2) Installation of the generating facilities should be started promptly after completion of the foundation work. Work for machinery and electric equipment should also be conducted in parallel with this installation.

3) The following work is needed to connect the project generating facilities with the existing ones and involves the shutdown of the existing generating facilities. Therefore, this work must be executed by carefully studying specific methods including the sequence of execution and construction period.

   a) Work for branching and connecting flows of heavy oil, diesel oil and cooling water in the existing tank yard

   b) Work for installing the switchgear for line connection with the existing 11 kV distribution facilities in the generator building

   c) Work for installing cables in the existing cable pits in the generator building

   d) Work for connecting the steam pipe from the Project exhaust gas boiler to the steam header of the existing steam facilities

5-4-2 Implementation Method

This project will be executed under the framework of Japan's grant aid. The project will proceed to execution after it has been approved by both governments and Exchange of Notes (E/N) concluded between them. Subsequently, the Japanese consulting firm will be selected by the Sierra Leone government and detailed design work will be started. Upon completion of documentation for the detailed design, the Japanese contractor selected by holding a tender will construct facilities and procure equipment and materials. In executing the project, basic points, particularly those requiring particular attention, are as follows:

(1) Executing Agency

NPA, which is the power sector in Sierra Leone, is the agency in Sierra Leone responsible for execution of this project. At NPA, the Electricity Section, Technical Division, is responsible for this execution as shown in 2-2-1. The Sierra Leone government is required to appoint a full-time official in charge of this project in order to maintain close contact and conduct discussion with the Japanese consultant and contractor, and smoothly carry out all the work under the project.

The director of the Kingtom Power Station is considered best suited as this responsible official because the director should be most familiar with the condition of the proposed construction site. This official must fully explain to his staff at the Power Station and have them thoroughly understand contents of the project, and remind them to ensure safety during execution of construction work, and instruct them to cooperate in smooth progress of the project.

(2) Consultant

To construct the facilities and procure equipment and materials under the grant aid for this project, the Japanese consultant firm will conclude a consultant contract with the Sierra Leone government and conduct the detailed design for the construction and procurement and carry out supervision and control of the construction work. The consultant firm will also prepare tender documentation and promote the tender on behalf of the Sierra Leone side.

(3) Contractor

Under Japan's grant aid, the Japanese contractor selected in a public tender will construct the facilities and procure necessary equipment and materials.

It is considered necessary for the contractor to continue to supply spare parts and render services at the time of failures even after completion of the facilities construction work. Therefore, the

contractor should give due consideration to communications and coordination between the Sierra Leone side and the Japanese counterpart after completion of the construction work.

(4) Necessity for Dispatch of Engineers

The construction work for the generating facilities requires special, experienced engineers who are well versed in the configuration and functions of these facilities. The manufacturer of the generating facilities in Japan are required to send engineers well versed in construction, etc., of the generating facilities to the site because no such technically qualified engineers are available in Sierra Leone.

(5) Instructions to be Followed in Execution

In view of the fact that construction work for the generating facilities is carried out in the compound of the Power Station in operation and that it is a project under grant aid, due consideration should be given to the following points:

1) The execution methods and construction machinery should be carefully selected to avoid damage to existing facilities in the Power Station.

2) Temporary facilities and equipment and materials stock yard required for construction work should be located in areas where they will neither interfere with existing traffic lines of the Power Station nor adversely affect NPA's future rehabilitation and improvement plans for the existing facilities.

3) For work requiring interruption of the Power Station's operation such as connection with the existing facilities, the contractor should confirm the date, required number of hours for stoppage of operation, etc. with NPA in advance and strictly adhere to these points.

4) To strictly meet the extremely short implementation period, several works should be executed simultaneously under an overlapped schedule.

5-4-3 Supervisory Control Plan

Under the the role for Japan's grant aid and the main objectives of the basic design, the consultant firm will organize a consistent project team for detailed design and supervisory work and smoothly perform all this work. In the supervisory control stage, the consultant firm will send to the site technically qualified field supervisory personnel for liaison and guidance on the execution of work. The field supervisory personnel will be dispatched according to the construction schedule as follows:

First half (about 2.5 months before rainy season)	1 civil engineer (supervision of foundation work for major equipment)
Second half (about 5 months after rainy season)	1 mechanical engineer (supervision of equipment installation work)

In addition, the consultant firm will send an engineer responsible for each field of design for a short period of time as required according to the progress of work to supervise execution and witness inspection.

(1) Basic Policy for Supervisory Control of Execution

The consultant firm is required to perform appropriate supervisory control over the entire work so that the construction work can be positively and safety executed within the required construction period. For this purpose, the consultant firm will render its service under the following basic policy:

1) Management of work progress

a) To perform control over the manufacture and delivery of equipment and materials, and progress of work, all based on actual performance by comparing respective plans and completed work

b) To control the schedule for each item of work by month, week and day and give guidance to the contractor to rigidly meet the delivery under the contract

2) Quality control

a) To control quality of equipment and materials by checking them against detailed design documentation

b) To witness accuracy inspection, work process inspection, and various performance tests, regarding installation work, piping work, wiring work, connection work, etc., that are undertaken in the field

3) Safety control

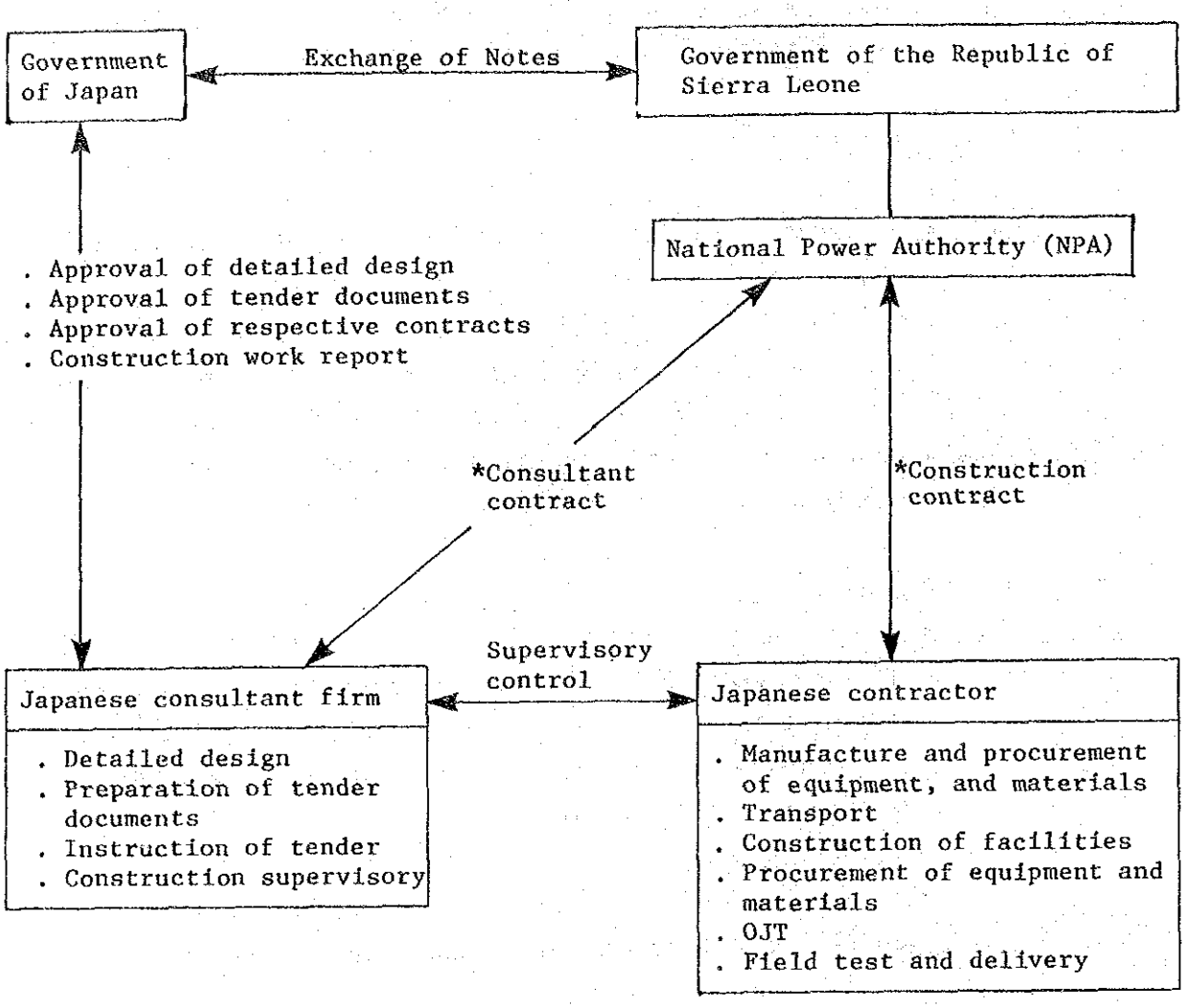
a) To give guidance to the contractor so that workers down to those at the lowest level will be conscious about prevention of various accidents while the foreman class will be trained in how to prevent hazards

b) To make efforts to prevent accidents by always checking condition of heavy equipment and machines such as cranes

c) When transport vehicles, construction equipment, etc. travel within the construction site, slow driving will strictly instructed and every caution will be taken to prevent traffic accidents which may cause injuries or damage existing facilities.

(2) General Relations When Supervisory Control is Performed

The following chart shows general relations of the supervisory control system and related organizations when supervisory control is performed.



Remarks: * Both consultant and construction contracts are subject to verification of Japanese government.

Fig. 5-1 Chart Showing Relations in Execution of Project

(3) Execution Supervisor

For the contractor to complete construction of the facilities conforming to the detailed design documentation within the construction period, the execution supervisor requires the ability to smoothly manage joint work with local execution contractors and give adequate technical guidance to such local contractors. Additionally, it is desirable that the execution supervisor have experience in similar projects in order to secure a higher quality of work.

According to the scale and contents of the facilities under the Project, it is assumed that the contractor station the following class and number of execution supervisors in the field:

Site manager	:	1 person To supervise whole work and give OJT
Mechanical supervisor	:	1 person To supervise installation of mechanical equipment and manage progress of work
Electrical supervisor	:	1 person To supervise installation of electrical equipment and progress of work
Civil work supervisor	:	1 person To supervise work for equipment foundation, enclosure, etc. and manage progress of work
Administration supervisor	:	1 person (site manager will carry out this duty) To supervise import of equipment and materials, labor and clerical work

Aside from the above, engineers should be sent to the site for supervision of equipment installation, test run, and adjustments as required for each item of work according to the progress of work.

5-4-4 Procurement Plan

(1) Source of Equipment and Materials

Equipment and materials for both construction and procurement of machinery for this project will be supplied from Japan or third countries with the exception of aggregate for concrete. This is because such equipment and materials are not locally available. Sierra Leone imports some of these items but such imports cannot be used because they would have difficulty in meeting delivery or quality requirements.

As a result of a comparative study in standards, specifications, quality, production, stability of supply and lead time, equipment and materials for the project will be obtained from following sources:

Table 5-5 Sources of Equipment and Materials

Source	Equipment and Materials	Remarks
Sierra Leone	Sand and gravel Fuel oil	
Third countries	11 kV switchgear for line connection	Required to conform to existing BRUSH unit (UK) in configuration and mechanism
Japan	Diesel engine Generator Enclosure Transformer 11 kV switchgear on generator side Mechanical auxiliary equipment Electrical auxiliary equipment Piping facilities Cabling facilities Steel products Cement Paints Special tools for maintenance Spare parts	

The radiator may be procured in a third country for quality and delivery considerations because Japanese manufacturers do not have much experience in production of large capacity radiators.

(2) Transport Method

Considering conditions at the unloading port in Sierra Leone and the project site, construction equipment and materials will be in principle shipped from Japan as container cargo. However, separate transport methods will be studied for large equipment such as engines that cannot be loaded into container.

As described earlier (see 3-3-1), freight vessels fitted with cranes will be used for shipment from Japan because no cargo handling equipment capable of handling heavy loads is available at Queen Elizabeth II Port. Trailers, etc., will be used for inland transport over a distance of about 5 km from the port to the Kingtom Power Station.

5-4-5 Implementation Schedule

In the event this project is executed under the Japan's grant aid, the facilities will be constructed and equipment and materials procured in following three stages after conclusion of the Exchange of Notes (E/N) between both governments: ① Preparation of detailed design document, ② tender and contract of the construction work, and ③ execution of construction work.

(1) Detailed Design Work

After conclusion of E/N, the Japanese consultant firm will immediately conclude the consultant contract with the Sierra Leone government and start detailed design work.

Based on confirmation results of basic and detailed design surveys, the consultant firm will prepare the tender document (including tender specifications and detailed design drawings). The consultant

firm will hold thorough discussion with responsible organizations in Sierra Leone in both the initial and final stages of detailed design, and proceed to tender business upon approval of the final work by the Sierra Leone side.

All this work is expected to take 3 months.

(2) Awarding of Contract

Acting for Sierra Leone, the consultant firm will make tender announcement, accept applications for participation in tender, evaluate tenderers for prequalifications, hold briefings on the tender, and distribute tender documentation. After allowing a certain period of time for preparation of the tender, the consultant firm will accept tenders and promptly examine them, and promote conclusion of a construction contract between Sierra Leone and a Japanese contractor.

The tender is opened in the presence of all parties concerned and the participant who tendered the lowest price will become the successful bidder if contents of the tender are found appropriate and will conclude the construction contract with the Sierra Leone government.

The period from the tender to conclusion of the contract is expected to be 2 months.

(3) Construction Work and Procurement of Equipment and Materials

After signing the construction contract, the contractor will start to work upon verification by the Japanese government. Judging from the scale of the project and contents of the facilities, if preparatory work for which the Sierra Leone side is responsible smoothly proceeds, the detailed design work is expected to be completed in 3 months, procurement of equipment and materials in 8 months and site construction from the commencement of foundation works to the completion of the project in 12 months.

However, no field work will be undertaken during the June - September rainy season, which has an average monthly rainfall of as high as about 800 mm, because it is considered difficult to ensure safety in the field work under such condition. To strictly meet delivery for the whole work, foundation work for major items of equipment should be completed before the rainy season sets in.

The consultant firm shall hold discussions with the contractor before commencement of work, give guidance and supervisory instructions to the contractor on the delivery of equipment and materials to the site, execution methods and construction schedule, perform process and quality control, and complete all the work within the period set forth in E/N.

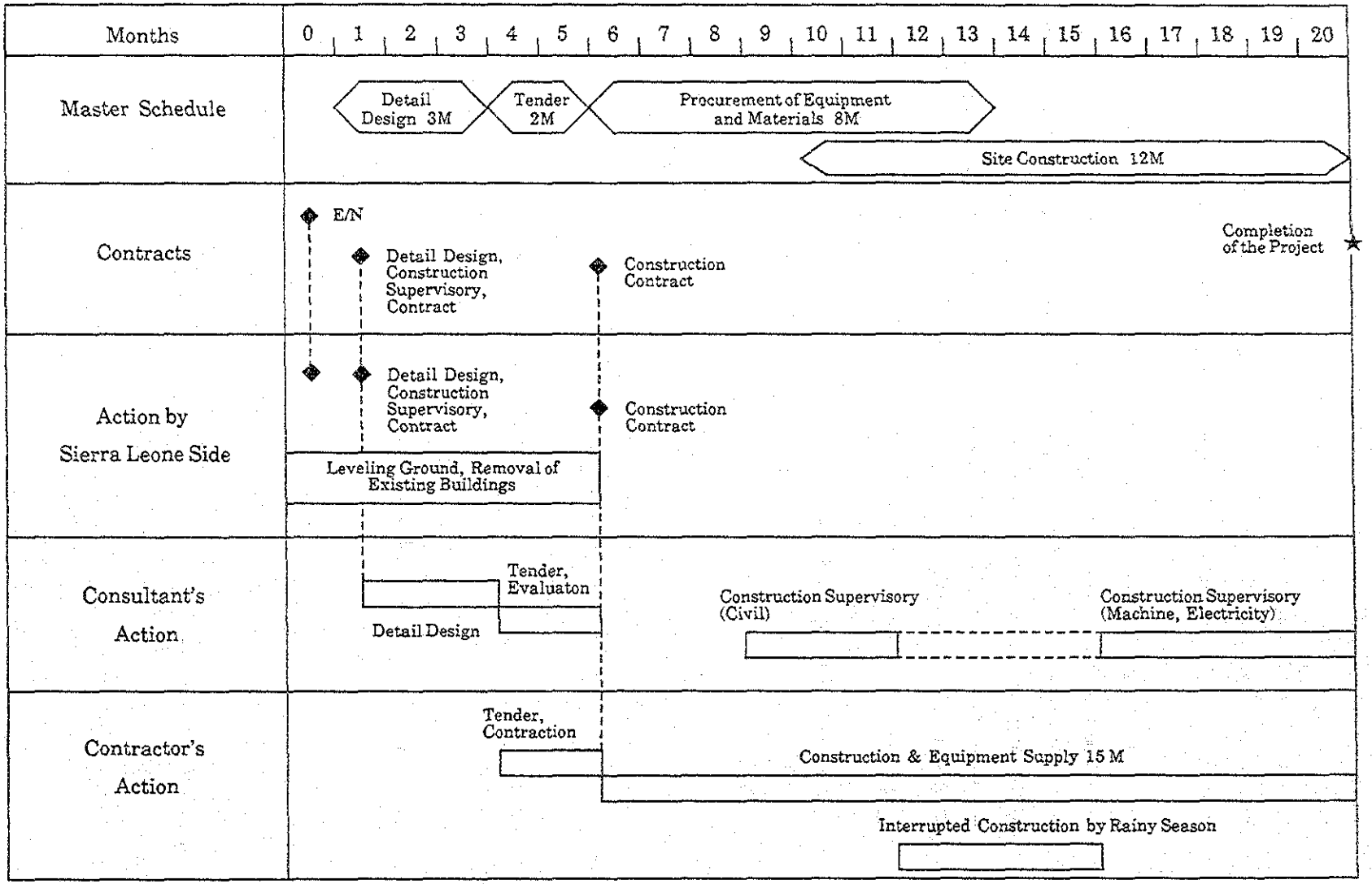


Fig. 5-2 Project Implementation Schedule

5-4-6 Scope of Work

(1) Scope of Work

1) Scope of work to be borne by the Government of Japan

a) To undertake construction work for diesel generating facilities (5 MW)

b) To procure equipment and materials including spare parts

c) To provide OJT

2) Scope of work to be borne by the Government of Sierra Leone

a) To relocate or remove existing structures in the construction site and secure land for construction

b) To bear the cost of opening an account at a foreign exchange bank authorized by the Japanese government and all other costs and expenses, other than those met by the grant, necessary for execution of the project

c) To promptly unload equipment and materials necessary for execution of the project, exempt taxes on their import and re-export, internal taxes, customs duties and other levies on Japanese corporations and Japanese involved in execution of the project, and extend other facilities to Japanese or other foreign nationals dispatched for execution of the project

d) To secure necessary approval for execution of the project from relevant Sierra Leone government agencies

e) To assign OJT trainees

f) To secure the stoppage of power supply of the existing generating facilities as well as the suspension of fuel oil

supply to the facilities as required during the construction period

g) To give permission to enter the Kingtom Power Station and provide necessary information materials

h) To provide the land for temporary site office, warehouse and stock yard for construction work, as well as disposal places for waste oil and waste water that will be discharged during construction work

i) To witness and confirm construction work when inspection and maintenance are carried out, and supply power and water required for execution of construction work

j) To provide adequate maintenance control to the generating facilities after completion of the project and secure the necessary budget for this operation

k) To control traffic and remove obstacles during inland transport of equipment and materials for the project

(2) Approximate Project Cost to be Borne by Sierra Leone Government

Construction cost to be borne by the Sierra Leone government is as follows:

- Relocation and removal of existing structures in construction site	115,710 leones
- OJT training	75,000 leones
Total	190,710 leones

Additionally, the following expenses will be incurred:

- Commission for banking arrangements : 0.01% of E/N value
- Advising commission of Authorization to Pay (A/P) : Approx. 3,000 yen for each A/P issued

CHAPTER 6 PROJECT EVALUATION AND CONCLUSION

CHAPTER 6 PROJECT EVALUATION AND CONCLUSION

6-1 Effects

It is believed that implementation of the project will bring about the following direct and indirect effects:

6-1-1 Direct Effects

As direct effects, the project is expected to improve the power generating capacity of the Kingtom Power Station and increase revenues from electricity charges as a result of this improved capacity.

