GUYANA ELECTRICITY CORPORATION
THE CO-OPERATIVE REPUBLIC OF GUYANA

No. 1

BASIC DESIGN STUDY REPORT
ON
THE PROJECT FOR THE IMPROVEMENT OF ELECTRICITY GENERATION IN DEMERARA
IN
THE CO-OPERATIVE REPUBLIC OF GUYANA

NOVEMBER 1995

JAPAN INTERNATIONAL COOPERATION AGENCY
EPDC INTERNATIONAL LIMITED

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PREFACE

In response to a request from the Government of the Co-operative Republic of Guyana, the Government of Japan decided to conduct a basic design study on the Project for the Improvement of Electricity Generation in Demerara and entrusted the study to the Japan International Cooperation Agency (JICA).

JICA sent to Guyana a study team from May 30 to July 2, 1995.

The team held discussions with the officials concerned of the Government of Guyana, and conducted a field study at the study area. After the team returned to Japan, further studies were made. Then, a mission was sent to Guyana in order to discuss a draft basic design, and as this result, the present report was finalized.

I hope that this report will contribute to the promotion of the project and to the enhancement of friendly relations between our two countries.

I wish to express my sincere appreciation to the officials concerned of the Government of the Co-operative Republic of Guyana for their close cooperation extended to the team.

November 1995

Kimio Fujita
President
Japan International Cooperation Agency

November, 1995

Letter of Transmittal

We are pleased to submit to you the basic design study report on the Project for the Improvement of Electricity Generation in Demerara in the Co-operative Republic of Guyana.

This study was conducted by EPDC International Limited, under a contract to JICA, during the period from May 26, 1995 to December 11, 1995. In conducting the study, we have examined the feasibility and rational of the project with due consideration to the present situation of Guyana and formulated the most appropriate basic design for the project under Japan's grant aid scheme.

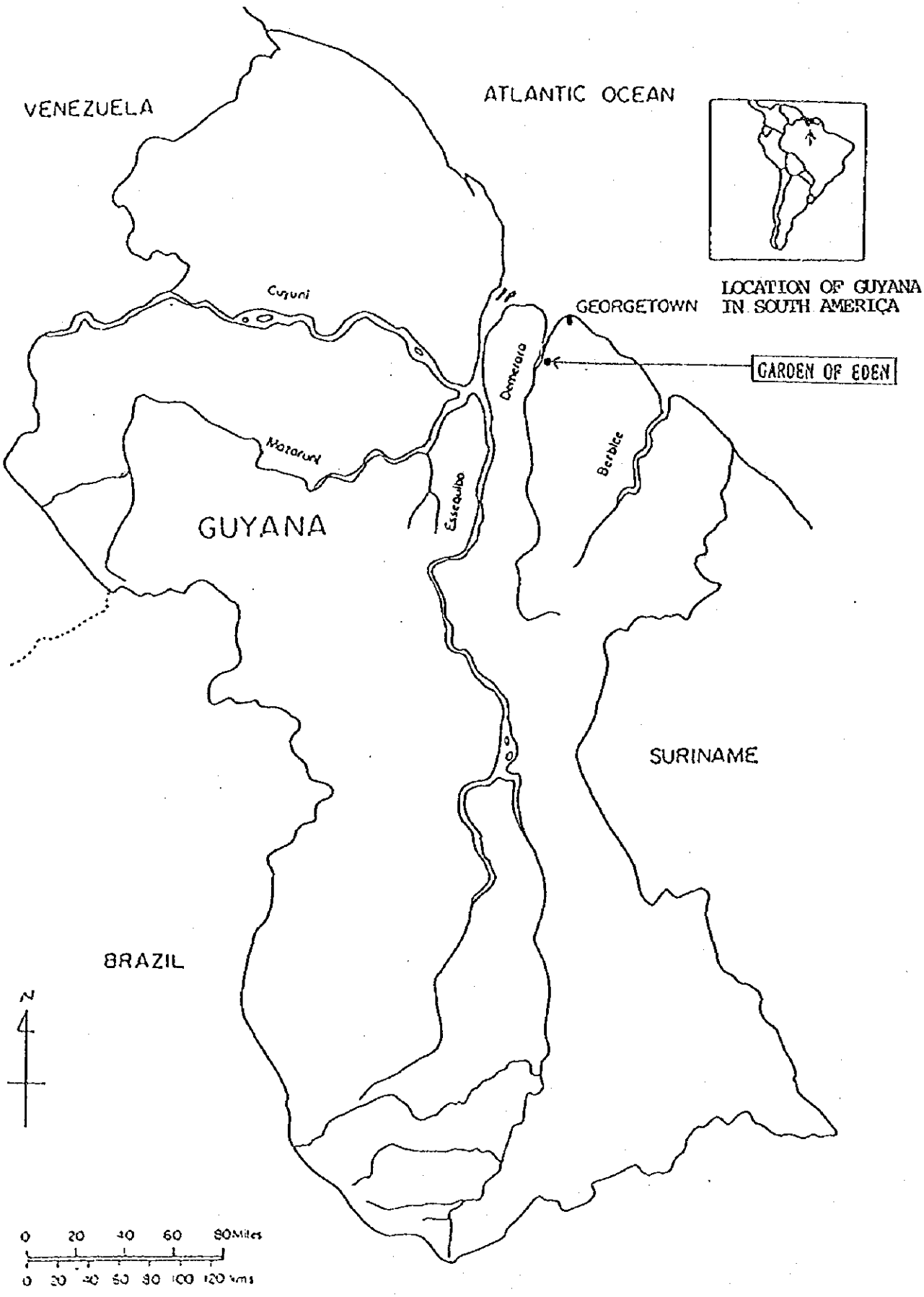
Finally, we hope that this report will contribute to further promotion of the project.

