King Fahd University of Petroleum & Minerals

Collage of Electrical Engineering

Summer Training Program (EE-399)

In collaboration with:

Islamic Development Bank

Infrastructure Department

Training Advisor:

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ACKNOWLEDGEMENTS

First and foremost, I thank Allah for his guidance and protection throughout my entire life. I feel very proud that Allah, most gracious, most merciful, had given me the health and the energy to glorify his name through the accomplishment of this report.

I wish to thank our great Electrical Engineering Department, for giving me the chance to gain a substantial exposure with the real world of the technical engineering. A great appreciation delivered to my Summer Training adviser Dr. Saad Al- Ahmadi for his valuable assistance to me in order to complete this document by his advises and suggestions.

I would like to express my great honor for being a member in the Islamic Development Bank, hereinafter abbreviated as IDB. Also, I would like to acknowledge my indebtedness to several individuals who have been instrumental for me in the IDB organization. Many thanks to Eng. Hussein Muqaibel and Eng. Edzwan Redza Anwar, my supervisors, whose painstaking guidance have served as exemplary motivation for me.

Abstract

This report begins with introduction to the Islamic Development bank (IDB) organization and the Infrastructure department. This is followed by a description of some activities. After that there will be a case study represents what I did through the training period.

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Acronyms and Abbreviations

ENE	**Energy & ICT Division**
ICT	**International Communication**
IDB	**Islamic Development Bank**
INFD	**Infrastructure Department**
IRTI	**Islamic Research and Training Institute**
KFUPM	**King Fahd university of Petroleum and Minerals**
OMVG	**Gambia River Basin Development Organization**
PLCs	**Programmable Logic Controller**
PPP	**Public Private Partnership**
TD	**Transport Division**
UDD	**Urban Development and Services Division**
	UNITS
GWh	**Gigawatt-hour = 1, 000, 000 kWh**
km	**Kilometer = 1,000 meters**
kWh	**Kilowat-hour = 1,000 Wh**
kV	**Kilovolt = 1,000 volts**
kVA	**Kilovolt Ampere**
m	**Meter**
m^2	**Square Meter**
m^3	**Cubic Meter**
MW	**Megawatt = 1, 000, 000 W or 1, 000 kW**

Introduction:

The Islamic world, which consists of 56 countries, is categorized in most of its countries as third world countries. Excluding the Gulf Counties and some other Islamic countries, about two thirds of the Islamic world is considered as poor countries. Poverty is not just the leak of enough income. It is the leak of the minimum standards of living like education, healthcare, housing and infrastructure services. From this point, the Finance Ministers of Muslim Countries felt the importance of establishing a development organization shared by the Islamic countries. In pursuance of the Declaration of Intent issued by the Conference of Finance Ministers of Muslim Countries held in Jeddah in Dhul Q'adah 1393H, corresponding to December 1973, the Islamic Development Bank (IDB) was established.

1. IDB Group in Brief:

1.1. Overview:

The Islamic Development Bank Group (IDB Group) is a south-south multilateral development financing institution comprising of five entities (Figure 1). They are:

(i) Islamic Development Bank (IDB):

This entity was the first part of the IDB group. It aims to foster the economic development through performing many infrastructure projects or industrial ones in accordance with the principles of Shari'ah (Islamic law).

(ii) Islamic Research and Training Institute:

This comprises research papers, background and discussion papers, seminar proceedings, lectures, and articles published in the IRTI journal "Islamic Economic Studies" (a bi-annual journal published in Arabic, English, and French).

(iii) Islamic Corporation for the Insurance of Investment and Export Credit:

It enhances trade transactions and flow of investments among member countries by providing an export credit insurance and reinsurance to cover non-payment of export receivables resulting from commercial and non-commercial risks.

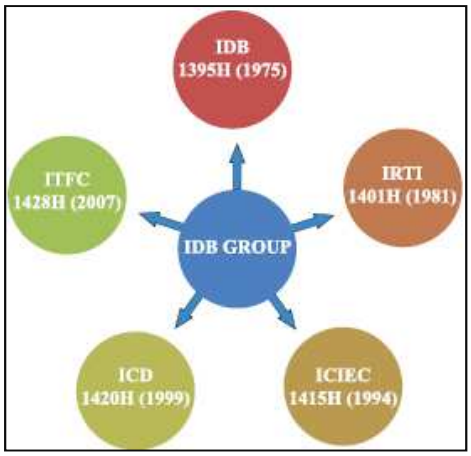
(iv) Islamic Corporation for the Development of the Private Sector:

This institute supports economic development of its member countries through supporting the private sector development in accordance with principles of the Shari'a. Also, it provides advices to governments and private organizations to encourage

the establishment, expansion and modernization of private enterprises.

(v) International Islamic Trade Finance Corporation:

It tries to enhance the trading between its member countries by supporting some of the Islamic world products.



