

Appendix A

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Appendix B

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Appendix C

Site Selection Presentation

» **Dibamba Power Project (DPP) Cameroon
Site Selection
By Hassan/Isaac
Douala, Cameroon**

May 25, 2007



» **Index**

- Basic Configuration
- Environmental and Permitting
- Site Selection
- Land Base Installation
- Barge Mount
- Interconnection Selection
- EPP 225 KV Interconnect Option
- EPP 90 KV Interconnect Option
- Conclusion

» **Basic Configuration**

- » 3 Frame 6 gas turbines (3X333MW)
- » Used from Dominican Republic
- » Fuel HFO1500
 - Locally available
 - Trucking or Barge delivery option
 - Seven day storage at site
- » Capacity factor 50%
 - Dry session heavy loading
 - Wet session Peaker operation
 - Load forecast and management simulation is being revised
- » No gas monitoring and conditioning equipment
- » Fast Track development and installation schedule
 - Base case 12 Months
 - P.O and NTP within 4 Weeks

» **Environmental and Permitting**

- No enforced local limits for the air pollutant or PMs.
- Noise a major issue if power plant is in vicinity of housing.
 - One of the important consideration in site selection.
- Environmental and Construction permits on expedited bases are required to meet schedule
 - National crisis status
 - Expedited concession for transmission lines.
- IFC guideline line may have to be met due to financing!

Cameroon		
°	Substances	Limits
1	CO	650 mg/Nm3
2	NOx	300 mg/Nm3
3	SO2	2000 mg/Nm3
4	PM	50 mg/Nm3

IFC		
Table C.1. Ambient Air Quality in Thermal Power Plants (micrograms per cubic meter)		
Pollutant	24-hour average	Annual average
PM ₁₀	150	50
TSP ^a	250	80
Nitrogen dioxide	150	100
Sulfur dioxide	150	80

a. Measurement of PM₁₀ is preferable to measurement of TSP.

» **Site Selection**

- Seven possible sites were visited
- Four Land Based installation
- Three Barge Mount installation
- Considerations in site selection
 - Real state not feasible to fit in the existing Switchyard
 - Environmental
 - Noise
 - Air quality
 - Interconnection
 - Line N-1 Scenario
 - Switchyard 90 or 225KV
 - Power evacuation and system stability
 - Site access
 - Equipment unloading
 - Barge access to site
 - People access to site
 - Fuel
 - Delivery
 - Storage
 - Water Availability

» **Land Base Installation**

- Best land based option is near Dibamba River
- 20 Km south-east of Douala city
- 7 Km from Njodi Bekoko substation
- 3 Km of new TL required
- Easy site access
- No noise issues
- No major site work required
- Fuel delivery by trucks
- On-site storage of 7 days fuel
- One Km from state highway
- Slightly elevated flat deforested land
- 90 and/or 225KV interconnection possible



» **Barge Mount**

- Best Barge mount option is at Dibamba River
- 22 Km south east of Douala city
- 9 Km from Njodi Bekoko substation
- 5 Km of new TL
- One Km from state highway
- No Noise issues
- May need 2-3 Km dredging (known)
- Need 25 Km water way draft survey
- Survey request submitted three weeks ago
- BOP and electrical connection is expensive because of river swelling
- No regular river traffic so we may need to dredge regularly in case of barge fuel delivery
- 90 and/or 225KV interconnection possible
- Fuel delivery by trucks possible
- Storage on land or at the barge

River Bank looking from north to south



Dibamba River Bank from bridge

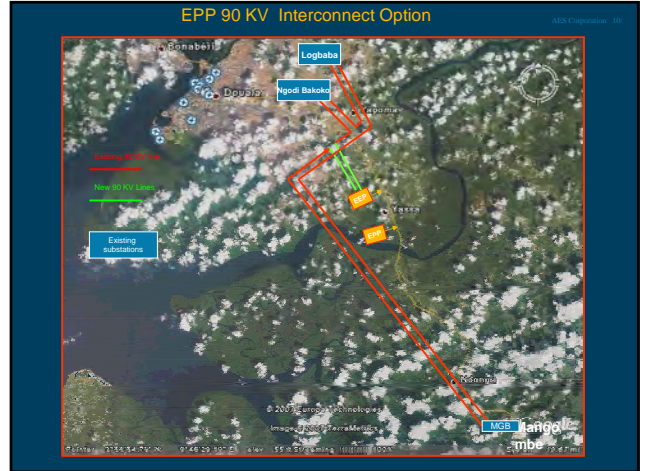
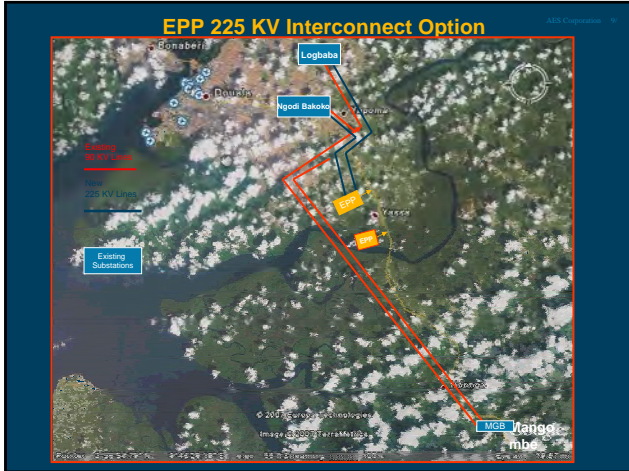


» **Interconnection Selection**

- 90 or 225 KV options for Land or Barge Mount options
- No power evacuation issue for either option
- Load rejection may be required in case of 90 KV TL loss.
 - Magnitude of load rejection may not be a vital issue
 - New grid simulation is on-going
- 225 KV interconnection is \$7Million addition to base option of 90KV interconnection
 - No utilization of existing switch yard in Dominion Republic (DR)
 - New 225KV breakers required
 - Upgrade of 90KV line to 225KV required
- 225KV interconnection will be critical path
- No load rejection in case of 225KV interconnect

8KM

adds 8 weeks



» Conclusion

- Need Draft Survey ASAP if Barge mount option required
- Interconnection to 90KV is acceptable and most economical
- Land based option near Dibamba River with 90 KV interconnect is the least cost option
- 225KV interconnect option is costly and delays the completion schedule by two (2) months
- Project team must be formed ASAP
- Preliminary work on EIA and permits must be started ASAP
- Purchase decision on or before 17 June

Final site selection???

Appendix D

Terms of Reference Approval Letter

Yaoundé, le 21 AOÛT 2007

LE MINISTRE

Réf : VIL MM/SC/DEPP/01 du 19 juillet 2007

Objet : Termes de référence de l'étude d'impact
environnemental du projet de construction de la
centrale thermique de Dibamba

A Monsieur le Directeur Général
de la Société AES SONEL
B.P : 4077
Fax : 33 42 22 47 / 33 42 04 29
DOUALA

Monsieur le Directeur Général,

J'ai l'honneur d'accuser réception de votre correspondance MM/SC/DEPP/01 du 19 juillet 2007, relative à l'étude d'impact environnemental de votre projet de construction d'une centrale thermique à Dibamba.

L'examen desdits termes de référence a suscité les observations suivantes :


- ~ Le paragraphe "Impacts potentiels et mesures d'atténuation" objet du sous-chapitre 9.6 ne relève pas de l'analyse des alternatives (chapitre 9). Il doit faire l'objet d'un chapitre à part ;
- ~ Dans la section traitant des objectifs spécifiques, l'évaluation des impacts semble limitée au milieu physique et socioéconomique; il y a lieu de prendre en compte le milieu biologique ;
- ~ Conformément à la réglementation en vigueur, l'étude devra être soumise à la procédure des audiences publiques dont vos termes de référence ne font pas mention.

Moyennant la prise en compte des observations ci-dessus, vos termes de référence reçoivent mon approbation. Je vous demande de me retourner sans délai, le document révisé en 3 exemplaires.

Les termes de référence ainsi approuvés tiennent lieu de prescription du cahier de charges, stipulé dans l'article 17, alinéa 1 de la Loi 96/12 du 05 août 1996, portant loi-cadre relative à la gestion de l'environnement au Cameroun.

Veuillez agréer, Monsieur le Directeur Général, l'assurance de ma parfaite considération.

LE MINISTRE



Dr. Léona Siméon Njindou

Appendix E

Terms of Reference



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EMERGENCY POWER PLANT

88 MW

DIBAMBA

PROJET

ESIA TERMS OF REFERENCE

July 2007



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CONTENTS

	2
1. INTRODUCTION	6
2. CONTEXT AND JUSTIFICATION	7
2.1. <i>Expected generation capacity</i>	7
2.1.1. Hydro Ressources	7
2.1.2. Diesel generation	8
2.1.3. Expected demand growth and profile	8
2.1.4. Need for the project	8
3. OBJECTIVES OF THE ESIA	8
3.1. <i>Overall objective</i>	8
3.2. <i>Specific objectives</i>	9
3.3. <i>Expected Results</i>	9
4. SCOPE OF THE ENVIRONMENTAL ASSESSMENT	9
4.1. <i>Generic Tasks for the Environmental Assessment</i>	10
4.2. <i>Specific Tasks for the Environmental Assessment</i>	10
5. LEGISLATION, POLICY AND ADMINISTRATION FRAMEWORK	11
5.1. <i>Cameroon Legislative Framework</i>	11
5.2. <i>Government Administration Framework</i>	12
5.3. <i>International Protocols and Agreements</i>	12
5.4. <i>World Bank , IFC, AFDB, and FMO Standards.....</i>	12
5.5. <i>AES SONEL Policies and Programs.....</i>	12
6 LOCATION	13
7 DESCRIPTION OF THE PROPOSED PROJECT	13
7.1. <i>Description of Project related activities</i>	14
8. DESCRIPTION OF THE INITIAL STATE OF THE ENVIRONMENT	15
8.1. <i>Natural and Physical Environment</i>	15
8.1.1. Fauna and Flora	15
8.1.2. Topography	16
8.1.3. Climate	16

8.1.4.	Geology and soils	16
8.1.5.	Hydrology and Drainage	16
8.1.6.	Water resources and quality	17
8.1.7.	Landscape	17
8.2.	<i>Social and Economic Environment</i>	17
8.2.1.	Civil Administration	17
8.2.2.	Human Beings	17
8.2.3.	Air quality	18
8.2.4.	Noise	18
8.2.5.	Land use	18
8.2.6.	Traffic and Transport	18
8.2.7.	Recreation and amenity	18
8.2.8.	Cultural and National Heritage	19
9.	ANALYSIS OF ALTERNATIVES	19
9.1.	<i>Framework for the analysis</i>	19
9.2.	<i>Demand management options</i>	19
9.2.1.	Technical and commercial losses	19
9.2.2.	High efficiency fluorescent bulbs	20
9.2.3.	Price constraints	20
9.2.4.	Plant load factor and the need for synergies	20
9.3.	<i>Generation options</i>	21
9.3.1.	Gas options	21
9.3.2.	Liquid fuel options	21
9.3.3.	other generation options	21
9.4.	<i>Alternative Location</i>	21
9.4.1.	Power plant location for proximity to grid load centre	23
9.5.	<i>Summary</i>	23
9.5.1.	Preferred option	23
10	POTENTIAL ENVIRONMENTAL IMPACT AND MITIGATION MEASURE	24
10.1.	<i>Potential Environmental Impact</i>	
10.1.1.	Air quality	24



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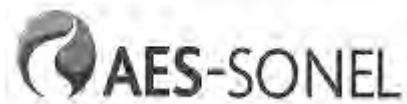
TEL: +237 33 42 15 53, +237 33 42 83 09, +237 33 43 00 33, +237 33 42 47 14 - FAX : +237 33 42 22 47

10.1.2.	Noise	25
10.1.3.	Traffic and Transport	26
10.1.4.	Water Resources	27
10.1.5.	Social Impact	28
10.1.6.	Visual Impact	29
10.1.7.	Land use impacts	29
10.1.8.	Flora and fauna	29
10.1.9.	Cultural Heritage	30
10.1.10.	Infrastructures	30
10.2.	<i>Project Mitigation</i>	30
11.	ENVIRONMENTAL ASSESSMENT CONSULTANT	30
11.1.	Impact assessment	31
12.	AES-SONEL ENVIRONMENTAL MANAGEMENT PLAN	31
12.1.	<i>EIA Project Management</i>	31
13.	DURATION	31
14.	CONTENT OF THE ENVIRONMENTAL IMPACT STATEMENT (EIS)	32

APPENDICES

15. DRAWINGS

16. PROJECT SCHEDULE



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ABBREVIATION AND ACRONYMS

ARSEL :	Agence de Regulation du Secteur de l'Electricité
EIA :	Environmental Impact Assessment
EA :	Environmental Assessment
EIS :	Environmental Impact Statement
EMP :	Environmental Management Plan
HSE :	Health, Safety and Environment
MINEP :	Ministère de l'Environnement et de la Protection de la Nature
MINEE :	Ministère de l'Energie et de l'Eau
NGO :	Non Governmental Organisation
PM :	Premier Ministère
ToR :	Terms of References

UNITS OF MEASURE

kV :	Kilovolt
M:	Meter
Km:	Kilometer
MWA:	Megawatt Ampère



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1. INTRODUCTION

Privatised on July 18th 2001, SONEL, the defunct National Electricity Corporation became AES-SONEL, with the triple objective to generate, transmit and distribute safe, reliable and clean electrical energy to consumers all over the national territory.

The existing generation capacity is based on the river flows and, the hydrology during the five last years was poor. The industrial and demographic expansion increase more than 8% per year. It's becomes very difficult to avoid the shortfall.

In order to address this issue, AES-SONEL has embarked on constructing an additional Emergency thermal power plant associated with approximately 3km or 5km overhead transmission line to connect the power plant in the existing Ngodi Bakoko sub station. The site is located at the Dibamba Village about 15km from Douala town.

As a result, the proposed power plant will provide additional capacity in period of poor hydrology will also increase AES-SONEL supply capacity and will help to satisfy the growth demand for electricity power in all sectors.

The principal works to be undertaken are as follows:

- Dibamba thermal power plant Buildings
- Construction of 3km or 5km 90kV Lines to connect the power plant in the Ngodi Bakoko sub station.

As a prerequisite, the public utility decree application file, declaring public utility the construction of Dibamba thermal power plant and the associated lines has been submitted.

In accordance with the Ministerial Order N°0070/MINEP of 22 April 2005 defining the categories of operations subject to Environmental and Social Impact Assessment (ESIA), and Decree N° 2005/0577/PM of 23 February 2005 defining the conditions for undertaking ESIA, an environmental and social impact assessment must be prepared and submitted to the Ministry of Environment and Protection of Nature for review and approval.

These Terms of reference are aimed at ensuring compliance with Cameroon environmental legislation and selecting an environmental consultant to undertake the Environmental and Social Impact Assessment.

The environmental consultant shall be selected through a tendering process as per AES-SONEL requirements, after the acceptance of the Terms of Reference by the Ministry of Environment and Protection of Nature (MINEP).



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To meet the requirements of the Lenders, the Environment Impact Statement will need to integrate the Lenders requirements, including their standards for social impact assessment.

Additionally, the Lenders required a specialised and enhanced compensation action plan, referred to as a Resettlement Action Plan or “RAP” as the development of this infrastructure will cause involuntary resettlement and resettlement action plan is also included in this document.

Under the electricity Act, a thermal power plant is categorised as a classified installation. Ministerial Authorisation is required for classified installations and the authorisation is obtained under Decree N° 99/818/PM dated 9 November 1999.

The selected environmental and social consultants shall in accordance with the approved Terms of Reference in conjunction with the scope of work detailed below conduct a full ESIA and produce the ESIS.

2. CONTEXT AND JUSTIFICATION

EXPECTED GENERATION CAPACITY

Hydro Resources

Understanding the hydrology of the Sanaga River is critical to planning for future electricity demand growth in south Cameroon. From 2000 to 2006 the river flows have been 92% and 84% of the 35 years average (average flow 2,100m/s) flows respectively, which when coupled with the increasing demand for power in Cameroon, resulted in the reservoirs are very unlikely to fill completely by the end of the 2008 wet-season unless rainfall is considerably higher than normal. Historical patterns would indicate that the next two years will also be drier than average, resulting in the ongoing situation perpetually part full or empty reservoirs. The root cause of this has been the lack of new investment in new generation capacity in a period in which, since 1995, the demand has been growing steadily at up to 8%.

The two hydro plants Édéa (comprising 14 turbines with an installed capacity of 264 MW) and Song Loulou (comprising 8 turbines with an installed capacity 384 MW) are currently capable of operating at 64% and 88% of their nameplate capacity respectively. Refurbishment of turbines at Édéa and Song Loulou has been studied, but this would only make sense for reliability reasons or if the regulated river flow can be increased sufficiently to enable the full capacity of the two plants to be utilised. This will only be possible with additional storage capacity.

An analysis of the historical flow data over the previous 35 years shows a cycle of higher and lower flow flows with the 5-year trend on the way down. Probable available generation from Song Loulou and Édéa over the next five years has been calculated on the basis of the 5 years average flow cycle trend. These data have been used in conjunction with anticipated demand growth data to estimate various possible production shortfall scenarios; the variance in the outcome of these scenarios is extremely large. These estimates indicate that having taken account of generation from the two hydro stations, there will always be a peak generation shortfall. It



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should, however, be borne in mind that the estimate of needed new capacity cannot take full account of the impact of load shedding and suppressed demand: thus the forecasts of peak demand may be too low.

Diesel generation

The predicted shortfall in generation could theoretically be partly covered, at some considerable cost, by additional thermal generation. However, the cost involved when compared with the revenues received for such thermal capacity would make AES-SONEL's financial position unsustainable. Utility systems typically maintain reserve capacity margins of at least 10-15% (i.e. 10-15% greater installed capacity than peak system demand) to cover for unexpected breakdowns and failures and with the variability in rainfall experienced in Cameroon and its reliance on hydro capacity, it is vital that this is maintained to provide system security. Additionally, to date, this system has not been operated with a rolling reserve. As a result, any unexpected failure of generation will lead to either a blackout or a brownout on the system. This is not a good operating practice.

Expected demand growth and profile

The quality of information and data on historical demand does not lend itself to providing a solid foundation for the evaluation of future load growth potential. Levels of suppressed demand are difficult to evaluate and widespread meter fraud among medium voltage commercial consumers masks underlying trends. For the purposes of the study, a growth rate of 9% for the next two years and the historical figure of 8% growth per annum subsequently have been used. This demand growth prediction will, however, be updated as and when more accurate data become available. The demand profile shows a large daily peak in the evening hours with an average daily load factor of demand of 74%. The levels of annual growth over recent years obscure any clear annual load profile.

Need for the project

AES-SONEL is of the opinion that the level of load shedding seen during the two past dry seasons cannot be repeated in future. It is unreasonable to expect that the dams be full by next dry season. If the reservoir levels at the start of the next dry season are close to those in the past dry years, we estimate that at the peak the generation shortfall from hydro alone could be high, requiring the installation of new capacity.

AES-SONEL therefore propose to approach the problem in two stages: in the short-term, installing emergency thermal plants to cover generation shortfall, with a longer-term study being undertaken in parallel to identify a long-term sustainable solution for meeting current and future energy demands.

3. OBJECTIVES OF THE ESIA

OVERALL OBJECTIVE



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The ESIA is aimed at ensuring compliance with the environmental legislation and regulations in force, identifying the most important environmental indicators, as well as the environmental components likely to be affected by the construction and operation of the extended plant. This

study also aims at determining potential environmental impacts of the plant and associated T line on the components of the environment.

SPECIFIC OBJECTIVES

Specific objectives include the following:

- Evaluate potential positive and negative impacts of the project on the physical environment;
- Evaluate potential positive and negative impacts of the project on the socio-economic environment;
- Evaluate potential positive and negative impacts of the project on the biological environment;
- Evaluate mitigation measures;
- Evaluate eventual technological risk;
- Elaborate an Environmental Management Plan (EMP);
- Make recommendations

EXPECTED RESULTS

The results expected from the ESIA study are as follows:

- A full EIA and an EIS produced according to the legislation;
- An environmental management plan;
- An HSE plan for operations;
- A consultation and disclosure Log;
- An environment monitoring programme

4. SCOPE OF THE ENVIRONMENTAL ASSESSMENT

The completion of the EIA shall require the following specialist surveys;

- Noise survey;
- Soil and geology Survey;
- Fauna and Floral survey;
- Socio-economical survey;
- Air quality Survey;
- Traffic survey;
- Hydrological survey

In addition, it requires the consultation and consents of the community people in order to:

- Inform them of the project;
- Collect their views and concerns;
- Consider public opinion in decision making;
- Increase confidence in public;
- Enable project acceptance

GENERIC TASKS FOR THE ENVIRONMENTAL ASSESSMENT

As part of the ESIA, the environmental consultant shall undertake the following key generic tasks:

N°	Key Task
1	Review of the ToR
2	Confirmation of the scope of the environment assessment
3	Justification of the project
4	Review of Regulatory, Legislative and administrative framework
5	Description of the proposed project
6	Definition of the project area
7	Analysis of Alternatives
8	Visit of the project area
9	Description of Baseline Conditions
10	Disclosure, Meetings, Public Consultation and Publics Audiences
11	Impact assessment and mitigation measures
12	Preparation, production and submission of the EIS

To complete the above generic tasks the environmental consultant shall conduct the following studies within the project area:

- Hydrological and drainage survey
- Soil and geology survey
- Water resource quality assessment
- Infrastructure review
- Recreation and amenity facility review

SPECIFIC TASKS FOR THE ENVIRONMENTAL ASSESSMENT

The specific tasks of an ESIA for the construction of the Dibamba plant and associated T line include specialist survey to be conducted prior to the commencement of work. The contents of these surveys shall be included in the final version of the EIS.

N°	Key Specific tasks
1	Noise survey
2	Socio-economic survey

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3	Fauna and Flora survey
4	Traffic survey
5	Air quality
6	Meetings, Public Consultation, Publics Audiencies and Disclosure Action Plan

5. LEGISLATION, POLICY AND ADMINISTRATIVE FRAMEWORK

CAMEROON LEGISLATIVE FRAMEWORK

Legislation and regulations in Cameroon include the following in hierarchical order:

English Term	French Term
The consultation	La consultation
International treaties and agreements	Les traits et accords internationaux
Laws	Les lois
Orders, edict	Les ordonnances
Decrees	Les décrets
Order, decree	Les arrêtés
Decisions	Les décisions
Permis	Les autorisations

The key legislative relevant to the proposed project is summarised below

Law, Decree and Order	Title
Law N° 98/022, 24 December 1998	The regulation of the Electricity sector ('Electricity Act')
Decree N° 99/125, 15 June 1999	The organisation and Functioning of the electricity sector Regulation Agency
Decree N° 2000/464/PM, 30 June 2000	Register of Activities of the Electricity sector
Order N° 74/1, 6 July 1974	Regulating of the land sector
Order N° 74/3, 6 July 1974	Relating of expropriate procedure for public utility and the compensation modalities
Decree N°2003/418/PM,25 February 2003	Regulating crops evaluation and the associated compensation
Law N° 96/012 , 05 August 1996	Relating to environmental management
Decree N° 2001/718, 3 September 2001	The organisation and functioning of the Interministerial Committee on the Environment
Decree N° 1999/780/PM , 11 Oct. 1999	Modification and Completion of the Deposition of article 3 of decree 94/259/PM
Decree N° 94/259/PM, 31 May 1994	Creation of a National Consultative Commission on the Environmental and Sustainable Development
Law N° 92/007 , 14 August 1992	Relating to code on working conditions
Law N° 98/015 , 14 July 1998	Relating to establishments classified as dangerous, unhealthy or obnoxious

Law N° 98/005 , 14 April 1998	Concerning regulations governing water resources
Order N° 039/MTS/INI	Regulates general occupational health and safety
Decree N° 2005/0577/PM , 23 February 2005	Defining the conditions for undertaking EIA
Order N° 0070/MINEP, 22 April 2005	Defining the categories of operations subject to EIA
Order N° 00004/MINEP, 03 July 2007	Concerning the Ministerial consultant Agreement process

GOVERNMENT ADMINISTRATIVE FRAMEWORK

The Ministry of Environment and protection of Nature (MINEP) is responsible for conservation of the environment. It is represented in the Littoral province by a provincial delegation.

Pursuant to decree N ° 2005/0577/PM of 23 February 2005, relevant correspondences should be submitted to the Ministry of Environment and Protection of Nature, to the Ministry of Water & Energy, and to the electricity sector regulating Agency. According to decree N°001/718 of 3 September 2001, regulating the organisation and functioning of the Interministerial Committee on the Environment, an Interministerial Committee on Environment is also responsible for appreciating the ESIA.

INTERNATIONAL PROTOCOL AND AGREEMENTS

With respect to international agreements and conventions, Cameroon is a signatory to a number of conventions. The most relevant of these are set out below.

- The Convention on Climate Change (Rio de Janeiro, 1992)
- The Convention on biological diversity (Rio de Janeiro, 1992)
- The African Convention on conservation of wild life and natural resources (Alger, 1968)
- The Bamako Convention that prohibits import, sale and transportation of toxic and dangerous wastes, (Bamako 1991).
- The International Convention for the Prevention of pollution from Shipping (MARPOL 1973/78)
- The International Convention on the Prevention of Marine pollution by Dumping of Wastes and order Matter (London Convention, 1972 and the 1996 Protocol)
- The accord on the joint Control of Fauna and Flora in the Lake Chad Basin (1977)

5.4 WORLD BANK, IFC, AFDB AND FMO STANDARDS:

AES-Sonel is committed to implement best practices according to WB, IFC, AFDB and FMO standards therefore this standard will be considered during study phase and to define mitigation measures.

The International Finance Corporation's Policy and Performance Standards on Social & Environmental Sustainability (April 30, 2006) can be use as a guideline.



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5.5 AES SONEL POLICIES AND PROGRAMS:

AES-Sonel has established internal policies and programs, which have to be considered and implemented on present project.

This includes Environmental and Social Action Plan (ESAP) for AES-Sonel.

Applicable AES-Sonel policies will be available to conduct ESIA.

6. LOCATION

The project area is in approximately 15 km to Douala (Littoral Province). The road is feasible at any season.

The Ngodi Bakoko sub-station is located between COGEFAR and CARREFOUR YASSA on the Douala – Yaoundé high way.

Limited topographical data was obtained, eco-topographical survey is required to define the project zone.

Topographical survey conducted for engineering will be available for ESIA or can be part of the ESIA.

