2000. The third phase (upgrading the plant from single cycle to combined cycle power generation) was initially planned for commissioning in 2002, but political instability in the country impeded the development plan of the Project.

Decommissioning should not take place before 2034. As the Azito Power Station will be transferred by Azito Energie to the Ivory Coast State 20 years after the construction of the Phase III, the decommissioning work will therefore be the responsibility of the Ivoirian authorities. Decommissioning activities should be consistent with Ivoirian regulations and internationally-recognized guidelines and standards.

b. Main environmental and social components

The study area includes the main site of the Azito Project where activities should take place and the surrounding area that may be vulnerable to direct and indirect impacts on the natural or human environment. The scope covers the extended potential sphere of influence of the Project, which corresponds to a radius of 2 km around the site of Azito. This radius takes into account the area within which the noise impacts associated with the Azito power plant are the most likely.

Côte d'Ivoire is located in the transition zone between the humid equatorial climate and the dry tropical climate. The climate of the region is influenced by the seasonal movement of the Intertropical Convergence Zone.
Rainfall varies between 1500 and 2000 mm per year. The annual average rainfall in Abidjan reaches 1847.6 mm. The months of August and September, often referred to as the short dry season, are dry and fresh. The main hot and dry season occurs between December and March. Winds from the southwest are predominant in the Abidjan area. Their most common hourly average speed is of the order of 7-10 knots (3.5-5 ms⁻¹), and this during 57% of the time.

The coastal zone in the Abidjan region is an area of low relief with an average altitude of 3 m. The Azito thermal power plant’s altitude is between 0.5 m and 5.0 m over a distance of about 500 m, with a slight slope of about 1% towards the lagoon in the south and southeast. Towards the east of the site, two watercourses carry runoff from the city of Yopougon and other nearby urban areas. They discharge the collected water into the lagoon. Close to the lagoon and the watercourses the land is particularly flat and marshy. The thermal power plant of Azito is implemented on soils composed of loose sandy clay, of between 1 and 4 m depth with pockets of silt and clay. Close to the lagoon, and particularly in the marshy areas, the soils are sandy with shell deposits and vegetative debris.

The study area covers part of the Ebrié Lagoon. The three main rivers discharging into the Ebrié Lagoon are the Agneby to the west of the study area and the Comoé and The Mé to the east. Currently industrial and domestic waste waters are discharged in the lagoon.

The lagoon ecosystem is directly and indirectly affected by the seasonal variation in marine and terrestrial inflows and, on this basis, the lagoon can be considered to be affected by three seasons:

- **Dry Season (January to April)** - rainfall and runoff are negligible, evaporation is high and the influence of the marine tidal currents dominates - high temperature and saline stratification in the deeper waters near the Vridi Canal and the Abidjan Basin.
- **Rainy season (May to October)** - rainfall and runoff from the local catchment area is high and the influence of the marine tidal current is limited - lower temperature (reaching a minimum) and the water column is well mixed by the wind.
- **Runoff Season (September to December)** - runoff from the larger Comoé catchment draining the north of the Ivory Coast. In most areas there is very low or no salinity observed. Salinity gradients can occur however when high salinity water bodies are trapped in the deeper parts of the estuary near Abidjan due to fluvial freshwater overlaying marine water at depth.

These three seasons may vary each year, depending on the dominance of rainfall and river flows. Water samples from the Ebrié lagoon were analyzed in August 2010. These samples were taken at the Azito plant draw-off to assess the quality of the water which would potentially be used in the cooling system (an option that was eventually dropped). Waters of the Ebrié lagoon have a high bacteriological contamination, mainly due to waste water discharge and the lack of sanitary networks in the city of Abidjan.

Groundwater in the area flows to the south and east towards the lagoon. Groundwater is collected at a a depth of about 100 m. This sedimentary formation to the north of the lagoon houses an important aquifer which represents a major source of drinking water for Abidjan. In some parts of the water body, especially around Abidjan and other urban centers, nitrate, nitrite and ammonia in groundwater are high due to pollution from wastewater sources. A groundwater production well was built on the site in 1999. It is 60 m deep and has a flow rate of 45 m³/h. The pumped water is temporarily stored in a tank of 1000 m³, mainly for fire-fighting and, after demineralization for industrial cleaning operations.

**Wastewater**

Wastewater generated by the site operations (sanitary wastewater, cleaning and oil) are discharged into the evaporation collecting basin located along the eastern boundary of the site. When the basin level reaches its maximum, a local laboratory is mandated to sample and test the waters. If measured concentrations for the various parameters comply with the Ivorian guidelines, the water is pumped from the basin and rejected on the grounds outside the eastern boundary of the site. The Management of the plant stated that the basin is drained and generally sampled twice per year. It is sometimes necessary to adjust the pH before discharging the water into the environment.
**Air Quality**

The Azito site is located in the southwestern part of Yopougon. The municipality is characterized by a small-scale local industrial and low-rise residential housing. The likely sources of contaminant emissions to air in the Project area are:

- Vehicles (private vehicles and commercial transport mainly).
- Domestic fuel and charcoal use for open-fire cooking and lighting, and
- Local industry: industrial activities around the Azito site are limited to small-scale activities and crafts; the Yopougon industrial area lies some six kilometres to the North-East.

Ambient concentrations of air pollutants are not monitored in Cote d’Ivoire.