Table 6-1 shows expected direct effects from execution of this project.

Table 6-1 Direct Effects from Execution of the Project

Item	Anticipated output in 1991	Effect of execution of the Project (1992)	Remarks
Total output of Kingtom Power Station	25 MW	30 MW	Increase in installed capacity of generating facilities (5 MW)
Anticipated increase in revenues from electricity charges (revenues and expenditures of operation)		Approx. 28.04 million leones	

Assumed conditions for study:

(1) With the subject year study set at 1992, it was assumed that the rehabilitation plan for Kingtom Power Station will be completed in 1991 (see 3-4-2).

(2) The expected increase in revenues from electricity charges was based on anticipated revenues and expenditures when the generating facilities are operated at an annual operation rate of 90% (an annual operation of about 7,780 hours). (see 4-2-2(2))

It is expected that the total number of consumers served by the Kingtom Power Station (beneficiary population) in 1992 will be 33,000 households (about 231,000 persons). (This is based on the following conditions: Average number of persons per households is 7, population growth, 5.8%/year, and electrification, 32%. See 2-1-2 and 2-2-3.)

6-1-2 Indirect Effects

Implementation of this project is expected to bring about the following indirect effects:

(1) Use of Electric Power

1) The generating facilities installed by the project will provide a solid foundation for the greater Freetown area power supply plan that the Sierra Leone government has already formulated.

2) Transfer of O&M technology will improve technical capability, contribute to securing a stable source of power supply, and self-reliance and efficiency of maintenance control work.

(2) Civic Life

1) Stable power supply will stabilize people's daily lives and promote stable operation and improvement of social welfare facilities including education and medical service.

2) Reduction in blackouts by power cuts will contribute to maintaining public peace and order.

(3) Socio-economic Conditions

1) Stable energy source for public facilities will vitalize economic activities.

2) Stable power supply will also promote economic activities.

3) Improved power supply will contribute to "increased food self-sufficiency under expanded agricultural policy," which is one of the major targets of the 3rd 5-year development plan.

6-2 Propriety

6-2-1 Technical Aspect

The planned installed capacity of the generating facilities is optimum in scale to meet the power demand for social welfare facilities including hospitals and schools in the completion date of the project (assumed to be 1992). Also, it is planned that these generating facilities will make effective use of the existing facilities while causing no interference with the implementation of NPA's future plan, "the rehabilitation of the existing diesel generating facility at Kingtom Power Station."

From these facts, the project for construction of the generating facilities is considered technically proper.

6-2-2 Financial Aspect

Since sustained increase in revenues from the supply power can be expected by installation of the proposed generating facilities, the project will contribute to changing NPA's financial condition for the better. Meanwhile, no increase in the cost of operation personnel will be incurred by the Sierra Leone government. This is because the operation and maintenance of the new generating facilities will require no additional personnel and can be handled by the present operating crew.

6-2-3 Maintenance and Control Aspect

Upon provision of OJT under the project, the Sierra Leone side is expected to be able to maintain and control the generating facilities with their own technical capability and to apply this capability to other generating facilities as well.

Consequently, the propriety of this project is high based on its evaluation from technical, financial and maintenance and control aspects.

6-3 Conclusion

As described earlier (see 3-4), the greater Freetown area suffers from a difficult power supply situation because of obsolete generating facilities, lack of proper operation and maintenance technology and acute shortage of spare parts due to scarce funds. These various problems have reduced the output of the generating facilities or stopped their operation. In 1989, the difference between the peak power demand (about 40 MW) and total available capacity (12.7 MW) widened to as great as about 27.3 MW. The resulting daily power cut has seriously affected the lives of the people, operation of social welfare facilities and industrial and economical activities in the area. However, the difference between demand and supply can not be improved in a short period of time in view of Sierra Leone's financial condition. It is desired that the situation be gradually improved by implementing medium and long range plans.

This project is intended to serve as an emergency power supply improvement plan based on the medium range power supply plan which Sierra Leone has already formulated. Thus, the generating facilities to be constructed under the project are expected to stabilize activities of social welfare facilities and improve civic life in the greater Freetown area. Furthermore, the scale of the project is considered the most ideal as a result of study on the planned installed capacity from technical, financial and maintenance control aspects.

Also, the project conforms to Sierra Leone's national development plan as an emergency measure for improvement of energy supply in support of one of the targets listed in the 3rd 5-year plan, "Strengthening of Self-reliance by expanding agriculture policy," as already described (see 2-3-1).

Kingtom Power Station, where the generating facilities for the project will be constructed, is the sole supplier of power to the greater Freetown area. Considering this fact, the implementation of the project will have a great beneficial effect on stable lives of people in Sierra Leone, particularly those of residents in the community, as well as economic and industrial activities.

Based on the above, it is considered that the implementation of the project under Japan's Grant Aid is highly significant and proper.

6-4 Recommendations

6-4-1 Recommendations on Implementation of the Project

The generating facilities for the project will become an integral part of Sierra Leone's stable power supply system. To secure and maintain this function over a long period, the Sierra Leone side should take following measures:

(1) Engineers in Sierra Leone should review the operation plan for the whole of Kingtom Power Station including the generating facilities for the project and its other generating facilities. Based on this review, they should develop a specific operation and maintenance control plan for the project generating facilities and establish highly reliable power supply system.

(2) To effectively implement the project and attain its objectives and goals, the Sierra Leone side should appoint full-time engineers who will actually carry out control and maintenance of the generating facilities, and have them participate in OJT from classroom training until completion of the construction work.

(3) The Sierra Leone engineers assigned to OJT should acquire O & M technology from Japanese engineers and strive to improve their technical level by continuing their study even after completion of the construction work.

(4) Engineers assigned to OJT should transfer acquired technology to other Sierra Leone engineers who could not participate in OJT, thereby striving to spread this technology and raise technical level in Sierra Leone.

6-4-2 Recommendations on Future Power Supply Operation

For the future power supply operation, it is considered necessary that Sierra Leone take following measures:

(1) To secure reliability in power supply (to secure reserve generating capacity)

In power supply service, efficient and stable operation of generating facilities is an essential requirement. To cope with the uncertainty element of a drop in supply capacity due to equipment breakdown, accidents, etc., efforts should be made to secure adequate reserve capacity and increase reliable facilities.

When the 2 on-going projects (Kingtom Rehabilitation Plan and Bunbuna Hydroelectric Power Station Construction Plan) are completed (scheduled for 1995), the total generated energy in the greater Freetown area (60.5 MW) is expected to surpass only slightly the peak demand (58.8 MW). However, firm capacity (total generated energy minus output of the largest generating facilities) will be far short of peak power demand. As a result, a stoppage owing to a breakdown or maintenance at a certain power station would cause the situation in which a frequent power cut is again necessary. (see 3-4-2(2))

To cope with such situation, provision of adequate reserve generating capacity is considered necessary.

(2) Improvement of Technical Capabilities

Sierra Leone should develop both short- and long- range plans to improve technical capabilities for planning, operation and maintenance control of power supply, and conduct follow-up efforts on these plans. Particularly, it is considered an urgent task to train engineers for operation and maintenance.

For this purpose, Japan's technical cooperation in the following specific areas is considered most effective. It is thus believe desirable that the Sierra Leone government make a request for this cooperation separately from the request for the project.

1) To provide training in generating facilities in Japan

2) To send specialists in O & M of the generating facilities for the project after completion of this project

(Electric and mechanical engineers: 1 each)

APPENDIX 1 Basic Design Study Team

Basic Design Study Team

Assignment	Name	Position
- Team Leader	Toshimichi Aoki	First Basic Design Division, Grant Aid Planning and Survey Department, JICA
- Power Plant Planner	Mitsuhisa Nishikawa	Yachiyo Engineering Co., Ltd.
- Generator Facility and Auxiliary Planner	Kenji Miwa	Yachiyo Engineering Co., Ltd.
- Diesel Engine Facility Planner	Masatsugu Komiya	Yachiyo Engineering Co., Ltd.

APPENDIX 2 Field Survey Schedule

Field Survey Schedule

No.	Date	Day of the Week	Weather	Place of Stay	Schedule	Detail of study items
1	Nov. 26	Sun.	Fine	in air-plane	Lv. Narita SR-163 21:00	Departure of Basic Design Study Team from Tokyo.
2	Nov. 27	Mon.	Cloudy	Zurich	Ar. Zurich 5:30	Internal meeting of the Study Team
3	Nov. 28	Tue.	Fine	Monrovia	Lv. Zurich SR-248 12:30 Ar. Mon-rovia 20:20	
4	Nov. 29	Wed.	Fine	Monrovia		Internal meeting of the Study Team. Study Team paid a courtesy call to the Embassy of Japan in Liberia and had a meeting.
5	Nov. 30	Thu.	Fine	Freetown	Lv. Mon-rovia KL-580 21:45 Ar. Free-town 22:50	Courtesy call to the Embassy of Japan in Freetown.
6	Dec. 1	Fri.	Fine	Freetown		Study Team paid a courtesy call to the Ministry of Foreign Affairs, the Ministry of Energy and Power, and the National Power Authority (NPA) and had meetings.
7	Dec. 2	Sat.	Fine	Freetown		Inspection of King-tom Power Station (K.T/P.S), Falcon Bridge Power Station (F.B/P.S) and Black Hall Road Power Station (B.H/P.S) Meeting of NPA

No.	Date	Day of the Week	Weather	Place of Stay	Schedule	Detail of study items
8	Dec. 3	Sun.	Cloudy	Freetown		Internal meeting of the Study Team. Preparation of Minutes of Discussions (M/D). A Team member Komiya's arrival in Freetown
9	Dec. 4	Mon.	Fine	Freetown		Meeting of NPA Explanation of Inception Report, Questionnaire and Japan's Grant Aid Program
10	Dec. 5	Tue.	light rain	Freetown		Signning of M/D.
11	Dec. 6	Wed.	Fine	Freetown		Courtesy call to EEC, Collection of data and information and study of K.T/ P.S. A visit to NPA, collection of data and infor- mation. The Team leader Aoki left Freetown for Japan
12	Dec. 7	Thu.	Fine	Freetown		Study of K.T./P.S. A call to NPA
13	Dec. 8	Fri.	Light rain	Freetown		Study of K.T/P.S Study of data and information
14	Dec. 9	Sat.	Cloudy	Freetown		Study of K.T/P.S. Study of data and information
15	Dec.10	Sun.	Fine	Freetown		Preparation of Field Report Inter- nal meeting of the Study Team
16	Dec.11	Mon.	Fine	Freetown		Study of K.T/P.S Collection of data and information.

No.	Date	Day of the Week	Weather	Place of Stay	Schedule	Detail of study items
17	Dec.12	Tue.	Fine	Freetown		Study of K.T/P.S. Collection of data and information
18	Dec.13	Wed.	Fine	Freetown		Study of K.T/P.S. A call to EEC office and preparation of Field Report
19	Dec.14	Thu.	Fine	Freetown		Study of K.T/P.S. Collection of data and information
20	Dec.15	Fri.	Fine	Freetown		Study of ports and transportation routes, and of B.H/ P.S. and of data and information
21	Dec.16	Sat.	Fine	Freetown		Study of data and info. (Collection of Questionnaire) Preparation of Field Report
22	Dec.17	Sun.	Fine	Freetown		Preparation of Field Report
23	Dec.18	Mon.	Fine	Freetown		Study of K.T/P.S and explanation of Field Report
24	Dec.19	Thu.	Fine	Freetown		Call to N.P.A and explanation of Field Report
25	Dec.20	Wed.	Fine	Freetown		Call to the Ministry of Energy and Power and explanation of Field Report. Call to N.P.A. and approval of Field Report

No.	Date	Day of the Week	Weather	Place of Stay	Schedule	Detail of study items
26	Dec.21	Thu.	Fine	Monrovia	Lv. Freetown KL-579 19:25 Ar. Monrovia 20:40	The Study Team called to the Ministry of Energy and Power and to the Ministry of Foreign Affairs
27	Dec.22	Fri.	Fine	Monrovia		Call to the Embassy of Japan in Liberia with the Final Report
28	Dec.23	Sat.	Fine	London	Lv. Monrovia BA-083 9:40 Ar. London 20:10	
29	Dec.24	Sun.	Cloudy	in airplane	Lv. London BA-007 14:30	
30	Dec.25	Mon.	Cloudy	Tokyo	Ar. Tokyo 11:30	Arrival at Tokyo

APPENDIX 3 List of Interviewees

List of Interviewees

Place of Work and Name	Position
Embassy of Japan in Liberia:	
H.E. Hirosuke Oshima	Ambassador Extraordinary & Plenipotentiary
Mr. Mikio Morimoto	Counsellor
Mr. Hideki Yamazaki	Second Secretary
Mr. Masaru Hattori	Third Secretary
Mr. Kimitoshi Yamaguchi	Administrative Officer
JICA:	
Mr. Minoru Yoshimura	Coordinator
Ministry of Foreign Affairs:	
Mr. W.A.Jones	Acting Secretary to the Minister of Foreign Affairs
Mr. S.S.A.Sankoh	Acting Director of Economic Affairs and Technical Cooperation Division
Mr. J.A.Goodwyll	Assistant Secretary
Ministry of Energy and Power:	
Hon.Dr. Sheku Sesay	Minister
Mr. E.C.S.Kargbo	Acting Permanent Secretary
Mr. S.Garber	Deputy Secretary
Ministry of Finance:	
Mr. Sylvanus Taylor	Principal Deputy Financial Secretary
National Power Authority (NPA):	
Mr. Dumbuya	General Manager
Mr. S.S.Labor	Deputy General Manager
Mr. A.Conteh	Chief Engineer
Mr. Mustapha Kargbo	Distribution Manager
Mr. A.S.Kanu	Acting Finance Director
Mr. S.T.Powers	Commercial Director
Mr. J.A.M.Wilkinson	Assistant Superintendent
Mr. M.Kamara	Assistant Commercial Manager
Mr. A.F.Yartch	Acting Planning Manager
Mr. A.Timbo	Planning Officer (Electrical)
Mr. M.Dumbuya	Planning Officer (Mechanical)
Mr. A.S.Jabba	Planning Officer (Electrical)

Kingtom Power Station (NPA):

Mr. Mahdi	Acting Generation Manager
Mr. Lowson	Electric Engineer
Mr. Macauley	Maintenance Engineer
Mr. A.Vandi	Mechanical Engineer

Ministry of Lands, Housing and the Environment:

Mr. I.O.K.Otoo	Senior Surveyor of Topographical Survey Division

Falcon Bridge Power Station (NPA):

Mr. E.O.Jarrett	Senior Superintendent

Central Statistics Office:

Mr. M.Williams	Statistician of Demographic Section

Consulate of Japan in Sierra Leone:

Mr. Kishore Shankerdas	Honorary Consul of Japan

EEC:

Mr. J.Trestour	Delegate of the Commission
Mr. Hegarty	Engineering Advisor

Ministry of Development and Economic Planning:

Mrs. Olabisi Taylor	Deputy Director of Planning, Central Planning Unit

Connaught Hospital:

Miss. Fatmata Sankoh	Forensic Analyst of Public Health Laboratory
Mrs. Rita Kamara	Laboratory Superintendent

APPENDIX 4 Minutes of Discussions

MINUTES OF DISCUSSIONS

ON

THE PROJECT FOR

IMPROVEMENT OF ELECTRICITY POWER SUPPLY

TO GREATER FREETOWN

IN

THE REPUBLIC OF SIERRA LEONE

In response to the request of the Government of the Republic of Sierra Leone, the Government of Japan decided to conduct a basic design study on the Project for Improvement of Electricity Power Supply to Greater Freetown and entrusted the study to the Japan International Cooperation Agency (JICA). JICA sent to the Republic of Sierra Leone the study team headed by Mr. Toshimichi Aoki from November 30 to December 21, 1989.

The Japanese team had a series of discussions and exchanged views on the Project with the authorities concerned of the Government of the Republic of Sierra Leone headed by Mr. Ahmed C. Dumbuya, General Manager, National Power Authority and conducted a field survey on the sites.

As a result of the study and discussions, both parties mutually agreed to recommend to their respective Governments that the major points of understanding reached between them, attached herewith, should be examined towards the realization of the Project.

Freetown, December 5, 1989

Toshimichi Aoki
Leader
Basic Design Study Team
Japan International Cooperation Agency

Ahmed C. Dumbuya
General Manager
National Power Authority

S.S.A. Sankoh
Director
Economic and Technical Cooperation Division
Ministry of Foreign Affairs

ATTACHMENT

1. Objective of the Project

The objective of the Project is to improve electricity power supply to Freetown and Greater Freetown.

2. Description of the Project

The Project consists of the following items:

(1) Supply and installation of one(1) Diesel Engine Generator (approximately 5MW) with necessary auxiliaries, including On-the-Job Training for NPA's staff for operation and maintenance during the implementation period.

