Chapter 3 Project Evaluation

3-1 Preconditions for the implementation of the Project

The HFO-fired diesel generators (5 MW capacity x 2 sets) are to be installed for the Project run on heavy fuel oil. Therefore, the preconditions are receiving and transporting heavy fuel oil, and repairing the storage tank. Since this Project is an Emergency Rehabilitation Project, any delay in progress could impact its production of effect. So that this does not occur, the possibility of using light oil that can currently be procured in Liberia for normal operations has also been anticipated, and the installation of light oil storage facilities (10-day storage capacity) is included in the scope of the Project.

The Liberian side is also responsible for obtaining environmental permits related to the Project is preconditions for implementation of the Project.

A summary of preconditions for implementing the project are as shown below.

- The building of a facility to unload heavy fuel oil into Liberia, building storage tank facilities, and the repair of transfer pipes to the Bushrod Power Station are preconditions. Plans for this work are progressing as investment projects for private corporations.
- The building of a heavy fuel oil storage tank facility within the Bushrod Power Station is a precondition. This is planned as a LESEP component.
- Obtaining environmental permission is a precondition. As required in the Liberian environmental impact assessment guidelines, a Project Brief will be submitted to the Environmental Protection Agency (EPA) by the LEC using a local consultant.

3-2 Necessary Inputs by Recipient Country

In order produce and sustain the effects of the Project, the Liberian side should address the following issues.

(1) Prior to start of work

- The Liberian side is required to level the ground, etc. at installation sites within the Bushrod Power Station that are relevant to the HFO-fired diesel generators provided through the Project. They are also required to make budget provisions relevant to Liberian-side work without delay.
- The Liberian side is required to procure a local consultant promptly after the Project is approved by the Cabinet and submit a Project Brief to the EPA.
- The Liberian side is required to assign engineers and operations/maintenance personnel to engage in the operations and maintenance management of the HFO-fired diesel generators provided through the Project. They are also required to create a system for operations and maintenance management.

(2) During the construction period and after service is started

- Coordinating with the work schedule for the Japanese side procurement and installation of the HFO-fired diesel generators for the Project, the Liberian side is required to perform connection work such as final connections to the existing high speed diesel generators. This includes planned power outages (including notifying users, processing disputes, and providing compensation).

- The Liberian side is required to select an engineer to be in charge of the Project, and to ensure the smooth progression of work through the creation of a work schedule plan, personnel plan, and materials/equipment purchase plan, etc.

- Based on the operations and maintenance management plan created in advance, the Liberian side is required to promptly assign engineers and operations personnel to participate in soft component programs such as "initial operating instruction" and "operations instruction" that will be implemented during the installation work period. In addition to having engineers participate in training, the Liberian side must also ensure that skills are spread laterally to other engineers who did not participate in the training.

- The Liberian side is required to provide tax exemptions and assistance in regard to necessary materials and equipment, as well as Japanese national dispatched for the Project.

- After completion of Japanese-side work, the Liberian side is required to ensure the smooth progression of installation for the 22kV distribution lines and low-voltage distribution lines, as well as connection work to users so that effects of the Project are promptly produced.

- The Liberian side must make budget provisions to ensure that operations and maintenance management of the HFO-fired diesel generator and auxiliary equipment provided through the Project is conducted appropriately. To secure those funds, it is necessary to collect electricity fees based on an appropriate rate system.

3-3 External Conditions

External conditions that are preconditions for producing and sustaining the effects of the project are as shown below.

(1) For priority objectives

- Policies regarding the improvement of the Monrovia power supply are not changed.

- The government and the economy are stable.

(2) For project objectives

- Operations and maintenance management is performed continuously.

- Security for the facility is ensured.

(3) For anticipated results

- Facilities for unloading, transporting and storing heavy fuel oil are repaired.
- The distribution line installation project is executed according to the plan.
- Connecting power to users is expedited through a resident or GPOBA subsidy system to shoulder connection fees.
- Electricity charge is paid properly

3-4 Project Evaluation

3-4-1 Relevance

As shown below, this Project contributes to the implementation of Liberia's development plan and energy policies while providing a service that widely benefits public facilities and residents of the target area, including impoverished people. Therefore, it is determined that the relevance of the Project is high.

(1) Compatibility with upper level plans

1) Compatibility with the National Energy Policy (NEP), January 2009

For the National Energy Policy, which is the upper level plan for the electrical power sector, the following four points are given as the pillars for the policy. This Project contributes to the fulfillment of ① and ② of the policy.

Four Pillars of the National Energy Policy

① **Establish universal access to energy including establishment of an energy master plan**
② **Protect vulnerable customers and minimize energy production cost**
③ **Apply world-class best practices to the energy sector**
④ **Promote public private partnership (PPP) in the energy sector**

In addition, the NEP has set a goal of 30% as the rate for access to trustworthy and modern energy in the capital and greater metropolitan area by 2015. In the Electric Master Plan formulated by the LEC, a goal was set to bring the current 1% rate of connection to electrical power users to 14% by 2015. The implementation of the Project contributes to realizing this Master Plan, thus contributing to achieving the goals for energy access as given in the NEP.

2) Compatibility with the Liberia Electricity System Enhancement Project (LESEP)

For the emergency rehabilitation of the electrical power system that was destroyed by civil war, the Liberia Electricity System Enhancement Project (LESEP) was begun in November 2010 mainly by the World Bank, in cooperation with other donors. Emergency rehabilitation of the power distribution grid within Monrovia was completed by the EU, and as shown in Table 1-4-2, a large portion of the aid funds was earmarked for the installation of 22 kV distribution lines, low-voltage distribution lines, and for a connection fee subsidy system for low-income residents.

Adding to the 10 MW HFO-fired diesel generator system of the Project, the World Bank provided additional funding to LESEP for a 10 MW HFO-fired diesel generator. A 10 MW HFO-fired diesel generator is also planned with support from the government of Liberia, with the current capacity to be increased to 15 MW for HFO-fired diesel generation equipment.

Transmission and distribution line work is progressing with assistance from other donors, and coordination is balanced between the Project, the World Bank's additional funding for LESEP, and the development of power sources by LEC with its owns funds.

3) Compatibility with Liberia Electricity Corporation's Electric Master Plan

In order to improve power supply conditions in Monrovia and the LEC's financial standing, LEC and the Ministry of Lands, Mines and Energy entered into a 5-year management contract with Manitoba Hydro International (MHI) in July 2010. The objectives of the management contract as shown in Table 3-4-1-1. To meet these targets, LEC and MHI formulated the Electric Master Plan in March 2011 and revised in June 2012 as a road map for distribution line installation in Monrovia.

The Electric Master Plan indicates a policy for securing electrical power through HFO-fired diesel generators for the medium-term, and from the Western Africa Power Pool (WAPP) for the medium to long-term. Power distribution is planned according to the progress of power source development and the scale of fund procurement for the power transmission and distribution project. The road map for distribution work is formulated based on the assumption of beginning operations of a new 10 MW HFO-fired diesel generator in 2013~2014.

Table 3-4-1-1 Target described in Management Contract

		2011	2012	2013	2014	2015
		First year	Second year	Third year	Fourth year	Fifth year
New Connection	Each year	3,000	5,000	7,000	8,000	10,000
	Estimated	3,000	8,000	15,000	23,000	33,000
Power supply loss		23%	15%	12%	12%	12%
Power fee correction rate		94%	95%	97%	97%	97%

Source: LEC Electric Master Plan

(2) Benefits

This Project is designed for emergency rehabilitation of power source facilities in the capital of Monrovia, where emergency rehabilitation of the electrical power system is progressing. Not only for regular households, will the Project also allow for the stable supply of power to hospitals, schools, public facilities, and major industries in the supply district. The following describes the benefits that can be expected for a wide range of the general population, including impoverished people.

1) Improvement of the lives of the general population, including impoverished people

In urban areas of Monrovia, there are 213,781 private households (2008 census). In contrast, as of October 2012, LEC supplies power to only 11,000 residential users. Following the aforementioned Master Plan, LEC plans to increase the number of connected residences to 33,000 in the next five years (began in 2011). However, as of 2012, while the transformer for the only power plant in Liberia (Bushrod) has a transmission capacity of 10 MVA (max. dispatched capacity of 8.5 MW when assuming the power factor at 0.85), the maximum demand power has been recorded at 8.3 MW. Thus, it can be seen that power generation capacity falls short of what is necessary to implement the plan. The 10 MW HFO-fired diesel generator equipment provided though the Project is critical to the Master Plan, and its effects widely contribute to the lives of the general population, including impoverished people.

2) Contribution to medical facility operations

The target region for the Project is the capital city of Monrovia, where the highest level of medical practice in the Liberian hospital network is conducted. The country's only tertiary care facility and national hospital are also located here. Liberia's hospital network system and the number of medical facilities in Monrovia are shown in Table In addition to the national hospital in Monrovia, there are also two state hospitals that are used as secondary care facilities. It is estimated that there approximately 180 health centers and clinics, including non-governmental facilities. (Basis for calculation, see Table 3-4-1-2 Remarks)

The JFK Medical Center (national hospital with 250 outpatients and 160 inpatients) is currently obtaining power from the LEC electrical system, but struggles with the unstable power supply (voltage drops, frequency changes). The use of basic diagnostic equipment such as ultrasound scanners, fluoroscopic x-ray apparatus and endoscopes used by doctors is hindered.

Redemption Hospital is a secondary care facility that received power from LEC's commercial system until one year ago. However, since the large fluctuations in voltage and frequency caused malfunctions in expensive medical equipment such as fluoroscopic x-ray apparatus and the electricity fees were exorbitantly high, they cancelled LEC commercial system services. They then shifted to a system of obtaining 24-hour power from their own generation facilities (two generators).

Health centers (operated 24-hours) and clinics (8:00 a.m. ~ 4:00 p.m.) store drugs and vaccines in refrigerators powered by photovoltaic systems and use gas-burner sterilizers. Although photovoltaic systems are furnished with batteries, recharging is insufficient during the rainy season, often causing a situation where power cannot be obtained. The shortage of grid power due to insufficient supply capacity obstructs the use of necessary medical and electrical equipment in primary health care.

The Project will improve power supplying capabilities and allow these commercial medical facilities to be connected to the power supply.

Table 3-4-1-2 Number of Medical Facilities in Monrovia City

Medical level	Tertiary health care	Secondary health care	Primary health care
Medical facilities responsible	National hospital	County hospital	Health Center Clinic
Number of Medical facilities	1 Facility ➢ JFK Medical Center	2 facilities ➢ Redemption Hospital ➢ James N. David & Son Memorial Hospital	*1) Assumed to be 180

Remarks: *1) According to the national census of 2008, the population of Montserrat County is 1,118,241, while the population of Monrovia is 970,824. (Approximately 87% of the total county population is concentrated in capital of Monrovia.) As there is no statistical data for the city of Monrovia alone, this proportion is used to estimate the number of facilities within Monrovia.

3) Contribution to educational facility operations

The target region for the Project is the Liberian capital city of Monrovia, where the University of Liberia, Stella Maris Polytechnic, and other higher education institutions that foster the human resources who will shoulder the industry and economy of the next generation are located. Electrical equipment such as computers for educational purposes is used for computer skills lectures and for creating course materials. As of October 2012, the supply capacity is insufficient, and the number of users connected to the LEC commercial system is stopped at 11,000. Education facilities remain unconnected to the commercial system. Therefore, each school operates its own power generating equipment, with a technical department created at the institutions for operations and maintenance. Since synchronized operation of the school generators is not possible, multiple generators must be placed in different areas of the school, creating inefficient operating conditions.

There are also several primary, middle, and secondary schools in the target region for the Project, as shown in Table 3-4-1-3. Due to power shortages, the same educational equipment used in schools in other developing countries such as computers and television (for showing educational programs) cannot be used. This hinders the acquisition of knowledge and skills necessary in society. The implementation of the Project will make the supply of power possible, which will improve this situation.

Table 3-4-1-3 Number of schools and students in Monrovia City

	Primary (6 years)	Secondary (3 years)	Tertiary (3 years)
*1) Number of schools in Monrovia City	1,114 schools	550 schools	200 schools
Average scale of school in country Montserrado County	163 peoples/school	100 peoples/school	186 peoples/school
*1) Estimated number of students	181,139 peoples	55,059 peoples	37,078 peoples

Remarks: *1) According to the national census of 2008, the population of Montserrado County is 1,118,241, while the population of Monrovia is 970,824. (Approximately 87% of the total county population is concentrated in capital of Monrovia.) As there is no statistical data for the city of Monrovia alone, this proportion is used to estimate the number of facilities within Monrovia.

(3) Urgency

The maximum demand in 1980 before the civil war was 74 MW. In contrast, the maximum demand in 2011 was 8.3 MW, creating a serious power shortage for Monrovia, which must function as the capital city. The emergency rehabilitation of transmission lines by the EU has been completed, and LESEP continues to progress with work on distribution in cooperation with donors. Securing funds related to power source development and distribution work is an urgent issue for improving the power supply in Monrovia. In the LEC Electric Master Plan as well, a road map was formulated with the precondition of the development of 10 MW-class HFO-fired diesel generators provided through the Project in 2013~2014. Therefore, the urgency level of the Project is high.

(4) Operations and management capacity

As a Japanese Grant Aid project, the Monrovia Power Supply Improvement Plan (1988) was implemented in Liberia and HFO-fired diesel generators were installed. The specifications for the HFO-fired diesel generators planned for procurement and installation through the Project are of the same level as the equipment procured in the past with Grant Aid, and the technology needed for operations and maintenance management does not exceed that level.

However, with the outflow of engineers caused by the civil war and the stagnation of operations and maintenance work over several years, LEC's level of technology related to diesel generator management has declined. In addition the "initial operating instruction" and "operations instruction" provided by the manufacturer during the installation period of the diesel generators provided through the Project, capabilities will be enhanced through soft component services implemented by a consultant.

In regard to the content and input plan for soft components, considering that technology will be transferred from MHI during the 5-year contracted period for management with LEC, the scope of implementation shown in Item 2-2-4-8 "Soft Component Plan" is thought to be sufficient in developing operations and maintenance management technology.

3-4-2 Effectiveness

Effects that are expected with the implementation of the Project are as follows.

(1) Quantitative effects

Indicators	Baseline data (FY 2012)	Anticipated achievement Without Project (FY2017)	Target achievement With Project (FY2017)
Capacity of generation equipment (Firm capacity)	**8MW**	**40MW** [Breakdown] Existing : 15MW World Bank : 10MW GOL : 10MW Mt. Coffee (Hydro repair) : 5MW	**50MW** [Breakdown] Existing : 15MW World Bank : 10MW GOL : 10MW Japan's grant : 10MW Mt. Coffee (Hydro repair) : 5MW
Fuel cost per unit power generation	24.7 cent/kWh 100% (current level)	18.3 cent/kWh (74%)	18.2 cent/kWh ✳ (73.8%)

✳ Estimated as ;HFO / Diesel oil cost ratio = 90%, Middle speed unit / High speed unit fuel consumption ratio = 90%.

(2) Qualitative effects

Current situation and problems	Project measures	Effects of the plan and degree of improvement
(Medical facilities) The target region for the Project is the capital city of Monrovia, where the only tertiary care facility and national hospital are located. In addition to the national hospital in Monrovia, there are also two state hospitals that are secondary care facilities. It is estimated that there are approximately 180 health centers and clinics, including non-governmental facilities. The JFK Medical Center is currently obtaining power from the LEC electrical system, but struggles with the unstable power supply. The use of basic diagnostic equipment such as ultrasound scanners, fluoroscopic x-ray apparatus, and endoscopes used by doctors is hindered.	The components of the Project that contribute to the improvement of the power supply in Monrovia are as follows. (1) Installation of HFO-fired diesel generators at the Bushrod Power Station with a facility capacity of 10 MW (5 MW × 2) (2) Procurement of maintenance management vehicles ➢ Truck for transporting maintenance workers (5-seater): 5 ➢ Aerial bucket truck: 1 ➢ Auger and crane truck: 1 ➢ 2.9t crane truck: 2	Through the Project, the supply of power will be improved so that basic diagnostic equipment needed by doctors such as fluoroscopic x-ray apparatus, etc. can be used in a stable manner. Based on the data, medicine can be practiced in a stable manner. Additionally, the medical environment will be improved not only for area residents, but also for emergency patient and outpatients that come from distant regions. Through this project, the supply of power will be improved so that refrigerators for drugs/vaccines and sterilizers, etc. can be used with assurance. With this, basic medical care at health centers and clinics, as well as home visits in the community for vaccinations can be conducted in a stable manner. This

Current situation and problems	Project measures	Effects of the plan and degree of improvement
Redemption Hospital (secondary care facility) obtained power from LEC's commercial system until one year ago. However, since the large fluctuations in voltage and frequency caused malfunctions in expensive medical equipment such as fluoroscopic x-ray apparatus and the electricity fees were exorbitant, they cancelled LEC commercial system services. They then shifted to a system of obtaining 24-hour power from their own generation facilities using two generators. Health centers and clinics store drugs and vaccines in refrigerators powered by photovoltaic systems and use gas-burner sterilizers. Although photovoltaic systems are furnished with batteries, recharging is insufficient during the rainy season, often causing a situation where power cannot be obtained. The shortage of grid power due to insufficient supply capacity obstructs the use of necessary medical and electrical equipment.		will contribute to maintain the health of patients, including many children and pregnant women. Additionally, patients can also be seen safely at night. <Summary of benefitting facilities in Monrovia> ・National hospital: 1 ・State hospital: 2 ・Heath centers/clinics: approx. 180 Examples of benefiting facilities: <JFK Medical Center> ・No. of outpatients: total 250/day ・No. of beds: 500 ・No. of inpatients: 160 ・No. of doctors: 6 ・Area served: all of Liberia (area pop. 1.2 million) <Redemption Hospital> ・No. of outpatients: 800/day ・No. of beds: 205 ・No. of inpatients: 300 ・No. of doctors: 9 (residents) ・Area served: Bushrod Island (area pop. 250,000) <Clara Health Center> ・No. of outpatients: 150/day ・No. of beds: 12 ・No. of inpatients: none ・No. of doctors: none (visiting doctor once a week) ・Area served: Port facility area (area pop. 86,000)
(Educational facilities) The target region for the Project is the capital city of Monrovia, where the University of Liberia, Stella Maris Polytechnic, and other higher education institutions that foster the human resources who will shoulder the industry and economy of the next generation are located. As of September 2012, the supply capacity is insufficient, and the number of users connected to the LEC commercial system is stopped at 11,000. Education facilities remain unconnected to the commercial system. Therefore, each school operates its own power	Same as above	Through the Project, the supply of power will be improved so that lighting facilities, computers, equipment for experiments and training can be used at educational institutions in the target area in a stable manner, thus stimulating educational activities. Additionally, since power is stably supplied from the commercial electricity system, management work the generators installed at each school will be reduced. <Summary of benefitting facilities in Monrovia> ・Primary school: 1 ・Junior high school: 2

Current situation and problems	Project measures	Effects of the plan and degree of improvement
generating equipment, with a technical department created at the institutions for operations and maintenance. Since synchronized operation of the school generators is not possible, multiple generators must be placed in different areas of the school, creating inefficient operating conditions. There are also several primary, middle, and secondary schools in the target region for the Project, as shown in Table 4-4-3. Due to power shortages, the same educational equipment used in schools in other developing countries such as computers and television (for showing educational programs) cannot be used. This hinders the acquisition of knowledge and skills necessary in society.		・High/secondary school: approx. 180 Examples of benefiting facilities: <University of Liberia> ・No. of students: approx. 23,000 ・No. of instructors: <Stella Maris Polytechnic> ・No. of students: approx. 2,000 ・No. of instructors: approx. 6,700
Foreign direct investment In Monrovia, the unstable power supply and high electricity fees are obstacles for foreign direct investment. According to a statement by the Minister of Land, Mines, and Energy, investment opportunities of one million dollars were lost in 2011.	Same as above	Through the Project, power supply capacity will be strengthened, and by introducing medium speed diesel generators using low-cost HFO, the supply of power will stabilize and lowering electricity rates will become possible. Increased foreign direct investment in Liberia, the creation of job opportunities, and stimulation of the economy are expected.

Appendices

A- 1 Member List of the Study Team

LIST OF TEAM MEMBERS
(First Field Survey)

Name	Assignment	Organization
Teruyuki ITO	Team Leader	Japan International Corporation Agency
Naoto FURUKAWA	Planning Management	Japan International Corporation Agency
Kyoji FUJII	Chief Consultant / Power Development Plan	Yachiyo Engineering Co., Ltd.
Kazunari NOGAMI	Deputy Chief Consultant/ Generation Equipment Design (Diesel Engine Generator)	Yachiyo Engineering Co., Ltd.
Masayuki TAMAI	Transmission and Distribution Equipment Design	Yachiyo Engineering Co., Ltd.
Takashi HARA	Environment and Social Considerations	Yachiyo Engineering Co., Ltd.

LIST OF TEAM MEMBERS
(Second Field Survey)

Name	Assignment	Organization
Hitoshi SATO	Team Leader	Japan International Corporation Agency (Ghana Office)
Maki OKUSA	Planning Management	Japan International Corporation Agency (Ghana Office)
Kyoji FUJII	Chief Consultant / Power Development Plan	Yachiyo Engineering Co., Ltd.
Kazunari NOGAMI	Deputy Chief Consultant/ Generation Equipment Design (Diesel Engine Generator)	Yachiyo Engineering Co., Ltd.
Toru FUJII	Procurement and Installation Plan/ Cost Estimation	Yachiyo Engineering Co., Ltd.
Masayuki TAMAI	Transmission and Distribution Equipment Design	Yachiyo Engineering Co., Ltd.
Takashi HARA	Social and Environmental Considerations	Yachiyo Engineering Co., Ltd.
Susumu IMAI	Architectural Facilities Design/ Natural Condition Survey/ Cost Estimation	Yachiyo Engineering Co., Ltd.
Seiichi OYAMADA	Coordinator/ Assistance for Generation Equipment Design	Yachiyo Engineering Co., Ltd.

LIST OF TEAM MEMBERS
(Supplementary Field Survey)

Name	Assignment	Organization
Kyoji FUJII	Chief Consultant / Power Development Plan	Yachiyo Engineering Co., Ltd.

LIST OF TEAM MEMBERS
(Explanation on Draft Final Report)

Name	Assignment	Organization
Fuyuki SAGARA	Team Leader	Japan International Corporation Agency (Ghana Office)
Naoto FURUKAWA	Planning Management	Japan International Corporation Agency
Kyoji FUJII	Chief Consultant / Power Development Plan	Yachiyo Engineering Co., Ltd.
Kazunari NOGAMI	Deputy Chief Consultant/ Generation Equipment Design (Diesel Engine Generator)	Yachiyo Engineering Co., Ltd.
Toru FUJII	Procurement and Installation Plan/ Cost Estimation	Yachiyo Engineering Co., Ltd.

A-2 Study Schedule

Preparatory Survey on the Project for Rehabilitation of Monrovia Power System in the Republic of Liberia (First Field Survey)

No.	Date	Day	Contents of Survey						Accommodation
			Officials (JICA)		Consultants (Yachiyo Engineering Co., LTD.)				
			Team Leader	Planning Management	Chief Consultant/ Power Development Plan	Social and Environmental Considerations	Transmission and Distribution Equipment Design	Deputy Chief Consultant/ Generation Equipment Design	
			Teruyuki ITO	Naoto FURUKAWA	Kyoji FUJII	Takashi HARA	Masayuki TAMAI	Kazunari NOGAMI	
1	11th Sep.	Sun.			· Trip by air {Narita 11:45 to London 16:20 by JL-401}				London
2	12th Sep.	Mon.		· Trip {Haneda→London} · Trip by air {London 14:40 to Accra 20:20 by BA-081}					Accra
3	13th Sep.	Tue.	· Trip {Narita→}	· Courtesy call and, explanation of and discussion on survey contents and schedule to JICA Ghana Office · Courtesy call and, explanation of and discussion on survey contents and schedule to EOJ				· Trip {Narita→Paris}	Accra/ Paris
4	14th Sep.	Wed.	· Trip {→Paris→Monrovia}	· Trip by air {Accra 13:00 to Monrovia 15:00 by KQ-508}				· Trip {Paris→Monrovia}	Monrovia
5	15th Sep.	Thu.	· Courtesy call and, explanation of and discussion on survey contents and schedule to MLME · Courtesy call and, explanation of and discussion on survey contents and schedule toLEC · Discussion on components of the Project with LEC						Monrovia
6	16th Sep.	Fri.	· Data collection from the World Bank · Data collection from USAI · Data collection from NORAD · Discussion on the draft MD with LEC			· Data collection from Environmental Authorities · Data collection from Road Management Authorities	· Site Survey (Transmission and Distribution Planning)	· Site Survey (Generation Planning)	Monrovia
7	17th Sep.	Sat.	· Site Survey (Land Condition Survey for Generators, Fuel Storage Equipment and, Transmission Route Survey)						Monrovia
8	18th Sep.	Sun.	· Internal meeting						Monrovia
9	19th Sep.	Mon.	· Discussion on the draft MD with MLME · Discussion on the draft MD with LEC · Signing on MD			· Site Survey (Transmission and Distribution Route Survey)		· Site Survey (Generation Planning)	Monrovia
10	20th Sep.	Tue.	· Trip {Monrovia→Accra } · Report to JICA Ghana Office · Report to EOJ · Trip {Accra→London}		· Site Survey (Transmission and Distribution Route Survey)				Monrovia
11	21st Sep.	Wed.	· Trip {London→}		· Site Survey (Generation and Substation Planning)				Monrovia
12	22nd Sep.	Thu.	· Trip {→Haneda}		· Site Survey (Transmission and Distribution Route Survey)				Monrovia
13	23rd Sep.	Fri.			· Discussion on components of the Project with LEC				Monrovia
14	24th Sep.	Sat.			· Preparation of Field Report				Monrovia
15	25th Sep.	Sun.			· Preparation of Field Report				Monrovia
16	26th Sep.	Mon.			· Explanation of Field Report to MLME and Signing · Explanation of Field Report to LEC and Signing				Monrovia
17	27th Sep.	Tue.			· Preparation of Field Report in Japanese (Issues to be discussed in Japan and results of survey scoped before First Field Survey)				Monrovia
18	28th Sep.	Wed.			· Trip {Monrovia 17:30 to Accra 19:30 by KQ-509}				Accra
19	29th Sep.	Thu.			· Report of results of the First Field Survey to JICA Ghana Office · Report of results of the First Field Survey to EOJ · Trip {Accra 22:45 to London 06:25+1 by BA-078}				in Plane
20	30th Sep.	Fri.			· Trip {London 19:15 to Narita 15:00+1 by JL-402}				in Plane
21	1st Oct.	Sat.							Japan

Abbreviation

EOJ	Embassy of Japan
JICA	Japan International Cooperation Agency
MLME	Ministry of Land, Mines and Energy
LEC	Liberia Electricity Corporation
WB	World Bank
USAID	United States Agency for International Development
NORAD	Norwegian Agency for Development Cooperation
MD	Minutes of Discussion

Preparatory Survey on the Project for Rehabilitation of Monrovia Power System in the Republic of Liberia (Second Field Survey)

No.	Date	Day	Contents of Survey				Stay
			Officials (JICA)		Consultant (Yachiyo Engineering Co., Ltd.)		
			Team Leader	Planning Management	Chief Consultant / Power Development Plan	Other Consultant Members	
			Hitoshi Sato	Maki Okusa	Kyoji Fujii	Kazunari Nogami, Toru Fujii, Masayuki Tamai, Takashi Hara, Susumu Imai, Seiichi	
1	10-Jan	Tue			・Trip by air {Haneda 01:30→Paris 06:20 by JL-041} ・Trip by air {Paris 10:30→Monrovia 18:10 by AF-752}		Monrovia
2	11-Jan	Wed			・Courtesy call, explanation and discussion on survey contents and schedule to MLME ・Courtesy call, explanation and discussion on survey contents and schedule to LEC		Monrovia
3	12-Jan	Thu			・Discussion with LEC on the Project Components ・Preparation of subcontract for geological and topographic survey		Monrovia
4	13-Jan	Fri			・Site Survey (Generation, Transmission and Distribution) ・Survey on procurement and construction companies, request for cost estimation ・Preparation of subcontract for geological and topographic survey		Monrovia
5	14-Jan	Sat			・Survey for transportation route for generators ・Preparation of subcontract for geological and topographic survey		Monrovia
6	15-Jan	Sun			Internal Meeting		Monrovia
7	16-Jan	Mon			・Site Survey (Generation and Transmission) ・Subcontract works for geological and topographic survey		Monrovia
8	17-Jan	Tue			・Subcontract works for geological and topographic survey ・Identification of issues relating to operation and maintenance ・Survey on finance of LEC ・Survey on power transmission expansion program ・Survey on tariff and tariff collection rate ・Initial environment examination		Monrovia
9	18-Jan	Wed			Ditto		Monrovia
10	19-Jan	Thu			Ditto		Monrovia
11	20-Jan	Fri			Ditto		Monrovia
12	21-Jan	Sat			・Survey on port facilities		Monrovia
13	22-Jan	Sun		・Travel by air {Accra 13:00 →Monrovia 15:00 by KQ-509}	Internal Meeting		Monrovia
14	23-Jan	Mon		・Courtesy call to MLME ・Discussion on the project components with MLME ・Courtesy call to LEC ・Discussion on the project components with LEC		・Basic design on power generation facility ・Initial environmental examination ・Preparation of technical note ・Preparation of the field report	Monrovia
15	24-Jan	Tue		・Discussion on the project components with LEC ・Data collection from the World Bank ・Data collection from the USAID ・Data collection from the NORAD		ditto	Monrovia
16	25-Jan	Wed	・Travel by air {Accra→ Monrovia}	・Discussion on Minutes of Discussion with MLME ・Site Survey (Generation, Transmission and Distribution)		ditto	Monrovia
17	26-Jan	Thu	・Discussion on the Minutes of Discussion with MLME ・Discussion on the Minutes of Discussion with LEC ・Sign on the Minutes on Discussion			ditto	Monrovia
18	27-Jan	Fri	・Travel by air {Monrovia→Accra} ・Report to JICA Ghana ・Report to EOJ		・Basic design on power generation facility ・Initial environmental examination ・Preparation of the field report ・Survey on procurement and construction conditions		Monrovia
19	28-Jan	Sat			ditto		Monrovia
20	29-Jan	Sun			Internal Meeting		Monrovia
21	30-Jan	Mon			・Submission of the field report to LEC ・Explanation and discussion on the field report		Monrovia
22	31-Jan	Tue			・Explanation and discussion on the field report ・Preparation of the field report in Japanese		Monrovia
23	1-Feb	Wed			Ditto		Monrovia
24	2-Feb	Thu			Ditto		Monrovia
25	3-Feb	Fri			・Explanation of the field report to MLME and sign on the report ・Explanation of the field report to LEC and sign on the report		Monrovia
26	4-Feb	Sat			・Preparation of the field report in Japanese		Monrovia
27	5-Feb	Sun			・Travel by air {Monrovia 18:25→Accra 20:25 by DL-135}		Accra
28	6-Feb	Mon			・Submission of the field report to JICA Ghana and explanation of the survey ・Report of the survey to EOJ ・Travel by air {Accra 23:30→London 06:20+1 by BA-078}		on plain
29	7-Feb	Tue			・Travel b y air {London 19:00→Narita 16:00+1 by JL-402}		on plain
30	8-Feb	Wed			・Travel by air {arrival in Narita at 16:00 by JL-402}		Japan

Abbreviation

EOJ	Embassy of Japan
JICA	Japan International Cooperation Agency
MLME	Ministry of Land, Mines and Energy
LEC	Liberia Electricity Corporation
WB	World Bank
USAID	United States Agency for International Development
NORAD	Norwegian Agency for Development Cooperation
MD	Minutes of Discussion

Preparatory Survey on the Project for Rehabilitation of Monrovia Power System in the Republic of Liberia (Supplemental Survey)

No.	Date	Day	Contents of Field Survey Consultant Member Mr. Kyoji Fujii	Stay at
1	August 7	Tue	Trip {Tokyo 00:40→Paris 06:20 by JL041}、{Paris 10:30→Monroiva 17:05 by AF752}	Monrovia
2	August 8	Wed	①Courtesy call to MLME and LEC ②Confirmation on the components of revised request ③Field survey at Bushrod Power Station	ditto
3	August 9	Thu	- Submission of a draft Minutes of Discussions - Discussion on the scope and components of revised request	ditto
4	August 10	Fri	①Signing of M/D with LEC ③Courtesy call to JICA Liberia Field Office ④Trip{Monrovia 19:10→Paris 06:00+1 by AF755}	on board
5	August 11	Sat	Trip{arrival in Paris 06:00 by AF755}、{Paris 11:00→Tokyo 06:00+1 byJL042}	on board
6	August 12	Sun	arrival in Tokyo 06:00 by JL042	