The ESIA 1998 developed by ERM for the proposed power project estimated the annual average pollutants background concentrations of the Project area, taking into account the potential emissions, the land use and knowledge of concentrations in similar environments. The ranges thus obtained are presented below:

- Annual average NO2 concentrations: 5-25 μg/m3;
- annual average concentrations of SO2: 2-10 μg/m3, and
- annual mean concentrations of PM10: 10-50 μg/m3.

As recommended in the 1998 ESIA, Azito Energie organised a background air quality control campaign using diffusion tubes installed in the city of Abidjan with a focus on the Yopougon district. The campaign was organized from 1999 to the end of 2002. Diffusion tube monitoring of NO2 and SO2 offers a low cost method of obtaining average pollutant concentrations for a specific area.

For 2001, NO2 concentrations were between 2 and 28 μg/m3 and those of SO2 μg/m3 between 0.8 and 12 μg/m3. No information was available concerning the results of analysis of diffusion tubes for the years 1999-2000 and 2002.

However, according to the compiled results, no significant change on air quality was observed since the commissioning of the two gas turbines. Measured concentrations are indeed of the same order of magnitude compared to the annual average concentrations estimated by ERM within the ESIA 1998 (5-25 μg / m3 for NO2 and 2-10 μg / m3 for SO2).

A continuous automatic analyzer of the NOX for baseline air quality was installed in 1999 monitoring. The analyser was initially installed 300 m away from the turbines but transferred in 2009 to the site following a flood event. The maximum concentration of NOx, presented in the annual environmental report was recorded in 2001 (6.52 μg / m3).

Since the construction of the plant, emissions of SO2 and NOx are continuously monitored at the right of the GT1 and 2 (gas turbines) stacks.

As recommended in the site environmental license of 1999, daily average concentrations are monthly recorded. The measurement results show that the monthly average concentrations of SO2 and NOx in atmospheric emissions from the stacks do not exceed the World Bank and Ivoirian emissions standards presented in the emissions guidelines and the environmental permit.

The results for SO2 are particularly low, considering that the fuel oil was not used to run the plant since its commissioning. Emissions of particulate matters are not controlled at the site. The threshold value presented in the environmental permit and that cannot be exceeded is 100 mg/m3. However, particulate matters emissions from the combustion of natural gas are considered to be negligible (<10 mg/m3).

**Noise**

The Azito power plant is located to the south of the Yopougon district of Abidjan. Béago village is located approximately 285 m to the north whilst to the west is located the Azito village, at a distance of approximately 325 m. The Ebré lagoon lies to the south and the east.

The plant consists of a turbine hall south of the site, with the air intake facing east (towards the Azito village) and beyond them the external the switchyard, consisting of multiple electricity pylons. The exhaust stacks generators are located at the west side of the turbines hall. Directly to the north of the turbine hall (facin
northeast of the site) are located an office building and a warehouse. Further north and west, are located the gas processing facilities of Foxtrot and Afren, and south of these units, two fuel oil storage tanks. The preliminary baseline noise survey in November 2011 revealed high noise levels in some areas around the plant. A more detailed noise survey was carried out in December 2011 to assess the ambient noise at the site boundary and at the right of closest noise sensitive receptors to the site. The results show only daytime audible. The results of the study was used to investigate certain aspects of the noise environment, including effect on noise levels from the process of clearing the dust filters on the air intakes, elevated levels of noise from the Foxtrot processing facilities

Cleaning the filters

The frequency with which the dust filters are cleaned depends on the amount of dust in the surrounding air, generally greater in the dry season. Baseline noise surveys were carried out at the end of the short rainy season and the small filter cleaning occurs about every ten seconds. However, this frequency can significantly increase during the dry season. Thus, the effect on average noise levels of doubling the filters cleaning frequency was considered. This is clearly audible to the west of the site, where there is little or no filtering devices air intake. Boundaries measurements and noise sensitive receptors to the north and northwest of the site are not significantly affected by the filter cleaning

Noise from the Foxtrot plant

Baseline measurements and observations made around the site showed elevated noise levels from the Foxtrot plant area, located to the north of the site. Foxtrot supplies approximately 70% of the gas used by the Azito plant (the remaining being supplied by Afren). The acoustic observations made at sensitive receptors have concluded that the Foxtrot plant could be heard and was a significant source of nuisance.

Azito village

In the Azito village, noise levels (LAEq, period) during the day ranged between 47 dB and 49 dB. Significant sources of noise included music, people and children, while further south, the noise of the plant was more prominent as well as a generator in the nearby settlement. During the night, noise levels (LAEq, period) ranged between 46 dB and 50 dB. The noise generated by the cleaning particulate filters was clearly audible at certain points but not others. An increase in the frequency of filter cleaning during the dry season could increase noise levels of the plant. Other receptors are potentially sensitive to noise, north and south of the road leading to the plant. These include residential properties but also a church. During the day, the noise levels (LAEq, period) ranged between 46 dB and 51 dB. Significant sources of noise come from human activities and the location 3, the singing of birds and the humming of overhead cables. During the night noise levels (LAEq, period) were lower between 44 dB and 49 dB.