(Figure 1: IDB Group Representation)

1.2. Objective:

In this regard, the following three major strategic objectives have been identified to drive forward the Group actions:

- Poverty alleviation
- Promotion of Islamic financial industry and institutions
- Promotion of cooperation among member countries

1.3. Principle of Operations:

The Islamic Development Bank operates according to the Islamic Shari'ah principles. Shari'ah is the set of rules derived from the Holy Quran, the authentic traditions (Sunnah) of the Prophet (peace be upon him) and the scholarly opinions (Ijtehad) which are based on the Holy Quran and the

Sunnah. The principles of Shariah that govern Islamic banking are the following:-

- Prohibition of interest (riba) in all financial transactions, such as: riba in debts, riba in sales, including forward currency deals and futures exchanges.
- Participation in profit and loss sharing, since return is not guaranteed in an Islamic transaction.

2. IDB:

2.1. Operation Sector:

This represents the heart of the IDB. As the name indicates, any project for IDB is built up in this sector. It consists of 8 departments and they are represented in Appendix (1).

2.1.1. Infrastructure Department:

The Infrastructure department, hereinafter marked as INFD, is one of the most important departments in the bank since the development of proper infrastructure is vital for economic growth of any country. Infrastructure consists of many things such as roads, railways, port and harbor, airport, electricity, telecommunication, water supply etc. The department contains 4 divisions as follow:

1- Energy & ICT Division (ENE):

This division is primarily about energy and communication sectors' development. However, it also participates in funding mining and petroleum projects. The usual types of projects assigned to this division are mainly about constructing power

plants, either thermal or hydro power plants, or electrification projects.

2- Urban Development and Services Division (UDD):

The division concerns about health care, education and training in the urban areas.

3- Transport Division (TD):

Constructing roads, railways or metros is assigned to this division.

4- Public-Private Partnership Division (PPP):

The objective of this division is to encourage the private sectors and the governments to share either constructing or operating, or even both, public projects. Any project from the other divisions involves private sector participation assigned to this division.

3. Summer Internship Program and activities:

3.1. Brief Overview:

The plan of the internship program in the INFD divided the period of the internship into 4 sections.

The first two weeks were mainly about knowing the function of the division. What is the role of the INFD division in the financing process? This was important because it gives a clear clue about the duties of each division's member. The task of the INFD division is mainly about technical revision for the proposed project and to provide a recommendation report for the president.

The second two weeks were mainly about understanding the project cycle in the IDB. It is useful to know what the status of the project is.

The third part of the training period was about studying the IDB standards for choosing the projects and its formal rules in processing them. This is including the studying of the IDB guidelines.

The last part is about the participation in the real work of the division. This part is more explained in the next section of this report.

Throughout the training period, previous projects had been reviewed and here is a short description of them:

- Neelum Jhelum Hydropower Plant Project: this project is in Pakistan and it involves the construction of a hydropower plant capable of producing 5150 GWh annually.
- Low Cost Rural Electrification Project: This project is in Mozambique. It aims to connect around 9000 household to electricity in the northern region of the country.
- The 110 KV Aigul Tash to Samat Transmission Line and Substation Project, Kyrgyz Republic.
- Hamma Power Plant Extension Project, Algeria.

4. CASESTUDY

THE SAMBANGALOU AND KALÉTA HYDROELETRIC POWERPLANTS AND THEIR 225KV INTERCONNECTION (OMVG Project)

4.1. Project Introduction:

The Gambia River Basin Development Organization (OMVG) applied for the IDB involvement in funding the first phase of the OMVG project. The organization provided the bank with the feasibility study along with the technical designs of the project.

The OMVG regroups Gambia, Guinea, Guinea-Bissau and Senegal. This sub-regional organization is the execution organ of integrated development programs for the four member countries for a rational and harmonious exploitation of common resources in the basins of the Gambia, Kayanga-Gébas and Koliba-Corubals Rivers.

The main purpose of the Project is to provide low-cost renewable energy to four countries of West Africa, thus improving the well being of the local populations and encouraging the economic development of this region of the world. This Project will also permit to reduce substantially the consumption of petroleum products required by the thermal power generating stations, thus preserving the environment and reinforcing the energy independence of the countries.

The project was assigned to the ENE division to review the project from a technical aspect of view and the assigned team was:

1- Eng. Hussein Muqaibel, Electrical Eng. ,KFUPM.
2- Eng. Edzwan Redza Anwar, Civil Eng. Bristol University.
3- Summer Intern Saleh Mohammad, Internship, KFUPM student.

4.2. Project Description:

The project involves the four OMVG countries, i.e. Gambia, Guinea, Guinea Bissau, and Senegal. It includes two hydroelectric power stations, one at Sambangalou in Senegal with an installed power capacity of 160MW at rated hydraulic head, and the other in Kaleta, Guinea, with an installed power capacity of 228MW at rated hydraulic head. A 1,677-km, 225kV transmission network joins the four countries and is fed by the output of both power stations. Fifteen substations will supply power to population aggregates along the network. The project map is represented in Appendix 2. The structure of the proposed energy project is composed of 2 main phases:

- Hydroelectric Development of Sambangalou and Kaléta.
- Interconnection of power grids 225kV, 1,677 km long in 4 member states.