7. DESCRIPTION OF THE PROPOSED PROJECT

Eight Wartsila 18V38 diesel engine with all associated equipment and interconnection facilities configured in open cycle 50Hz operational mode with all associated equipment and interconnection facilities in full operational condition.

The characteristics of generating units are:

- | | |
|---------------------|----------------|
| • Capacity | 8 x 11 MW |
| • Type of fuel | HFO 3500 |
| • Consumption | 190g/kWh |
| • Rated voltage | 11.5- 15 /90kV |
| • 2 transformers of | 50 MVA |

Each generator set comprises of the following:

8 diesel engines and alternators
2 x 50MVA transformers

✓ The main features of the project are:

- The plant
- The adjoining premises
- The Radiators
- Tanks
 - 2 of fuel with 2500 m³,

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- 1 of gazole with 500 m³ + 3 daily tanks of 500 m³,
- 2 of water with 500 m³ and 2 with lubrication oil
- The adjoining structures: (offloading station, treatment station, fire fighting pumping premises, cables trenches, etc.)
- Fences
- Access roads

✓ The mechanical auxiliaries comprise the following systems:

- HFO & LFO decanting and treatment Fuel system
- Lubrication system
- Compressed air system
- Plant and engine cooling system
- Charge air system
- Exhaust gas system

Each of these systems has his appropriate organs (pumps, motors, compressors, etc.)

The plant electrical equipments comprise of the following:

- ✓ The equipment of the MV and LV cells, i.e. :
 - The MV cells and their equipments with circuit breakers and protections
 - The earth circuit
 - The LV cells of the auxiliaries
 - Various cables
 - The 11.5/15 kV/90 kV bus bars and their measurement and protection accessories
- ✓ The direct current auxiliaries comprising :
 - 1 set of batteries of 48 and 110 V,
 - 2 batteries chargers
 - 1 direct current distribution cabinet
- ✓ The control & command system of the plant

7.1. DESCRIPTION OF PROJECT RELATED ACTIVITIES

- Studies and production of drawings and documentation
- Civil works (excavations, concrete, etc.)
- Construction of the plant building
- Electromechanical works (erection)



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B. P. 4077 DOUALA – REPUBLIQUE DU CAMEROUN
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- Supply and erection of defective or missing equipments
- Erection of equipments
- Overhaul of units and auxiliaries
- Testing and commissioning
- Acceptance
- Training of operators
- Guaranty

Inspection of machines and equipments

All the equipments will be inspected in particular:

- ☞ Inspection of engines
 - The engine block
 - Cam shafts (visual inspection)
 - The gears (visual inspection of the cog wheels)
 - The cylinders, pistons and valves
 - The cylinder head, pistons (one each row), main bearings
- ☞ Inspection of the generators
 - Intake filters
 - Visual inspection
 - Measurement of the resistance of the insulation
 - Inspection of the bearing without disassembling them
- ☞ Inspection of electromechanical auxiliaries, instruments and control & command.

Supply of missing equipments

- ☞ All categories of equipments involved and which are not supplied with the kit and those who are found to be unacceptable after inspection and following the acceptance of AES SONEL.

8. DESCRIPTION OF THE INITIAL STATE OF THE ENVIRONMENT

Introduction

This section considers the baseline conditions at the DIBAMBA premises. The description only covers those conditions for which information was available at the time of writing. Information that was not available for the ToR will be collected as part of the ESIA.

8.1. NATURAL AND PHYSICAL ENVIRONMENT

8.1.1. Fauna and Flora

There are no protected areas of special floral or fauna interest either in the site or within the vicinity of the site (Carte synthèses du plan de Zonage, July 2001) and alongside of the corridor. Data collection would be required to establish typical species present and any protected species on the project area.

8.1.2. Topography

The land adjacent to the site is predominantly flat. No areas of land adjacent to the site are at a higher elevation than the site itself.

Limited topographical data was obtained, eco-topographical survey is required to define the project zone.

Topographical survey conducted for engineering will be available for ESIA

8.1.3. Climate

The DIBAMBA power plant and associated T line are located within the equatorial zone. The climate in this zone is the same as Douala, and can be divided into four approximate seasons:

- A rainy season between March and June
- The large rainy season between August and November
- A dry season between June and August
- The large dry season between November and March.

The annual mean rainfall is 4 000 mm while the average temperature varies between 24°C and 36°C.

8.1.4. Geology and Soil

The geology in the Douala region is characterized by sedimentary formations. Although the ground in the site is predominantly concrete, soil investigations will be undertaken to determine the soil characteristics prior to any works.

Soils in the projected T line are typically dark and yellow derived from basaltic rocks. The soils vary in depth and are generally acidic and low in nutrients. In forested areas soils are protected by vegetation cover and ground litter.

The opening of access roads and excavation of soil for the implantation of pylons may affect the soil geology, as there shall be mixing of different soil strata. This may affect the environment.

A soil survey conducted for engineering will be undertaken as part of the EIA.



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8.1.5. Hydrology and Drainage

As the plant is located on an incline, drainage from the site is good. A number of trenches will be constructed around the plant, where all the rainfall will be collected and discharged into a stream outside the site boundary. All Fuel storage tanks are bundled and the water collected is drained to a separator. Only clean water is discharged into the trenches.

Existing drainage facilities along the proposed route of the new transmission line will be investigated as part of the ESIA.

8.1.6. Water resources and quality

Due to the insufficient supply of water in the Dibamba village, a survey shall be conducted as part of the ESIA to identify stream used by population and what they used it for.

8.1.7. Landscape

The landscape around Dibamba village is characterized by low level (single storey) residential properties. The perimeter security fence is bordered by vegetation, including small trees. However, the predominant landscape features is the soap factory.

The land use along the projected line corridor is predominantly plantation crops, farmlands.

A survey of the land use around the plant area and along the proposed transmission line route would be undertaken as part of the ESIA.

8.2. SOCIAL AND ECONOMIC ENVIRONMENT

8.2.1. Civil Administration

Since august 1983, the national territory of Cameroon has been divided into a number of different administrative levels:

Provinces	Under the authority of Governors
Divisions	Under the authority of senior division officers
Subdivisions (or 'arrondissements')	Under the authority of sub divisional officers
Districts	Under the authority of district heads
Villages	Under the traditional chief

Dibamba is located within the Littoral province and administrative issues are addressed by local council. In addition to the civil structure, there is a local administrative unit headed by a traditional chief.

A social survey shall be conducted as part of the ESIA to provide information on the social aspect of Dibamba Village. Therefore, during the selection of the site much was done to avoid residential and plantations areas.



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8.2.2. Human Beings

A number of different ethnic groups reside in Dibamba Village including the Bassa, Douala, and Bamilékés.

The main economic activities in and around Dibamba include trade, Soap-industry and Farmlands. The principal sources of employment are the soap factory located at 1Km from the power plant. The environmental consultant should provide socioeconomic data on sources of livelihood on the project area.

Dibamba has no dispensaries (chemists), no public hospital and no medical doctors.

8.2.3. Air Quality

Air quality is not systematically recorder in Cameroon. Climate information and land use is therefore likely to provide the main background input into the determination of air quality at the project sites.

However, the closest sources of other potentially significant emissions to air are the soap industries, which are located approximately 1 km to Dibamba village.

In the absence of national guidelines for ambient air quality, World Bank Group requires that air emissions comply with those set out in the World Bank Group's Pollution Prevention and Abatement Handbook (1998 - WBG's PPAH) and that incremental ambient air quality impacts are limited to ensure that the resultant ambient air quality levels are maintained within the ambient air quality guidelines also set out in the WBG's PPAH. The air emission guidelines that would apply to the proposed Dibamba plant (HFO-fueled reciprocating engine power plant) are 2,000 mg/Nm³ for NO_x (dry at 15% oxygen), 50 mg/Nm³ for particulate matter (dry at 15% oxygen), and 0.2 ton SO₂/day/MWe for SO_x, assuming that the background ambient air quality levels are clean and the resultant NO₂ ambient air quality levels are less than 150 micro gram per cubic meter (24-hour average). More details are provided in the WBG's PPAH.

The maximum emission levels set out above should be achieved for at least 95% of the time that the unit is operating, to be calculated as a proportion of annual operating hours. The remaining 5% of annual operating hours is assumed to be for start – up, shutdown and emergency fuel use, and unexpected incidents.

8.2.4. Noise

Preliminary noise survey will be undertaken as part of the ESIA. As a result, we will have a database of ambient noise levels, at day time and at night time.

8.2.5. Land use



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The land use in Dibamba, the village which the plant is located and along the projected line corridor is predominantly plantation crops, farmlands.

A survey of the land use in Dibamba and along the proposed transmission line route would be undertaken as part of the ESIA.

Environmental consultant will carry out the correct estimation of the affected people & accordingly compensation will be made as per IFC requirements for mitigating involuntary resettlement.

8.2.6. Traffic and Transport

The highway shall be used for the transportation of materials.

The safety action plan to ensure public safety shall be review to ensure road traffic hazards are taken into account

8.2.7. Recreation and amenity

No known recreation and amenity facilities are identified within the project area.

Potential recreational and amenity areas within the study area will be investigated as part of the ESIA.

8.2.8. Cultural and National Heritage

No known sites of cultural and archaeological importance were identified around the site and along the projected line corridor; some areas may have these sites as a grave.

This would be assessed as part of the ESIA

9. ANALYSIS OF ALTERNATIVES

FRAMEWORK FOR THE ANALYSIS

In evaluating the options for meeting the demand for power in Cameroon over the next five years and to determine the preferred course of action, the options have undergone a preliminary analysis taking into consideration the following:

- Initial capital cost and finance ability
- Ongoing operation and maintenance cost
- Timescale for development and execution of the option
- Probability of success
- Future flexibility / adaptability
- Environmental and Social issues
- Associated or synergetic benefits



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Affordability of produced power for the customer

The framework for analysis will be developed further as part of the long-term investigation into emergency power generation in Cameroon.

DEMAND MANAGEMENT OPTIONS

Technical and commercial losses

Efforts to reduce losses, both technical (e.g. transformer, heat, reactive power) and commercial (e.g. theft, faulty or missing meters), are ongoing. Reducing technical losses significantly is an exercise that follows the law of diminishing returns. For every further incremental reduction in losses, the capital cost involved increases, to the point at which it is no longer economically attractive. Efforts to reduce commercial losses do not generally result in lower demand as commercial losses represent unlawful demand. Faced with a choice between paying for electricity previously stolen or received for free and having no electricity supply, customers generally elect to pay rather than lose their supply. A large portion, of commercial losses, particularly in the Douala area, is in fact from commercial scale customers who tamper with their meters. Efforts are however ongoing to combat this issue.

Transmission system studies are being carried out to determine ways to reduce technical losses, particularly in the western transmission system, by the installation of reactive power compensation. The results of these studies will shortly be made known.

High efficiency fluorescent bulbs

A key component of the daily demand profile, which sees peak demand occurring during the evening hours, is the use of incandescent domestic light bulbs. Assuming 500,000 75W light bulbs are replaced with 20W fluorescent bulbs, the evening peak demand could be reduced by up to 25MW. We are currently in a preliminary evaluation stage to determine the Terms of Reference for a full study and pilot programme that will be executed within the next three months. The short-term capital outlay savings may be as much as \$10 million as investment in peak generation capacity is avoided.

Price constraints

The tariff structure stipulated in the concession agreement places a restriction on the degree to which increased costs from “in-house” thermal generation can be passed on to the customer. There is, however, a mechanism to pass through higher costs due to power supplied by third parties and the option for a third party to own and operate new thermal generation plant should be considered. The short time frame available to address the current generation shortfall would, however, not permit contractual agreements to be put in place before construction would have to have begun. There may be a way to construct the plant whilst negotiating the sale of the facility to a third party and a power purchase agreement with that party in parallel.



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In the meantime, it will be necessary to agree an emergency power tariff increase to pass the additional costs involved in the generation through to the customers. This need to be agreed in advance of full project development and implemented at the time of commissioning to ensure costs are recovered immediately. The emergency tariff will primarily be designed to cover the high cost of hydrocarbon fuels that are needed for the emergency generation. Without knowing the exact amount of emergency generation required over the dry season, assumptions on total use will have to be made and agreed upon in advance for the purpose of setting the emergency tariff. Any under or over estimation will be passed through to the customers at the next tariff review.

9.2.4. Plant load factor and the need for synergies

In that the demand for power is seasonal, any thermal unit will only be in operation for a portion of the year. The unit price during the period of operation will thus have to be higher to cover the initial capital costs. It will be beneficial to find some means of increasing revenues or lowering costs to maintain economic viability. This may be in the form of an integrated solution that allows alternative or supplementary revenues to be generated through steam sales for example, or through finding alternative customers or uses for the plant. Intermittent operation also poses problems in securing economic fuel supply arrangements, particularly with respect to gas supply, which is a constant process intolerant of large swings in supply volume.

9.3. GENERATION OPTIONS

Generation options can be split by fuel type. This might be geothermal, solar, hydro (storage and run of river), wind, coal, oil (various grades), natural gas, LPG, other petroleum based fuels (e.g. methanol, refinery residues, condensates from natural gas production, Chad-Cameroon crude oil tops), or some combination of the above. Thermal generation can also be split by plant type. This includes combustion turbines, reciprocating engines and conventional boiler and steam turbine. The plant may be leased, rented or purchased and may be located on land or water.

9.3.1. Gas options

Cameroon has significant proven and unproven gas reserves, (120-270 bcm total estimated reserve of which 2bcm per year is being flared. However, preliminary studies of potential sites at Matanda, Dibamba, Sanaga Sud, ETINDE/Isongo and the Rio del Rey indicates that none of the fields currently under evaluation is capable of being brought operation within a project execution time of 18-24 months.

Considering the need to maintain competition between the various suppliers and the probable difficulties involved in the selection, approval, permitting and financing of any of the gas fields, this period extends to 30-36 months for initial exploitation of the gas reserves for the purpose of



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power generation. As the power generation will be highly seasonal, the requirement to have further alternative market demand in addition to the seasonal power generation demand means that gas powered thermal generation is a medium term solution, either for further generation capacity or for the conversion of any the short-term liquid fuelled generation that may be installed.

9.3.2. Liquid fuel options

“Diesel” reciprocating engines

(i) Existing capacity

AES SONEL is in the process of increasing installed Diesel engine capacity in Cameroon from 35 to 225 MW This comprises 9.6MW of new installed capacity to the 9.0MW already installed at the Bassa substation and 17.6MW of new capacity at the Logbaba substation, both in Douala. Outside Douala, 16MW is being added to the existing 18MW at Oyomabang and 4.7MW is being added to the 9.6MW at Bafoussam. These machines are all relatively low capacity medium or high-speed units operating on diesel oil and suitable for emergency, stand-by or peak lopping duties. They typically generate power at a unit cost of 22 cents/kWh owing mainly to the high fuel cost. This is nearly three times the revenue received on sale of the power to residential consumers. We have also Limbé and the future Kribi power plants respectively with 85 MW and 150 MW. The Logbaba and Bassa plants are containerised units that can relatively easily be moved to alternative remote locations and it is expected that this will be carried out when larger and more cost effective thermal generation has been installed.

9.3.3. Other generation options

Hydropower capacity increase

Many different schemes for increasing hydropower generation capacity have been studied. Some of the more promising include:

- Increasing inflows at Mape reservoir to improve wet season filling.
- Increasing storage capacity at Mbakaou reservoir by raising the dam wall.
- Njock falls schemes.
- Song Dong and Msongbengue schemes.
- Bayomen.

These and many other schemes present varying benefits and costs but are all not achievable within at least a four-year timeframe. Some schemes may take much longer to bring to fruition, if possible, owing to heightened global awareness of and environmental concerns about hydropower

schemes, particularly those involving large amounts of inundation. As such, all hydropower options for increasing dry season or base load power production are medium or long-term solutions. A wide ranging study of all conceivable options, both larger scale and mini, is currently being carried out. The extensive list of potential projects will be reduced to a smaller number of more attractive options for more detailed evaluation in a process of examination against a framework of considerations such as guaranteed dry season capacity, cost per kWh produced, environmental and social impact and concept integration into a longer-term transmission grid.

9.4. ALTERNATIVE LOCATIONS

Seven possible sites were visited. Four (4) locations for land Based installation and three(3) for barge Mount installation.

The location of the new power generation plant will be in a balance between proximity to the “fuel” source and proximity to a point of access to the electricity grid and key load centres. In the balance, the proximity to the load centre is relatively more important owing to the costs and time involved in making any initial connection to the grid and more importantly, the long-term stability and cost of grid operation.

9.4.1. Power plant location for proximity to the fuel source and the easiest access to grid and the cost of the land acquisition

Land base installation near Dibamba River

20 Km south-east of Douala city
7 Km from Ngodi Bakoko substation
3 Km of new T Line required
Easy site access
1 Km from stated highway
No noise issues
No major site work required
90KV and /or 225KV interconnection possible
Fuel delivery by trucks
On- site storage of seven (7) days fuel.
400 mm FCFA is the estimated budget for land acquisition

Barge Mount installation swelling over Dibamba river

22 Km south-east of Douala city
9 Km from Ngodi Bakoko substation
5 Km of new T Line required
1 Km from stated highway
No noise issues
Barge availability period



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Change in natural flow of the river
In case oil spillage in the river
Cost of Barge & associated equipment

9.5. SUMMARY

9.5.1. Preferred option

An initial analysis of the various options on the basis of the initial framework is presented in above paragraphs. No single option can be considered optimal – therefore the chose option or option will of necessity represent a compromise between technical, economic, strategic and environmental factors and be deficient in some respects from an “ideal” solution.

Given the need to have a solution in place by June 2008, the preferred solution is to install the plant at Dibamba. This option has the following advantages:

- Technically feasible;
- Plant are available within the timescale;
- There will be minimal impact during construction at the plant will be installed at rural area
- The plant can be easily connected to the existing supply network at these sites.

10. POTENTIAL ENVIRONMENTAL IMPACT AND MITIGATION MEASURES

10.1. POTENTIAL ENVIRONMENTAL IMPACT

This section considers the potential environmental impacts of the Wartsila 18V38 engine at the Dibamba site.

In line with standard environmental impact assessment (EIA) practice and IFC guidelines, the environmental assessment will assess the likely significance of the impact based on the magnitude of the impact in relation to sensitive receptors and environmental resources. The assessment will cover the direct effects and temporary, positive and negative effect of the development during construction and operation. Measures to avoid minimise and mitigate key potential environmental impacts that could result from construction and operation activities of the projects will be identified and an evaluation of the residual, i.e. remaining, impacts after implantation of the mitigation measures will be undertaken in the EIA. The EIA will also consider the cumulative impacts of the project.

Although the key issues associated with the project will be scoped during the EA process, a preliminary assessment indicates that the key potential impacts would include:

- Air quality
- Noise
- Traffic and transport
- Water resources and quality
- Social impacts

Other potential impacts include:

- Impacts on land use
- Flora and fauna

10.1.1. Air Quality

Potential impact

The proposed project will potentially have a significant adverse impact on air quality during both construction and operation.

- During construction*, the use of construction equipment and vehicles will result in the emission of dust and fugitive emissions from construction plant and vehicles. These may arise from:
 - On site earth moving operations for foundations and excavation;
 - Vehicles movement over bare patches in dry weather;
 - Blow off and spillage from vehicles;
 - Wind blow from bare dry construction areas.

The potential for dust to be emitted during construction is strongly dependent on the type of activities taking place, on wind speed and on whether winds carry emitted particles towards sensitive receptors, such as residential or commercial properties. As the proposed works will be undertaken within the rural area , the impact on air quality during construction is likely to be Major and temporary.

- During operation*, the combustion of fuel will give rise to emissions of sulphur oxides, nitrogen oxides, carbon dioxide and particulate matter. These emissions are of potential concern to human health and local ecology, and in relation to their potential contribution to greenhouse gas levels.

A survey will be done to assess the impact of the proposed temporary plant on local air quality.

Mitigation measures

During construction, the programme would incorporate ‘good site practices’ to reduce the risk of dust impacts, for example dust suppression measures such as damping of haul roads and enforcement of a maximum speed limit over all unmade surfaces.

During operation, the impact on air quality will be controlled by compliance with emission limits set out by the Cameroon government and in accordance with those limits recommended by the ESIA and agreed with the Lenders. The ESIA will check whether the proposed stack height is sufficient to limit the incremental air quality impacts as part of its air dispersion analysis.

The ESIA will provide quantitative estimation of greenhouse gas emissions from the proposed project and an evaluation of options considered to reduce greenhouse gas emissions such as generation technology choice, fuel choice, feasibility of utilizing energy from exhaust gas, etc.

10.1.2. Noise

Potential impacts

The construction and operation of the proposed plant has the potential to generate noise impacts:

- Construction* : the noise sources associated with the preparation of the site and the movement of the power units onto the site.
- Operation* : the noise sources associated with the operation of the proposed power plant. The main sources are likely to be the exhaust stacks, exhaust diffuser, air inlet, engine building and main transformers.

The significance of these impacts will depend on ambient noise levels at the sites and the potential for this to impact on sensitive receptors, for example operating staff and local residents. Ambient noise levels will be measured as part of the ESIA. The ESIA will provide noise impact assessment to demonstrate that the noise control measures are sufficient to limit noise impacts on the nearby residential receptors in compliance with the relevant noise requirements by the Cameroon government and the WBG's PPAH.

Mitigation measures

During construction, good working practices should be exercised. This will include measures such as construction works being restricted to daytime hours, the proper use of machinery, and the distancing of noisy plant from sensitive locations.

Mitigation measures during operation will be partly restricted to the type of plant available on the market for the provision of immediate power generation. However, generic mitigation measures that may be applicable include the following:

- The use of inherently quiet plant where possible
- The use of silencers on air inlet and exhaust silencers
- Enclosure of the engine within a unit designed to minimise noise
- Use of screens (natural or manmade) to reduce noise attenuation.

10.1.3. Traffic and Transport



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The projected site and line corridor runs alongside the highway from Douala to Yaoundé the highway shall be used for the transportation of materials.

The safety action plan to ensure public safety shall be review to ensure road traffic hazards are taken into account

Potential impacts

The potential impacts on traffic and transport are likely to arise as a result additional traffic associated with the proposed power plant during construction and operation. The impact can occur in the form of increased traffic noise levels and air pollution, conflicts with other road users, and specific annoyance due to additional heavy goods vehicle movements. The installation of the plant will involve the transportation of the plant components and workforce to the site. The operational phase will involve traffic movements to deliver raw materials, for example fuel, to the site. The significance of the impact on sensitive receptors such as community and commercial properties and existing and future road users will depend on the number and type of vehicles to be used.

The movement of construction traffic will be temporary, for the construction period only. During operation, the movement of additional vehicles for fuel delivery would take place within the dry season, i.e. during the period in which the plant was operational. As the proposed plant is a temporary solution to the immediate problem of power supply, any adverse impact will be temporary. As part of the EA, a traffic assessment will be undertaken to assess the overall impact of the temporary project on traffic and transport and to identify suitable mitigation measures.

Mitigation measures

The following measures could be employed:

- Traffic assessment as part of the ESIA to assess the significance of impacts as a result of traffic movements during construction and plant operation;
- Assessment of the optimal route to the sites;
- Upgrading of roads where required ;
- Restriction of hours during which traffic movement is permitted;
- Traffic management scheme

10.1.4. Water Resources

Potential impacts

The potential for proposed power plant to impact upon local water resources (surface waters and groundwater) will depend mainly on the requirement for water as part of the operational processes, although there will also be some minor impact during construction:

- During construction*, site preparation and construction works could alter the existing drainage characteristics of the site and result in surface water run-off. There is a potential for adverse impacts on surface waters through the spillage of lubricants, oils and machine fuel during construction activities and the disturbance of soil and dust, which is washed off into local watercourses.
- During operation*, impacts on water resources will arise from the potential need for water injection to abate nitrogen oxide emissions. Although a full assessment of available water resources would be undertaken as part of the ESIA, it is likely that availability of water resources will be a constraint given the current low river levels and low rainfalls in the last three years. Any water abstraction could have a significant adverse impact on water resources.

In addition to water resource issues, operation of the plant could result in pollution to local water resources through drainage runoff from the site during rainfall events, which may contain contamination due to leaks or spills on site.

Mitigation measures

The majority of construction impacts can be avoided through the adoption of good engineering and construction working practices. Such practices may:

- Routing of all site drainage to silt traps, allowing suspended solids settlement and initial oil interception of drainage;
- Incorporation of measures to protect surface water and drainage features, for example fencing off of work areas;
- Location of storage tanks on impervious base or the use of drip trays during refuelling.

During operation, the proposed plant will be air cooled and therefore will not require additional water supplies for cooling. The EA will investigate the requirement for water injection to reduce nitrogen oxide emissions. If it is assessed that water injection is required, the ESIA will investigate suitable supplies of water and measures for potential reuse of water on site.

As the site is not operated, a number of facilities are missing. All water supplies required for the project would be from sustainable sources.

10.1.5. Social Impact

Potential impacts

Potential impacts on human beings are related to the construction and operation stage:

- Construction activities* will have the potential to have an adverse impact on local communities through the temporary increase in disturbance through an increase in noise, dust and traffic. The significance of this impact will depend on the location of these sensitive receptors in relation to the works site and access routes.

The construction activities may potentially have a positive socio-economic impact by the provision of employment due to the need for temporary construction staff. The number of staff required is unlikely to be in such numbers to result in undue pressure on local resources. In particular, both proposed sites are located within the outskirts of the main city of Douala and therefore within reach of a large potential working population that will not have to relocate to undertake the work.

- During operation*, the proposed plant will have both a positive and a negative impact. Most significantly, the plant will result in a positive impact through a regular and reliable supply of electricity to the system to cover the predicted shortfall in generation through hydroelectric sources. This will reduce the problems currently faced by existing commercial, industrial and commercial users as a result of power cuts and load shedding and will also provide a sound base for future economic opportunities. It is estimated that each kWh unavailable to business costs the economy between 50 ¢ and \$1. (Compare this with Government tax revenues on diesel oil fired generation of ~5 ¢ per kWh). The operation of the plant is unlikely to result in any additional jobs, as existing AES SONEL staff will operate the plant.

The operation of the plant will potentially have a negative impact on human beings in terms of health and safety of both operational staff and of local communities. For example, the operation of the plant could result in an adverse impact on staff through the levels of noise and air emissions. Local communities may be adversely affected because of air emissions and an increase in noise and traffic. As the proposed plant will be operational temporarily only, the potential for an adverse long-term impact on human beings will be minimal.