[Remarks]

MLME : Ministry of Lands, Mines and Energy
LEC : Liberia Electricity Coprporation
JICA : Japan International Cooperation Agency
M/D : Minutes of Discussions

Preparatory Survey on the Project for Rehabilitation of Monrovia Power System in the Republic of Liberia (Explanation on Draft Final Report)

No.	Date	Day	Contents of Survey				Stay
			Officials (JICA)		Consultant (Yachiyo Engineering Co., Ltd.)		
			Team Leader	Planning Management	Chief Consultant / Power Development Plan	Other Consultant Members	
			Fuyuki Sagara	Naoto Furukawa	Kyoji Fujii	Kazunari Nogami, Toru Fujii	
1	15-Oct	Mon			・Courtesy call to MEWR, NPA and JICA Sierra Leone Office	・Trip by air {Narita 11:10→Paris 16:45 by JL-405}	
2	16-Oct	Tue			・Joint Cordination Comitee	・Trip by air {Paris 10:30→Monrovia 17:05 by AF-752}	Monrovia
3	17-Oct	Wed			・Workshop for NPA	・Courtesy call to LEC and JICA Liberia Field Office	Monrovia
4	18-Oct	Thu			・Confirmation of minutes of meeting for Joint Cordination Comitee	・Explanation of Preparatory Survey Reports	Monrovia
5	19-Oct	Fri			・Report to JICA Sierra Leone Field Office ・Trip by air {Free Town 17:30→Accra 19:50 by KQ511}	ditto	Monrovia
6	20-Oct	Sat			・Trip by air {Accra 13:00→Monrovia 15:00 by KQ508}	Internal Meeting and field survey at Bushrod power station	Monrovia
7	21-Oct	Sun		・Trip by air {Haneda 01:00→Monrovia 17:00 by SN245}	・Internal Meeting and field survey at Bushrod power station		Monrovia
8	22-Oct	Mon	・Trip by air {Accra→Monrovia}	・Courtesy call to Minister of MLME, LEC and JICA Liberia Field Office ・Explanation of Preparatory Survey Report ・Discussion of M/D			Monrovia
9	23-Oct	Tue	・Explanation of Preparatory Survey Report ・Discussion of M/D				Monrovia
10	24-Oct	Wed	・Explanation of Preparatory Survey Report ・Discussion of M/D				Monrovia
11	25-Oct	Thu	・Signing of M/D ・Report to JICA Liberia Field Office ・Trip by air {Monrovia 18:35→Accra 20:40 by DL27}	・Signing of M/D ・Report to JICA Liberia Field Office ・Trip by air {Monrovia 18:35→Accra 20:40 by DL27, Accra 22:45→London 06:25+1 by BA78}		・Signing of M/D ・Report to JICA Liberia Field Office	on plain
12	26-Oct	Fri		・Trip by air {London 08:55→Haneda 04:55+1 by BA007}	・Trip by air {London 19:15→Narita 15:00+1 by JL402}	・Supplementary field survey ・Trip by air {Monrovia 19:10→Paris 06:00+1 by AF755}	on plain
13	27-Oct	Sat		・Arrival at Haneda 04:55 by BA007	・Arrival at Narita 15:00 by JL402	・Arrival at Paris 06:00 by AF755 ・Trip by air {Paris 19:30→Narita 14:20+1 by JL406}	on plain
14	28-Oct	Sun				・Arrival at Narita 14:20 by JL406	

Abbreviation

MEWR	Ministry of Energy and Water Resources in Sierra Leone
MLME	Ministry of Land, Mines and Energy in Liberia
NPA	National Power Authority in Sierra Leone
LEC	Liberia Electricity Corporation
JICA	Japan International Cooperation Agency
M/D	Minutes of Discussions

A-3 List of Parties Concerned In Recipient Country

A-3. List of Parties Concerned in the Recipient Country

Name and Organization	Position
Ministry of Lands, Mines and Energy (MLME)	
Hon. Roosevelt G. Jayjay	Minister
Atty. Peter Y. Kerkula	Chief of Staff
Mr. Saye H. Gwaikolo	Technical Assistant to Minister
Mr. George Y. Mullin	Assistant Minister
Mr. Syo M. Maugui	Director/Energy
Mr. Sylvester M. Massaquoi	Director/Alternative Energy
Mr. Edward M. Konneh	Assistant Director/Energy
Mr. J.Y. Gbarbea	Assistant Director
Mr. Morris Kanneh	Land Reform Program Coordinator
Liberia Electricity Corporation (LEC)	
Mr. Shahid Mohammad	Chief Executive Officer
Mr. Joseph T. Mayah	Deputy Chief Executive Officer
Mr. Bill Jasura	Chief Finance Officer
Mr. Henry A. Lewis, Sr.	Training Manager
Mr. Matthew F. Konai	Acting Planning Manager
Mr. David F. Beyan	Generation Manager
Mr. Kelly Smith	Sr. Generation Manager
Mr. Abu D. Sanso	Acting T&D Manager
Mr. Arthur S. Johnson	Planning Engineer
Mr. Jacob Dukuly	Planning Engineer
Environmental Protection Agency of Liberia (EPA)	
Mr. Nathaniel T. Blama, Sr.	Deputy Executive Director
Mr. Johansen Voker	Planning Manager
Mr. David K. Wah	Compliance Manager
Mr. Varney Conneh	EIA Coordinator
Ministry of Public Works	
Mr. Samuel F. Kpakio	Director, Zoning Inspectorate
The World Bank	
Ms. Fanny Missfeldt-Ringius	Senior Energy Economist, Africa Energy Department
Ms. Coleen R. Littlejohn	Sr. Operations Officer, the World Bank Country Office in Liberia

Ms. Kristin Kelly Stroup	Energy Specialist, Africa Energy Department
African Development Bank (AfDB)	
Mr. Mbonapeka Alain-Pierre	Principal Results Officer
USAID Liberia	
Mr. Michael L. Boyd	Senior Economic Growth Officer
Mr. Danijel Dasic	Infrastructure Advisor
Delegation of the European Union to Liberia	
Ms. Paula Vazquez Horyaans	Head of Section Operation
Mr. Giorgio Kirchmayr	Charge of Programmes Infrastructure
Royal Norwegian Embassy in Ghana	
Mr. Fred R. Rasmussen	Counselor
Embassy of Japan in Ghana	
Mr. Hisanabu MOCHIZUKI	Counselor
Ms. Yumi MAEDA	Second Secretary
JICA Ghana Office	
Mr. Jiro INAMURA	Chief Representative
Mr. Kouichi KITO	Senior Representative
Mr. Fuyuki SAGARA	Senior Representative
Ms. Maki OKUSA	Project Formulation Advisor
Mr. Ichiro FUKUHARA	Project Formulation Advisor
JICA Liberia Field Office	
Mr. Shitaru MIURA	Country Manager
Ms. Kie Maegawa	General Affaire/Training Program
Norway Consultant	
Ms. Kine Gosse	Project Engineer
Local Consultant (Environment) **Earthtime Inc.**	
Mr. Wassim A. Hamdan	President

A-4 Minutes of Discussions（M/D）

First Field Survey

Minutes of Discussions
on the Preparatory Survey on the Project for
Rehabilitation of Monrovia Power System
in the Republic of Liberia

In response to the request from the Government of the Republic of Liberia, the Japan International Cooperation Agency (hereinafter referred to as "JICA"), in consultation with the Government of Japan, decided to conduct a Preparatory Survey (hereinafter referred to as "the Survey") on the Project for Rehabilitation of Monrovia Power System (hereinafter referred to as "the Project").

JICA sent to the Republic of Liberia the Preparatory Survey Team (hereinafter referred to as "the Team"), headed by Mr. Teruyuki ITO, Director for Electric Power Division, Natural Resources and Energy Group, Industrial Development and Public Policy Department, JICA. The Team is scheduled to stay in the country from September 14 to September 28, 2011.

The Team held discussions with the officials of concerned authorities in Liberia (hereinafter referred to as "the Liberian side"). In the course of the discussions, both sides have confirmed the main items described in the sheets attached hereto.

Monrovia, September 19th, 2011

Mr. Teruyuki Ito
Leader
Preparatory Survey Team
Japan International Cooperation Agency

Hon. Roosevelt G. Jayjay
Minister
Ministry of Lands, Mines and Energy

Mr. Shahid Mohammed
Chief Executive Officer
Liberia Electricity Corporation
19/9/2011

ATTACHMENT

1. Objective of the Project

The objective of the Project is to ensure the continuous supply of electric power to most part of Monrovia.

2. Project Site

The Project site is located in Monrovia City as shown in Annex-1.

3. Responsible and Implementing Organization

(1) The responsible ministry is the Ministry of Lands, Mines and Energy (MLME).
(2) The implementing organization is the Liberia Electricity Corporation (LEC).
(3) The Organization Structure of LEC is shown in Annex-2.

4. Requested component from Liberian side

Confirmed requests and the priority (A, the highest, to D, the lowest) of the Project from Liberian side are as follows.

(1) Installation of 2x5 MW HFO-fired medium speed diesel generators — A
(2) Construction of new power house in existing Bushrod Power Plant — A
(3) Suitable modification of the 66/22 kV substation system at Bushrod island to include the following items — A
   - One (1) 15 MVA 22/66 kV transformer to connect the 10x1 MW USAID funded power plant to the 66 kV bus
   - One (1) 7 MVA 22/66 kV transformer to connect the 5x1 MW NORAD funded power plant to the 66 kV bus

(4) Construction of 22kV/400-230V distribution substation (10 sets) in the blocks defined by — B
   - Education Ministry
   - Finance Ministry
   - Justice Ministry
   - Ecobank
   - Centennial Pavillion
   - IB Bank
   - Civil Service Agency
   - Roxy Cinema
   - Holiday Inn
   - Excusive Superstore

   Insulated overhead aerial cables strung on galvanized poles, pad-mounted 500kVA/1,000 kVA transformers preferred.

(5) Installation of 400/230 V underground distribution system in central Monrovia — B
(6) Construction of overhead distribution network from ELWA junction to Marshall City junction — B
(7) Supply of maintenance vehicles — A
   - Five (5) special purpose/dedicated crew trucks/lorries
   - Two (2) multiple purpose bucket trucks equipped with
     - ✓ A bucket
     - ✓ An augur
     - ✓ A tree trimming cutter
     - ✓ A pole lifter
   - Two (2) 7 ton crane trucks

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The Team explained that the requested 7 components are considered as candidate components to be implemented; however, the items of the components might be adjusted due to the budget frameworks of the Japanese side and result of the survey.

5. Japan's Grant Aid Scheme

(1) JICA confirmed that the Liberian side understood Japan's Grant Aid Scheme explained by the Team as described in Annex-3 and 4.

(2) The Liberian side will take the necessary measures, as described in Annex-5, for smooth implementation of the Project as prerequisites for the Japan's Grant Aid to be implemented.

6. Schedule of the Survey

The Team will continue the Survey in Liberia until September 28, 2011.

7. Other Relevant Issues

(1) Status of the Survey

The Team explained that the purpose of the Survey is to collect information and data necessary for the outline design and cost estimation of the Project components which are confirmed through the Survey and the analysis in Japan.

(3) Coordination among relevant projects

The Team requested the Liberian side to ensure coordination among relevant projects for smooth implementation of the Project. The Team explained to the Liberian side that the Project needs to coordinate with the project of World Bank, which is to rehabilitate Heavy Fuel Oil (HFO) storage facilities in LEC compound, and the project to be conducted by private company, which is to rehabilitate HFO unloading and transfer facilities. The Liberian side accepted to provide the Team with information regarding the construction schedule, commissioning date and specification of equipment of the above projects to be conducted by World Bank and private company.

(4) Environmental and Social Considerations

a) The Team requested the Liberian side to conduct the required environmental procedures, and obtain approval on environmental clearance for implementation of the Project.

b) The Liberian side agreed to comply with the JICA Guidelines for Environmental and Social Considerations (hereinafter referred to as "JICA Guidelines") as well as laws and regulations in Liberia, and was requested to prepare Environmental Checklist and Monitoring Form which are designated by JICA Guidelines for an outline design.

c) The Liberian side agreed to make necessary arrangements with governmental organizations concerned in order to secure funding for and execution of the above environmental matters in a schedule as required for smooth execution of the Project.

d) The Liberian side agreed to complete necessary procedures by May, 2012.

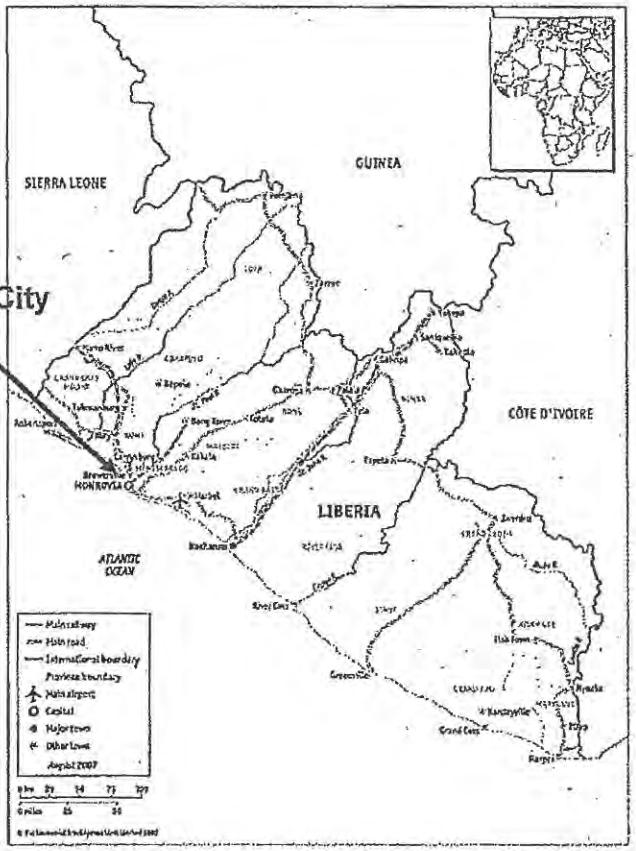
(End)

Annex-1	Project Sites
Annex-2	Organization Chart of LEC
Annex-3	Japan's Grant Aid
Annex-4	Flow Chart of Japan's Grant Aid Procedures
Annex-5	Major Undertakings to be taken by Each Government

19/9/2011

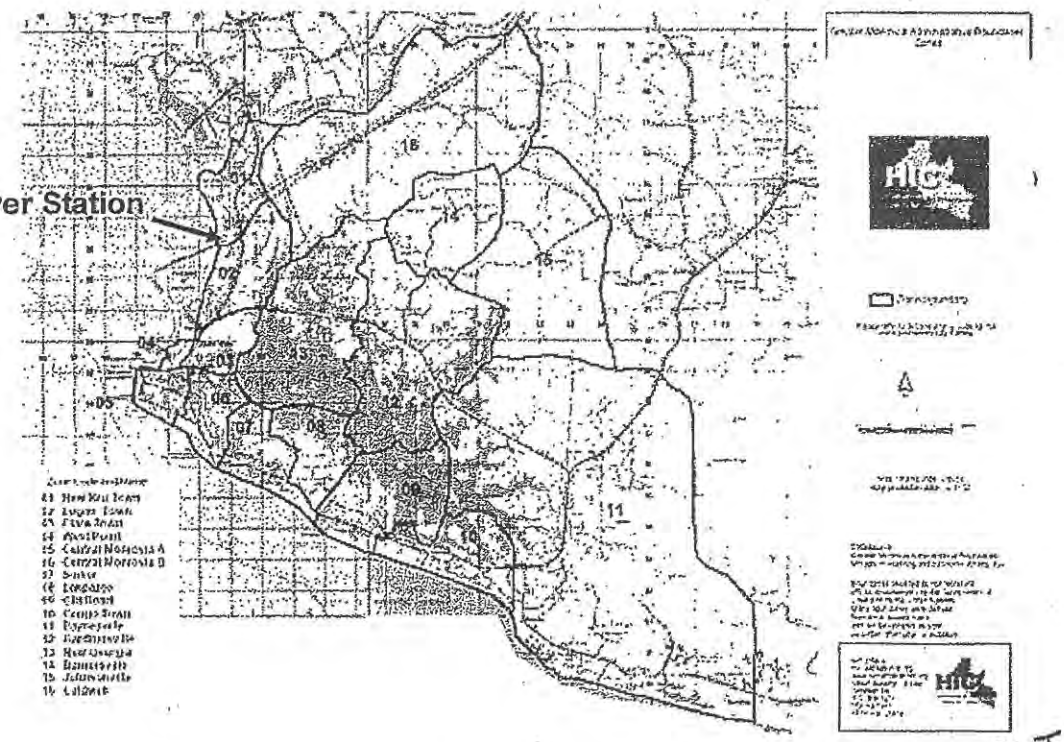
Annex 1

Project Sites



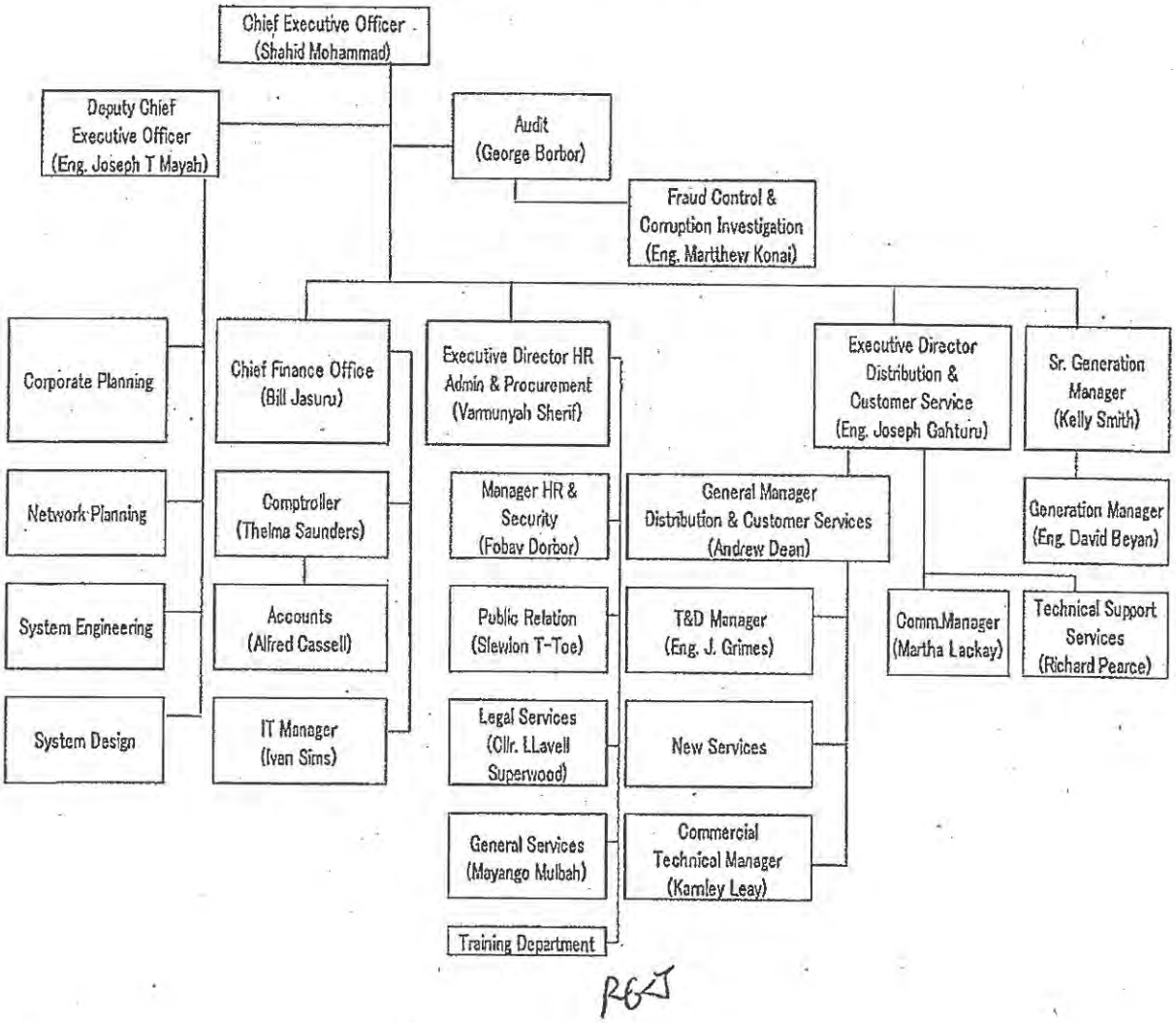
Monrovia City

Bush rod Power Station



Annex 2

Organization Chart of LEC



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Annex-3

Japan's Grant Aid

The Government of Japan (hereinafter referred to as "the GOJ") is implementing the organizational reforms to improve the quality of ODA operations, and as a part of this realignment, a new JICA law was entered into effect on October 1, 2008. Based on this law and the decision of the GOJ, JICA has become the executing agency of the Grant Aid for General Projects, for Fisheries and for Cultural Cooperation, etc.

The Grant Aid is non-reimbursable fund provided to a recipient country to procure the facilities, equipment and services (engineering services and transportation of the products, etc.) for its economic and social development in accordance with the relevant laws and regulations of Japan. The Grant Aid is not supplied through the donation of materials as such.

1. Grant Aid Procedures

The Japanese Grant Aid is supplied through following procedures :

・Preparatory Survey
- The Survey conducted by JICA

・Appraisal &Approval
-Appraisal by the GOJ and JICA, and Approval by the Japanese Cabinet

・Authority for Determining Implementation
-The Notes exchanged between the GOJ and a recipient country

・Grant Agreement (hereinafter referred to as "the G/A")
-Agreement concluded between JICA and a recipient country

・Implementation
-Implementation of the Project on the basis of the G/A

2. Preparatory Survey

(1) Contents of the Survey

The aim of the preparatory Survey is to provide a basic document necessary for the appraisal of the Project made by the GOJ and JICA. The contents of the Survey are as follows:

- Confirmation of the background, objectives, and benefits of the Project and also institutional capacity of relevant agencies of the recipient country necessary for the implementation of the Project.
- Evaluation of the appropriateness of the Project to be implemented under the Grant Aid Scheme from a technical, financial, social and economic point of view.
- Confirmation of items agreed between both parties concerning the basic concept of the Project.
- Preparation of a basic design of the Project.

- Estimation of costs of the Project.

The contents of the original request by the recipient country are not necessarily approved in their initial form as the contents of the Grant Aid project. The Basic Design of the Project is confirmed based on the guidelines of the Japan's Grant Aid scheme.

JICA requests the Government of the recipient country to take whatever measures necessary to achieve its self-reliance in the implementation of the Project. Such measures must be guaranteed even though they may fall outside of the jurisdiction of the organization of the recipient country which actually implements the Project. Therefore, the implementation of the Project is confirmed by all relevant organizations of the recipient country based on the Minutes of Discussions.

(2) Selection of Consultants

For smooth implementation of the Survey, JICA employs (a) registered consulting firm(s). JICA selects (a) firm(s) based on proposals submitted by interested firms.

(3) Result of the Survey

JICA reviews the Report on the results of the Survey and recommends the GOJ to appraise the implementation of the Project after confirming the appropriateness of the Project.

3. Japan's Grant Aid Scheme

(1) The E/N and the G/A

After the Project is approved by the Cabinet of Japan, the Exchange of Notes(hereinafter referred to as "the E/N") will be singed between the GOJ and the Government of the recipient country to make a pledge for assistance, which is followed by the conclusion of the G/A between JICA and the Government of the recipient country to define the necessary articles to implement the Project, such as payment conditions, responsibilities of the Government of the recipient country, and procurement conditions.

(2) Selection of Consultants

In order to maintain technical consistency, the consulting firm(s) which conducted the Survey will be recommended by JICA to the recipient country to continue to work on the Project's implementation after the E/N and G/A.

(3) Eligible source country

Under the Japanese Grant Aid, in principle, Japanese products and services including transport or those of the recipient country are to be purchased. When JICA and the Government of the recipient country or its designated authority deem it necessary, the Grant Aid may be used for the purchase of the products or services of a third country. However, the prime contractors, namely, constructing and procurement firms, and the prime consulting firm are limited to "Japanese nationals".

19/9/2014

(4) Necessity of "Verification"

The Government of the recipient country or its designated authority will conclude contracts denominated in Japanese yen with Japanese nationals. Those contracts shall be verified by JICA. This "Verification" is deemed necessary to fulfill accountability to Japanese taxpayers.

(5) Major undertakings to be taken by the Government of the Recipient Country

In the implementation of the Grant Aid Project, the recipient country is required to undertake such necessary measures as Annex.

(6) "Proper Use"

The Government of the recipient country is required to maintain and use properly and effectively the facilities constructed and the equipment purchased under the Grant Aid, to assign staff necessary for this operation and maintenance and to bear all the expenses other than those covered by the Grant Aid.

(7) "Export and Re-export"

The products purchased under the Grant Aid should not be exported or re-exported from the recipient country.

(8) Banking Arrangements (B/A)

a) The Government of the recipient country or its designated authority should open an account under the name of the Government of the recipient country in a bank in Japan (hereinafter referred to as "the Bank"). JICA will execute the Grant Aid by making payments in Japanese yen to cover the obligations incurred by the Government of the recipient country or its designated authority under the Verified Contracts.

b) The payments will be made when payment requests are presented by the Bank to JICA under an Authorization to Pay (A/P) issued by the Government of the recipient country or its designated authority.

(9) Authorization to Pay (A/P)

The Government of the recipient country should bear an advising commission of an Authorization to Pay and payment commissions paid to the Bank.

(10) Social and Environmental Considerations

A recipient country must carefully consider social and environmental impacts by the Project and must comply with the environmental regulations of the recipient country and JICA socio-environmental guidelines.

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(End)

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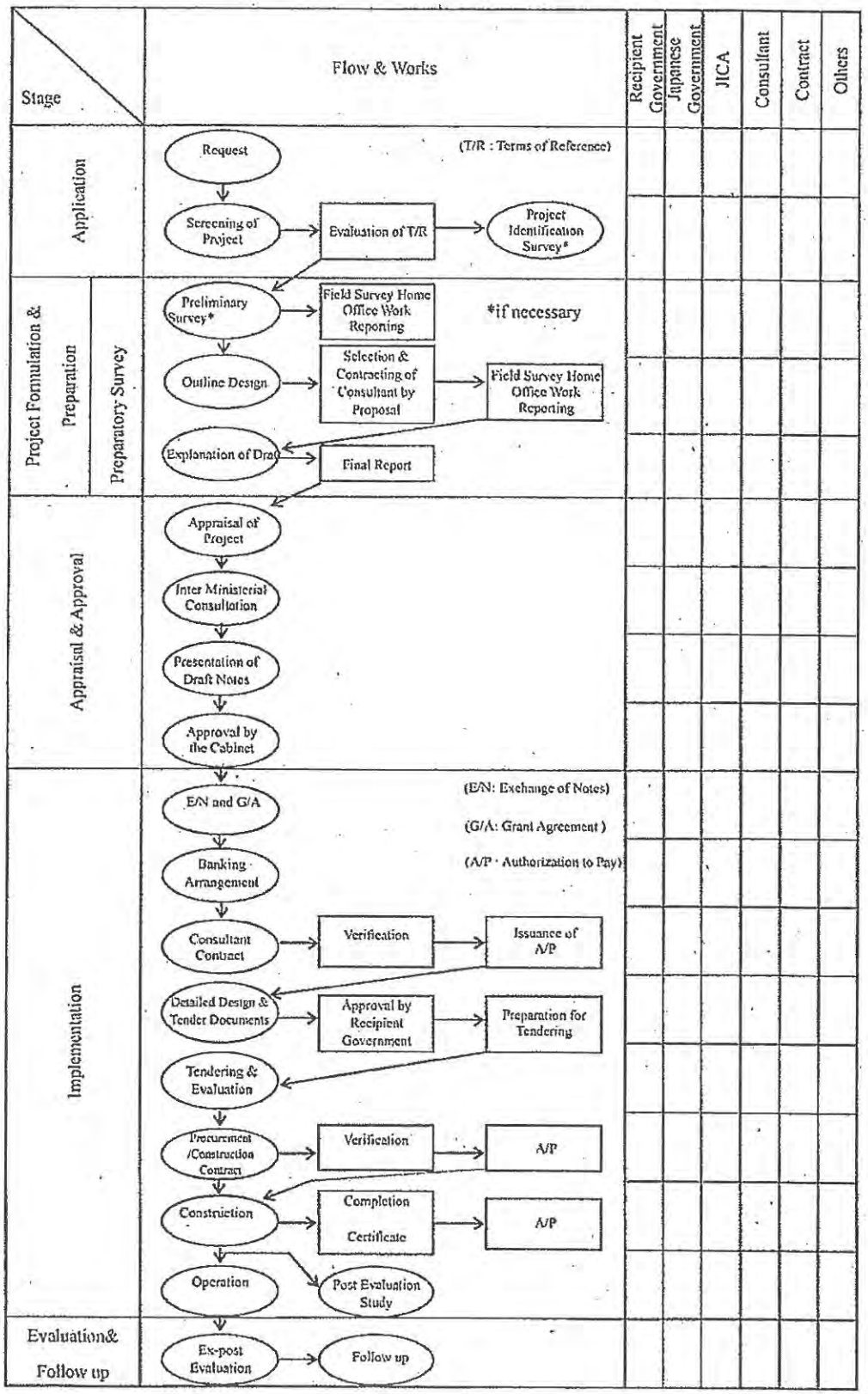
Annex-4

Flow Chart of Japan's Grant Aid Procedures



Annex-5

Major undertakings to be taken by each Government

No.	Items	To be covered by Grant Aid	To be covered by Recipient Side
1	to secure [a lot] /[lots] of land necessary for the implementation of the Project and to clear the [site]/[sites];		●
2	To construct the following facilities		
	1) The building	●	
	2) The gates and fences in and around the site		●
	3) The parking lot	●	
	4) The road within the site	●	
	5) The road outside the site		●
3	To provide facilities for distribution of electricity, water supply and drainage and other incidental facilities necessary for the implementation of the Project outside the [site]/[sites]		
	1)Electricity		
	a. The distributing power line to the site		●
	b. The drop wiring and internal wiring within the site	●	
	c. The main circuit breaker and transformer	●	
	2) Water Supply		
	a. The city water distribution main to the site		●
	b. The supply system within the site (receiving and elevated tanks)	●	
	3) Drainage		
	a. The city drainage main (for storm sewer and others to the site)		●
	b. The drainage system (for toilet sewer, common waste, storm drainage and others) within the site	●	
	4) Gas Supply		
	a. The city gas main to the site		●
	b. The gas supply system within the site	●	
	5) Telephone System		
	a. The telephone trunk line to the main distribution frame/panel (MDF) of the building		●
	b. The MDF and the extension after the frame/panel	●	
	6) Furniture and Equipment		
	a. General furniture		●
	b. Project equipment	●	
4	To ensure prompt unloading and customs clearance of the products at ports of disembarkation in the recipient country and to assist internal transportation of the products		
	1) Marine (Air) transportation of the Products from Japan to the recipient country	●	
	2) Tax exemption and custom clearance of the Products at the port of disembarkation		●
	3) Internal transportation from the port of disembarkation to the project site	●	
5	To ensure that customs duties, internal taxes and other fiscal levies which may be imposed in the recipient country with respect to the purchase of the products and the services [be exempted] / [be borne by the Authority without using the Grant]		●
6	To accord Japanese nationals whose services may be required in connection with the supply of the products and the services such facilities as may be necessary for their entry into the recipient country and stay therein for the performance of their work		●
7	To ensure that [the Facilities and the products]/[the Facilities]/ [the products] be maintained and used properly and effectively for the implementation of the Project		●
8	To bear all the expenses, other than those covered by the Grant, necessary for the implementation of the Project		●
9	To bear the following commissions paid to the Japanese bank for banking services based upon the B/A		
	1) Advising commission of A/P		●
	2) Payment commission		●
10	To give due environmental and social consideration in the implementation of the Project.		●

*1 B/A : Banking Arrangement, A/P : Authorization to pay) *2 If the environmental screening category is C, No. 10 is unnecessary

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19/9/

Second Field Survey

Minutes of Discussions
on the Preparatory Survey on the Project for
Rehabilitation of Monrovia Power System
in the Republic of Liberia
(Second Field Survey)

In response to the request from the Government of the Republic of Liberia, the Japan International Cooperation Agency (hereinafter referred to as "JICA"), in consultation with the Government of Japan, decided to conduct a Preparatory Survey (hereinafter referred to as "the Survey") on the Project for Rehabilitation of Monrovia Power System (hereinafter referred to as "the Project").