(2) Commissioning work for above (1)

(3) Supply of spare parts for above (1)

(4) Foundation work for above (1)

3. Executing Agency for the Project

National Power Authority (NPA)

4. Project Site

The Project site is located at Kingtom power station in Freetown as shown in Annex-1.

5. The Sierra Leone side understood contents of the inception report as explained by the study team.

6. The Sierra Leone side understood the Japan's Grant Aid system as explained by the study team in which contracts are to be concluded with a Japanese consulting firm and a Japanese contractor.

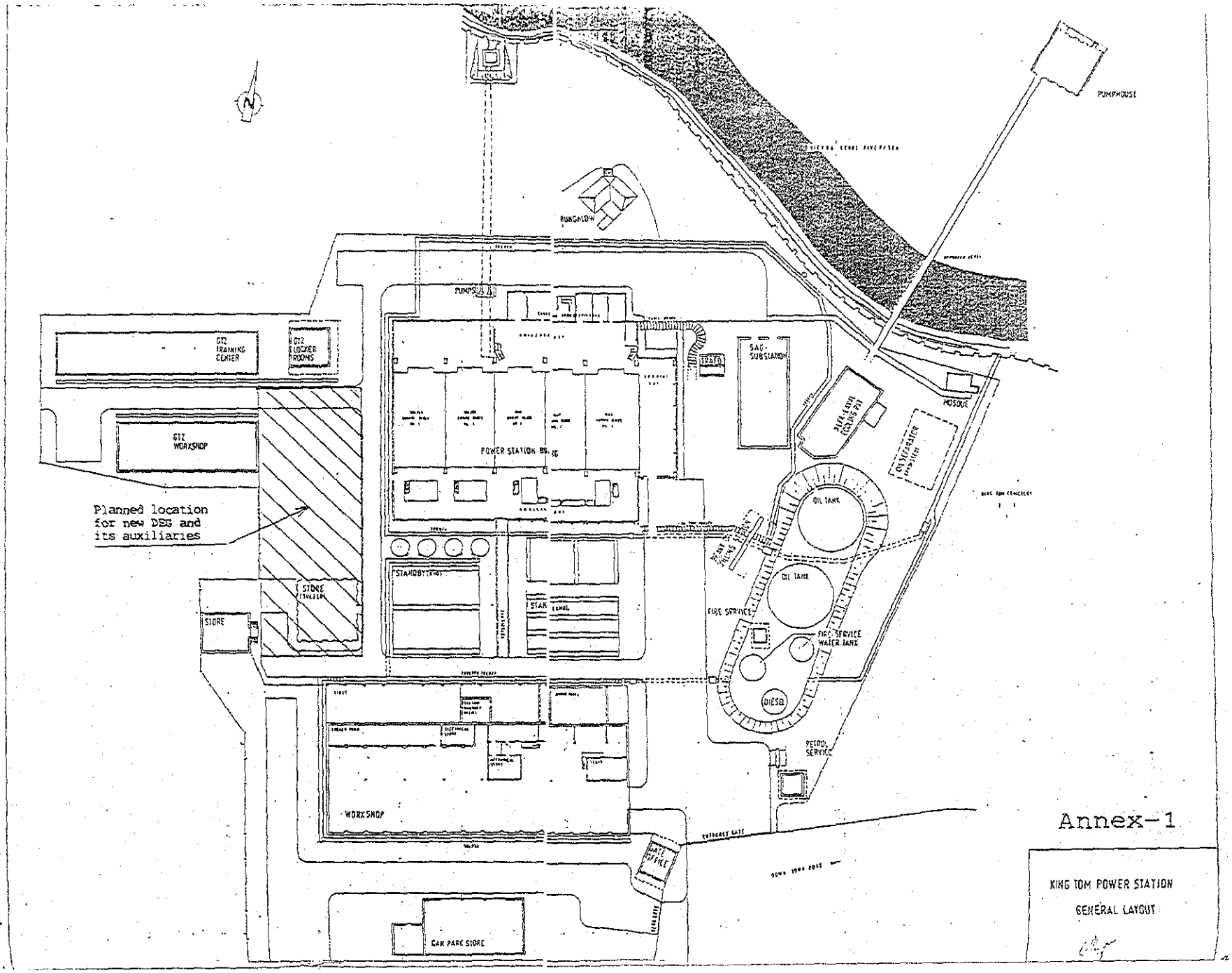
7. The basic concept of the Project will be described in the field report to be submitted to the Sierra Leone side by the Japanese side at the end of this field survey.

S.S.A.

8. The Sierra Leone side agreed to take necessary measures as listed in Annex-2 on condition that the Grant Aid would be extended to the Project.

9. The Sierra Leone side agreed to provide the necessary budget and personnel for proper and effective operation and maintenance of the Diesel Engine Generator (DEG) with auxiliaries to be installed under the Grant Aid.

10. Final Report (10 copies, in English) will be submitted to the Sierra Leone side before the end of April, 1990.


PUMPHOUSE
BUNGALOW
PUMPS
GTZ TRAINING CENTER
GTZ LOCKER ROOMS
GTZ WORKSHOP
POWER STATION BLDG
SAC SUBSTATION
MOSQUE
Planned location for new DES and its auxiliaries
STORE
STORE
OIL TANK
OIL TANK
FIRE SERVICE
FIRE SERVICE WATER TANK
DIESEL
PETROL SERVICE
WORKSHOP
GATE OFFICE
CAR PARK STORE
Annex-1
KING TOM POWER STATION
GENERAL LAYOUT

ANNEX-2 UNDERTAKINGS BY THE GOVERNMENT OF THE REPUBLIC OF SIERRA LEONE

(1) To provide cleared and leveled land for the new DEG and its auxiliaries to be installed.

(2) To provide the land for temporary site office, warehouse and stock yard during the implementation period.

(3) To ensure speedy unloading, tax exemption, custom clearance of the products purchased for the Project at the port of disembarkation in the Republic of Sierra Leone.

(4) To accord Japanese nationals whose services may be required in connection with the supply of the products and the services under the verified contracts such facilities as may be necessary for their entry into the Republic of Sierra Leone and stay therein for the performance of their work.

(5) To exempt Japanese nationals from customs duties, internal taxes and other fiscal levies which may be imposed in the Republic of Sierra Leone with respect to the supply of the products and services under the verified contracts.

(6) To bear commissions to the Japanese foreign exchange bank for the banking services based upon the Banking Arrangement.

(7) To bear all the expenses, other than those to be borne by the Grant Aid necessary for the execution of the Project.

(8) To provide proper arrangements for the construction, such as water supply, electricity, drainage, etc., if necessary.

(9) To assign exclusive counter part engineers/technicians for the Project in order to transfer the operation and maintenance technique for the new DEG and its auxiliaries to be installed.

S. S. A.

(10) To provide proper disposal places of waste water and oil discharged during the implementation period.

(11) To provide necessary data for the Project, including samples of water, fuel oil, etc., and permission to take those to Japan.

(12) To secure the stoppage of electricity of the switchgear for the connection works of new power cables, when necessary.

S.S.A.

APPENDIX 5 Field Report

THE BASIC DESIGN STUDY
ON
THE PROJECT FOR
THE IMPROVEMENT OF ELECTRICITY POWER SUPPLY
TO
GREATER FREETOWN
IN
THE REPUBLIC OF SIERRA LEONE

FIELD REPORT

December 19, 1989

JAPAN INTERNATIONAL COOPERATION AGENCY
(JICA)

C.A. Dumbuya 19/12/89.
S.M. (N.P.A.).

CONTENTS

ANNEX

ATTACHMENT DRAWINGS

1. Introduction

This field report is prepared by the basic design study team (hereinafter referred to as "the team") for the Project for Improvement of Electricity Power Supply to Greater Freetown (hereinafter referred to as "the Project"), based on the field survey and discussions with the authorities concerned of the Government of Sierra Leone, in accordance with the Minutes of Discussions concluded between both the Government of Sierra Leone and the Government of Japan on December 5, 1989.

This report describes some fact findings obtained through the field survey, as well as the basic concept of the Project including outline of main equipment including scope of supply for the new diesel engine generator set (hereinafter referred to as "DEG").

However all the items of the basic concept shall be subject to the approval of the Japanese Government.

In addition to the above, this report describes some undertakings to be carried out by the Government of Sierra Leone if Grant Aid is extended.

As described in the Inception Report, the team will continue the study in Japan in accordance with this field report.

The final report of the Project shall be prepared in consultation with the Japanese authorities concerned, and will be submitted before the end of April, 1990 as mentioned in the Minutes of Discussions.

2. Power demand and supply in Greater Freetown

2.1 Present generating capacity

There are two power stations of diesel engine generator (Kingtom and Falconbridge) under operation by National Power Authority (hereinafter referred to as "NPA") in Freetown and Greater Freetown .

NPA also has a hydro-electric power station (Guma Dam power station, installation capacity 2.2 MW) in this area. However this power station is out of order at present.

Falconbridge power station is used only for black-start of DEG at Kingtom power station. Therefore all the electricity power are supplied to the consumers by Kingtom power station.

As of December 1989, the firm capacity of Kingtom Power Station is only 7.5 MW and available capacity is 12.5 MW, although the peak demand in this area at present is about 40 MW.

The following table shows the present generating capacity in Freetown and Greater Freetown.

Table-1 Present Generating Capacity in Kingtom P/S

As of December 1989

Unit No.	DEG Manufacturer	Commencement Date of Operation	Installed Capacity (MW)	Available Capacity (MW)	Remarks
1	MAN	1971	6.6	--	Out of order
2	MAN	1964	6.6	--	Out of order
3	MAN	1964	6.6	--	Out of order
4	SULZER	1978	9.2	5.2	
5	SULZER	1980	9.2	4.5	
6	KHD	1986	3.0	1.5	emergency use only
7	KHD	1986	3.0	--	ditto
8	KHD	1986	3.0	1.5	ditto
9	KHD	1986	3.0	--	ditto

Table-2 Present Generating Capacity in Falconbridge P/S

As of December 1989

Unit No.	DEG Manufacturer	Commencement Date of Operation	Installed Capacity (MW)	Available Capacity (MW)	Remarks
1	ENGLISH ELECTRIC	1962	1.5	--	Out of order
2	ENGLISH ELECTRIC	1962	1.5	--	Out of order
3	MIRRLEES	1976	1.0	--	Out of order
4	MIRRLEES	1976	1.0	0.8	
5	MIRRLEES	1976	1.0	0.8	

2.2 Future extension and rehabilitation plan

NPA has rehabilitation plans in the medium and long term. The medium term plan includes the rehabilitation of the existing generators and the common systems in Kingtom Power Station. According to NPA's figures, the rehabilitation items in the medium term are as follows:

Table-3 Rehabilitation Plan in Kingtom P/S

Unit No.	Type	Avail. Capa. (as of Dec. 1989 (MW)	Planned Available Capacity (after rehabilitation) (MW)	Planned Implementation Year and Finance
4	SULZER	5.2	7.5	1991, EEC
5	SULZER	4.5	7.5	1991, EEC
6	KHD	1.5	2.5	1990, EEC
7	KHD	--	2.5	1990, EEC
8	KHD	1.5	2.5	1990, EEC
9	KHD	--	2.5	1990, EEC

2.3 Power balance in medium term

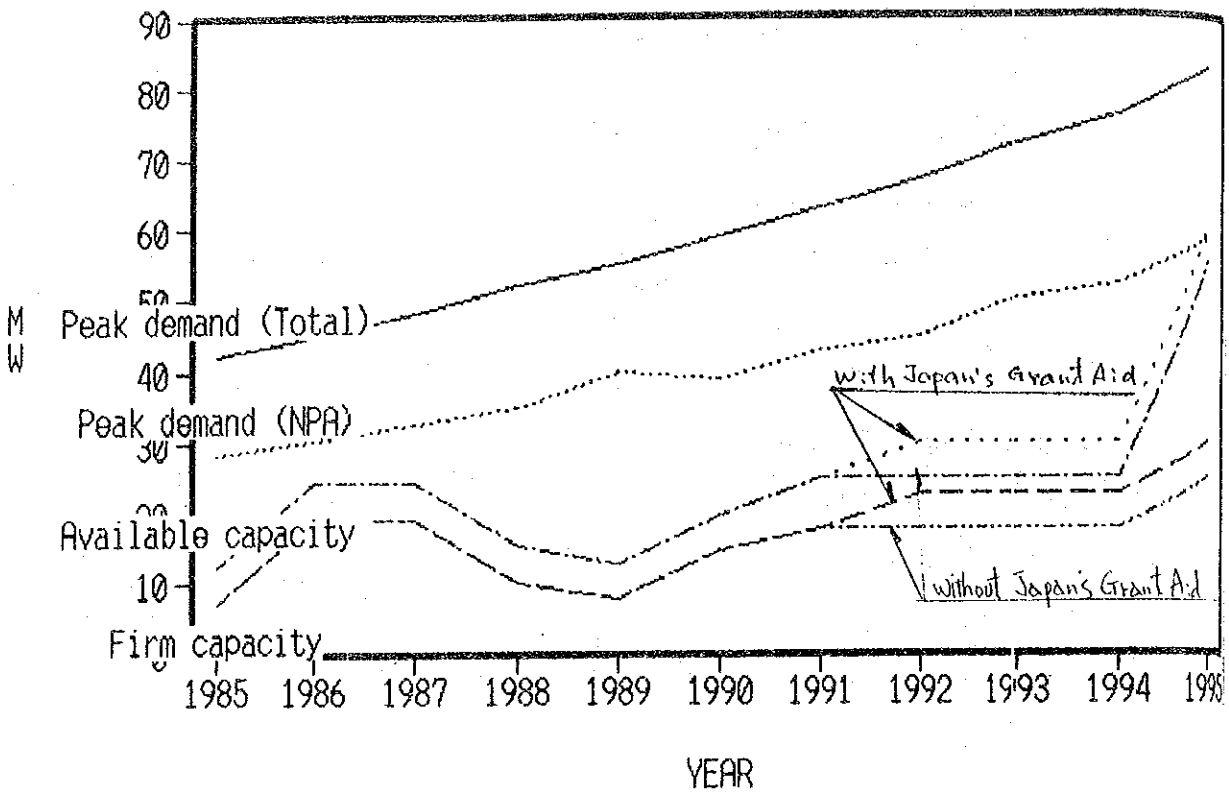
As described in the aforesaid section 2.1, real gap between demand and the present generating capacity is extremely big (about 27.5 MW).

In order to improve this situation, NPA has made a request to the Japanese Government to provide urgently one 5 MW DEG set in Kingtom power station by Grant Aid from the view of the medium term of the power supply system in Freetown and Greater Freetown area.

Figure 1 shows the power balance of western area in the medium term in case the Project is extended by Grant Aid.

Data for the power balance in Greater Freetown are given in the Annex-1 "Power balance of western Area".

Figure 1 Power Balance of western area



3. Present situation of Kingtom Power Station

3.1 General

Kingtom power station is located near the seaside of Kingtom in Freetown.

The power house accommodates 3 sets of MAN DEG (out of operation) and 2 sets of SULZER DEG (under operation with poor available capacity). Total available capacity of SULZER DEG sets is 9.6 MW (as of December 1989), while total installed capacity of SULZER DEG sets are 18.4 MW.

In the power house, some common facilities, such as auxiliary boiler, 11KV switchgear, remote control panels, etc., are installed.

4 sets of outdoor type KHD DEG are installed in narrow space between the power house and workshop. They are under rehabilitation by the KHD engineers financed by the Government of Sierra Leone.

2 sets of heavy fuel oil (HFO) tank, 1 set of diesel oil tank and 2 sets of water tank for fire protection system are placed in the same

area of the eastern part of the site (tank yard). They are utilized for the entire DEG sets as common facilities.

Desk type control panels for all the DEG sets are installed in the 1st floor of the power house. Self-standing type of switchgear control panels are placed in front of the DEG control panels.

Although the DC battery system is placed in the ground floor, most of the battery cells are out of order. When black out occurs in the station, all the control panels cease to work because of lack of DC power source.

In the control room, it is observed that rain water is leaking in the roof.

In the west side of the power station, a workshop for training and a class room are situated. Open space, approx. 400m^2, is found next to the workshop.

All the existing DEG sets including common facilities are planned to be rehabilitated by NPA in the medium term.

3.2 Planned construction area for the new DEG

As a result of the field survey, it is recommended that the open space surrounded by the power house, the workshop for training, the store for SULZER DEG spares and KHD DEG sets shall be used for the new DEG.

In consideration of the required space for the new DEG as shown in the attached drawing No.1 "Plot Plan", the existing store for SULZER DEG spares and the old store shall be relocated by NPA.

The area between the workshop and the clinic may be recommended as a new space of the store for SULZER DEG spares.

3.3 Mechanical system

The existing common mechanical systems which will be related with the Project are as follows:

(1) HFO tanks (407,000 gallons x 2 sets)
(2) Diesel oil tank (11,000 gallons x 1 set),
(3) Water supply line for cooling system and exhaust gas boiler
(4) Drainage channel
(5) Steam line

3.4 Electrical system

The existing common electrical systems which will be related with the Project are as follows:

(1) 11KV switchgears
(2) Control panels
(3) Earthing system

4. Conceptual plan for the Project

4.1 General

This section describes the basic concept of design for the installation of the new DEG set which will be supplied under the Project if Grant Aid is extended.

As a result of the field survey on the present site conditions such as site location, power house, fuel oil system, water supply system, switchgear, common electric supply system, etc., as well as the future extension and rehabilitation plan of NPA, the following items shall be taken into consideration of the design for the Project in principle:

(1) One (1) DEG with five (5) MW output capacity shall be installed in order to urgently improve the present electricity power shortage.

(2) Outdoor type with enclosure shall be applied for the new DEG.

(3) Heavy fuel oil shall be used as main fuel.

(4) Medium speed type shall be applied for the engine.

(5) Generated power shall be fed through the existing 11KV switchgear.

(6) The design for the auxiliary system of the new DEG shall be considered that modifications of the existing common utilities and facilities such as fuel oil system, cooling water system, steam supply system, compressed air system, earthing system, etc., will be minimized as much as possible.

(7) New equipment will not be installed in the area which has been identified for the rehabilitation and/or extension plan of NPA.

(8) Japanese codes and standards shall be applied.

4.2 Design conditions

Considering the site location and surrounding circumstances, the following design conditions shall be applied for the Project:

(1) Ambient temperature	: max. 35^{O}C
(2) Inner temperature of enclosure of the new DEG	: max. 45^{O}C
(3) Relative humidity	: max. 98%
(4) Mean annual rainfall	: approx. 3,500mm From July to September, approx. 800 mm per month.