Slaughterhouse and its surroundings

A small group of properties lies close to the slaughterhouse to the northwest of the site. These, used for residential purposes during parts of the year only, were inhabited at the time of the study. During the day, the sound levels (LAEq, period) ranged between 50 dB and 52 dB. The plant is a major source of noise. Night noise levels (LAEq, period) fell to 46 dB and significant sources of noise were the plant and crickets. The range of noise levels (LAEq, period) at night (ignoring measurements containing significant extraneous noises), ranged between 46 dB and 50 dB. At this location, noise from the Foxtrot plant was clearly audible

South-west of the site

Between the south end of boundary of the Azito village and the the power plant switchyard (south-west of the site), a group of three residential properties can be identified. During the day, the sound levels (LAEq, period) ranged around 49 dB/50 dB. Significant noise sources were the plant, noise from the people living in these properties and distant people noise. At night, noise levels (LAEq, period) fell to 49 dB. The plant also brought an important contribution to these locations. Noise from the particules filter cleaning was clearly audible. To the south of these properties, along the bank of the lagoon, there are several recreational facilities (including bars).
These premises are not used for sleeping and are therefore only noise sensitive during the day. Noise from the particles filter cleaning was clearly audible.

**Beago village**

Measurements were made at the southern end of Béago village, at the closest property to the plant (Location 9). The noise level (L\text{Aeq},\text{period}) during the day was 49 dB. The dominant noise source was the plant. During the night, noise levels (L\text{Aeq},\text{period}) ranged between 52 dB and 57 dB. In addition to plant noise, high levels of noise were produced by crickets. After filtering cricket noise from these measurements (see Section B1.4.3 in Annex B), levels ranged between 45 dB and 48 dB, suggesting cricket noise significantly influenced noise levels at this location. Noise from the Foxtrot unit was clearly audible at this location (see Section B1.4.2 in Annex B). Noise emissions from cleaning particulate filters were not significant.

Measurements were also carried further to the north-west of the Beago village (location 10). Daytime noise levels (L\text{Aeq},\text{period}) ranged between 44 dB and 45 dB, while no action was carried out at night, because the noise of the plant was significantly low.

**Terrestrial Environment – flora**

- The biodiversity assessment carried out on the site and surroundings resulted in the identification of the following ecosystems
- In the 300 m exclusion area around the site: The flora observed within this area consists of small trees, herbaceous, and ruderal species.
- Area of ponds and mangrove highly degraded on the southern side of the site, between the lagoon shore and the site boundary.
- Human habitat, anthropogenic activities and ornamental plants: the site and its surroundings are directly influenced by anthropogenic activities. Extensive crop and vegetable fields were observed around the site. Ornamental plants were also identified on the site and its surroundings during the assessment.

None of the species identified during the assessment within the Study Area are listed on the IUCN (International Union for Nature Conservation) as being rare, threatened or endemic.

**Terrestrial Environment – fauna**

Due to the low biological diversity of the area and the strong human pressure there is very limited terrestrial fauna in and around the site area. The dominant species within the site are as follows:

- Amphibians and reptiles: in French the “margouillat” or “agame des colons” (Agama agama) is observed throughout the site and a colony of varans lived in the study area. This hunting of this reptile is regulated since 1965 by Law No. 65-255. The presence of varans could not be verified in 2011;
- Crustaceans: crabs nests (Cardisoma) were observed along the shore of the lagoon;
- Rodents: the giant rat Emin (Cricetomys emini) is reported in the area;
- Birds: The study area, located along the lagoon, is a suitable habitat for water birds. The cattle egret (Bubulcus Ibis, in French “Héron Garde Boeuf”), various Trochilidae (colibris) and ravens species (Corvus spp) were observed on the site during the assessment, and
- Insects: termite colonies were identified in the study area.

Additionally, various types of ants, butterflies and coleoptera were identified. None of the species identified as part of the field surveys are known to be listed as threatened by the UICN. The closest protected area is the Forest of Anguededou about 10 km in the northwest of the site.

**Breeding, nesting sites and feeding areas**

Local farmers use part of the study area for cattle grazing, especially grassy open land in the exclusion area immediately beyond the site fence.
A significant amount of Chrysobalanus icaco shrubs are present within the proposed site. The seeds of these plants constitute a source of food for birds. These shrubs are common throughout the West African coastal region.

**Aquatic environment**

Given the balance and interaction between diurnal variations from sea water intrusion and seasonal freshwater inflows, the lagoon is made of a range of biotopes from estuaries, to brackish and freshwater, depending on the distance from the connection with the sea.

**SOCIAL ENVIRONMENT**

The Azito power station is located at the end of an access road coming from the Yopougon municipality, situated to the north of the study area. The power station is surrounded by:

- the Azito village to the west and Béago villages to the north;
- remote shacks to the west;
- a slaughterhouse to the north-west (near the entrance road to the Azito plant); and
- some recreational resorts and bars along the shore of the Ebrié lagoon, to the south-west.

There is a residential area in the east of Yopougon municipality. The industrial area is located to the north. To the west of Yopougon, natural sites which dominate the landscape, peppered with a few villages such as Kouté village, Yopougon-Health Azito, Béago, Niangon Lokoua, Niangon Adjamé and Adiopodoumè.

The population of Yopougon currently counts one million inhabitants, of which 51% are men, 49% are women and 56% are children under the age of 20 years. Since the socio-political crisis of September 2002, the population has increased rapidly due to the migration of people towards Abidjan.