JICA conducted a first field survey from September 14th to 28th, and Minutes of Discussions signed on September 19th, 2011. Through discussions and field survey, JICA examined the appropriateness of requested sites and components.

In order to conduct further study and discussion, JICA sent a Second Field Survey Team (hereinafter referred to as "the Team"), which was headed by Mr. Hitoshi SATO, Senior Representative, JICA Ghana Office. The Team is scheduled to stay in the country from January 10 to February 5, 2012.

The Team held discussions with the officials of concerned authorities in Liberia (hereinafter referred to as "the Liberian side"). In the course of the discussions, both sides have confirmed the main items described in the sheets attached hereto.

Monrovia, January 26th, 2012

Mr. Hitoshi SATO
Leader
Preparatory Survey Team
Japan International Cooperation Agency

Hon. Roosevelt G. Jayjay
Acting Minister
Ministry of Lands, Mines and Energy

Mr. Shahid Mohammad 27/1/2012
Chief Executive Officer
Liberia Electricity Corporation

ATTACHMENT

1. Objective of the Project

The objective of the Project is to ensure the continuous supply of electric power to most part of Monrovia.

2. Project Site

The Project site is located in Monrovia City as shown in Annex-1.

3. Responsible and Implementing Organization

(1) The responsible ministry is the Ministry of Lands, Mines and Energy (MLME).
(2) The implementing organization is the Liberia Electricity Corporation (LEC).
(3) The Organization Structure of LEC is shown in Annex-2.

4. Requested component from Liberian side

Confirmed requests and the priority (the highest, "A", the middle, "A-", and the lowest, "B") of the Project of each component from Liberian side is as follows.

(1) Installation of 2x5 MW HFO-fired medium speed diesel generators and Construction of new power house in existing Bushrod Power Plant — A
(2) Construction of new substation in existing Bushrod Power Plant to include the following items — A-
   - One (1) 15 MVA 22/66 kV transformer
   - Six (6) 22 kV switchgear
(3) Supply of maintenance vehicles — B
   - Five (5) special purpose/dedicated crew trucks/lorries
   - One (1) bucket truck
   - One (1) pole construction truck
   - Two (2) 2.9 ton crane trucks

The Team explained that the requested 3 components are considered as candidate components to be implemented; however, the components are finally subject to the approval of the Government of Japan based on the result of the survey.

The Liberian side strongly requested to the Government of Japan for the approval of implementing all 3 components under this Project and their request was noted by the Team.

5. Japan's Grant Aid Scheme

(1) JICA confirmed that the Liberian side understood Japan's Grant Aid Scheme explained by the Team as described in Annex-3 and 4.
(2) The Liberian side will take the necessary measures, as described in Annex-5, for smooth implementation of the Project as prerequisites for the Japan's Grant Aid to be implemented.

6. Schedule of the Survey

The Team will continue the Survey in Liberia until February 5, 2012.

7. Other Relevant Issues

(1) Status of the Survey

The Team explained that the purpose of the Survey is to collect information and data necessary for the outline design and cost estimation of the Project components which are confirmed through the Survey and the analysis in Japan.

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(2) Coordination among relevant projects

The Team requested the Liberian side to ensure coordination among relevant projects for smooth implementation of the Project. The Team explained to the Liberian side that the Project needs to coordinate with the project of World Bank, which is to rehabilitate Heavy Fuel Oil (HFO) storage facilities in LEC compound, and the project to be conducted by private company, which is to rehabilitate HFO unloading and transfer facilities. The Liberian side accepted to provide the Team with information regarding the construction schedule, commissioning date and specification of equipment of the above projects to be conducted by World Bank and private company.

(3) Operation and Maintenance

The Team requested the Liberian side to constantly secure the necessary budget for operation and maintenance including major overhauls, of equipment/generators to be procured under the project, and assignment of qualified engineers and skilled technicians, to ensure long-term stable power supply. The Liberian side agreed it.

(4) Customs and Tax exemption

The Liberian side understood that it shall be fully responsible on exemption of taxes, custom duties and any other levies imposed in the Republic of Liberia, in case the Project is implemented.

(5) Counterpart Personnel

The Team requested the Liberian side that the necessary number of counterpart personnel shall be assigned to the Team and the necessary arrangements with related organizations be made during the Survey in Liberia. The Liberian side has agreed to follow the request.

(6) Environmental and Social Considerations

a) The Team requested the Liberian side to conduct the required environmental procedures, and obtain approval on environmental clearance for implementation of the Project.
b) The Liberian side agreed to comply with the JICA Guidelines for Environmental and Social Considerations (hereinafter referred to as "JICA Guidelines") as well as laws and regulations in Liberia, and to prepare Environmental Checklist and Monitoring Form which are designated by JICA Guidelines for an outline design.
c) The Liberian side agreed to make necessary arrangements with governmental organizations concerned in order to secure funding for and execution of the above environmental matters in a schedule as required for smooth execution of the Project.
d) The Liberian side agreed to complete necessary procedures by August, 2012.

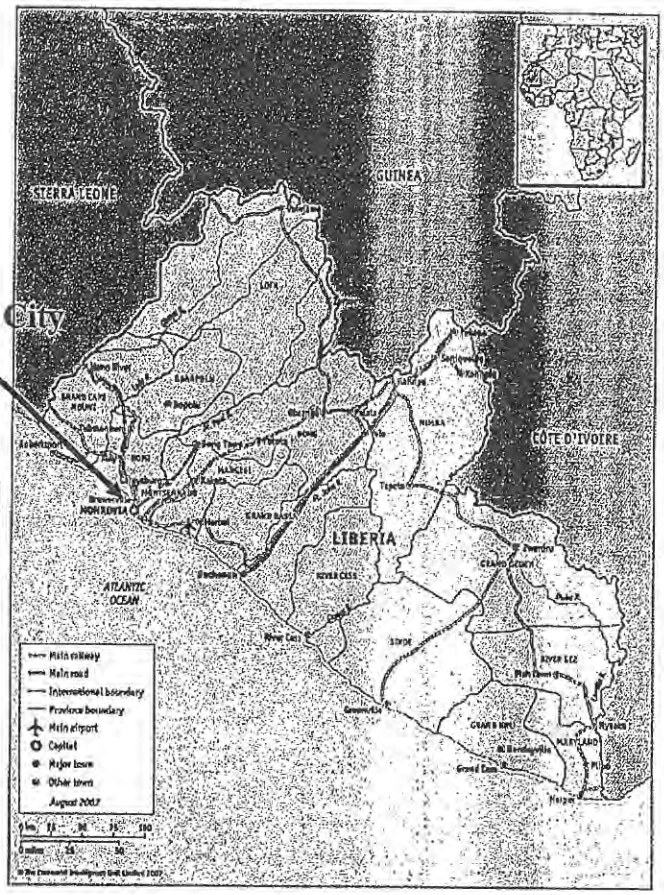
(End)

Annex-1 Project Sites
Annex-2 Organization Chart of LEC
Annex-3 Japan's Grant Aid
Annex-4 Flow Chart of Japan's Grant Aid Procedures
Annex-5 Major Undertakings to be taken by Each Government

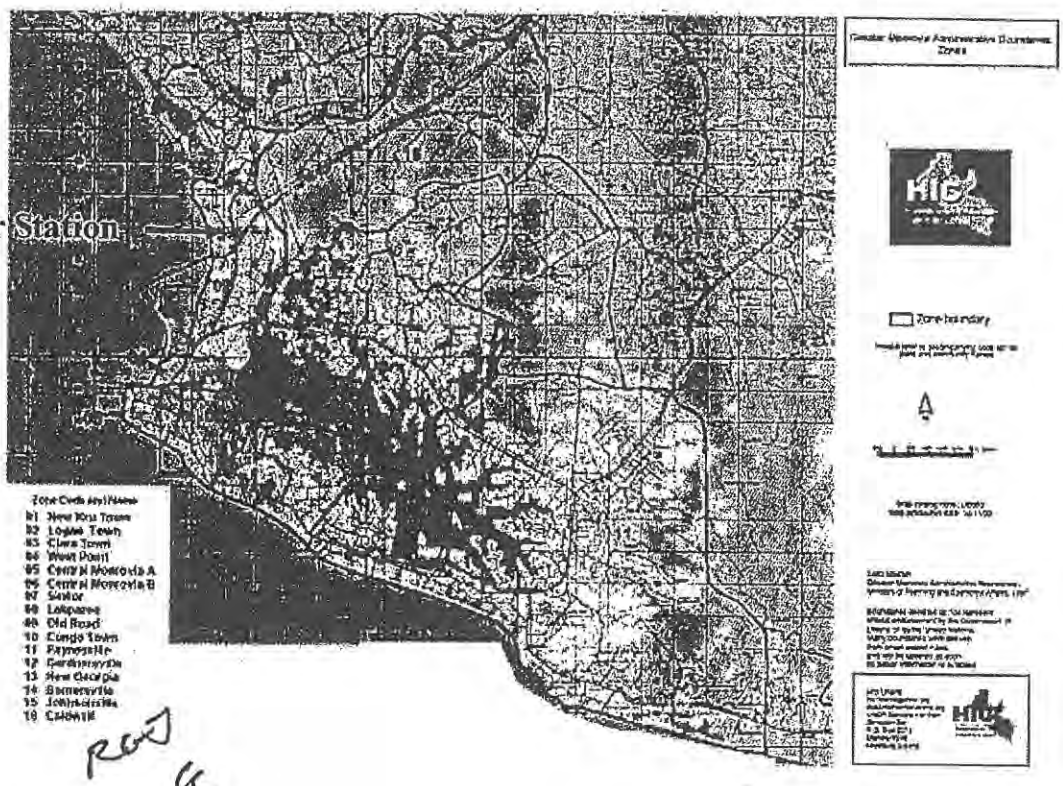
Annex 1

Project Sites

Monrovia City

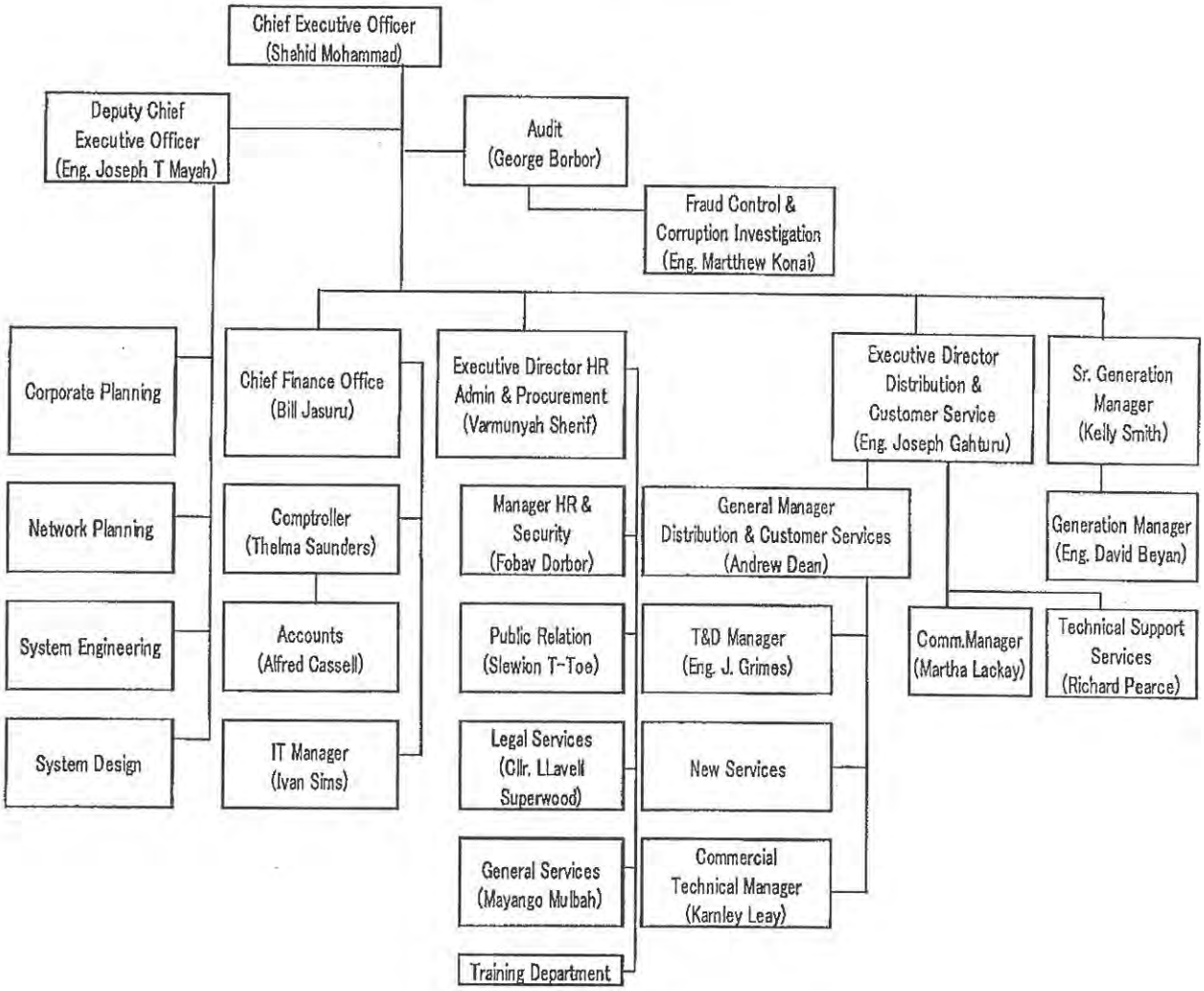


Bushrod Power Station



Annex 2

Organization Chart of LEC



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Japan's Grant Aid

The Government of Japan (hereinafter referred to as "the GOJ") is implementing the organizational reforms to improve the quality of ODA operations, and as a part of this realignment, a new JICA law was entered into effect on October 1, 2008. Based on this law and the decision of the GOJ, JICA has become the executing agency of the Grant Aid for General Projects, for Fisheries and for Cultural Cooperation, etc.

The Grant Aid is non-reimbursable fund provided to a recipient country to procure the facilities, equipment and services (engineering services and transportation of the products, etc.) for its economic and social development in accordance with the relevant laws and regulations of Japan. The Grant Aid is not supplied through the donation of materials as such.

1. Grant Aid Procedures

The Japanese Grant Aid is supplied through following procedures :

- Preparatory Survey
  - The Survey conducted by JICA
- Appraisal &Approval
  - -Appraisal by the GOJ and JICA, and Approval by the Japanese Cabinet
- Authority for Determining Implementation
  - -The Notes exchanged between the GOJ and a recipient country
- Grant Agreement (hereinafter referred to as "the G/A")
  - -Agreement concluded between JICA and a recipient country
- Implementation
  - -Implementation of the Project on the basis of the G/A

2. Preparatory Survey

(1) Contents of the Survey

The aim of the preparatory Survey is to provide a basic document necessary for the appraisal of the Project made by the GOJ and JICA. The contents of the Survey are as follows:

- Confirmation of the background, objectives, and benefits of the Project and also institutional capacity of relevant agencies of the recipient country necessary for the implementation of the Project.
- Evaluation of the appropriateness of the Project to be implemented under the Grant Aid Scheme from a technical, financial, social and economic point of view.
- Confirmation of items agreed between both parties concerning the basic concept of the Project.
- Preparation of a basic design of the Project.

RGJ

- Estimation of costs of the Project.

The contents of the original request by the recipient country are not necessarily approved in their initial form as the contents of the Grant Aid project. The Basic Design of the Project is confirmed based on the guidelines of the Japan's Grant Aid scheme.

JICA requests the Government of the recipient country to take whatever measures necessary to achieve its self-reliance in the implementation of the Project. Such measures must be guaranteed even though they may fall outside of the jurisdiction of the organization of the recipient country which actually implements the Project. Therefore, the implementation of the Project is confirmed by all relevant organizations of the recipient country based on the Minutes of Discussions.

(2) Selection of Consultants

For smooth implementation of the Survey, JICA employs (a) registered consulting firm(s). JICA selects (a) firm(s) based on proposals submitted by interested firms.

(3) Result of the Survey

JICA reviews the Report on the results of the Survey and recommends the GOJ to appraise the implementation of the Project after confirming the appropriateness of the Project.

3. Japan's Grant Aid Scheme

(1) The E/N and the G/A

After the Project is approved by the Cabinet of Japan, the Exchange of Notes(hereinafter referred to as "the E/N") will be singed between the GOJ and the Government of the recipient country to make a pledge for assistance, which is followed by the conclusion of the G/A between JICA and the Government of the recipient country to define the necessary articles to implement the Project, such as payment conditions, responsibilities of the Government of the recipient country, and procurement conditions.

(2) Selection of Consultants

In order to maintain technical consistency, the consulting firm(s) which conducted the Survey will be recommended by JICA to the recipient country to continue to work on the Project's implementation after the E/N and G/A.

(3) Eligible source country

Under the Japanese Grant Aid, in principle, Japanese products and services including transport or those of the recipient country are to be purchased. When JICA and the Government of the recipient country or its designated authority deem it necessary, the Grant Aid may be used for the purchase of the products or services of a third country. However, the prime contractors, namely, constructing and procurement firms, and the prime consulting firm are limited to "Japanese nationals".

(4) Necessity of "Verification"

The Government of the recipient country or its designated authority will conclude contracts denominated in Japanese yen with Japanese nationals. Those contracts shall be verified by JICA. This "Verification" is deemed necessary to fulfill accountability to Japanese taxpayers.

(5) Major undertakings to be taken by the Government of the Recipient Country

In the implementation of the Grant Aid Project, the recipient country is required to undertake such necessary measures as Annex.

(6) "Proper Use"

The Government of the recipient country is required to maintain and use properly and effectively the facilities constructed and the equipment purchased under the Grant Aid, to assign staff necessary for this operation and maintenance and to bear all the expenses other than those covered by the Grant Aid.

(7) "Export and Re-export"

The products purchased under the Grant Aid should not be exported or re-exported from the recipient country.

(8) Banking Arrangements (B/A)

a) The Government of the recipient country or its designated authority should open an account under the name of the Government of the recipient country in a bank in Japan (hereinafter referred to as "the Bank"). JICA will execute the Grant Aid by making payments in Japanese yen to cover the obligations incurred by the Government of the recipient country or its designated authority under the Verified Contracts.

b) The payments will be made when payment requests are presented by the Bank to JICA under an Authorization to Pay (A/P) issued by the Government of the recipient country or its designated authority.

(9) Authorization to Pay (A/P)

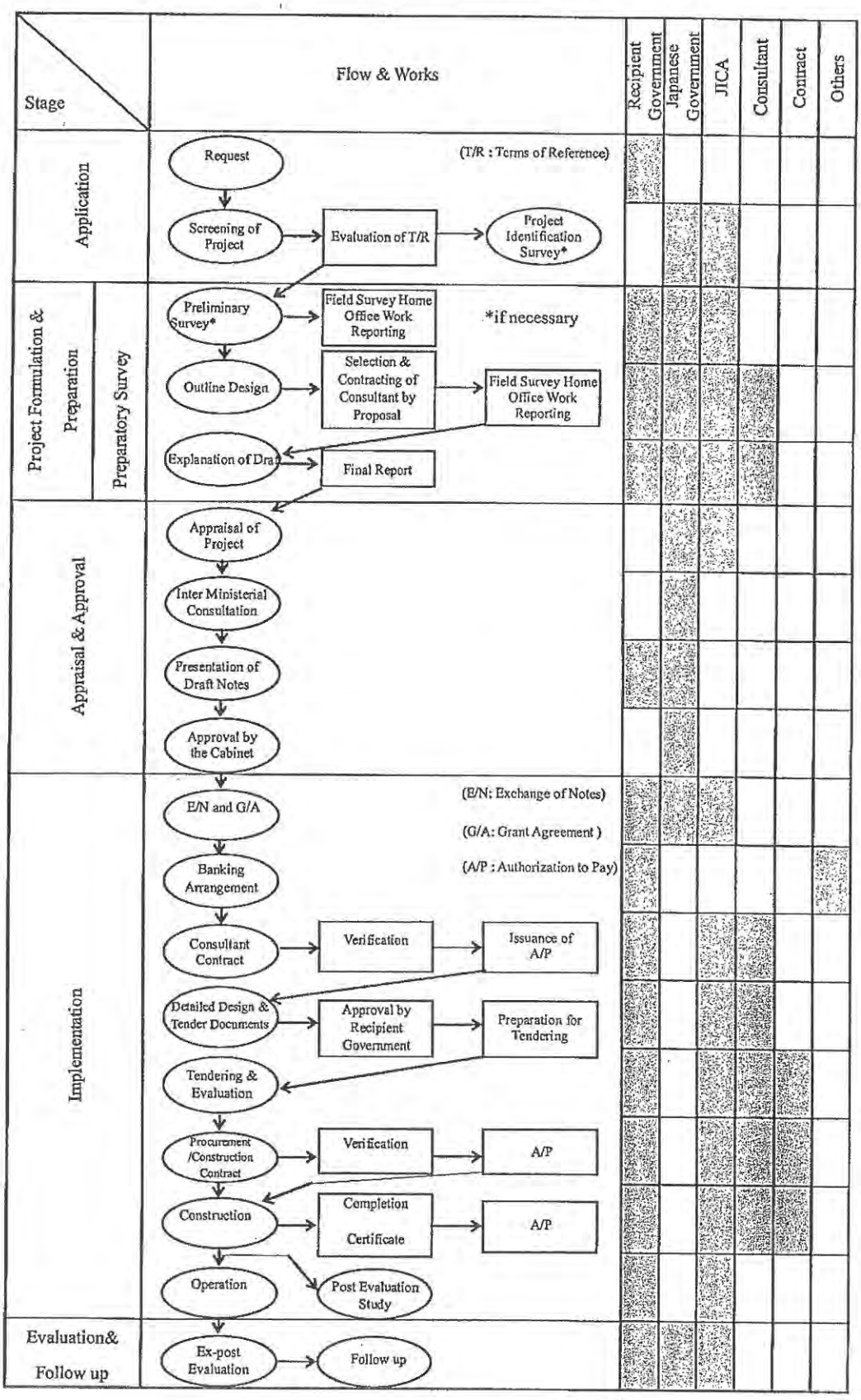
The Government of the recipient country should bear an advising commission of an Authorization to Pay and payment commissions paid to the Bank.

(10) Social and Environmental Considerations

A recipient country must carefully consider social and environmental impacts by the Project and must comply with the environmental regulations of the recipient country and JICA socio-environmental guidelines.

(End)

Flow Chart of Japan's Grant Aid Procedures



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Major undertakings to be taken by each Government

No.	Items	To be covered by Grant Aid	To be covered by Recipient Side
1	to secure [a lot] /[lots] of land necessary for the implementation of the Project and to clear the [site]/[sites];		●
2	To construct the following facilities		
	1) The building	●	
	2) The gates and fences in and around the site		●
	3) The parking lot	●	
	4) The road within the site	●	
	5) The road outside the site		●
3	To provide facilities for distribution of electricity, water supply and drainage and other incidental facilities necessary for the implementation of the Project outside the [site]/[sites]		
	1)Electricity		
	a. The distributing power line to the site		●
	b. The drop wiring and internal wiring within the site	●	
	c. The main circuit breaker and transformer	●	
	2) Water Supply		
	a. The city water distribution main to the site		●
	b. The supply system within the site (receiving and elevated tanks)	●	
	3) Drainage		
	a. The city drainage main (for storm sewer and others to the site)		●
	b. The drainage system (for toilet sewer, common waste, storm drainage and others) within the site	●	
	4) Gas Supply		
	a. The city gas main to the site		●
	b. The gas supply system within the site	●	
	5) Telephone System		
	a. The telephone trunk line to the main distribution frame/panel (MDF) of the building		●
	b. The MDF and the extension after the frame/panel	●	
	6) Furniture and Equipment		
	a. General furniture		●
	b. Project equipment	●	
4	To ensure prompt unloading and customs clearance of the products at ports of disembarkation in the recipient country and to assist internal transportation of the products		
	1) Marine (Air) transportation of the Products from Japan to the recipient country	●	
	2) Tax exemption and custom clearance of the Products at the port of disembarkation		●
	3) Internal transportation from the port of disembarkation to the project site	●	
5	To ensure that customs duties, internal taxes and other fiscal levies which may be imposed in the recipient country with respect to the purchase of the products and the services [be exempted] / [be borne by the Authority without using the Grant]		●
6	To accord Japanese nationals whose services may be required in connection with the supply of the products and the services such facilities as may be necessary for their entry into the recipient country and stay therein for the performance of their work		●

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7	To ensure that [the Facilities and the products]/[the Facilities]/ [the products] be maintained and used properly and effectively for the implementation of the Project		●
8	To bear all the expenses, other than those covered by the Grant, necessary for the implementation of the Project		●
9	To bear the following commissions paid to the Japanese bank for banking services based upon the B/A		
	1) Advising commission of A/P		●
	2) Payment commission		●
10	To give due environmental and social consideration in the implementation of the Project.		●

*1 B/A : Banking Arrangement, A/P : Authorization to pay) *2 If the environmental screening category is C, No. 10 is unnecessary

RGJ

Supplementary Field Survey

Minutes of Discussions
on the Supplemental Field Survey on the Project for
Rehabilitation of Monrovia Power System
in the Republic of Liberia

In response to the request from the Government of the Republic of Liberia, the Japan International Cooperation Agency (hereinafter referred to as "JICA"), in consultation with the Government of Japan, decided to conduct a Supplemental Field Survey (hereinafter referred to as "the Survey") on the Project for Rehabilitation of Monrovia Power System (hereinafter referred to as "the Project").

JICA sent to the Republic of Liberia a Supplemental Field Survey Team (hereinafter referred to as "the Team"), headed by Mr. Kyoji FUJII, Chef Consultant, Yachiyo Engineering Co., Ltd. The Team is scheduled to stay in the country from August 7th to 10th, 2012.

The Team held discussions with the officials of concerned authorities in Liberia (hereinafter referred to as "the Liberian side"). In the course of the discussions, both sides have confirmed the main items described in the sheets attached hereto.

Monrovia, August 10th, 2012

Mr. Kyoji Fujii
Chief Consultant
JICA Preparatory Survey Team
Yachiyo Engineering Co., Ltd.

Hon. Patrick Sendolo
Minister
Ministry of Lands, Mines and Energy

Mr. Shahid Mohammed 08/2012
Chief Executive Officer
Liberia Electricity Corporation

ATTACHMENT

1. Revision of requested components from the Liberian side

The following (1) to (3) are the final items requested from the Liberian side confirmed on the minutes of discussions signed on January 26th, 2012.

(1) Installation of 2x5 MW HFO-fired medium speed diesel generators and construction of new power house in existing Bushrod Power Plant

(2) Construction of new substation in existing Bushrod Power Plant to include the following items
- One (1) 15 MVA 22/66 kV transformer
- Six (6) 22 kV switchgear

(3) Supply of maintenance vehicles
- Five (5) special purpose/dedicated crew trucks/lorries
- One (1) bucket truck
- One (1) pole construction truck
- Two (2) 2.9 ton crane trucks

After the signing of the minutes of discussions, the Liberian side revised its Electric Master Plan (EMP) in June 2012 so as to incorporate the latest progress of power development and the commitment of donor assistance into the plan. In light of the change in the EMP, the Liberian side requested the Japanese side to delete the above item (2), i.e., construction of new substation in existing Bushrod Power Plant including one (1) 15 MVA 22/66 kV transformer and six (6) 22 kV switchgears from its final request. The Liberian side also requested the Japanese side to change the step up voltage of 2x5MW diesel generators from 66/6.6kV to 66/22kV in accordance with the EMP. The Team confirmed the technical appropriateness of the requests from the Liberian side and accepted them. The revised scope and design of the Project is shown in Annex-1. The change in the scope and design will be incorporated into the outline design of the Project. The revision leads the delay in forthcoming cabinet approval, etc. at least 2 months. Liberian side agreed that.

2. Schedule of other donor's assistance

The above mentioned revision of scope necessitates the procurement and installation of 66kV and 22kV substation facilities which other donor's assistance is expected. The Liberian side shall complete such substation works by the end of September 2014.

3. Installation area for new diesel generators

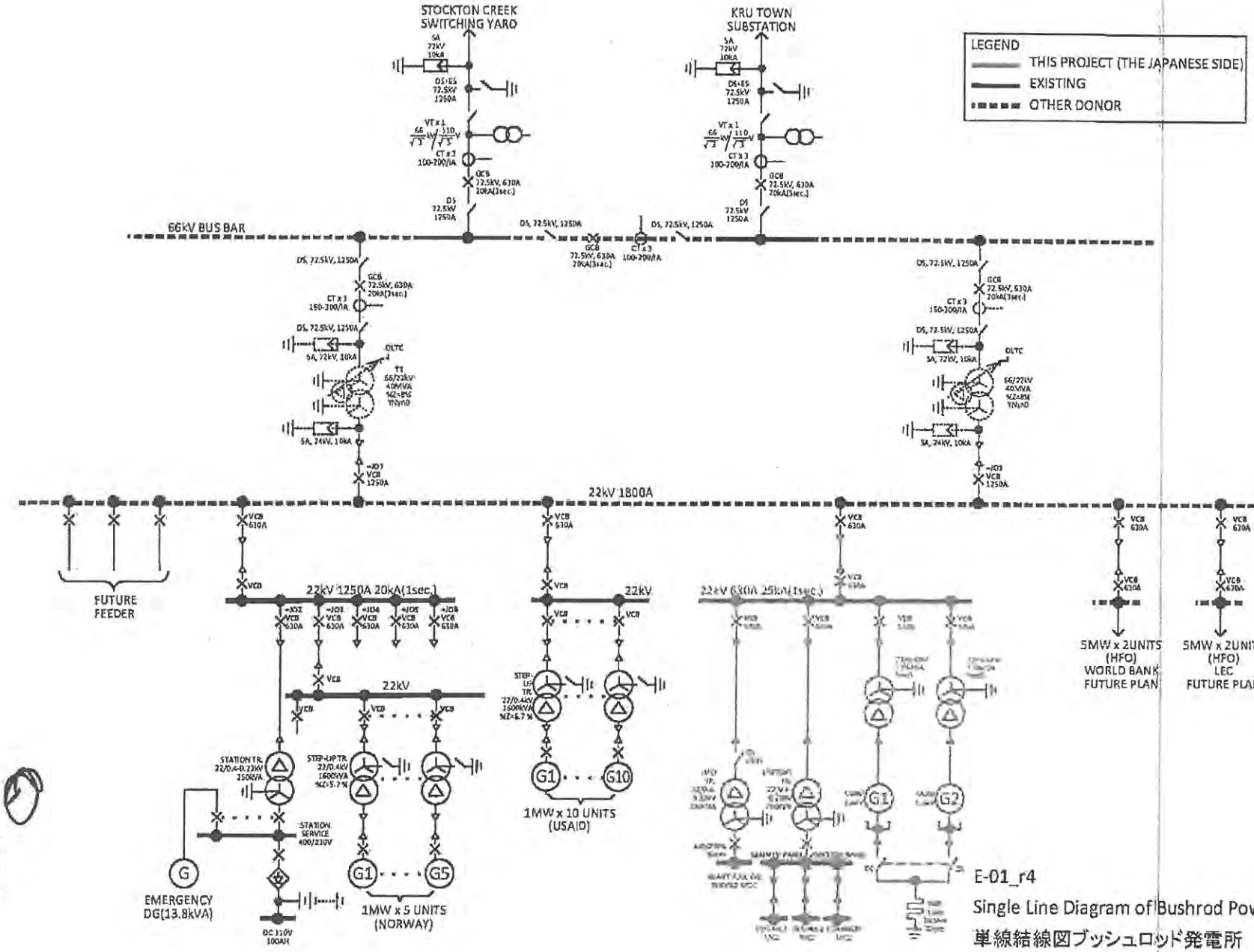
The Liberian side shall take necessary measures to prevent interference of installation areas for new 66/22kV substation facilities (other donor) and 2x5MW diesel generators under Japan's grant aid.

4. Environmental and social considerations

The Liberian side commenced the Environment Impact Assessment for new heavy fuel oil fired diesel generating plants which are to be financed by the Liberian government, the World Bank and the government of Japan and will be completed by April, 2013.