4.2.1. Hydroelectric Development:

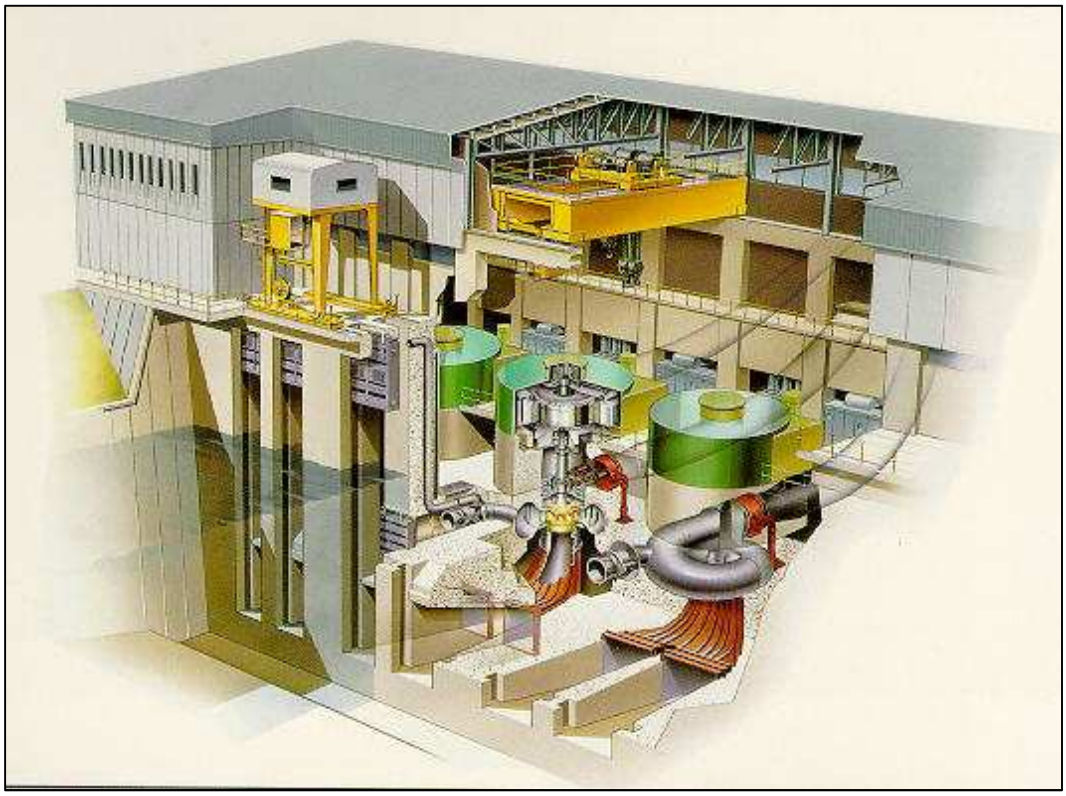
4.2.1.1. Dams Construction:

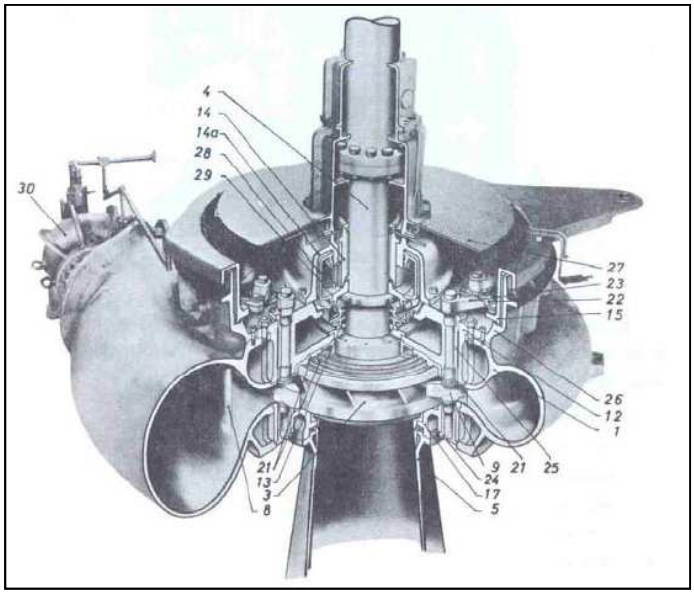
The hydroelectric development starts with civil work in both of the locations. Two dams will be built in Sambangalou and Kaléta so that one of the dams will work as a water reservoir during the dry seasons of the year. This will provide the second dam, powerhouse dam, with enough water to maintain an optimum head for the turbines to run at a constant speed throughout the year.

The reservoir dam has a height of 90 m above natural ground, and its length will be 573 m. Its volume will be 3.8 million m^3. Appendix 3 contains the location and proposed designs for the dam.

4.2.1.2. Powerhouse dam:

The rated head of the dam is 46m in both locations, Sambangalou and Kaléta. Each powerhouse has 4 installed turbines all are of a vertical Francis turbine type (Figure 3).