According to the available data of 1998, the population of Azito village was 1,479 inhabitants – of which 54% were men. Assuming a population growth rate of 2.13% (based on 2009 data) and taking into account the increased demographic pressure in Abidjan over the last 10 years, it can be realistically estimated that the population of Azito village would now be close to 2,000 inhabitants. According to the Technical Director of Yopougon city council, Azito village, and more generally the municipality of Yopougon, have become a “dormitory suburbs” for population commuting to work in the city center of Abidjan (mainly the Banco Plateau administrative area, Zone 4 and Vridi industrial areas).

The closest village to the power plant, just outside the study area is Azito, one of the 14 villages of the Yopougon municipality located at 300 m west of the plant. In 1998, the inhabitants of Azito were mostly fishermen and cattle farmers. The main sources of employment and economic activity for the male population were the security sector (security guarding of industrial sites and private housing) and craftsmanship - in particular tailoring, dressmaking and embroidery. Women mainly worked as market or street vendors (selling mainly fish, meat, poultry, donuts, fruits, roasted or fried plantain, and attiéké).

Béago is one of the 14 villages in the municipality of Yopougon, north-east of the study area. It is mainly downstream of the plant. The demographic distributions show that the population in both villages is relatively young. In Azito, children under 5 years represent 12.5% of the total population and young people between 15 and 24 years old represent 27% of the active range between 15-49 years. The active range (15-49 years) represents 60.7% of the total population. Elderly people (over 55) represent 4.5% of the total population. The Azito and Béago Villages have no sewage and waste water collection systems.

Yopougon is the largest industrial area of Côte d'Ivoire. With its port area of more than 300 companies located within its territory, the municipality plays an important economic role.

In the Azito village, a large part of the population (nearly 40%) is employed in the formal or informal sector. About 25% of the population is unemployed, 20% are pupils or students, 13% are housewives, and the rest of the population is retired workers.
Women are mainly employed in the informal sector. The income-generating activities are trade of donuts, fried bananas ("alloco"), and attiéké. The latter is the main source of income for women in Azito. Each basket of attiéké is sold on the market at 3,000 FCFA, which generates an estimated monthly income of 100,000 FCFA per vendors.

In terms of education, the villages of Azito and Béago each have a public elementary school and offer housing to teachers. These institutions are characterized by overpopulation and lack of desks. There is no high school or vocational training centers in the area.

Yopougon has several health facilities (public and private). These include:
• a university hospital (CHU);
• an urban clinic (FSU);
• eleven community-based health centers (FSC);
• a school health centre;
• a Pasteur institute; and
• several private clinics.

The main cause of death in the Project area is malaria. The second cause is HIV-AIDS which has a national prevalence rate of 4.7% (data www.UNICEF.org). Diarrheic diseases are also an important public health problem because of the quality of the water used by people living in urban and suburban areas (Ebrié lagoon water among others).

Land use and activities in the vicinity of the study area

Fishing
The traditional way of fishing in the lagoon Ebrié uses canoes and nets. Today, very few indigenous young people are involved in this activity. Professional and commercial fishing is mostly conducted by non-indigenous Ghanaians and Malians commonly called Bozo. These fishermen migrated to the Boulay Island where they live now.

Agriculture
The land of the villages is mainly occupied by residential areas. The use of land for harvesting crops is not developed in the Lagoon area. Cattle breeding are observed in the vicinity of the study area. Poultry farming is also a major activity in the area.
Small size cattle farms were observed within in the study area. The cattle is owned by Ivorian citizen and managed on the day to day bases by Malian emigrants. Although there is no formal agreement between the power station management and the farmers, the animals graze within the 300 m exclusion zone during the day.

Public slaughterhouse
The public slaughterhouse is the only authorized building within the 300 m radius around the Azito power station. It already existed prior to the construction of the power plant in 1998. The slaughterhouse operates mainly at night (to supply meat-markets in the morning). During the day, nearby residents are provided with potable water from the facility.

Recreational resorts and bars in the area
About five recreational resorts and bars are located between the power plant and Azito village, along the shores of Ebrié lagoon. The resort owners rent land from land owners from Azito village.

Road network
The total length of the roads network in the commune of Yopougon is estimated at 454 km. The main road leading to the Azito Power Plant is a paved road which is currently deteriorating due to heavy rainfall and erosion. Inside the villages (Azito and Béago), roads are not paved.
Drinking water - electricity
The Azito and Béago villages are equipped with a modern system for water distribution, managed by SODECI. Most of the households have access to electricity. However, residents complain about insufficient public lighting.

Culture and traditions
No archaeological sites were identified in the planned expansion area of the plant.

Culture and traditions of the Ebrié people
The community surrounding the study area is a mix of Ivorian and foreign ethnic groups. The indigenous Ivorian ethnic group 'the Tchaman' have founded the Azito and Béago village. Gradually, these villages serve as dormitory towns for people working in the developed industrial area of Yopougon and the city of Abidjan.