	In June and October, approx. 300 mm per month.
(5) Wind velocity	: max. 120 km/hour
(6) Seismic factor	: not considered
(7) Salt air	: Salt conditions shall be considered.
(8) Dust	: Dust conditions shall be considered.
(9) Soil bearing capacity	: more than 10 kg/cm^2(according to GTZ report)

4.3 Outline of main equipment

Outline of the main equipment for the Project are as follows:

(1) Diesel Engine

- Operation duty : Continuous (base load)
- Capacity : 5,000 KW (approx. 7,090 PS)
- Revolution speed: not more than 750 rpm
- Stroke : 4 stroke
- Engine type : turbo charged, water cooled, inter cooled, multi cylinder V type
- Fuel : Diesel oil for start-up
  Heavy oil for main fuel

(2) Generator

- Operation duty : Continuous
- Capacity : 6,250 KVA
- Frequency : 50 Hz
- Phase : 3 phase
- Rated voltage : 11 KV
- Revolution speed: same as engine
- Power factor : 0.8 (lagging)
- Connection : Y connection, neutral shall be earthed by using neutral earthing resistor.
- Excitation : Brushless thyristor type

(3) Other mechanical equipment

- Fuel supply system including heavy oil purifier unit, fuel oil circulating pump, etc.
- Lubrication oil system including lubrication oil purifier, lubrication oil cooler, etc.
- Cooling water system including cooling water radiator, jacket cooling water pump, etc.
- Compressed air system including air compressor and air receiver.
- Intake air filter and silencer
- Exhaust gas silencer
- Exhaust gas boiler
- Elastic fastening equipment
- Enclosure for the new DEG

(4) Other electrical equipment

- Generator control panel
- Auxiliary transformer
- 11 KV switchgear
- Synchronizing panel

4.4 Equipment layout

As described in the aforesaid section 3.2, the new DEG set will be installed in the open space next to the workshop for training.

In order to minimize the effect of the noise which would be created by the new DEG set on the training center and class room, new engine shall be placed away from the said buildings as much as possible, i.e., south side of the project area.

On the other hand, for simple connection of the power cables from the new DEG to the new 11 KV switchgear, the new generator shall be placed by the side of the existing 11 KV switchgear, i.e., north side of the project area.

For easy maintenance work of the new DEG set, rails for removing the enclosure of the new DEG will be installed on the ground extending to both the generator and the engine sides.

In addition, maintenance space for the existing KHD DEG sets is required in a part of the space next to the workshop for training.

Considering the above, the new equipment will be installed as the attached drawings No.1 "Plot Plan" and No.2 "General Arrangement".

4.5 Mechanical design

4.5.1 Fuel oil system

The existing HFO and diesel oil tanks shall be utilized for the new DEG.

Therefore, both new HFO and diesel oil lines shall be connected to the existing lines.

The connection points for both HFO and diesel oil lines shall be at the existing tank yard. For the connections, new tee branch pipes shall be installed in the existing lines.

Please refer to the attached drawing No.3 "Fuel oil system".

The following fuel oil consumption for the new DEG will be required:

(1) HFO : approx. 24.5 m^3 per day (approx. 210 g/kWh)

(2) Diesel oil : approx. 1 - 2 m^3 (for each starting & stopping)

4.5.2 Lubricating oil system

There is no existing common lubricating oil supply system including luburicating oil tank.

Therefore, the new DEG set will have own individual lubricating oil supply system.

As shown in the attachment drawing No.4 "Lubricating oil system", supplementary lubricating oil will be supplied to the the new DEG set.

4.5.3 Cooling water system

According to the GTZ report, the existing common cooling water system for MAN and SULZER DEG sets using the sea water shall be rehabilitated.

Therefore an independent cooling system such as radiator cooling system and cooling tower system shall be recommended to be installed for the new DEG set.

From the point of view of water consumption, comparing the above two systems, the radiator cooling system have much economical benefit regarding the operation cost than the cooling tower system. In case the radiator cooling water system is applied, water consumption will be estimated as 0.6 m^3/hour. In case of the cooling tower system, the water consumption may be ten (10) times of the above.

Maximum outlet water temperature of the radiator will be designed as 43^{o}C at ambient temperature 35^{o}C, i.e., 35^{o}C plus 8^{o}C.

In addition, according to NPA staff at the power station, NPA staff are familiar with the radiator cooling system which is applied to KHD DEG sets for their cooling system.

Considering the above, the radiator cooling system will be recommended for the new DEG set.

The new water piping will be connected with the existing water line of the fire fighting system at the tank yard.

Please refer to the attached drawing No. 5 "Cooling water system".

4.5.4 Steam system

To increase viscosity of HFO, the steam system will be provided for heating up the HFO system such as heavy oil tank, HFO piping line, and lubricating purifier unit.

The existing common auxiliary boiler for MAN and SULZER DEG sets under operation with poor supply capacity was installed in 1964.

According to GTZ report, Volume 5 (Common systems), major parts of the existing auxiliary boiler are planned to be rehabilitated or replaced.

In the rehabilitation plan, there is no consideration to increase steam capacity for the new DEG set.

As for KHD DEG sets, electrical oil heating system is applied instead of steam heating system.

In the light of the present power supply shortage in Greater Freetown, consideration shall be made to minimize power consumption for auxiliary system in the power station.

For the above reasons, it is recommended that an exhaust gas boiler will be installed for the new DEG set.

By adopting this exhaust gas boiler system, station running cost on fuel will be minimized.

Surplus steam generated by the new exhaust gas boiler will be supplied to the existing steam header which is connected to the existing HFO tanks.

For the water supply to this system, the same water line as the cooling system above will be utilized.

Please refer to the attached drawing No. 6 "Steam system".

4.5.5 Compressed air supply

Although there is a common compressed air system which was installed in 1978 for the existing DEG sets, the system is not operated satisfactorily at present.

Considering the equipment time life, it would be estimated that the existing system be replaced.

Therefore, it is recommended that the new DEG set will have its own compressed air supply system.

Please refer to the attached drawing NO. 7 "Compressed air system".

4.5.6 Air intake and exhaust system

Suitable air intake and exhaust system will be provided for the new DEG set with the necessary filter and silencer.

4.5.7 Sludge treatment system

There is no sludge treatment facility in the power station. The existing drainage channels are utilized for both rain water and sludge oil discharge.

According to the GTZ report, an oil separator is recommended to be constructed near the existing HFO tanks, and all drainage channels will be connected to this separator.

Forecasting the pollution problems in the future, the above separator should be constructed as an indispensable facility for the power station and that is expected to be constructed by NPA as soon as possible.

For the new DEG set, it is recommended that the new sludge separator tank and oily water separator will be installed near the new DEG set and overflowed water except sludge and oil will be drained into the existing drainage channel near the new DEG set.

The sludge and oil accumulated in the sludge separator tank shall be discharged and proper measures will be taken to avoid environmental pollution by NPA.

Estimated waste water, oil and sludge will be as follows:

- Total : 0.7 m^3 per day (water : 70%, oil : 15%, sludge : 15%)

Please refer to the attached drawing No. 8 "Sludge treatment system".

4.5.8 Piping route

The following pipe lines will be required for the new DEG set:

- HFO piping
- Diesel oil piping
- Steam supply piping
- Water supply piping

All the piping will be installed beside the existing piping route.

In the piping route which crosses the existing road, new piping will be installed in the concrete pipe trench.

Please refer to the attached drawing No. 1 "Plot plan".

4.6 Electrical design

4.6.1 General

The electrical system of the new generator will be the same as the existing generators, i.e., 11 KV, 50 Hz, 3 phase, 3 wire.

Therefore, the generated power of the new generator shall be fed through the existing 11KV switchgear (BUS "B").

Oneline diagram is given in the attached drawing No. 9.

4.6.2 11 KV switchgear

11 KV switchgear for line connection

One (1) set of new 11 KV switchgear with rating of 11 KV, 50Hz, 3 phase, 1,600A, 350MVA (same as the existing switchgear rating), will be installed in line with the existing switchgear on ground floor of the power house.

In order to make easy connection with the existing switchgear (Brush VSI type), it is recommended that the new switchgear has the same shape as the existing one. The position of bus bar shall be same as the existing one.

11 KV switchgear will be equipped with over current relay and earth fault relay for protection of new power cable.

DC power source for new 11 KV switchgear shall be same as the existing, i.e., DC 220 Volts.

The existing DC power source has been out of order with the battery cells.

Therefore, the control power source (DC 220 Volts) for the new 11 KV switchgear shall be supplied from the new DEG set.

Please refer to the attached drawing No. 10 "Outline of HV switchgear".

Generator switchgear

A generator switchgear with a vacuum type circuit breaker, protection relays, etc., will be installed in the enclosure.

4.6.3 Control system

Local control panel

Start up and shut down of the new DEG set shall principally be controlled at engine side, in order to observe safety conditions of the new DEG operation. Therefore a local generator control panel will be installed in the enclosure.

The local generator control panel will be equipped with necessary instruments, control switches and alarm system.

All the protection relays for the new generator will be installed in the panels located in the enclosure.

Remote control panel

For the purpose of supervising the new DEG operation, a remote control panel will accommodate necessary instrument, alarm indicators and control switches including emergency stop button.

The remote control panel will be installed in line with the existing remote control panel for No.9 DEG set in the existing central control room on 1st floor.

Please refer to the attached drawing No. 11 "Layout of control room".

4.6.4 Exciting equipment

An exciting equipment, static type, will be installed in control panels in the enclosure.

4.6.5 DC system

For the purpose of DC power supply to control and protection equipment, the new DEG set will have own DC power supply system.

The DC system will consist of lead acid battery and battery charger (input voltage : AC 415 volts, output voltage : DC 110 volts).

All the DC system will be installed in the enclosure.

4.6.6 Auxiliary transformer

An outdoor type transformer, 11KV/415-240V, 50Hz, 3 phase, for the new DEG's auxiliary equipment and other facilities such as ventilation fan, lighting, socket outlet, etc., will be installed near the enclosure.

4.6.7 Earthing system

There are two methods for generator neutral earthing system, i.e., 1) Connection with the existing earthing resistor and 2) Installation of new earthing resistor.

In the GTZ report, it is described that the existing earthing system shall be rehabilitated.

In addition, according to the said report Volume 5, section 5.2.1.3, it is planned to operate the existing 11 KV BUS A and BUS B separately.

Considering the above, it is recommended that an outdoor type new earthing resistor be installed for the new DEG set (Plan No.2 above).

The existing earthing electrode will be utilized for the new DEG set.

4.6.8 Cable route

Cable route for the Project is given in the attached drawing No. 1 "Plot plan".

In the power house

The existing cable pit will be utilized for new cables. Necessary cable racks will be installed in the pit.

For penetration on the existing wall, some modification works of the existing pipe trench and drainage channel will be required.

Please refer to the attached drawing No. 12 "Modification plan of cable pit".

Outdoor

For cable protection, all the cables will be installed in conduit pipes.

4.7 Spare parts supply

Spare parts for stock will be supplied.

The items and quantities to be supplied will be determined in the final report based on the study results of the field survey.

All the items shall be subject to the confirmation with the Japanese authorities concerned.

4.8 On-the-job training (OJT) program

OJT for operation and maintenance (O&M) will be carried out by the Japanese contractor of the Project during the implementation period.

The program will contain the following items:

(1) O&M plan of the new DEG including O&M schedule control, spare parts control and O&M record and document control.

(2) O&M procedure of the new DEG set.

(3) O&M execution know-how of the new DEG set.

5. Undertakings by the Government of Sierra Leone

The undertakings by the Government of Sierra Leone are described in the Minutes of Discussions (M/D) concluded on December 5, 1989.

In addition to the above, necessary measures for the following additional notes and/or items shall also be taken by the Government of Sierra Leone if Grant Aid is extended.
Items marked with "*" show additional items to M/D.

(1) To provide cleared and leveled land for the new DEG and its auxiliaries to be installed.

This item shall include relocating of the existing SULZER store and old store.

(2) To provide the land for temporary site office, warehouse and stock yard during the implementation period.

The space, min. 600 m^2, will be required.

(3) To provide proper arrangements for the construction, such as water supply, electricity, drainage, etc., if necessary.

This item shall include the supply of the fuel oil for test run and commissioning of the new DEG set.

*(4) To secure the stoppage of supply of fuel oil for the connection works of new fuel pipings, when necessary.

*(5) To obtain necessary permission required for implementation of the Project.

*(6) To witness and confirm by authorities concerned when the test run and commissioning for the Project are carried out.

*(7) To arrange necessary traffic control when equipment and facilities are transported from port to the site.

*(8) To relocate temporarily the existing obstruction such as overhead wires and cables on the road from port to the site.

6. Tentative implementation schedule

The Project may be executed in accordance with the attached tentative implementation schedule on condition that Grant Aid is extended to the Project.

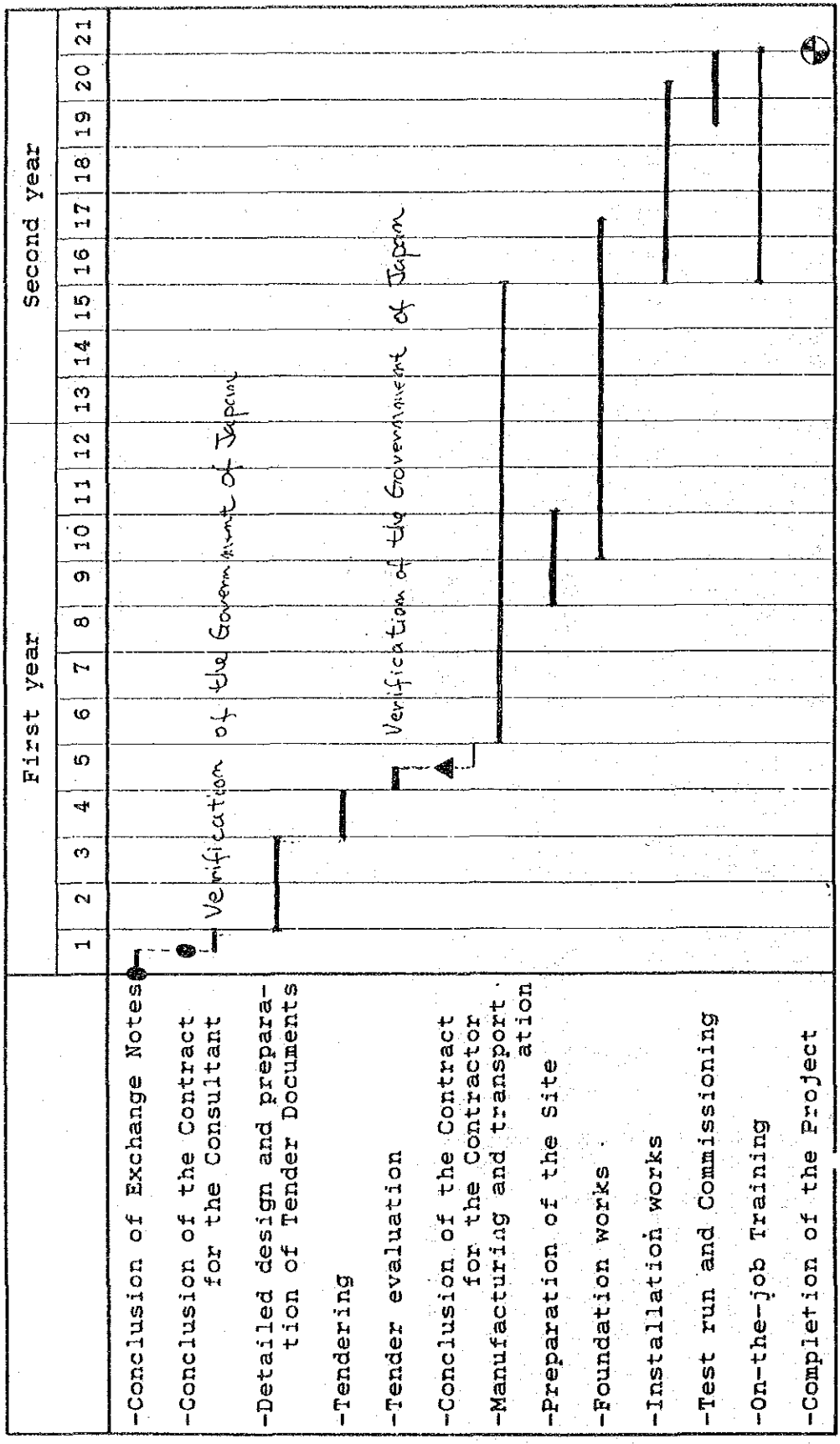
Please refer to the Annex-2 "Tentative implementation schedule".