Mitigation measures

The EA will result in the identification of mitigation measures suitable for each site. Potential mitigation measures include:

- Location of the plant sites away from sensitive receptors adjacent to the site;
- Adoption of good construction working practices such as the restricting of working areas;
- Implementation of a traffic management plan;
- Construction of noise barriers if required to minimise noise;
- Preparation of a worker's health and safety manual including the implantation of appropriate measures to ensure that workers are not exposed to undue levels of noise, for example through the provision of ear protectors;
- Preparation of an emergency contingency / spillage plan.

10.1.6. Visual impacts

Potential impacts

The power plant will result in an adverse visual impact due to the nature of the plant. However, the plant is containerised and, as it will be located within , it will have a minimal adverse visual impact.

Mitigation measures

Mitigation measures to reduce the impact of the proposed plant are restricted by the fact that the plant will be hired and therefore there will be little opportunity to influence the design of the plant. However, if required, the following measures could be employed to reduce overall impact of the plant:

- Location of the plant within the site boundary to minimise visual impact from sensitive receptors outside the site boundary;
- Position of lighting within the site to prevent light scatter outside the site;
- Planting around the perimeter of the site to screen the plant from sensitive view points.

10.1.7. Land use impacts

Potential impact and mitigation measures

The proposed plant will be located far away from Douala. There is no sufficient infrastructure. We will need to construct additional infrastructure.

Land use outside could potentially be affected by the plant, depending on the nature of the land use and the potential impacts arising from air emissions and noise. However, the impacts will be measured which will include compensation for assets at replacement cost and restoring lost livelihood if any.

10.1.8. Flora and Fauna

Potential impacts and mitigation measures

There are no reserves affected by the project.

Data collection would be required to establish typical species present and any protected species on the power plant site and along the route.

It is understood that there are no protected sites within the vicinity of the sites.

There may be a potential adverse impact on aquatic flora and fauna arising from the drainage of surface runoff containing contaminants. However, as the production of wastewaters will be minimal (e.g. from routine cleaning operations) and measures will be employed to minimise the potential for water contamination on the site, the proposed project is unlikely to have a significant adverse impact on flora and fauna.



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10.1.9. Cultural heritage

Potential impacts and mitigation measures

No known sites of cultural and archaeological importance were identified around the site and along the projected line corridor; some areas may have these sites as a grave. This would be assessed as part of the ESIA

10.1.10. Infrastructures

Road/Railway

No road or railway is affected by the project; safety of operation access way to the main road will be assessed as part of ESIA

Telecom

There may antennas programmed by the telecommunication companies but presently no project is identified.

Airstrips

Site is located far away from the Douala airport.

However, a survey shall be conducted to identify and mitigate potential impacts of the line on this airstrip.

10.2. PROJECT MITIGATION

The mitigation measures identified as part of the EIA will be recorded as a table within the environmental assessment report. This will identify who is responsible for implementation of mitigation measures, an implementation schedule, and estimated implementation cost to the extent available.

11. ENVIRONMENTAL ASSESSMENT CONSULTANT

A local environmental consultant shall be selected through a tendering process to undertake the ESIA in collaboration with, AES-SONEL staff and the Administration. This is to assess the project area and identify the components of the environment that are most likely to be affected by the project and propose mitigation and cost.

The consultant shall be required to prepare and implement an HSE plan. The residents, environmental consultants, administrative and local authorities and the public at large will be consulted and their views taken into consideration as part of the EIA process.

11.1. IMPACT ASSESSMENT

Survey shall be carried out to evaluate the positive and negative effects of the project on the environment; these may likely include the following:

- Ecological survey ;
- Socio-economic survey;



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- Land use survey;
- Topographical survey;
- Traffic and transport survey;
- Soil survey
- Water resource quality assessment;
- Visual impact assessment;
- Cultural heritage and archaeological survey.

12. AES-SONEL ENVIRONMENTAL MANAGEMENT PLAN

As part of the EIA, measures for mitigating negative impacts will be designed and AES-SONEL's Environmental management plan will be improved for the plant to operate in compliance with Cameroonian Environmental Regulations.

Furthermore, the identified mitigation measures will be recorded as a table within the EIS. This will identify who is responsible for implementation of mitigation measures and an implementation schedule.

12.1. ESIA PROJECT MANAGEMENT

The ESIA process and the preparation of relevant documents will need careful programming and implementation to avoid delay in construction programme. Good project management can only achieve this; it is therefore essential that the roles and responsibilities of those involved in the project are well defined and that good communication links are established.

13. DURATION

The total duration of the ESIA will be 3 months to be agreed upon with the environmental consultant. The period for site visits to evaluate baseline conditions and collect data is inclusive. However, in respect of the tasks to be accomplished it could be possible to modify the agreed schedule.

14. CONTENT OF THE ENVIRONMENTAL IMPACT STATEMENT (EIS)

Based on Ministerial order N° 0070/MINEP of 08 March 2005 defining the categories of operations subject to EIA following is the content of the EIA report for the construction of the Dibamba power plant and associated line.

- Executive Summary in English and French
- Description and analysis of the initial state of the environment (Physical, biological, socio-economic and human beings)
- Description and analysis of all natural resources, and socio cultural components likely to be affected by the project as well as justification of the choose of the location
- Description of the project



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- Presentation and analysis of alternatives
- Justification of project amongst other possible solutions
- Identification and evaluation of possible effects of project implementation on the environment and human beings
- Indication of mitigation measures envisaged to avoid, minimize, eliminate or compensate for adverse effect of project on the environment and estimate the related cost.
- Information and awareness programme as well as report of consultation meetings held with the project affected people, NGOs, Labour representatives, leaders and other groups concerned.
- Environmental Management plan consisting of mechanisms to monitor the project, and the environment, as well as the compensation plan.
- Terms of Reference for the EIA.
- References and Bibliography.

Appendix F

Divisional Officer's Permission Letter

DEPARTEMENT DU WOURI

PREFECTURE DE DOUALA

SECRETARIAT PARTICULIER

Douala, le _____

N° _____ /N /C19 /SP./-

NOTE CIRCULAIRE

A -Sous-Préfet de l'arrondissement de
Douala III^{ème}
-Chefs cantons **BAKOKO, BASSA**
- Tous Chefs de village secteur **YASSA**

- DOUALA -

En vous informant de ce que la société AES-SONEL, dans le cadre du projet de construction d'une Centrale Thermique commettra de temps en temps des équipes techniques en vue de la réalisation de certaines études préalables à la finalisation du projet (travaux topographiques, sondages et autres),

J'ai l'honneur de vous demander de bien vouloir chacun en ce qui le concerne, sensibiliser vos populations en vue d'accorder des facilités d'accès de mouvements à ces différentes équipes qui se présenteront sur le terrain munies des badges.

Vous voudrez bien inviter les populations à signaler toute destruction des biens qui devra faire l'objet d'une expertise suivi d'un procès verbal de constat et d'évaluation par le personnel assermenté membre de la commission mise en place par arrêté préfectoral (Délégué d'agriculture).

Je compte sur votre civisme éprouvé pour un bon déroulement de toutes les activités liées à ce projet dont l'importance n'est plus à signaler

Copie :

- **Gouverneur à titre de compte rendu**
- **Commandant de groupement pour information et suivi**
- **Commissaire Central N° 2 pour information et suivi**
- **Délégué Départemental agriculture, désigner collaborateur en vue suivre travaux. Prendre attache Mme MPACKO, Coordinatrice site**

Appendix G

Attendees and minutes of village meeting
Prepared by AES Sonel / Scott Wilson

PROJET DE CONSTRUCTION DE LA CENTRALE THERMIQUE DE YASSA-DIBAMBA

PROCES –VERBAL DES CONSULTATIONS PUBLIQUES

L'an deux mille sept
Et le vingt sept du mois de novembre à 16 heures

Se sont déroulées à la chefferie de **YASSA**, les consultations publiques **relatives à l'étude d'impact environnemental et social du projet de construction de la Centrale Thermique de Yassa-Dibamba**, conformément à la Loi N° 96 /12 du 5 août 1996 portant Loi cadre relative à la gestion de l'environnement et au **Décret N° 2005 /0577/PM du 23 en leurs articles 17 et 11.**

Cette importante réunion d'information et de sensibilisation des populations était présidée par M. YAMPEN OUSMANOU, Sous-préfet de l'Arrondissement de Douala 3^{ème}.

Y participent :

Les autorités administratives

Les autorités traditionnelles,

Les représentants de AES SONEL

Les représentants de Scott Wilson (consultant)

-Emily Spearman (project manager)

-Ian Breakley

Et SAFEX (bureau d'études Camerounais) représenté par Richard NDEMANOU

Voir liste détaillée des participants en annexe

Ce forum s'est déroulé comme suit : l'autorité administrative a présidé cette cérémonie, le promoteur du projet (AES SONEL) et le consultant Scott Wilson et son représentant local SAFEX) ont présenté le projet et les impacts aux populations, ensuite le président de séance a ouvert le jeu des questions/réponses.

DIFFERENTES ALLOCUTIONS

Allocution du Sous- préfet de Douala 3ème

Prenant la parole, le Sous- préfet de Douala 3ème souhaite une chaleureuse bienvenue à tous ceux qui ont pris la peine de participer à ce forum; présente ses excuses à l'assistance pour le retard accusé, dû au fait qu'il devait assister à plusieurs réunions à la Préfecture, dont l'une d'entre elles portait sur le projet de construction de la centrale à fuel lourd de Dibamba.

Il déclare que le problème de déficit énergétique se posant avec acuité, l'Etat du Cameroun et AES SONEL se sont engagés à apporter rapidement une solution à ce problème, à la grande satisfaction des opérateurs économiques et des autres usagers.

Il rappelle que les consultations publiques ont pour but de présenter aux populations et à ceux qui s'y intéressent, les problèmes environnementaux pouvant résulter de la construction d'un ouvrage, cas de la centrale à fuel lourd de DIBAMBA; Et que cette consultation publique fait suite à plusieurs réunions de sensibilisation et d'information des populations qui se sont tenues à la chefferie de YASSA.

Il invite toutes les populations à adresser leurs observations, leurs doléances et leurs suggestions à AES SONEL qui est le promoteur du projet et /ou au consultant retenu pour conduire les études socio-économiques et d'impact environnemental.

La parole est ensuite donnée au chef du canton BAKOKO.

Allocution de sa majesté MADIBA (Chef du canton BAKOKO)

Il s'excuse de ne pas pouvoir assister aux débats en raison du démarrage tardif des assises lié aux contraintes du Sous-préfet, évoquées plus haut. En sa qualité de président du NGONDO 2007, il a donné des rendez vous qu'il doit honorer.

Néanmoins, même en son absence, les populations doivent participer massivement au jeu de questions réponses pour connaître les tenants et les aboutissants de ce projet.

Il présente l'honorable MAKEMBE qui a tenu à être présent à YASSA. Natif de ce village et élu du peuple à l'Assemblée Nationale du Cameroun, il voulait suivre les différentes communications, afin de participer aux débats sur les questions relatives à l'environnement. Malheureusement, il se trouve dans l'obligation d'honorer à d'autres engagements.

Le Sous préfet donne la parole au représentant de AES SONEL.

Allocution de Albert Matha

Le représentant de AES SONEL présente les différentes personnes qui font partie de sa délégation à savoir :

Mesdames:

Kenfack Albertine,

Marcelline NGOM,

Messieurs : Yoland Akohachere et Désiré Tchui kam

Poursuivant les présentations Mme Kenfack a rappelé :

- l'objectif du projet

- Réduire le déficit énergétique en construisant une Centrale à fuel lourd de 88 mégawatts
- l'intérêt des consultations publiques
 - Sensibiliser les populations sur les différents effets négatifs et positifs qui peuvent résulter de la présence de la centrale dans ce village.

Elle a ensuite exhorté les populations à exprimer leurs préoccupations, à faire des observations et même des suggestions.

Elle a également précisé que l'Etat pendant un certain nombre d'années, prenait la décision de construire des ouvrages de façon unilatérale, sans avis préalable des populations concernées par le projet. De nos jours, les choses ayant évolué, les populations sont désormais des partenaires du promoteur du projet; C'est la raison pour laquelle elles doivent s'informer sur le déroulement du processus du début jusqu'à la fin.

Ce processus se déroulera en deux phases : la première phase porte sur les consultations publiques et la deuxième sur les audiences publiques.

Elle a relevé que les termes de référence qui couvrent les études relatives à la qualité de l'air, le bruit, l'écologie, la flore et la faune, l'héritage culturel, les ressources en eau, les aspects socio- économiques, les impacts potentiels, prennent en compte l'étude d'impact environnemental et social qui sera approuvée par le Ministère de l'Environnement et de la Protection de la Nature (MINEP).

Il est alors revenu au consultant indépendant Scott Wilson de présenter les membres de son équipe, y compris son représentant local SAFEX.

Scott Wilson a fait un bref rappel de la réglementation qui prescrit les consultations publiques à savoir :

La Loi N° 96 /12 du 5 août 1996 portant Loi cadre relative à la gestion de l'environnement qui prescrit la réalisation d'une étude d'impact environnemental en son article 17. Par ailleurs, le Décret N° 2005 /0577/PM du 23 février 2005 relatif aux études d'impacts environnementaux dispose en son article 11 :« la réalisation de l'étude d'impact environnemental doit être faite avec la participation du public ou des populations concernées par le projet, à travers des consultations et audiences publiques, afin de recueillir les avis des populations sur le projet. Les consultations publiques consistent en des réunions pendant l'étude dans les localités concernées par le projet ; l'audience publique est destinée à faire la publicité de l'étude, à enregistrer les oppositions éventuelles et à permettre aux populations de se prononcer sur les conclusions de l'étude».

Ensuite, un rapport est établi en plusieurs exemplaires. Ce dernier est déposé au MINEP qui organise les audiences publiques. Les audiences publiques auront pour but de vérifier si les informations recueillies pendant les consultations publiques figurent dans le rapport du consultant.

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La procédure impose à AES SONEL de rédiger les termes de référence qu'elle dépose au MINEP pour approbation et une étude détaillée des travaux et des prestations qu'elle envisage de réaliser.

Il est à noter que les études d'impacts environnementaux se réalisent en deux phases ; notamment la phase de développement (construction proprement dite de la Centrale thermique) et la phase d'exploitation (production de 88 mégawatts).

En phase de développement, les impacts sont mineurs (pertes des cultures, des terres habitables)

Alors que en phase d'exploitation, les impacts porteront sur la qualité de l'air, le bruit, le traitement des eaux, les fumées. Ces impacts s'étalent dans le temps.

Quelles sont les mesures qui peuvent être prises ? C'est ce que le consultant va réaliser. Toutes les mesures d'atténuation et de compensation doivent être traduites en actions pour maîtriser les impacts.

Les populations dresseront leurs observations, leurs doléances et leurs suggestions pour améliorer leur cadre de vie. Celles-ci seront consignées dans les registres ouverts pendant les audiences publiques supervisées par l'administration.

Le rapport sur les observations et suggestions collectées, est soumis à l'approbation d'un comité interministériel, lequel est composé des représentants de tous les Ministères concernés.

Au vu des différents éléments produits, le Comité rejettera le dossier ou donnera le OK pour la réalisation du projet.

Le plan de réinstallation

Les personnes affectées par le projet seront indemnisées.

Un plan de gestion d'impact environnemental sera mis sur pied.

A la suite des allocutions des différents intervenants, le Sous Préfet de Douala 3ème ouvre les débats

INTERVENTIONS/QUESTIONS/ REPOSES

Le Chef NGOSSO déplore le fait que cet ouvrage soit appelé « Centrale de DIBAMBA » par AES SONEL, alors qu'il sera implanté sur les terres du village YASSA- BAKOKO, Arrondissement de Douala 3^{ème} et non sur les terres de la DIBAMBA.

Intervention du représentant de AES SONEL

Pour apporter un correctif à ce malentendu, le représentant de AES SONEL lui présente des excuses séance tenante.

Intervention de Maître MOUDINE AVOCAT (au barreau du Cameroun)

Cet avocat qui se présente comme le représentant de cette collectivité s'inquiète du sort qui sera réservé aux indemnités portant sur les terrains expropriés, les constructions et d'autres biens éludés par le consultant.

Réponse de YOLAND AKOHACHERE (Agent de AES SONEL)

Répondant à cette inquiétude, Yoland affirme que toutes les victimes des différents dégâts des biens (cultures, constructions, terrains), seront désintéressées conformément à la réglementation en vigueur. La commission d'évaluation va identifier toutes les personnes concernées par ces dégâts et procéder à l'évaluation individuelle de leurs biens.

Réponse du Sous- Préfet de Douala 3ème

Revenant sur cette question, le Sous- préfet déclare que les personnes susceptibles de bénéficier de l'indemnisation se manifestent timidement pour se faire identifier. Les travaux de la sous commission d'évaluation des dégâts avancent lentement à cause de ce manque d'engouement de la population. Il déplore que les travaux de la commission d'évaluation ne soient pas encore finalisés à cause de ce manquement.

Il profite de cette réunion pour lancer un vibrant appel aux personnes qui verront leurs biens endommagés, aux propriétaires des cultures, des terrains et des immeubles de bien vouloir se rapprocher de la commission d'évaluation, des services du cadastre ou de l'agriculture du Wouri.

Intervention de EKOKO (natif du village YASSA)

Se plaint du défaut de sensibilisation des populations sur la teneur de ce projet. Il se félicite enfin de voir le Sous-préfet de Douala 3^{ème} parmi les habitants de ce village. M. EKOKO conteste la représentation des populations de YASSA par Maître MOUDINE qui s'est présenté comme étant l'avocat de cette collectivité.

Réponse du Sous-préfet:

Répondant à cette accusation, le Sous-préfet rappelle qu'il y a un Chef dans ce village YASSA. Le chef est l'émanation de la volonté des populations. Dans le souci de la légalité et de la légitimité, ce sont les chefs du canton et du village YASSA qui

représentent leurs populations. C'est la raison pour laquelle le Sous-préfet ne peut pas saisir individuellement chaque habitant du village YASSA.

S'agissant de la qualité de représentant de la collectivité Yassa dont se prévaut maître MOUDINE et qui est contestée par certains membres de celle-ci, le Sous-préfet exhorte les populations à adresser leurs observations au promoteur du projet et au consultant Scott Wilson.

Question d'un intervenant non identifié

Il pose une question sur la superficie réelle qui doit être expropriée.

Réponse du Sous-préfet

Le Sous-préfet déclare que la Déclaration d'Utilité Publique (DUP) initiale prévoyait une superficie de 7 hectares ; Une DUP additive a été signée le **16 novembre 2007** par le MINDAF. Celle-ci porte sur une superficie de 5 hectares. La surface totale est de 12 hectares. Le MINDAF a signé cette DUP additive pour prévoir un rayon de sécurité large, afin de mettre les populations à l'abri de toute nuisance éventuelle, due au fait de la présence de cette centrale dans ce village.

Intervention du chef YASSA

Le Chef YASSA déclare qu'il aurait reçu la visite d'un membre d'une organisation non gouvernementale (ONG) qui lui a déclaré que sur un rayon d'environ 100 km, les cultures et les plantes médicinales ne pourront plus pousser ; Il s'inquiète sur le fait que les populations de YASSA vivant essentiellement du produit du travail de la terre, celles-ci risquent de souffrir de la pollution de leur écosystème et d'un manque à gagner incommensurable. Ce qui laisserait penser que le village YASSA serait en danger.

Il invite le consultant à jouer le jeu de la transparence en prenant ses responsabilités. Scott Wilson doit dire clairement ce que le projet va entraîner comme impact.

Intervention de EDROKAN MANDO George du village YASSA

Pose la question de savoir s'il y'a des écologistes dans la salle ou ceux qui s'occupent de l'environnement. Il voudrait avoir des informations sur les impacts négatifs et positifs de la Centrale?

Intervention de M.MINOUE Pascal / personne affectée

Cet intervenant demande l'adresse de Scott Wilson ; il déclare qu'il avait acheté un lopin de terrain sur lequel il voulait bâtir une case. Cependant, des personnes qu'il n'a pas identifiées lui demandent d'arrêter les travaux. Il déclare avoir acheté du matériel qui a été volé alors qu'il a souscrit un abonnement à AES SONEL depuis le 15 Octobre 2007, mais n'a pas été jusqu'à ce jour connecté. Son matériel aurait été volé à cause du défaut de lumière sur son chantier.

Il pose la question de savoir qui va le dédommager pour ce manque à gagner ? Est-ce que le cabinet prendra ces dommages en compte ? Est-ce que la commission va tenir

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compte du préjudice qu'il a subi? Son terrain d'une superficie de 1254 m² sera découpé en plusieurs petites parcelles d'une superficie réduite. Pourra t il construire des studios à cet endroit déclaré d'utilité publique? Est-ce que les lignes ne vont pas provoquer des nuisances qui vont rendre la vie difficile à sa famille ?

Réponse d'Albert MATHA de AES SONEL

Albert invite le plaignant à lui présenter les reçus de règlement de son abonnement afin qu'une suite soit rapidement donnée à sa requête.

Réponse du Sous- préfet

Rappelle que conformément à la DUP signée par le MINDAF, la commission d'évaluation est instituée par un Arrêté Préfectoral (Préfet du Wouri). Celle-ci doit identifier les personnes concernées par les dégâts des biens. Différents communiqués ont été lus à la radio. L'indemnisation concerne les biens immatriculés ou non. Les incidents ou les plaintes doivent être soumis à l'appréciation des différents membres des commissions. Il s'agit du chef service des domaines, du cadastre, de l'agriculture ; Si votre maison est détruite, elle sera identifiée et évaluée par la commission d'évaluation.

Tous ceux qui sont concernés doivent aller vers les responsables du cadastre, des domaines, de l'agriculture. Que ce soit les cas des travaux provisoires ou définitifs, des cases construites en matériaux provisoires ou définitifs,

Le problème de communication demeure. Le responsable de l'agriculture est passé voir le chef pour ce problème de l'identification des personnes concernées par le site. Il exhorte les populations à se faire identifier massivement.

Le représentant du MINEP

Lance un appel aux populations pour les inviter à avoir confiance au gouvernement et à l'Etat qui est garant de leurs droits. Déclare que zéro risque n'existe pas, mais il existe des mesures d'atténuations. Les invites à se renseigner sur les régions où ce genre de projet a été implanté.

Intervention du chef du village YASSA

En ce qui concerne l'indemnisation des terrains expropriés, AES SONEL n'indemniser pas les détenteurs de faux titres de propriété.

Intervention de NOUBAY Auguste

A la suite des différentes plaintes, il rappelle que dans la paix, il faut la tolérance, dans la justice, il faut l'entente. Le chef doit être un rassembleur. Il doit d'abord résoudre les dissensions qui existent en interne pour l'intérêt de la commission d'évaluation.

Intervention de M EBOUMBOU MOUKOKO

Président de la commission environnement et protection de la nature au sein du NGONDO et en sa qualité d'ingénieur spécialisé dans la gestion des zones côtières relève que tous les problèmes relatifs à l'environnement doivent être abordés. Les populations de YASSA doivent se rapprocher de celles de Limbe, localité dans laquelle AES a

implanté une centrale à fuel lourd depuis quelques années. Elles auront des éléments pertinents d'appréciation.

Réponse de M EBOUMBOU à l'inquiétude d'un intervenant

En ce qui concerne le problème de pollution du village YASSA sur 100 km, il précise que certaines ONG divulguent des fausses informations qui ne sont basées sur aucun fondement scientifique. Des lignes haute tension traversent des villes entières, mais aucun des cas de maladies (cancer) évoquées par les ONG n'a été signalé depuis de longues années.

Cependant, il s'inquiète des problèmes qui pourront naître : du transport du fuel lourd de Limbe à YASSA, de l'écoulement du fuel lourd à travers la nappe phréatique vers le fleuve DIBAMBA et/ou vers la mangrove qui est une plante protégée. Il exhorte AES SONEL à prendre des mesures appropriées pour éviter tout dommage résultant de l'écoulement du fuel lourd dans ces zones protégées d'une part, à attirer l'attention du fabricant des cuves et des générateurs sur les risques éventuels pouvant résulter du déversement du fuel dans l'environnement d'autre part.

Intervention d'une personne non identifiée

Celle-ci déclare que le consultant étant à la merci de ceux qui l'ont commis, il ne pourra pas faire un travail objectif; il évoque le problème des émanations toxiques du fuel souillé.

Il pose la question de savoir le lieu où sera déversé le fuel? Combien de personnes seront victimes des infections pulmonaires? AES SONEL doit répondre à toutes ces préoccupations.

Intervention de EDOUARD MOUTOUBE (consultant)

Déclare que les interventions du consultant et de AES SONEL sont pertinentes. Selon lui, le problème de fond est posé à AES SONEL. Impact global résultant de la construction d'une centrale est irréversible. Quelques soient les effets positifs de ce projet (problème de délestage, emplois, installation), il souhaiterait que les techniques plus modernes soient mises en place

Intervention du représentant du MINEP

Pour une bonne compréhension du processus des consultations et audiences publiques, il invite les populations de YASSA à se rendre à LOGBABA pour voir comment se déroulent les audiences publiques et s'inspirer des doléances inscrites dans le registre des doléances des populations

Plus rien n'étant évoqué par les différents intervenants, et pour clore
Les débats, Monsieur Le Sous- préfet de DOUALA 3^{ème} :

- Réitère la volonté du Gouvernement camerounais à prendre en compte les préoccupations pertinentes des populations et à protéger leurs intérêts.
- Tous les moyens doivent être mis en œuvre pour la réalisation de ce projet aussi stratégique que vital pour notre pays.
- Il a demandé à tous ceux qui sont susceptibles d'être affectés par ce projet de se rapprocher de la commission préfectorale, de Scott Wilson et du promoteur pour présenter leurs doléances, leurs préoccupations, leurs observations et leurs suggestions.
- Il exhorte les populations à se faire identifier par les membres de la commission d'évaluation des biens et des personnes affectées.
- Déclare que toutes les parties prenantes doivent contribuer à la réussite de ce projet vital pour l'économie nationale.
- Il déclare qu'une réunion d'évaluation sera programmée pour le mercredi 5/12/2007 à 15heures à la Préfecture du Wouri.

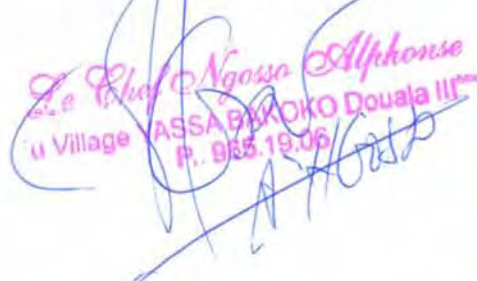
La séance est levée à 19heures 30.