Land acquisition process
The process of lands acquisition is summarized in the following table:

<table>
<thead>
<tr>
<th>Date</th>
<th>Events</th>
</tr>
</thead>
<tbody>
<tr>
<td>1998-1999</td>
<td>At the time of the construction, 345 persons were displaced by the Project, most of them on a temporary basis. Ivory Coast Government promises the displaced population to compensate the loss of their land with an equivalent, new, piece of land.</td>
</tr>
<tr>
<td>2001</td>
<td>Azito power plant management launches its annual satisfaction survey, targeting Azito village.</td>
</tr>
<tr>
<td>18.12.2007</td>
<td>The inhabitants of Azito village barricade the main and only road access to the power station, preventing employees to go to work. They protest against the Government for not keeping its promise to compensate them with new land.</td>
</tr>
<tr>
<td>20/12/2007</td>
<td>Following the conflict related to the relocation of part of the village, a protocol was signed between the representative of the Ivorian State and the village’s chiefs for a cash compensation of 400 million CFA francs and the attribution of 25 ha to the village.</td>
</tr>
<tr>
<td>Spring 2008</td>
<td>The cash compensation has been fully paid by the State but the villagers are still waiting for the land.</td>
</tr>
</tbody>
</table>

2. Main environmental and social impacts

2.1 Positive impacts

The project will generate opportunities for Cote d’Ivoire and the surrounding countries as it will increase the total installed capacity of the Azito plant from about 290 MW to 420 MW, adding about 10% to overall national capacity., this will have a very positive impact on the quality of people's lives.

In terms of energy efficiency and carbon footprint, the impacts of the Phase III project are clearly positive. By switching from single cycle to combined cycle, the nominal installed capacity of the overall facility increases by a nominal 50% at constant fuel gas consumption; the energy efficiency of the overall power plant therefore also increases in similar proportions, from about 29.5% to about 44%. Atmospheric emissions are unchanged, therefore decreasing the greenhouse-gas footprint per unit power produced of the facility in the same proportions.

2.2 Negative impacts

Air quality
The main sources of impacts associated with the construction activities of the Phase III are possible dust and exhaust gases arising from the traffic of construction vehicles on site. Quantities of air pollutant emissions from construction vehicles and generator operations are expected to be relatively minimal and are not anticipated to
result in measurable impacts on air quality. The potential associated with dust arising during construction are also expected to be minor. Airborne dust will be limited by the moist climatic conditions prevalent in Abidjan, and the residual dust generation potential is manageable through good construction site management practices. (tarping trucks carrying loose materials, cleaning the wheels, optimal management of raw material storage, ...).

The Phase III operation will not result in any incremental air emission from power generation compared to the existing situation. Rather, the retrofitting of HRSGs and a STG will allow optimizing the fuel efficiency of the overall installation, by switching from single cycle to combined cycle power generation. A dispersion model was developed for the 1998 ESIA to assess the potential impacts of atmospheric emissions, including the Phase III installation. The result of the model shows that the impacts to ambient air quality resulting from gas-fired turbines in the Phase III plant configuration complies with the currently applicable versions of the Ivorian regulatory limits (2008) and the IFC Performance Guidelines (2007-2008). In the 1998 ESIA, the effectiveness of the atmospheric dispersion of turbine emissions was modeled for stack heights of 40 m and 50 m. The model verified that compliance was maintained in both cases. Considering technical feasibility, the base-case scenario for the plant stack height selected by the Sponsor has therefore been set to 40 m. In the absence of new continuous emissions source, the potential impacts on the air quality during the operation of the Phase III, in comparison with the current situation in Phase I and II, are expected to be minor.

**Noise**

During construction, potential sources of noise include construction equipment and temporary increases in traffic. Noise from construction equipment has been predicted at the nearest noise sensitive receptors (Azito and Beago villages) for the noisiest phases of construction. From this assessment, the potential impacts associated with the Phase III construction are expected to be minor.

During operation, noise emissions from the Phase 3 equipment will add a contribution to existing sources of noise from the existing operational power plant, the neighboring Foxtrot small gas processing facility, and other noise sources in this peri-urban environment. As part of the ESIA, baseline ambient noise has been monitored, and future ambient noise levels with the Phase III facilities have been predicted. Noise abatement measures have been identified to ensure that applicable standards will be met at sensitive receptor locations (the Azito and Béago villages). The predicted increase in ambient noise associated with operation of Phase 3 compared to the existing situation is expected to be low (within 1 dBA).

Mitigation measures of noise were identified and proposed to ensure compliance with applicable law to sensitive receptors (Azito and Béago villages). The estimated increase in noise levels associated with the operation of Phase III facilities, compared to the current situation should be low.

**Water quality and resources**

Water requirements for the Project construction activities are mainly related to water consumption for domestic purposes on the site and the use of water for construction. The quantity of water used during construction will be limited. Potential impacts associated should be negligible.

In the operational phase, two main sources cover the water needs: drinking water comes from the existing municipal network and the existing drilling will feed up the site with industrial water. The potential impacts on water resources associated with the operation of the plant should be minor.

Impacts on water quality from the construction phase may result from:
- turbid run-off from the construction site, during rainy events (mostly from stripped construction surfaces and excavation material tips);
- direct discharges of sanitary effluent; and
- accidental leaks or spills.

During the operations of the Phase III plant, oily waste water from the collecting pits, sanitary waste water as well as industrial waste water will be centralized in the existing treatment system. After equalization in the junction pit, the water is neutralized by chemical dosing and pH adjustment and directed to the evaporation...
pond. Rain water will be collected from building roofs and connected with the existing storm water discharge ditches, leading to the discharge point, out of the site.