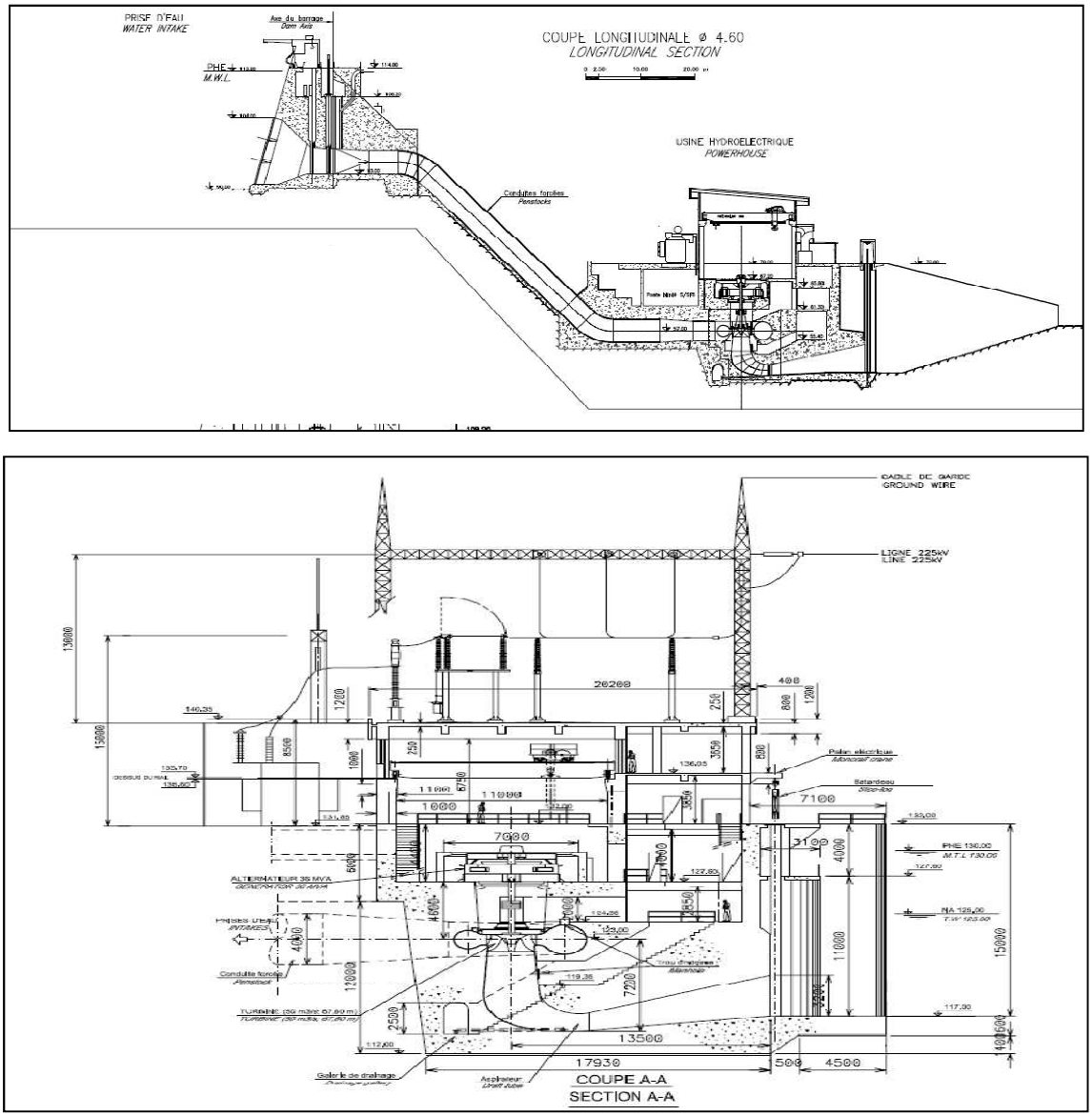


(Figure 2: General View of the Vertical Francis Turbines)

The turbines specifications are as follow:

- 90 m^3/s flow and 180 m^3/s , two by two.
- Nominal shaft speed, no load, is 176.47 rpm for the 90 m^3/s and 138.43 for the 180 m^3/s.
- Efficiency is 0.93

So, the nominal shaft power is 38 MW for the 90 m^3/s and 76MW for the 180 m^3/s.



(Figure 3: Power House Representation)

4.2.1.3. Electrical Equipments:

The hydroelectric plant will be equipped with four synchronous, three phases, 36MVA vertical axis generators. The generating voltage is 10.2kV. The automatic voltage regulator will keep the voltage stable at all times, without oscillations. Given the large size of the OMVG network and the stability problems that could occur the excitation systems will be static type and equipped with power stabilizers. 15kV cables will be used to connect the generators to their unit transformers.

A 100kVA emergency diesel generating set will be installed to feed the essential services in case of network black-out. Other electrical equipments are as follow:

- Medium voltage switchgear, connected to the generator terminals, with voltage and current transformers, protection and measuring circuits, isolating switches and protective relays;
- Neutral point and its grounding device;
- Medium and low voltage auxiliary power services;
- Autonomous power supplies, both direct current and inverted (uninterrupted power supply);
- Process control system with its PLCs for starting/shutting down, protection, measuring and various back-up relays for security;
- Local control equipment and those in the control room, with screens and digital control systems as well as measuring centers;
- External lighting, dam lighting, access road and bank lighting;
- Normal and back-up internal lighting, exit lights;
- Electric test bed and the electronics laboratory
- Safety and life saving equipment

For the Sambangalou plant, the line circuit breakers, the by-pass switches and the measuring transformers will be located the Sambangalou substation 1.7km farther down due to the space limitation.