Sous-préfet de
Douala 3^{ème}



AMPHEN OUSMANOU
Administrateur Civil

Chef de village de
Yassa



Le Chef Ngossa Alphonse
du Village YASSA BAKOKO Douala III^{ème}
P. 985.19.06

AES Sonel

Pour le chef de
Projet et P/O
CHARGE D'ETUDE HSE

Stambi



AES-SONEL
JOLAND AKACHACHERE
13 DEC. 2007
SOUS DIRECTION PROJET
CONSTRUCTION DIBAMBA



REPUBLIQUE DU CAMEROUN
Ministry of Environment and Forestry

LE CHEF SECTION DU DEVELOPPEMENT
DURABLE



Paul Nanfack
Technicien Supérieur des
Eaux et Forêts

**PROJET DE CONSTRUCTION D'UNE CENTRALE THERMIQUE A FUEL
LOURD DE 88 MW A YASSA-DIBAMBA ET D'UNE LIGNE DE TRANSPORT
D'ENERGIE DE 225 KV ENTRE YASSA ET NGODI BAKOKO**

ETUDE D'IMPACT ENVIRONNEMENTAL ET SOCIAL

PROCES-VERBAL DES CONSULTATIONS PUBLIQUES

(Yassa, le 27 Novembre 2007)

1^{ère} phase : Exposés

L'an deux mille sept et le vingt sept du mois novembre à 16h20mn, ont eu lieu à la Chefferie du canton Yassa les consultations publiques dans le cadre de la réalisation de l'étude d'impact environnemental et social du projet de construction d'une centrale thermique à Yassa-Dibamba. Cette importante concertation était présidée par M. YAMPEN OUSMANOU, Sous-Préfet de l'arrondissement de Douala 3^e.

Dans son mot introductif, le Sous-Préfet a relevé l'importance du projet qui intervient dans un contexte de crise énergétique que le Cameroun traverse actuellement.

Il a par la suite passé la parole au représentant d'AES SONEL pour la présentation du projet. L'on en retient que le projet de centrale thermique à fuel lourd dans le site de Yassa-Dibamba, aura une puissance de 88 MW et l'énergie produite sera transportée sur une distance de 2 km jusqu'au poste de transformation de Ngodi Bakoko par une ligne de haute tension de 225 KV.

La parole est ensuite revenue au représentant de SCOTT WILSON, Bureau d'études international ayant été retenu après appel d'offres pour la réalisation de l'étude d'impact environnemental et social, qui bénéficie dans le cadre de la conduite de l'étude de l'appui de la Société Africaine d'Expertise (SAFEX), Bureau d'études national.

Ce dernier a tout d'abord présenté le fondement législatif et réglementaire sur lequel s'appuie la pratique des consultations publiques. Il a par la suite présenté le contenu des termes de référence de l'étude avant d'expliquer de manière détaillée la méthodologie adoptée pour conduire cette étude. Celle-ci respecte la procédure de réalisation et d'approbation des études d'impact environnemental au Cameroun, conformément aux dispositions du Décret N° 2005/0577/PM du 23 février 2005 fixant les modalités de réalisations des EIE au Cameroun.

Après cette première phase consacrée aux exposés, le Sous-préfet a ouvert la seconde phase réservée aux questions, observations et autres remarques pertinentes des différentes parties prenantes et en particulier les populations riveraines au projet.

2^{ème} phase : Questions-réponses

Question : Le chef du village Yassa désire que le nom du projet soit rectifié car le projet est situé dans le Département du Wouri.

Réponse : Le projet dans un premier temps devait être construit dans la localité de la Sanaga maritime, et c'est ce qui justifie sa dénomination actuelle.

Question (Me François MOUDIME, conseil du village Yassa) : vous avez parlé des cultures qui seront indemnisées ; qu'en est-il des autres biens ?

Réponse : Si l'on a cité les cultures, ce n'était qu'un exemple, car tous les biens seront indemnisés.

La commission est à pied d'œuvre sur le terrain ; mais la principale difficulté est l'absence des concernés sur le terrain. Il est souhaitable que les populations soient présentes pendant le passage des membres de la commission.

Question (EKOKO Isaac, natif du village Yassa) :

- Nous n'avons jamais été saisis de la séance de travail que vous avez tenu avec le Préfet. Qu'en est-il ?
- Nous n'avons jamais donné mandat à quiconque pour agir en qualité de conseil
- Nous ignorons la superficie et le site à exploiter.

Réponse :

- dans le village Yassa, il y a un chef qui représente les populations. Lorsqu'il y a une réunion, nous nous adressons au chef. Pour la réunion dont vous parlez, nous avons saisi le chef qui est la courroie de transmission entre l'administration et les populations.
- La présence d'un conseil ne doit pas empêcher à quiconque de parler, d'exprimer ses préoccupations. Nous sommes dans un débat ouvert où chacun est libre de s'exprimer.
- Superficie du site : 12 ha au total dont 7 ha pour le site et 5 ha pour le corridor.

Question (Chef du village) : Jusqu'à présent, je savais que la superficie totale était de 4 ha. Je suis surpris d'entendre 12 ha aujourd'hui. S'il y a des évolutions nous devons être informés. C'est pourquoi j'insiste que les procès verbaux des réunions soient lus avant adoption et signature.

Réponse : L'acte a été signé le 16 Novembre dernier. Il n'y a pas eu d'occasion pour qu'on mette cette dernière information à la disposition des populations. Nous jouons la carte de la transparence.

Par ailleurs, vous devez vous méfier des rumeurs ; prenez le soin de vous informer à la bonne source. C'est parce que le Gouvernement veut préserver les intérêts des populations que l'étude a été commanditée et que la superficie a été réévaluée à la hausse.

Question (Georges, natif de Yassa) : quels sont les impacts positifs et négatifs du projet ?

Réponse : comme impacts négatifs on a les émissions atmosphériques pouvant altérer la qualité de l'air, le bruit, les pertes de terres agricoles et autres cultures. Pour atténuer

l'impact dû au bruit, la technologie utilisée sera celle qui réduit au maximum les bruits afin de respecter les normes internationales préétablies qui sont de 70 décibels en zone industrielle et de 55 décibels en zone d'habitation.

Question (MINOE Pascal, élite de Yassa) :

- quelles sont les coordonnées des bureaux d'études (SCOTT WILSON et SAFEX).
- Je suis propriétaire d'un lopin de terre qui a été incorporé dans le site de la centrale mais je ne suis pas informé des travaux de la commission.

Réponse:

Coordonnées des bureaux d'études : SCOTT WILSON qui est basé en Grande Bretagne et SAFEX qui est basé à Yaoundé au Cameroun. Ils ont une bonne expérience dans le domaine des études d'impact environnemental. Ce sont eux qui ont réalisé l'EIES du projet à gaz de Kribi.

Si votre terrain n'a pas été évalué, il n'est pas tard car les travaux de la commission se poursuivront. Nous avons passé plusieurs communiqués pour informer les populations de ces travaux.

Nous faisons de temps à autre des descentes sur le terrain pour vérifier les travaux de la commission mais nous n'avons pas encore été saisis de ce genre de difficulté.

Vous ne serez pas mis à l'écart, tous ceux qui sont touchés seront pris en compte sans exception. Vos préoccupations sont les nôtres. Venez à la direction me rencontrer pour votre problème d'abonnement.

Question (NOUBA Auguste, Notable) : je demande à la population qu'il règne la paix avant le début des travaux.

Question (EBOUMBOU MOUKOKO, Président de la commission environnementale du Ngondo, Ingénieur spécialiste des régions côtières) :

- je suis entièrement favorable au projet et je félicite AES SONEL. Le projet en cours à Yassa est à maints égards semblables à celui de Limbé. Se rapprocher de la centrale de Limbé pour connaître les impacts sur l'environnement.
- Quel est l'impact du fuel lourd sur les mangroves ?
- Quelles sont les émissions atmosphériques (qualité de l'air)
- Quel est le devenir des huiles après utilisation ?
- Tenir compte des préoccupations de la société civile pour la proposition des mesures d'atténuation d'impact.

Question (DIPOKO NOE , élite Yassa) : comment aller vous gérer les émanations toxiques, combien de personnes seront victimes d'infections pulmonaires ?

Question (Edouard MOUTOBE, natif de Yassa) : toutes les interventions concernant l'impact environnemental ont été pertinentes. Pourquoi avoir choisi le fuel lourd à la place du gaz par exemple ?

Réponse : nous vous rassurons que des mesures adéquates seront prises pour atténuer et compenser les impacts du projet sur l'environnement. Vous aurez l'occasion d'en prendre connaissance dans le rapport pendant la phase d'audiences publiques.

Observations du Chef du Village : je veillerai à ce que AES SONEL n'indemnise pas ceux qui présenteront des titres fonciers et autres documents frauduleux car nous nous attaquerons à eux.

Aux questions posées, des réponses adéquates ont été fournies ; par ailleurs, les propositions et autres suggestions des participants ont été notées pour une prise en compte effective dans le Rapport d'étude.

En guise de conclusion, le Sous-préfet a réitéré la volonté du Gouvernement à protéger les intérêts des populations. C'est pourquoi il a demandé à tous ceux qui sont concernés par ce projet de se rapprocher de la commission préfectorale pour exprimer leurs éventuelles doléances.

Le Sous-préfet de Douala 3^e

Le Chef de village de Yassa

Le Représentant de AES SONEL

le Représentant de SCOTT WILSON



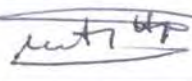
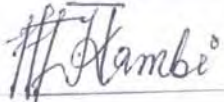

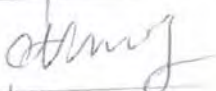
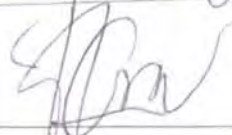

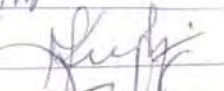
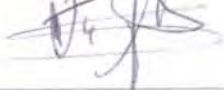


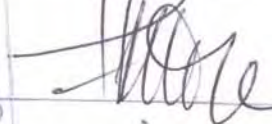

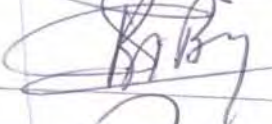

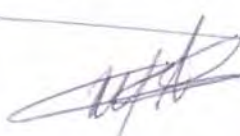
	Nom	Organisme/Fonction	Contact	Signature
12	LOBE ANTOINE	NOTABLE (JAPONA)	9995-65-30	
13	Depita Paul	Notable de Japonna	7494 35-46	
14	NGANGUE dolphins	Vie à Yassa		
15	N Doukou Juliette	filie ABANA		
16	Mme Njiky ROSE	Élève Yassa	7742-20-96	
17	Ngneankang Agnes		99 20. 34 73 Japonna	
18	Veuve Billong Suzy	Vie à Yassa	99.06.88. 831	
19	Mme Ngosso Charlotte	Vie à Nyalla		
20	MINOUE BATANGUE	AUDITEUR FINANCIER	99.953152	
21	IKAMDO ERIC	chef d'entreprise entrepreneur	99414166	
22	MOUKATE Diandave	MAÇON	711.98-9652	
23	Jean-SERAPHIN TAKOUKAM	Ancien militaire du Gend	74953229	
24	Ngody Andrie	Chauffeur	977 74-57	
25	NGO Byron Paulho	électrofitice	77 69 4469	
26	Kuatahe Famolie Stanislas	Margacam		
27	FOTHOM MATHIAS	MARGACAM	99323937	
28	DJIOIJOVA SIMO FOISO	MANAGERIE. Brazzaville.	99773409	


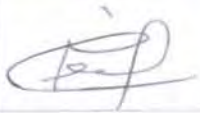
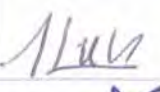




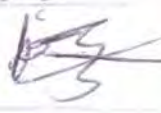





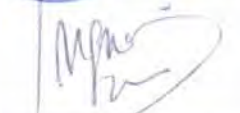
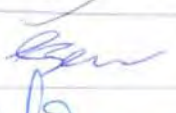


NOH	Fonction	Tel	Signature
29	^{Esther} Md Fougoung Manager	9953 96-51	
30	Abu Madjidjou Menager	74506708	
31	Pactou cultivatrice yassa Bernadette	7510 1664	
32	Touko Deuton cultivatrice à yassa Antoinette	75-93-35-73	
33	Dzemmi - Marguerite cultivatrice à yassa	75 07 67 73	
34	Djiodjip NGUENENG Inocent	74 95 16 27	
35	Sumen NUSUETTE menagerie	75 75 27 43	
36	XANGOUÉ Jean Claude cultivateur XASSA	75-80-77-23	
37	NGUENANG Nicaise cultivatrice XASSA	75-58-29-78	
38	Jlengne Elise Carine A yassa cultivatrice		
39	Mekamché Elisabeth à yassa cultivatrice	96-53-64-60	
40	Makoutsing Eveline à yassa cultivatrice	94-01-01-22	
41	Bitomo. Z. Valéri Desire Machiniste	7775 1277	
42	CHOMFE EPOSE TUEAN EANGHIN cultivatrice à yassa	96.97.71.86	
43	Higain Marie cultivatrice à yassa	74 67 28 47	
44	Meké jeanne cultivatrice à yassa	74 67 28 47	
45	Kapchie Emilieune A yassa cultivatrice	7.576 21.20	

46	HAKOUI SING BERNADETTE	Cultivatrice à Yassa	77 02 02 10	HS
47	KAWI OUA ELISE	ELIS Cultivatrice à Yassa	96 97 71 86	HS
48	TANGA DAVID	Employé de Bureau	9635 4685	HS
49	DAKLEU GASTON	Magasinier	77 36 24 79	HS
50	DSEUHAN LYDIE	chef d'entreprise	99 86 62 21	HS
51	MOUTCHEU Fidèle	Auxiliaire financier	99 84 74 56	HS
52	KOLIEGHEN Marie Chantal	Aide Comptable	77 89 18 41	HS
53	NGO MACHUKO	Cultivatrice à Yassa	77 51 42 - 96	HS
54	NBO, NTouch Josephine	ménagère	75 35 01. 11.	HS
55	NBOCK NDEBI Benoit	Cultivateur	75 67 40 32 75 35 01. 11	HS
56	Nyembé Thérèse	Agricultrice (ménagère)	96 06 32 95	HS
57	MBIOL née Ngo Oum Antoinette	agricultrice	77 44 74 51	Mant
58	SILIKI Hassam	Agricultrice	75 73 90 01	HS
59	Ousman née MUKO Alice	Agricultrice	77 44 74 51	HS
60	De NZEME RAOU	Agriculteur	77 89 18 41	HS
61	Manoza Antoinette	Compta. Gestion	96-40-42-13	HS
62	NZIMA DAVID	MANŒUVRE		HS

63	DIME Samuel	NOTABLE Japoma	96423883	to
64	Wouatto	cultivatrice	79900496	finf
65	BISSA Rosette	Agriculture	99150714	by
66	Tadia Chrisantus	Fame	75561681	elo
67	Wandji Joseph	Agriculture	75077172	ku
68	EKINDE NGUCHEDE	Driver	75-59-78-78	ku
69	ETROUKANG MANSO Georges	Elite de JAPO MA	Cell. n° 75-59-63-57	ku
70	Niganque Emmanuel	Elite (japoma)	77748020	ku
71	Ndokat JC	Elite TAPOMA	99993284	ku
72	Jipe Nemours	Elite MBANGA B.	77328965	ku
73	MPEDI A.	ELITE MBANGA	99867268	ku
74	ESSEKE Martin	elite MBANIA	96738827	ku
75	PALLEY Prewler	ELITE MBANIA	77767785	ku
76	MPAN GUE Bipoko	elite NGOMI	75646739	Muonif.
77	EJOBO M. Theodor	Elite XIYASSA	75.55.7685	ku
78	NGOH.N. Rogea	ELITE YASSA	77.85.40.52	ku
79	ELOMBD CHRISTIAN		96.77.9617	ku

80	Elombo Eitel	Electrotechnicien	99109915	Signature
81	NBOUYEMO Charles	maçon	77609047	Signature
82	NEKAM Jern-pierre	Gestionnaire	77228789	Signature
83	TAMO Pieuvre	Editeur de musique	99978117	Signature
84	ESSOMBE Jimbongo Sadrack	YASSA	7773.0037	Signature
85	Joko Lume	YASSA		Signature
86	MOUTEBE EBOUKA	ENSEIGNANT CONSULTANT	77755272	Signature
87	Dipoko Daniel	Elite Chef de Famille	99802932	Signature
88	DIPOKO Noé	Elite YASSA	99185970	Signature
89	BONGA ILLI	AGENT JONTEL		Signature
90	EKWE			Signature
91	Ngosro Dorotte	Epouse du chef	94-16-01-33	Signature
92				
93				
94				
95				
96				

	Organisme / Fonction	Contact	Signature
1	YAMPEA OUSMANOU	Sous-Prefet D1a III 77762718	
2	NANFACK Paul	CSAD/Wouni MINEP 99821138	
3	Albert MATHA	AES SONEC 96290975	
4	AKOHACHERE YOLANDA	AES - SONEC 96510889	
5	Albertine KENFACK	AES - SONEC 77114044	
6	N. GODINACHINE	AES SONEC 99684882	
7	NGOC Lo	chef Village YAKIT 996519.06	
8	EBOUMBOU Moukoko	Président Commission environnement du NGONDO 999123.92	
9	NKembé Emile	chef gazona 77.63.02.32	
10	MPEDI Pierre	chef de RBANGA 77416122	
11	NBANENE Robert		
12	M ^{lle} MOUNDINE	représentante chef foyer YAKITINSOM 77608338	
13	—		
14	EBOUMBOU HONDRÉ	CONSEILLER MUNICI- PAL - YANSOKI 77046181	
15	EDOUBWAN Jean	ELITE BAKOKO 99363021	
16	JACQUES CHANCEL ETONNE	Elite - BAKOKO 7725.26.06	
17	BIBOUAN Paul	chef BRAG S/Proche D43e 77823685	
18	NYANYA DAVID	S/Proche D43e —	
19	TANQUETE Germaine	— a — 99721241	

	organisme / Fonction	Contact	Signature
20	Njikam Chef de Brigade du Cadastre de l'arrondissement de D6 ^{3e}	77782091	
21	Houyoukou Dan Notable / Yatchke	9960-12-58	
22	Ebonye Epe Joseph Notable Yapoma	96929872	
23	Wombo Ernest Chef de Famille Mbanga	77834470	
24	Edimo Felix Notable Ngodi	96254058	
25	Moundi Jérémie 1 ^{er} Notable Yatchke	75604658	
26	LOBE Martin H. Notable	7703-50-32	
27	BEBE Bernardin Chef de famille	77-82-18-02	
28	Youta Leonard Propriétaire terrien	77820623	
29	Depick Jeanne Chef de section Dep. des ZSP. D.D. de Cnu Vivroment du Wouri	77626083	
30	Joseph TONYE Commandant de Brigade Bakoko à Yassa	99856934	
31	NGASSAM BASILE LE GRAND Cist 14 ^e ADRT DLA	77276909 99950826	
32	Nkayengam Ndam S. Caine Spécial 243 ^e	77817065	
33	BILLONG PASCAL CommisAnaire de Police CommisAnaire et central N°2	99916230	
34	Lou BRENKLEY SCOTT WILSON SOCIO-ECONOMIST		
35	Jean Calixte Ngopi SAFEX	99833647	
36	LUZ SPANANU SCOTT WILSON PROJECT MANAGER		
37	Richard ODEANOU SAFEX / local Manager of ESIA	99-98-4651	

		Organisme/Fonction	Contact	Signal
39	KANGANG	SAFEX		
40	ANOU MOLANGERIE	SAFEX		
41	NGOM ARMAND JUNIOR	AES SONEL	99 93 53 28	
42	TONYE Paul Blaise	AES Sonel	99 54 52 37 79 95 65 80	
43	MBIADPEP Jean Claude	SAFEX	77-73-01-69	
44	ASSALA ASSALA	DDADER/W	77-10-95-75	
45	MANOGA	DDADER/W	99341247	
46			99882155	
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Appendix H

Air Quality Dispersion Model

Dispersion Modelling Assessment

Dispersion Model Selection

The air quality impacts of the proposed power plant are best evaluated using a refined, near-field (less than 50km from the emission source) Gaussian Plume Dispersion Model, which is able to calculate maximum ground level concentrations at receptors close to the plant boundary. Gaussian models assume that pollutants do not decompose in the atmosphere, and therefore do not account for the long-range transport of atmospherically reactive pollutants. They are designed to produce results that are close to monitored values.

The assessment has been undertaken using the US EPA preferred model AERMOD, developed by the American Meteorological Society and U.S. Environmental Protection Agency Regulatory Model Improvement Committee (AERMIC). AERMOD is an advanced plume model that incorporates the latest understanding of the atmospheric boundary layer, and includes the PRIME downwash algorithm for the assessment of structure effects.

In addition to AERMOD, there are two input data processors that make up the regulatory components of the modelling system. AERMET is a meteorological data pre-processor that incorporates air dispersion based on planetary boundary layer turbulence structure and scaling concepts, while AERMAP is a terrain data pre-processor that allows the incorporation of complex terrain effects within the model.

During its development, AERMOD has undergone a number of validation studies, the most recent of which was published in 2003. Comparisons with the previous ISC-PRIME model show similar results for most databases, with occasional notable improvements.

This assessment has used the latest version (5.8.0) of the software package ISC-AERMOD View, produced by Lakes Environmental Software.

Power Plant Configuration

This assessment is based on a power plant configuration consisting of eight Wärtsilä 18V38A2 reciprocating engines. Discharge to atmosphere from the plant occurs via eight stacks, grouped into two clusters, one stack for each engine. The location of the power plant stacks is illustrated in Figure 5.3.1, and listed in Table H.1.

Table H.1: List of Stack Locations					
Stack Number	X Coordinate	Y Coordinate	Stack Number	X Coordinate	Y Coordinate
1	924701	1441603	5	924735	1441597
2	924704	1441602	6	924738	1441596
3	924702	1441605	7	924735	1441600
4	924705	1441605	8	924738	1441599

Note: The x and y coordinates listed are specific to the modelled grid and do not relate directly to national or international co-ordinate systems.

Model Scenarios

The power plant is intended to operate during situations when additional capacity is required and it is not expected that the station will operate at continuous load throughout the day or year. No continuous base load scenario has therefore been considered within the assessment.

The output from the proposed power plant would be higher during the evening hours, when there is a greater demand for electricity. At other times of the day, the plant would run at a much lower load, with as little as one power unit (engine) operating between the hours of 2300 and 1700 during the wet season. During the dry season, when production from hydropower stations is limited due to low water regulated flows, the proposed power plant is expected to run at full load between the hours of 1700 and 2300. The variation of emissions from the power plant have therefore been modelled according to the load profile set out in Table H.2. An engine has been assumed to be running at 100% load whenever it is operating.

Table H.2: Power Plant Load Profile		
Months	Number of Units Operating at 100% load	
	1700 - 2300	2300 - 1700
January – June (Dry Season)	8	2
July – December (Wet Season)	4	1

A summary of the emissions modelled from each engine (when operational) is provided in Table H.3.

Table H.3: Engine Emission Data (18V38)		
Scenario	100% load, HFO	Notes
Stack Internal Diameter (m)	1.2	
Exit Velocity (m/s)	25.8	Calculated, based on supplied volumetric flow rates (actual).
Stack Exit Temperature (K)	620	
CO emission rate (g/s) ¹	2.7	-
NO _x emission rate (g/s) ¹	44.0	Calculated as NO ₂
SO ₂ emission rate (g/s) ¹	24.0	
PM ₁₀ emission rate (g/s) ¹	1.1	As total dry particulate dust, assumed to be PM ₁₀

¹ Emission rates are per engine stack; there are 8 stacks in total.

Terrain Data

The area around the proposed plant location is gently undulating at an altitude of approximately 50m above sea level. The land between the stacks and the receptors does not slope sufficiently to justify the consideration of terrain effects within the model and for the purposes of this assessment the terrain has been regarded as flat or simple terrain.

Building Downwash Effects

Nearby buildings and structures have the potential to effect the dispersion of emissions from the plant stacks. As the wind blows over and around these buildings the airflow will be disrupted and pollutants may become entrained within the eddy (cavity) near to the building or within the associated zone of turbulent air (wake), resulting in higher near-field ground level concentrations.

A number of planned structures on the proposed site have been incorporated into the dispersion modelling. The principal buildings with the potential to generate building downwash on the site, due to their size and proximity to the power plant stacks, are the engine house buildings. The building dimensions have been entered into the model and the BPIP-PRIME downwash model run to supply AERMOD with building downwash data. Building downwash effects have therefore been considered within the model.

Meteorological Data

Discussions were held with the UK Met Office (a leading meteorological agency), to establish the most representative source of meteorological data for use in dispersion modelling assessments in Cameroon. Of the options considered, data from Libreville in Gabon (World met organisation's (WMO) international reference number, 64500) 400 km to the south of the site, was considered to be the best available source of data. The measurement site is close to the coast and would experience similar meteorological conditions to those in the Yassa area.

Ideally, hourly sequential meteorological data is used for dispersion modelling purposes, however in this case this has not been possible, because of the sites identified, none collect readings on an hourly basis. Libreville data is 3-hourly, while other sites report on a 6-hourly basis. For this reason, data from Libreville for the years 2003 to 2005 has been recommended and supplied by the UK Met Office as the most appropriate for use in dispersion modelling for this assessment. Additionally, the Libreville site also has a higher data coverage rate than other locations.

The data was supplied in ADMS format, and was converted to SAMSON format using the built-in converter within AERMET. The data was then pre-processed in AERMET, using the input variables in Table H.4.

Table H.4: AERMET Input Data	
Parameter	Variable
Station Location	0.50°N 9.41°W
Site Location	3.98°N 9.81°W
Upper Air Data	Upper Air Estimator within AERMET
Wind Direction Sectors	1
Surface Parameters	Albedo: 0.28 Bowen: 0.75 Surface Roughness: 1.0
Anemometer Height	10m

Receptors

Ground level concentrations of the pollutants modelled have been calculated using a site-centred polar grid at 10° radial increments, with 100m distance increments from the origin up to 5km, then at 500m increments up to 10km. Additionally, the change in air quality statistics at selected residential properties has been considered by including their locations as discrete receptors. The location of receptors was chosen from aerial mapping of the area surrounding the site. Each receptor represents the level of exposure that would also be experienced at other receptors in their vicinity. The location of the selected discrete receptors is illustrated in Figure 5.3.1, and listed in Table H.5. The concentration of pollutant at each receptor was modelled at ground level.