**Biodiversity**
Two areas surrounding the fence line, located to the north-west and south-west from the site are planned to be used as a temporary storage areas during the construction phase. Neither of these areas sustains any sensitive habitats. They consist of grass land and peri-urban shrub. Habitat loss from Phase III construction is considered to be negligible as no rare or endemic species were identified.

The footprint of the Phase III expansion facility will be located essentially within the existing concession area of the Azito facility. A small portion of land located outside of the fenced area (but already within the concession allocated to Azito Energie) will also be used for the construction. Potential sources of operational impact on the biodiversity of the area include the spillages or leakages of products and chemicals on site or along the transport route. Very few product and limited volumes will be used on site for the phase III expansion. Therefore, the potential impacts on the biodiversity during the operations are expected to be negligible.

**Solid waste**
The volumes of waste produced during the construction of the Phase III facilities has not been estimated at this stage but can be anticipated to be relatively low for hazardous wastes the order of a few cubic metres per month. Most hazardous wastes consist essentially in oil-contaminated wastes, which can be readily collected and disposed off through contracts with industrial wastes recycling and elimination contractors in Ivory Coast. The project will produce no significant quantities of solid process waste compared to the actual situation during the operations phase. Packaging and general domestic waste will be collected by an independent waste management company and disposed of at the municipal dumping area in Abidjan.

The waste management plan associated with the operation of Phase III will however be implemented and integrated into the existing plan currently available for Phases I and II.

**Health & Safety of the communities**
Health & Safety measures related to the working conditions will be developed in a Health and Safety Plan prior to the beginning of the work. Influx of employees and job seekers could also result in the spread of diseases, including sexually transmitted diseases and HIV/AIDS.

The influx of workers and people looking for a job and the work could increase the population density in the region and thus cause an increase in petty crime, violence and security problems in the area. The site is now guarded by a detachment of policemen. These measures will apply during the construction and operation of Phase III facilities.

Other measures mainly concern the implementation of recruitment policies for the hiring of local employees, fight against economic immigration in the region of the plant and reducing road accidents by implementing speed limit mechanisms (signs, raising awareness of drivers).

**Traffic**
During construction, although a large number of construction equipment will be brought to the site from the Port of Vridi by boat through the Abidjan lagoon, traffic in Yopougon and in the area of Azito is expected to increase notably, since other construction equipment and workers labor will be using the road to access the site. Given the area’s high population concentration, traffic-related risks are expected to increase.

**Right-of-Way**
The land area to be used under Phase III will primarily be located within the concession site of Azito. A small portion of land outside the site boundary, already owned by Azito Energy, will also be used for construction purposes.

**Fishing activities**
Transport by boat could disrupt fishing activities along the lagoon. Given the low number of loads relative to the traffic in the lagoon and the fact that this option is temporary, the impact of sea transport of construction materials can be considered negligible.

**Decommissioning and Abandonment**

A detailed decommissioning plan will be developed at the end of the projects lifetime. Decommissioning would involve demolition, recovery and removal of the power station installations and buildings (if they are not re-used for another purpose). This plan will be consistent with Ivoirian regulations and both Azito and internationally recognized guidelines and standards.

**Cumulative impacts**

A cumulative impact is an impact created as a result of the combination of the evaluated project together with other projects causing related impacts. These impacts occur when the incremental impact of the project, combined with the effects of other past, present and reasonably foreseeable future projects, are cumulatively considerable. Different options have to be considered:

- Incremental impact from a number of separate projects/developments;
- combined effect of individual impacts, (e.g. noise, dust and visual, from one project on a particular receptor); and
- several developments with insignificant impacts individually but which together have a cumulative effect.

Cumulative impacts studied for this project relate to the future bridge project Yopougon-Boulay island-costal shore, as well as the rapid urbanization of Abidjan.

The construction of the bridge (formerly called Pont Laurent Gbagbo) is delayed due to the post-election crisis of 2010. This suspended bridge will crosses the Ebrié Lagoon twice, connecting the Yopougon mainland with the Boulay Island and the Boulay Island with the coastal shore. The connection to the land in the Yopougon area should be located in the surrounding of the Azito power plant. The date of the construction and the precise location of the bridge are however still unknown.

At this stage, it is realistic to suggest that significant cumulative impacts associated with the construction of the bridge and the development of the Azito Phase III Project may be related to: the following:

- Increased contribution of the bridge construction and traffic to the surrounding noise levels;
- waste / water management issues
- visual impacts, and
- Socio-economic impacts associated with the land take in the surrounding villages and economic development of the area affected by the construction of the main road.

In addition, severe cumulative impacts associated with the expansion and developments of urbanization in the city of Abidjan include:

- Ambient noise levels: the urbanization of the area leads to an increase of the noise levels due to traffic increase and urban activities (markets, restaurants, etc).
- Land pressure in the area due to the increase of the population.
- Impacts on biodiversity associated to the land take impacts, but also to the increase of waste production and waste water effluents.
- Water consumption.
- Waste water management: the absence of sewage and waste water collection system in the area leads to a potential deterioration of the water quality (lagoon and rivers) and of the soil and groundwater.
3. **Enhancement and Mitigation Program**

**a) Air emissions**

**Construction Phase**
- Apply best practices, including:
  - Construction vehicles and generators will be regularly maintained and inspected by the construction contractor;
  - Atmospheric emissions of all transport vehicles used during the construction (material, backfill or excavated soil, workers, etc.) will be reduced by minimizing the number of trips to the extent practical;
  - Appropriate management and maintenance of stockpiles to minimize airborne dust.
  - Sheeting of lorries during transportation of friable construction material.
  - Reducing the drop heights for material transfer activities such as unloading of friable material;
  - Speed limitation enforcement on unpaved roads;
  - Wheel washing for vehicles leaving the site.