Conclusion:

In conclusion, the Summer training program was a good chance for me to learn about the real application and problems in the engineering field, especially in my major. During my Summer training, I learned how to be an employee before being an engineer. Also, I learned how to manipulate the real world facts in order to apply theories and science.

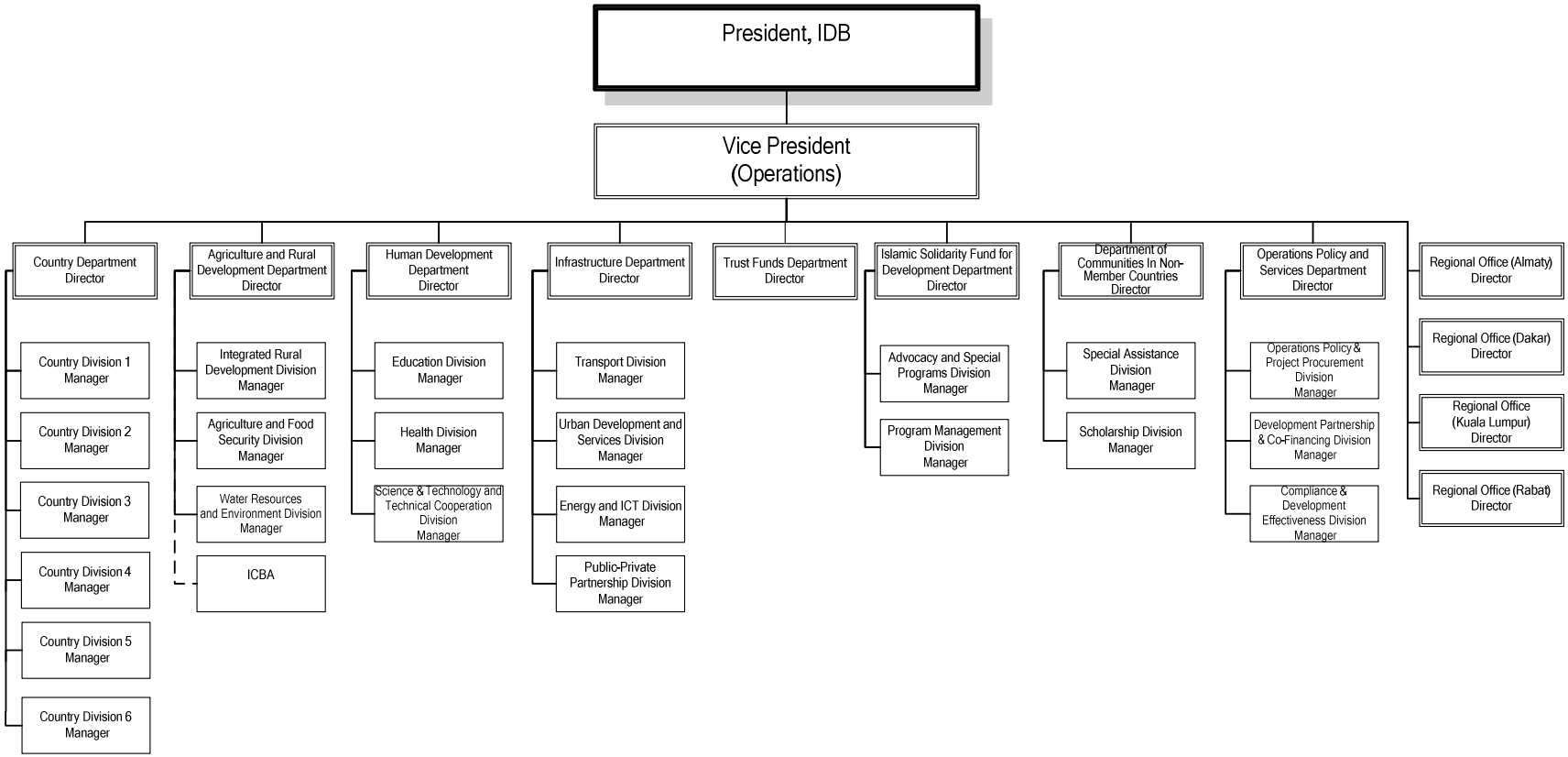
However, working to the Islamic Development Bank is something special. Because you are not working for an organization or country but you aim to serve the entire Islamic world. Each time we are assigned a project, we try to work at it as fast and as good as possible because we know that millions of our brothers are waiting for the project. I am really happy with what I have done and what I have gained during my training period and I think that I did the right choice when I selected IDB to spent my training in.