Very truly yours,

M. Mikuni

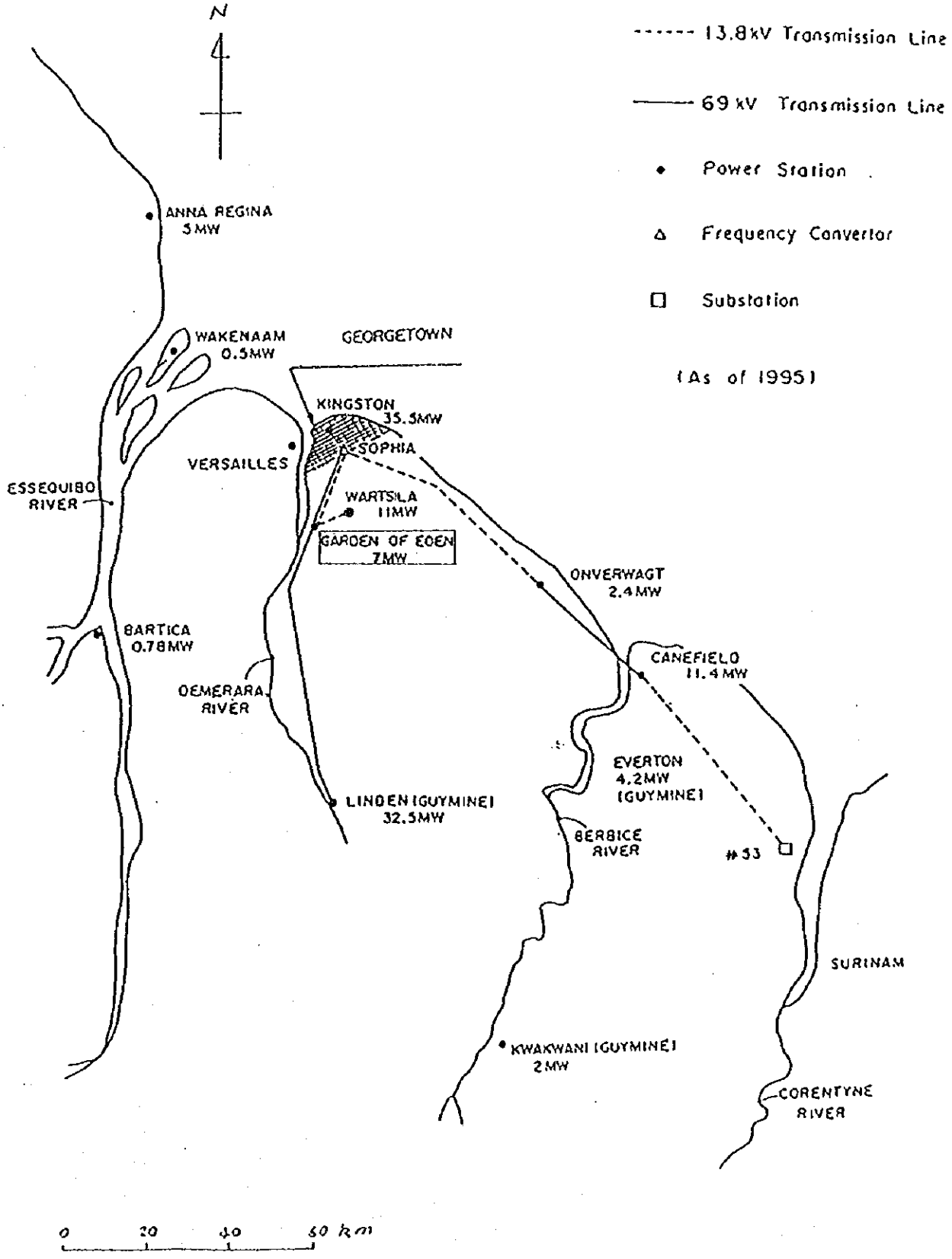
Masashi Mikuni
Project Manager
Basic Design Study Team on
the Project for the Improvement of
Electricity Generation in Demerara
EPDC International Limited

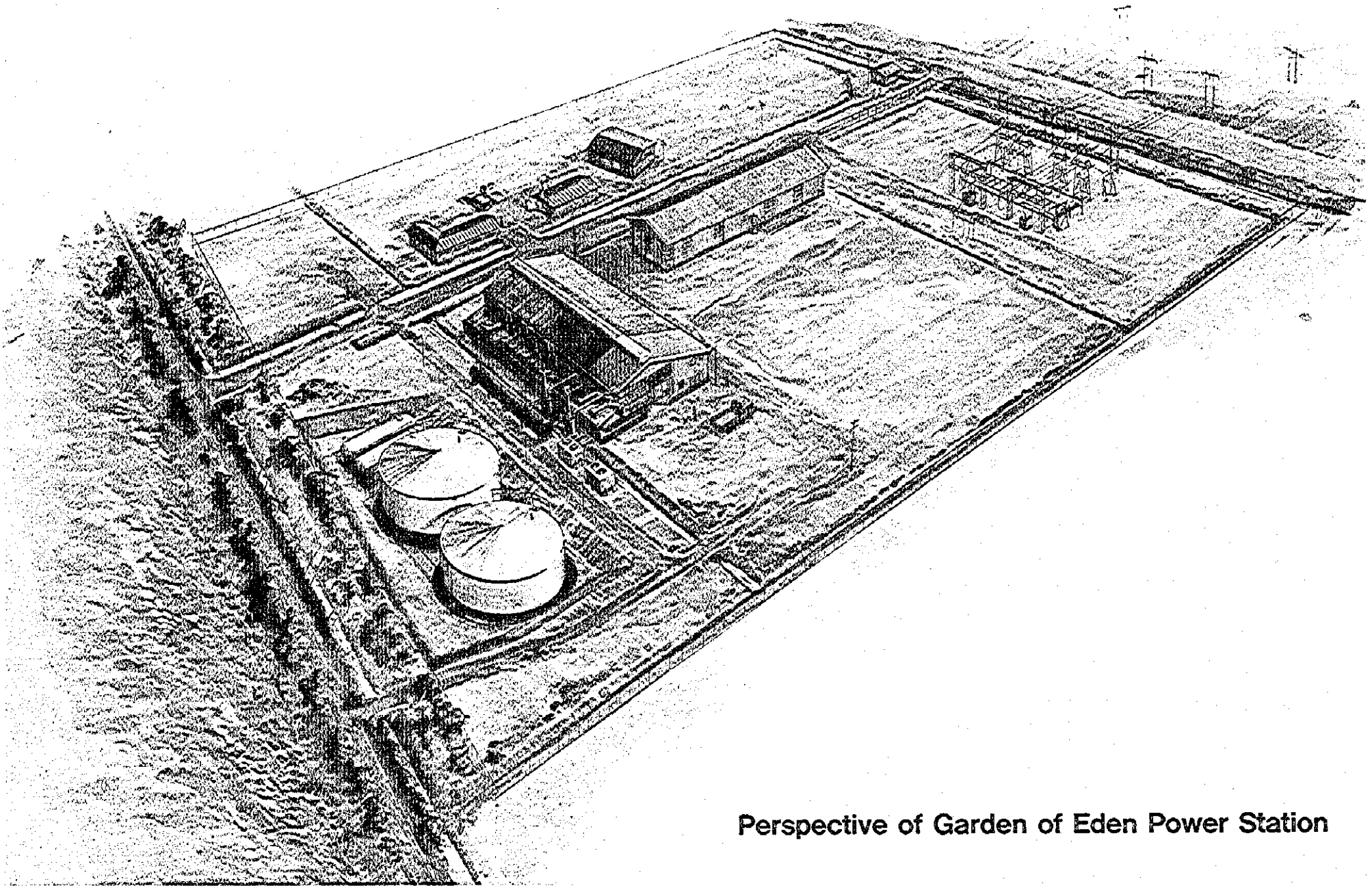
LOCATION OF SITE IN GUYANA



LOCATION OF GUYANA IN SOUTH AMERICA

LOCATION OF GEC SYSTEMS





Perspective of Garden of Eden Power Station

ABBREVIATIONS

Agencies

C I P	:	Canadian International Power Services Inc.
G O G	:	Government of Guyana
G E C	:	Guyana Blectricity Corporation
J I C A	:	Japan International Cooporation Agency
I M F	:	International Monetary Fund
I D B	:	Inter-American Development Banks

Term

BHN	:	Basic Human Needs
B/A	:	Banking Arrangement
B/N	:	Exchange of Notes
GDP	:	Gross Domestic Products
GNP	:	Gross National Products
G$	:	Guyana dollar
G/T	:	Gas turbine
S/T	:	Steam Turbine
CAN	:	Canefield
GOB	:	Garden of Eden
K/STON	:	Kingstone
ONV	:	Onverwagt
WART	:	Wartsila

Unit

W	:	Watt
KW	:	Kilowatt = 10^3 W
MW	:	Megawatt = 10^3 KW
Kwh	:	Kilowatt hour = 10^3 wh
MWh	:	Megawatt hour = 10^3 KWh
Pf	:	Power factor
r.p.m	:	Revolution per minuts
Hz	:	Hertz (cycles per second)
EL	:	Elevation

Table of Contents

CHAPTER 1

BACKGROUND OF THE PROJECT

Chapter 1 Background of the Project

The Co-operative Republic of Guyana is located at the northeastern end of the South American continent on the Atlantic Ocean and has a total land area of some 215,000 km^2. Guyana is bordered on the west by Venezuela, on the east by Surinam and on the south by Brazil.