(End)

Annex-1 Single line diagram of Bushrod power station



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Single Line Diagram of Bushrod Power Station

単線結線図ブッシュロッド発電所

Explanation on Draft Final Report

Minutes of Discussions
on the Preparatory Survey on the Project for
Rehabilitation of Monrovia Power System
in the Republic of Liberia
(Explanation on Draft Final Report)

In response to the request from the Government of the Republic of Liberia, the Japan International Cooperation Agency (hereinafter referred to as "JICA"), in consultation with the Government of Japan, decided to conduct a Preparatory Survey (hereinafter referred to as "the Survey") on the Project for Rehabilitation of Monrovia Power System (hereinafter referred to as "the Project").

JICA conducted a first field survey from September 14th to 28th, 2011. Second field survey was conducted from January 10th to February 5th, 2012. Supplemental survey was conducted from August 7th to 10th, 2012. Through discussions, field surveys and the result of technical examination in Japan, JICA prepared a Draft Final Report of the Survey.

In order to explain and to consult with the officials of concerned authorities in Liberia (hereinafter referred to as "the Liberian side") on the contents of the Draft Final Report, JICA dispatched to Liberia the Preparatory Survey Team for Draft Final Report Explanation (hereinafter referred to as "the Team"), which is headed by Mr. Fuyuki SAGARA, Deputy Resident Representative, JICA Ghana Office. The Team is scheduled to stay in Liberia from October 16th to 26th, 2012.

The Team held discussions with the Liberian side. As a result of the discussions, both sides have confirmed the main items described in the sheets attached hereto.

Monrovia, October 25th, 2012

相良 冬木

Mr. Fuyuki SAGARA
Leader
Preparatory Survey Team
Japan International Cooperation Agency

Mr. Patrick Sendolo
Minister
Ministry of Lands, Mines and Energy

Mr. Yancon-Dargbe Nimley
Assistant Minister for Economic Cooperation and Integration
Ministry of Planning and Economic Affairs

25/10/2012

Mr. Shahid Mohammed
Chief Executive Officer
Liberia Electricity Corporation

ATTACHMENT

1. Objective of the Project

The objective of the Project is to ensure the continuous supply of electric power to most part of Monrovia.

2. Project Site

The Project site is located in Monrovia City as shown in Annex-1.

3. Contents of the Draft Final Report

The Liberian side agreed and accepted in principle the contents of the Draft Final Report and the Draft Technical Specifications of the Survey explained by the Team.

4. Responsible and Implementing Organization

(1) The responsible ministry is the Ministry of Lands, Mines and Energy (MLME).
(2) The implementing organization is the Liberia Electricity Corporation (LEC).
(3) The Organization Structure of LEC is shown in Annex-2.

5. Components of the Project

The following are selected as the Project Components.

(1) Installation of 2x5 MW Heavy Fuel Oil (HFO)-fired medium speed diesel generators
(2) Construction of new power house in existing Bushrod Power Plant
(3) Supply of maintenance vehicles
- Five (5) special purpose/dedicated crew trucks/lorries
- One (1) bucket truck
- One (1) pole construction truck
- Two (2) 2.9 ton crane trucks

6. Confidentiality of the Project

(1) Project Cost

The Team explained the estimated cost of the Project as described in Annex-3. The Liberian side also agreed that the cost for the Project contains procurement cost of equipment, construction cost of facility, transportation cost up to the Project site, installation cost and the Consultant fees.

The Liberian side agreed that the cost for the Project should not exceed the amount agreed on the Exchange of Notes (E/N) to be signed between the governments. The Liberian side understood that the estimated cost for the Project attached as Annex-3 is not the final and is subject to change as a result of the detailed design to be implemented after the E/N.

(2) Detailed specifications of the Facilities and Equipment

Both sides agreed that all the information related to the Project including the estimated cost, detailed drawings and specifications of the facilities and equipment, and other technical information shall not be disclosed to any outside parties (i.e. outside of JICA and the Liberian side) before the conclusion of all contract(s) for the Project.

7. Possibility of Change in Scope, Schedule and Cost of the Project

The Team stressed that the scope, the schedule, and the cost for the Project are tentative and subject to change due to the domestic circumstances in Japan and in Liberia. The Liberian side understood it.

8. Japan's Grant Aid Scheme

(1) JICA confirmed that the Liberian side understood Japan's Grant Aid Scheme explained by the Team as described in Annex-4 and 5.

(2) The Liberian side will take the necessary measures, as described in Annex-6, for smooth implementation of the Project as prerequisites for the Japan's Grant Aid to be implemented.

9. Other Relevant Issues

(1) Coordination among relevant projects

The Team requested the Liberian side to ensure coordination among following projects for smooth implementation of the Project.

a) The project by World Bank, which is to rehabilitate HFO storage facilities and to install 10MW HFO-fired generator in Bushrod power plant.

b) The project by LEC own fund, which is to install 10MW HFO-fired generator in Bushrod power plant.

c) The project by private company, which is to rehabilitate HFO unloading and transfer facilities.

d) The project by Norway, which is to procure and to install 66kV and 22kV substation facilities by the end of January 2014.

The Liberian side realized that it is critical to implement the project by Norway on schedule for the Project. The Liberian side accepted to provide the Team with information regarding the construction schedule, commissioning date and specification of equipment of the above projects. The Team and the Liberian side agreed the facility plan of each 10MW generator in Bushrod power plant as Annex-7.

(2) Operation and Maintenance Cost

The Team emphasized it is essential that the Liberian side ensures to constantly secure the necessary budget for operation and maintenance including major overhauls, of equipment to be procured under the project, to ensure long-term stable power supply. The Liberian side has fully understood and shared the same view.

(3) Customs and Tax exemption

The Liberian side understood that it shall be fully responsible on exemption of taxes, custom duties and any other levies imposed in the Republic of Liberia, in case the Project is implemented.

(4) Operation and Maintenance system of new facilities

The Team emphasized that the allocation of enough number of qualified engineers and skilled technicians for operating and maintaining the new facilities is a prerequisite to implement the Project. The Liberian side under stood the prerequisite.

(5) Counterpart Personnel

The Team requested the Liberian side that the necessary number of counterpart personnel shall be assigned to the Team and the necessary arrangements with related organizations be made during implementing stage in Liberia. The Liberian side has agreed to follow the request.

(6) Environmental and Social Considerations

a) The Team requested the Liberian side to conduct the required environmental procedures, and obtain approval on environmental clearance for implementation of the Project.

b) The Liberian side agreed to comply with the JICA Guidelines for Environmental and Social Considerations (hereinafter referred to as "JICA Guidelines") as well as laws and regulations in Liberia, and was requested to prepare Environmental Checklist and Monitoring Form which are designated by JICA Guidelines for an outline design.

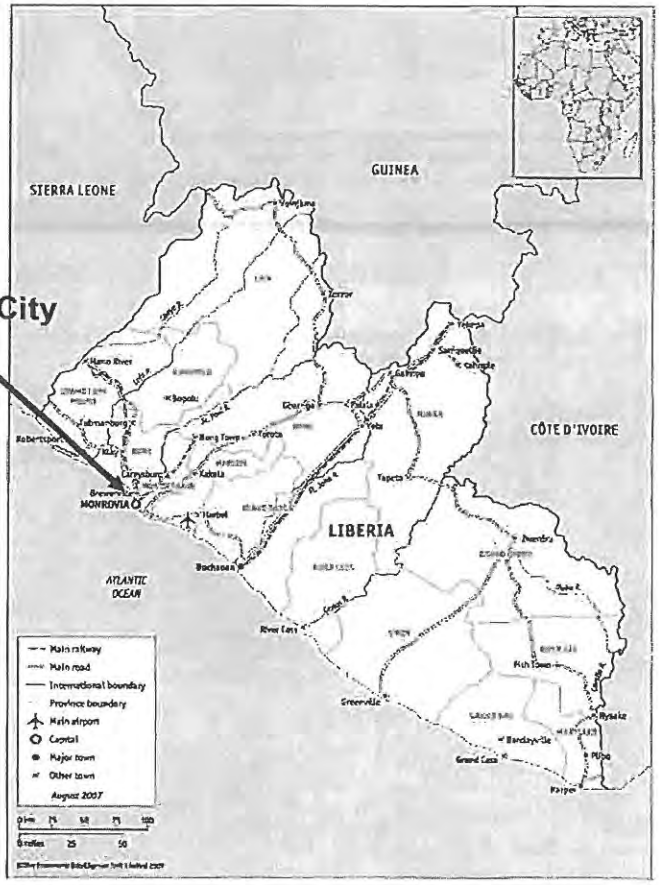
c) The Liberian side agreed to complete the Environment Impact Assessment for new heavy fuel oil fired diesel generating plants which are to be financed by the Liberian government, the World Bank and the government of Japan will be completed by April,

2013.

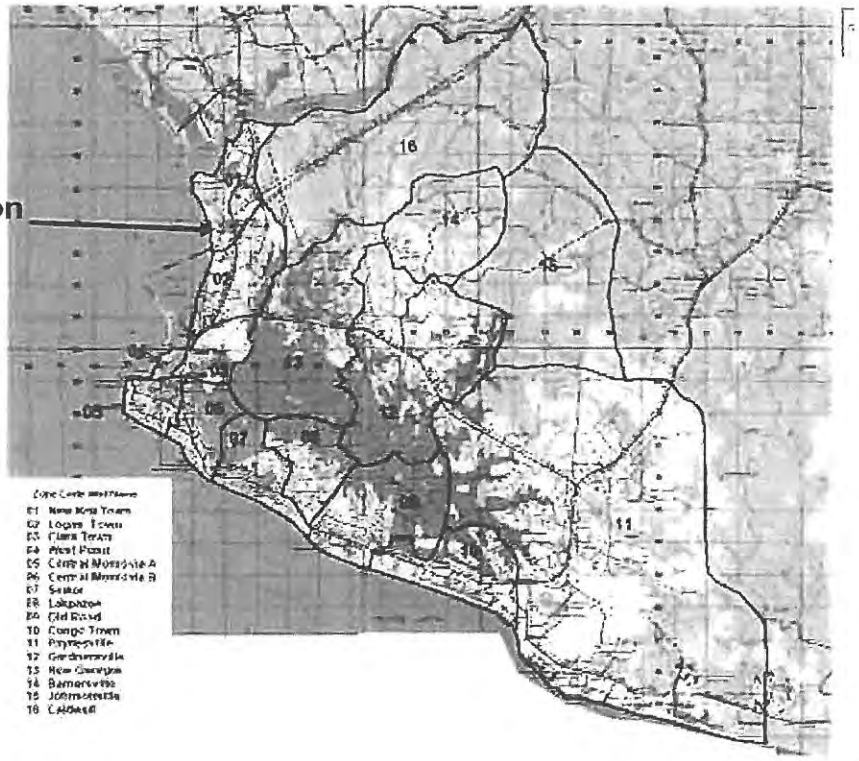
(End)

Annex-1	Project Site
Annex-2	Organization Chart of LEC
Annex-3	Estimated Project Cost (Confidential)
Annex-4	Japan's Grant Aid
Annex-5	Flow Chart of Japan's Grant Aid Procedures
Annex-6	Major Undertakings to be taken by Each Government
Annex-7	Facility plan in Bushrod power plant

Project Site



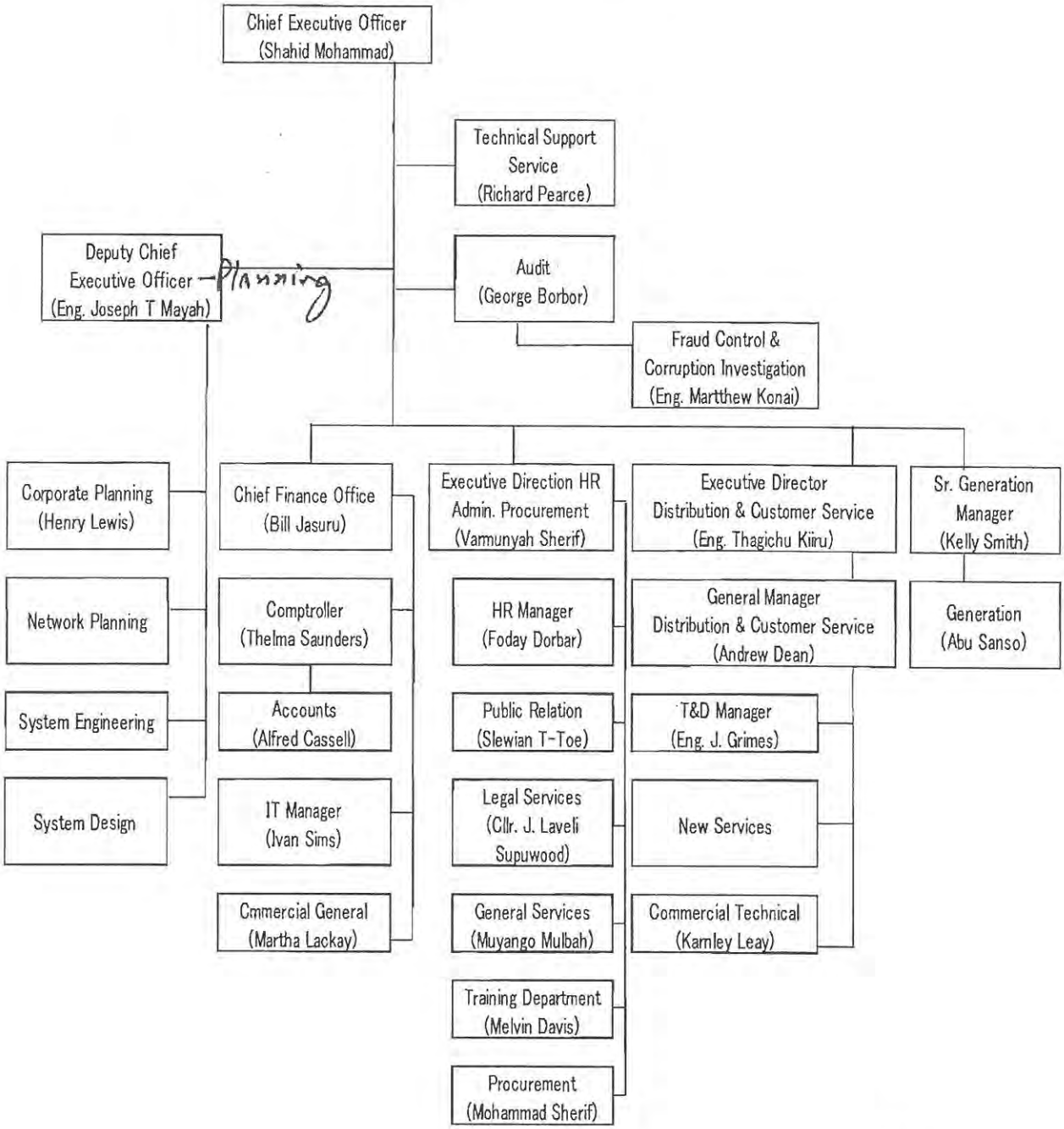
Monrovia City



Bush rod Power Station

Annex 2

Organization Chart of LEC



(Confidential)
Estimated Project Cost

This page is closed due to confidentiality.

Japan's Grant Aid

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・Implementation
-Implementation of the Project on the basis of the G/A

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(1) Contents of the Survey

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- Confirmation of items agreed between both parties concerning the basic concept of the Project.
- Preparation of a basic design of the Project.

- Estimation of costs of the Project.

The contents of the original request by the recipient country are not necessarily approved in their initial form as the contents of the Grant Aid project. The Basic Design of the Project is confirmed based on the guidelines of the Japan's Grant Aid scheme.

JICA requests the Government of the recipient country to take whatever measures necessary to achieve its self-reliance in the implementation of the Project. Such measures must be guaranteed even though they may fall outside of the jurisdiction of the organization of the recipient country which actually implements the Project. Therefore, the implementation of the Project is confirmed by all relevant organizations of the recipient country based on the Minutes of Discussions.

(2) Selection of Consultants

For smooth implementation of the Survey, JICA employs (a) registered consulting firm(s). JICA selects (a) firm(s) based on proposals submitted by interested firms.

(3) Result of the Survey

JICA reviews the Report on the results of the Survey and recommends the GOJ to appraise the implementation of the Project after confirming the appropriateness of the Project.

3. Japan's Grant Aid Scheme

(1) The E/N and the G/A

After the Project is approved by the Cabinet of Japan, the Exchange of Notes(hereinafter referred to as "the E/N") will be singed between the GOJ and the Government of the recipient country to make a pledge for assistance, which is followed by the conclusion of the G/A between JICA and the Government of the recipient country to define the necessary articles to implement the Project, such as payment conditions, responsibilities of the Government of the recipient country, and procurement conditions.

(2) Selection of Consultants

In order to maintain technical consistency, the consulting firm(s) which conducted the Survey will be recommended by JICA to the recipient country to continue to work on the Project's implementation after the E/N and G/A.

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Under the Japanese Grant Aid, in principle, Japanese products and services including transport or those of the recipient country are to be purchased. When JICA and the Government of the recipient country or its designated authority deem it necessary, the Grant Aid may be used for the purchase of the products or services of a third country. However, the prime contractors, namely, constructing and procurement firms, and the prime consulting firm are limited to "Japanese nationals".

(4) Necessity of "Verification"

The Government of the recipient country or its designated authority will conclude contracts denominated in Japanese yen with Japanese nationals. Those contracts shall be verified by JICA. This "Verification" is deemed necessary to fulfill accountability to Japanese taxpayers.

(5) Major undertakings to be taken by the Government of the Recipient Country

In the implementation of the Grant Aid Project, the recipient country is required to undertake such necessary measures as Annex-6.

(6) "Proper Use"

The Government of the recipient country is required to maintain and use properly and effectively the facilities constructed and the equipment purchased under the Grant Aid, to assign staff necessary for this operation and maintenance and to bear all the expenses other than those covered by the Grant Aid.

(7) "Export and Re-export"

The products purchased under the Grant Aid should not be exported or re-exported from the recipient country.

(8) Banking Arrangements (B/A)

a) The Government of the recipient country or its designated authority should open an account under the name of the Government of the recipient country in a bank in Japan (hereinafter referred to as "the Bank"). JICA will execute the Grant Aid by making payments in Japanese yen to cover the obligations incurred by the Government of the recipient country or its designated authority under the Verified Contracts.

b) The payments will be made when payment requests are presented by the Bank to JICA under an Authorization to Pay (A/P) issued by the Government of the recipient country or its designated authority.

(9) Authorization to Pay (A/P)

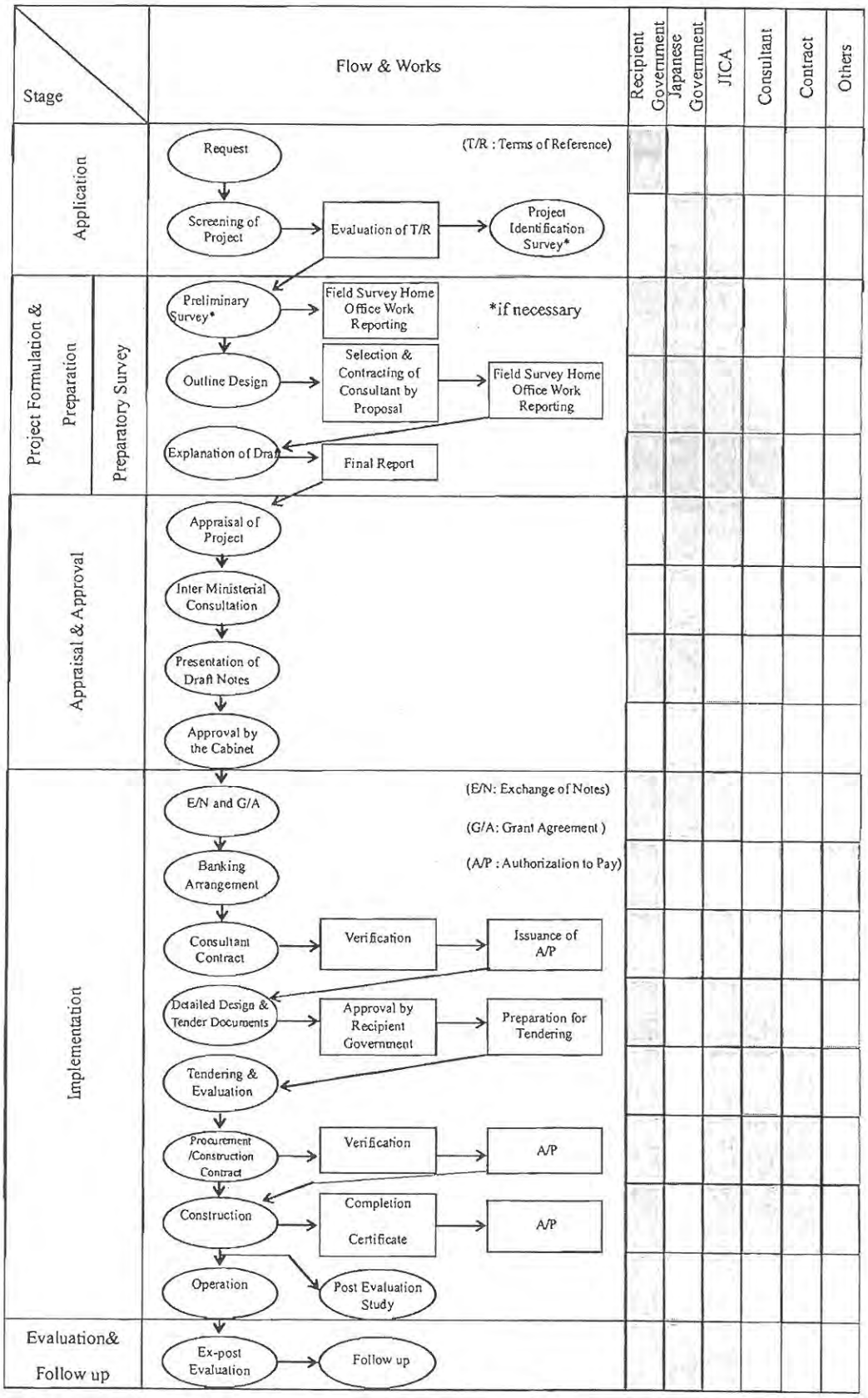
The Government of the recipient country should bear an advising commission of an Authorization to Pay and payment commissions paid to the Bank.

(10) Social and Environmental Considerations

A recipient country must carefully consider social and environmental impacts by the Project and must comply with the environmental regulations of the recipient country and JICA socio-environmental guidelines.

(End)

Flow Chart of Japan's Grant Aid Procedures

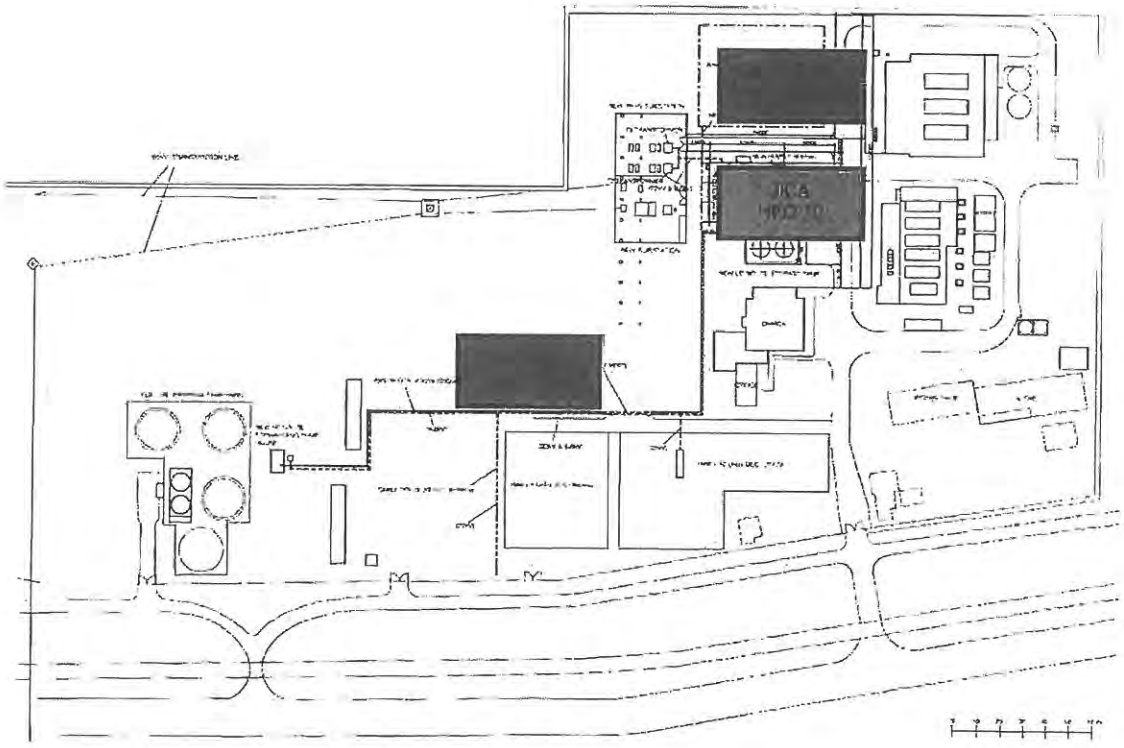


Major undertakings to be taken by each Government

No.	Items	To be covered by Grant Aid	To be covered by Recipient Side
1	to secure [a lot] /[lots] of land necessary for the implementation of the Project and to clear the [site]/[sites];		●
2	To construct the following facilities		
	1) The building	●	
	2) The gates and fences in and around the site		●
	3) The parking lot	●	
	4) The road within the site	●	
	5) The road outside the site		●
3	To provide facilities for distribution of electricity, water supply and drainage and other incidental facilities necessary for the implementation of the Project outside the [site]/[sites]		
	1)Electricity		
	a. The distributing power line to the site		●
	b. The drop wiring and internal wiring within the site	●	
	c. The main circuit breaker and transformer	●	
	2) Water Supply		
	a. The city water distribution main to the site		●
	b. The supply system within the site (receiving and elevated tanks)	●	
	3) Drainage		
	a. The city drainage main (for storm sewer and others to the site)		●
	b. The drainage system (for toilet sewer, common waste, storm drainage and others) within the site	●	
	4) Gas Supply		
	a. The city gas main to the site		●
	b. The gas supply system within the site	●	
	5) Telephone System		
	a. The telephone trunk line to the main distribution frame/panel (MDF) of the building		●
	b. The MDF and the extension after the frame/panel	●	
	6) Furniture and Equipment		
	a. General furniture		●
	b. Project equipment	●	
4	To ensure prompt unloading and customs clearance of the products at ports of disembarkation in the recipient country and to assist internal transportation of the products		
	1) Marine (Air) transportation of the Products from Japan to the recipient country	●	
	2) Tax exemption and custom clearance of the Products at the port of disembarkation		●
	3) Internal transportation from the port of disembarkation to the project site	●	
5	To ensure that customs duties, internal taxes and other fiscal levies which may be imposed in the recipient country with respect to the purchase of the products and the services [be exempted] / [be borne by the Authority without using the Grant]		●
6	To accord Japanese nationals whose services may be required in connection with the supply of the products and the services such facilities as may be necessary for their entry into the recipient country and stay therein for the performance of their work		●
7	To ensure that [the Facilities and the products]/[the Facilities]/ [the products] be maintained and used properly and effectively for the implementation of the Project		●
8	To bear all the expenses, other than those covered by the Grant, necessary for the implementation of the Project		●
9	To bear the following commissions paid to the Japanese bank for banking services based upon the B/A		
	1) Advising commission of A/P		●
	2) Payment commission		●
10	To give due environmental and social consideration in the implementation of the Project.		●

*1 B/A : Banking Arrangement, A/P : Authorization to pay) *2 If the environmental screening category is C, No. 10 is unnecessary

Facility plan in Bushrod power plant



A- 5 Topographic Survey Report

TOPOGRAPHIC SURVEY

FOR THE

REHABILITATION OF MONROVIA POWER STATION

IN THE

REPUBLIC OF LIBERIA.

FINAL REPORT

PREPARED BY:

BEZALEEL + TURNKEY CONTRACTORS INC.
77, CAREY STREET
MONROVIA,
LIBERIA.

CLIENT:

YACHIYO ENGINEERING CO. LTD.

May, 2012

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Summary

REPORT OF TOPOGRAPHICAL SURVEY

1.0 INTRODUCTION

The topographical survey of the site covered was 1.218399 acres. The fieldwork commenced on 23.Feb.2012 and completed on 25.Feb.2012. The Topographical survey of the area covered, is as under: The site survey of the proposed Rehabilitation of Monrovia Power Station was carried out on the basis of the boundaries shown by Yachiyo Engineering Co. Ltd.

2.0 METHODOLOGY

The survey team comprised of:

1. Engineering Surveyor
2. Assistant Surveyor
3. Field Assistants.

Instruments used:

1. Garmin GPS-60
2. Compass
3. Nikon DTM 322 Total
4. Station
5. Tripod
6. Prism
7. Prism Pole

The survey team using the **Garmin GPS-60** to operate satellite coordinates **(WGS-UTM-84,29^0 N -Datum)** transferred the station points B1, B2 and B3. After determining this, the total station was centered to start work.

The survey team used Transvers method to shoot all terrain points from ground, to determine ground Levels (Datum), the horizontal (North) and Vertical (East) angle coordinates was also determined.

3.0 ANALYSIS

After the shooting process, all data downloaded from the instrument was carried out using **Trimble Transfer Software** which is in **DAT** format. These data is later transferred to **Microsoft Excel** and converted to **EXL** file and then downloaded to a survey software for drafting of the final drawing, Printing was done using the **HP 1280** for the A3 size sheet of this work.

The list of Station Points, GPS Coordinates and Bore Hole Coordinates are enlisted below.

STATION POINTS				
SL.NO	POINTS	NORTHING	EASTING	ELEVATION
1	S1	703601.000	302204.000	100.000
2	S2	704234.800	303330.000	100.306
3	S3	704362.300	297645.800	99.982
4	S4	697498.100	301310.560	99.745
5	S5	698793.400	295509.160	99.434
6	S6	704751.900	298365.400	99.702

GPS COORDINATES				
SL.NO	POINTS	NORTHING	EASTING	ELEVATION
1	S1	703601.000	302204.000	14.000 M
2	GROUND LEVEL OF S1	703601.000	302204.000	13.725 M
3	CON.PAD			13.825M
4	TANK AREA 1	703374.000	302286.000	13.825 M
5	TANK AREA 2	704654.490	303076.888	13.860 M

BORE HOLE COORDINATES				
SL.NO	POINTS	NORTHING	EASTING	ELEVATION
1	B1	701513.300	298823.700	99.256
2	B2	699791.500	299483.300	99.239
3	B3	699308.500	296933.900	99.296

ATTACHMENT

SOIL INVESTIGATION WORKS

FOR THE

REHABILITATION OF MONROVIA POWER STATION

IN THE

REPUBLIC OF LIBERIA.

FINAL REPORT

PREPARED BY:

BEZALEEL + TURNKEY CONTRACTORS INC.
77, CAREY STREET
MONROVIA,
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CLIENT:

YACHIYO ENGINEERING CO. LTD.

May, 2012

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EXECUTIVE SUMMARY

The depth of the sub soil formation explored is up to the depth of 30m in all the 3No test bores. These were drilled by conducting Standard Penetration Test (SPT) at every 1.5m intervals up to maximum depth of 30m below the existing ground level. The samples obtained at different depths were also tested in the laboratory in order to determine the geotechnical properties of the subsoil at the various boring locations.

Based on the results obtained the sub soils of the various locations and their SPT N value are as presented below.

Table A1: SPT N_{30} Value

Depth (m)	SPT N_{30} VALUE			Lithology
	BH 1	BH 2	BH 3	
0.0-0.6	4	4	2	Fill material and organic soil
1.5-2.1	11	11	9	Fine sand
3.0-3.6	24	16	14	Fine sand
4.5-5.1	29	25	23	Fine sand
6.0-6.6	16	17	19	Coarse sand
7.5-8.1	32	23	27	Coarse sand
9.0-9.6	12	23	23	Fine sand and clay
10.5-11.1	48	39	37	Fine sand and coarse sand
12.0-12.6	80	40	42	Fine sand and coarse sand
13.5-14.1	62	40	37	Fine sand and coarse sand
15.0-15.6	60	36	34	Fine sand
16.5-17.1	72	39	37	Fine sand
18.0-18.6	50	45	46	Fine sand
19.5-20.1	49	22	39	Fine sand, coarse sand and clay
21.0-21.6	53	46	44	Fine sand and coarse sand
22.5-23.1	58	44	42	Fine sand and coarse sand
24.0-24.6	39	52	44	Fine sand
25.5-26.1	51	39	45	Fine sand
27.0-27.6	54	45	47	Fine sand
28.5-29.1	67	57	55	Very dense Sand
30.0-30.6	80	54	54	Very dense Sand
	EB	EB	EB	Very dense Sand

* EB - End of Boring.