Appendixes

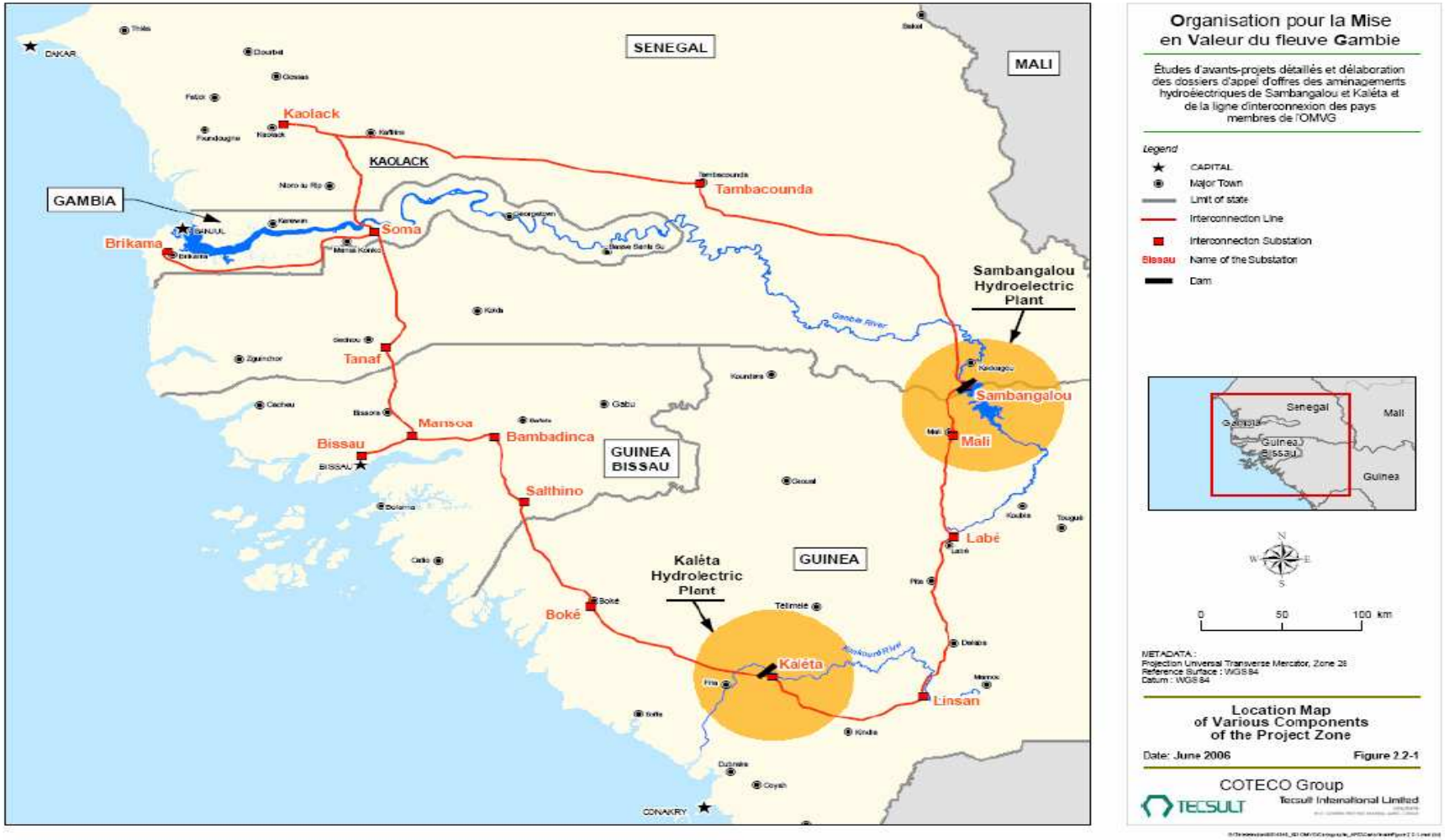
Appendix 1

ISLAMIC DEVELOPMENT BANK