Long coastal plains spread along the Atlantic Ocean with tropical rain forests ranging on the western and southern sides of the coastal plains. Hilly areas lie scattered, gradually increasing in altitude as they approach the Venezuelan and Brazilian borders. According to a statistical handbook issued by the Statistics Bureau of Guyana in December 1994, the total population in the third quarter of 1994 was estimated at about 768,000 people.

Since pre-independence, Guyana has been a typical primary product (sugar, bauxite and rice) exporting country as she remains to the present time. Following gaining independence in 1966, the nation's infrastructure was considerably upgraded and the economy stabilized. In light of this, an economic development plan was established aiming at industrialization by freeing Guyana from its dependence on primary products. However, the plan failed to realize the anticipated result and the Guyanese economy has remained extremely sluggish since the later half of 1970s, to the extent that Guyana became one of the poorest countries in Central and South America.

To overcome this situation, the Government of Guyana launched its economic rehabilitation programme (ERP) on the basis of an agreement with the International Monetary Fund (IMF) in 1989. Price control was abolished and accordingly, public utilities charges were raised by a large margin. Governmental enterprises were also placed under private management. Subsequently, the Guyanese economy has shown a strengthening since 1991.

Guyana has great latent agricultural potential for which irrigation facilities were established in the coastal areas and for the rich

forest resources in inland areas. The principal products include sugar and rice. Bauxite and alumina are major sources for obtaining foreign currency. In 1992, exports were US$ 292 million.

The principal imports are industrial products, machinery, foodstuffs and oil. In 1992, imports represented US$ 382 million.

Regarding Guyana's economic indexes, in 1992 the gross domestic product (GDP) was US$ 375 million, GNP per capita US$ 330. The economic growth rate was 8.3% and the price increase rate was 10.8%.

The Guyana Electricity Corporation (GEC) has five steam and diesel power stations in the Demerara and Berbice coastal areas. Due to the advanced aging of its power generation facilities after many years of operation, the total power generation output has fallen to a 57 MW equivalent, being about 60% of the total facility capacity. In actuality, the power generation capacity has fallen even further due to delays in the rehabilitation programme and suspension due to troubles and accidents. Today, the power supply shows a large short-fall against increasing power demands. In this situation, Georgetown is forced to cut power supply for an average of 3.2 hours per day with the result that civic life and economic activities are greatly hindered. The abolition of two power generation facilities is expected in two years in the Kingston Power Station which handles the greatest power supply in the Demerara and Berbice system. According to power demand forecasts for 2000, this supply shortage will accelerate and the power situation will become very serious wherein there will be twice the demand than supply. The only way to overcome this situation is to introduce new power generation facilities in order to improve an ever-worsening electric situation in a short period. The Government of Guyana has formulated a power generation equipment renewal plan for the Garden of Eden (GOE) Power Station as an emergency measure and applied to the Government of Japan for her grant aid.

This Project is intended to meet increasing power demand for the stabilization of the people's living standards and the promotion

of industrial activities by installing one 5.7 MW diesel generator and others in the GOE Power Station which presently outputs only 7 MW of its 22.8 MW capacity due to superannuation since its construction in 1976.

For the above power station, Japanese grant aid was provided for supplying and installing one set of 5.7 MW diesel generating equipment (approx. 600 million Japanese Yen) and also the follow-up measures of the power station improvement project (approx. 9 million Japanese Yen) was taken by the Government of Japan. Another grant aid was provided by the Government of Japan for procurement and installation of three (3) units of diesel-engine generator sets and ancillary equipment (amounting to approximately 600 million Japanese Yen) with an installed capacity of 2.0 MW each at the Versailles Power Station located in the Demerara and Berbece power system area in 1984. Spare parts amounting to around 150 million Japanese Yen were also provided according to Japan's grant aid system as rehabilitation measures for the Versailles Power Station in 1993.

CHAPTER 2

CONTENTS OF THE PROJECT

Chapter 2 Contents of the Project

2-1 Objectives of the Project

Canadian International Power Services Inc (CIP) of Canada has formulated an electric power development plan based on its power demand projection, and this report was submitted in 1991. Based on this report, the Energy Policy Committee has presented a draft of Eenrgy Policy of Guyana to the President in July 18, 1994, in which two major policy guidelines are recommended.

(1) The petroleum fuels (for power plants and automobiles) which currently depend on imports shall be reduced in amount in future by improving its consumption efficiency.

(2) In order to effectively utilize the indigenous energy resources available as alternative fuels, the Biomass power generation (power generation utilizing sugar canes residues, waste woods and crop husks) and hydroelectric power generation (small and large hydroelectric projects) must be studied and promoted.

The Demerara-Barbice power system, to which GOE Power Station owned by the Guyana Electricity Corporation (GEC) is connected, supplies the major portion of Georgetown, the capital city of Guyana. The power demand/supply balance of this power system for the period from 1995 to 2004 is illustrated in Tables 2-1, 2-2 and Figure 2-1.

The causes of the chronic supply shortage being experienced since 1996 are the large proportion of old power facilities which have elapsed their service lives and abandoned, and there is no plan for new power generation facilities to deal with the power demand.

In particular, the power generation facilities of Kingston Power Station, which once accounted for approximately 52% (35.5 MW) of

the total power generation output of Demerara-Barbice system in 1995, are decommissioned one by one, and will be completely abolished in 1999. In addition, existing power generation facilities are scheduled to be decommissioned, with the exception of Wartsila Power Station.

The electric power development plan and its draft of the Cooperative Republic of Guyana defines the objectives of efficient utilization of oil resources and development of new energy resources. This Project is designed to contribute to attaining the first objective and at the same time as an emergency provision for the tentative period before the realization of the second objective. Specifically, this Project is intended to construct one, 5.7 MW diesel generator inside GOE Power Station to contribute to the maintenance of the capital city function and to the stabilization of people's livelihood.

Table 2-1 AVAILABLE CAPACITY ON DEMERARA - BERBICE POWER SYSTEM

(In MW)

	EXISTING								PLAN					SYSTEM TOTAL
	KINGSTON			GOE	WARTSILA	CANE FIELD	OVER WAGT	EXITING TOTAL	GOE	WOOD WAST	BAGASSE	RICEHUSK	PLAN TOTAL	
	Steam	Gas	Total											
1995	25.5	10.0	35.5	7.0	11.0	11.4	2.4	67.3	0.0	0.0	0.0	0.0	0.0	67.3
1996	25.5	0.0	25.5	12.7	11.0	11.4	2.4	63.0	0.0	0.0	0.0	0.0	0.0	63.0
1997	17.0	0.0	17.0	14.4	11.0	11.4	2.4	56.2	5.7	5.0	0.0	0.0	10.7	66.9
1998	8.5	0.0	8.5	14.4	11.0	11.4	2.4	47.7	5.7	5.0	20.0	5.0	35.7	83.4
1999	0.0	0.0	0.0	14.4	11.0	11.4	2.4	39.2	5.7	5.0	30.0	5.0	45.7	84.9
2000	0.0	0.0	0.0	8.7	11.0	11.4	2.4	33.5	5.7	5.0	30.0	5.0	45.7	79.2
2001	0.0	0.0	0.0	5.7	11.0	11.4	2.4	30.5	5.7	5.0	30.0	5.0	45.7	76.2
2002	0.0	0.0	0.0	5.7	11.0	5.7	0.0	22.4	5.7	5.0	30.0	5.0	45.7	68.1
2003	0.0	0.0	0.0	5.7	11.0	5.7	0.0	22.4	5.7	5.0	30.0	5.0	45.7	68.1
2004	0.0	0.0	0.0	5.7	11.0	0.0	0.0	16.7	5.7	5.0	30.0	5.0	45.7	62.4

1996
- GOE #2 (5.7MW) REH.
- K/STON #1 GAS (10MW) RET.