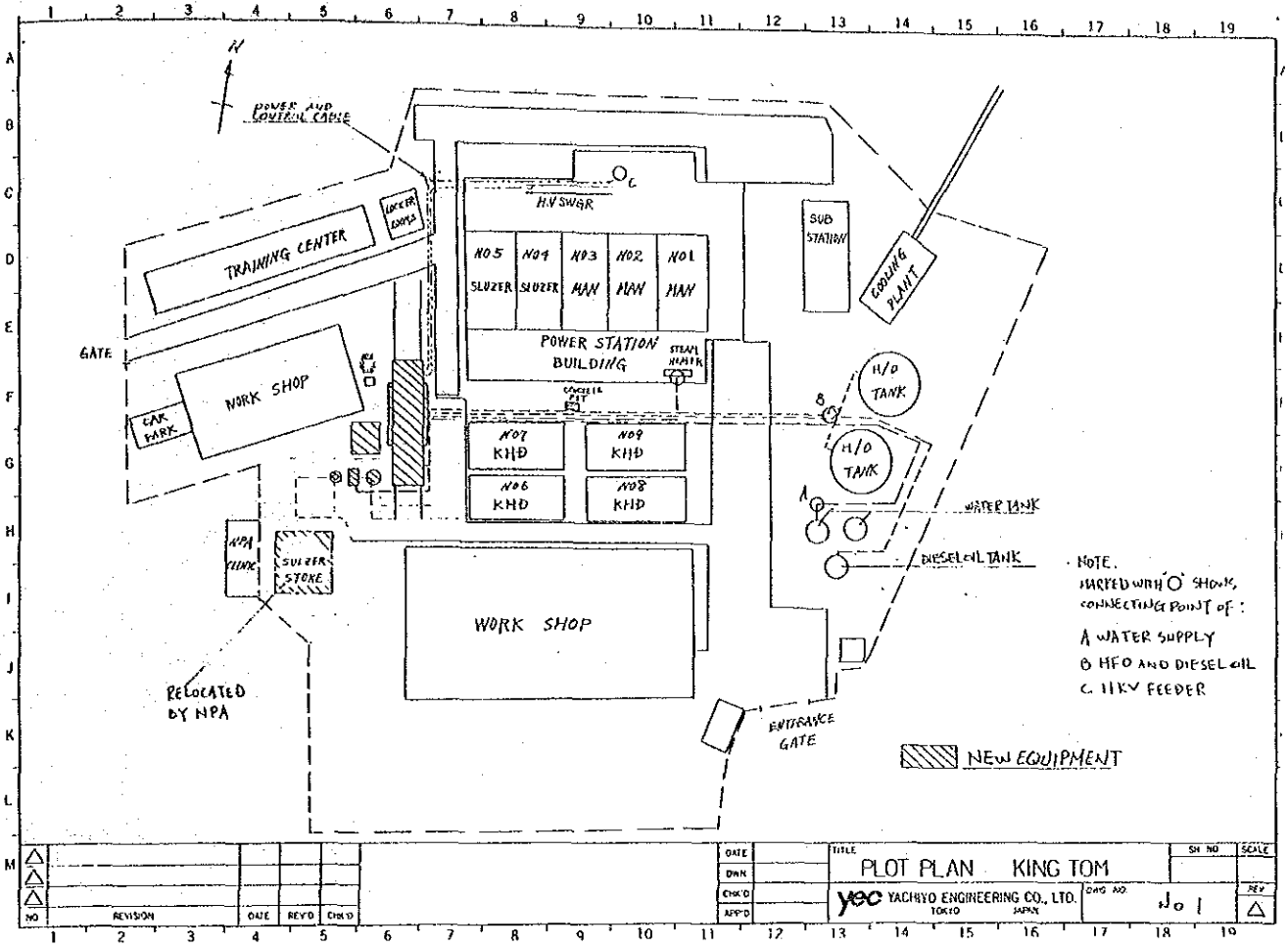
Power Balance in Greater Freetown (UNIT : MW)

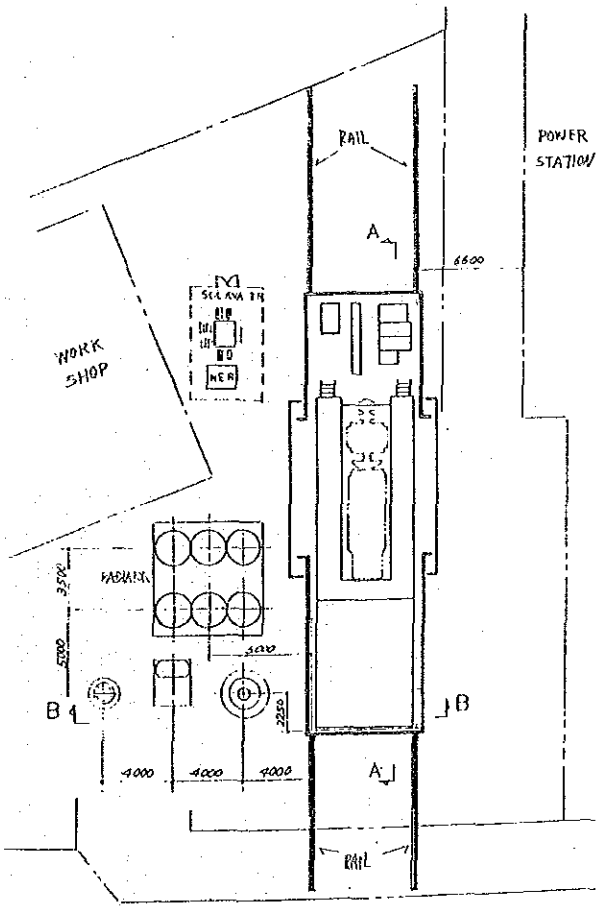
		(PURPOSE)	(PROJECT)	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995
1.	Peak demand													
1.1	Peak demand (NPA)			28.2	30.3	32.6	35.0	40.0	39.0	43.0	45.0	50.0	52.0	58.8
1.2	Peak demand (Private)			14.0	14.7	15.5	17.0	15.0	20.0	20.0	22.0	22.0	24.2	24.2
1.3	Peak demand (Total)			42.2	45.0	48.0	52.0	55.0	59.0	63.0	67.0	72.0	76.2	83.0
2.	Installed capacity													
2.1	King Tom Power Station													
	No.1 DEG (MAN)	BASE	WB-RPLC	6.6	6.6	6.6	6.6	6.6	6.6	6.6	6.6	6.6	6.6	6.6
	No.2 DEG (MAN)	BASE	WB-RPLC	6.6	6.6	6.6	6.6	6.6	6.6	6.6	6.6	6.6	6.6	6.6
	No.3 DEG (MAN)	BASE	WB-RPLC	6.6	6.6	6.6	6.6	6.6	6.6	6.6	6.6	6.6	6.6	6.6
	No.4 DEG (SULZER)	BASE	EC-RHBL,1991	9.2	9.2	9.2	9.2	9.2	9.2	9.2	9.2	9.2	9.2	9.2
	No.5 DEG (SULZER)	BASE	EC-RHBL,1991	9.2	9.2	9.2	9.2	9.2	9.2	9.2	9.2	9.2	9.2	9.2
	No.6 DEG (KHD)	PEAK	EC-RHBL,1990	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
	No.7 DEG (KHD)	PEAK	EC-RHBL,1990	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
	No.8 DEG (KHD)	PEAK	EC-RHBL,1990	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
	No.9 DEG (KHD)	PEAK	EC-RHBL,1990	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
	No.10DEG (JAPANESE)	BASE	JPN-GRT.1992	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.0	5.0	5.0	5.0
	(Total)			50.2	50.2	50.2	50.2	50.2	50.2	50.2	55.2	55.2	55.2	55.2
2.2	Falconbridge Power Station													
	No.1 DEG (ENGLISH ELEC.)	BLK-STRT		1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5
	No.2 DEG (ENGLISH ELEC.)	BLK-STRT		1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5
	No.3 DEG (MIRRLEES)	BLK-STRT		1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
	No.4 DEG (MIRRLEES)	BLK-STRT		1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
	No.5 DEG (MIRRLEES)	BLK-STRT		1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
	(Total)			6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0
2.3	Bumbuna Power Station													
	No.1 Hydro-Elec. Gene.	BASE	LOAN.1995	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	47.0
	(Total)			0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	47.0
2.4	Total Installed Capacity			56.2	56.2	56.2	56.2	56.2	56.2	56.2	61.2	61.2	61.2	108.2
(I. With Japan's Grant Aid)														
3.	Available capacity													
3.1	King Tom Power Station													
	No.1 DEG (MAN)	BASE	WB-RPLC	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	No.2 DEG (MAN)	BASE	WB-RPLC	2.5	2.5	2.5	2.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	No.3 DEG (MAN)	BASE	WB-RPLC	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	No.4 DEG (SULZER)	BASE	EC-RHBL,1991	5.2	5.2	5.2	5.2	5.2	5.2	7.5	7.5	7.5	7.5	7.5
	No.5 DEG (SULZER)	BASE	EC-RHBL,1991	4.5	4.5	4.5	4.5	4.5	4.5	7.5	7.5	7.5	7.5	7.5
	No.6 DEG (KHD)	PEAK	EC-RHBL,1990	0.0	3.0	3.0	1.5	1.5	2.5	2.5	2.5	2.5	2.5	2.5
	No.7 DEG (KHD)	PEAK	EC-RHBL,1990	0.0	3.0	3.0	0.0	0.0	2.5	2.5	2.5	2.5	2.5	2.5
	No.8 DEG (KHD)	PEAK	EC-RHBL,1990	0.0	3.0	3.0	1.5	1.5	2.5	2.5	2.5	2.5	2.5	2.5
	No.9 DEG (KHD)	PEAK	EC-RHBL,1990	0.0	3.0	3.0	0.0	0.0	2.5	2.5	2.5	2.5	2.5	2.5
	No.10DEG (JAPANESE)	BASE	JPN-GRT.1992	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.0	5.0	5.0	5.0
	(Total)			12.2	24.2	24.2	15.2	12.7	19.7	25.0	30.0	30.0	30.0	30.0
3.2	Falconbridge Power Station													
	No.1 DEG (ENGLISH ELEC.)	BLK-STRT		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	No.2 DEG (ENGLISH ELEC.)	BLK-STRT		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	No.3 DEG (MIRRLEES)	BLK-STRT		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	No.4 DEG (MIRRLEES)	BLK-STRT		0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8
	No.5 DEG (MIRRLEES)	BLK-STRT		0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8
	(Total)			1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6
3.3	Bumbuna Power Station													
	No.1 Hydro-Elec. Gene.	BASE	LOAN.1995	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	30.5
	(Total)			0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	30.5

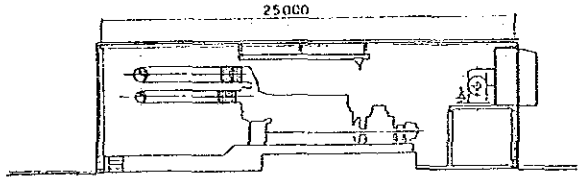
				1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995
3.4	Total Available Capacity(incl Black-start)			13.8	25.8	25.8	16.8	14.3	21.3	26.6	31.6	31.6	31.6	62.1
3.5	Total Avail. Capa(without Black-start)			12.2	24.2	24.2	15.2	12.7	19.7	25	30	30	30	60.5
4.	Firm capacity(with Japan's Grant Aid)			7.0	19.0	19.0	10.0	7.5	14.5	17.5	22.5	22.5	22.5	30.0
5.	Balance													
5.1	Firm capa - NPA peak demand			-21.2	-11.3	-13.6	-25.0	-32.5	-24.5	-25.5	-22.5	-27.5	-29.5	-28.8
(II. Without Japan's Grant Aid)														
6.	Available capacity													
6.1	King Tom Power Station													
	No.1 DEG (MAN)	BASE	WB-RPLC	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	No.2 DEG (MAN)	BASE	WB-RPLC	2.5	2.5	2.5	2.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	No.3 DEG (MAN)	BASE	WB-RPLC	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	No.4 DEG (SULZER)	BASE	EC-RHBL,1991	5.2	5.2	5.2	5.2	5.2	5.2	7.5	7.5	7.5	7.5	7.5
	No.5 DEG (SULZER)	BASE	EC-RHBL,1991	4.5	4.5	4.5	4.5	4.5	4.5	7.5	7.5	7.5	7.5	7.5
	No.6 DEG (KHD)	PEAK	EC-RHBL,1990	0.0	3.0	3.0	1.5	1.5	2.5	2.5	2.5	2.5	2.5	2.5
	No.7 DEG (KHD)	PEAK	EC-RHBL,1990	0.0	3.0	3.0	0.0	0.0	2.5	2.5	2.5	2.5	2.5	2.5
	No.8 DEG (KHD)	PEAK	EC-RHBL,1990	0.0	3.0	3.0	1.5	1.5	2.5	2.5	2.5	2.5	2.5	2.5
	No.9 DEG (KHD)	PEAK	EC-RHBL,1990	0.0	3.0	3.0	0.0	0.0	2.5	2.5	2.5	2.5	2.5	2.5
	No.10DEG (JAPANESE)	BASE	JPN-GRT.1992	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	(Total)			12.2	24.2	24.2	15.2	12.7	19.7	25.0	25.0	25.0	25.0	25.0
6.2	Falconbridge Power Station													
	No.1 DEG (ENGLISH ELEC.)	BLK-STRT		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	No.2 DEG (ENGLISH ELEC.)	BLK-STRT		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	No.3 DEG (MIRRLEES)	BLK-STRT		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	No.4 DEG (MIRRLEES)	BLK-STRT		0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8
	No.5 DEG (MIRRLEES)	BLK-STRT		0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8
	(Total)			1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6
6.3	Bumbuna Power Station													
	No.1 Hydro-Elec. Gene.	BASE	LOAN.1995	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	30.5
	(Total)			0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	30.5
6.4	Total Available Capacity(incl Black-start)			13.8	25.8	25.8	16.8	14.3	21.3	26.6	26.6	26.6	26.6	57.1
6.5	Total Avail. Capa(without Black-start)			12.2	24.2	24.2	15.2	12.7	19.7	25	25	25	25	55.5
7.	Firm capacity(without Japan's Grant Aid)			7.0	19.0	19.0	10.0	7.5	14.5	17.5	17.5	17.5	17.5	25.0
8.	Balance													
8.1	Firm capa - NPA peak demand			-21.2	-11.3	-13.6	-25.0	-32.5	-24.5	-25.5	-27.5	-32.5	-34.5	-33.8