Receptor	X Coordinate	Y Coordinate	Receptor	X Coordinate	Y Coordinate
R1	925272	1441898	R8	923615	1442365
R2	925185	1441858	R9	923177	1442221
R3	924817	1442000	R10	922891	1442851
R4	924615	1442074	R11	924227	1442678
R5	924458	1442187	R12	923320	1440992
R6	924240	14423234	R13	923824	1440444
R7	923912	1441937			

Note: The x and y coordinates listed are specific to the modelled grid and do not relate directly to national or international co-ordinate systems.

NO to NO₂ conversion

NO_x emissions from the power plant will consist of both NO and NO₂, however NO₂ is of the most concern regarding health effects. At the point of emission into the atmosphere NO will be the predominant chemical form, around 95% of NO_x produced by combustion is NO. In rural areas, with low background levels of pollution, oxidation to NO₂ will rapidly occur in the presence of O₃.

As shown in Table 5.3.1, background concentrations of O₃ in the region are relatively high. It can be assumed, therefore, that the conversion of NO to NO₂ would not be O₃ limited at extended distances from the emission point. However, as a number of selected sensitive receptors in are within 1km of the proposed plant, an estimate of how much NO has been converted to NO₂ at these locations has been made using the NO_x to NO₂ conversion module in AERMOD. The model was set to use the OLM (Ozone Limiting Method), the ratio of NO/NO₂ in the plant stacks was assumed as 0.95/0.05 and the ambient O₃ concentration in the atmosphere around the plant was assumed to be a constant 39 µg/m³ (value taken from Table 5.3.1).

Dispersion Modelling Results

The results of the dispersion modelling with emissions data for the power station burning HFO are presented in Tables H.6 to H.7, the values in these tables include the contribution from background concentrations of NO₂ and SO₂ respectively.

In addition, the spatial distribution of the contribution of the plant's emissions to annual mean concentrations of each pollutant are illustrated for NO₂ in Figures 5.3.2a-c, for SO₂ in Figures 5.3.3a-c. and for PM₁₀ in Figures 5.3.4a-c.

Table H.6: Dispersion Modelling Results, HFO, NO₂

Receptor	1-hour average (µg/m ³)			24-hour average (µg/m ³)			Annual average (µg/m ³)		
	2003	2004	2005	2003	2004	2005	2003	2004	2005
R1	346.5	347.0	347.1	43.1	45.2	40.9	34.4	36.7	35.2
R2	351.8	352.2	351.5	43.8	43.2	40.6	32.1	34.2	32.5
R3	352.9	349.4	349.1	39.2	40.7	43.1	13.6	16.4	14.2
R4	348.3	335.6	337.9	33.4	20.2	25.4	7.7	8.7	8.4
R5	336.0	324.0	337.9	21.0	19.4	19.7	6.3	6.8	5.9
R6	336.2	338.8	335.6	19.6	20.2	21.2	3.9	4.3	3.8
R7	83.9	324.5	327.8	10.5	19.0	19.6	2.7	2.7	3.1
R8	134.4	247.6	317.1	8.5	14.8	18.6	2.3	2.7	3.0
R9	131.1	213.4	270.3	8.3	13.0	16.0	2.3	2.1	2.8
R10	222.6	110.3	278.9	13.4	7.3	16.4	2.0	2.2	2.4
R11	321.3	319.0	327.5	19.5	18.7	19.1	6.6	6.9	5.6
R12	260.4	149.0	320.4	15.6	9.3	18.7	2.2	2.2	2.3
R13	51.3	316.6	107.6	3.8	18.7	6.9	1.8	2.1	2.0
World Bank Standard (µg/m³)	-			150			100		
WHO Standard (µg/m ³)	200			-			40		

Table H.7: Dispersion Modelling Results, HFO, SO₂

Receptor	10 minute average (µg/m ³)*			24-hour average (µg/m ³)			Annual average (µg/m ³)		
	2003	2004	2005	2003	2004	2005	2003	2004	2005
R1	661.0	668.2	669.9	55.6	52.0	46.5	30.0	33.2	33.2
R2	735.8	741.4	732.5	60.6	48.9	50.2	28.5	31.4	31.1
R3	751.2	701.5	698.5	55.9	39.7	40.0	12.2	14.1	12.7
R4	687.2	506.2	538.6	31.1	23.4	29.6	6.5	7.6	7.1
R5	512.2	341.6	539.6	23.3	16.3	24.5	5.3	5.3	4.6
R6	514.6	552.3	506.7	23.4	25.3	24.0	3.4	3.8	3.3
R7	117.2	349.3	395.4	8.3	16.4	18.6	2.5	2.5	2.8
R8	96.1	176.3	244.6	5.6	9.0	11.9	2.2	2.4	2.6
R9	93.7	152.1	192.4	5.5	8.0	9.7	2.2	2.1	2.5
R10	158.6	79.0	198.6	8.2	5.0	9.9	2.1	2.2	2.2
R11	303.8	271.1	392.0	14.6	13.0	18.2	5.0	5.1	4.2
R12	185.4	106.5	291.1	9.4	6.0	13.9	2.2	2.1	2.3
R13	37.2	237.3	77.1	3.0	11.7	4.7	1.9	2.1	2.1
World Bank Standard (µg/m³)	-			150			80		
WHO Standard (µg/m ³)	500			125			50		

*Derived from 1-hour averages, correction factor of 1.3 applied.

Table H.8: Dispersion Modelling Results, HFO, PM₁₀						
Receptor	24-hour average (µg/m³)			Annual average (µg/m³)		
	2003	2004	2005	2003	2004	2005
R1	2.5	2.3	2.1	1.3	1.5	1.5
R2	2.7	2.2	2.2	1.2	1.4	1.4
R3	2.5	1.7	1.8	0.5	0.6	0.5
R4	1.4	1.0	1.3	0.2	0.3	0.3
R5	1.0	0.7	1.1	0.2	0.2	0.1
R6	1.0	1.1	1.0	0.1	0.1	0.1
R7	0.3	0.7	0.8	0.0	0.0	0.1
R8	0.2	0.3	0.5	0.0	0.0	0.1
R9	0.2	0.3	0.4	0.0	0.0	0.0
R10	0.3	0.2	0.4	0.0	0.0	0.0
R11	0.6	0.5	0.8	0.2	0.2	0.1
R12	0.4	0.2	0.6	0.0	0.0	0.0
R13	0.1	0.5	0.1	0.0	0.0	0.0
World Bank Standard (µg/m³)	150			50		
WHO Standard (µg/m³)	-			-		

Sensitivity Analysis

The results of the sensitivity analysis are presented in Tables H.3 to H.5.

Air quality statistics have been calculated for all pollutants using meteorological measurements for three different years: 2003, 2004 and 2005. The results for NO₂ are represented in Table H.9. As expected the model proved sensitive to differences in meteorological conditions, with each dataset returning different predicted pollutant concentrations. By including three years of meteorological data in the assessment it is likely that worst-case conditions for atmospheric dispersion have been considered in the assessment of mitigated impacts.

The importance of stack height has been considered for the chosen option of 40m for the height of release, and variants of 30m, 35m, 45m and 50m (see Table H.10). The diameter of the release, volumetric flow rate, velocity of release and the temperature of the exhaust gases was the same for each model run. For all options the model predicted impacts on air quality that would achieve World Bank criteria at all sensitive receptors. The WHO hourly standard for NO₂ would only be achievable with a stack height in excess of 50m, however

WHO ambient air quality guidelines are not mandatory. A height of 40m has been used for the main assessment.

The terrain surrounding the site is largely covered by dense vegetation and the effect of turbulent mixing in the airflow over this surface has been represented in the assessment of impacts through the use of a surface roughness coefficient of 1.0. To allow for variation in the density and structure of the vegetation an alternative average surface roughness value of 0.7 was also considered. Overall the model predicted (see Table H.11) impacts of greater magnitude at all receptors when the higher roughness coefficient of 1.0 was used.

Overall the model has demonstrated its sensitivity to model conditions and in each scenario the worst-case option has been selected for use in the assessment.

Table H.9: Effect of Meteorological Data Year on Maximum 24-hour NO₂ Concentrations			
Receptor	Year		
	2003	2004	2005
R1	42	44	40
R2	43	42	40
R3	38	40	42
R4	32	19	24
R5	20	18	19
R6	19	19	20
R7	10	18	19
R8	7	14	18
R9	7	12	15
R10	12	6	15
R11	19	18	18
R12	15	8	18
R13	3	18	6
<i>Maximum</i>	43	46	54

Table H.10: Effect of Stack Height on Maximum 24-hour NO₂ Concentrations

Receptor	30m Stack			35m Stack			40m Stack			45m Stack			50m Stack		
	2003	2004	2005	2003	2004	2005	2003	2004	2005	2003	2004	2005	2003	2004	2005
R1	43	48	42	43	47	41	42	44	40	42	42	42	42	39	37
R2	45	48	42	44	45	41	43	42	40	42	38	42	42	37	37
R3	41	46	48	40	44	47	38	40	42	37	31	37	36	29	33
R4	38	22	28	35	20	26	32	19	24	25	19	25	25	18	23
R5	22	19	20	21	19	19	20	18	19	19	18	19	19	18	18
R6	19	20	23	19	19	21	19	19	20	18	19	18	19	19	19
R7	10	18	19	10	18	19	10	18	19	9	18	9	8	18	19
R8	14	15	18	10	14	18	7	14	18	5	13	5	5	14	16
R9	12	12	18	10	12	17	7	12	15	6	12	6	6	13	14
R10	15	7	17	14	7	16	12	6	15	11	6	11	12	7	16
R11	21	18	18	19	18	18	19	18	18	18	18	18	18	18	18
R12	18	11	18	16	9	18	15	8	18	13	7	13	14	8	18
R13	4	18	8	3	18	7	3	18	6	3	18	3	3	18	5
Maximum	47	48	55	45	47	54	43	46	54	42	45	50	42	45	51

Table H.11: Effect of Surface Roughness on Maximum 24-hour NO₂ Concentrations						
Receptor	Surface Roughness = 0.7			Surface Roughness = 1.0		
	2003	2004	2005	2003	2004	2005
R1	42	37	36	42	44	40
R2	42	37	36	43	42	40
R3	34	24	24	38	40	42
R4	21	17	22	32	19	24
R5	18	16	17	20	18	19
R6	18	19	18	19	19	20
R7	8	18	18	10	18	19
R8	5	14	7	7	14	18
R9	7	14	16	7	12	15
R10	5	7	12	12	6	15
<i>Maximum</i>	<i>18</i>	<i>14</i>	<i>18</i>	<i>43</i>	<i>46</i>	<i>54</i>

Appendix I

Noise Perception and Terminology
Baseline Noise Monitoring
Noise Assumptions
Noise Source Data and Prediction Calculations

I.1 Noise Perception and Terminology

Between the quietest audible sound and the loudest tolerable sound there is a million to one ratio in sound pressure (measured in pascals, Pa). Because of this wide range a noise level scale based on logarithms is used in noise measurement; it is called the decibel (dB) scale. Audibility of sound covers a range of approximately 0 to 140dB.

The human ear system does not respond uniformly to sound across the detectable frequency range and consequently instrumentation used to measure noise is weighted to represent the performance of the ear. This is known as the 'A-weighting' and annotated as dB(A).

The following table lists the sound pressure level in dB(A) for common situations.

Table I.1: Noise Levels for Common Situations.	
Approximate Sound Pressure Levels dB(A)	Example
0	Threshold of hearing
30	Rural area at night
50	Quiet office, no machinery
80	General factory noise level
100	Pneumatic drill at 5m
140	Threshold of pain

The noise level at a measurement point is rarely steady, even in rural areas, and varies over a range dependent upon the effects of local noise sources and their variable operation. Furthermore, the range of night-time noise levels can often be smaller and the levels significantly reduced compared to daytime levels. When considering environmental noise, it is necessary to consider how to quantify the existing noise (the ambient noise) to account for these second to second variations.

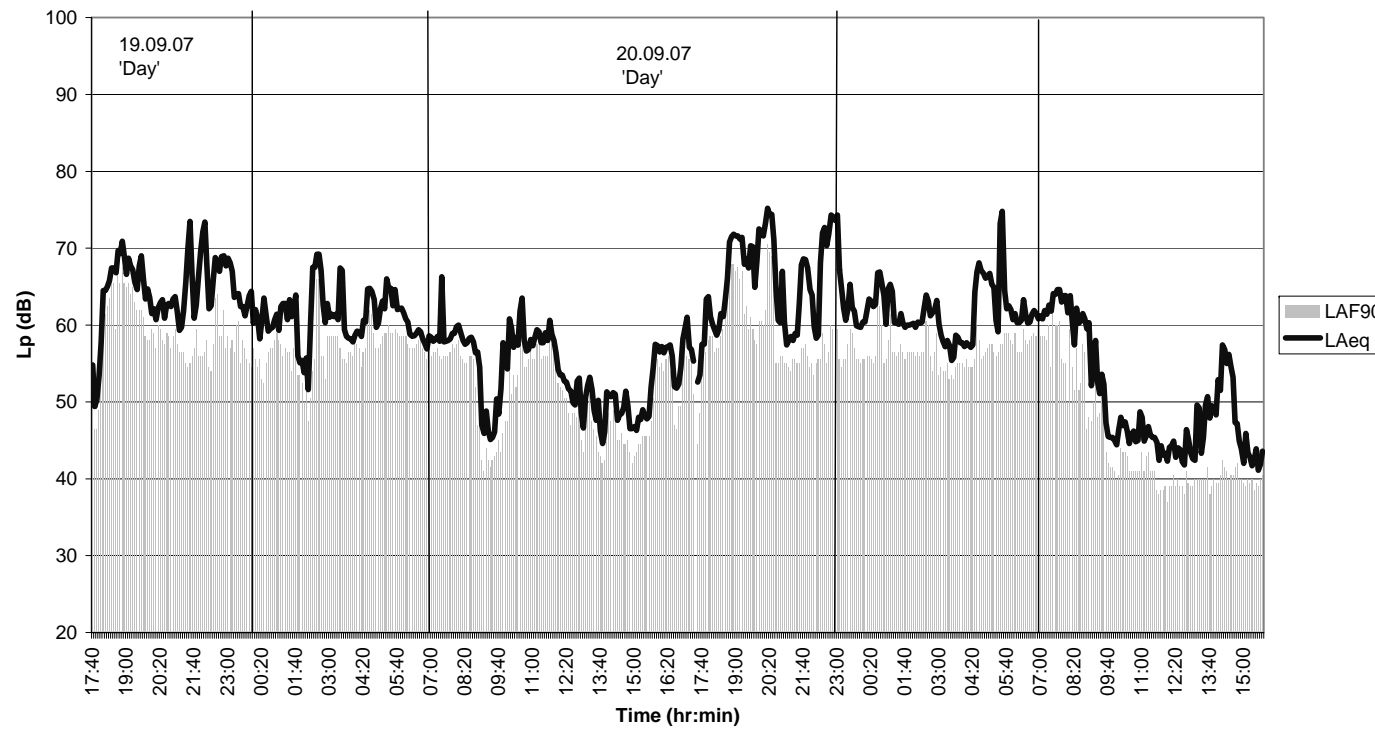
A parameter that is widely accepted as reflecting human perception of the ambient noise is the background noise level, L_{A90} . This is the noise level exceeded for 90% of the measurement period and generally reflects the noise level in the lulls between individual noise events. Over a one hour period, the L_{A90} will be the noise level exceeded for 54 minutes.

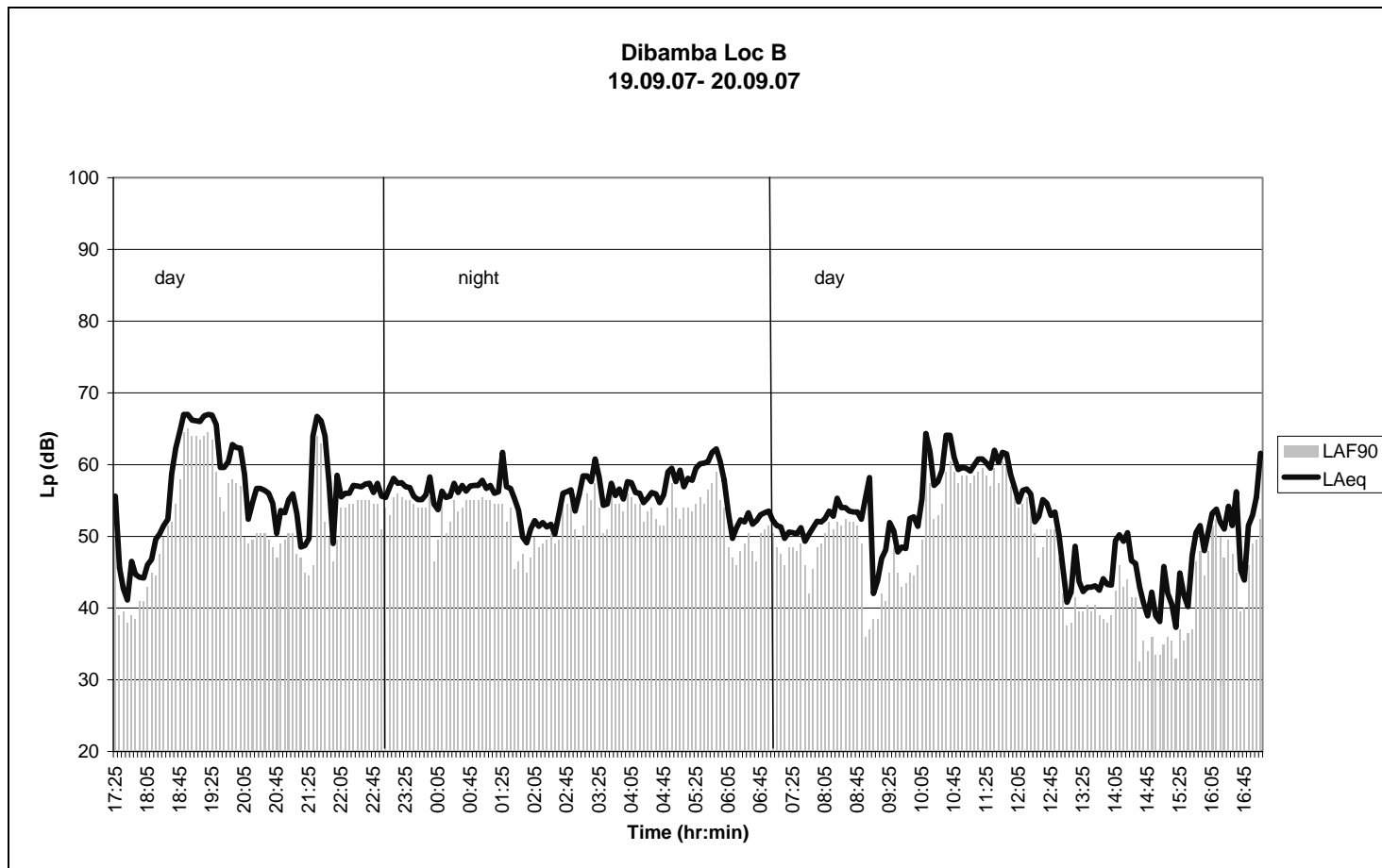
The equivalent continuous A-weighted sound pressure level, L_{Aeq} , is the single number that represents the total sound energy measured over that period. The L_{Aeq} is the sound level of a notionally steady sound having the same energy as a fluctuating sound over a specified measurement period. It is commonly used to express the energy level from individual sources that vary in level over their operational cycle.

Human subjects, under laboratory conditions, are generally only capable of noticing changes in steady levels of no less than 3dB(A). It is generally accepted that a change of 10dB(A) in an overall, steady noise level is perceived to the human ear as a doubling (or halving) of the noise level.

I.2 Baseline Noise Monitoring

Dibamba Location A
19.09.07 - 21.09.07





I.3 Noise Assumptions

Assumed Construction Phases and Associated Plant

Phase	Plant	number	Single Lw dB(A)	source ref
Site preparation	Dozer	4	107	Def T2 14
	Compactor	3	91	T3C 121
	grader	2	84	TC3 75
	excavator	2	99	Def T2 21
	HGV movements	200 to 300 / day	105	TC3 59
	frontloaders	4	103	Def T6 32
	truck (dumper)	2	105	Def T4 9
Civil works	Excavator	2	99	Def T2 21
	motor compactor	3	105	TC3 119
	crane	2	95	Def T4 46
	concrete trucks	2	99	Def T4 19
	concrete pump truck	2	95	Def T4 24
	HGV movements	10 to 20 / day	105	TC3 59
	concrete vibrator	2	97	Def T4 34
Electro/piping installation	vibration blade	2	91	Def T4 35
	crane	2	95	Def T4 46
	truckcranes	2	99	Def T4 50
	trailer truck	1	107	Def T4 75
	skylift (various)	2	63	Def T4 58
	scaffolding	1	68	TC7 3
	welding machine	2	101	Def T3 31
	HGV movements	10 to 20 / day	105	TC3 59
Tank (and building) erection	handtools	2	65	TC3 35
	crane	2	95	Def T4 46
	welding machines	2	101	Def T3 31
	HGV movements	10 to 20 / day	105	TC3 59
	small kit/handtools	2	65	TC3 35

Additional Assumptions

- Distance from site to Receptor A: 310m
- Distance from site to Receptor B: 995m
- Distance from haul road to Receptor A: 25m
- Distance from haul road to Receptor B: 900m
- Activity Durations: 100% 'on-time' in 1hr assumed for all plant.
- 100% soft ground is assumed in all directions from the site.
- 50% soft ground is assumed between the site and the soap factory.
- Barrier / topographical screening: none assumed.
- No piling activities are anticipated

I.4 Noise Source Data and Prediction Calculations

Wärtsilä Noise Data Sheet_Dibamba 8x18V38 (Doc. ID: DBAA332365)

Engine A-weighted sound power level total 8pcs										
Frequency	31.5	63	125	250	500	1000	2000	4000	8000	Total
Sound pow	78	89	102	114	121	123	121	121	115	128
Exhaust gas A-weighted sound power level at turbo charger total 8pcs										
Frequency	31.5	63	125	250	500	1000	2000	4000	8000	Total
Sound pow	101	116	126	125	122	122	113	109	109	130
Charge air intake A-weighted sound power level at turbo charger total 16pcs										
Frequency	31.5	63	125	250	500	1000	2000	4000	8000	Total
Sound pow	64	86	100	110	119	122	129	139	134	141
Ventilation unit A-weighted sound power level total 16pcs										
Frequency	31.5	63	125	250	500	1000	2000	4000	8000	Total
Sound pow	57	72	84	97	90	83	79	66	58	98
Ventilation outlet on power house roof A-weighted sound power level total 2x79m										
Frequency	31.5	63	125	250	500	1000	2000	4000	8000	Total
Sound pow	74	82	92	98	99	95	99	94	80	105
Power House Walls										
Frequency	31.5	63	125	250	500	1000	2000	4000	8000	
R[dB]		25	28	32	34	31	44	57		
Exhaust gas silencer transmission loss total 8pcs										
Frequency	31.5	63	125	250	500	1000	2000	4000	8000	
TL[dB]	17	22	33	36	40	42	38	30	24	
Charge air silencer transmission loss total 16pcs										
Frequency	31.5	63	125	250	500	1000	2000	4000	8000	
TL[dB]	3	5	14	17	26	46	47	45	38	

Wärtsilä Technical Specification Document for Power plant Configuration 8 x 18V38 A, dated 07 October 2007 (PO700526)

Cooling Radiators_ 61dB(A) at 40m

Each engine set has its own cooling radiator package, comprising 2 radiators

Based on information regarding the engine halls contained within the same document, internal absorption properties have been sourced from 'Kingspan' product data sheets as below:

Surface	Octave Band Sound Reduction Index (dB)							
	63	125	250	500	1k	2k	4k	8k
Wall	0.07	0.25	0.20	0.10	0.15	0.10	0.08	0.15
Roof	0.15	0.45	0.70	0.85	0.90	0.90	0.75	0.60

Internal surface areas have been calculated from:

Wärtsilä drawing number: DBAA232765 as 3705m² and 2447m² respectively for engine hall 'a' and 'b' respectively.

Based on the above information, a combined sound power level of the installation has been calculated as follows:

Exhaust gas A-weighted sound power level at turbo charger, total 8pcs											
Frequency (Hz)	31.5	63	125	250	500	1000	2000	4000	8000	Total	Total
Sound power level Lw [dB(A)]	101	116	126	125	122	122	113	109	109	130	all pcs
Exhaust gas silencer transmission loss, total 8pcs											
Frequency (Hz)	31.5	63	125	250	500	1000	2000	4000	8000		
TL [dB]	17	22	33	36	40	42	36	30	24		
	84	94	93	89	82	80	75	79	85	98	107
Charge air intake A-weighted sound power level at turbo charger, total 16pcs											
Frequency (Hz)	31.5	63	125	250	500	1000	2000	4000	8000	Total	
Sound power level Lw [dB(A)]	64	86	100	110	119	122	129	139	134	141	
Charge air silencer transmission loss, total 16pcs											
Frequency (Hz)	31.5	63	125	250	500	1000	2000	4000	8000		
TL [dB]	3	5	14	17	26	46	47	45	38		
	61	81	86	93	93	76	82	94	96	100	112
Engine A-weighted sound power level, total 8pcs											
Frequency (Hz)	31.5	63	125	250	500	1000	2000	4000	8000	Total	
Sound power level Lw [dB(A)]	78	89	102	114	121	123	121	121	115	128	
Calculated Reverberant Level											
	65.7	78.0	85.2	96.0	103.0	104.3	102.7	103.8	98.1	110	with four running
smallest building											
$L_i = L_p - 6$	59.7	72.0	79.2	90.0	97.0	98.3	96.7	97.8	92.1		
Power House Walls											
Frequency (Hz)	31.5	63	125	250	500	1000	2000	4000	8000		
R [dB]	15	25	28	32	34	31	44	57	58		
$L_w = L_i - R + 10 \log A$	77.1	79.4	83.6	90.4	95.4	99.7	85.1	73.2	66.5	102	105
Ventilation unit A-weighted sound power level, total 16pcs											
Frequency (Hz)	31.5	63	125	250	500	1000	2000	4000	8000	Total	
Sound power level Lw [dB(A)]	57	72	84	97	90	83	79	66	58	98	110
Ventilation outlet on power house roof A-weighted sound power level, total 2x79m											
Frequency (Hz)	31.5	63	125	250	500	1000	2000	4000	8000	Total	
Sound power level Lw/m [dB(A)]	74	82	92	98	99	96	99	94	80	105	108
cooling radiators											
61 dB(A) at 40m										101	*16pcs 113
Worst case total Lw of all sources											118 dB (A)

Additional Assumptions

- Distance from plant to Receptor A: 310m

-
- Distance from plant to Receptor B: 995m
 - Distance from plant to Receptor C (soap factory): 50m
 - Activity Durations: 100% 'on-time' in 1hr assumed for all plant.
 - Barrier / topographical screening: none assumed.
 - All doors to the power house buildings (during operation of the generator sets) are assumed to be closed.