1997
- K/STON #1 (8.5MW) RET.
- GOE #5 (4.0->5.7MW) REH.
- GOE NEW (5.7MW) ADD
- WOODWAST NEW (5MW) ADD

1998
- K/STON #2 (8.5MW) RET.
- BAGASSE NEW (20MW) ADD
- RICE HUSK NEW (5MW) ADD

1999
- K/STON #3 (8.5MW) RET.
- BAGASSE NEW (10MW) ADD

2000
- GOE #2 (5.7MW) RET.

2001
- GOE #4 (3.0MW) RET.

2002
- CANFIELD #4 (5.7MW) RET.
- ONVERWAGT #5 (2.4MW) RET.

2004
- CANFIELD #3 (5.7MW) RET.

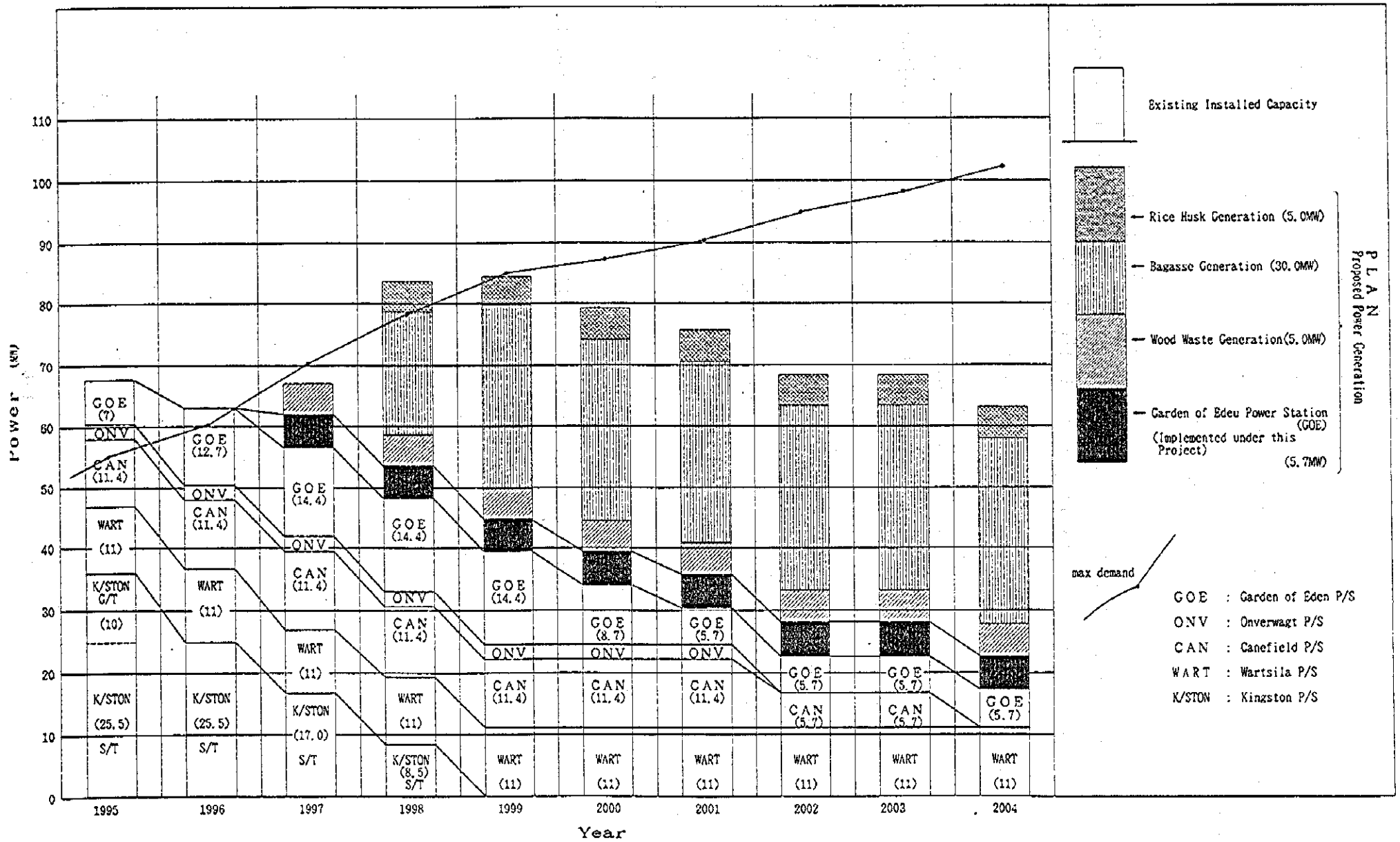
Table 2-2 POWER BALANCE ON DEMERARA - BERBICE POWER SYSTEM

(In MW)

	Generator end	Station end	Max demand	Balance
1995	67.3	64.6	55.0	9.6
1996	63.0	60.5	60.4	0.1
1997	66.9	64.2	70.7	-6.5
1998	83.4	80.1	77.9	2.2
1999	84.9	81.5	85.2	-3.7
2000	79.2	76.0	87.6	-11.6
2001	76.2	73.2	90.9	-17.7
2002	68.1	65.4	94.5	-29.1
2003	68.1	65.4	98.1	-32.7
2004	62.4	59.9	101.8	-41.9

Note: Output at Power Station end = Output at Generator end - Station service use (4% of output at Generator end)

Fig. 2-1 Power Demand and Supply Balance of Demerara/Berbice Power System (As of June 1995)



2-2 Basic Concept of the Project

2-2-1 Location of the Power Station

Because the GOE Power Station provides the following advantages, it offers an ideal location to provide an additional source of power inside an existing power station:

(1) Proximity to the power consuming area

(2) Taking advantage of the existing power plant facilities (transmission lines, substations and tele-communications equipment)

(3) Taking advantage of the auxiliary equipment and facilities in the existing power plant (fuel equipment including fuel storage tanks, cooling water supply equipment, cranes, administration building, and warehouses).

(4) Well-equipped port facilities are available nearby with a good access road.

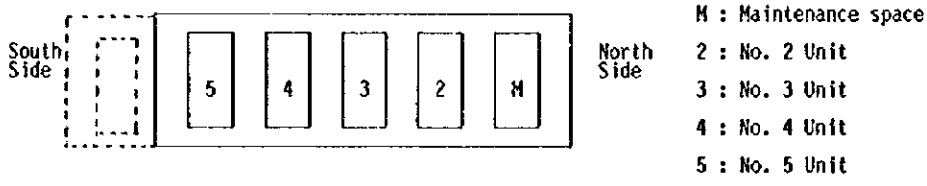
(5) Adequate land space is already available for the Project.