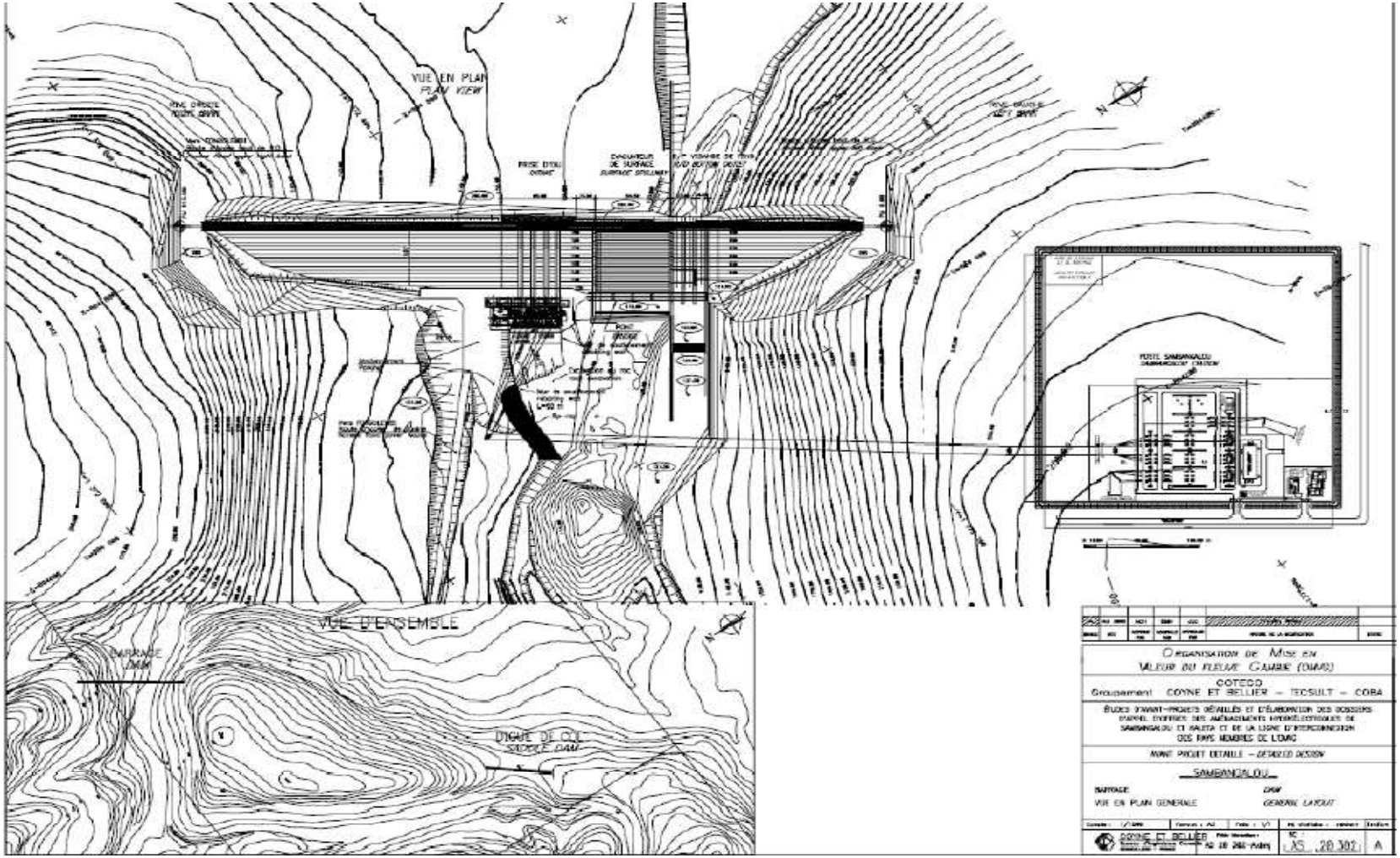
BASIC AND SECONDARY ORGANIZATION STRUCTURE OF THE VICE PRESIDENT (OPERATIONS) COMPLEX