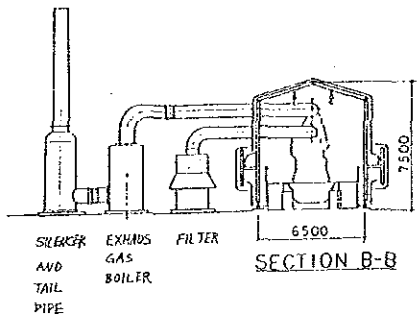
Tentative Implementation Schedule







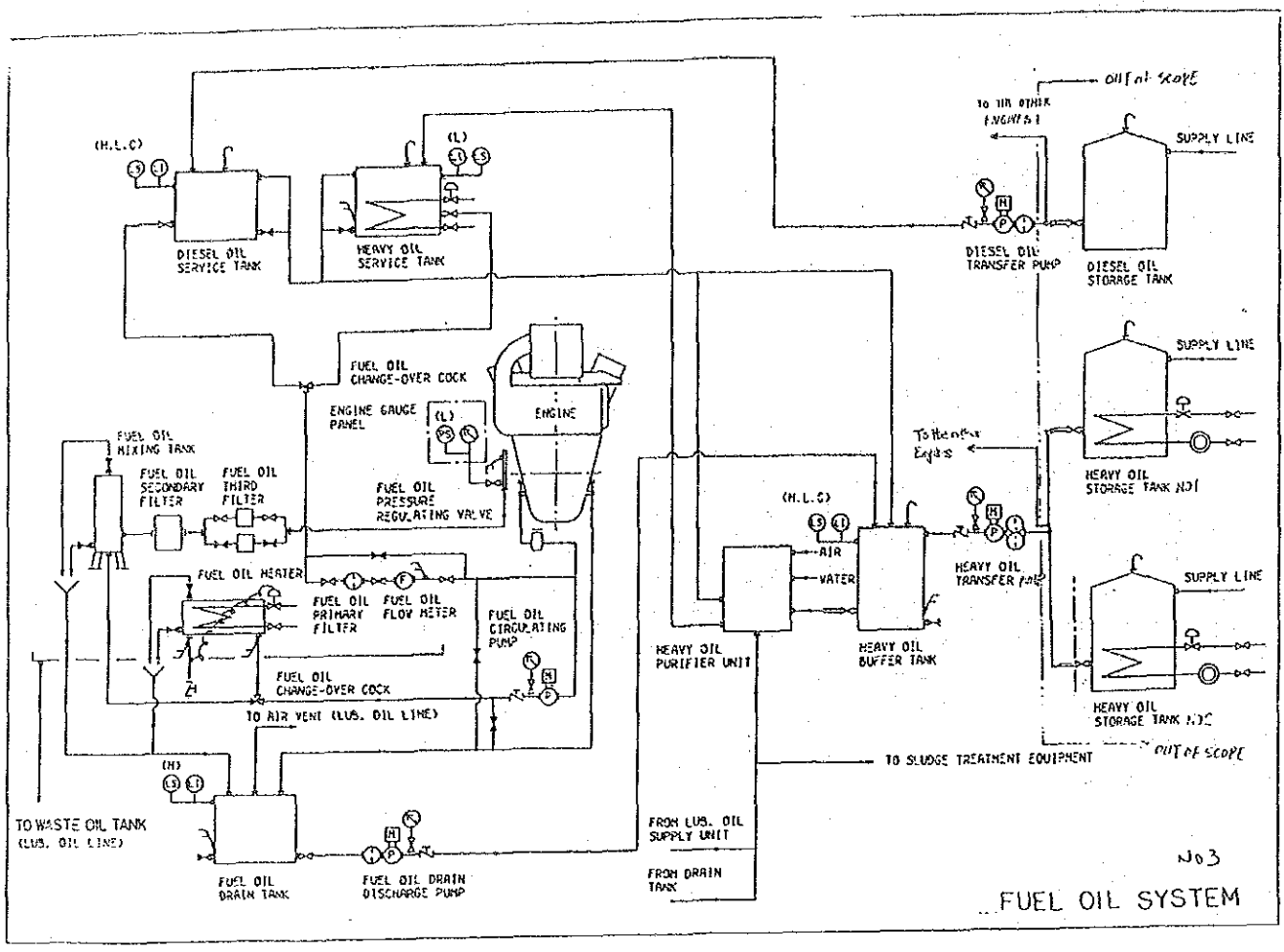


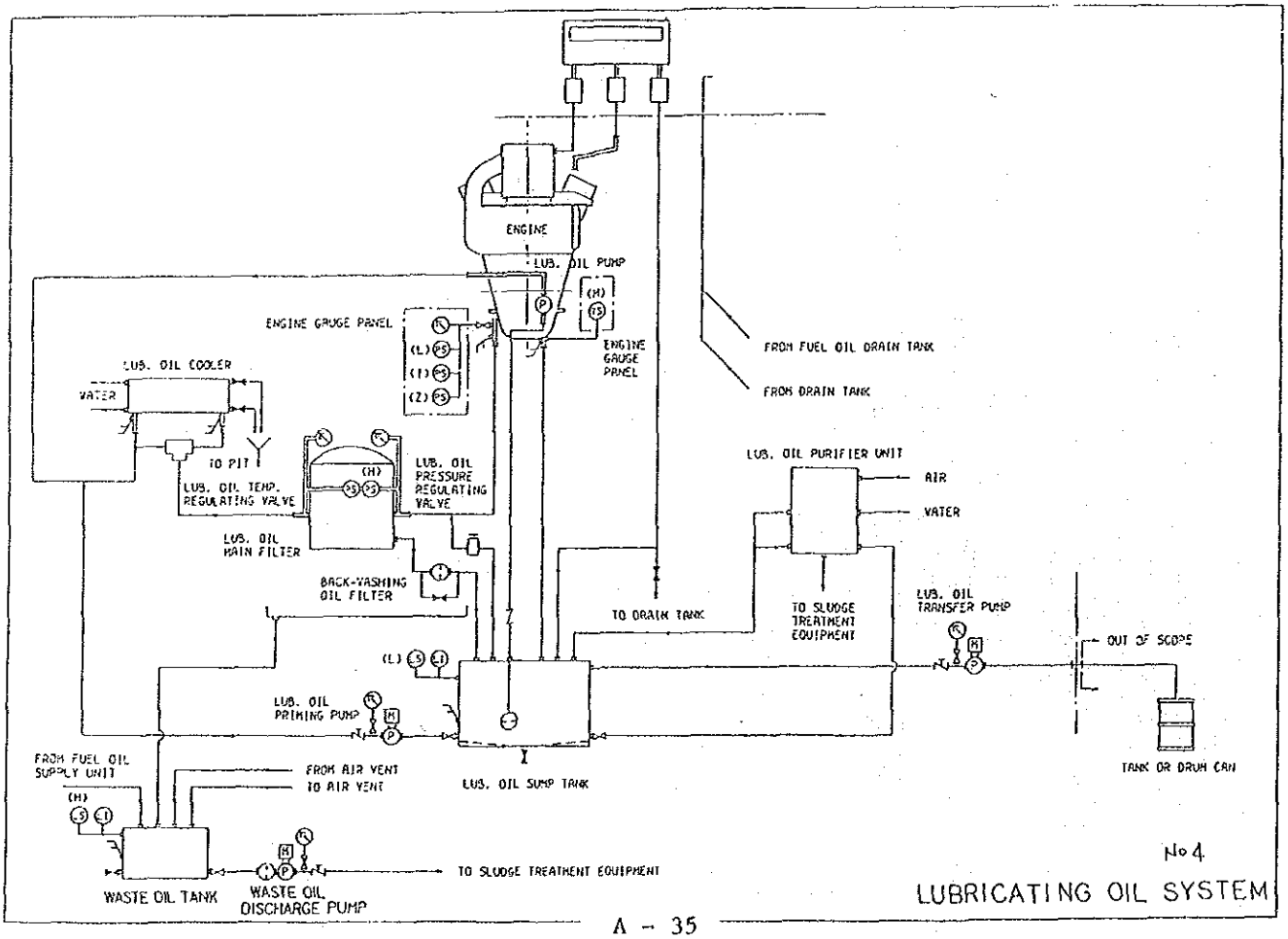


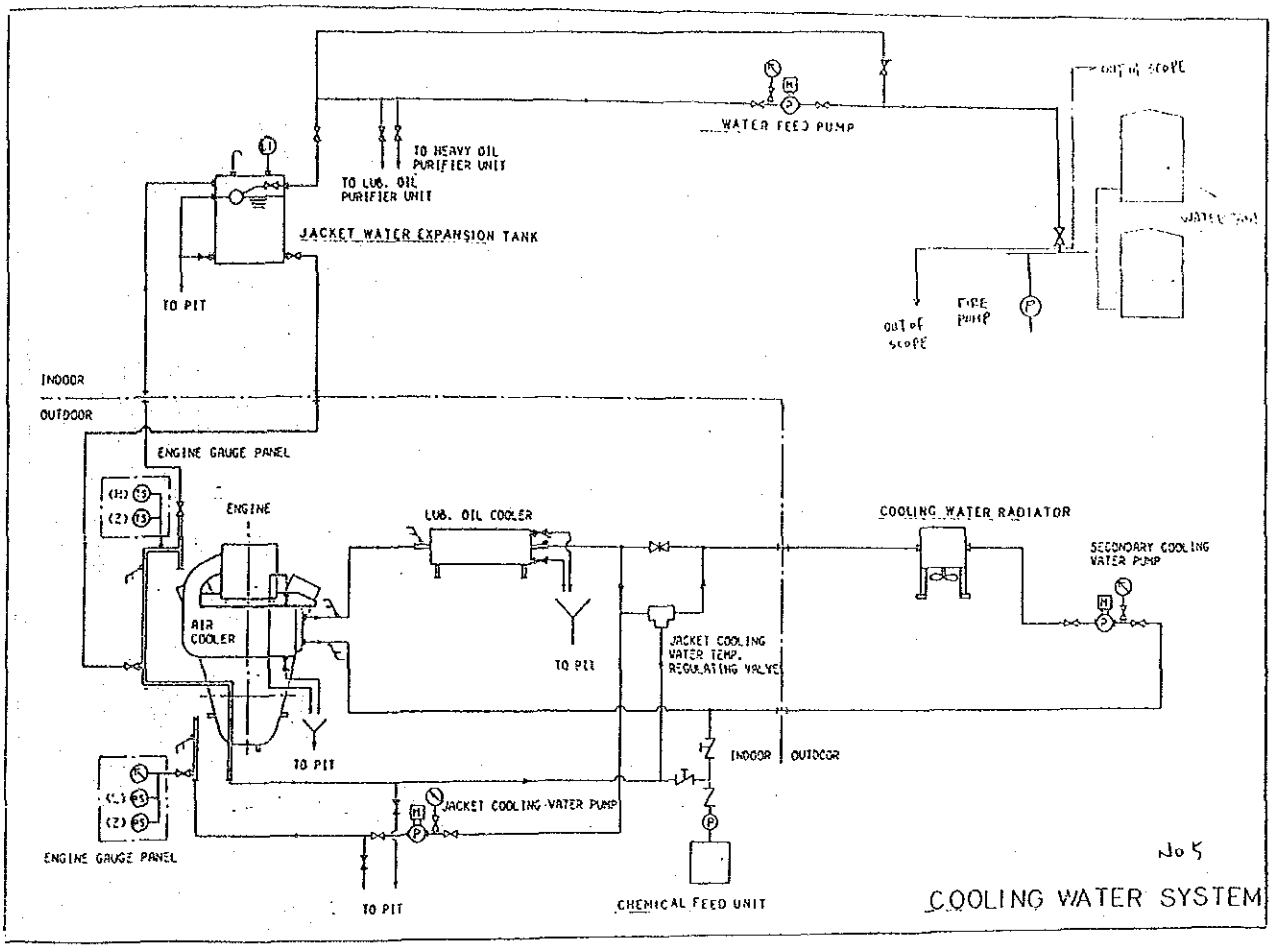
REMARKS · ABOVE DIMENSIONS ARE ONLY REFERENCE.

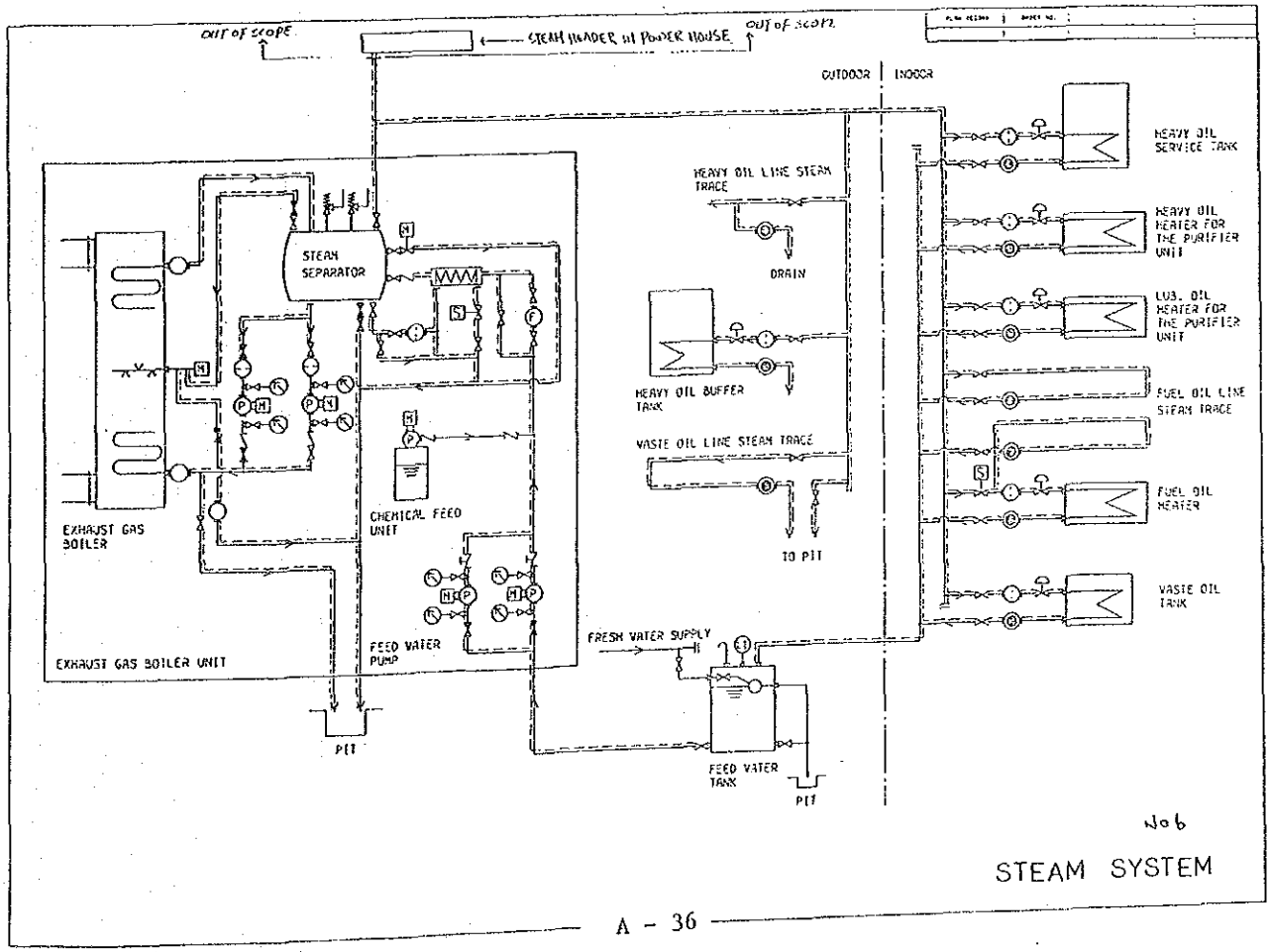
No 2.

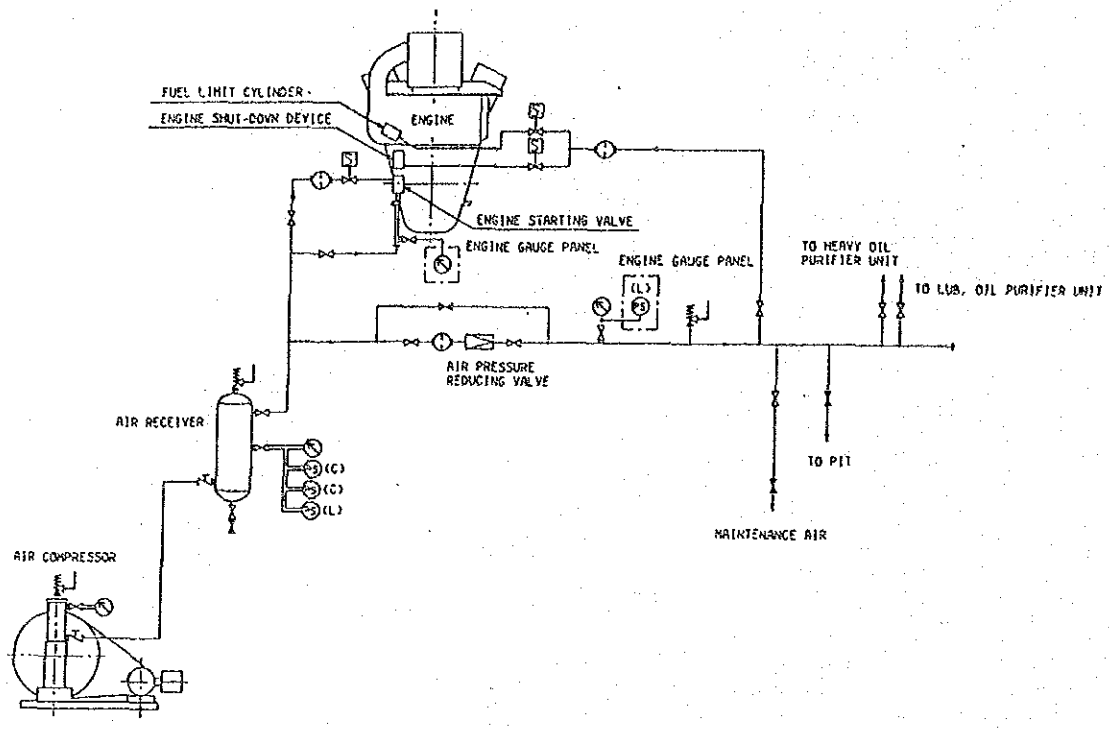
GENERAL ARRANGEMENT


OUT of SCOPE
TO THE OTHER ENGINES
SUPPLY LINE
DIESEL OIL TRANSFER PUMP
DIESEL OIL STORAGE TANK
(H.L.C)
(L)
DIESEL OIL SERVICE TANK
HEAVY OIL SERVICE TANK
FUEL OIL CHANGE-OVER COCK
ENGINE GAUGE PANEL
ENGINE
FUEL OIL MIXING TANK
FUEL OIL SECONDARY FILTER
FUEL OIL THIRD FILTER
FUEL OIL PRESSURE REGULATING VALVE
FUEL OIL HEATER
FUEL OIL PRIMARY FILTER
FUEL OIL FLOW METER
FUEL OIL CIRCULATING PUMP
FUEL OIL CHANGE-OVER COCK
TO AIR VENT (LUB. OIL LINE)
TO WASTE OIL TANK (LUB. OIL LINE)
FUEL OIL DRAIN TANK
FUEL OIL DRAIN DISCHARGE PUMP
HEAVY OIL PURIFIER UNIT
AIR
WATER
HEAVY OIL BUFFER TANK
HEAVY OIL TRANSFER PUMP
HEAVY OIL STORAGE TANK NO1
HEAVY OIL STORAGE TANK NO2
TO SLUDGE TREATMENT EQUIPMENT
FROM LUB. OIL SUPPLY UNIT
FROM DRAIN TANK
No3
FUEL OIL SYSTEM


ENGINE
LUB. OIL PUMP
ENGINE GAUGE PANEL
ENGINE GAUGE PANEL
FROM FUEL OIL DRAIN TANK
FROM DRAIN TANK
LUB. OIL COOLER
WATER
TO PIT
LUB. OIL TEMP. REGULATING VALVE
LUB. OIL PRESSURE REGULATING VALVE
LUB. OIL MAIN FILTER
BACK-WASHING OIL FILTER
LUB. OIL PURIFIER UNIT
AIR
WATER
TO DRAIN TANK
TO SLUDGE TREATMENT EQUIPMENT
LUB. OIL TRANSFER PUMP
OUT OF SCOPE
TANK OR DRUM CAN
LUB. OIL PRIMING PUMP
LUB. OIL SUMP TANK
FROM FUEL OIL SUPPLY UNIT
FROM AIR VENT
TO AIR VENT
WASTE OIL TANK
WASTE OIL DISCHARGE PUMP
TO SLUDGE TREATMENT EQUIPMENT
No4
LUBRICATING OIL SYSTEM

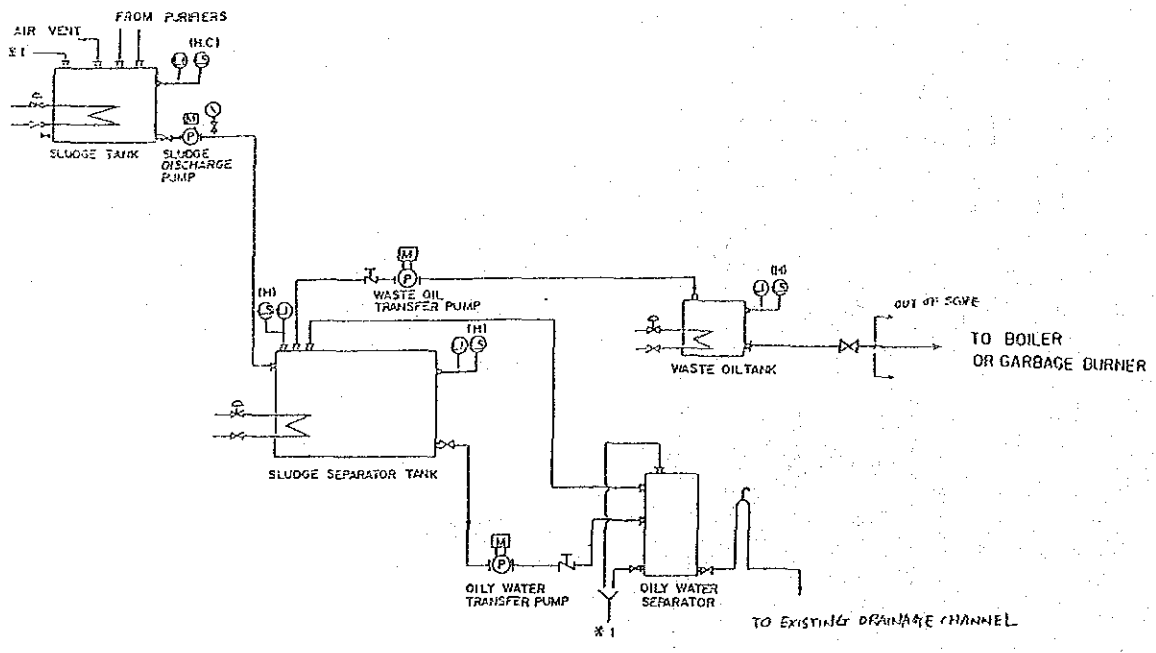

WATER FEED PUMP
TO HEAVY OIL PURIFIER UNIT
TO LUB. OIL PURIFIER UNIT
JACKET WATER EXPANSION TANK
TO PIT
out of scope
FIRE PUMP
INDOOR
OUTDOOR
ENGINE GAUGE PANEL
ENGINE
LUB. OIL COOLER
COOLING WATER RADIATOR
SECONDARY COOLING WATER PUMP
AIR COOLER
TO PIT
JACKET COOLING WATER TEMP. REGULATING VALVE
INDOOR OUTDOOR
JACKET COOLING WATER PUMP
ENGINE GAUGE PANEL
TO PIT
CHEMICAL FEED UNIT
No 5
COOLING WATER SYSTEM


out of scope
STEAM HEADER in POWER HOUSE
out of scope
OUTDOOR
INDOOR
HEAVY OIL SERVICE TANK
HEAVY OIL LINE STEAM TRACE
HEAVY OIL HEATER FOR THE PURIFIER UNIT
DRAIN
LUB. OIL HEATER FOR THE PURIFIER UNIT
STEAM SEPARATOR
HEAVY OIL BUFFER TANK
FUEL OIL LINE STEAM TRACE
WASTE OIL LINE STEAM TRACE
FUEL OIL HEATER
TO PIT
EXHAUST GAS BOILER
CHEMICAL FEED UNIT
WASTE OIL TANK
FRESH WATER SUPPLY
EXHAUST GAS BOILER UNIT
FEED WATER PUMP
PIT
FEED WATER TANK
PIT
No 6
STEAM SYSTEM