2-2-2 Output Level of the Generator

Three 5.7 MW diesel engine sets are already in operation in the existing GOE Power Station. The operators and maintenance personnel are quite familiar with the system. Also, spare parts will be interchangeable if the new equipment is of the same type with the same power output as the old one. It is, therefore, considered advantageous to install a 5.7 MW diesel engine set, it being the same as the existing unit.

2-2-3 Location of the New Power Unit to be Installed

The configuration of the building and the layout of the diesel engine generators of GOE is shown below:



The commissioning year, scheduled retirement year, and current operating status of each unit are listed below:

	Commission-ing year	Scheduled retirement year	Current operating status
No. 2 Unit	1976	2000	The current operating status Overhaulcompleted; resume operation end of this year (5.7 MW)
No. 3 Unit	1976	1994	Retired; scheduled to removed
No. 4 Unit	1976	2001	In operation (3.0 MW)
No. 5 Unit	1991	2011	In operation (4.0 MW)

There are three alternative plans regarding the location of the power generating equipment for this Project. Table 2-3 shows the comparative costs of construction and the results of the technical reviews of those three alternatives:

Table 2-3 COMPARISON OF INSTALLATION PLACES OF NEW GENERATING SET

	Plan No. 1			Plan No. 2			Plan No. 3		
	Borne by Japan	Borne by Guyana	Total	Borne by Japan	Borne by Guyana	Total	Borne by Japan	Borne by Guyana	Total
Comparison of Construction Cost (Assuming that the figure of Plan 1 are 100%)	99.6	0.4	100	99.5	27.5	127	42.1	89.9	132
Category of Major Works (1) Foundation Works	• New Work (Japan)			• New Work (Japan)			• Repair of Foundation for No. 3 Unit (Japan)		
(2) Powerhouse Building	• Extension Work (Japan) • Removal of Wall at the Southern Part of the Powerhouse Building (Guyana)			• Partial Removal of Wall at the Northern Part of the Powerhouse Building (Guyana)			• Partial Removal of Wall at the Northern Part of the Powerhouse Building (Guyana)		
(3) Major Machine				• Dismantle and Removal of No. 3 Unit and Making of Maintenance Space at the Demolished Place (Guyana)			• Dismantle and Removal of No. 3 Unit (Guyana) • Transfer of No. 2 Unit to the Place from where No. 3 Unit is Removed (Guyana)		
(4) Auxiliary Equipment				• Transfer of Common Fuel Storage Tank for No. 2 & No. 4 Units (Guyana) • Transfer of Buttery Room and Construction of Toilette (Guyana)					
Technical Problems	• Easiness of Construction Works • No Stopping of Existing Generating Facilities Required • Lesser Financial Burden on the Part of the Guyanese Side			• This Plan Entails Stopping of No. 2 and No. 4 Units for About One Week • Larger Financial Burden on the Part of the Guyanese Side			• This Plan Entails Stopping of No. 2 Unit for About Four Months. • Transfer of No. 2 Unit Requires the Guidance of Technical Personnel from the British Manufacturer. • Biggest Financial Burden on the Part of the Guyanese Side		

1. Plan No. 1

A new building will be added on the south side of Unit No. 5 to install the new engine set.

- It is possible to work freely, unaffected with the on-going operation of the existing generating facilities. Temporary shut-downs of the existing units will not be required.

2. Plan No. 2

Provide the foundation for the new unit in the maintenance space at (M) for its installation. To provide the new maintenance space (M), remove No. 3 Unit (3) to make room for the new unit.

- As the auxiliary equipment would need to be removed elsewhere, it would be necessary to temporarily shut-down Nos. 2 and 4 Units for about a week.

3. Plan No. 3

Remove Unit No. 3 and grade the land to transfer and install Unit No. 2 (2) on completion of its overhaul. The space thus vacated by Unit No. 2 will be used to install the new power unit.

- This will necessitate the transfer and installation of a major component of the power station. Moving around Unit No. 2 would require on-the-spot instruction of engineers dispatched from the engine manufacturer of U.K.

As shown in Table 2-3, the portion of the installation cost to be borne by Japan becomes less by the order of Plan Nos. 3, 2, and 1, whereas the portion to be borne by Guyana becomes more by the order of Plan Nos. 1, 2, and 3.

Plan No. 3 calls for a temporary shut-down during the period of the equipment transfer (max. 4 months).

Considering Guyana's present financial situation, it would be impossible to expect a large financial commitment from the Government of Guyana for this Project, which would be a good financial reason for adopting Plan No. 1.

Furthermore, there would be major conflicts between the equipment replacement program based on the future retirement schedule of old equipment and the requirements to remove the retired equipment and bring in the new units, necessitated by executing either Plan No. 2 or Plan No. 3.

It is, therefore, concluded that Plan No. 1 is the most appropriate in selecting where to put the new diesel power generating unit.

2-2-4 Basic Concept of the Project

In view of the above, it is believed that the basic concept of the Project is to extend the present power house within the compound of the GOE Power Station and install a new diesel power generator with an output of 5.7 MW to cope with the deteriorating power supply situation caused by the fast growing demand and the aging of the existing power generating equipment.

2-3 Basic Design

2-3-1 Design Concept

1. Natural Conditions

(1) Regarding the pattern of rainfall that will influence efficiency in the civil engineering and construction works,

May, June and the first half of July are the rainy season, whereas February, March, and April are the basic dry season, with a lightly dry season from August, September, October and December with some rain once or twice a week. It is, therefore, recommended to launch the civil engineering work including the piling, foundation for the engine and the ground work for the building in the second half of July as the rainy season draws to a close.

(2) The monthly average highest and lowest temperatures were 32.6°C and 21.8°C respectively, from 1980 to 1994 (for 15 years). Normal consideration will be sufficient in the design specifications when considering the temperature change factor.

(3) As none occurs in this area, there are no limitations imposed on the design specifications of equipment regarding earthquakes or hurricanes.

(4) As the altitude of the GOE Power Station is a mere 4 meters, no altitude deteriorating factor is required to determine the output of the diesel engine.

(5) The site is situated on the right bank of the Demerara River, standing on land reclaimed from the river-terrace. To provide adequate foundation, it is, therefore, necessary to provide piling for soil improvement.

2. Social Conditions

(1) The site is located in an industrial district with few residential housing areas. Noise or vibration will not, therefore, present a factor affecting the human environment.

(2) The site is located along a highway. There is also a well-maintained access road to the job site so that no serious problems in transportation are expected.

(3) Since Guyana has no environmental pollution control laws, Japanese laws and regulations will be applied for the control of atmosphere (SOx and NOx), noise, vibration and waste water.

3. Local Conditions over Construction Work, and Any Other Special Conditions Regarding Local Societies of Construction Work

(1) It is seen that with their existing knowledge and experience, the local construction companies are able to carry out any normal form of construction work.

(2) The skills of the local workers are also satisfactory in both quality and quantity.

(3) All types of ordinary general construction materials and equipment are locally available.

4. Utilization of Local Construction Firms (Builders and Consultants) and of Locally Available Materials and Equipment

(1) Guyana's principal industries are bauxite and gold mining and sugar production. There are several companies which meet the various needs of the industries, including the manufacture of tins and of simple machines and mechanical devices, together with the servicing and repair of industrial machines and equipment.

(2) In Guyana it has been the established practice for the owner to consign an engineering company to do its construction work with detailed work performed by smaller sub-contractors under its supervision. It is, therefore, recommended to engage the services of a local engineering company that has a group of

local sub-contractors working for it.