The materials encountered at site within the explored depths of 0.0-30.0 are predominantly sands and clay; therefore considering the nature of the subsoil at the boring locations at a depth of between 1.0-.3.0m the foundations of the various structures are recommended as follows;

Transformer Base and Other Installations

The foundation of the structures and plants should be ***CELLULAR RAFT FOUNDATION*** at depth of ***2.0 – 2.50m*** below the existing ground level; considering allowable bearing capacity values of 90 - 240kN/m^2 at that depth.

Alternatively depending on the loading combinations of the structures ***DRIVEN PILES OR BORED PILES*** which could are ***CAST IN PLACE PILES*** at depth of ***15 - 20m*** from the existing ground level could be adopted.

Non Load Bearing Structures

Considering the bearing capacity values of 90 - 110kN/m^2 at depth of 1.50-2.0m, the foundation of the building should be ***GROUND BEAMS*** at depth of ***1.5m*** below the existing ground level.

Due to the depth of water table level observed at the excavated depth of about 2.20 – 2.30m, ***TANKING MATERIAL*** should be utilized at the hardcore level (DPC – damp proof course) to prevent the ingress of water at the foundation base.

As result of the high ground water observed at the depth of 2.20 – 2.30m provision should be made to dewater the site to a safe level to allow for ease of foundation construction. Adequate drainage and pumping methods should be provided around the site to drain away the water during and after construction.

1.0 INTRODUCTION

GENERAL

1.1 The report of the Geotechnical foundation investigation conducted for the Proposed Construction of New Power House and New Substation at Bushrod Island Power Station, Monrovia, Liberia, is presented herein.

Reference your offer to carry out Geotechnical investigations at the above named site. We mobilized to site on 7th March, 2012 for the field work.

SCOPE OF WORK FOR THE INVESTIGATIONS

1.2 The objectives of the investigations were as follows:

i. To Conduct Standard Penetration Tests (SPT) at every 1.5m depth intervals, to the depth of 30m at 3Nos test bores;

ii. Evaluate the bearing capacity of soils for foundation of structures;

iii. To ascertain the depth to bed rock and water table level for design purpose;

iv. Obtain open tube of 50 x 350mm long undisturbed samples and split spoon samples from boreholes for laboratory analyses;

v. Evaluate by conducting laboratory tests the physical properties and strength of the soils obtained for both disturbed and undisturbed samples from the test bores.

1.3 The field work commenced on 11th March, 2012 and it involved rotary drilling as well as sampling materials. A total of 3Nos test bores were drilled up to depths of 30m.

Samples were obtained at different depths in the 3Nos test bores. The samples were carefully identified, preserved and taken for further laboratory tests and analyses.

Table 1 shows the coordinates of the boring locations.

Table 1: Coordinates of Test Locations

S/No.	Borehole No.	Coordinates
1	BH1	E: 298823.700 N: 701513.300
2	BH 2	E: 299483.300 N: 699791.500
3	BH 3	E: 296933.900 N: 699308.500

2.0 GEOMORPHOLOGY

2.1 General Geology

The geology of the project is of the younger sedimentary basins. Along the Atlantic Ocean, the coastline is characterized by lagoons, mangrove swamps, and river-deposited sandbars. It is of the Quaternary age and Neogene – Mosozoic age comprising of sands and clay.

Climate

Liberia is known for its sustained heat and heavy rainfall. Because the republic lies south of the Tropic of Cancer and only a few degrees north of the equator, the days vary little in length. The tropical solar radiation is intense and the radiation is uniform across the country. Temperatures remain warm throughout the country, and there is little change in temperature between seasons.

2.2 Topography

The topography of the area is of a relatively flat terrain and it falls within built up area.

3.0 GEOTECHNICAL INVESTIGATIONS:

3.1 Field Work

Three (3Nos) deep boreholes were drilled using the rotary drilling rig with HW (4'') casing in the overburden.

The test borings were drilled to depths of 30m using the wet drilling technique. In each test bore Standard Penetration Tests (SPT) was conducted at 1.5m interval.

The sampling procedure consisted of driving a standard split spoon as set forth in ASTM D1586-1990 and BS 5930. This was by repeated blows of hammer of 63.5kg weight falling through 760mm height. The relationship between the penetration resistance (N - value) and depth are shown in Appendix B.

Samples recovered from the borings as outlined above were visually classified and geologically logged. After these, they were taken to the laboratory for determination of the parameters outlined in section 5.0.

The layout of boring locations and soil profile are shown in Figure 1 - 3.

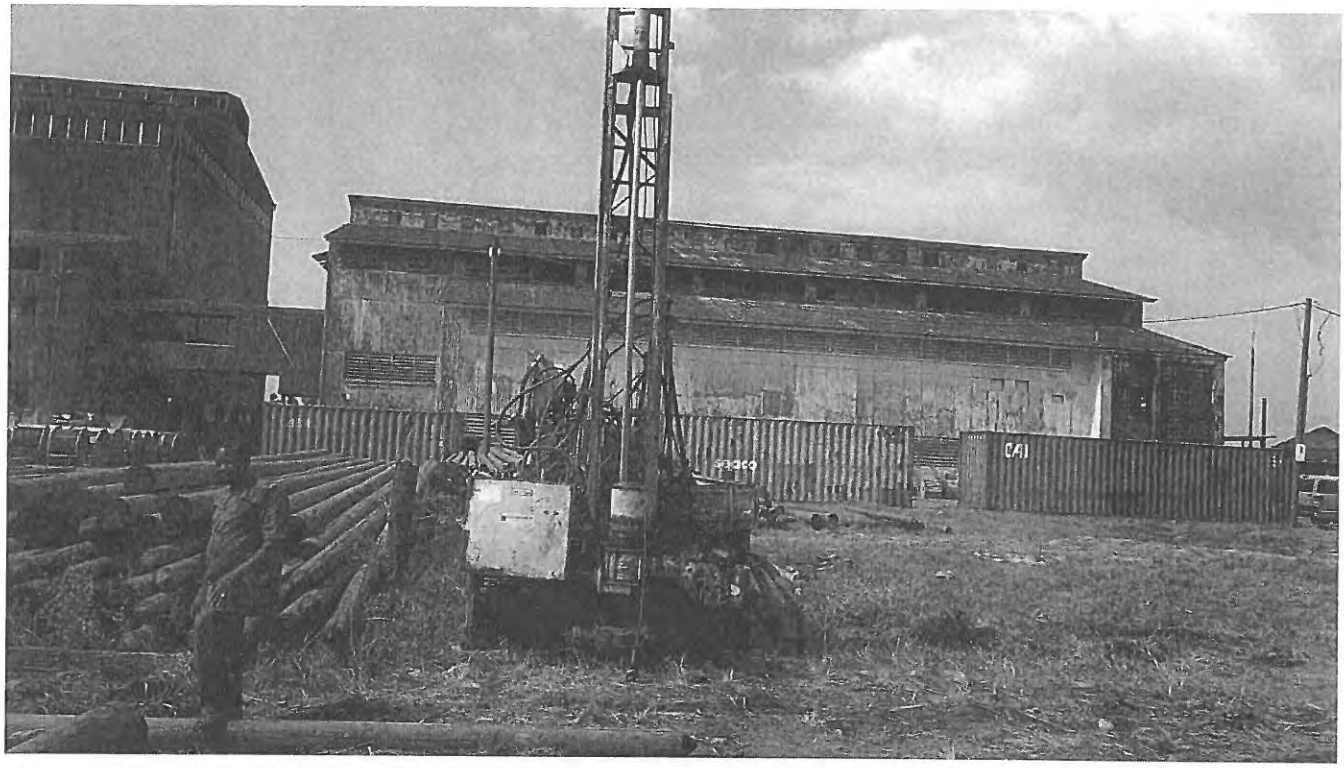

Plate A: Position of Rig at Test Location.

Plate B: Drilling Process at Test Location.

4.0 SUBSOIL AND GROUNDWATER CONDITION

4.1 The Stratigraphies of the subsurface deposits as observed from the logs of test bores performed at this site exhibited similarities both in nature and in strength characteristics from the beginning of the boreholes till their termination. A generalised description for the site can thus be as given below;

Abstract of Findings

The materials proved at all the test borings include fine sand, coarse sand, clay and dense sand. These were observed within total explored depth of 0.05 - 30m in all the 3Nos test bores. The bearing capacity of the formation explored range between 20 - 800kN/m^2.

Stratigraphy

Fine Sand

These are strata of fine grained brown sandy material observed between 0.05 - 27.0m.

Coarse Sand

Layers of medium grained sandy material observed between 6.0 - 21.0m.

Clay

These are stiff medium consolidated clayey material with high plasticity as proved at depth of 9.0 and 20m.

Dense Sand

Layers of dense compacted sandy material occurring at different layers proved between 10.0 – 30.0m with good bearing pressures.

4.2 Ground Water Table

The groundwater level in all the test boring locations were observed to be at depth of 2.20 – 2.30m as at the time this investigation was carried out.

The phreatic surfaces were observed from all the borings and were taken twenty-four hours later (static). These values are recorded in each boring logs and are shown in Table 2 below.

Table 2: Observed Water Table Level

S/No	Boring Location	Static Water Table Level (m)
1	BH 1	2.30
2	BH 2	2.20
3	BH 3	2.30

5.0 LABORATORY TESTING.

5.1 Laboratory classification tests and other tests to determine geotechnical parameters were carried out on the undisturbed and disturbed samples obtained from the boreholes to improve on the field identification and classification. The tests were conducted in accordance with the relevant British Standard as Specified in BS 1377 (1990). The tests carried out include:

* Moisture Content Determination
* Atterberg Limit Tests
* Particle Size Distribution Tests.
* PH Value of Water in Soils.
* Sulphate Content of Water in Soils.
* British Standard Compaction Test.
* Undrained Triaxial Compression Test.
* Specific Gravity Test.
* Consolidation (Oedometer) Test.
* Bulk Density Test

5.2 The Geotechnical properties of the soils encountered at the various strata formation of the overburden were obtained from the tests conducted in laboratory. The summary of the results are given below.

Property	**Min.**	**Max.**
Natural Moisture Content (%)	4	36
Liquid Limit (%)	32	34
Plastic Limit (%)	16	17
Plasticity Index (%)	16	17
Passing # 200 Sieve (%)	0.53	50.89
Bulk density (kN/m^3)	15.68	18.26
Apparent Cohesion (kN/m^2)	0	28
Angle of Internal Friction (Ø)	16	31
Coefficient at compressibility (m^2/kN)	3.84×10^{-4}	3.86×10^{-3}
Specific Gravity	2.59	2.75

The detailed laboratory tests results are presented in laboratory result sheet.

5.3. Chemical Test Result

The chemical test results are shown in Table 3. These results indicate sulphate and chloride content of between 171.21 - 187.08mg/l and 285.03 – 292.45mg/l respectively with pH values ranging from 6.63 - 6.71. The PH value is considered slightly acidic while the sulphate and chloride content is considered moderate, within limit.

Table 3: Results of Chemical Tests

S/N	Boring Location	Chemical Results			Remarks
		PH Value	Sulphate content (mg/l)	Chloride content (mg/l)	
1	BH 1	6.71	185.63	285.03	Slightly acidic soil with moderate sulphate and chloride content
2	BH 2	6.67	171.21	292.45	Slightly acidic soil with moderate sulphate and chloride content
3	BH 3	6.63	187.08	287.72	Slightly acidic soil with moderate sulphate and chloride content

6.0 BEARING CAPACITY VALUES

6.1 The allowable bearing pressure imposed by a foundation is a function of characteristics of the shear strength of the soil as well as the depth and dimension of the foundation. The bearing capacities for selected boring locations were calculated from the laboratory shear strength tests conducted on soil samples for a typical boring location for depth between 1.5-3.0m is as shown below;

BH3@2.0m

$Q_{Ultimate} = CNc + \gamma D\,(N_q - 1) + \frac{1}{2}\,\gamma B N\gamma.$

Where C =2kN/m^2, Ø = 26°, γ= 16.87kN/m^3, B = 1.0m, D = 2.0m.

The Bearing capacity coefficients; (shallow foundations)

$N_c = 27.09$, $N_q = 14.21$, $N\gamma = 9.84$.

Therefore, $q_{(Ult.)} = 2 \times 27.09 + 6.87 \times 2.0 \times 13.21 + 0.5 \times 6.87 \times 1 \times 9.84$

$= 54.18 + 181.51 + 33.80$

= 296.49kN/m^2

Factor of safety = 3.0

Q (allowable) = **89.83kN/m^2**

Note: Cohesion is only 2kN/m^2 which shows presence of silt in the sand and silt has a small degree of cohesion.

6.2 The bearing capacity of soil at the various depths is based on the standard penetration Tests (SPT) as a function of penetration resistance, which is the undrained shear strength in kN/m^2. The values are as shown in the table 4 below.

Table 4: Bearing Capacity Values

Depth (m)	Bearing Capacity Values (kN/m^2)		
	BH1	BH2	BH3
0.0-0.6	40	40	20
1.5-2.1	110	110	90
3.0-3.6	240	160	140
4.5-5.1	290	250	230
6.0-6.6	160	170	190
7.5-8.1	320	230	270
9.0-9.6	120	230	230
10.5-11.1	480	390	270
12.0-12.6	800	400	420
13.5-14.1	620	400	370
15.0-15.6	600	360	340
16.5-17.1	720	390	370
18.0-18.6	500	450	460
19.5-20.1	490	220	390
21.0-21.6	530	460	440
22.5-23.1	580	440	420
24.0-24.6	390	520	440
25.5-26.1	510	390	450
27.0-27.6	540	450	470
28.5-29.1	670	570	550
30.0-30.6	800	540	540
	EB	EB	EB

* EB - End of Boring.

7.0. SETTLEMENT OF FOUNDATION BY MEYEHORF'S METHOD

This method is used to estimate the settlement of a footing on soil and is given by the relationship.

$$\rho = \frac{\Delta P \times B}{2\ Cr}$$

Where ρ - Settlement

ΔP - The net foundation pressure increase which is simply the foundation loading less the value of vertical effective stress at foundation level (δv)

B - The least dimension of the footing

Cr - The average value of SPT over a depth below the footing equal to B

Cr = 400 x N (kN/m^2)

At 1.50m

$\Delta P = 100 - (6.47 \times 1.5)$

$= 90.30 kN/m^2$

B = 2.0m

Cr = 400 x 10 = 4,000kN/m^2

$\rho = \frac{90.30 \times 2}{4{,}000 \times 2} = \frac{180.60}{8{,}000}$

ρ = 22.57mm

at 3.0m

$\Delta P = 180 - (6.46 \times 3.0)$

$= 160.62 kN/m^2$

Cr = 400 x 18 = 7,200kN/m^2

$\rho = \frac{160.62 \times 2}{7{,}200 \times 2} = \frac{321.24}{14{,}400}$

ρ = 22.31mm

Settlement analysis for each strata of soils at various depth, are as contained in Table 5 below;

Table 5: Settlement Analysis Result

Depth of layer Below Ground(m)	Net Foundation Pressure ΔP (kN/m^2)	The Average value of SPT Cr (kN/m^2)	Settlement (mm)
1.5	90.30	4000	22.57
3.0	160.62	7200	22.31

The average immediate settlement at 3.0m is 22.31mm and it decreases with depth depending on imposed load.

8.0 SAFE LOAD CAPACITY OF PILES

The predominant materials are sand overburden, which are highly permeable such that pore pressures induced in these soils by the applied loads are dissipated rapidly. The total pile carrying capacity is a function of the frictional resistance and end bearing resistance.

The Total Pile capacity = SF + ER (Skin Friction + End Resistance)

$$q_s = K_s\ \gamma_{vo} \tan \emptyset$$

Where, q_s = Friction resistance

K_s = Coefficient of horizontal soil stress

γ_{vo} = Average effective overburden pressure ($\gamma_s - \gamma_w$)

δ = Angle of wall friction

And

$$q_b = N_q \gamma_{vo}\ A_b$$

q_b = base resistance

N_q = bearing capacity friction

δ_{vo} = effective overburden pressure at length of the soil layer

A_b = Area of base of pile (based on diameter of pile)

BH1

$q_s = K_s\ \delta_{vo} \tan \emptyset$

$K_s = 1$, for Bored and cast in Place Piles (after Kulhawy); γ_{vo} (average) = 16.73kN/m^3;

$\delta = 1 \times \emptyset$, for cast in place piles, $\emptyset = 27^0$, tan $\emptyset = 0.510$

Depth (h) = 15m, Area = 0.283m ($\emptyset$ = 600mm)

q_s = $1 \times (16.73 - 10) \times 15 \times 0.510$

= $51.49 kN/m^2$

Pile capacity due to friction (SF) = Frictional Resistance (q_s) x Contact Area ($2\pi r_1$)

= $51.49 \times 2\pi r_1$

= $51.49 \times 2 \times 3.142 \times 0.3 \times 15$

= $1,455.88kN$

End Resistance (ER) = 600kN/m^2

Cross sectional Area (CA) = 0.283m^2 (d = 0.6m)

Pile capacity due to end resistance (ER x CA) = 600 x 0.283 = ***169.80kN***

Total pile capacity (SF + ER) = 1455.88 + 169.80

= ***1625.68kN***

Safe pile capacity = 1625.88/3 = **542*kN***

The diameter of the pile is considered for 600mm and 1000mm.

Table 6a: Safe Load Capacity for Pile (600mm Diameter)

Boring No.	K_S	γ_b	Depth of boring (m)	Tan Ø	Pi (π)	Pile Diameter (m)	Pile length (m)	Skin friction (KN)	A_b (m^2)	End Resistance (KN/m^2)	Total Pile Capacity (KN)	Safe Pile Capacity FOS=3.0 (KN)
BH 1	1.0	6.73	15	0.510	3.142	0.6	15	1455.88	0.283	600	1625.68	542
BH 2	1.0	6.45	15	0.554	3.142	0.6	15	1515.69	0.283	360	1617.57	539
BH 3	1.0	6.64	15	0.532	3.142	0.6	15	1498.37	0.283	340	1594.59	531

FOS=Factor of Safety

Table 6b: Safe Load Capacity for Pile (1000mm Diameter)

Boring No.	K_S	γ_b	Depth of boring (m)	Tan Ø	Pi (π)	Pile Diameter (m)	Pile length (m)	Skin friction (KN)	A_b (m^2)	End Resistance (KN/m^2)	Total Pile Capacity (KN)	Safe Pile Capacity FOS=3.0 (KN)
BH 1	1.0	6.73	15	0.510	3.142	1.0	15	2426.46	0.785	600	2897.47	966
BH 2	1.0	6.45	15	0.554	3.142	1.0	15	2526.14	0.785	360	2808.74	936
BH 3	1.0	6.64	15	0.532	3.142	1.0	15	2497.29	0.785	340	2764.19	921

FOS=Factor of Safety

9.0 FOUNDATION DISCUSSION AND RECOMMENDATIONS

9.1 DISCUSSION

The total depth explored in the entire 3No test bores is 30.0m. These consist of sands and clay, subsoil, these were observed between 0.05 – 30.0m with bearing pressure of 20 – 800kN/m^2.

The ground water levels were observed to at depth of 2.20 – 2.30m.

The standard penetration test (SPT) revealed that the subsoil at the site has average bearing pressure at the shallow depth but was observe to be varying with depth and strata formation as shown in Appendix B.

9.2 RECOMMENDATIONS

* The recommendations as contained in this report are based on careful correlation and interpretation of the results of the field results and analyses.
* The settlement at 3.0m is between 22.31mm and it decreases with depth based on the imposed load on the foundation;
* The materials encountered at site within the explored depths of 0.0-30.0 are predominantly sands and clay; therefore considering the nature of the subsoil at the boring locations at a depth of between 1.0-.3.0m the foundations of the various structures are recommended as follows;

Transformer Base and Other Installations

The foundation of the structures and plants should be ***CELLULAR RAFT FOUNDATION*** at depth of ***2.0 – 2.50m*** below the existing ground level; considering ultimate bearing capacity values of 90 - 240kN/m^2 at that depth.

Alternatively depending on the loading combinations of the structures ***DRIVEN PILES OR BORED PILES*** which could are ***CAST IN PLACE PILES*** at depth of ***15 - 20m*** from the existing ground level could be adopted.

Non Load Bearing Structures

Considering the bearing capacity values of 90 - 110kN/m^2 at depth of 1.50m, the foundation of the building should be ***GROUND BEAMS*** at depth of ***1.5m*** below the existing ground level.

* Due to the depth of water table level observed at the depth of about 2.20 – 2.30m, ***TANKING MATERIAL*** should be utilized at the hardcore level (DPC) to prevent the ingress of water at the foundation base.

As result of the high ground water observed at the depth of 2.20 – 2.30m provision should be made to dewater the site to a safe level to allow for ease of foundation construction. Adequate drainage and pumping methods should be provided around the site to drain away the water during

and after construction.

* The chemical tests on the water in soil samples confirmed the sulphate and chloride content of between 171.21 – 187.08g/l and 285.03 – 292.45mg/l respectively with pH values from 6.63 – 6.71 which is considered slightly acidic with moderate sulphate and chloride content. Therefore, Ordinary Portland Cement with cement content not less than 370kg/m^3 and maximum water cement-ratio of 0.40 could be used.

Table 7: Summary of Foundation Recommendations

Locations	Recommendations	Bearing Capacity Values (KN/m^2)
Transformer Base and Other Installations	***CELLULAR RAFT FOUNDATION*** at depth of ***2.0 - 2.50m*** below existing ground level. Alternatively depending on the loading combinations of the structures ***DRIVEN PILES*** or ***BORED PILES*** which could are ***CAST IN PLACE PILES*** at depth of ***15 - 20m***	90 – 240kN/m^2 at depth of 2.0 - 3.0m
Non Load Bearing Structures	***GROUND BEAMS*** at depth of ***1.5m*** below existing ground level	90 – 110kN/m^2 at depth of 1.5 - 2.0m

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No 12A Nuhu Bamali Close,
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ATTACHMENT

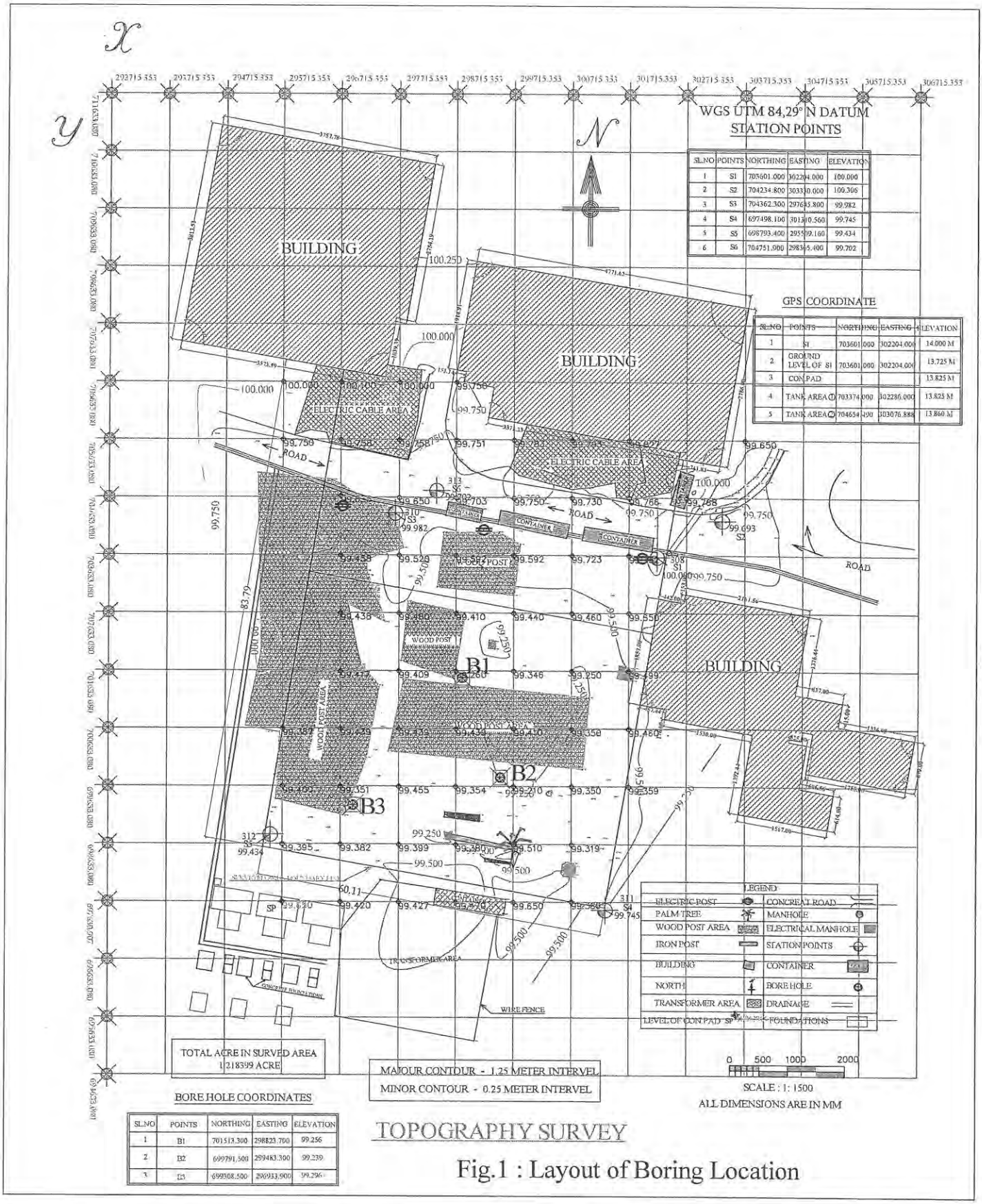


Fig.1 : Layout of Boring Location

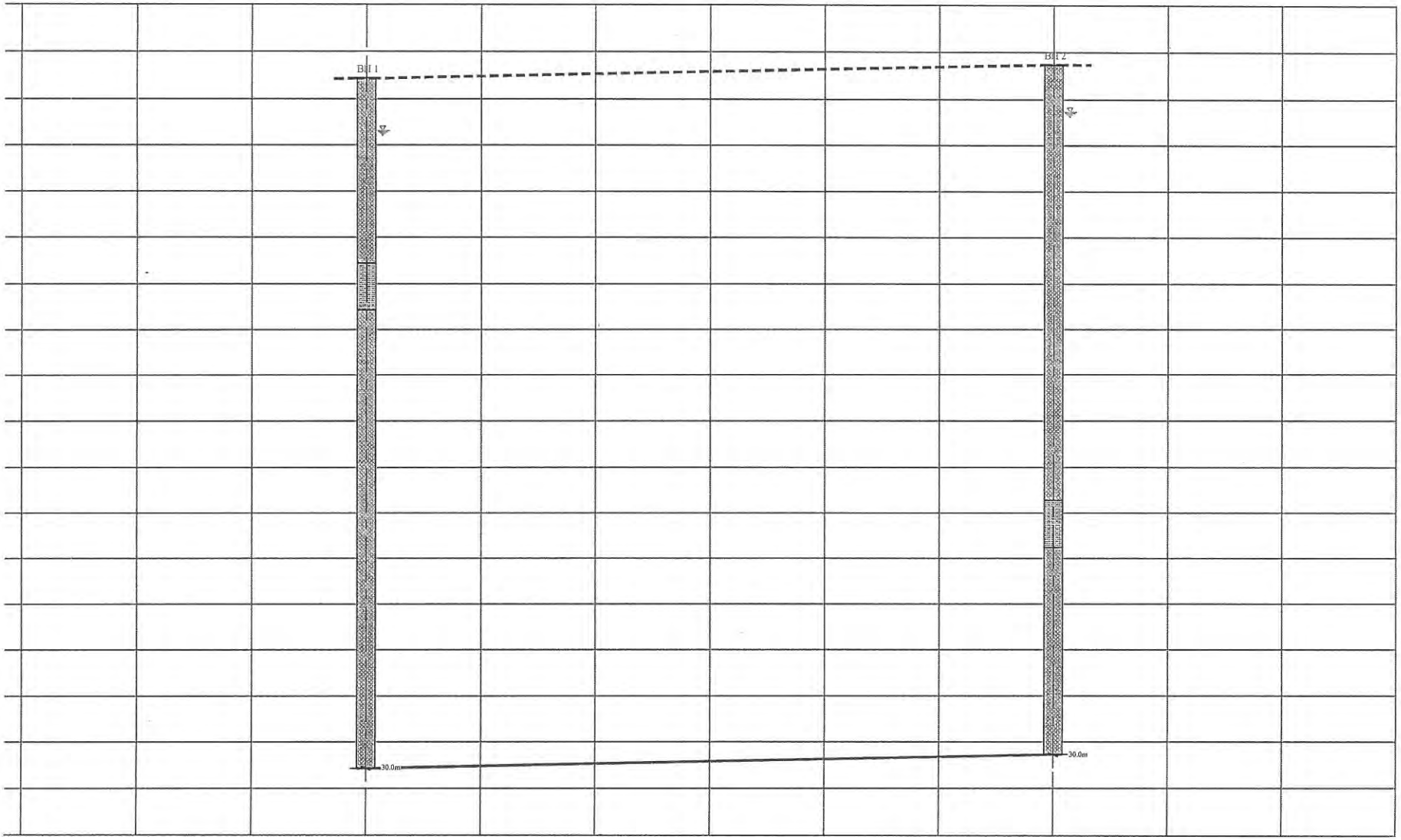


Fig. 2: Soil Profile (1 - 2)

Legend

- Fine sand, coarse sand and dense sand
- Clay
- Boring Locations at Depth of Excavation
- End of Boring
- Water Table Level

Bezaleel + Turnkey Contractors,Inc.

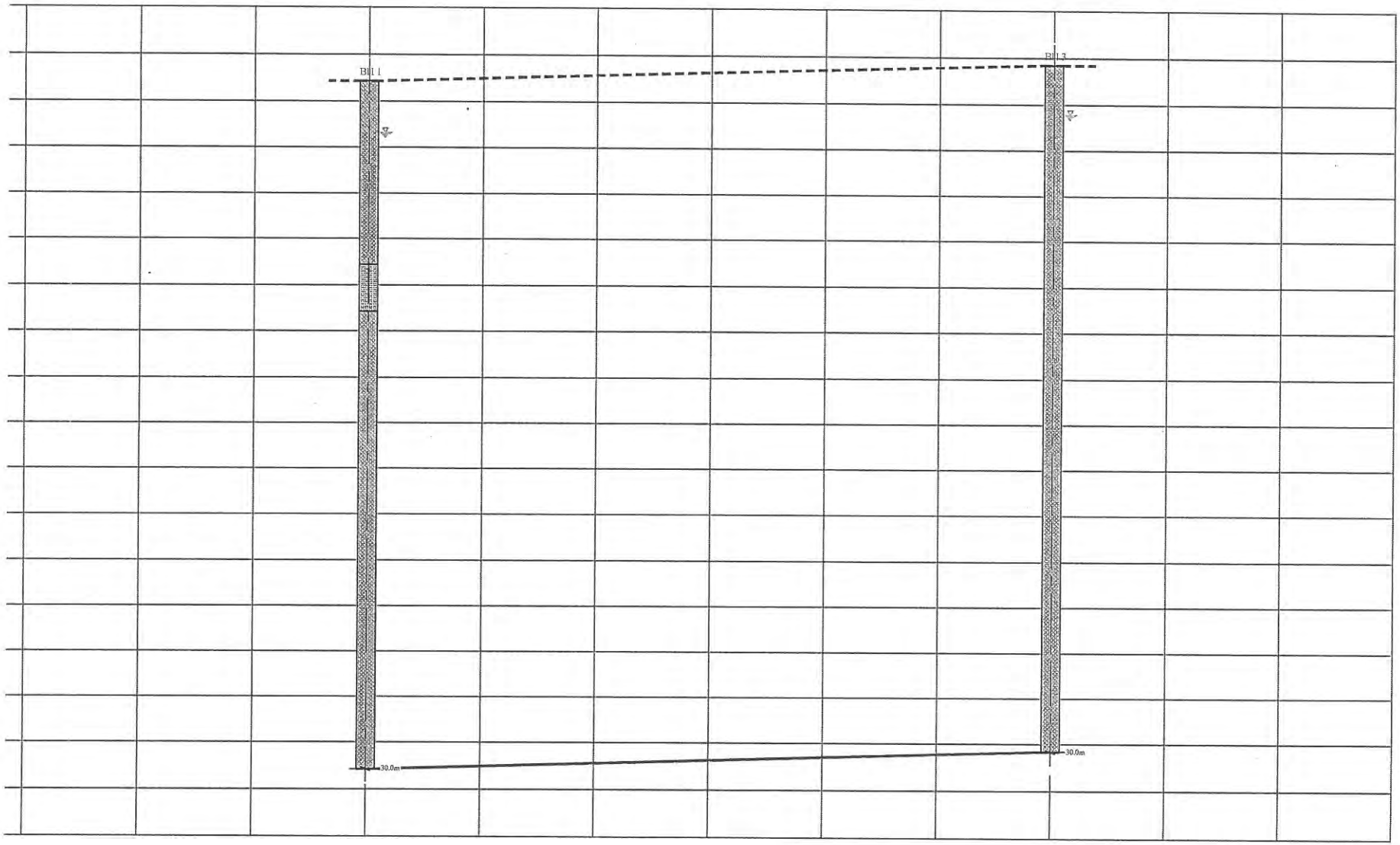


Fig. 3: Soil Profile (1 - 3)

Legend

- Fine sand, coarse sand and dense sand
- Clay
- Boring Locations at Depth of Excavation
- End of Boring
- Water Table Level

Bezaleel + Turnkey Contractors,Inc.