Engine number operation, based on information received from the operators.

Season	Number of Operational Engines (8 max)	
	Day	Night
Dry (Jan – June)	8	2
Rainy (Jul-Dec)	4	1

Appendix J

Plant List IUCN Vulnerable Species

J.1 Plant List

	t=tree	fr=forest relic
	<i>h=herb</i>	lh=liana & herb
	<i>l=liana</i>	p=pioneer
	<i>s=shrub</i>	c=crops
	<i>c=cultivated</i>	
1	<i>Albizia adianthifolia</i>	t p
2	<i>Albizia zygia</i>	t p
3	<i>Alchornea cordifolia</i>	s p
4	<i>Anchomanes difformis</i>	h p
5	<i>Anthocleista schweinfurthii</i>	t p
6	<i>Anthonotha macrophylla</i>	s fr
7	<i>Antiaris africana</i>	t fr
8	<i>Anisophyllea purpurascens</i>	s fr
9	<i>Ageratum conyzoides</i>	h p
10	<i>Aspilia africana</i>	h p
11	<i>Alstonia boonei</i>	t fr
12	<i>Asystasia gangetica</i>	h p
13	<i>Baphia maxima</i>	ll p
14	<i>Baphia nitida</i>	s pfr
15	<i>Borreria sp</i>	h p
16	<i>Carica papaya</i>	h c
17	<i>Ceiba pentandra</i>	t fr
18	<i>Celosia sp</i>	h p
19	<i>Chromoleana odorata</i>	h p
20	<i>Cissus sp</i>	lh p
21	<i>Clerodendron</i>	lh p
22	<i>Clerodendron</i>	lh p
23	<i>Cnestis ferruginea</i>	ll p
24	<i>Commelina sp</i>	h p
25	<i>Corchorus sp</i>	h p
26	<i>Costus afer</i>	h p
27	<i>Cucumeropsis mannii</i>	h p
28	<i>Zehnelia multiplora</i>	h c
29	<i>Desbordesia glaucescens</i>	t fr
30	<i>Desmodium ascendens</i>	lh p
31	<i>Didelotia brevipaniculata</i>	t fr
32	<i>Dioscorea bulbifera</i>	h p
33	<i>Dioscorea alata</i>	lh p
34	<i>Elaeis guineensis</i>	h c
35	<i>Ficus exasperata</i>	t p
36	<i>Ficus mucuso</i>	t p
37	<i>Glyphaea brevis</i>	s p
38	<i>Harungana madagascariensis</i>	s p
39	<i>Haumania dankelmanniana</i>	lh p
40	<i>Hymenocardia lyrata</i>	s p
41	<i>Hypselodelphys violata</i>	lh p
42	<i>Icacina sp</i>	s p

43	<i>Indigofera sp</i>	h	p
44	<i>Lannea kerstingii</i>	t	fp
45	<i>Lavigera macrocarpa</i>	ll	fr
46	<i>Maesobotrya sp</i>	s	fr
47	<i>Manihot esculenta</i>	s	c
48	<i>Markhamia lutea</i>	t	p
49	<i>Milica excelsa</i>	t	fr
50	<i>Millettia sanagana</i>	s	p
51	<i>Mucuna sp</i>	lh	p
52	<i>Mimosa pudica</i>	ll	p
53	<i>Morinda lucida</i>	s	p
54	<i>Musa paradisiaca</i>	h	c
55	<i>Musa corniculata</i>	h	c
56	<i>Myrianthus arboreus</i>	s	p
57	<i>Oncoba sp</i>	s	P
58	<i>Ocimum graticinum</i>	h	p
59	<i>Palisota ambigua</i>	h	p
60	<i>Palisota hirsuta</i>	h	p
61	<i>Panicum maximum</i>	h	p
62	<i>Paspalum odoratum</i>	h	p
63	<i>Paspalum sp</i>	h	p
64	<i>Pennisetum sp</i>	h	p
65	<i>Pentachletra macrophylla</i>	t	fr
66	<i>Pentadiplandra brazzeana</i>	h	p
67	<i>Phyllanthus sp</i>	h	p
68	<i>Platostoma africana</i>	h	p
69	<i>Poulzolzia guineensis</i>	h	p
70	<i>Pycnanthus angolensis</i>	t	fr
71	<i>Rauvolfia vomitoria</i>	s	fr
72	<i>Senna alata</i>	s	p
73	<i>Sesamum sp</i>	h	p
74	<i>Spathodea campanulata</i>	t	fr
75	<i>Sterculia tragacantha</i>	t	fr
76	<i>Trema orientalis</i>	s	p
77	<i>Triumfetta cordifolia</i>	h	p
78	<i>Triumfetta sp</i>	h	p
79	<i>Vernonia amygdalina</i>	s	c
80	<i>Canne à sucre</i>		
81	<i>Ananas sp</i>		

J.2 IUCN Red List for Cameroon Birds

[Source: <http://www.iucnredlist.org>]

Latin name	English name	Red List Category & Criteria
<i>Andropadus montanus</i>	CAMEROON GREENBUL (Eng)	NT ver 3.1 (2001)
<i>Apus sladeniae</i> (<i>Apus barbatus</i> ssp. <i>sladeniae</i> (Ogilvie-Grant, 1904))	FERNANDO PO SWIFT (Eng)	DD ver 3.1 (2001)
<i>Balearica pavonina</i>	BLACK CROWNED-CRANE (Eng)	NT ver 3.1 (2001)
<i>Batis minima</i>	GABON BATIS (Eng)	NT ver 3.1 (2001)
<i>Bradypterus bangwaensis</i>	BANGWA FOREST WARBLER (Eng)	NT ver 3.1 (2001)
<i>Bradypterus grandis</i>	DJA RIVER WARBLER (Eng)	NT ver 3.1 (2001)
<i>Bubo shelleyi</i>	SHELLEY'S EAGLE-OWL (Eng)	NT ver 3.1 (2001)
<i>Campephaga oriolina</i>	EASTERN WATTLED CUCKOO-SHRIKE (Eng)	DD ver 3.1 (2001)
<i>Ceratogymna elata</i>	YELLOW-CASQUED HORNBILL (Eng)	NT ver 3.1 (2001)
<i>Circaetus beaudouini</i>	BEAUDOUIN'S SNAKE-EAGLE (Eng)	VU A2bcd+3bcd+4bcd; C1+2a(ii) ver 3.1 (2001)
<i>Circus macrourus</i>	PALLID HARRIER (Eng)	NT ver 3.1 (2001)
<i>Cisticola dorsti</i>	DORST'S CISTICOLA (Eng)	DD ver 3.1 (2001)
<i>Columba albinucha</i>	WHITE-NAPED PIGEON (Eng)	NT ver 3.1 (2001)
<i>Coracias garrulus</i>	EUROPEAN ROLLER (Eng)	NT ver 3.1 (2001)
<i>Falco vespertinus</i>	RED-FOOTED FALCON (Eng)	NT ver 3.1 (2001)
<i>Francolinus camerunensis</i>	MOUNT CAMEROON FRANCOLIN (Eng)	EN B1ab(i,ii,iii,v); C2a(ii) ver 3.1 (2001)
<i>Francolinus streptophorus</i>	RING-NECKED FRANCOLIN (Eng)	NT ver 3.1 (2001)
<i>Gyps africanus</i>	WHITE-BACKED VULTURE (Eng)	NT ver 3.1 (2001)
<i>Gyps rueppellii</i>	RUEPPELL'S GRIFFON (Eng)	NT ver 3.1 (2001)

Latin name	English name	Red List Category & Criteria
<i>Jubula lettii</i>	MANED OWL (Eng)	DD ver 3.1 (2001)
<i>Kupeornis gilberti</i>	WHITE-THROATED MOUNTAIN-BABBLER (Eng)	EN B1ab(i,ii,iii,v) ver 3.1 (2001)
<i>Limosa limosa</i>	BLACK-TAILED GODWIT (Eng)	NT ver 3.1 (2001)
<i>Malaconotus gladiator</i>	GREEN-BREASTED BUSH-SHRIKE (Eng)	VU B1ab(i,ii,iii,iv,v); C2a(i) ver 3.1 (2001)
<i>Malaconotus kupeensis</i> (<i>Telophorus kupeensis</i> (Serle, 1951))	MOUNT KUPE BUSH-SHRIKE (Eng)	EN B1ab(i,ii,iii,v); C2a(i); D ver 3.1 (2001)
<i>Malaconotus monteiri</i>	MONTEIRO'S BUSH-SHRIKE (Eng)	DD ver 3.1 (2001)
<i>Melignomon eisentrauti</i>	YELLOW-FOOTED HONEYGUIDE (Eng)	DD ver 3.1 (2001)
<i>Morus capensis</i>	CAPE GANNET (Eng)	VU A2bce+3bce+4bce; B2ab(iii,iv,v) ver 3.1 (2001)
<i>Muscicapa tessmanni</i>	TESSMANN'S FLYCATCHER (Eng)	DD ver 3.1 (2001)
<i>Nectarinia ursulae</i>	URSULA'S SUNBIRD (Eng)	NT ver 3.1 (2001)
<i>Neophron percnopterus</i>	EGYPTIAN VULTURE (Eng)	EN A2abcd+3bcd+4abcd ver 3.1 (2001)
<i>Neotis denhami</i>	STANLEY'S BUSTARD (Eng)	NT ver 3.1 (2001)
<i>Phyllastrephus poliocephalus</i>	GREY-HEADED GREENBUL (Eng)	NT ver 3.1 (2001)
<i>Picathartes oreas</i>	GREY-NECKED PICATHARTES (Eng)	VU C2a(i) ver 3.1 (2001)
<i>Platysteira laticincta</i>	BANDED WATTLE-EYE (Eng)	EN B1ab(i,ii,iii,iv,v) ver 3.1 (2001)
<i>Ploceus bannermani</i>	BANNERMAN'S WEAVER (Eng)	VU B1ab(i,ii,iii,v) ver 3.1 (2001)
<i>Ploceus batesi</i>	BATES'S WEAVER (Eng)	EN C2a(i) ver 3.1 (2001)
<i>Poliolais lopezi</i>	WHITE-TAILED WARBLER (Eng)	NT ver 3.1 (2001)
<i>Psittacus erithacus</i>	GREY PARROT (Eng)	NT ver 3.1 (2001)
<i>Speirops melanocephalus</i>	MOUNT CAMEROON SPEIROPS (Eng)	VU D2 ver 3.1 (2001)
<i>Sterna balaenarum</i>	DAMARA TERN (Eng)	NT ver 3.1 (2001)
<i>Tauraco bannermani</i>	BANNERMAN'S	EN B1ab(i,ii,iii,iv,v)

Latin name	English name	Red List Category & Criteria
	TURACO (Eng)	ver 3.1 (2001)
<i>Torgos tracheliotos</i>	LAPPET-FACED VULTURE (Eng)	VU C2a(ii) ver 3.1 (2001)
<i>Trigonoceps occipitalis</i>	WHITE-HEADED VULTURE (Eng)	VU C2a(ii) ver 3.1 (2001)
<i>Zoothera crossleyi</i>	CROSSLEY'S GROUND- THRUSH (Eng)	NT ver 3.1 (2001)

Appendix K

Archaeological Site Survey Report

**Rapport d'Evaluation du Potentiel Archéologique
des futurs sites à centrale thermique de
Dibamba (Douala) et Mpolongwé (Kribi)**



Tessons de poterie du site de Dibamba

OSLISLY Richard (IRD Yaoundé)
avec la collaboration de
Kinyock Pierre et Nlend Pascal

Novembre 2007

Résumé

Une mission d'évaluation de trois jours (6-8 novembre) commandée par AES SONEL a été conduite sur les aires de construction des centrales thermiques de Dibamba (Douala) et Mpolongwé (Kribi) afin d'évaluer le potentiel archéologique réel des zones concernées par le projet.

Les résultats attestent l'existence de sites dont la chronologie s'étale de l'Age de la pierre récente (LSA) à la période précoloniale en incluant le Néolithique et l'Age du fer. Le site de Dibamba est caractérisé par un ensemble de restes de métallurgie du fer, céramique et des objets attestant des contacts avec l'Occident ; Mpolongwé révèle des fosses, des pierres (taillée, à cupules) et de la céramique.

Ces premières observations nous permettent de dire qu'il s'agit de sites importants pour l'étude de l'histoire ancienne des localités concernées par le projet.

Cependant, le caractère partiel de cette évaluation et la nature des découvertes, nous impose de recommander de nouvelles investigations archéologiques appropriées à ces sites.

Summary

A mission of three days evaluation (6-8 november) commanded by AES SONEL was led on the areas of construction of the thermal power plants of Dibamba (Douala) and Mpolongwé (Kribi) to estimate the real archaeological potential of zones concerned by the project.

The results give evidence of the existence of sites which chronology spreads out from Late Stone (LSA) to precolonial period, including the Neolithic and Iron Age. The site of Dibamba is characterized by remains of metallurgy, ceramic and artefacts giving evidence of contacts with Europeans; Mpolongwé reveals pits, lithic material (stone tool, stone cup marks) and some ceramics.

All these observations lead to the conclusion that these sites are important for the study of ancient history of the region concerned by the project.

However, the partial character of this evaluation and the nature of discoveries impose us to recommend future archaeological investigations of those sites.

1- Le projet et son impact sur le patrimoine archéologique

Le projet de AES SONEL doit créer deux centrales de production d'énergie électrique dont une à fuel à Dibamba (Yassa) près de Douala et l'autre à gaz à Mpolongwé près de Kribi, ce qui conduira à la construction d'infrastructures sur une superficie totale de 22 ha. Toutes les terres situées dans cette emprise seront soumises à des terrassements et une partie abritera des structures définitives. Ces infrastructures vont vraisemblablement ensevelir des sites archéologiques et les terrassements quant à eux, auront le potentiel d'endommager ou de détruire certains de ces sites. Tout ce qui précède rend donc l'évaluation archéologique des centrales unique :

- En général les sites archéologiques aussi nombreux qu'ils soient, ont chacun leur particularité ce qui les rend uniques par définition et les dégâts deviennent irréversibles.
- Les sites qui se retrouveront dans l'emprise des infrastructures fixes ne pourront pas être contournés ou évités.

La région de Douala, à laquelle appartient le site de Dibamba, n'avait jamais connu de recherches archéologiques avant cette première visite de terrain, au contraire de la région de Kribi qui recèle de nombreux sites archéologiques¹.

2 - Objectif de l'évaluation archéologique

Il s'agissait sur le terrain de rechercher des indices pouvant confirmer l'existence d'un potentiel archéologique sur les sites de Dibamba et de Mpolongwé.

3 – Méthode de travail et résultats

Nous allons présenter de manière succincte la méthode de recherche qui nous a permis de réaliser les différentes découvertes.

3-1 La méthodologie de recherche

La méthode de travail est une adaptation de celle mise au point par Oslisly et White (1998) au Gabon s'articulant autour de trois points fondamentaux, à savoir une bonne étude cartographique, des analyses botaniques poussées et l'exploitation systématique des ouvertures (pistes, zones d'érosion, jachères, layons) et la reconnaissance de surface.

la cartographie

La préparation d'une mission de terrain débute par l'acquisition de cartes topographiques. Puis on recherche les données concernant la géologie et les données sur la pédologie.

¹ Oslisly, Lavachery, Kadomoura, Nlend, Atéba, Eggert, Gouem.

la botanique

Il est souhaitable pour tout archéologue travaillant en forêt tropicale de disposer d'un minimum de connaissances en botanique et en ethnobotanique. En effet au cours des nombreuses prospections en Afrique Centrale, Oslisly et White sont arrivés au constat selon lequel, l'homme favorise de façon directe ou indirecte le peuplement d'espèces végétales bien spécifiques : palmiers (*Elaeis guineensis*), manguiers (*Mangifera indica*); la plupart de ces espèces sont des indicateurs d'anciens villages du dernier millénaire de notre ère.

L'exploitation systématique des ouvertures de terrain

Elle constitue le dernier élément que l'on associe lors des campagnes de prospections. Oslisly et White recommandent de mettre à profit les ouvertures pratiquées dans la couverture végétale qu'elles soient naturelles (chablis, berges de rivières, pistes, routes, falaises...) ou artificielles (grands travaux, routes, pistes, chemin de fer, oléoduc...).

L'expérience de terrain nous a permis de confirmer une fois de plus que les hommes ont toujours eu une forte préférence dans le choix de l'emplacement de leur village, à savoir une position d'altitude, le sommet de colline.

En somme, il s'agissait de faire une reconnaissance de surface consistant à parcourir le site afin d'identifier les zones dont la topographie et d'autres facteurs pouvant influencer l'établissement des populations anciennes. L'examen des zones ouvertes et d'érosion pouvant permettre une observation directe du sol sans recourir à des sondages a été effectué. En plus nous avons examiné les carottes issues des sondages géotechniques en cours sur le site de Dibamba.

3. 2. La méthodologie d'enregistrement des données

Lors de l'évaluation, les outils de travail se sont limités à un GPS (Garmin 12), permettant l'obtention des coordonnées géographiques du site découvert, une boussole et une carte topographique, un cahier de notes, un petit matériel de fouilles, un appareil photo numérique et des fiches d'inventaire de site.

Lorsqu'un site était repéré, la procédure suivante a été adoptée :

- les limites approximatives du site sont définies par rapport à l'aire de la centrale
- le site est relevé au GPS en coordonnées géographiques classiques et en UTM
- le site est photographié
- une fiche d'inventaire qui comporte des informations pertinentes sur le site (voir fiches inventaires en annexe) est établie.

Les sites sont enregistrés selon un code et un numéro de séquence : exemple : le lieu ou site (quatre lettres), le numéro du site (le chiffre). Ainsi une fiche portant la mention MPOL 1 correspond au site de Mpolongwé et le chiffre 1 correspondant au numéro de séquence 1 (voir fiche inventaire en annexe).

Les enregistrements se faisaient aussi à travers des plans de situation des zones de concentration des vestiges en surface.

4. Les résultats de la mission

L'évaluation menée sur les superficies des futures centrales thermiques de Dibamba et de Mpolongwé a nouvellement confirmé l'existence de sites archéologiques avec une diversité d'occupation humaine (Age de la pierre, néolithique, Age du fer, période précoloniale).

4.1. Zones couvertes

Pour le site de Dibamba, l'évaluation a permis de révéler deux zones de concentration de vestiges correspondant aux zones où la visibilité du sol varie entre 30 % pour les transects existants dans le site et 100 % pour la piste d'accès.

En ce qui concerne le site de Mpolongwé nous avons axé notre évaluation sur les zones actuellement habitées, les transects et les pistes traversant le site et les talus ce qui a conduit à la découverte de quatre zones d'occupation.

D'une manière générale, ces occupations se matérialisent comme suit :

Centrales	Zones	Structures
Dibamba	1	Ferrier, scories, restes de fourneau, horizon de céramique, perle, poterie tournée (précoloniale)
	2	Horizon de céramique
	3	Fosses en dehors du site
Mpolongwé	1	Fosses, horizon de céramique (enceinte des cases)
	2	Fosse sur la piste vers le ruisseau Gongoyima
	3	Petit talus au bord du ruisseau Gongoyima)
	4	Fosse et pierre à cupules dans une concession

4.2. Présentation, description et analyses préliminaire des sites sur l'aire de la centrale de Dibamba.

Les prospections se sont limitées aux ouvertures et layons ; il faut dire que l'état de brousse épaisse (ouvertures peu étendues) a affecté la visibilité pendant notre mission.

4.2.1. Le site de Dibamba

Le site de Dibamba se situe à proximité de l'axe routier Douala-Yaoundé. C'est un plateau sur lequel on retrouve des jachères ; l'évaluation a permis d'identifier trois zones d'occupation humaines.

La zone 1 (DIB 1a)

Elle est située sur l'actuelle piste d'accès au projet. Cette piste fait 8 m de large et part de la route nationale n° 1 jusqu'au site. La zone concernée par les découvertes s'étend sur environ 100 m et correspond à une association d'un ferrier (concentration de scories de fer) sur plus de 20 mètres avec des fragments de poterie, à des fragments de tuyères, des fragments de minerais de fer, de noix de palme calcinées, du charbon de bois, une perle cassée bleue et une

poterie tournée qui semblent attester de la présence d'échanges précoloniaux. Sa superficie totale ne peut pas encore à ce stade être évaluée avec précision, mais de plus amples recherches (en surface et en stratigraphie) révéleraient que le site est encore beaucoup plus vaste.



Perle de verre de couleur azur de la période précoloniale- Zone 1



Scories de fer- Zone 1



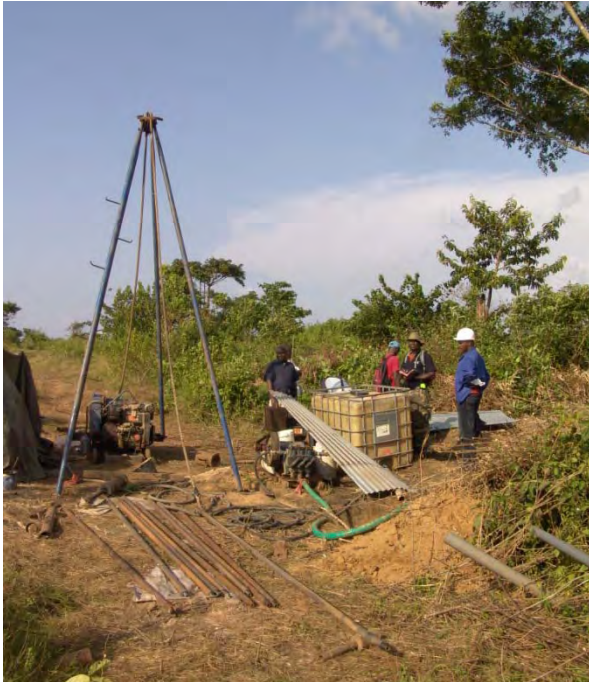
Reste de tuyère d'un four de réduction de fer de la zone 1



Fond de poterie retournée de la zone 1

La zone 2 (DIB 1b)

Située à l'est de la zone 1, cette aire est une jachère dans la quelle on retrouve des tessons de poterie en surface ; il s'agit de nombreux fragments de céramique décorés et non décorés. Certains tessons apparaissent très érodés et d'autres sont bien conservés. Il est cependant important de rappeler que la visibilité du sol dans cette zone est de l'ordre de 5% et le sol a été fortement remanié par les populations qui cultivaient dans la zone. Cependant, l'existence des sites sous la couche humifère, est attestée à travers l'examen d'une carotte issue du sondage B8 (sondage géotechnique) ; elle contient des fragments de poterie à près de 150 cm de profondeur.

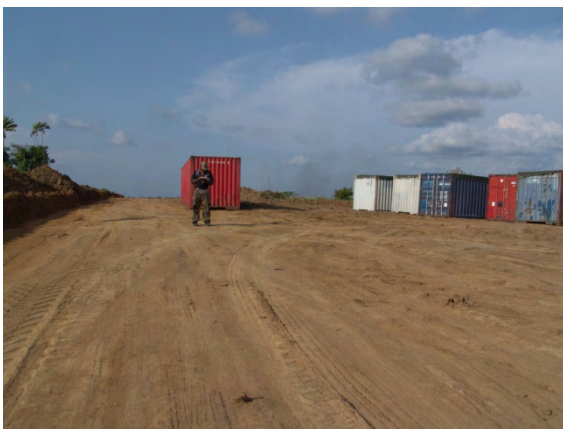


Zone 2 – vue sur le sondage B8 où nous avons découvert le tesson décoré ci-dessus

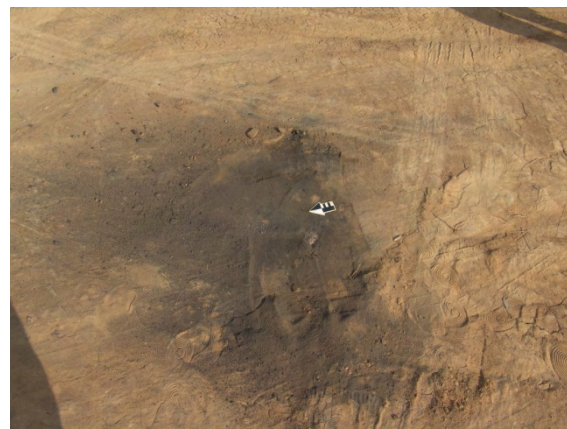
La zone 3 (DIB 1c) ou Zone à containers

Nous attirons votre attention sur la zone 3 (zone à containers), limitrophe à l'Est est en dehors du site mais contiguë au site.

Elle a été décapée et présente des traces de fosses avec de la céramique (UTM N 591 222 - E 441 738).