(3) It is hardly possible for a local sub-contractor to perform its assignment correctly by himself. It will be, therefore, necessary that work at the job site, such as schedule setting and quality control be performed under the guidance of Japanese technical personnel to be deputed to the site.

(4) It is possible to purchase ordinary construction materials in Guyana.

5. Operation and Maintenance Capabilities of Implementing Agency

(1) In this regard, GEC is fully capable as it has operated and maintained many diesel power generating units.

(2) The operators and maintenance personnel currently working for the GOE Power Station should be able to continue performing their duties with no additional manpower after the completion of this Project.

(3) Regarding the cost of operation and maintenance, the increased revenues resulting from the addition of another diesel engine set (one unit of 5.7 MW) will be more than enough to cover the cost of the operation and maintenance of the said new unit.

6. Product Grade Alignment for Facilities and Equipment

(1) This Project is an expansion work within the compound of the GOE Power Station and requires all the new equipment and facilities to match the existing building, diesel power generating units, power generation control system, etc. The product grades of these new facilities and equipment must, therefore, be as close as possible to the grades of the existing plant facilities and equipment. It will be essential to utilize existing facilities to the fullest extent.

Regarding engineering standards, however, Japanese or international standards would have to be applied wherever applicable, since Guyana has not yet enacted its own series of industrial standards.

(2) The conpositions of fuel and cooling water that influence the design of the diesel engine, are summarized below:

1) Fuel Composition

The composition of fuel presently used in the GOE Power Station is as follows:

No particular problems are expected to arise in the use of this type of fuel, which corresponds to Heavy Oil "A" in JIS.

Specific gravity 15°C:		0.8667
Viscosity 40°C	:	3.6 mm^2/sec
Flash point	:	76°C
Sulfur content	:	0.4% (weight)
Water content	:	0.05% or less (volume)
Precipitate	:	0.01% or less (weight)
Cetane number	:	46

2) Composition of Cooling Water

The raw water now in use at the GOE Power Station is as follows: Although certain reservations may be held regarding its iron content and turbidity, it will be usable for this Project as long as it is processed or treated by GEC, as in the case of NO. 5 Unit.

Conductivity	:	80 μs/cm
pH 25 C	:	6.3
M-Alkalinity	:	23 PPM
Total hardness	:	8 PPM
Chloride ions	:	6 PPM
Sulfur ions	:	11.3 PPM
Silica ions	:	15 PPM

(3) Applicable Industrial Standards

The industrial standards to apply for design specifications in this Project are listed below:

These include the Japanese domestic standards. Any international standards corresponding to any of the Japanese standards listed below may be accepted as and where applicable.

- Japan Industrial Standards (JIS)
- Standard of the Japanese Electrotechnical Committee (JEC)
- Standard of the Japan Electrical Manufacturers (JEM)
- Japan Cable Manufacturers' Standards (JCS)
- Noise Control Law
- Air Pollution Protection Law
- Vibration Control Law
- International Standards (ISO)
- British Standards (BS)
- Deutsche Institute fur Normung (DIN)
- International Electrotechnical Commission (IEC)
- National Electrical Manufacturers Association (NEMA)
- American Society of Testing Materials (ASTM)

7. Work Schedule

This Project will be completed by the end of fiscal 1996 (the end of March, 1997 in calendar year). These being outdoor works, the ground foundation work and erection of the new building will start in mid-July in order to avoid the rainy season. Works which are adverse to rain or wind, including the installation of the diesel engine, generator, and electric distribution panels, should start only after the new building is completed.

2-3-2 Basic Design

(1) General Planning

The diesel generating set is to be installed on the south side within the premise of the GOE Power Station. (Refer to Fig. 2-2) As the site is in an industrial zone with few residences nearby, the vibration and noise of the power plant will provide no serious effects. The road to the power plant site is in good condition, and there will be no problems in the transportation of construction materials and equipment. Consequently, the proposed site has appropriate conditions.

Under this Project, it is planned to extend the southern side of the existing powerhouse by approximately 9.6 meters to install a 5.7 MW diesel power generating unit and its auxiliary equipment. Enough land is available for this expansion. However, as the ground is soft, foundation piles will be driven upon which the generator foundations and building foundations will be built.

In case of installing another new generating set in the near future, it can be set up on the south side of the proposed new generating unit. Addition of diesel engine set(s) in or after

2000 may be possible at places from where existing generating sets will be removed for retirement.

(2) Materials and Equipment Planning

1) The operation and maintenance personnel have performed well in the management of the existing power plant. If specifications identical to the existing equipment are chosen, the time required for periodical inspection and overhaul will be reduced. The time required for recovery from failure will also be shortened.

The reduction of these outage times will increase the tariff revenue, and also contribute to the stable operation of the power system.
Based on the above, a power generating facility with the same specification as the existing units will be installed.

2) To ensure much interchangeability of spare parts and tools will lead to reduction of repair costs.

3) In order to avoid accident(s) due to mal-operation of a machine, it is desirable that the modes of operation and protection of the new generating set be the same as those of the existing generating set.

4) The major equipment for this Project is listed as follows:

(A) Diesel Engine

No.	Item	General Specification	Unit	Amount	Function
A	Diesel engine and auxiliary equipment				
A.1	Main engine	Type: 4-cycles stationary type for power generation Output: 8,072 PS continuous Speed: 720 rpm Cooling system: water cooled	Unit	1	Generating power
A.2	Auxiliary equipment				
A.2.1	Fuel system		Set	1	
	(1) Diesel oil pump system	Including motors and gear pumps	Unit	1	Supplying fuel to diesel engine
	(2) Diesel oil service tank	5,000 liter	Unit	1	
	(3) Fuel feed pump	Gear pump attached to engine	Unit	1	
	(4) Fuel flow meter				
	(5) Fuel oil filter	Primary filter and secondary filter	Set	1	
	(6) Fuel drain tank	With a 200 liter strainer			
	(7) Fuel drain pump	Motor and gear pump	Unit	1	
		8,000 liter	Unit	1	
A.2.2	Lubrication system	Including motor and gear pump			
	(1) Lubricant tank		Unit	1	Supplying lubricant to diesel engine
	(2) Lubricant priming pump	Including thermostat valve	Unit	1	
	(3) Lubricant cooler		Set	1	
	(4) Lubricant filter	With motor and gear pump	Unit	1	
	(5) Lubricant control valve		Unit	1	
	(6) Lubricant feed pump	250 liter with filter	Unit	1	
	(7) Drain tank	Motor and gear pump	Unit	1	
	(8) Drain pump	250 liter	Unit	1	
		Centrifugal pump attached to engine	Unit	1	
A.2.3	Cooling water system				
	(1) Primary coolant expansion tank		Unit	1	
	(2) Primary coolant pump	With thermostat valve	Unit	1	Supplying cooling water to diesel engine
	(3) Primary coolant cooler	Rectangular, cross flow type	Unit	1	
	(4) Secondary coolant pump		Unit	1	
	(5) Cooling column	Motor driven, 30kg/cm3, 5.5 kW	Unit	1	
	Air compressor	Diesel engine driven, 30 kg/cm3, 9.0 PS			
A.2.4	(1) Air compressor	500 liter	Unit	1	Feeding air and discharging exhaust gas
	(2) Air compressor	Including frame	Unit	1	
	(3) Air tank	900 mm diameter 500 mm diameter	Unit	1	
	Intake/exhaust system	Oil screen type			
	(1) Exhaust muffler		Set	1	
	(2) Exhaust duct		Set	1	
	(3) Intake duct		Set	1	
	(4) Intakd filter		Unit	1	
	(5) Intake silencer		Unit	1	
A.3	Spare parts and tools		Set	1	For operation and maintenance

: GEC desire larger capacity lubricant cooler than the one provided previously for the No. 5 Diesel Generator.