APPENDIX A

STANDARD PENETRATION TEST: FIELD RESULT

Start date: 11/03/2012 End date: 12/03/2012

PROJECT: Proposed Construction of New Power House and New Subsation at Bushrod Island Power Station, Monrovia, Liberia.
BORING: BH 1
RIG: Mobile Drill Rig
STATION:
METHOD OF BORING: Rotary
CA SIZE : 4"
DRILLER: Mohammed
FIELD TECHNICIAN: Ahmed

WL = 2.30m

Depth (m)	Number of Blows at 0.15 m interval	Description of Layer
0.00 - 0.60	2, 2, 2	Brownish loose organic top soil
1.5 - 2.1	3, 5, 6	Greyish medium dense SAND
3.0 - 3.6	9, 11, 13	Brownish medium dense fine SAND
4.5 - 5.1	10, 13, 16	Brownish medium dense fine SAND
6.0 - 6.6	11, 8, 8	Brownish medium dense coarse SAND
7.5 - 8.1	8, 14, 18	Brownish dense coarse SAND
9 - 9.6	2, 4, 8	Greyish stiff CLAY
10.5 - 11.1	9, 28, 20	Brownish dense coarse SAND
12 - 12.6	10, 32, 48	Brownish very dense coarse SAND
13.5 - 14.1	11, 28, 34	Brownish very dense coarse SAND
15 - 15.6	11, 28, 32	Brownish very dense fine SAND
16.5 - 17.1	12, 30, 42	Brownish very dense fine SAND
18.0 - 18.6	12, 21, 29	Brownish very dense coarse SAND
19.5 - 20.1	13, 22, 27	Brownish dense fine SAND

APPENDIX A

STANDARD PENETRATION TEST: FIELD RESULT

Start date: 11/03/2012 End date: **12/03/2012**

PROJECT: Proposed Construction of New Power House and New Subsation at Bushrod Island Power Station, Monrovia, Liberia.
RIG: Mobile Drill Rig
METHOD OF BORING: Rotary
DRILLER: Mohammed

BORING: BH 1 Cont'd
STATION:
CA SIZE : 4"
FIELD TECHNICIAN: Ahmed

Depth (m)	Number of Blows at 0.15 m interval	Description of Layer
21.0 - 21.6	18, 21, 32	Brownish very dense fine SAND
22.5 - 23.1	19, 28, 30	Brownish very dense fine SAND
24.0 - 24.6	11, 18, 21	Brownish dense SAND
25.5 - 26.1	14, 21, 30	Brownish very dense fine SAND
27.0 - 27.6	18, 21, 33	Brownish very dense SAND
28.5 - 29.1	15, 28, 39	Brownish very dense SAND
30.0 - 30.6	21, 32, 48	Brownish very dense SAND
31.5 - 32.1		
33.0 - 33.6		
34.5 - 35.1		
36.0 - 36.6		
37.5 - 38.1		
39.0 - 39.6		
40.5 - 41.1		

APPENDIX A

STANDARD PENETRATION TEST: FIELD RESULT

PROJECT: Proposed Construction of New Power House and New Subsation at Bushrod Island Power Station, Monrovia, Liberia.
Start date: 13/03/2012 **End date: 14/03/2012**
RIG: Mobile Drill Rig
METHOD OF BORING: Rotary
DRILLER: Mohammed
BORING: BH 2
STATION:
CA SIZE : 4"
FIELD TECHNICIAN: Ahmed

WL = 2.20m

Depth (m)	Number of Blows at 0.15 m interval	Description of Layer
0.00 - 0.60	1, 2, 2	Loose fill material
1.5 - 2.1	4, 6, 5	Greyish medium dense fine grain SAND
3.0 - 3.6	6, 9, 7	Brownish grey medium dense fine SAND
4.5 - 5.1	8, 11, 14	Brownish grey medium dense fine SAND
6.0 - 6.6	7, 8, 9	Brownish medium dense coarse SAND
7.5 - 8.1	9, 11, 12	Brownish medium dense coarse SAND
9 - 9.6	10, 13, 10	Brownish medium dense fine SAND
10.5 - 11.1	13, 18, 21	Brownish red dense fine SAND
12 - 12.6	14, 17, 23	Brownish dense fine SAND
13.5 - 14.1	11, 18, 22	Brownish red dense fine SAND
15 - 15.6	19, 17, 19	Greyish dense fine SAND
16.5 - 17.1	14, 18, 21	Brownish dense fine SAND
18.0 - 18.6	11, 21, 24	Brownish dense fine SAND
19.5 - 20.1	8, 10, 12	Greyish very stiff CLAY

APPENDIX A

STANDARD PENETRATION TEST: FIELD RESULT

PROJECT: Proposed Construction of New Power House and New Subsation at Bushrod Island Power Station, Monrovia, Liberia.
RIG: Mobile Drill Rig
METHOD OF BORING: Rotary
DRILLER: Mohammed

Start date: 13/03/2012 **End date: 14/03/2012**
BORING: BH 2 Cont'd
STATION:
CA SIZE : 4"
FIELD TECHNICIAN: Ahmed

Depth (m)	Number of Blows at 0.15 m interval	Description of Layer
21.0 - 21.6	16, 22, 24	Brownish dense coarse SAND
22.5 - 23.1	18, 23, 21	Brownish dense coarse SAND
24.0 - 24.6	16, 24, 28	Brownish very dense fine grain SAND
25.5 - 26.1	11, 18, 21	Brownish dense fine grain SAND
27.0 - 27.6	13, 21, 24	Brownish dense fine SAND
28.5 - 29.1	18, 25, 32	Brownish very dense SAND
30.0 - 30.6	19, 24, 30	Brownish very dense SAND
31.5 - 32.1		
33.0 - 33.6		
34.5 - 35.1		
36.0 - 36.6		
37.5 - 38.1		
39.0 - 39.6		
40.5 - 41.1		

APPENDIX A

STANDARD PENETRATION TEST: FIELD RESULT

PROJECT: Proposed Construction of New Power House and New Subsation at Bushrod Island Power Station, Monrovia, Liberia.
RIG: Mobile Drill Rig
METHOD OF BORING: Rotary
DRILLER: Mohammed

Start date: 16/03/2012 **End date: 17/03/2012**
BORING: BH 3
STATION:
CA SIZE : 4"
FIELD TECHNICIAN: Ahmed

WL = 2.30m

Depth (m)	Number of Blows at 0.15 m interval	Description of Layer
0.00 - 0.60	1, 1, 1	Brownish loose fill material
1.5 - 2.1	3, 5, 4	Dark brownish loose fine SAND
3.0 - 3.6	5, 8, 6	Dark brownish medium dense fine SAND
4.5 - 5.1	9, 10, 13	Brownish medium dense fine SAND
6.0 - 6.6	8, 9, 10	Brownish medium dense coarse SAND
7.5 - 8.1	7, 12, 15	Brownish medium dense coarse SAND
9 - 9.6	11, 14, 9	Brownish medium dense fine SAND
10.5 - 11.1	12, 17, 20	Brownish red medium dense fine SAND
12 - 12.6	13, 18, 24	Brownish dense fine SAND
13.5 - 14.1	10, 17, 20	Brownish dense fine SAND
15 - 15.6	18, 16, 18	Brownish dense fine SAND
16.5 - 17.1	13, 17, 20	Reddish brown dense fine SAND
18.0 - 18.6	11, 21, 25	Brownish red dense fine SAND
19.5 - 20.1	11, 18, 21	Brownish dense fine SAND

APPENDIX A

STANDARD PENETRATION TEST: FIELD RESULT

PROJECT: Proposed Construction of New Power House and New Subsation at Bushrod Island Power Station, Monrovia, Liberia.
RIG: Mobile Drill Rig
METHOD OF BORING: Rotary
DRILLER: Mohammed

Start date: 16/03/2012 **End date: 17/03/2012**
BORING: BH 3 Cont'd
STATION:
CA SIZE : 4"
FIELD TECHNICIAN: Ahmed

Depth (m)	Number of Blows at 0.15 m interval	Description of Layer
21.0 - 21.6	15, 21, 23	Brownish dense fine SAND
22.5 - 23.1	17, 22, 20	Brownish dense fine SAND
24.0 - 24.6	15, 20, 24	Brownish dense fine SAND
25.5 - 26.1	11, 21, 24	Brownish dense fine SAND
27.0 - 27.6	14, 22, 25	Brownish dense fine SAND
28.5 - 29.1	18, 26, 29	Brownish very dense SAND
30.0 - 30.6	19, 25, 29	Brownish very dense SAND
31.5 - 32.1		
33.0 - 33.6		
34.5 - 35.1		
36.0 - 36.6		
37.5 - 38.1		
39.0 - 39.6		
40.5 - 41.1		

Bezaleel + Turnkey Contractors,Inc.

FIGURE: APPENDIX B
BORING: BH 1
STATION:
DATE: MARCH, 2012.

PROJECT: PROPOSED STRUCTURES FOR LEC EXPANSION, BUSHROD ISLAND, MONROVIA, LIBERIA.

DRILLER: MOHAMMED SPOON OD: 1 1/2" CASING SIZE: 4" CORE SIZE: 2"

SAMPLE CONDITION
- UNDISTURBED
- DISTURBED
- LOST

SAMPLE TYPE
- A.S. AUGER
- S.S. SPLIT SPOON
- T.O. OPEN TUBE
- P.S. PISTON
- R.C. ROCK CORE

FIELD AND LABORATORY TESTS
- + INSITU-VANE UNDIST
- × INSITU-VANE REMOULDED
- ● WATER CONTENT
- O I O ATTERBERG LIMITS
- ▼ UNDRAINED COMPRESSION
- SPT
- G GRAIN SIZE
- C CONSOLIDATION
- U UNCONFINED
- Q UNDRAINED TRIAXIAL
- Y WET UNIT WEIGHT

4 - 0%
13 - 0 - 5%
10%
STRAIN AT FAILURE FOR UNDRAINED COMPRESSION

DEPTH (m) | SAMPLE COND. | SAMPLE NO. | SAMPLE TYPE | Y - KN/m³ | OTHER TESTS

SPT BLOWS/METRE: 10 20 30 40 50 60 70 80 90 100 110 120

UNDRAINED SHEAR STRENTH KN/m²: 100 200 300 400 500 600 700 800 900 1000 1100 1200

SPT BLOWS/m

SPT N

SOIL DESCRIPTION	STRATA	GWL	LEVEL DEPTH (m)
GROUND LEVEL			
Top Soil			
Brownish Loose Organic Soil			▽ 0.6 m
Greyish Medium Dense SAND			▽ 2.1 m
Brownish Medium Dense Fine SAND			▽ 3.6 m
Brownish Medium Dense Fine SAND			▽ 5.1 m
Brownish Medium Dense Coarse SAND			▽ 6.6 m
Brownish Dense Coarse SAND			▽ 8.1 m
Greyish Stiff CLAY			▽ 9.6 m
Brownish Dense Coarse SAND			▽ 11.1m
Brownish Very Dense Coarse SAND			▽ 12.6m
Brownish Very Dense Coarse SAND			▽ 14.1m
Brownish Very Dense Fine SAND			▽ 15.6m
Boring Continues on the next Page			

SOIL PROFILE

SITECH ENGINEERING LIMITED

FIGURE: APPENDIX B

BORING: BH 1 Cont'd

STATION:

PROJECT: PROPOSED STRUCTURES FOR LEC EXPANSION, BUSHROD ISLAND, MONROVIA, LIBERIA.

DRILLER: MOHAMMED SPOON OD: 1 1/2" CASING SIZE: 4" CORE SIZE: 2"

DATE: MARCH, 2012.

SAMPLE CONDITION
- UNDISTURBED
- DISTURBED
- LOST

SAMPLE TYPE
- A.S. AUGER
- S.S. SPLIT SPOON
- T.O. OPEN TUBE
- P.S. PISTON
- R.C. ROCK CORE

FIELD AND LABORATORY TESTS
- + INSITU-VANE UNDIST
- × INSITU-VANE REMOULDED
- ● WATER CONTENT
- O I ATTERBERG LIMITS
- ▼ UNDRAINED COMPRESSION SPT
- G GRAIN SIZE
- C CONSOLIDATION
- U UNCONFINED
- O UNDRAINED TRIAXIAL
- Y WET UNIT WEIGHT

4 - 0%
13 - 0 - 5%
10%
STRAIN AT FAILURE FOR UNDRAINED COMPRESSION

DEPTH (m) | SAMPLE COND | SAMPLE NO. | SAMPLE TYPE | Y - KN/m³ | OTHER TESTS

SPT BLOWS/METRE: 10 20 30 40 50 60 70 80 90 100 110 120

UNDRAINED SHEAR STRENTH KN/m²: 100 200 300 400 500 600 700 800 900 1000 1100 1200

SOIL PROFILE

SOIL DESCRIPTION	STRATA	GWL	LEVEL DEPTH (m)
GROUND LEVEL			15.6 m
Brownish Very Dense Fine SAND			17.1 m
Brownish Very Dense Coarse SAND			18.6 m
Brownish Dense Coarse SAND			20.1 m
Brownish Very Dense Fine SAND			21.6 m
Brownish Very Dense Fine SAND			23.1 m
Brownish Dense SAND			24.6 m
Brownish Very Dense Fine SAND			26.1 m
Brownish Very Dense SAND			27.6 m
Brownish Very Dense SAND			29.1 m
Brownish Very Dense SAND			30.6 m
End of Boring			

SPT N

Bezaleel + Turnkey Contractors Inc.

FIGURE: APPENDIX B
BORING: BH 2
STATION:
DATE: MARCH, 2012.

PROJECT: PROPOSED STRUCTURES FOR LEC EXPANSION, BUSHROD ISLAND, MONROVIA, LIBERIA.

DRILLER: MOHAMMED SPOON OD: 1 1/2" CASING SIZE: 4" CORE SIZE: 2"

SAMPLE CONDITION
- UNDISTURBED
- DISTURBED
- LOST

SAMPLE TYPE
- A.S. AUGER
- S.S. SPLIT SPOON
- T.O. OPEN TUBE
- P.S. PISTON
- R.C. ROCK CORE

FIELD AND LABORATORY TESTS
- + INSITU-VANE UNDIST
- × INSITU-VANE REMOULDED
- ● WATER CONTENT
- O ATTERBERG LIMITS
- ▼ UNDRAINED COMPRESSION
- SPT
- G GRAIN SIZE
- C CONSOLIDATION
- U UNCONFINED
- Q UNDRAINED TRIAXIAL
- Y WET UNIT WEIGHT

4 - 0%
13 - 0 - 5%
10%
STRAIN AT FAILURE FOR UNDRAINED COMPRESSION

DEPTH (m) | SAMPLE COND | SAMPLE NO. | SAMPLE TYPE | Y - KN/m² | OTHER TESTS

SPT BLOWS/METRE: 10 20 30 40 50 60 70 80 90 100 110 120

UNDRAINED SHEAR STRENTH KN/m²: 100 200 300 400 500 600 700 800 900 1000 1100 1200

SPT BLOWS/ft

SPT N_{60}

SOIL PROFILE

SOIL DESCRIPTION	STRATA	GWL	LEVEL DEPTH (m)
GROUND LEVEL			
Top Soil			
Brownish Loose Fill Material			0.6 m
Greyish Medium Dense Fine SAND			2.1 m
Brownish Grey Medium Dense Fine SAND			3.6 m
Brownish Grey Medium Dense Fine SAND			5.1 m
Brownish Medium Dense Coarse SAND			6.6 m
Brownish Medium Dense Coarse SAND			8.1 m
Brownish Red Medium Dense Fine SAND			9.6 m
Brownish Red Dense Fine SAND			11.1m
Brownish Dense Fine SAND			12.6m
Brownish Red Dense Fine SAND			14.1m
Greyish Dense Fine SAND			15.6m
Boring Continues on the next Page			

Bezaleel + Turnkey Contractors Inc.

FIGURE: APPENDIX B
BORING: BH 2 Cont'd
STATION:
DATE: MARCH, 2012.

PROJECT: PROPOSED STRUCTURES FOR LEC EXPANSION, BUSHROD ISLAND, MONROVIA, LIBERIA.

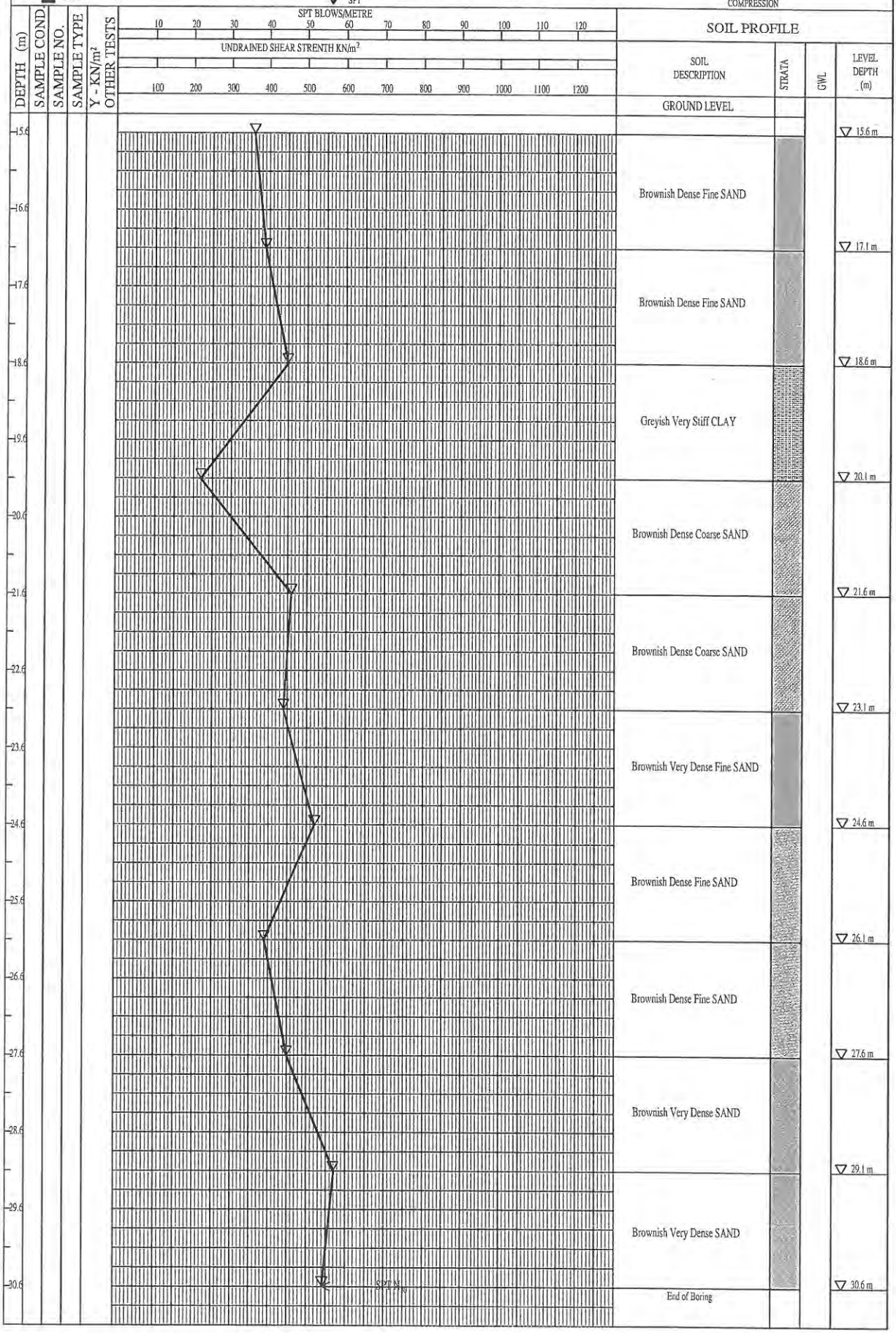
DRILLER: MOHAMMED SPOON OD: 1 1/2" CASING SIZE: 4" CORE SIZE: 2"

SAMPLE CONDITION
- UNDISTURBED
- DISTURBED
- LOST

SAMPLE TYPE
- A.S. AUGER
- S.S. SPLIT SPOON
- T.O. OPEN TUBE
- P.S. PISTON
- R.C. ROCK CORE

FIELD AND LABORATORY TESTS
- + INSITU-VANE UNDIST
- × INSITU-VANE REMOULDED
- ● WATER CONTENT
- I O I ATTERBERG LIMITS
- O UNDRAINED COMPRESSION
- ▼ SPT
- G GRAIN SIZE
- C CONSOLIDATION
- U UNCONFINED
- Q UNDRAINED TRIAXIAL
- Y WET UNIT WEIGHT

4 - 0%
13 - 0 - 5%
10%
STRAIN AT FAILURE FOR UNDRAINED COMPRESSION



Bezaleel + Turnkey Contractors Inc.

FIGURE: APPENDIX B
BORING: BH 3
STATION:
DATE: MARCH, 2012.

PROJECT: PROPOSED STRUCTURES FOR LEC EXPANSION, BUSHROD ISLAND, MONROVIA, LIBERIA.

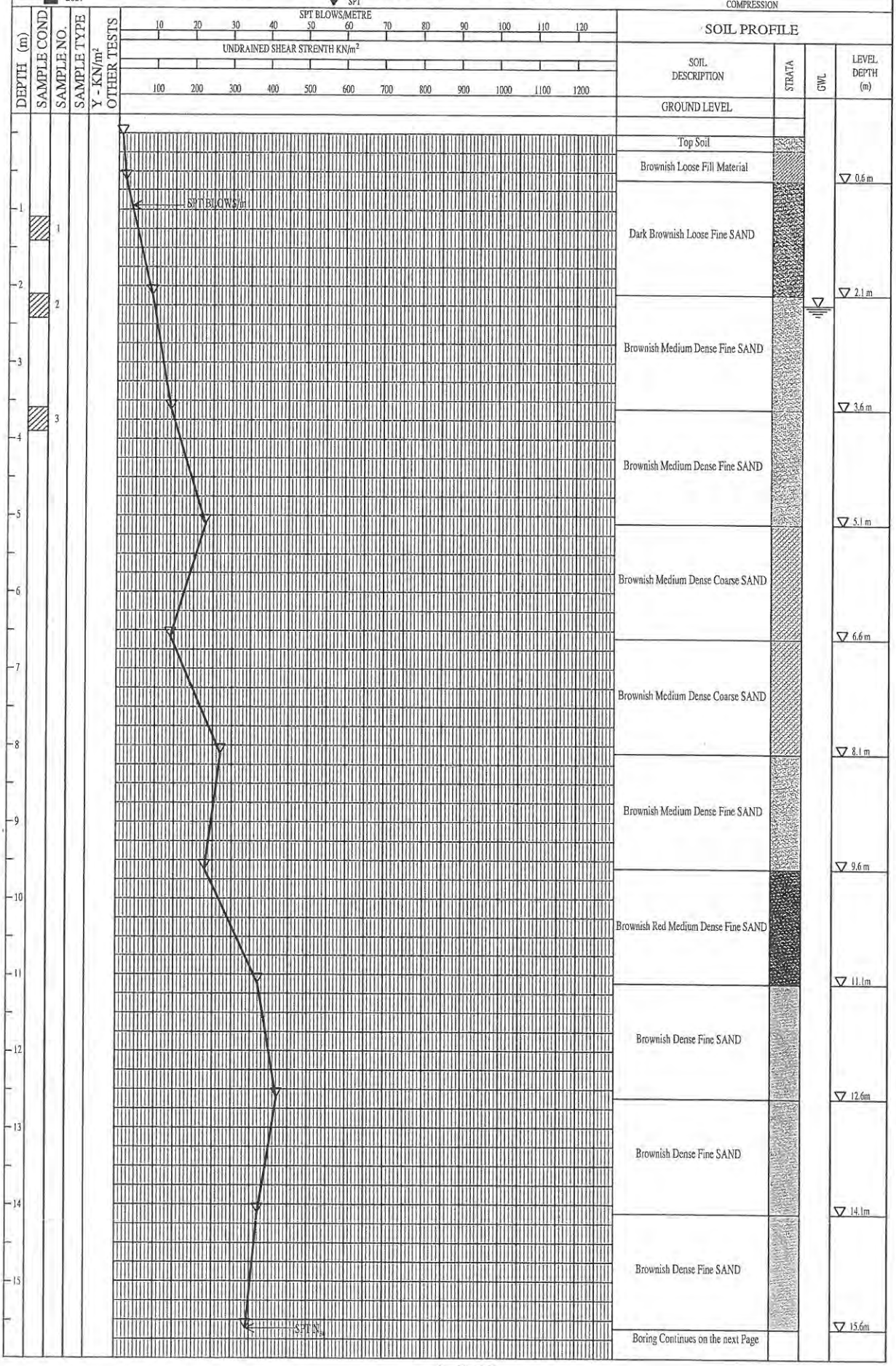
DRILLER: MOHAMMED SPOON OD: 1 1/2" CASING SIZE: 4" CORE SIZE: 2"

SAMPLE CONDITION
- UNDISTURBED
- DISTURBED
- LOST

SAMPLE TYPE
- A.S. AUGER
- S.S. SPLIT SPOON
- T.O. OPEN TUBE
- P.S. PISTON
- R.C. ROCK CORE

FIELD AND LABORATORY TESTS
- + INSITU-VANE UNDIST
- × INSITU-VANE REMOULDED
- ● WATER CONTENT
- I ATTERBERG LIMITS
- ○ UNDRAINED COMPRESSION
- ▼ SPT
- G GRAIN SIZE
- C CONSOLIDATION
- U UNCONFINED
- Q UNDRAINED TRIAXIAL
- Y WET UNIT WEIGHT

4 - 0%
13 - 0 - 5%
10%
STRAIN AT FAILURE FOR UNDRAINED COMPRESSION



Bezaleel + Turnkey contractors,Inc.

FIGURE: APPENDIX B
BORING: BH 3 Cont'd
STATION:
DATE: MARCH, 2012.

PROJECT: PROPOSED STRUCTURES FOR LEC EXPANSION, BUSHROD ISLAND, MONROVIA, LIBERIA.

DRILLER: MOHAMMED SPOON OD: 1 1/2" CASING SIZE: 4" CORE SIZE: 2"

SAMPLE CONDITION
- UNDISTURBED
- DISTURBED
- LOST

SAMPLE TYPE
- A.S. AUGER
- S.S. SPLIT SPOON
- T.O. OPEN TUBE
- P.S. PISTON
- R.C. ROCK CORE

FIELD AND LABORATORY TESTS
- + INSITU-VANE UNDIST
- × INSITU-VANE REMOULDED
- ● WATER CONTENT
- O I O ATTERBERG LIMITS
- ▼ UNDRAINED COMPRESSION
- SPT
- G GRAIN SIZE
- C CONSOLIDATION
- U UNCONFINED
- Q UNDRAINED TRIAXIAL
- Y WET UNIT WEIGHT

4 - 0%
13 - 0 - 5%
10%
STRAIN AT FAILURE FOR UNDRAINED COMPRESSION

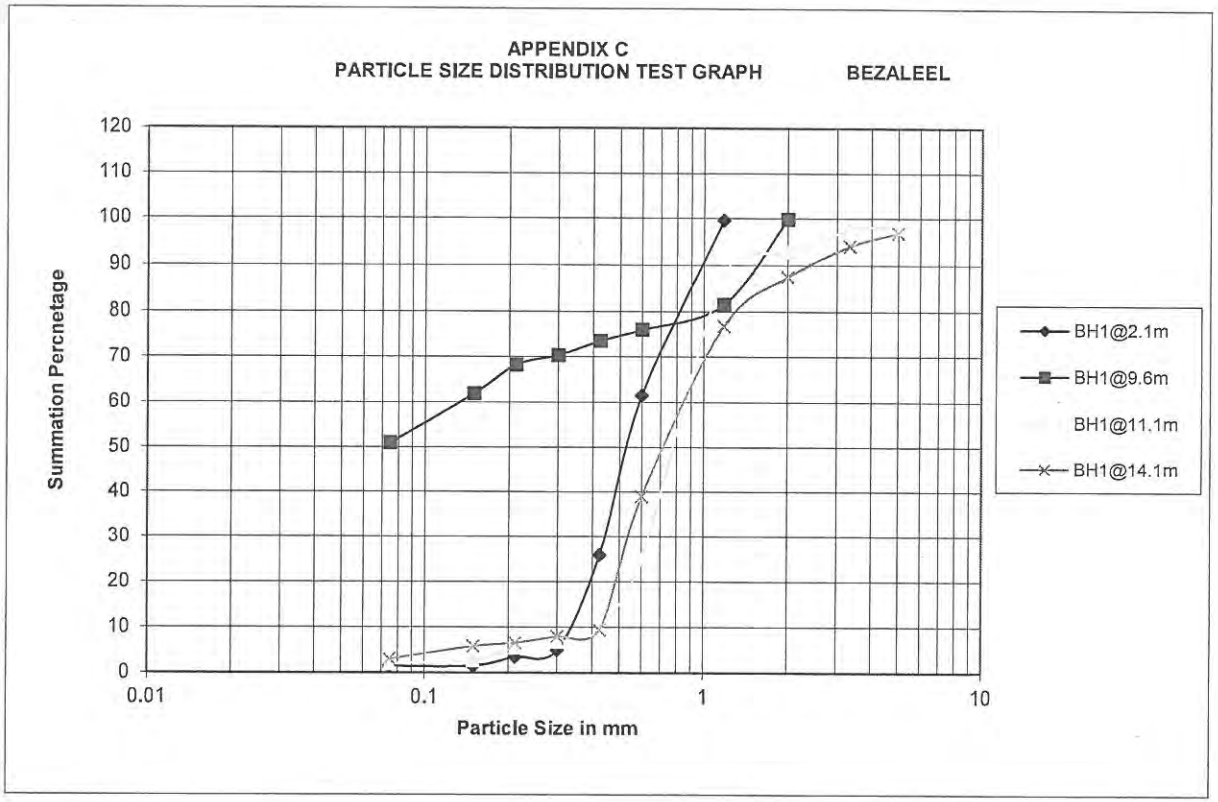
SPT BLOWS/METRE
10 20 30 40 50 60 70 80 90 100 110 120