Vue sur la zone 3, le décapage et les containers

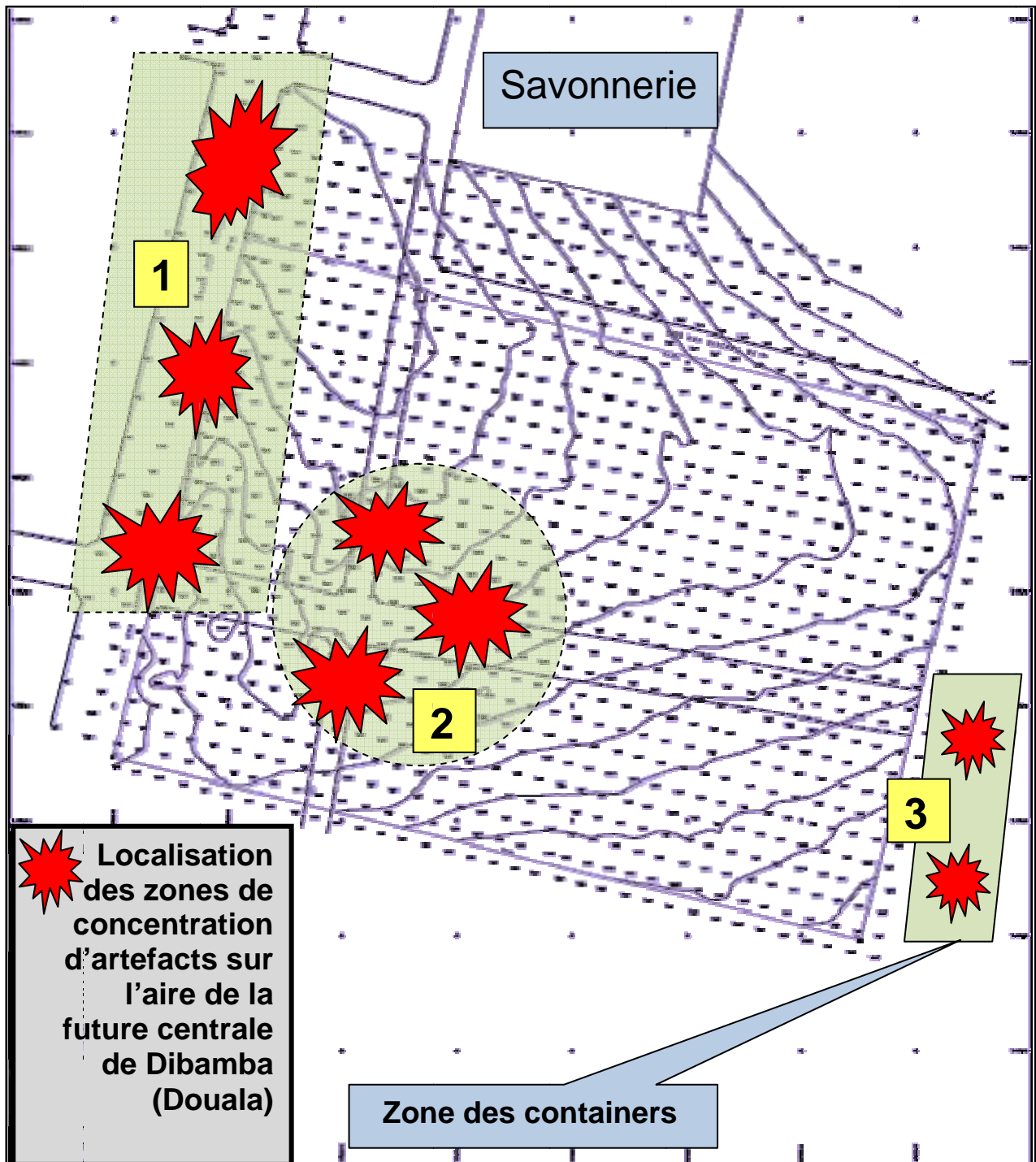


Tache charbonneuse correspondant à la tête d'une fosse dépotoir.

Interprétations

A ce stade de l'évaluation, Dibamba est le premier site archéologique reconnu pour la région de Douala ; il comporte plusieurs occupations humaines :

- (1) Un probable stade néolithique avec des populations fabriquant la poterie
- (2) Un Age du fer avec des traces attestant de la maîtrise des techniques de production du fer par des populations de métallurgistes (ferrier, scories, fragments de minerai de fer, fragments de tuyères, poterie)
- (3) Un période précoloniale marquée par la présence de perle et de poterie tournée caractéristiques des produits manufacturés européens des XVII et XVIII^e siècles.



Carte montrant les zones prospectées (1, 2, 3) sur le site de Dibamba sur fond topographique

4.3. Présentation, description et interprétation des sites sur l'aire de la centrale à gaz de Mpolongwé

Face à l'important couvert végétal, l'évaluation a été restreinte aux zones plus ou moins ouvertes permettant d'observer directement le sol telles que les cours et alentours des maisons, les pistes et les talus.

4.3.1. Le site de Mpolongwé (MPOL 1)

Le site de Mpolongwé est localisé à proximité de l'axe routier Edéa-Kribi sur un sommet de colline bordé au nord par la rivière Mpolongwé, au sud le ruisseau Mayingui et à l'est le ruisseau Gongoyima et à l'ouest par la route Edéa-Kribi. Ce site est actuellement occupé par les populations Mabi, sur le plan archéologique l'évaluation a permis de distinguer quatre zones potentielles d'occupation humaine ancienne.

La zone 1 (MPOL 1a)

Elle est constituée de six fosses reconnaissables à travers les traces noires et un aspect circulaire, un amoncellement de pierre associé à la céramique et au charbon de bois près des cases et des tombes. Le site est entouré d'une végétation fortement anthropisée constituée de *mangifera indica*, *dacryodes edulis*, *persea americana*, *chromoleana odorata*.



Trace circulaire révélant des tessons et une probable fosse dépotoir



Ensemble de pierres agencées associé à un tesson de poterie

La zone 2 (MPOL 1b)

C'est un ensemble de trois fosses distante de trois mètres l'une de l'autre sur la piste qui mène au ruisseau Gongoyima, reconnaissable par les tessons de poterie associés au lithique qui ont été exposés par l'érosion. La végétation environnante constitue une forêt secondaire fortement anthropisée à *ceiba pentadra*, *anthocleista schweinfurtheii*, *alchornea cordifolia*



Tête de fosse de la zone 2 révélant des tessons et des charbons de bois

La zone 3 (MPOL 1c)

Cette zone est représentée par un outil de pierre taillée sur du quartz laiteux trouvé incrusté dans un talus d'environ un mètre de hauteur à proximité du ruisseau Gongoyima. Ce type d'outil taillé est rare et c'est assez exceptionnel d'en trouver en place. L'environnement forestier du site est similaire au précédent.



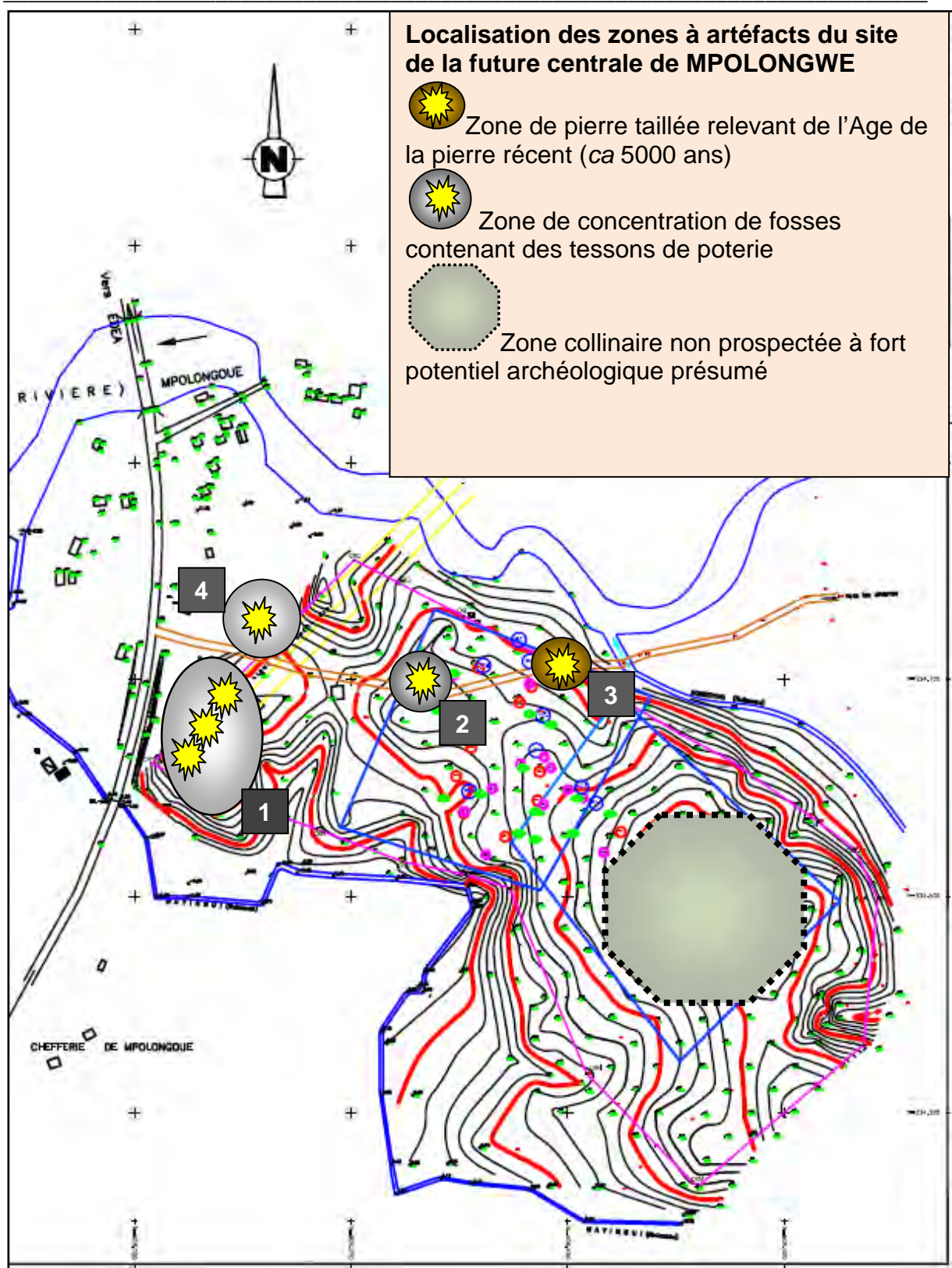
Emplacement de la pierre taillée dans le talus



Hachette taillée sur quartz laiteux

La zone 4 (MPOL 1d)

C'est un ensemble de deux fosses et une pierre à cupule (objet de pierre cubique permettant de casser des noix de palme) dans une concession, reconnaissable à travers les taches noires au sol avec des tessons de poterie, du charbon de bois et quelques noix d'*Elaeis guineensis*.



Localisation des zones à artefacts découvertes sur le site de Mpolongwé avec la représentation d'une zone collinaire non prospectée mais à fort potentiel archéologique.

Interprétations

Au vu des résultats de l'évaluation, de l'observation du type de vestiges archéologique, nous pouvons classer l'occupation du site en deux phases :

- (1) Un Age de la pierre récent caractérisé par la pièce bifaciale à bords parallèles plus ou moins allongée à talon communément appelé hachette. On peut estimer son âge dans une fourchette chronologique de 5000 - 6000 ans
- (2) Un stade néolithique ou Age du fer indiqué par la présence des fosses

5- Présentation synthétique des résultats de l'évaluation et priorisation des sites

Cette présentation va s'articuler autour de deux tableaux synthétiques des découvertes mais une explication de certaines têtes de rubriques s'impose :

- (1) Pour ce qui est de l'estimation du potentiel archéologique en fonction de la superficie du site, nous avons minutieusement parcouru la surface des gisements afin de positionner tous les artefacts visibles.
- (2) L'âge a été estimé à partir des vestiges mis en évidence et en corrélation avec d'autres zones de la région littorale du Cameroun.
- (3) Nous avons aussi ouvert une rubrique sur la stratigraphie et le contexte géographique des sites. Dans ce cas la position géographique du site a été décrite ainsi que la situation des vestiges, soit dans un contexte de niveau stratigraphique, soit contenus dans des fosses dépotoirs.
- (4) Le classement prioritaire d'un site n'est pas une mesure définitive de son importance scientifique mais plutôt une étape temporaire qui permet de tenir compte de son potentiel scientifique et des mesures à prendre dans le cadre de la construction. De cette manière un site classé « important » à sa découverte peut être re-évalué plus tard après étude comme sans importance. De la même manière des sites dont l'importance est incertaine peuvent être classés importants ou pas par la suite et être ou fouillés ou abandonnés.

Noms des sites	Zones	Structures	Nord (UTM 32)	Est (UTM 32)	Type	Artéfacts	Age probable	Intérêt scientifique	Priorité
Dibamba 1	1	DIB S1	590 899 590 897	441 874 441 859	Surface et Stratigraphie	Scories, céramique, fragments de tuyère	Age du fer	Haut	Haute
	1	DIB S2	590 893	441 838	Surface	Perle et poterie tournée	Précoloniale	Bas	Basse
	1	DIB S3	590 888	441 824	Surface et stratigraphie	Ferrier, système de soufflerie (fragments de tuyères) scories, céramique, charbons de bois	Age du fer	Haut	Haute
	1	DIB S4	590 881	441 798	Surface et stratigraphie	Fragments de vase	Néolithique	Haut	Haute
	2	DIB S5	590 905 590 920	441 780 441 742	Surface	céramique	Age du fer	Haut	Haute
	2	DIB S6	590 947	441 712	Stratigraphie	céramique	Néolithique	Haut	Haute
	2	DIB S7	590 995	441 757	Surface	céramique	Age du fer	Haut	Haute
	2	DIB S8	590 955 590 966	441 757 441 792	Surface	céramique	Age du fer	Haut	Haute

Noms des sites	Zones	Structures	Nord (UTM 32)	Est (UTM 32)	Type	Artéfacts	Age probable	Intérêt scientifique	Priorité
Mpolongwé	1	MPOL S1	608 107	334 680	Stratigraphie	Céramique associée au lithique	Néolithique	Haut	Haute
	1	MPOL S2	608 074	334 636	Stratigraphie	Céramique associée au lithique	Néolithique	Haut	Haute
	1	MPOL S3	608 094	334 644	Stratigraphie	Céramique associée au lithique	Néolithique	Haut	Haute
	1	MPOL S4	608 064	334 619	Stratigraphie	Céramique associée au lithique	Néolithique	Haut	Haute
	1	MPOL S5	608 064	334 637	Stratigraphie	Céramique associée au lithique	Néolithique	Haut	Haute
	2	MPOL S6	608 280	334 686	Stratigraphie	Céramique associée au lithique	Néolithique	Haut	Haute
	3	MPOL S7	608 422	334 702	Stratigraphie	lithique	LSA	Haut	Haute
	4	MPOL S8	608 134	334 748	Surface et stratigraphie	Céramique et pierre à cupules	Age du fer	Haut	Haute

6 - Recommandations pour les actions futures

La présente mission sur les sites des futures centrales thermiques de Dibamba et Mpolongwé avait pour objectif d'évaluer le potentiel archéologique de la zone d'impact des projets de construction. Nous rappelons que les résultats de cette courte mission ne peuvent ni être considérés comme ceux issus d'une étude d'impact à grande échelle ni servir à une intervention adéquate lors du plan d'action.

6-1- Prospections supplémentaires

D'une manière générale, près de 90 % des surfaces de la zone d'impact du Projet restent à prospector. Cette prospection, qui seule permet réellement de connaître le patrimoine archéologique avant la construction, doit être réalisée dans le cadre des actions futures :

- L'évaluation archéologique sur les zones ouvertes a prouvé la richesse des sites de Dibamba et Mpolongwé. Les surfaces en jachère (enforestées) doivent être entièrement prospectées
- Ces zones enforestées recèlent sûrement aussi un riche patrimoine archéologique : il doit être évalué. Un transect devrait être réalisé tous les 10 mètres partant de la piste d'accès ouest jusqu'à l'est du site. Pour ce faire, les archéologues doivent être en possession au plus vite de plans de construction précis localisant les zones de terrassement.
- Ces études supplémentaires combineront prospection de surface et carottages à la tarière.
- Il ne faudra pas oublier d'étendre les recherches archéologiques à l'aire de la future centrale de Bipaga. Nous n'avons pas prospecté cette zone faute de plan topographique et de l'aval formel donné par le consortium SNH – PERENCO.

6-2- Surveillance des travaux

Cette phase est très importante dans les actions futures du domaine de l'archéologie préventive. Elle s'applique uniquement aux chantiers impliquant des décapages de grande quantité de terre. Elle doit obligatoirement faire partie du plan d'action de l'entreprise pour la gestion du patrimoine culturel :

- Nous savons maintenant qu'entre 45 et 55% des sites présents dans l'aire d'un chantier de construction sont découverts lors de la surveillance des travaux (données du pipeline, des routes)².
- Les travaux de terrassement devraient donc être surveillés afin de permettre l'identification des sites qui n'auraient pas été découverts lors de la prospection préliminaire.
- La présence d'archéologues est nécessaire tout au long des travaux de terrassement.

² Lavachery *et al.* 2005, 2006 ; Oslisly *et al.* 2006 ; Delneuf *et al.* 2002.

FICHE D'INVENTAIRE DES SITES ARCHÉOLOGIQUES

Code d'inventaire: **DIB 1**

Nom du site : Dibamba

Localité: Douala

Province: Littoral

Altitude: 56,44 m

Coordonnées pour S.I.G UTM: **N 590 899 E 441 874**

Référence de la carte (INC Yaoundé): **Buéa-Douala NB-32-IV 1/200 000 (1976)**

Etat du site lors sa découverte: En place mais perturbé pour certaines zones

Nom de l'identificateur: Oslisly Richard

Date d'inventaire : **06/11/2007**

Substratum géologique: Horizon sablo-argileux sur formation sédimentaire calcaro-marneuse

Description géomorphologique et topographique: Plateau sommital

Couverture végétale : *Chromoleana odorata*, *Musa acuminata*, *Manihote esculenta*

Position des artefacts : Surface et stratigraphie

Type d'artefacts : Scories, céramique,

fragments de tuyère, perles

Implication chronologique: Age du fer, période précoloniale

Nécessite une fouille : Oui

Nécessite une datation au C14: Oui

Date de création de la fiche : **10/11/2007**

Auteur: Oslisly Richard

FICHE D'INVENTAIRE DES SITES ARCHÉOLOGIQUES

Code d'inventaire: **MPOL 1**

Nom du site: Mpolongwé

Localité: Kribi

Province: Sud

Altitude: 12,11 m

Coordonnées pour S.I.G UTM: N 608 107 E 334 680

Référence de la carte (INC Yaoundé): **Kribi NA-32-XVII 1/200 000 (1976)**

Etat du site lors sa découverte: En place

Nom de l'identificateur: Oslisly Richard

Date d'inventaire : 07/11/2007

Substratum géologique: Horizon argilo-sableux sur une formation de schistes micacés

Description géomorphologique et topographique: Alternance de sommets collinaires

Couverture végétale : *Ceiba pentandra*, *Alchornea cordifolia*, *Persea americana*

Position des artefacts : Surface et stratigraphie

Type d'artefacts : Lithique, céramique, pierre à cupules

Implication chronologique: Late Stone Age, Néolithique, Age du fer

Nécessite une fouille : Oui

Nécessite une datation au C14: Oui

Date de création de la fiche : **10/11/2007**

Auteur: Oslisly Richard

Calendrier du déroulement de la mission d'évaluation archéologique et personnel impliqué

Novembre 2007

Lun. 5	Mar. 6	Mer. 7	Jeu. 8	Ven. 9	Sam. 10
Préparation de la mission (R.O, K.P, N.P)	Voyage Yaoundé—Douala Réunion avec AES SONEL Évaluation Dibamba (R. O, K.P, N.P)	Voyage Douala —Kribi Évaluation Mpolongwé (R. O, K.P, N.P)	Voyage Kribi—Yaoundé (R. O, K.P, N.P)	Rédaction du Rapport (R. O, K.P, N.P)	Rédaction du Rapport (R. O, K.P, N.P)

R.O = Richard OS LISLY,

K.P = KINYOCK Pierre,

N.P = NLEND Pascal

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Appendix L

Framework Resettlement Action Plan Public Utility Decree Electromagnetic Fields

L.1 Framework for Resettlement Action Plan

World Bank Operational Policy 4.12 requires that Resettlement Action Plans (RAPs) fulfil certain criteria during both the documentation and process phases. The key principles and objectives for developing and implementing a resettlement action plan are found below.

Definition of Project Affected People:

The Project Affected People (PAPs) are identified from census data collected by the Compensation Commission during the baseline phase of the RAP. PAPs include the following:

- people whose houses are in part or in total affected (temporarily or permanently) by the project;
- people whose premises and /or agricultural land is in part or in total affected (permanently or temporarily) by the project);
- people whose businesses, residences and land are affected in part or in total (temporarily or permanently) by the project;
- people whose crops (annual or perennial) and trees are affected in part or in total by the Project;
- those who have formal legal rights to land (including customary and traditional rights recognised under Cameroon law);
- those who do not have formal legal rights to land at the time the census begins but have a claim to such land or assets - provided that such claims are recognised under the laws of Cameroon;
- those who have no recognisable legal right or claim to the land they are occupying.

The following principles and objectives should always apply when carrying out a RAP in compliance with World Bank OP 4.12 and IFC performance Standard 5:

- Acquisition of land and other assets and resettlement of people will be minimised as much as possible.
- All PAPs will be entitled to the provision of rehabilitation measures which are sufficient enough to assist them in improving or, at least, maintaining their pre-project living standards, income earning capacity and production levels.
- The rehabilitation measures to be provided are:
 - compensation at replacement cost for house and other structures; without deductions for depreciation, transaction fees or salvage materials
 - replacement of agricultural land for land of equal productive capacity or the cash equivalent, according to the PAP's preference;
 - replacement of premise land of equal size acceptable to the PAP or in cash equivalent

-
- compensation for income losses from businesses including transfer and subsistence allowances;
 - severely affected people, i.e. those who lose more than 10 percent of land and/or resources to the project, will also be provided with income restoration measures. These will include adequate income restoration measures (such as, preferential access to employment generated by the project, local procurement of goods and services, micro finance loan schemes, local community development programmes) and adequate cash compensation for loss of income;
- Replacement premises and agricultural land will be as geographically near as possible to the land that was lost, and be acceptable to the PAP.

Levels of Impact:

Different project-affected people will sustain different levels of impacts by the project in various ways, which will have implications for the type of compensation that they receive. The World Bank's OP 4.12 makes provision for this by requesting an entitlement matrix, as part of all RAPs. The entitlement matrix is a very useful tool for assessing PAPs' needs and requisite compensation. It is also useful for planning the resettlement and compensation budget.

When a full census has been carried out a list of the categories of entitlements can be drafted. The following detail is a sample entitlement matrix for some of the possible categories of PAPs that AES Sonel should use when assessing peoples' entitlements and levels of compensation in accordance with World Bank OP 4.12 and IFC Performance Standard 5.

The Resettlement Action Plan should adhere to the following outline as a guide for the analysis of resettlement impacts and mitigation measures:

Introduction

- Briefly describe the project.
- List project components including associated facilities (if any).
- Describe project components requiring land acquisition and resettlement; give overall estimates of land acquisition and resettlement.

Minimising Resettlement

- Describe efforts made to minimise displacement.
- Describe the results of these efforts.
- Describe mechanisms used to minimise displacement during implementation.

Census and Socio-economic Surveys

- Provide the results of the census, assets inventories, natural resource assessments, and socio-economic surveys.
- Identify all categories of impacts and people affected.
- Summarise consultations on the results of the various surveys with affected people.
- Describe need for updates to census, assets inventories, resource assessments, and socio-economic surveys, if necessary, as part of RAP monitoring and evaluation.

Legal Framework

- Describe all relevant local laws and customs that apply to resettlement.
- Identify gaps between local laws and World Bank Group policies, and describe project-specific mechanisms to address conflicts.
- Describe entitlement policies for each category of impact and specify that resettlement implementation will be based on specific provisions of agreed RAP.
- Describe method of valuation used for affected structures, land, trees, and other assets.
- Prepare entitlement matrix .

Resettlement Sites

The following pertinent questions must be worked through :

- Does the project require community relocation sites? Have affected people been involved in a participatory process to identify sites, assess advantages and disadvantages of each site, and select preferred sites?
- Have the affected people been involved in developing an acceptable strategy for housing replacement? Will new housing be constructed/allocated?
- Does the project involve allocation of agricultural land or pasture/rangeland?
- Have the individual households that will be allocated lands been involved in identifying potential new sites, and have they explicitly accepted the selected sites?
- Have the host communities been consulted about the RAP? Have they participated in the identification of likely impacts on their communities, appropriate mitigation measures, and preparation of the RAP? Do the host communities have a share of the resettlement benefits?

Thereafter,

- Describe the specific process of involving affected populations in identifying potential housing sites, assessing advantages and disadvantages, and selecting sites.
- Describe the feasibility studies conducted to determine the suitability of the proposed sites, including natural resource assessments (soils and land use capability, vegetation and livestock carrying capacity, water resource surveys) and environmental and social impact assessments of the sites.
- Demonstrate that the land quality and area are adequate for allocation to all of the people eligible for allocation of agricultural land. Provide data on land quality and capability, productive potential, and quantity.
- Give calculations relating to site requirements and availability.
- Describe mechanisms for: 1) procuring, 2) developing and 3) allotting resettlement sites, including the awarding of title or use rights to allotted lands.
- Provide detailed description of the arrangements for site development for agriculture, including funding of development costs.

Income Restoration

When calculating income restoration, the following factors and questions are critical components in the process:

-
- Are the compensation entitlements sufficient to restore income streams for each category of impact? What additional economic rehabilitation measures are necessary?
 - Briefly spell out the restoration strategies for each category of impact and describe their institutional, financial, and technical aspects.
 - Describe the process of consultation with affected populations and their participation in finalising strategies for income restoration.
 - How do these strategies vary with the area of impact?
 - Does income restoration require change in livelihoods, development of alternative farmlands or some other activities that require a substantial amount of training, time for preparation, and implementation?
 - How are the risks of impoverishment to be addressed?
 - What are the main institutional and other risks for the smooth implementation of the resettlement programmes?
 - Describe the process for monitoring the effectiveness of the income restoration measures.
 - Describe any social or community development programmes currently operating in or around the project area.
 - If social and community programmes exist, do they meet the development priorities of their target communities? Are there opportunities for the project proponent to support new programme or expand existing programmes to meet the development priorities of communities in the project area?

Institutional Arrangements

- Describe the institution(s) responsible for delivery of each item/activity in the entitlement policy; implementation of income restoration programmes; and coordination of the activities associated with and described in the resettlement action plan.
- State how coordination issues will be addressed in cases where resettlement is spread over a number of jurisdictions or where resettlement will be implemented in stages over a long period of time.
- Identify the agency that will coordinate all implementing agencies. Does it have the necessary mandate and resources?
- Describe the external (non-project) institutions involved in the process of income restoration (land development, land allocation, credit, training) and the mechanisms that will be put in place to ensure adequate performance of these institutions.
- Discuss institutional capacity for and commitment to undertake the resettlement process.
- Describe mechanisms for ensuring independent monitoring, evaluation, and financial audit of the RAP.
- Describe the mechanisms for ensuring that corrective measures are carried out in a timely manner.

Implementation Schedule

- List the chronological steps for implementation of the RAP. This shall include identification of agencies responsible for each activity with a brief explanation of each activity.
- Prepare a month-by-month implementation schedule of activities to be undertaken as part of resettlement implementation. A Gantt chart, for example, is a useful tool for this procedure.
- Describe the linkage between resettlement implementation and initiation of civil works for each of the project components.

Participation and Consultation

- Describe the various stakeholders.
- Describe the process of promoting consultation/participation of affected populations and stakeholders in resettlement preparation and planning.
- Describe the process of involving affected populations and other stakeholders in implementation and monitoring.
- Describe the plan for disseminating RAP information to affected populations and stakeholders, including information about compensation for lost assets, eligibility for compensation, resettlement assistance, and grievance redress.