: GEC prefer the cooling tower sheave to be of aluminium material rather than cast iron.

(B) Generator

No.	Item	General Specification	Unit	Amount	Function
B	Generator facility				
B.1	AC Generator	Specification: 3-phase horizontal single shaft generator 7,125 kVA 5,700 kW, PF = 0.8 13.8 kV, 60 Hz	Unit	1	Generating power to supply load and in-house auxiliary power
B.2	Switch board	Bench type	Board	1	Control and switching of power supply to provide stable power supply
	Generator control desk	Cubicle type	Board	1	
	AVR board	Cubicle type			
	Generator CB		Board	1	
	Generator protective relay board	Open type	Board	1	
	Station protection relay board	Open type			
	Neutral grounding board	100 A, 100 ohms, 30 seconds With line switch	Board	1	
	Auxiliary equipment board	Including power supply board, cubicle type	Set	1	Supplying in-house auxiliary power
	Auxiliary transformer board	With load switch and power fuse	Board	1	
	DC power supply board	Comprising alkali battery			
	Arrester board	Indoor, enclosed, self standing type	Board	1	Supplying auxiliary power, avoiding lightning, controlling transformer
	Auxiliary transformer secondary board	Cubicle type	Board	1	
			Board	1	
B.3	Spare parts and tools		Set	1	Operation and maintenance

(3) Construction Plan (Figures 2-2, 2-3, 2-4)

1) The existing powerhouse will be extended for 9.6 meters with a width of 31.7 meters (304 m^2).

The overhead travelling crane rails will also be extended for 9.6 meters.
Sufficient space is available for this extension.

2) Steel Frame Construction

H-section steel pillars and beams will be constructed, and crane girders and girder pillars will be erected.