**Operation Phase**
- No use of distillate fuel anticipated.
- The use of 40 m-high stack allows the project to meet the Ivorian as well as IFC standards;
- Ensure monitoring of stack emissions and ambient air quality as part of good environmental management practice.

**b) Noise disturbances**

**Construction Phase**
- Best practices will be adopted, including the use of modern, well maintained equipment and vehicles.
- Local authorities and surrounding community leaders will need to be informed of the construction schedule:
- Strong grievance procedures associated to an internal communication and follow-up plan will also need to be
- implemented to allow the neighbouring villagers to report any disturbance or issue related to the construction activities

**Operation Phase**
- Azito Energy will, at a minimum, ensure that the Phase III noise levels do not exceed a level of 40 dB (LAeq) at the nearest sensitive receptors;
- Boilers and heat recovery steam generators: The specified low noise can be achieved without mitigation. Lower noise versions are available, if required
- Installation of silencers at the exit of the heat recovery steam generators;
- Air Cooled Condenser: Substantial mitigation may be required, which may include the use of low noise fans and sound-attenuating baffles for the inlet and discharge of the Air Cooled Condenser
- Air Cooled Water Cooler: Low noise fans / acoustic baffles
- Station Service Transformers: Enclosure
- Vacuum Pumps: Low noise pumps / noise screen / enclosure
- Condensate Extraction Pumps: Low noise pumps / noise screen / enclosure
- Duct Drain Pumps: Low noise pumps / noise screen
- Condensate Pre-heater Pumps: Low noise pumps.
- Service Water Pumps: Low noise pumps / noise screen / enclosure
- Demi Water Pumps: Low noise pumps.

**c) Water Consumption**
- Optimise water use efficiency and minimise wastages
- Monitor water consumption with a view to identify overconsumption and provide a basis for increasing water
- efficiency
Water quality (surface and groundwater)
- Good site management practices should be observed to ensure that the products are properly stored on site (secondary containment, double walled tanks, over filling alarm system, etc.) and construction vehicle are controlled and maintained properly and regularly.
- Sanitary effluents should not be released into the lagoon. Construction site sanitary effluents will be treated to meet the general IFC EHS guideline discharge criteria before being discharged into the lagoon.
- Liquid waste resulting from the operation of the site will be collected and treated by an independent waste management company. Oily water will be treated in an oil/water separator before being directed to the evaporation pond.
- The measures currently in force on the site for the collection and treatment of wastewater will be implemented for Phase III facilities.
- The existing capacity of the evaporation pond will be assessed to control that the volume is sufficient to cover the waste water flow increase coming from the Phase III expansion.
- The design and technical specifications of water treatment facilities will be adapted to the Phase III to cover the additional effluents that will be produced. These measures should take into account, among others, the rehabilitation of the evaporation ponds, its protection (appropriate coating), improving the performance of the biological treatment unit, the neutralization pond and the oily water treatment unit.

Impact on biodiversity
- Good site management practices to ensure that spills and leakages do not affect the biodiversity in the surroundings of the site.
- Good design of site drainage and run-off associated with the extension project in order to collect and control any potential spills or leakages.

Waste generation
- All generated solid wastes will be collected, and disposed by the EPC Contractor in accordance with the Azito requirements;
- A study will be carried out after construction works to confirm that all cuttings and waste were removed and disposed of at the end of the construction phase;
- A Waste Management Plan will be developed prior to the construction phase and integrate the waste collection and management produced by the workers hired for the construction of the Phase III.
- A waste management plan will need to be developed and include the Phase III, to ensure adequate storage, collection and disposal of waste, including liquid, solid, hazardous and non-hazardous wastes. The plan will describe the waste segregation, transfer and disposal strategy to suitable locations.

Socio-economic measures
- The project will develop an employment policy and recruitment plan which will define the details to be filled for the construction phase and the corresponding skills.
- The recruitment plan will be implemented in coordination with the National Employment Agency and or external recruitment agencies, with a view to match the best candidates with the advertised positions.
- To the extent possible, unskilled positions will be preferentially filled by candidates from the local community in Azito, Béago and the wider Yopougon area.
- Sensitize workers on the prevention of HIV / AIDS and other sexually-transmitted diseases.
- Establish a "code of conduct" for Project employees.
- Develop workers grievance mechanism for workers to provide a transparent and easily accessible way of raising and address grievances.
- The project will inform communities about road and traffic hazards through frequent communication, road signaling and consultation with local authorities and community leaders.
- Local communities will be regularly consulted and informed by the Project sponsor on such items as property rights during the construction phase of Phase III. The consultation will also consider farmers who currently use the exclusion zone of 300 meters to cattle grazing.
In the context of the development of Phases I and II of the project, an Internal Operation Plan (IOP) was prepared following the construction of the plant. The latest update of this document was carried out in 2010. This IOP was developed according to the requirements of Ministerial Instruction No. 070/INT/PC of 13 May 1994 pertaining to the organization of disaster relief following technological breakdown of hydrocarbons and chemicals facilities. It aims at controlling the risks inherent in the O&M activities of AZITO and promoting effective intervention disaster relief.