UNDRAINED SHEAR STRENTH KN/m²
100 200 300 400 500 600 700 800 900 1000 1100 1200

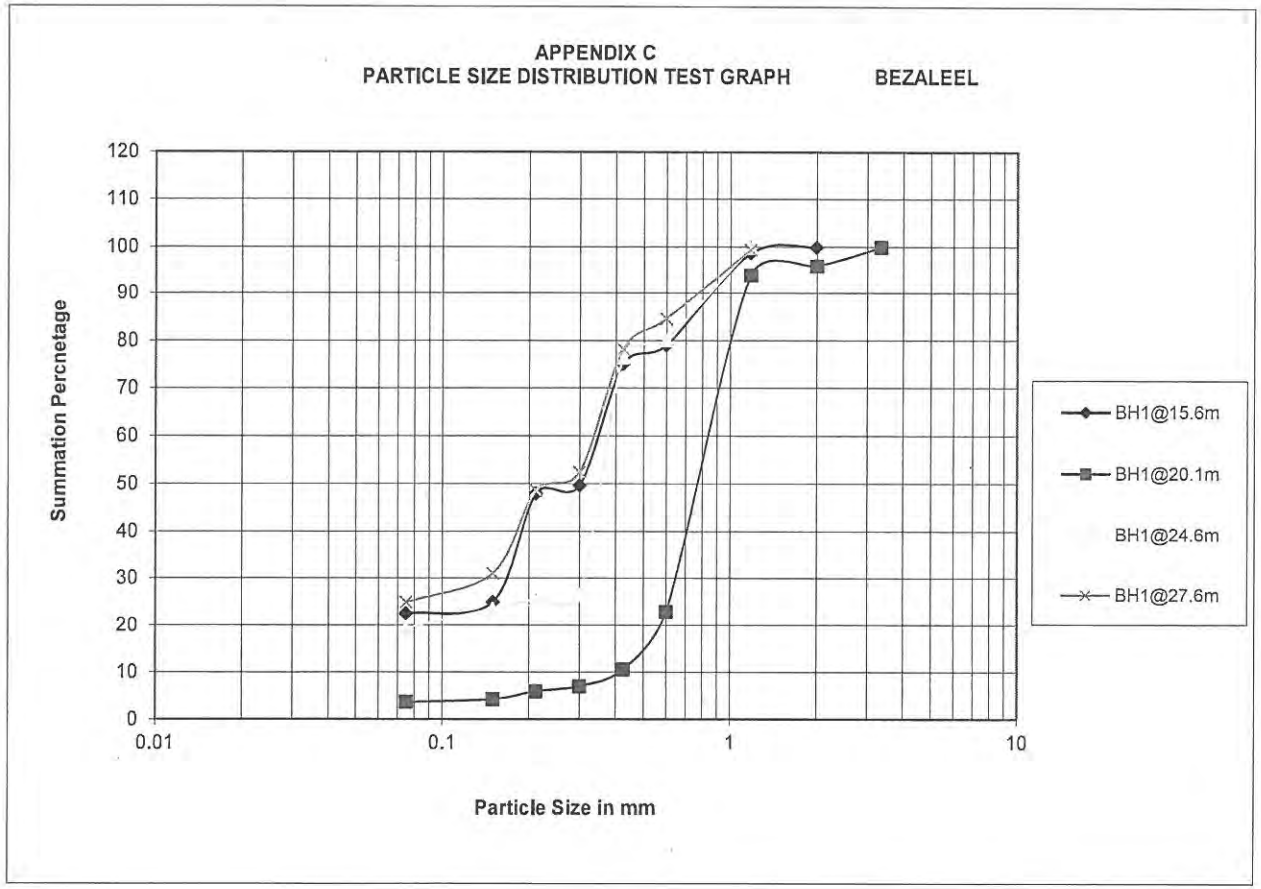
DEPTH (m)	SAMPLE COND.	SAMPLE NO.	SAMPLE TYPE	Y - KN/m²	OTHER TESTS	SOIL DESCRIPTION	STRATA	GWL	LEVEL DEPTH (m)
						GROUND LEVEL			
15.6									▽ 15.6 m
						Reddish Brown Dense Fine SAND			
16.6									▽ 17.1 m
						Brownish Red Dense Fine SAND			
18.6									▽ 18.6 m
						Brownish Dense Fine SAND			
19.6									▽ 20.1 m
						Brownish Dense Fine SAND			
21.6									▽ 21.6 m
						Brownish Dense Fine SAND			
22.6									▽ 23.1 m
						Brownish Dense Fine SAND			
24.6									▽ 24.6 m
						Brownish Dense Fine SAND			
25.6									▽ 26.1 m
						Brownish Dense Fine SAND			
27.6									▽ 27.6 m
						Brownish Very Dense SAND			
28.6									▽ 29.1 m
						Brownish Very Dense SAND			
30.6									▽ 30.6 m
						End of Boring			

SPT N_{60}

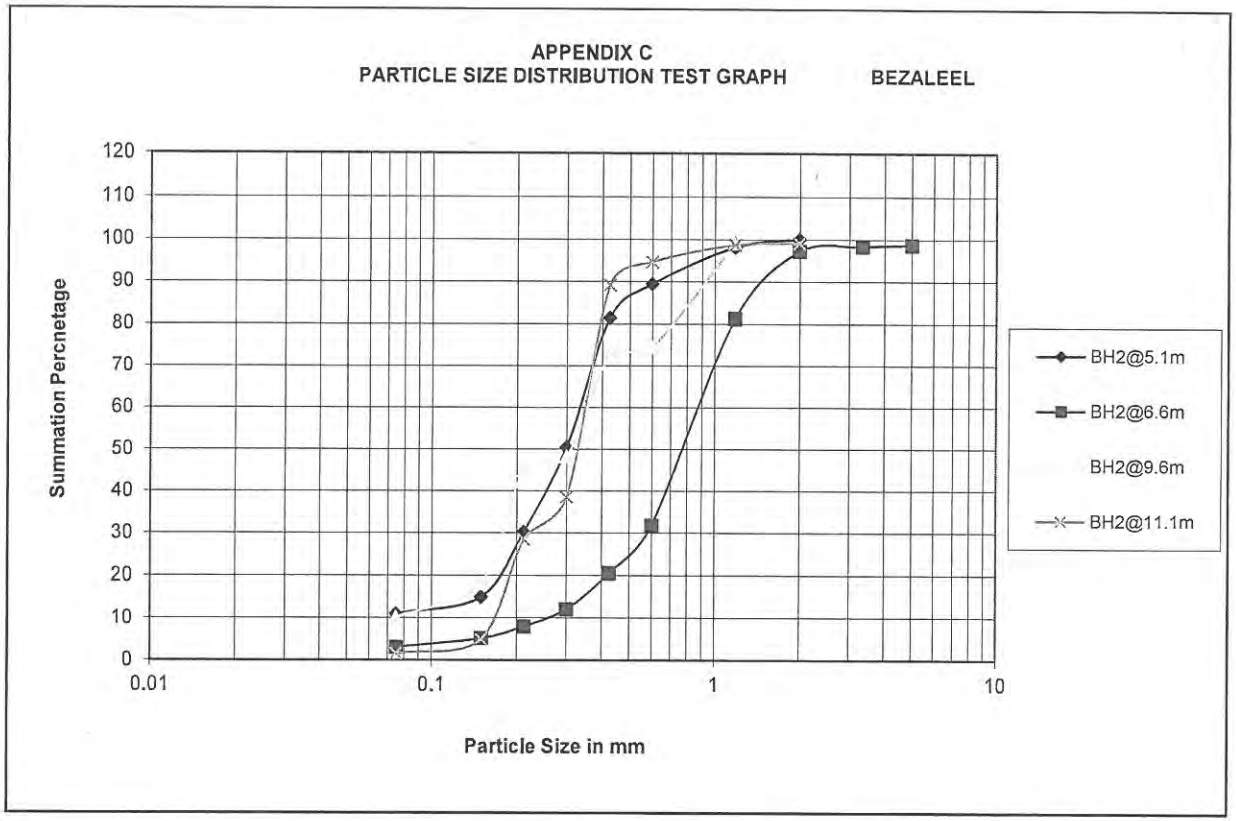
APPENDIX C
PARTICLE SIZE DISTRIBUTION TEST GRAPH BEZALEEL



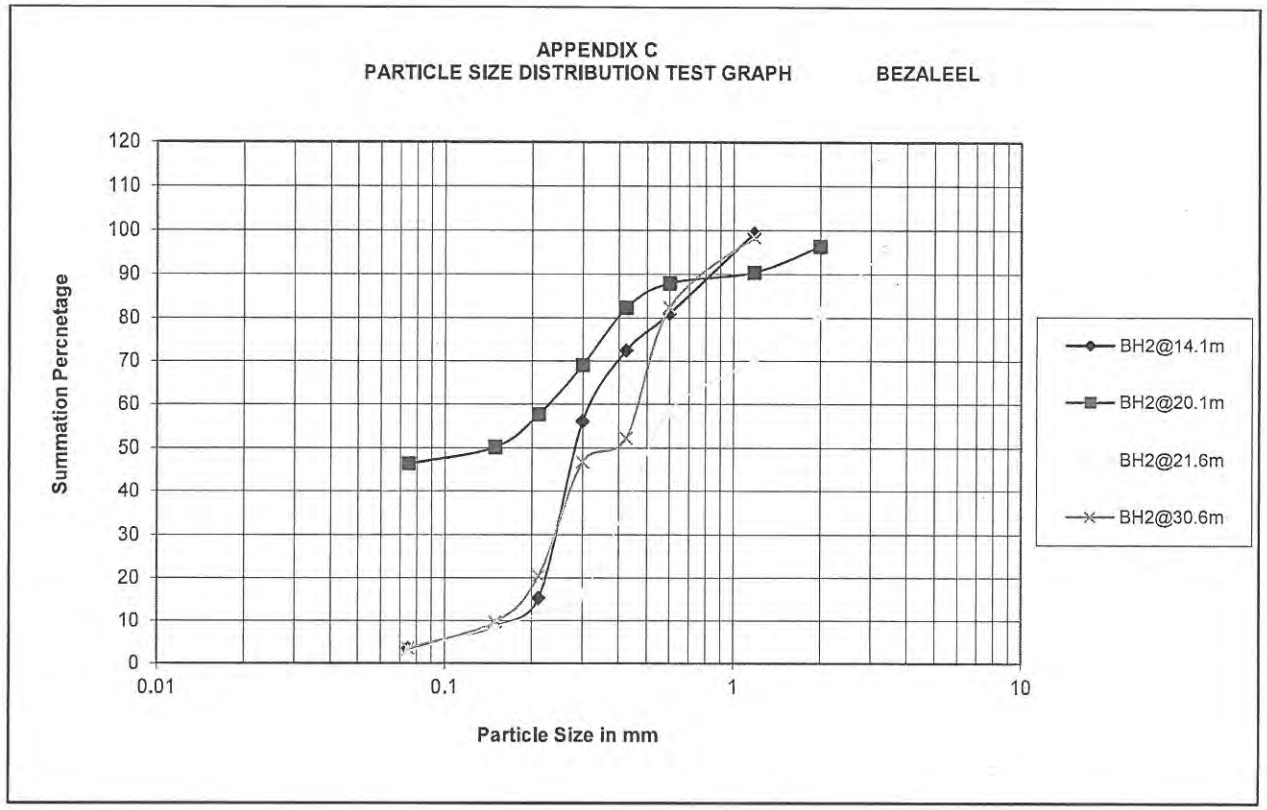
APPENDIX C
PARTICLE SIZE DISTRIBUTION TEST GRAPH BEZALEEL



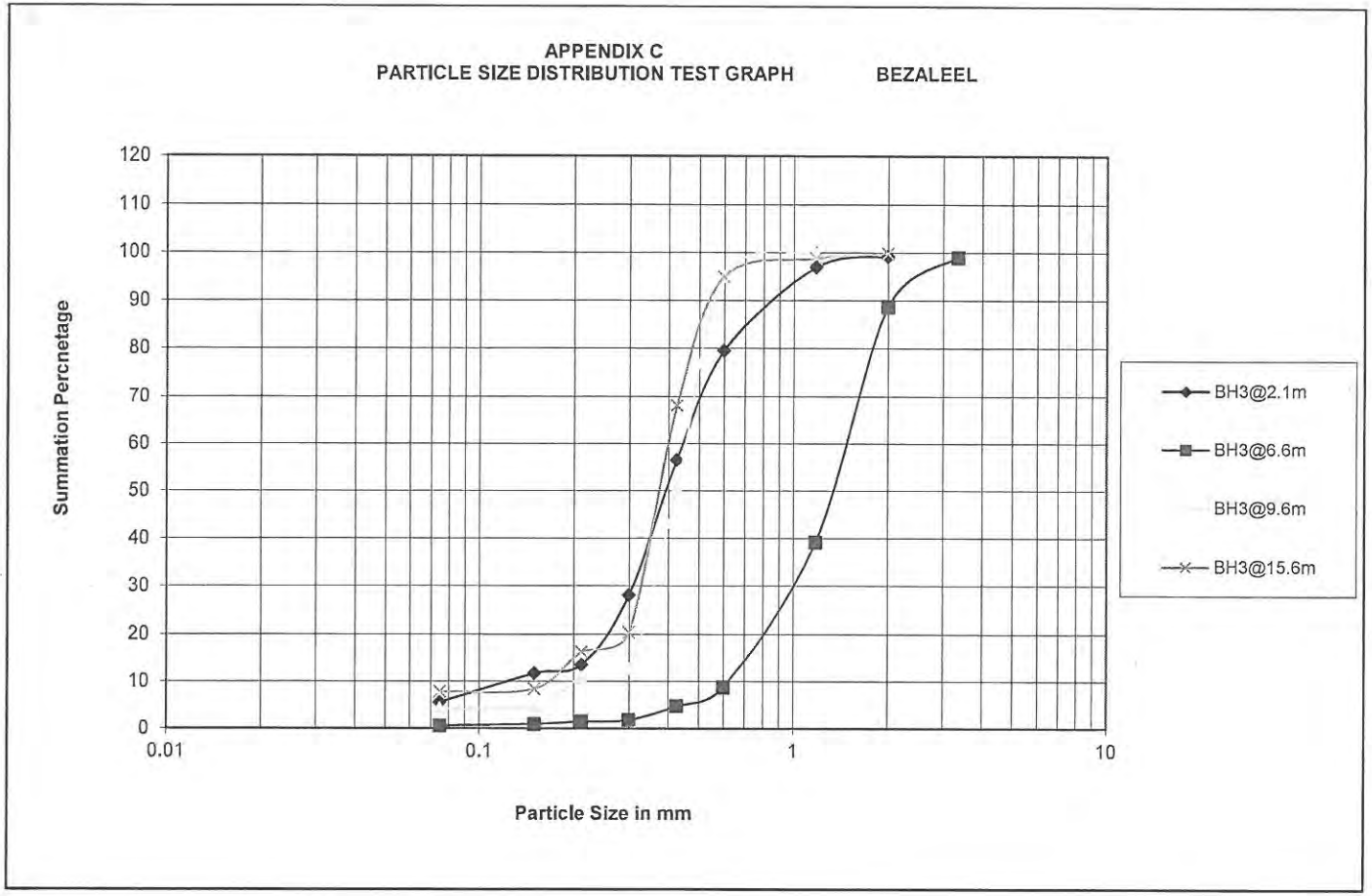
APPENDIX C
PARTICLE SIZE DISTRIBUTION TEST GRAPH BEZALEEL



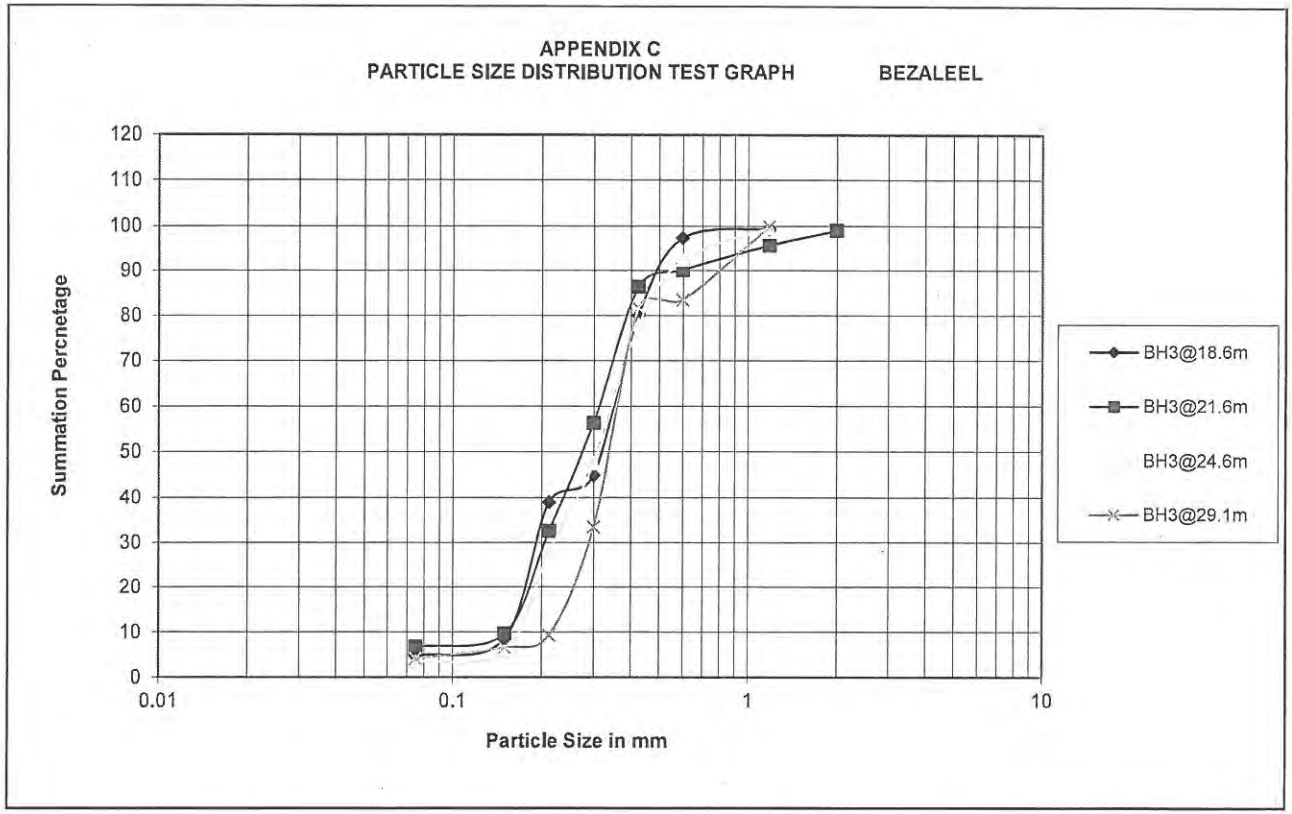
APPENDIX C
PARTICLE SIZE DISTRIBUTION TEST GRAPH BEZALEEL



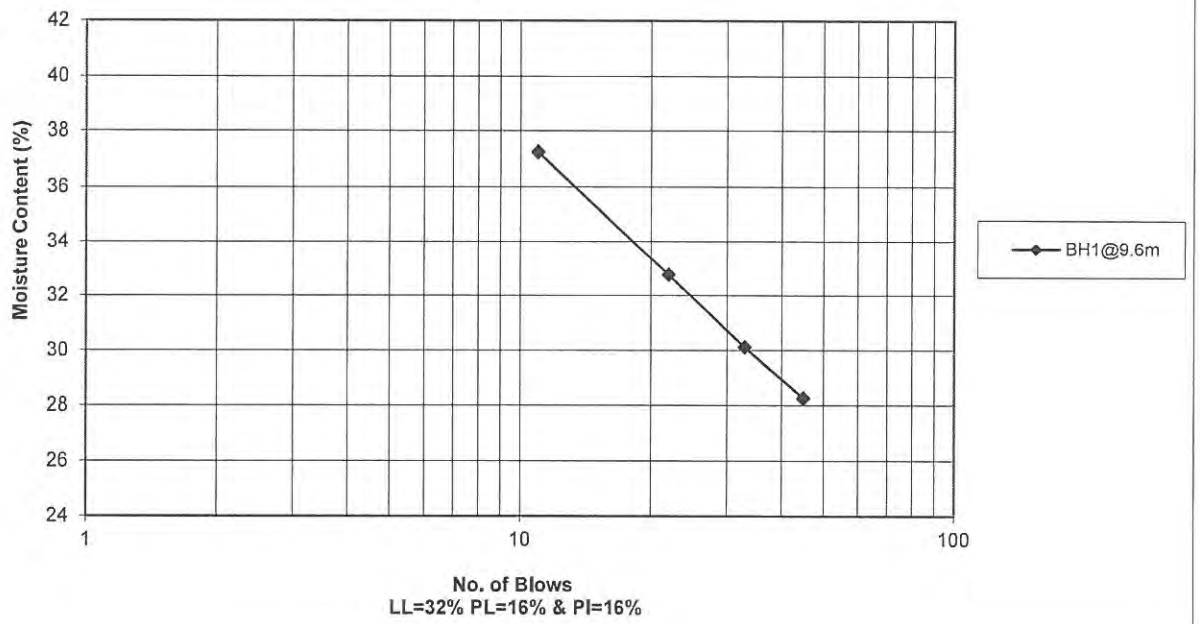
APPENDIX C
PARTICLE SIZE DISTRIBUTION TEST GRAPH BEZALEEL



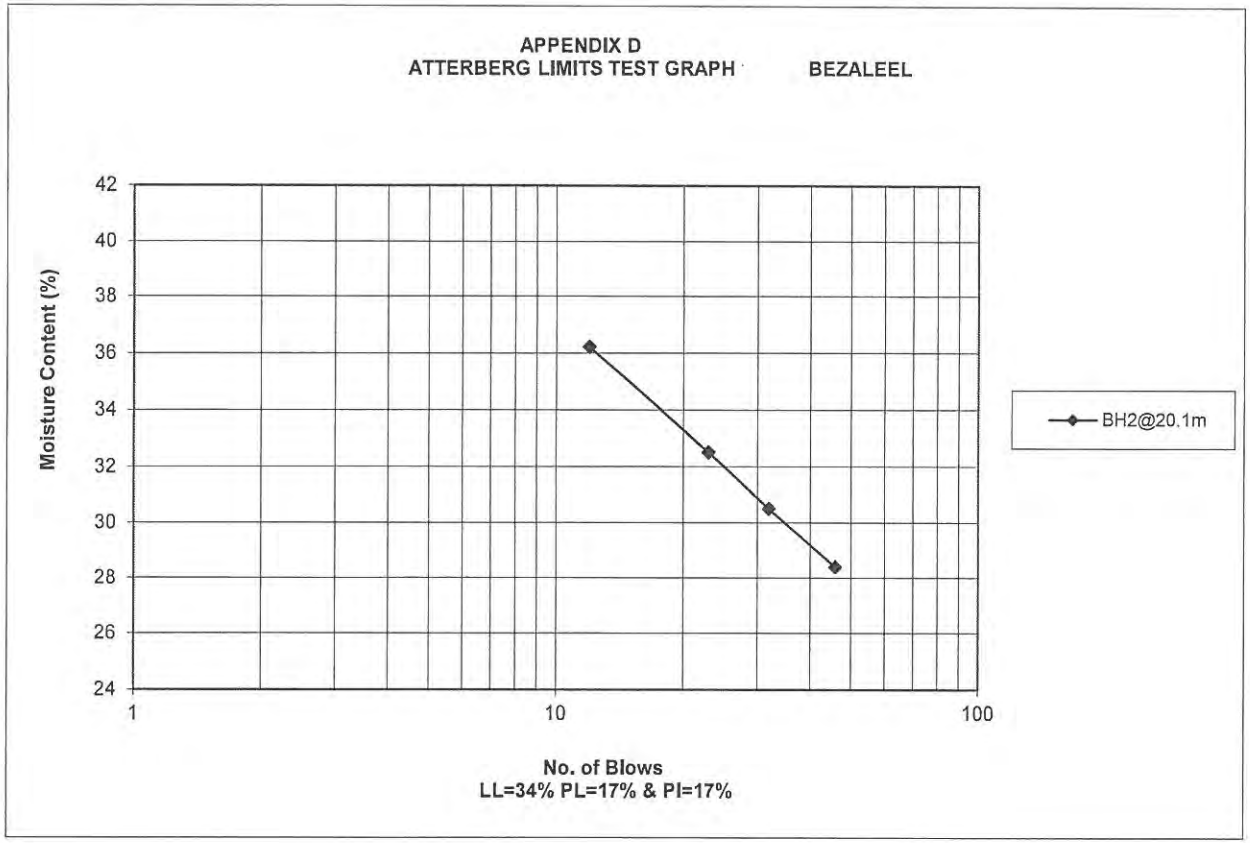
APPENDIX C
PARTICLE SIZE DISTRIBUTION TEST GRAPH BEZALEEL



APPENDIX D
ATTERBERG LIMITS TEST GRAPH BEZALEEL



APPENDIX D
ATTERBERG LIMITS TEST GRAPH BEZALEEL



Ref: BS 1377 (1990)

Bezaleel + Turnkey Contractors

UNDRAINED DIRECT SHEAR BOX TEST

APPENDIX E

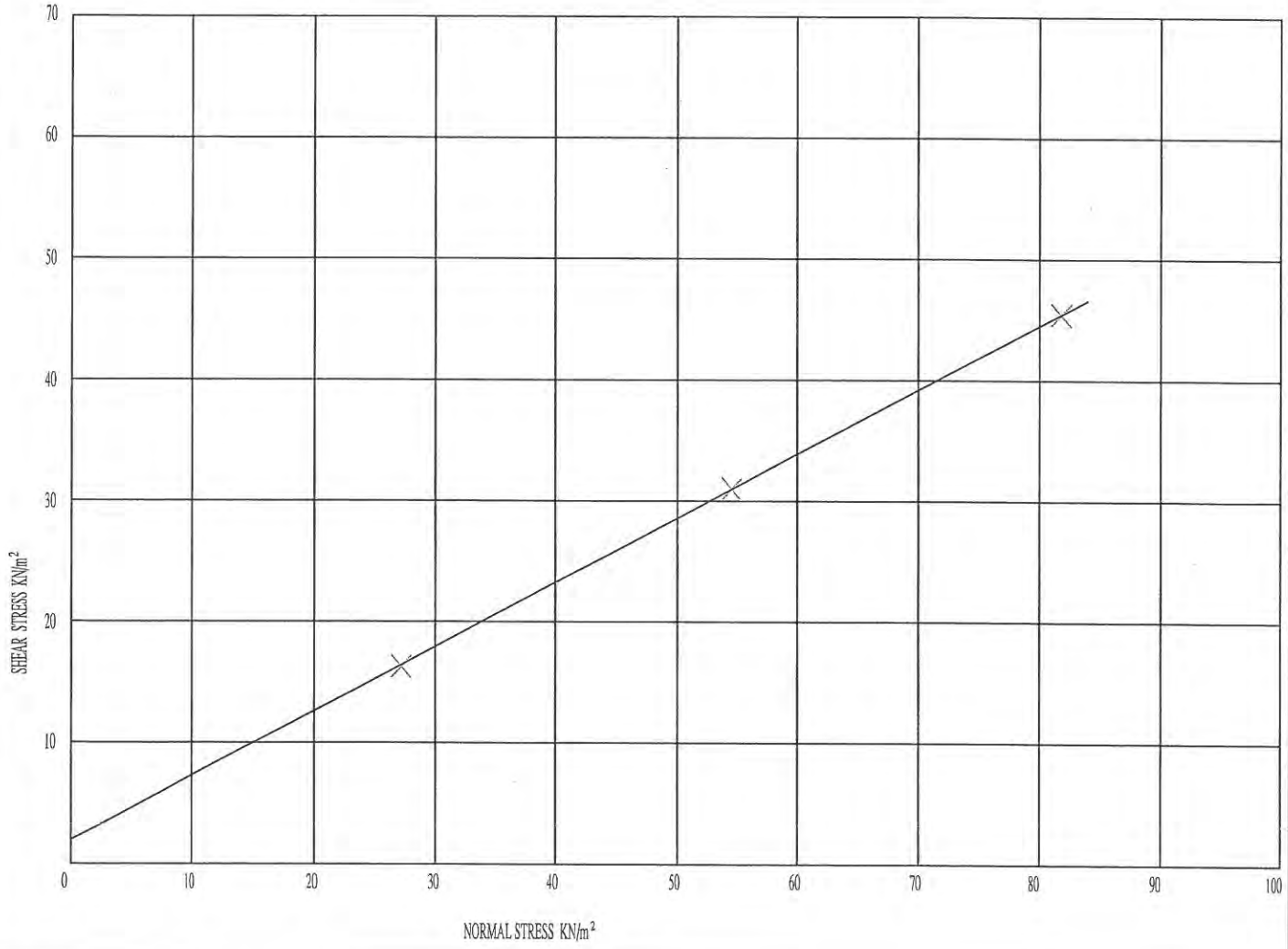
Project No. _____ Project Name: PROPOSED CONSTRUCTION OF NEW POWER HOUSE AND SUBSTATION AT BUSHROD ISLAND, MONROVIA.

Bore Hole No. BH 1 Sample No. 01/02

Depth of Sample 2.10 metres

Test No.	Load Kg	Normal Stress KN/m^2	Shear Stress KN/m^2
1	10	27.25	16.29
2	20	54.50	31.01
3	30	81.75	45.47

COHESION = 02.00 KN/m^2	ϕ = 28°	BULK DENSITY = 16.87 KN/m^3



Ref: BS 1377 (1990)

UNDRAINED TRIAXIAL TEST

B + T,Inc.

APPENDIX E

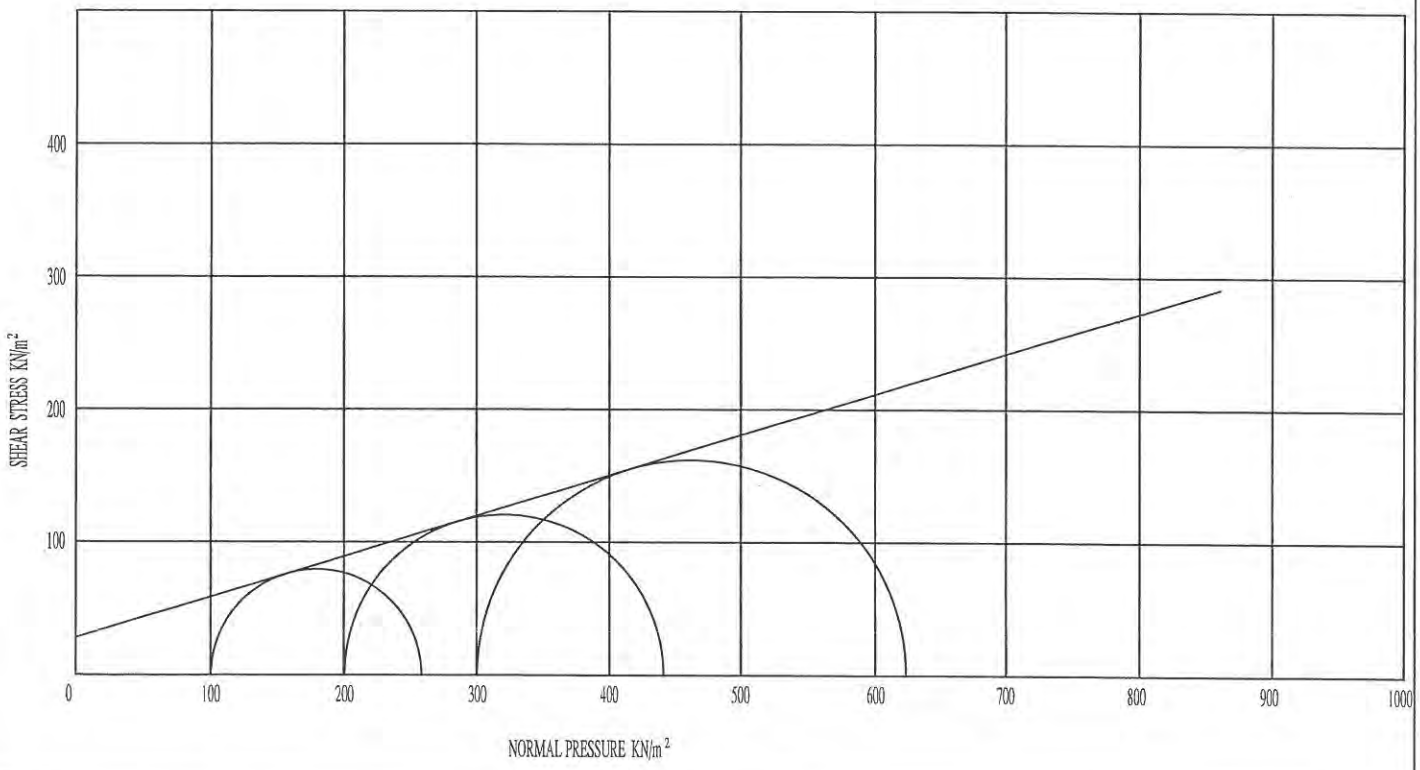
Project No. _____ Project Name: PROPOSED CONSTRUCTION OF NEW POWER HOUSE AND SUBSTATION AT BUSHROD ISLAND, MONROVIA.

Bore Hole No. BH 1 Sample No. 01/07

Depth of Sample 9.60 metres

Test No.	Normal pressure KN/m^2	Deviator Stress KN/m^2	Maximum Shear Stress KN/m^2
1	100	158.83	258.83
2	200	240.85	440.85
3	300	323.70	623.70

COHESION = 28.00 KN/m^2	ϕ = 17°	BULK DENSITY = 18.17KN/m^3



Ref: BS 1377 (1990)

UNDRAINED DIRECT SHEAR BOX TEST

B + T,Inc.