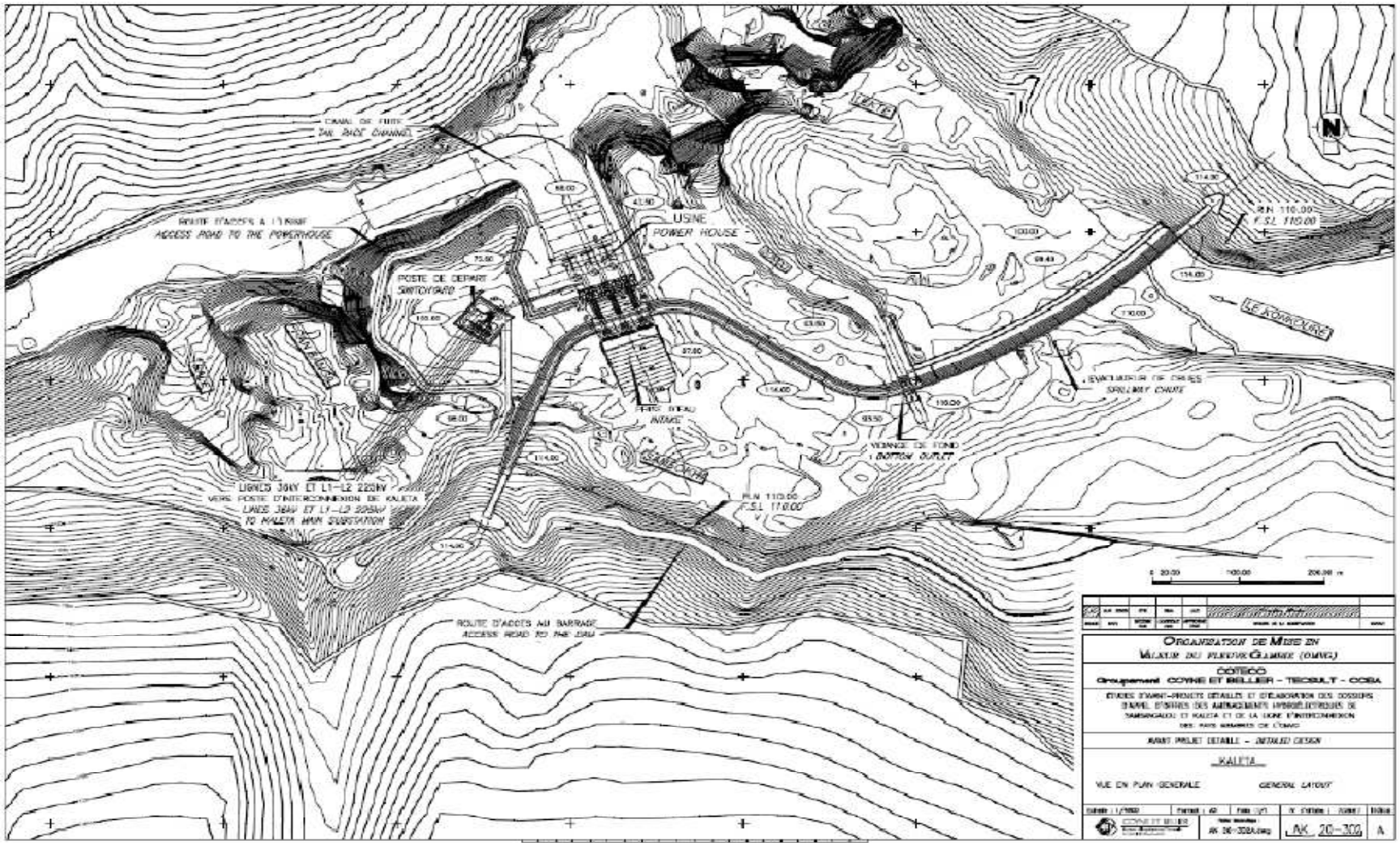
Appendix 2


SENEGAL
MALI
GAMBIA
GUINEA BISSAU
GUINEA
Kaolack
KAOLACK
Tambacounda
Soma
Brikama
Tanaf
Mansoa
Bissau
Bambadinca
Salthino
Boké
Kaléta Hydroelectric Plant
Kaléta
Sambangalou Hydroelectric Plant
Sambangalou
Mali
Labé
Linsan
DAKAR
BANJUL
CONAKRY
Gambia River
Organisation pour la Mise en Valeur du fleuve Gambie
Études d'avants-projets détaillés et délaboration des dossiers d'appel d'offres des aménagements hydroélectriques de Sambangalou et Kaléta et de la ligne d'interconnexion des pays membres de l'OMVG
Legend
CAPITAL
Major Town
Limit of state
Interconnection Line
Interconnection Substation
Name of the Substation
Dam
Senegal
Mali
Guinea Bissau
Guinea
0
50
100 km
METADATA :
Projection Universal Transverse Mercator, Zone 28
Reference Surface : WGS 84
Datum : WGS 84
Location Map of Various Components of the Project Zone
Date: June 2006
Figure 2.2-1
COTECO Group
TECSULT
Tecsult International Limited

Appendix 3-A


VUE EN PLAN
PLAN VIEW
VUE D'ENSEMBLE
DIGUE DE COL
SADDLE DAM
POSTE SAMBANGALOU
Organisation de Mise en
Valeur du fleuve Gambie (OMVG)
COTECO
Groupement COYNE ET BELLIER – TECSULT – COBA
ETUDES D'AVANT-PROJETS DETAILLES ET D'ELABORATION DES DOSSIERS
D'APPEL D'OFFRES DES AMENAGEMENTS HYDROELECTRIQUES DE
SAMBANGALOU ET SAMBA KI ET DE LA LIGNE D'INTERCONNEXION
DES PAYS MEMBRES DE L'OMVG
AVANT PROJET DETAILLE – DETAILED DESIGN
SAMBANGALOU
BARRAGE
VUE EN PLAN GENERALE
DAM
GENERAL LAYOUT
COYNE ET BELLIER
AS 28 302
A

Appendix 3-B


USINE
POWER HOUSE
ROUTE D'ACCES A L'USINE
ACCESS ROAD TO THE POWERHOUSE
POSTE DE DEPART
SWITCHYARD
CANAL DE FUITE
TAIL RACE CHANNEL
LIGNES 30kV ET L1-L2 225kV
VERS POSTE D'INTERCONNEXION DE KALETA
LINES 30kV ET L1-L2 225kV
TO KALETA MAIN SUBSTATION
ROUTE D'ACCES AU BARRAGE
ACCESS ROAD TO THE DAM
PRISE D'EAU
INTAKE
VIDANGE DE FOND
BOTTOM OUTLET
EVACUATEUR DE CRUES
SPILLWAY CHUTE
LE KOUROUSSA
N
PLN 110.00
F.S.L 115.00
PLN 110.00
F.S.L 118.00
ORGANISATION DE MISE EN
VALEUR DU FLEUVE GAMBIE (OMVG)
CETEC
Groupement COYNE ET BELLIER - TECSULT - CCBA
ETUDES D'AVANT-PROJETS DETAILLES ET D'ELABORATION DES DOSSIERS
D'APPEL D'OFFRES DES AMENAGEMENTS HYDROELECTRIQUES DE
SAMBANGALOU ET KALETA ET DE LA LIGNE D'INTERCONNEXION
DES PAYS MEMBRES DE L'OMVG
AVANT PROJET DETAILLE - DETAILED DESIGN
KALETA
VUE EN PLAN GENERALE
GENERAL LAYOUT
AK 20-300
A

Reference:

1- www.isdb.org

2- Standard Handbook for Electrical Engineer

3- Feasibility Studies of Each Project

4- Siemens Technical Education Program Books

5- Guidelines for the Use of Consultants Under IDB FINANCING

6- Procurement of Goods and Works Guidelines