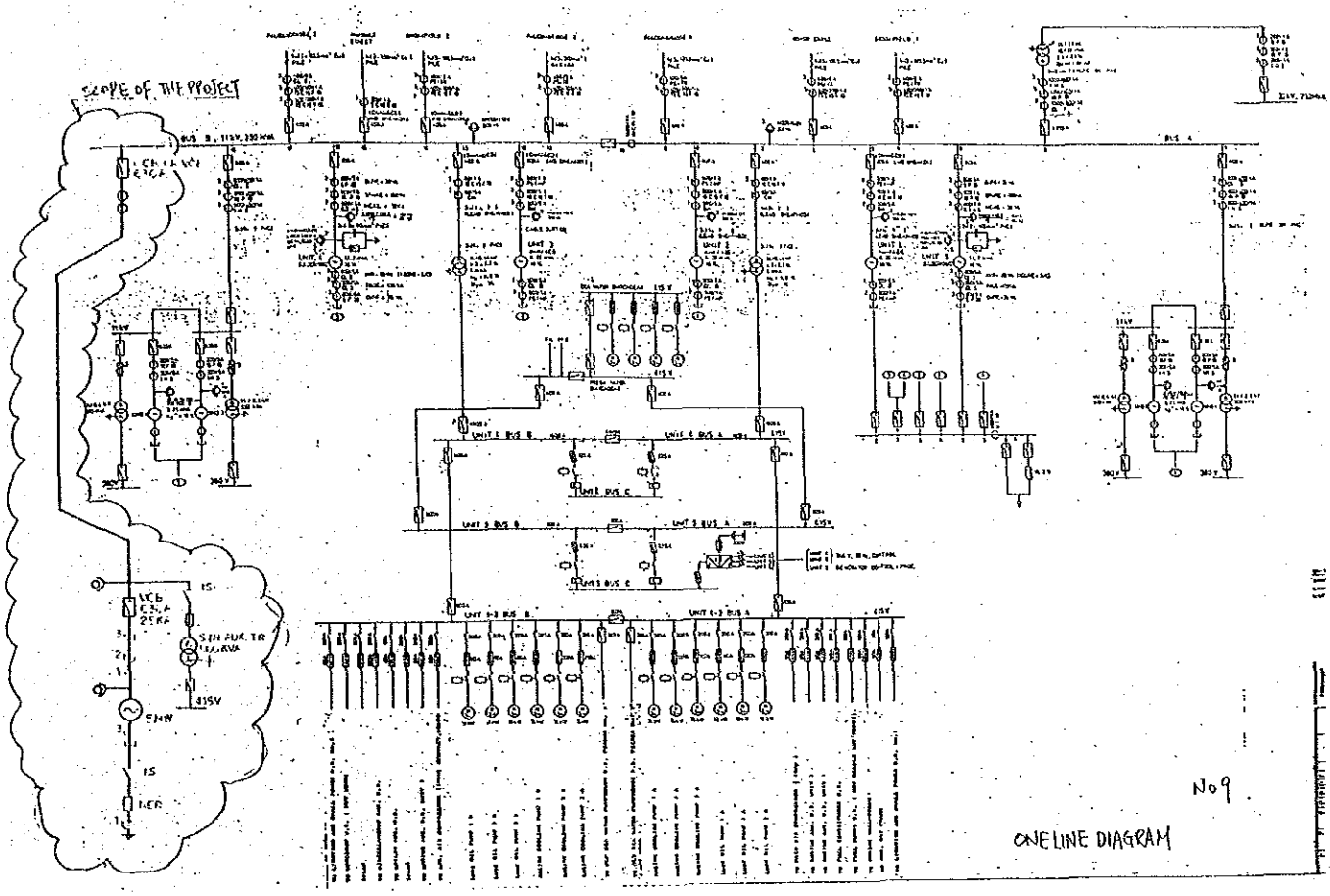
No 7

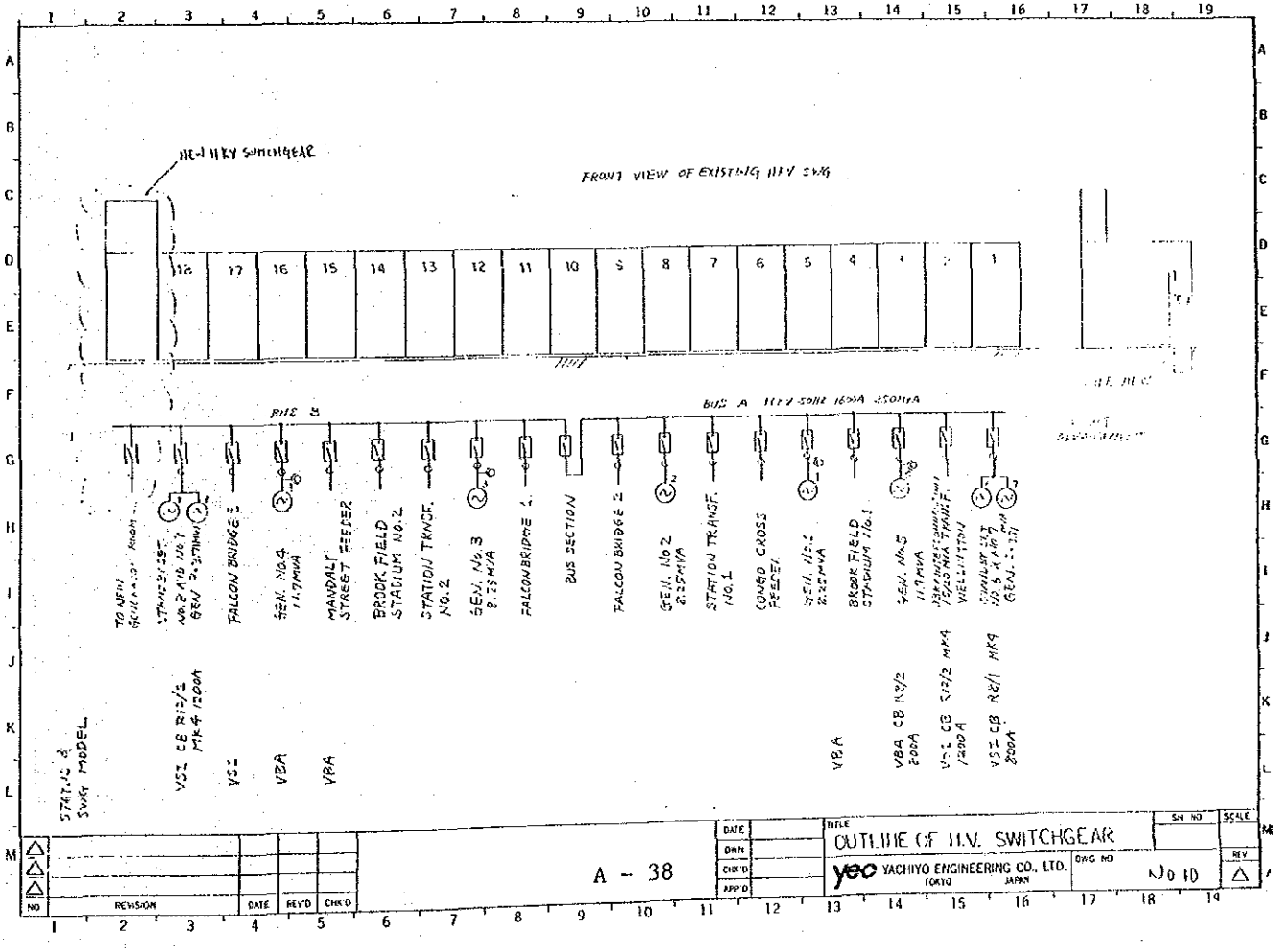
COMPRESSED AIR SYSTEM

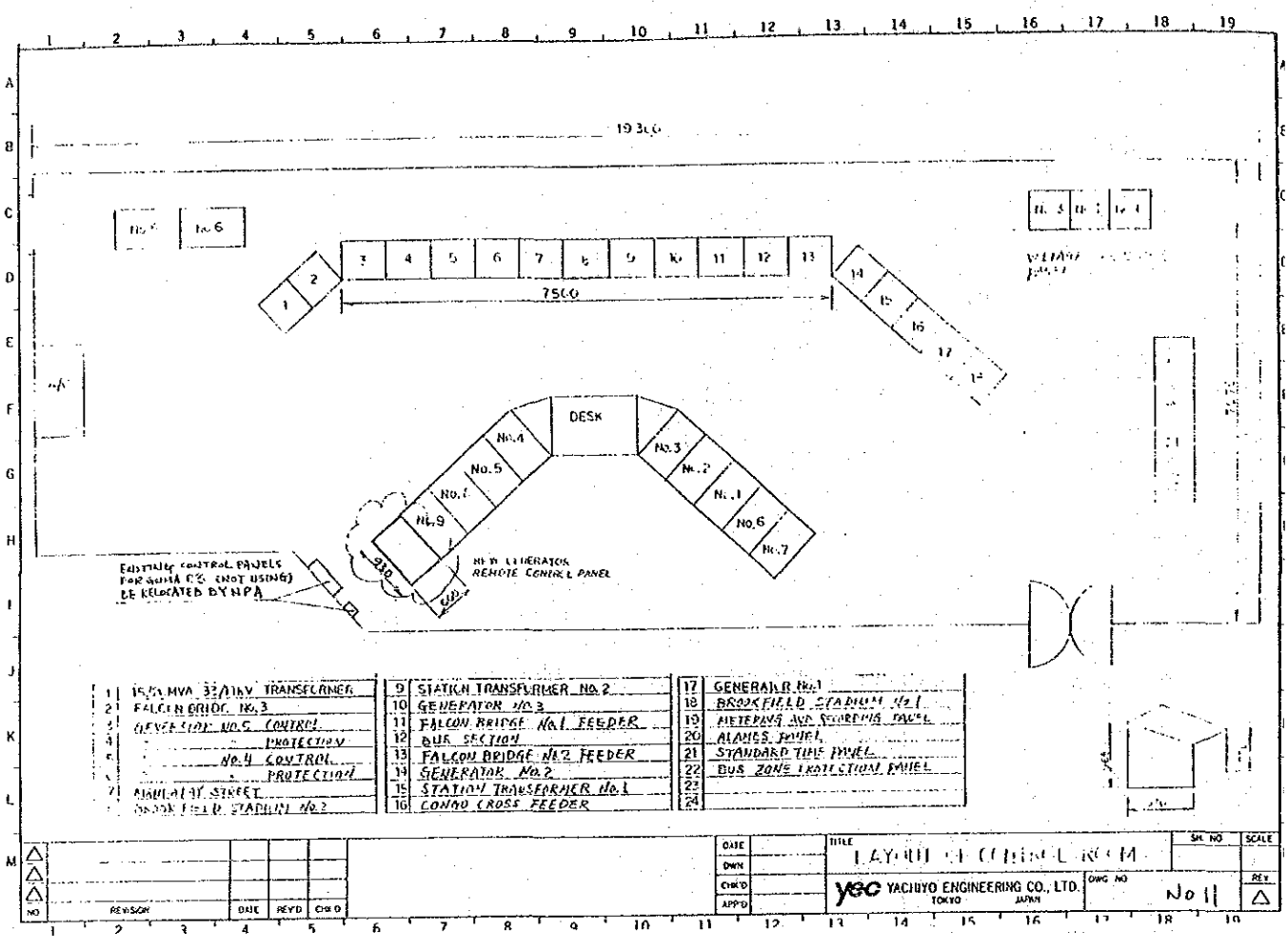


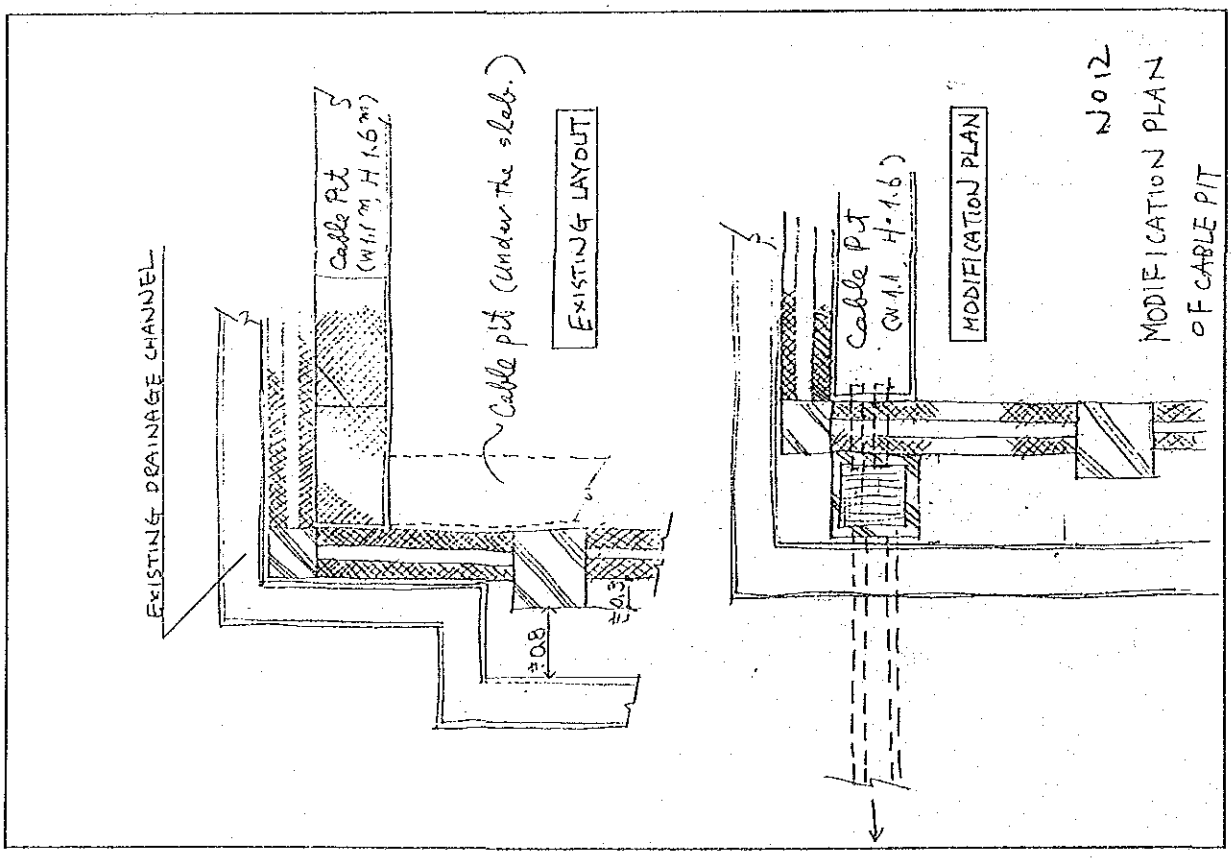
No 8

SLUDGE TREATMENT SYSTEM


SCOPE OF THE PROJECT
No 9
ONELINE DIAGRAM


NEW 11KV SWITCHGEAR
FRONT VIEW OF EXISTING 11KV SWG
BUS B
BUS A
BUS SECTION
A - 38
No 10
OUTLINE OF H.V. SWITCHGEAR
YACHIYO ENGINEERING CO., LTD.
TOKYO JAPAN


DESK
No.1
No.2
No.3
No.4
No.5
No.6
No.7
No.8
No.9
7500
1930
NEW GENERATOR REMOTE CONTROL PANEL
EXISTING CONTROL PANELS FOR UNIT 1~3 (NOT USING) TO BE RELOCATED BY NPA
1 15/20 MVA 33/11kV TRANSFORMER
2 FALCON BRIDGE No.3
3 GENERATOR No.3 CONTROL
4 " PROTECTION
5 No.4 CONTROL
6 " PROTECTION
7 ALABAT AV STREET
8 BROOKFIELD STADIUM No.2
9 STATION TRANSFORMER No.2
10 GENERATOR No.3
11 FALCON BRIDGE No.1 FEEDER
12 BUS SECTION
13 FALCON BRIDGE No.2 FEEDER
14 GENERATOR No.2
15 STATION TRANSFORMER No.1
16 CONRAD CROSS FEEDER
17 GENERATOR No.1
18 BROOKFIELD STADIUM No.1
19 METERING AND SYNCHRONIZING PANEL
20 ALARMS PANEL
21 STANDARD TILE PANEL
22 BUS ZONE PROTECTION PANEL
23
24
DATE
DWN
CHK'D
APP'D
TITLE LAYOUT OF CONTROL ROOM
YACHIYO ENGINEERING CO., LTD. TOKYO JAPAN
DWG NO No 11
SCALE
REV
NO REVISION DATE REVD CHK'D


EXISTING DRAINAGE CHANNEL
Cable Pit (W1.1m, H 1.6m)
Cable pit (under the slab.)
EXISTING LAYOUT
MODIFICATION PLAN
Cable Pit (W 1.1, H 1.6)
No 12
MODIFICATION PLAN OF CABLE PIT

APPENDIX 6 Submission and Request of Approval on the Field Report

National Power Authority
(Incorporating Former Sierra Leone Electricity Corporation)

Head Office:
Electricity House
36 Siaka Stevens Street, Freetown
Republic of Sierra Leone, West Africa

Telephones: 24361/4, 25720/3
Postal Address: Private Mail Bag, Freetown

CTRON FREETOWN

.....20th December, 1989.....

EM/T/18

Mr. M. Nishikawa,
Basic Design Study Team,
Japan International Co-operation Agency,

Dear Mr. Nishikawa,

SUBMISSION AND REQUEST OF APPROVAL ON THE FIELD REPORT

We refer to your letter dated 19th December, 1989 and the discussions held in my office and submit our comments on the Field Report:

1) DIESEL ENGINE GENERATOR

During our initial meeting when the inception report was discussed we had requested a low speed engine for the proposed project for the following reasons:

a) High efficiency of 48 - 50% (low fuel consumption)

b) Low maintenance cost (less wear and tear)

c) Longer life time of 20 years (minimum)

d) Low lubricating oil consumption

e) Low grade of heavy oil can be used.

In your Field Report you have proposed a medium speed engine which we will accept for the following reasons:

i) Limitation of the available Budget (750 Million Yen)

ii) Space requirement.

We however propose that consideration should be given to a speed of 500 R.P.M. in the final design.

.../2

2) ELECTRICAL SWITCHGEAR

We have noticed that you are proposing the extension of the existing 11KV Brush Panel to incorporate a VSI Switchgear. Circuit Break type will be vacuum.

Whilst we agree to this extension, we wish to draw your attenti on to plans being made to replace the complete switchgear because of age and possible obsolescence. It is possible that the breaking capacity of 350MVA of the switchgear cannot now be achieved.

We are therefore proposing that a switchgear of 500MVA rating be provided.