APPENDIX E

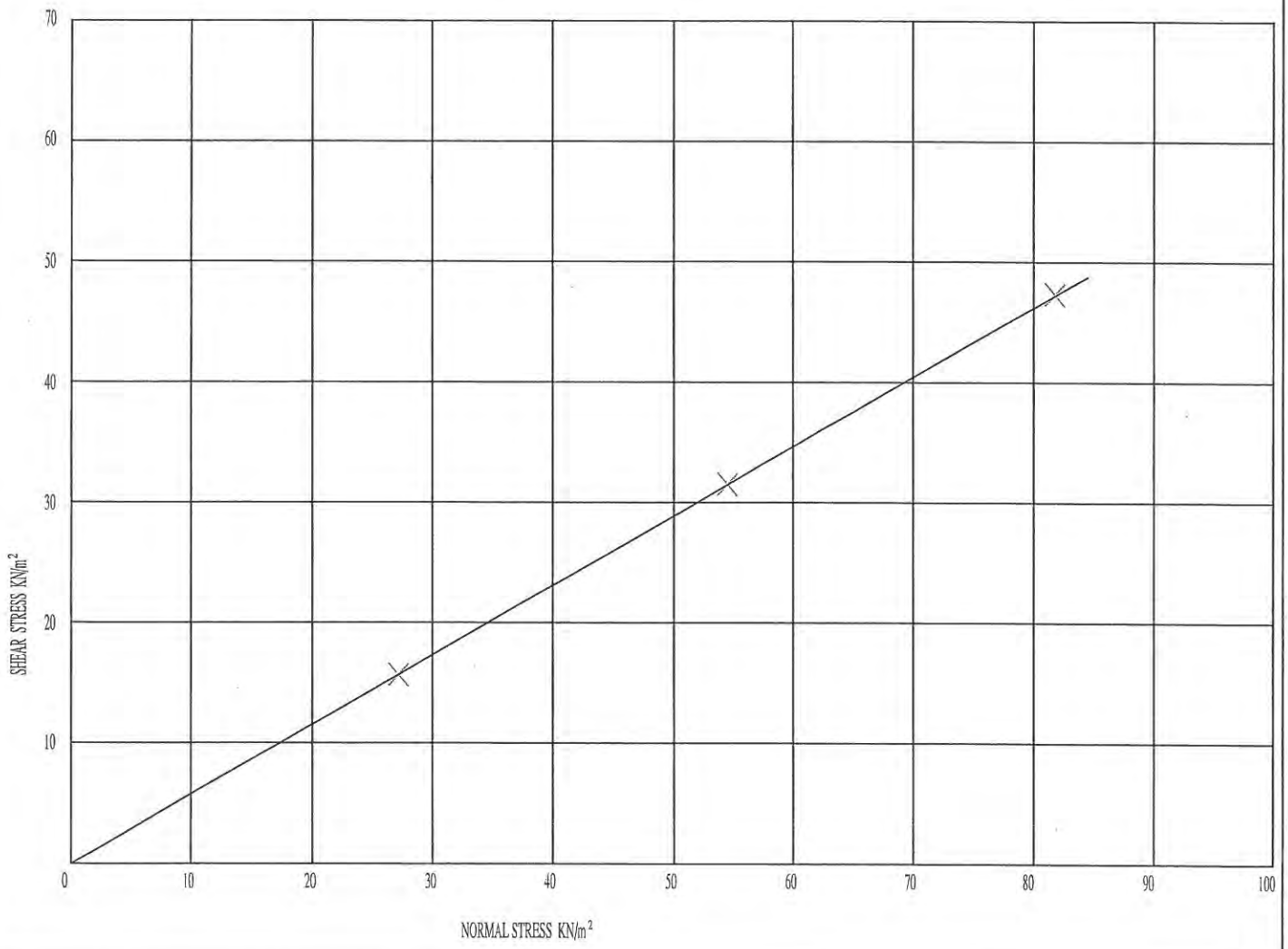
Project No._____ Project Name: PROPOSED CONSTRUCTION OF NEW POWER HOUSE AND SUBSTATION AT BUSHROD ISLAND, MONROVIA.

Bore Hole No. BH 2 Sample No. 02/05

Depth of Sample 6.60 metres

Test No.	Load Kg	Normal Stress KN/m^2	Shear Stress KN/m^2
1	10	27.25	15.89
2	20	54.50	31.52
3	30	81.75	47.24

COHESION = 00.00 KN/m^2	ϕ = 30°	BULK DENSITY = 16.40 KN/m^3



Ref: BS 1377 (1990)

UNDRAINED TRIAXIAL TEST

B + T,Inc.

APPENDIX E

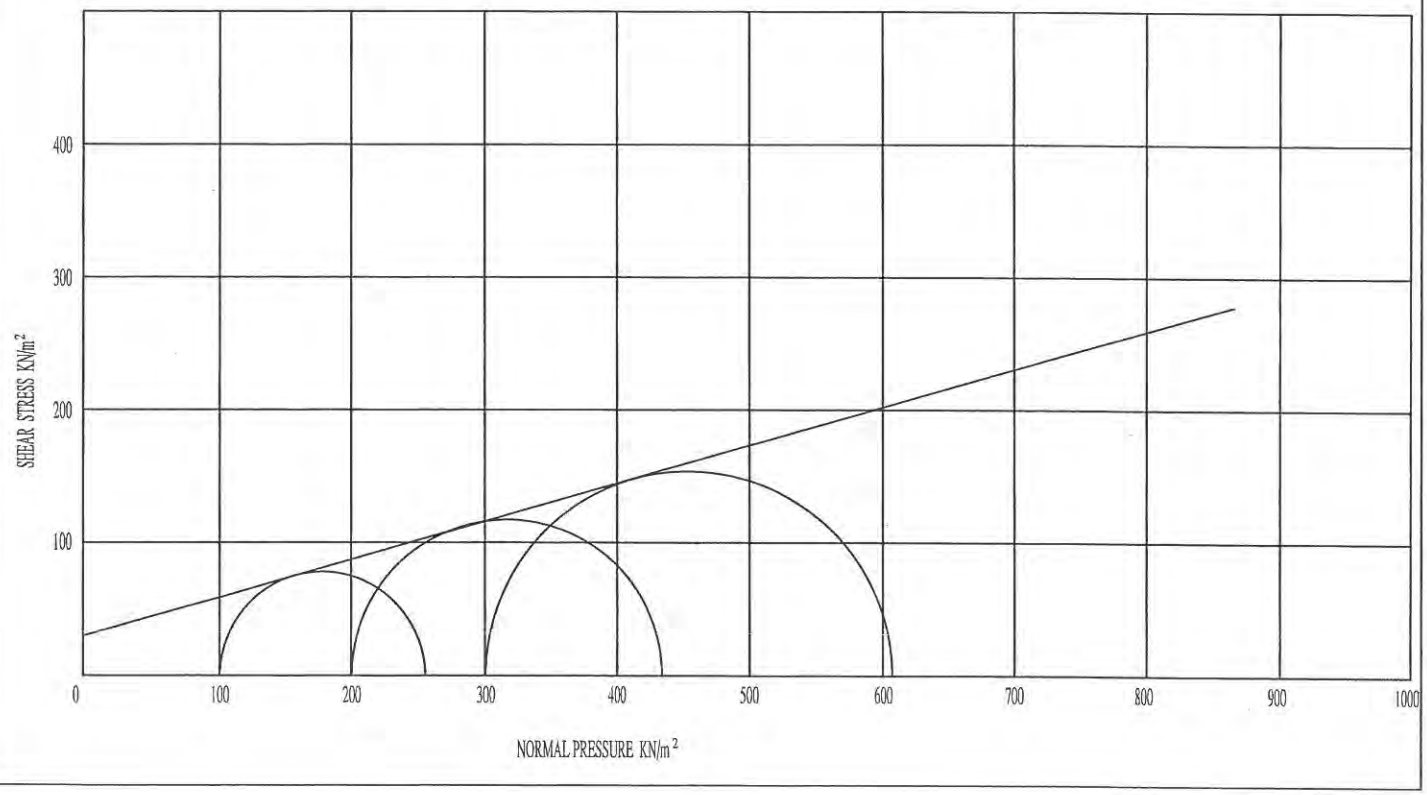
Project No. _____ Project Name: PROPOSED CONSTRUCTION OF NEW POWER HOUSE AND SUBSTATION AT BUSHROD ISLAND, MONROVIA.

Bore Hole No. BH 2 Sample No. 02/14

Depth of Sample 20.10 metres

Test No.	Normal pressure KN/m^2	Deviator Stress KN/m^2	Maximum Shear Stress KN/m^2
1	100	156.04	256.04
2	200	233.86	433.86
3	300	307.23	607.23

COHESION = 30.00 KN/m^2	ϕ = 16°	BULK DENSITY = 18.26KN/m^3



Ref: BS 1377 (1990)

UNDRAINED DIRECT SHEAR BOX TEST

BEZALEEL

APPENDIX E

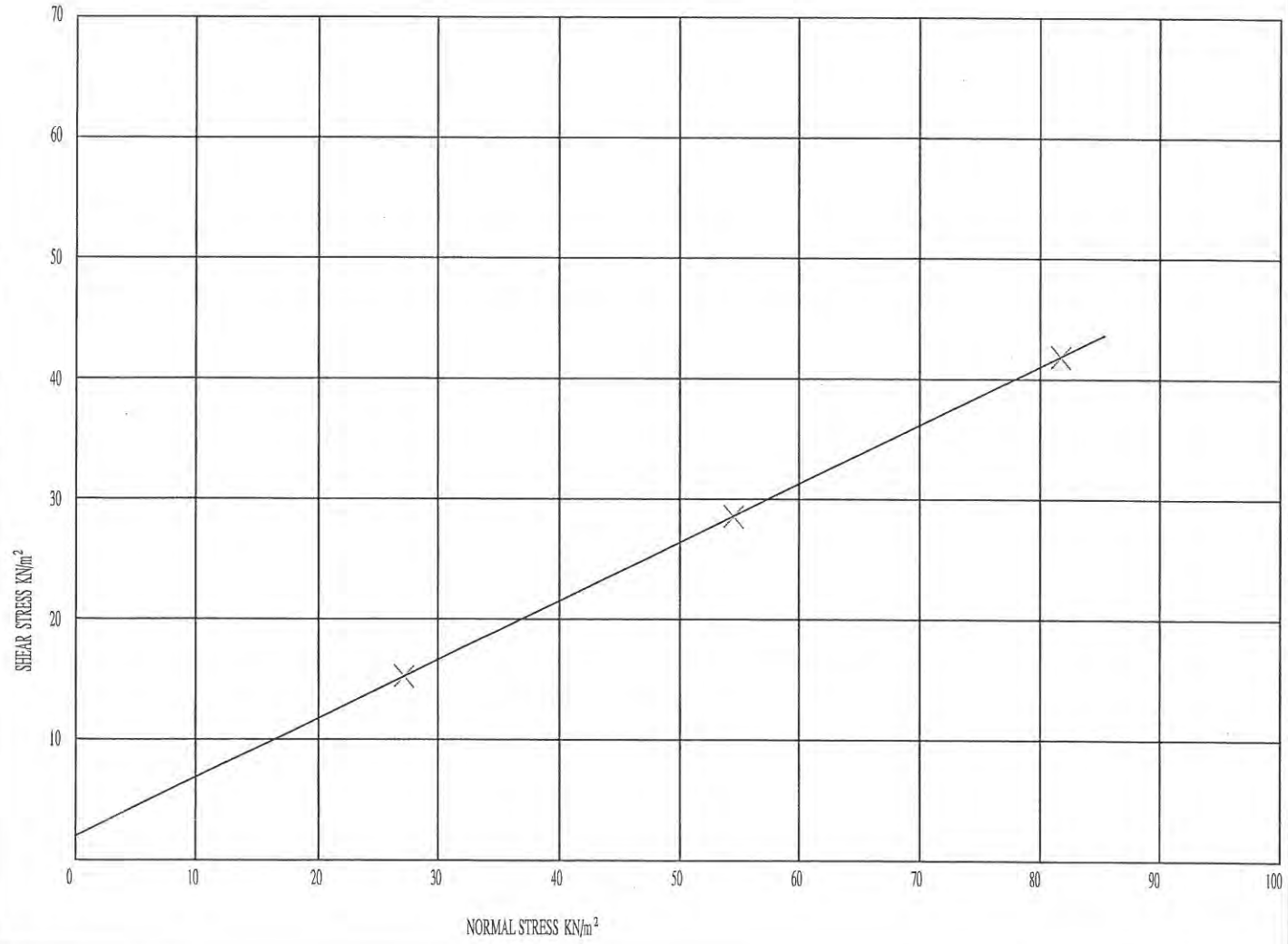
Project No. _____ Project Name: PROPOSED CONSTRUCTION OF NEW POWER HOUSE AND SUBSTATION AT BUSHROD ISLAND, MONROVIA.

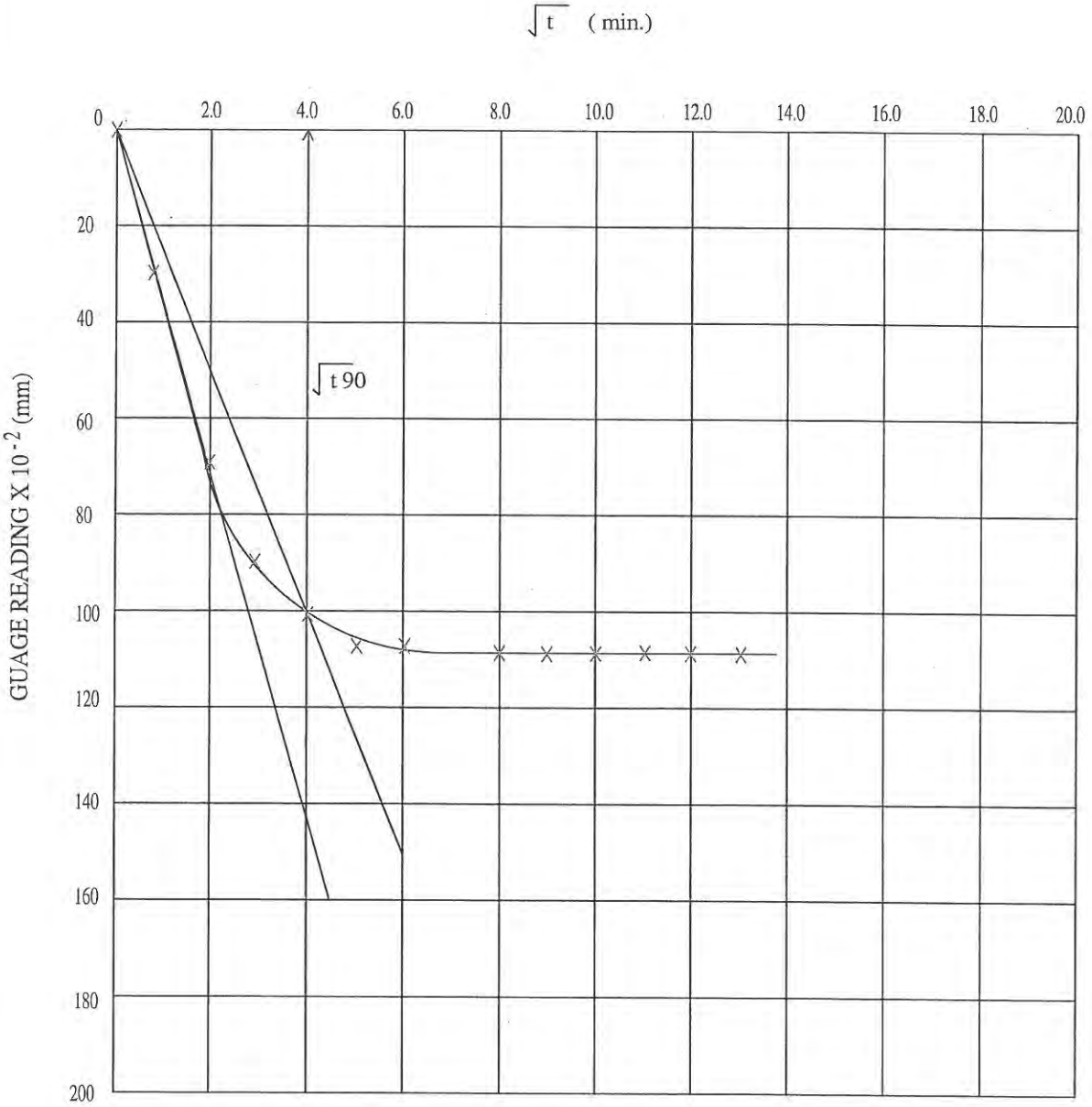
Bore Hole No. BH 3 Sample No. 03/02

Depth of Sample 2.10 metres

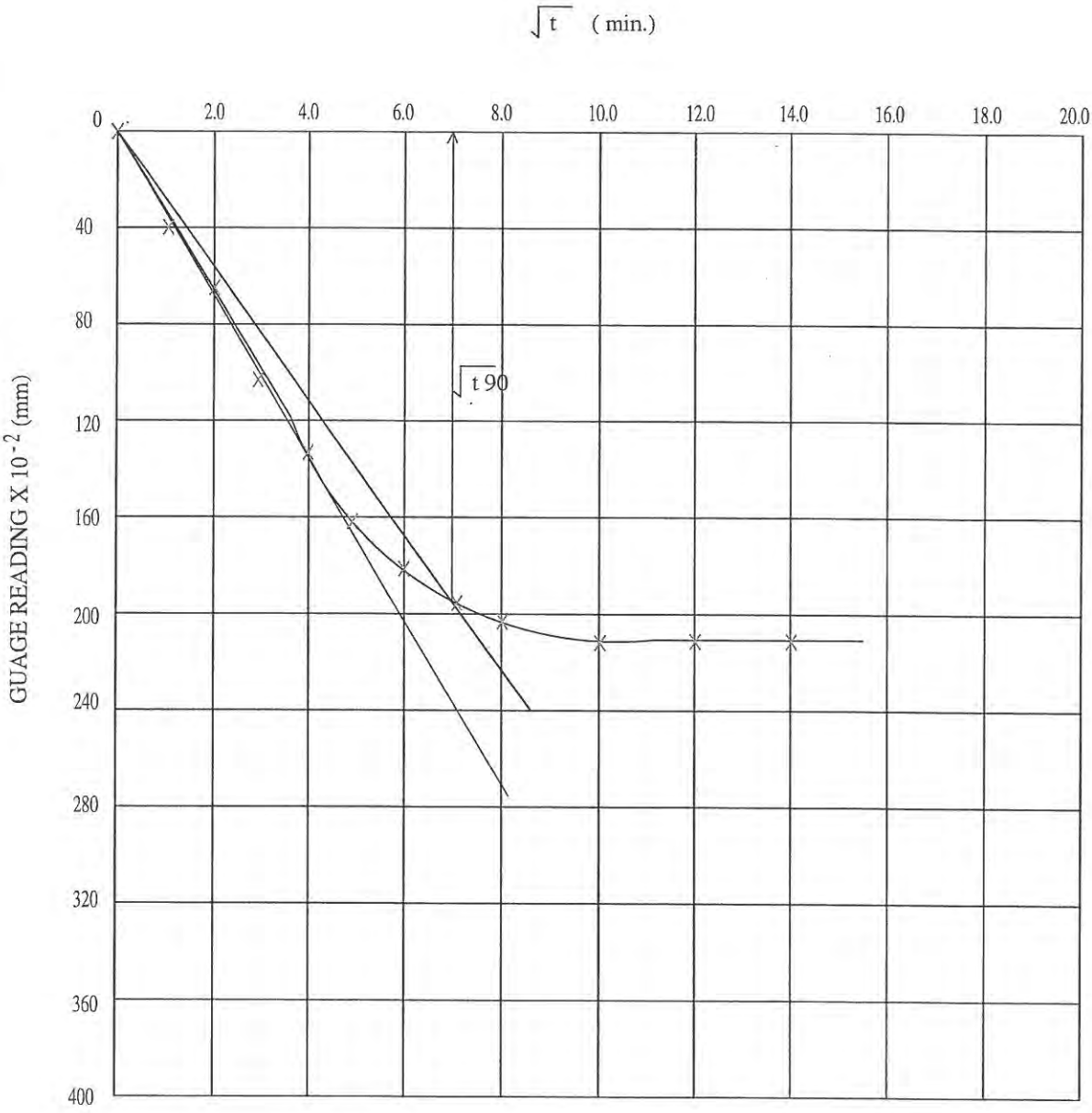
Test No.	Load Kg	Normal Stress KN/m^2	Shear Stress KN/m^2
1	10	27.25	15.28
2	20	54.50	28.66
3	30	81.75	41.91

COHESION = 02.00 KN/m^2	ϕ = 26°	BULK DENSITY = 15.68 KN/m^3





Height of sample	2.00	cm	Soil description: GREYISH STIFF CLAY	
Compression area	44.18	cm		
Coefficient of Consolidation, Cv	$1.40x10^{-2}$	m^2/yr	Boring No: BH 1	Location.:
Coefficient of Compressibility, Mv	$3.84x10^{-4}$	m^2/KN	Level:	Depth 9.6m
Unit weight before consolidation	18.17	KN/m^3	P_o = vertical, effective stress in situ	10 - 100 KN/m^2
Bezaleel + Turnkey Contractors,Inc.			CONSOLIDATION TEST	
Test: SITECH	Drawn: A. DARAMOLA		Project: PROPOSED NEW POWER HOUSE & SUBSTATION, BUSHROD ISLAND, MONROVIA.	
Check: SITECH	Appr. M. SHITTU		Date: MAY, 2012	Figure No.: APPENDIX F



Height of sample	2.00	cm	Soil Description: GREYISH VERY STIFF CLAY	
Compression area	44.18	cm		
Coefficient of Compressibility, Cv	1.89×10^{-2}	m^2/yr	Boring No: BH 2	Location.:
Coefficient of Consolidation, Mv	3.86×10^{-3}	m^2/KN	Level:	Depth: 20.10m
Unit weight before consolidation	18.26	KN/m^3	P_o = vertical, effective stress in situ	10 - 100 KN/m^2

Bezaleel + Turnkey Contractors,Inc.		CONSOLIDATION TEST	
Test: SITECH	Drawn: A. DARAMOLA	Project: PROPOSED NEW POWER HOUSE & SUBSTATION, BUSHROD ISLAND, MONROVIA.	
Check: SITECH	Appr. M. SHITTU	Date: MAY, 2012	Figure No.: APPENDIX F

BEZALEEL + TURNKEY CONTRACTORS INC.

DETAILED LABORATORY TEST RESULTS

Sample No.	Sample No.	Sample Depth (m)	Description of Sample	INDEX PROPERTIES				PARTICLE SIZE ANALYSIS										Direct Shear Strength		TRIAXIAL Shear Strength parameters		Bulk Density kN/m³	Specific Gravity	Consolidation	
				EMC (%)	LL (%)	PL (%)	PI (%)	5 (5mm)	#.7 (3.35mm)	#.10 (2mm)	#.14 (1.18mm)	#.25 (600µm)	#.36 (425µm)	#.52 (300µm)	#.72 (212µm)	#.100 (150µm)	#.200 (75µm)	C KN/m²	ø	C KN/m²	ø			Cv m²/yrs	Mv m²/KN
BH1	2	2.1	Greyish medium dense SAND	17	Non - plastic			-	-	-	99.53	61.47	25.9	4.90	3.43	1.40	1.37	2	28	-	-	16.87	2.70	-	-
BH1	3	3.6	Brownish medium dense fine SAND	21	Non - plastic			-	-	-	99.93	97.13	86.4	14.1	11.80	4.87	2.20	1	26	-	-	16.48	2.68	-	-
BH1	5	6.6	Brownish medium dense coarse SAND	16	Non - plastic			95.13	92.53	85.43	70.73	59.73	55.10	40.33	35.63	19.03	16.47	0	30	-	-	16.26	2.67	-	-
BH1	7	9.6	Greyish stiff CLAY	36	32	16	16	-	-	99.89	81.38	76.00	73.49	70.25	68.19	61.87	50.89	-	-	28	17	18.17	2.72	$1.40x10^{-2}$	$3.84x10^{-4}$
BH1	8	11.1	Brownish dense coarse SAND	9	Non - plastic			98.17	97.49	92.70	87.96	24.96	9.38	6.8	5.49	2.65	1.89	0	31	-	-	16.05	2.69	-	-
BH1	10	14.1	Brownish very dense coarse SAND	11	Non - plastic			96.86	94.00	87.4	76.89	38.96	9.40	7.96	6.50	5.78	2.96	1	31	-	-	16.49	2.65	-	-
BH1	11	15.6	Brownish very dense fine SAND	16	Non - plastic			-	-	99.89	98.6	79.00	74.96	49.6	47.89	24.96	22.49	1	27	-	-	16.78	2.69	-	-
BH1	13	18.6	Brownish very dense coarse SAND	13	Non - plastic			-	99.53	97.8	94.83	21.80	8.97	5.47	4.90	3.90	2.43	0	30	-	-	16.54	2.67	-	-
BH1	14	20.1	Brownish dense fine coarse SAND	12	Non - plastic			-	99.87	95.8	93.78	22.89	10.49	6.96	5.89	4.20	3.60	1	31	-	-	16.70	2.70	-	-
BH1	15	21.6	Brownish very dense fine grained SAND	14	Non - plastic			-	-	99.9	91.49	83.35	28.96	22.49	20.87	19.49	18.96	2	26	-	-	17.89	2.62	-	-
BH1	17	24.6	Brownish dense grained SAND	16	Non - plastic			-	-	-	99.86	80.11	76.40	26.49	25.48	23.49	19.40	2	27	-	-	17.40	2.69	-	-
BH1	19	27.6	Brownish very dense fine SAND	18	Non - plastic			-	-	-	99.27	84.5	78.19	52.38	48.57	30.96	24.87	1	25	-	-	17.60	2.70	-	-
BH1	21	30.6	Brownish very dense fine SAND	16	Non - plastic			-	-	-	99.38	74.96	68.90	41.89	34.96	27.96	23.46	0	28	-	-	17.90	2.74	-	-
BH2	2	2.1	Greyish medium dense fine grained SAND	17	Non - plastic			-	99.97	99.2	98.78	86.38	70.98	39.80	34.6	18.96	11.87	1	28	-	-	16.87	2.60	-	-
BH2	4	5.1	Brownish grey medium dense fine SAND	14	Non - plastic			-	-	100.0	98.19	89.38	81.40	50.38	30.19	14.86	10.96	2	27	-	-	16.49	2.61	-	-
BH2	5	6.6	Brownish medium dense coarse SAND	16	Non - plastic			98.68	98.34	97.2	81.16	31.68	20.5	12.02	7.96	5.09	3.01	0	30	-	-	15.98	2.70		
BH2	7	9.6	Reddish medium dense fine SAND	18	Non - plastic			-	-	-	99.17	74.41	72.57	48.17	44.92	18.19	10.14	1	29	-	-	16.86	2.65	-	-

APPENDIX G

Sample	Sample	Sample	Description of	INDEX PROPERTIES				PARTICLE SIZE ANALYSIS										Direct Shear Strength		TRIAXIAL Shear Strength parameters		Bulk Density	Specific Gravity	Consolidation	
No.	No.	Depth (m)	Sample	EMC (%)	LL (%)	PL (%)	PI (%)	5 (5mm)	#.7 (3.35mm)	#.10 (2mm)	#.14 (1.18mm)	#.25 (600μm)	#.36 (425μm)	#.52 (300μm)	#.72 (212μm)	#.100 (150μm)	#.200 (75μm)	C KN/m²	ø	C KN/m²	ø	kN/m³		Cv m²/yrs	Mv m²/KN
BH2	8	11.1	Brownish red dense fine SAND	22	Non - plastic			-	-	99.1	98.7	94.67	89.13	38.5	28.37	4.9	1.53	1	29	-	-	16.10	2.69	-	-
BH2	10	14.1	Brownish red dense fine SAND	19	Non - plastic			-	-	-	99.29	81.0	72.39	55.91	15.28	8.61	3.45	0	30	-	-	16.40	2.67	-	-
BH2	12	17.1	Brownish dense fine SAND	23	Non - plastic			-	99.83	99.73	99.6	98.7	96.17	34.53	29.93	5.60	2.97	0	29	-	-	16.38	2.71	-	-
BH2	14	20.1	Greyish very stiff CLAY	32	34	17	17	-	-	96.38	90.41	87.95	82.30	68.95	57.61	50.15	46.39	-	-	30	16	18.26	2.75	$1.89x10^{-2}$	$3.86x10^{-3}$
BH2	15	21.6	Brownish dense coarse SAND	11	Non - plastic			-	95.61	81.15	70.29	58.4	36.45	16.19	11.59	8.56	2.78	0	31	-	-	17.8	2.70	-	-
BH2	17	24.6	Brownish very dense fine grained SAND	20	Non - plastic			-	-	-	97.11	90.6	69.51	47.82	25.61	4.56	1.95	2	28	-	-	17.59	2.69	-	-
BH2	19	27.6	Brownish dense fine SAND	17	Non - plastic			-	-	-	99.9	88.4	67.20	32.30	28.77	7.86	5.10	0	29	-	-	17.6	2.72	-	-
BH2	21	30.6	Brownish very dense fine SAND	21	Non - plastic			-	-	-	98.41	82.39	52.15	46.78	20.38	9.64	3.45	1	30	-	-	17.96	2.74	-	-
BH3	2	2.1	Dark brownish loose fine SAND	16	Non - plastic			-	-	99.15	96.89	79.48	56.51	27.95	13.48	11.61	5.61	2	26	-	-	15.68	2.59	-	-
BH3	3	3.6	Dark brownish medium dense fine grained SAND	18	Non - plastic			-	-	-	99.1	62.93	34.23	7.89	5.80	3.13	1.87	2	27	-	-	16.4	2.70	-	-
BH3	5	6.6	Brownish medium dense coarse SAND	4	Non - plastic			-	98.93	88.73	39.23	8.77	4.77	1.77	1.40	0.90	0.53	0	30	-	-	15.96	2.63	-	-
BH3	7	9.6	Brownish medium dense fine SAND	18	Non - plastic			-	-	-	99.93	95.00	50.5	12.7	10.77	4.70	4.23	0	29	-	-	16.87	2.68	-	-
BH3	9	12.6	Brownish dense fine SAND	20	Non - plastic			-	-	98.78	95.14	79.96	65.2	20.33	18.53	4.38	2.98	1	27	-	-	17.40	2.70	-	-
BH3	11	15.6	Brownish dense fine SAND	22	Non - plastic			-	-	99.78	98.70	94.90	68.1	20.4	16.17	8.40	7.83	0	28	-	-	17.00	2.68	-	-
BH3	13	18.6	Brownish red dense fine SAND	21	Non - plastic			-	-	-	99.34	97.33	80.06	44.9	38.92	8.47	4.71	1	28	-	-	17.18	2.60	-	-
BH3	15	21.6	Brownish dense fine SAND	19	Non - plastic			-	-	98.99	95.61	90.11	86.38	56.26	32.61	9.58	6.69	1	30	-	-	17.01	2.64	-	-
BH3	17	24.6	Brownish dense fine SAND	23	Non - plastic			-	-	-	99.58	92.38	77.98	47.56	27.81	5.65	3.45	0	30	-	-	16.89	2.66	-	-

APPENDIX G

Sample No.	Sample No.	Sample Depth (m)	Description of Sample	INDEX PROPERTIES				PARTICLE SIZE ANALYSIS									Direct Shear Strength		TRIAXIAL Shear Strength parameters		Bulk Density kN/m³	Specific Gravity	Consolidation	
				EMC (%)	LL (%)	PL (%)	PI (%)	5 (5mm)	#.7 (3.35mm)	#.10 (2mm)	#.14 (1.18mm)	#.25 (600μm)	#.36 (425μm)	#.52 (300μm)	#.72 (212μm)	#.100 (150μm)	#.200 (75μm)	C KN/m²	ø	C KN/m²	ø			Cv m²/yrs	Mv m²/KN
BH3	20	29.1	Brownish very dense fine SAND	21	Non - plastic			-	-	-	99.85	83.45	81.68	33.41	9.25	6.58	4.16	0	30.00	-	-	17.67	2.69	-	-
BH3	21	30.6	Brownish very dense fine SAND	24	Non - plastic			-	-	-	99.01	80.2	69.15	46.28	14.39	9.35	2.09	1	29.00	-	-	17.98	2.71	-	-