Grievance Redress

- Describe the step-by-step process for registering and addressing grievances. Provide specific details regarding a cost-free process for registering complaints, response time, and communication methods.
- Describe the mechanism for appeal.
- Describe the provisions for approaching civil courts if other options fail.

Monitoring and Evaluation

- Describe the internal/performance monitoring process.
- Define key monitoring indicators derived from baseline survey. Provide a list of monitoring indicators that will be used for internal monitoring.
- Describe institutional (including financial) arrangements.
- Describe frequency of reporting and content for internal monitoring.
- Describe process for integrating feedback from internal monitoring into implementation.
- Define methodology for external monitoring.
- Define key indicators for external monitoring.
- Describe frequency of reporting and content for external monitoring.
- Describe process for integrating feedback from external monitoring into implementation.
- Describe arrangements for final external evaluation.

Costs and Budgets

- Provide a clear statement of financial responsibility and authority.
- List the sources of funds for resettlement and describe the flow of funds.
- Ensure that the budget for resettlement is sufficient and included in the overall project budget.
- Identify resettlement costs, if any, to be funded by the government and the mechanisms that will be established to ensure coordination of disbursements with the RAP and the project schedule.
- Prepare an estimated budget, by cost and by item, for all resettlement costs. The plan must include planning and implementation, management and administration, monitoring and evaluation, and contingencies.
- Describe the specific mechanisms to adjust cost estimates and compensation payments for inflation and currency fluctuations.
- Describe the provisions to account for physical and price contingencies.
- Describe the financial arrangements for external monitoring and evaluation including the process for awarding and maintenance of contracts for the entire duration of resettlement.

L.2 Public Utility Decree

REPUBLIQUE DU CAMEROUN
Paix - Travail - Patrie

MINISTRE DES DOMAINES ET
DES AFFAIRES FONCIERES

SECRETARIAT GENERAL

DIRECTION DES DOMAINES ↗

REPUBLIC OF CAMEROON
Peace-Work-Fatherland

MINISTRY OF STATE PROPERTY
AND LAND TENURE

SECRETARIAT GENERAL

DEPARTMENT OF STATE LANDS

00002357
N°...../Y.14.4/MINDAF/D220

Tél : 222.15.47 (CAB)
223.06.45 (DOM)

Réf : V/L du 15 octobre 2007

Objet : Travaux de construction
d'une centrale thermique à fuel
ou à gaz et d'une ligne de
transport de 250 ou 90 KV
reliant la centrale au réseau de
transport THT/HT existant sur
des terrains sis à YASSA,
Arrondissement de Douala III

Yaoundé, le... 16 NOV 2007

Le Ministre
A
Monsieur le Directeur Général
de la Société AES SONEL
BP 4077
- DOUALA

Monsieur le Directeur Général,

Faisant suite à votre correspondance dont la référence et l'objet sont repris à la marge,

J'ai l'honneur de vous faire tenir ci-joint, copie de l'arrêté modifiant et complétant certaines dispositions de l'arrêté n°000869/Y.14.4/MINDAF/D220 du 23 août 2007 déclarant d'utilité publique les travaux de construction d'une centrale thermique à fuel ou à gaz et d'une ligne de transport de 250 ou 90 KV reliant la centrale au réseau de transport THT/HT existant sur des terrains sis à YASSA, Arrondissement de DOUALA III, Département du WOURI.

Pour la suite de la procédure ainsi engagée, vous voudrez bien vous rapprocher du Préfet du Département du WOURI, président de la commission de constat et d'évaluation visée à l'article 2 de l'arrêté susvisé, en vue de remplir les formalités d'usage.

Je vous prie d'agréer, Monsieur le Directeur Général, l'expression de ma considération distinguée. /-

P.J. : - 01 copie d'arrêté



Anong Adibime Pascal

REPUBLIQUE DU CAMEROUN
Paix – Travail – Patrie

MINISTERE DES DOMAINES
ET DES AFFAIRES FONCIERES

REPUBLIC OF CAMEROON
Peace – Work – Fatherland

MINISTRY OF STATE PROPERTY
AND LAND TENURE

ARRETE N° 001004 /Y.14.4/MINDAF/D220 DU 19 NOV 2007
Modifiant et complétant certaines dispositions de l'arrêté n°
000869/Y.14.4/MINDAF/D220 du 23 août 2007 déclarant d'utilité publique
les travaux de construction d'une centrale thermique à fuel ou à gaz et d'une
ligne de transport de 250 ou 90 KV reliant la centrale au réseau de transport
THT/HT existant sur des terrains sis à YASSA, Arrondissement de DOUALA
IIIe, Département du WOURI.

LE MINISTRE DES DOMAINES ET DES AFFAIRES FONCIERES,

- Vu la Constitution ;
- Vu l'ordonnance n°74/1 du 06 juillet 1974 fixant le régime foncier, modifiée et complétée par l'ordonnance n° 77-1 du 10 Janvier 1977 ;
- Vu l'ordonnance n°74/2 du 06 juillet 1974 fixant le régime domanial, modifiée et complétée par l'ordonnance n° 77-2 du 10 Janvier 1977 ;
- Vu la loi n°85/09 du 04 juillet 1985 relative à l'expropriation pour cause d'utilité publique et aux modalités d'indemnisation et son décret d'application n°87/1872 du 16 décembre 1987 ;
- Vu le décret n°2005/178 du 27 mai 2005 portant organisation du Ministère des Domaines et des Affaires Foncières ;
- Vu le décret n°2007/268 du 07 septembre 2007 modifiant et complétant certaines dispositions du décret n°2004/320 du 08 décembre 2004 portant organisation du gouvernement ;
- Vu le décret n°2007/269 du 07 septembre 2007 portant réaménagement du gouvernement ;
- Vu l'arrêté n° 000869/Y.14.4/MINDAF/D220 du 23 avril 2007 déclarant d'utilité publique les travaux de construction d'une centrale thermique à fuel ou à gaz et d'une ligne de transport de 250 ou 90 KV reliant la centrale au réseau de

transport THT/HT existant sur des terrains sis à YASSA, Arrondissement de Douala IIIe, Département du WOURI ;

Vu la lettre du 15 octobre 2007 de Monsieur le Directeur Général de la Société AES-SONEL,

ARRETE:

Article 1^{er} : Les dispositions de l'arrêté n°000869/Y.14.4/MINDAF/D220 du 23 août 2007 sont modifiées et complétées ainsi qu'il suit :

Article 1^{er} nouveau : Sont déclarés d'utilité publique, les travaux de construction d'une centrale thermique à fuel ou à gaz et d'une ligne de transport de 250 ou 90 KV reliant la centrale au réseau de transport THT/HT existant sur des terrains sis à YASSA, Arrondissement de DOUALA IIIe, Département du WOURI, de superficies respectives de 7,66 ha et 4 ha 95a 90ca, et dont les principaux sommets sont définis par les coordonnées ci-après :

Centrale thermique à fuel ou à gaz de YASSA de superficies 7,66 ha.

Liste des coordonnées UTM WGS 84

POINT	X	Y
D1	590911	441904
D2	590979	441890
D3	590995	441883
D4	591237	441832
D5	591191	441611
D6	590864	441675

Ligne de transport de 225 ou 90 KV de superficie 04 ha 95a 90 ca

Liste des coordonnées UTM-WGS 8432 NORD

SOMMET	X	Y
S1	590894	442003
S2	590309	442118
S3	590351	442348
S4	589538	442238

Le reste sans changement.

Article 2 : Le présent arrêté sera enregistré et communiqué partout où besoin sera.

Yaoundé, le **19 NOV 2007**



Anong Adibimé Pascal

L.3 Electromagnetic fields

Baseline Conditions

Background

Electric and magnetic fields are present wherever electricity is used. For the last twenty years it has been widely debated as to whether these fields are damaging to human health. There is a range of divergent views, but the balance of scientific evidence to date suggests that Electromagnetic Fields (EMFs) do not cause disease. However, international organisations such as the International Commission on Non-Ionising Radiation Protection (ICNIRP) and independent states have set guidelines on exposure limits to EMFs to minimise the potential for shocks and interference with the body's nervous system.

A comprehensive literature review was undertaken of the most relevant and up-to-date information on this topic. From this, the potential for impacts to arise from the proposed power transmission line were assessed and the conclusions are reported below.

The information presented here refers to the potential for impacts to arise from a 400kV transmission line. The transmission line between the Dibamba Power Station and the Bakoko substation will be 90kV. Therefore, the potential impacts of the proposed power line will be significantly less than the impacts presented below.

EMF Fundamentals

Electromagnetic fields are produced both naturally and as a result of human activity. Wherever electricity is used there will also be electric and magnetic fields. A key characteristic of a field is the frequency (measured in hertz, Hz). The earth's magnetic and electric fields do not oscillate at all, but most electricity systems in the world produce fields at 50Hz, apart from USA at 60Hz (Electricity Association 2001).

An electric field is generated by voltage, the pressure behind the flow of electricity. The strength, or amplitude, of the electric field depends on the voltage, which remains more or less constant as the line is energised.

Current, the flow of electricity produces magnetic fields, which in the case of a power line would vary according to the demand for power at any given time.

One difference between electric and magnetic fields is that electric fields are easily screened, while magnetic fields pass readily through most buildings.

Potential Impacts

Electromagnetic Field and Distance to Transmission Lines

Transmission lines generate both electric and magnetic fields, which show the highest ground level values directly beneath the line.

The magnetic field produced by a current in a conductor falls with distance from the conductor. Where there is more than one current forming part of one or more electrical circuits there would be partial cancellation between the magnetic fields produced by the individual currents. That cancellation increases at greater distances, leading to the strongest magnetic field at the point closest to the conductors. This field however reduces rapidly

with distance. Similarly, there is partial cancellation between the electric fields produced by the voltages on individual conductors, and the electric field is usually highest at the point of closest approach to the conductors and again falls quite rapidly with distance (Energy Networks Association 2007).

The actual magnetic field depends on the current, the clearance of the line above the ground and the relative phasing of the two circuits. High spans of the transmission lines and transposed phasing, as opposed to 'un-transposed' phasing, produces lower magnetic fields.

In theory, the magnetic field decreases with the inverse square of the distance from a transmission line, with either single or double circuits, but with untransposed phasing. For transmission lines with transposed phasing, the magnetic field declines with the inverse cube of the distance.

The steady-state maximum ground-level magnetic field beneath a transmission line is 100 microteslas (μT), but in practice fields are often below $10\mu\text{T}$ (see Table M.1). Similar considerations apply to electric fields and the maximum ground-level electric field beneath a 400kV line at ideal situations is 11kV per metre (kV/m) (Energy Networks Association 2007).

Table M.1: Typical ground-level field levels from overhead power lines			
		Magnetic Field (μT)	Electric Field (V/m)
The largest steel pylons (275 kV and 400 kV)	Maximum field (under line)	100	11,000
	Typical field (under line)	5-10	3000-5000
	Typical field (25m to side)	1-2	200-500
Smaller Steel Pylons	Maximum field (under line)	40	4,000
	Typical field (under line)	0.5 – 2	1000-2000
	Typical field (25m to side)	0.05-0.2	100-200
Wooden Poles (11 kV and 33 kV)	Maximum field (under line)	7	700
	Typical field (under line)	0.2 – 0.5	200
	Typical field (25m to side)	0.01 – 0.05	10 - 20
<i>Source: Energy Networks Association 2007</i>			

Under a transmission line of up to 400kV there would never be a magnetic field above the ICNIRP reference value of $100\mu\text{T}$ and hence the basic restrictions of a current density of $2\text{mA}/\text{m}^2$ would not be exceeded. According to a European Environment Commission (EEC) report, 2600 ampere on a 420kV line gives a peak field of $55\mu\text{T}$ (National Grid 1996). It should be noted how quickly the magnetic field decreases with distance from the centreline of the power line.

Household appliances powered from the mains electricity produce elevated magnetic fields whenever they draw current (see Table M.2). Such fields generally fall with the inverse

cube of the distance, and at approximately 30m from a transmission line; the magnetic field would be similar to the field at 1 m from a normal household appliance

Table M.2: Typical magnetic fields from household appliances		
	Magnetic Field (μT)	
	Close to Appliance	1 metre away
Electric razor	2,000	0.3
Vacuum Cleaner	800	2
Television	50	0.2
Washing Machine	50	0.2
Bedside Clock	50	0.02
Fridge	2	0.01

Source: National Grid EMF, 2003

For a 400kV Spalding overhead transmission line (National Grid 1996), the calculated electric field at 1m above ground level for a clearance of 7.6m above ground were as follows:

Max. below line	7.86kV/m
At 25m distance	0.54kV/m
At 50m distance	0.33kV/m
At 100m distance	0.11kV/m
At 200m distance	0.03kV/m

(National Grid 1996)

Health Effects

Concern about potential adverse health effects was initially brought to attention by an epidemiological report two decades ago from two American scientists on childhood cancer but have also included worries about the effect of EMF on the nervous and muscular system (Ahlbom *et al.* 2001).

Established Short-term Effects

At the quantum energy of 50Hz, which is the frequency of most transmission lines, electromagnetic fields are too small to break chemical bonds. The main known way 50Hz fields interact with people is by inducing currents. Current densities of about 100mA/m² can stimulate excitable tissue and current densities above about 1000mA/m² can cause ventricular fibrillation as well as producing heating. However, these current densities correspond to fields far larger than ever encountered at 50Hz (Energy Networks Association 2007). The established effect observed in humans at the lowest magnetic field is the

magnetophosphene effect, where a flickering sensation is produced in peripheral vision by 50Hz magnetic fields above about 10,000 μ T.

In certain circumstances, a person exposed to a high electric field could experience small spark discharges on touching other objects, producing a prickling sensation similar to that caused by the static discharges commonly experienced in dry atmospheric conditions. According to the National Radiological Protection Board (2003) in the United Kingdom, the annoying effects caused by electric charge on the surface of the body will not occur at power-frequency electric field strengths below 12kV/m.

Chronic Diseases

Ahlbom *et al.* (2001) have reviewed the epidemiological literature on EMFs and risks of chronic diseases and have concluded that in the absence of experimental evidence and given the methodological uncertainties in literature, there is no chronic disease for which an etiological relation to EMF can be regarded as established.

Biological laboratory research shows that the low level EMFs of the type experienced by the public do not cause the diseases that have been claimed, such as cancer (Electricity Association 2001).

The largest of all epidemiological studies of EMFs and childhood cancer was performed in the 1990s – the United Kingdom Childhood Cancer Study (UKCCS). In 1999 it was reported that the “...study provides no evidence that exposure to magnetic fields associated with the electricity supply in the UK increases risk for childhood leukaemia, cancers of the nervous systems or any other childhood cancer.” In 2002 it was concluded “...there was no evidence that either proximity to electrical installations or the magnetic field levels they produce in the UK is associated with increased risk of childhood leukaemia or any other cancer” (Electricity Association 2001).

Other Health Effects

Breast cancer, cardiovascular disease, suicide and depression remain unresolved issues as stated in the review report by Ahlbom *et al* (2001).

Other Effects

In the environmental statement of a proposed Welsh 132kV transmission line crossing over open agricultural land, it is stated that there would unlikely be any agriculturally significant effects. In addition, by following the British Standard on Radio Interference Characteristics of Overhead Power Lines and High-voltage Equipment (BS5049:1994), the transmission line would not cause interference to radio or television services or to telecommunications systems (AES Barry Ltd 1996).

Electric and magnetic fields due to high voltage overhead power lines constitute a possible source of interference with the operation of some types of implanted cardiac pacemakers (National Grid 1996).

Fear Impact

EMF are not generally understood by the general public and therefore fear can be considered to be the most significant impact perceived with power transmission lines.

Exposure Guidelines and Legislation

Various bodies round the world have issued guidelines on safe levels of exposure to EMFs. Most of them are designed to prevent induced currents having effects on the body.

Cameroon

According to the WHO database for EMF World Wide Standards, there are currently no legislation or guidelines in place in Cameroon regarding exposure to EMF. In the absence of national guidance the Limbe Power Environmental Impact Statement (AES Sonel 2003a) made reference to both the International Commission on Non-Ionising Radiation Protection (ICNIRP) and the National Radiological Protection Borad (NRPB), see discussion below.

ICNIRP

The International Commission on Non-Ionising Radiation Protection (ICNIRP) was established in 1992. The function of the ICNIRP is to investigate the hazards that may be associated with the different forms of non-ionising radiation, develop international guidelines on non-ionising radiation exposure limits and deal with all aspects of non-ionising radiation protection (ICNIRP 1998).

All scientific literature on the health effects of EMF exposure was reviewed by ICNIRP. In general terms for EMF, the only adverse effects that were found to be fully verified were short term, immediate health consequences such as stimulation of the peripheral nerves and muscles (above $100\text{mA}/\text{m}^2$ at 50Hz – which is well above power line current density), functional changes in the nervous system and other tissues, shocks and elevated tissue temperatures ($1000\text{mA}/\text{m}^2$ at 50Hz). Other data for chronic low-level exposure indicate that there may be other health effects. However, according to the ICNIRP the data is insufficient to allow an exposure guideline to be established to this (ICNIRP 1999).

Limiting values are set as *basic restrictions*, which directly relate to established health effects, and *reference levels*, which are derived from the basic restrictions for worst-case exposure situations and are in quantities which are easily measured. The guidelines also differentiate between occupational and general public exposure – the general public guidelines levels for magnetic fields are set at a factor of 5 below the values set for occupational exposure (ICNIRP 1999).

The following ICNIRP are in place for fields at 50 Hz:

- *Basic Restriction*
 - *Occupational exposure – Current density: $10\text{mA}/\text{m}^2$*
 - *General public exposure – Current density: $2\text{mA}/\text{m}^2$*
- *Reference Levels*
 - *Occupational exposure –*

-
- *Electric Field Strength: 10kV/m*
 - *Magnetic Field Strength: 500 μ T*
 - *General public exposure*
 - *Electric Field Strength: 5kV/m*
 - *Magnetic Field Strength: 100 μ T*

European Union

A Recommendation to Member States of the EU on the limitation of exposure of the general public to EMFs in the frequency range 0Hz – 300GHz was passed on 12 July 1999 by the Council of the European Union and published in the Official Journal of the European Communities.

The recommendation is divided in two parts where, firstly, the *basic restrictions* on exposure to time-varying EMFs are based directly on established health effects and biological considerations. Secondly, the *reference levels* are provided for practical exposure-assessment purposes to determine whether the basic restrictions are likely to be exceeded. If the measured value exceeds the reference level, it does not necessarily follow that the basic restriction will be exceeded. However, it should be investigated if that is the case. Additionally, the restrictions are dependent on frequency of the fields.

The relationship between cancer and EMF exposure is considered not to be established. However, since there are safety factors of about 50 between the threshold values for acute effects and the basic restrictions, the recommendation should cover possible long-term effects.

The basic restriction for current density at 50Hz (the frequency for most transmission lines) is 2mA/m².

The reference levels are as follows:

- Electric field strength: 5kV/m;
- Magnetic field strength: 100 μ T.

UK National Radiological Protection Board (NRPB)

The National Radiological Protection Board (NRPB) is the independent body charged by the UK Parliament with giving advice on EMFs, including safe levels of exposure. There are no statutory regulations in the UK, which limit the exposure of people to power-frequency electric or magnetic fields.

The NRPB has recommended guidelines for exposure to EMFs. Guidelines for limiting exposure to electromagnetic fields are presently based on preventing established health effects, which for EMFs at 50Hz are those related to induced currents in the tissues of the central nervous system and indirect effects such as micro-shocks. However, deciding on these guidelines the evidence for all suggested effects of EMFs, including cancer, was

considered but the epidemiological evidence is currently not strong enough to justify a firm conclusion that magnetic fields cause such effects.

The guidelines, expressed as *basic restrictions* (relates directly to the effect on the body of EMF exposure) and *investigation levels* (aid in assessing whether the basic restriction is exceeded or not), are as follows:

- Basic restriction;
 - Induced current density in the central nervous system: $10\text{mA}/\text{m}^2$;
- Investigation levels;
 - Magnetic fields: $1,600\mu\text{T}$
 - Electric fields: $12\text{kV}/\text{m}$

It is the policy of the UK electricity industry to remain within these guidelines (Electricity Association 2001).

The WHO and European Union have launched an initiative aimed at achieving a harmonised international approach to the development of EMF guidelines. In May 2003, the NRPB published a consultation document (NRPB 2003) proposing that exposure guidelines of the ICNIRP be adopted in the UK. The key implication of this proposal would be a five-fold drop in the basic restriction for the general public, reducing the current density for general public exposure from $10\text{mA}/\text{m}^2$ to $2\text{mA}/\text{m}^2$.

Italy

Italy differs from other countries on the issue of limiting EMF to the general public. The limits are set in the law and include details of how close residential buildings are allowed to be to power lines. The restrictions are as follows (EURELECTRIC 2003):

- *Public*
 - *Electric field strength (E-field)*
 - *Exposure for significant periods of the day: $5\text{kV}/\text{m}$*
 - *Exposure limited to a few hours per day: $10\text{kV}/\text{m}$*
 - *Magnetic field strength –*
 - *Exposure for significant periods of the day: $100\mu\text{T}$*
 - *Exposure limited to a few hours per day: $1000\mu\text{T}$*
- *Residential buildings near power lines*
 - *Distance to conductors –*

- *132kV power line: 10m*
- *220kV power line: 18m*
- *380kV power line: 28m*

USA

Apart from countrywide advisory limits in the United States there are also state limits specific to overhead power lines. In Florida the limits are related to distance from transmission line and line voltage. The limits in Florida are as follows (EURELECTRIC 2003):

- *Limits applying to edge of right-of-way*
 - *Electric field strength: 2kV/m*
 - *Magnetic field strength –*
 - *for 230kV lined: 15μT*
 - *for 500kV lines: 20μT*
- *Limits applying everywhere*
 - *Electric field strength*
 - *for 69-230kV lines: 8kV/m*
 - *for 500kV lines: 10kV/m*

Switzerland

Switzerland is the only country in the world to have set national limits for power frequencies based on a precautionary approach to childhood cancer (EMF 2007). It came into force in February 2001 and existing installations have three years to meet its requirements.

The basic limits are similar to many other countries with an electric field limit of 5kV/m and magnetic field limit of 100μT. In addition, for “sensitive use locations” only (rooms in buildings regularly occupied for significant periods of time, children’s playgrounds etc), overhead transmission lines greater than 1kV have a limit of 1μT (some exceptions can be granted) (EURELECTRIC 2003).

South Africa

South Africa follows the ICNIRP guidelines (see above), as stated by the WHO database EMF World Wide Standards (2003).

International Conference on EMF - From bioeffects to legislation

An international conference on EMF was held on 8-9 November 2004 at Ljubljana, Slovenia. The Conference was organized and sponsored by the following scientific and government organizations:

- Institute of Non-Ionizing Radiation (INIS)
- World Health Organization (WHO)
- International Commission on Non-Ionizing Radiation Protection (ICNIRP)
- European Commission (DG EMPL)
- COST 281
- EMF NET
- Forum EMS
- Ministry of Health
- Ministry of Environment
- Ministry of Information Society of the Republic of Slovenia

The Conference conclusions and recommendations were as follows:

- It is openly recognized that the international ICNIRP guidelines are based on the best and most updated available science and, thus, a very wide scientific consensus.
- An assessment of the scientific evidence to date suggests that no adverse health consequences have been established at exposure levels below current international ICNIRP guidelines.
- National authorities in the EU, particularly in the new EU member states and candidate Members of the EU should protect their citizens and workers by adopting international guidelines or use the WHO framework for developing EMF standards for limiting exposure from EMF sources and encouraging compliance with these standards.
- Additional precautionary measures can be adopted, provided they do not undermine the science-based guidelines. The measures could address aspects such as emission limits or technical measures to reduce fields from the EMF sources, but should not modify exposure limits established by international guidelines.

- The recommendations from WHO are to protect human health by adopting the ICNIRP exposure limits as a mandatory requirement and to address continuing public concerns about health effects of EMF exposure by adopting voluntary precautionary measures as follows:
 - Governmental/industrial/academic research program that leads to better health risk assessments;
 - Encourage manufacturers to keep exposures to the minimum needed for the technology;
 - Better risk communication;
 - Target messages to audience with honest and accurate information;
 - Public involvement in decision-making, especially when siting facilities, to minimize EMF exposures and public concern.

Appendix M

AES Sonel Environment and Social Policy



AES - SONEL

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TO : ALL AES-SONEL PERSONNEL

SUBJECT : AES-SONEL ENVIRONMENTAL AND SOCIAL POLICY
(ESP 03) 17 January 2005

AES-SONEL takes its environmental and social responsibility seriously in order to generate, transmit, distribute and supply clean, safe and reliable electrical energy throughout the national territory.

All AES-SONEL businesses are committed to the following principles and implementation measures for a holistic and progress-oriented approach to environmental protection.

Principles:

1. To minimize the impacts of our businesses on the environment throughout Cameroon and ensure the social well being of all Cameroonians are not impaired by our operations;
2. To improve upon our environmental and social performance continuously so that AES-SONEL can aspire within ten (10) years to being within the top decile of utilities throughout the world in respect of its environmental and social performance;
3. To comply with environmental regulations with regards not only to Cameroon but also to international recognized standards and protection measures;
4. To integrate environmental and social factors into business decisions;
5. To ensure that any employee found deliberately flaunting environmental and social standards or procedures shall be subject to disciplinary action;
6. To achieve sustainable development, environmental protection shall constitute an integral part of the development process;
7. To develop and maintain, where significant hazards exist, emergency preparedness plans in conjunction with the emergency services, relevant authorities and the local community, while recognizing potential transboundary impacts.

Implementation:

AES-SONEL business leaders and employees shall implement these principles through the following actions:

- Raising employees' environmental and social awareness by providing training and education to facilitate a full understanding of the environmental implication of current and planned business activities;
- Managing and reducing where practicable the environmental and social impacts caused by our businesses through continual improvement of our operations, particularly emissions to air, discharges to water, disposal of waste and the use of natural resources;
- Establishing clear environmental goals and targets across the company for effective measurement of performance;
- Setting up programmes and an effective environmental and social management system throughout the company;
- Promoting the adoption of environmental and social management practices by contractors, and suppliers.

All AES-SONEL workers are obliged to participate actively and fully in the effective implementation of this initiative through Committees that have been set up across the company.

The publication and dissemination of the Environmental and Social Policy throughout the company is the responsibility of the Corporate Environmental Division assigned by the AES-SONEL management.

The General Manager


Jean David BILE

Douala, 17 January 2005