3) SPARE PARTS

Spare parts for 24,000 hours operation will be required. These should include consumable and maintenance spares. Insurance spares such as turbo-chargers etc. will be required.

4) COMMUNICATION

We are proposing that telephone link between the existi ng Control Room and the Lo cal Control Board of thee proposed Power Station be in-stalled.

5) PROTECTION AND SAFETYY

We are proposing that protection and safety equipment such as ear mufflers be provided for operational staff.

We have observed that you have made arrangement for the supply of fire fighting equipment.

6) TRAINING OF STAFF

According to the tentative implementation plan, on the job training for staff will be carried out locally.

We are proposing that in addition to this type of training, attachment to F actories in Japan will be required. This will enable trainees to appreciate manufacturing processes prior to erection of the engines.

.../3

7) TECHNICAL ASSISTANCE

One Mechanical Engineer and one Electrical Engineer for a period of three years will be required for the sustained maintenance of the engine after commissioning for the transfer of technology and operational and maintenance skills to indigenous staff.

We approve of the Field Report and look forward to the Final Report which will be submitted in due course.

Please be assured of our usual co-operation.

Yours sincerely,

A.C. Dumbuya
GENERAL MANAGER.

c.c. P.S., MEP
" Mr. S.S.A. Sankoh
Ag. Di rector of Economic Affairs,
Min. of Foreign Affairs.
" D.G.M. - NPA

APPENDIX 7 Country Data

1. Basic Indexes

(1) The Republic of Sierra Leone
Capital: Freetown

(2) Territorial land and population

Area	:	71,740 km^2
Population	:	3,515,812 persons (1985/86 census)
Population density	:	49 persons/km^2 (")
Population growth rate	:	2.5%/year (")

(3) Currency
1Leone = 100 cent
1US$ = 65 Leone (as of Dec. 1989)

(4) Meteorological Data
Rainy Season from June to September, especially from July to September, it rains heavily. At the beginning and at the end of this season, it has a tremendous clap of thunder. Dry Season from October to May.

(5) Topography
From the pacific coast to 112 km inland are large flatland with few small-sized mountains in Freetown. Far more in the continent are middle-sized forest with eight rivers, and east boundary areas are plateaux or mountains.

(6) Latitude longitude
7° to 10° North latitude, 11° to 13° West longitude

2. Socio-economic Indexes

(1) GDP: About US$1,645 million (1983/84 COUNTRY PROFILE, EIV)

(2) Per capita GNP: About US$310 (as of 1986, AFRICA RECOVERY '89 Oct., World Bank)

(3) Composition of Industry:
Main industry: Agriculture but abundant in underground resources like diamond, ironore, bauxite.
Main export countries: Belgium, West Germany, U.S., U.K.

GDP Rate of Each Industries (1984/85)

Industrial Item	GDP rate
Agriculture	35
Transportation & Communication	20
Trade & Tourism	11
Mining	10
Technology & Handicraft	6
Others	18
TOTAL	(100)

(Source: UNDP, ISSUE AND OPTIONS IN THE ENERGY SECTOR, 1987)

(4) Inflation rate

Changes of the Consumer Price Index

Item	1981	1982	1983	1984	1985	1986	1987	1988
Consumer price Index (1978: 100)	160.7	204.0	343.3	572.6	1,011.1	1,328.7	5,096.6	6,760.7
Change rate in Consumer Price Index	-	1.3	1.7	1.7	1.7	1.3	3.8	1.32

(Source: Central Statistic Office, 1989 Annual Statistical Digest)

(5) Financial Account

(Unit: million Leone)

Item	Actual 1986/87	Actual 1987/88	Estimates 1988/89
1. Total Revenue & Grants			
Tax revenue	1,227	1,786	2,590
Non tax revenue	37	128	60
Oil account surplus	-	341	-
Grants	838	305	850
(Sub-Total)	2,102	2,560	3,500
2. Expenditure			
Current expenditure	2,839	3,189	4,350
Development expenditure	1,398	999	1,980
Other expenditure	1,201	640	300
(Sub-Total)	5,438	4,828	6,630
3. Overall Deficit	-3,336	-2,268	-3,130
4. External Financing			
Drawings	560	800	1,000
Amortization	-158	-1,368	-1,500
(Sub-Total)	402	-568	-500
5. Change in Arrears (Decrease)			
Domestic	250	-270	-
External	528	1,659	2,180
(Sub-Total)	778	1,389	2,180
6. Domestic Financing			
ADB Project accounts deposit	-	192	-
Non-Bank sources	210	26	150
Banking system	1,946	1,229	1,300
(Sub-Total)	2,156	1,447	1,450

(Source: Government of the Sierra Leone, Estimates of Revenue and Expenditure 1988/89)

(6) Fluctuating of the exchange rate

Unit: Leone

	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987
per 1US$	1.046	1.057	1.050	1.158	1.238	1.678	2.510	4.730	8.396	30.769

(Source: IMF, INTERNATIONAL FINANCIAL STATISTICS)

3. Others

(1) National holidays (1990)

New Years Day	Jan. 1
Good Friday	Apr. 13
Easter Monday	Apr. 16
Independence Anniversary Day	Apr. 27
Feast of Eid-ul-Fitri	pending
Feast of Eid-ul-Adha	pending
Feast of Moulid-un-Nabi	pending
Christmas Day	Dec. 25
Boxing Day	Dec. 26

(2) Office time 8:30 - 16:30 (lunch time: 12:00 - 13:00)
Day off: Saturday and Sunday
Friday : 8:30 - 15:00

APPENDIX 8 Estimated Generation Supply of Freetown Area

Power Balance in Greater Freetown (UNIT : MW)

		(PURPOSE)	(PROJECT)	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995
1.	Peak demand													
1.1	Peak demand (NPA)			28.2	30.3	32.6	35.0	40.0	39.0	43.0	45.0	50.0	52.0	58.8
1.2	Peak demand (Private)			14.0	14.7	15.5	17.0	15.0	20.0	20.0	22.0	22.0	24.2	24.2
1.3	Peak demand (Total)			42.2	45.0	48.0	52.0	55.0	59.0	63.0	67.0	72.0	76.2	83.0
2.	Installed capacity													
2.1	King Tom Power Station													
	No.1 DEG (MAN)	BASE	WB-RPLC	6.6	6.6	6.6	6.6	6.6	6.6	6.6	6.6	6.6	6.6	6.6
	No.2 DEG (MAN)	BASE	WB-RPLC	6.6	6.6	6.6	6.6	6.6	6.6	6.6	6.6	6.6	6.6	6.6
	No.3 DEG (MAN)	BASE	WB-RPLC	6.6	6.6	6.6	6.6	6.6	6.6	6.6	6.6	6.6	6.6	6.6
	No.4 DEG (SULZER)	BASE	EC-RHBL,1991	9.2	9.2	9.2	9.2	9.2	9.2	9.2	9.2	9.2	9.2	9.2
	No.5 DEG (SULZER)	BASE	EC-RHBL,1991	9.7	9.7	9.7	9.7	9.7	9.7	9.7	9.7	9.7	9.7	9.7
	No.6 DEG (KHD)	PEAK	EC-RHBL,1990	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
	No.7 DEG (KHD)	PEAK	EC-RHBL,1990	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
	No.8 DEG (KHD)	PEAK	EC-RHBL,1990	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
	No.9 DEG (KHD)	PEAK	EC-RHBL,1990	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
	No.10DEG (JAPANESE)	BASE	JPN-GRT.1992	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.0	5.0	5.0	5.0
	(Total)			50.2	50.2	50.2	50.2	50.2	50.2	50.2	55.2	55.2	55.2	55.2
2.2	Falconbridge Power Station													
	No.1 DEG (ENGLISH ELEC.)	BLK-STRT		1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5
	No.2 DEG (ENGLISH ELEC.)	BLK-STRT		1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5
	No.3 DEG (MIRRLEES)	BLK-STRT		1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
	No.4 DEG (MIRRLEES)	BLK-STRT		1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
	No.5 DEG (MIRRLEES)	BLK-STRT		1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
	(Total)			6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0
2.3	Bumbuna Power Station													
	No.1 Hydro-Elec. Gene.	BASE	LOAN.1995	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	47.0
	(Total)			0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	47.0
2.4	Total Installed Capacity			56.2	56.2	56.2	56.2	56.2	56.2	56.2	61.2	61.2	61.2	108.2
	(I. With Japan's Grant Aid)													
3.	Available capacity													
3.1	King Tom Power Station													
	No.1 DEG (MAN)	BASE	WB-RPLC	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	No.2 DEG (MAN)	BASE	WB-RPLC	2.5	2.5	2.5	2.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	No.3 DEG (MAN)	BASE	WB-RPLC	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	No.4 DEG (SULZER)	BASE	EC-RHBL,1991	5.2	5.2	5.2	5.2	5.2	5.2	7.5	7.5	7.5	7.5	7.5
	No.5 DEG (SULZER)	BASE	EC-RHBL,1991	4.5	4.5	4.5	4.5	4.5	4.5	7.5	7.5	7.5	7.5	7.5
	No.6 DEG (KHD)	PEAK	EC-RHBL,1990	0.0	3.0	3.0	1.5	1.5	2.5	2.5	2.5	2.5	2.5	2.5
	No.7 DEG (KHD)	PEAK	EC-RHBL,1990	0.0	3.0	3.0	0.0	0.0	2.5	2.5	2.5	2.5	2.5	2.5
	No.8 DEG (KHD)	PEAK	EC-RHBL,1990	0.0	3.0	3.0	1.5	1.5	2.5	2.5	2.5	2.5	2.5	2.5
	No.9 DEG (KHD)	PEAK	EC-RHBL,1990	0.0	3.0	3.0	0.0	0.0	2.5	2.5	2.5	2.5	2.5	2.5
	No.10DEG (JAPANESE)	BASE	JPN-GRT.1992	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.0	5.0	5.0	5.0
	(Total)			12.2	24.2	24.2	15.2	12.7	19.7	25.0	30.0	30.0	30.0	30.0
3.2	Falconbridge Power Station													
	No.1 DEG (ENGLISH ELEC.)	BLK-STRT		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	No.2 DEG (ENGLISH ELEC.)	BLK-STRT		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	No.3 DEG (MIRRLEES)	BLK-STRT		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	No.4 DEG (MIRRLEES)	BLK-STRT		0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8
	No.5 DEG (MIRRLEES)	BLK-STRT		0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8
	(Total)			1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6
3.3	Bumbuna Power Station													
	No.1 Hydro-Elec. Gene.	BASE	LOAN.1995	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	30.5
	(Total)			0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	30.5
3.4	Total Available Capacity(incl Black-start)			13.8	25.8	25.8	16.8	14.3	21.3	26.6	31.6	31.6	31.6	62.1
3.5	Total Avail. Capa(without Black-start)			12.2	24.2	24.2	15.2	12.7	19.7	25	30	30	30	60.5
4.	Firm capacity(with Japan's Grant Aid)			7.0	19.0	19.0	10.0	7.5	14.5	17.5	22.5	22.5	22.5	30.0
5.	Balance													
5.1	Firm capa - NPA peak demand			-21.2	-11.3	-13.6	-25.0	-32.5	-24.5	-25.5	-22.5	-27.5	-29.5	-28.8
	(II. Without Japan's Grant Aid)													
6.	Available capacity													
6.1	King Tom Power Station													
	No.1 DEG (MAN)	BASE	WB-RPLC	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	No.2 DEG (MAN)	BASE	WB-RPLC	2.5	2.5	2.5	2.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	No.3 DEG (MAN)	BASE	WB-RPLC	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	No.4 DEG (SULZER)	BASE	EC-RHBL,1991	5.2	5.2	5.2	5.2	5.2	5.2	7.5	7.5	7.5	7.5	7.5
	No.5 DEG (SULZER)	BASE	EC-RHBL,1991	4.5	4.5	4.5	4.5	4.5	4.5	7.5	7.5	7.5	7.5	7.5
	No.6 DEG (KHD)	PEAK	EC-RHBL,1990	0.0	3.0	3.0	1.5	1.5	2.5	2.5	2.5	2.5	2.5	2.5
	No.7 DEG (KHD)	PEAK	EC-RHBL,1990	0.0	3.0	3.0	0.0	0.0	2.5	2.5	2.5	2.5	2.5	2.5
	No.8 DEG (KHD)	PEAK	EC-RHBL,1990	0.0	3.0	3.0	1.5	1.5	2.5	2.5	2.5	2.5	2.5	2.5
	No.9 DEG (KHD)	PEAK	EC-RHBL,1990	0.0	3.0	3.0	0.0	0.0	2.5	2.5	2.5	2.5	2.5	2.5
	No.10DEG (JAPANESE)	BASE	JPN-GRT.1992	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	(Total)			12.2	24.2	24.2	15.2	12.7	19.7	25.0	25.0	25.0	25.0	25.0
6.2	Falconbridge Power Station													
	No.1 DEG (ENGLISH ELEC.)	BLK-STRT		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	No.2 DEG (ENGLISH ELEC.)	BLK-STRT		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	No.3 DEG (MIRRLEES)	BLK-STRT		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	No.4 DEG (MIRRLEES)	BLK-STRT		0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8
	No.5 DEG (MIRRLEES)	BLK-STRT		0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8
	(Total)			1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6
6.3	Bumbuna Power Station													
	No.1 Hydro-Elec. Gene.	BASE	LOAN.1995	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	30.5
	(Total)			0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	30.5
6.4	Total Available Capacity(incl Black-start)			13.8	25.8	25.8	16.8	14.3	21.3	26.6	26.6	26.6	26.6	57.1
6.5	Total Avail. Capa(without Black-start)			12.2	24.2	24.2	15.2	12.7	19.7	25	25	25	25	55.5
7.	Firm capacity(without Japan's Grant Aid)			7.0	19.0	19.0	10.0	7.5	14.5	17.5	17.5	17.5	17.5	25.0
8.	Balance													
8.1	Firm capa - NPA peak demand			-21.2	-11.3	-13.6	-25.0	-32.5	-24.5	-25.5	-27.5	-32.5	-34.5	-33.8

APPENDIX 9 Estimated Operating Revenue and Expenditure of the Power Generating Plant Concerned

Table 1 Estimated Operating Revenue and Expenditure of the Power Generating Plant Concerned

Items	Unit	Operating Ratio				
		75%	80%	85%	90%	95%
I. Revenue						
1. Plant capacity	MW	5	5	5	5	5
2. Annual operating time	hr	6,480	6,912	7,344	7,776	8,208
3. Unit generated	MWh	32,400	34,560	36,720	38,880	41,040
4. Power loss rate in the plant		0.03	0.03	0.03	0.03	0.03
5. Power loss rate of transmission line		0.15	0.15	0.15	0.15	0.15
6. Sales units	MWh	26,568	28,339	30,110	31,882	33,653
7. Average tariff	Leone/kWh	6.67	6.67	6.67	6.67	6.67
8. Sales value	1,000 Leone	177,208	189,022	200,836	212,650	224,464
II. Expenditure						
1. Fuel cost	1,000 Leone	128,961	137,557	146,154	154,750	163,347
2. Lubricating oil cost	1,000 Leone	6,455	6,885	7,315	7,746	8,176
3. Cooling water cost	1,000 Leone	171	183	194	206	217
4. Labor cost	1,000 Leone	292	292	292	292	292
5. Maintenance cost	1,000 Leone	6,724	6,724	6,724	6,724	6,724
6. Administration cost	1,000 Leone	12,404	13,231	14,058	14,885	15,712
(Total expenditure)	1,000 Leone	155,009	164,875	174,740	184,605	194,470
III. Profit/loss	1,000 Leone	22,198	24,147	26,096	28,044	29,993

Assumed Conditions of Examination

(a) The tariff has been set at the average unit price (6.67 Leone/kWh) based on the new tariff NPA is now requesting the Sierra Leone Government to approve.

(b) Power loss rate within the plant and transmission line loss rate are based on the data supplied by NPA.

(c) The fuel, lubricating oil, waterworks and personnel costs have been set to the domestic prices prevalent as of December 1989 in Sierra Leone.

(d) Respective consumptions have been set as follows:

Fuel consumptions : 0.21g/kWh
Lubricating oil consumption : 2.0g/kWh
Water or radiators : 0.5m^3/day (about 20% of initial supply volume)
Water for exhaust gas boiler: 24m^3/day

(e) Average starting and stopping operations per year were set at 10 times and the time needed for one start-stop was set at 30 minutes.

(f) Assuming that about 1/10 of the staff of Generation Section in Technical Division of NPA (total of 155 staffers) would be assigned to management and maintenance of the power generating plant concerned, personnel costs for 3 engineers and 12 workers (total of 15) were appropriated as labor cost.

(g) As maintenance cost, about 3% of the unit prices of equipment was estimated for the annual cost of component parts.

(h) As management cost about 7% of the power sales revenue was estimated on the basis of actual record of NPA for 1987.

(i) No depreciation was estimated.

Table 2 Estimated Operating Revenue and Expenditure of the Power Generating Plant concerned with Depreciation Taken into Account

Items	Unit	Operating Ratio				
		75%	80%	85%	90%	95%
I. Revenue						
1. Plant capacity	MW	5	5	5	5	5
2. Annual operating time	hr	6,480	6,912	7,344	7,776	8,208
3. Unit generated	MWh	32,400	34,560	36,720	38,880	41,040
4. Power loss rate in the plant		0.03	0.03	0.03	0.03	0.03
5. Power loss rate of line transmission		0.15	0.15	0.15	0.15	0.15
6. Sales units	MWh	26,568	28,339	30,110	31,882	33,653
7. Average tariff	Leone/kWh	6.67	6.67	6.67	6.67	6.67
8. Sales value	1,000 Leone	177,208	189,022	200,836	212,650	224,464
II. Expenditure						
1. Fuel cost	1,000 Leone	128,961	137,557	146,154	154,750	163,347
2. Lubricating oil cost	1,000 Leone	6,455	6,885	7,315	7,746	8,176
3. Cooling water cost	1,000 Leone	171	183	194	206	217
4. Labor cost	1,000 Leone	292	292	292	292	292
5. Maintenance cost	1,000 Leone	6,724	6,724	6,724	6,724	6,724
6. Administration cost	1,000 Leone	12,404	13,231	14,058	14,885	15,712
7. Depreciation	1,000 Leone	23,908	23,908	23,908	23,908	23,908
(Total expenditure)	1,000 Leone	178,917	188,783	198,648	208,513	218,378
III. Profit/loss	1,000 Leone	-1,709	239	2,188	4,136	6,085

Remarks: 1) Assumed conditions for examination are identical with those of the previous table.

2) The depreciations in the table were calculated under the *fixed price method with the life of the power plant* concerned set at 15 years and the residual price taken as zero.