The major risks associated with the operation of the plant revolve around the risks of pollution, explosion / fire and safety hazards. This document also presents the emergency response scheme in case of fire and/or other disasters including the responsibilities of fire, police and emergency response services.

4. Monitoring Program and complementary initiatives

Monitoring Program
A monitoring program was established for the construction and operation phases of the project. The monitoring of the Project activities will be undertaken during construction and operation to:

• establish that the ESMP is implemented;
• assess the efficiency of mitigation actions; and
• provide information on environmental and social performance to permitting authorities as needed.

Designated EH&S staff will undertake monitoring activities from the start of the construction phase. During operations, monitoring periods are expected to occur more intermittently. Contractors EH&S supervisors will liaise directly with the Azito Project EH&S Manager regarding observations and any necessary actions. The Project EH&S Manager will conduct intermittent checks to confirm the quality implementation of EH&S supervisor activities and ESMP measures.

The following documentation will have to be properly managed and maintained:

• EH&S reports;
• incident reports and records of corrective actions;
• records of safe waste disposal at a licensed waste site or transfer station;
• training material and records of attendance at briefing sessions; and
• minutes of key meetings with contractors, sub-contractors, and Project team members.

Complementary initiatives

The sustainable development policy of Azito O & M is four-fold: local economic development, environmental protection, social equity, and health promotion. Over the past 10 years, the plant Management has conducted an annual survey of the village of Azito to monitor and understand their inhabitants’ views on the neighboring power plant. The Management has organized regular visits to the village and meetings with the notabilities. It has also developed several programs focused on the Azito community village and its surroundings.

Every year, Azito Management funds between 1 and 4 scholarships allocated to local development projects. It also contributes to local schools and a women's cooperative producing Attiéké. Azito O&M is also associated with development programs implemented by external agencies in the health sector (Committee against AIDS in Azito, support to the Azito medical center, etc.).

5. Institutional arrangements and capacity building requirements

The contractors will have an EH&S Officer who will work closely with the EH&S Manager of the Azito Project to participate in the organization and presentation of all meetings and coordinate with sub-contractors as needed. As such, contractors EH&S officers will be responsible for mitigation and management of potential environmental and social issues onsite and its surroundings.

The duties of the EH&S officer will be as follows:

• The management and mitigation of potential environmental and social issues on and offsite;
• Working with the Azito Project EH&S Manager in preparation of site visits and meetings;
• Working with second and third level subcontractors towards meeting ESMP requirements;
• Organizing and maintaining minutes of meetings and documents relating to mitigation and monitoring measures;
• Responding to the results of site inspections, and
• Receiving and processing complaints submitted by external parties.

6. Public consultations and disclosure requirements

The communities affected by the Project have been involved through the provision of information, consultation and informed participation.

Two rounds of consultation have already taken place in 2010 and 2011:

• The first round of consultation took place during the preliminary scoping visit in 2010. The goal was to present the project and receive feedback from the most important stakeholders on the planned expansion of the Azito power plant;
• The second round of consultation was held in November 2011. The objective was to inform key stakeholders about the scope of the assessment and the proposed project and to obtain feedback from them.

The following main stakeholders were consulted during the two campaigns:

• National and local Ivorian authorities: Ministry of the Environment (ANDE), Ministry of Energy, and the Mayor of the municipality of Yopougon.
• Local communities from the villages of Azito and Béago (consultation of notabilities and heads of villages and consultation with representatives of several focus groups).
• Local interest groups (consulted during group interviews) comprising cooperatives producing attiéké and cattle farmers

The inhabitants of the Azito village are recognized as traditional owners of the land prior to the construction of the Azito power plant. The village of Azito is the nearest community to the project. Its inhabitants are therefore the most important stakeholder group, both in terms of interest and influence on the project. Since the development of the Azito power plant, Azito Energy has recognized the need for maintaining proper communication and harmonious relationship with the communities at Azito is key in maintaining a social license to operate the project. As for the village of Béago which is more remote and has no right to land on or around the Azito site, the proximity of the Azito plant makes its inhabitants sensitive to air and noise emissions and likely to have an interest in potential economic benefits associated with the Project.

The environmental and social studies were approved by the National Environment Agency (ANDE) on 10 September 2012.

The summary of the Environmental and Social Management Plan (ESMP) is posted on the website of the African Development Bank at least 30 days prior to the approval of the project by the Board of Directors of the Bank.

7. Cost estimation

The estimated costs of the ESMP are as follows:
CFAF 3 900 000 (6 000 €) prior to the construction phase
CFAF 1 625 000 F CFA (2 500 €) per month during the construction phase
CFAF 4 485 000 F CFA (6 900 €) per year (2012 prices) during the operation phase
CFAF 11 352 500 F CFA (6 900 €) (2012 prices) during decommissioning

The estimated budget does not, however, consider the following costs:
• Costs associated with the responsibility of the EPC contractor;
• Costs that are considered standards and industry good practices relating to the management activities of the Azito power plant;
• Costs of decommissioning of the power plant
8. **Implementation schedule and reporting**
The project will report on the status of the environmental and social component through an environmental and social monitoring report which will be developed and sent to the Bank on an annual basis.