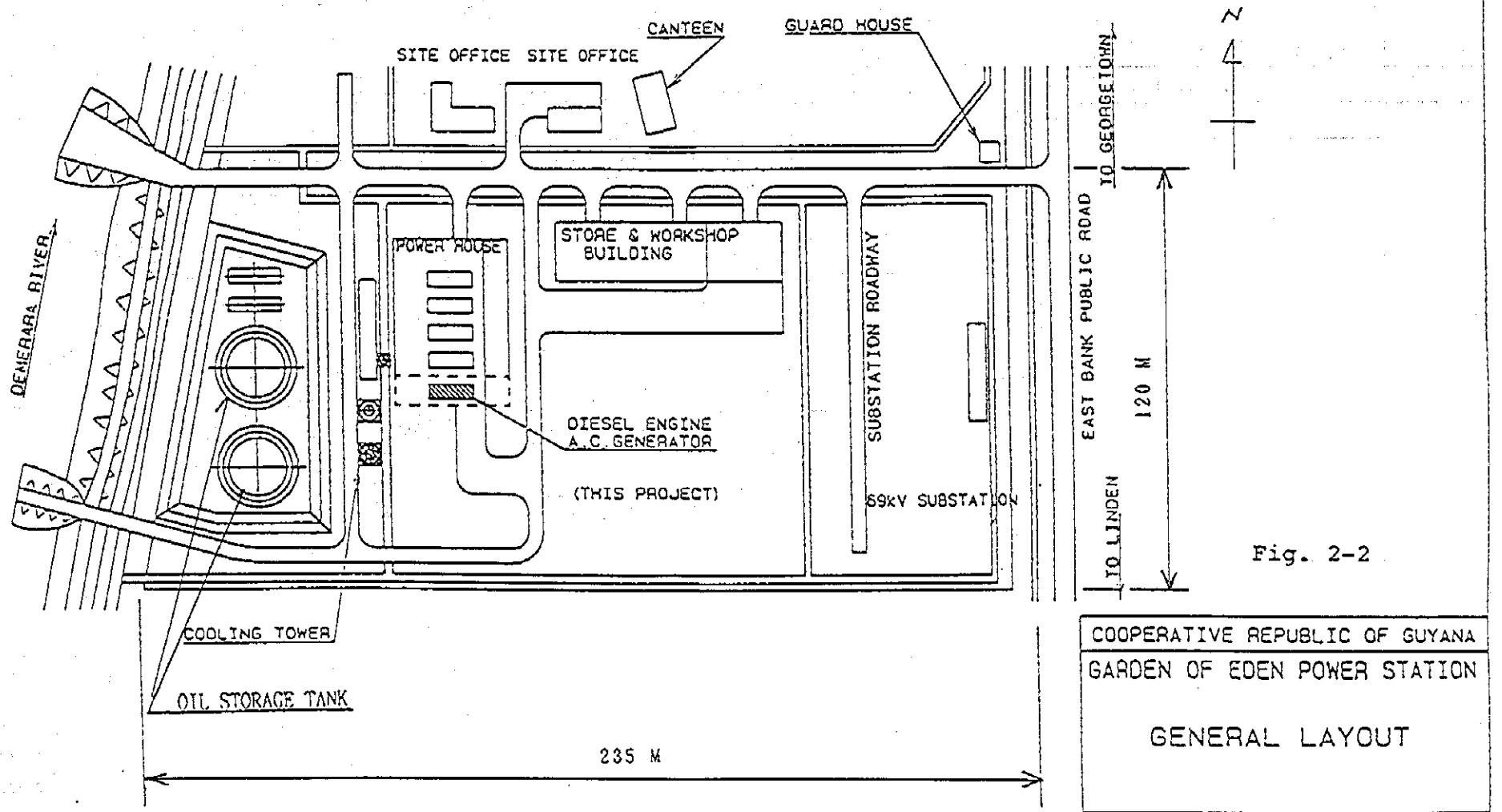


Fig. 2-2

COOPERATIVE REPUBLIC OF GUYANA

GARDEN OF EDEN POWER STATION

GENERAL LAYOUT

EPOC INTERNATIONAL LTD
TOKYO, JAPAN

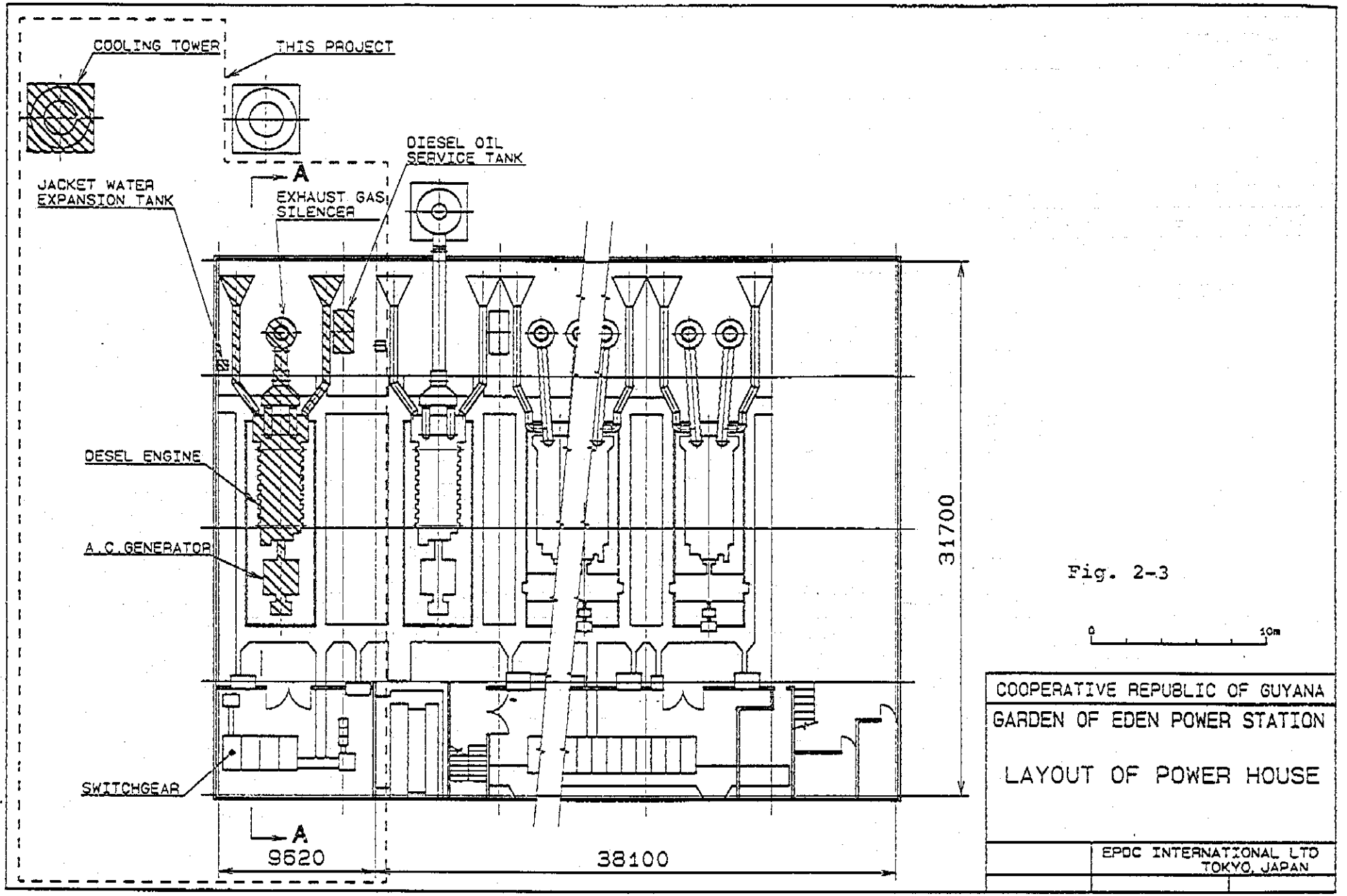
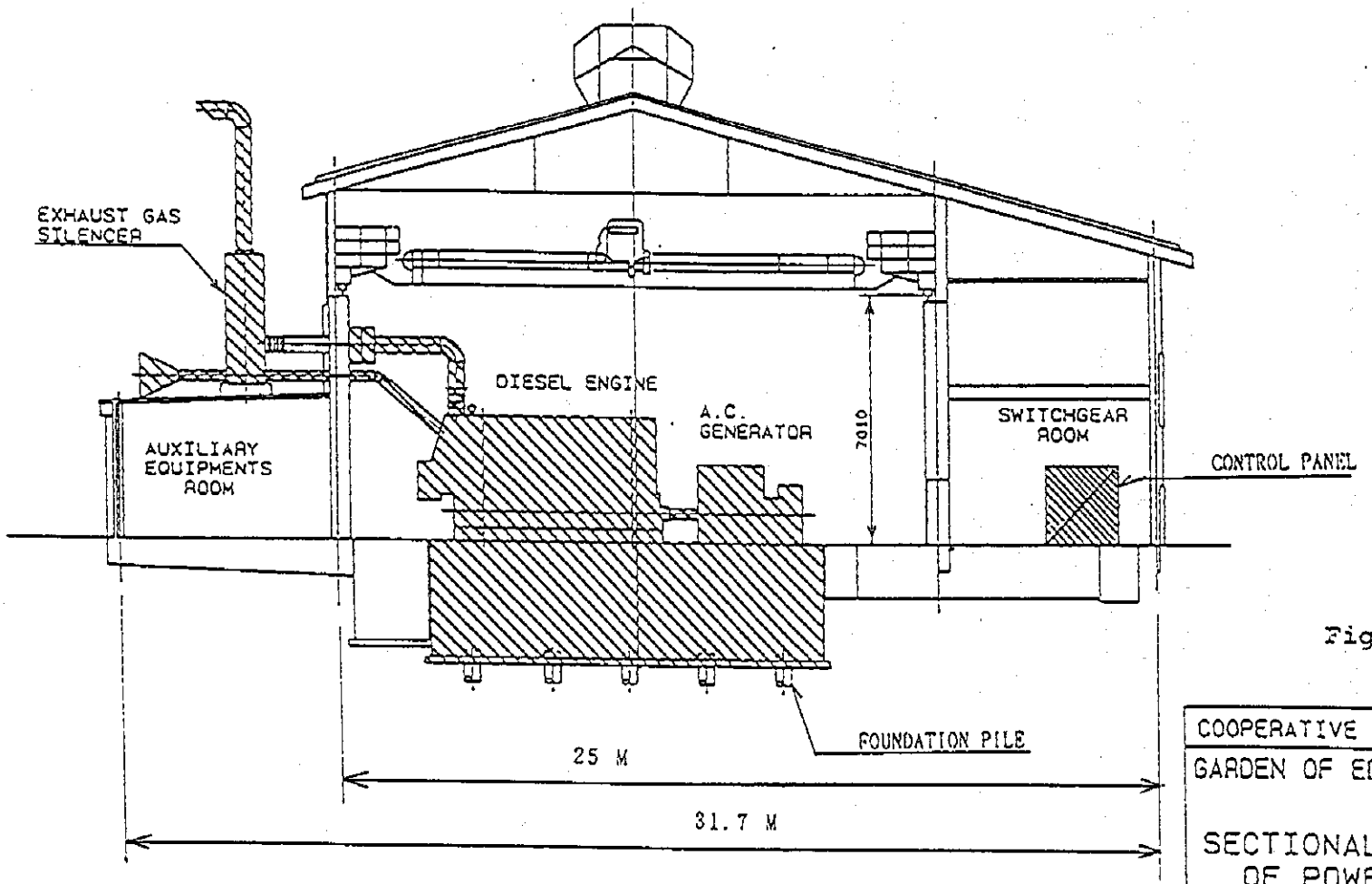

COOLING TOWER
THIS PROJECT
DIESEL OIL SERVICE TANK
A
JACKET WATER EXPANSION TANK
EXHAUST GAS SILENCER
DESEL ENGINE
A.C.GENERATOR
SWITCHGEAR
A
31700
9620
38100
0
10m
COOPERATIVE REPUBLIC OF GUYANA
GARDEN OF EDEN POWER STATION
LAYOUT OF POWER HOUSE
EPDC INTERNATIONAL LTD
TOKYO, JAPAN

Fig. 2-3



SECTION A-A

Fig. 2-4

COOPERATIVE REPUBLIC OF GUYANA	
GARDEN OF EDEN POWER STATION	
SECTIONAL OUTLINE (A-A) OF POWER HOUSE	
	EPDC INTERNATIONAL LTD TOKYO, JAPAN

3) Roof Construction

The roof will be covered by roof deck galvanium steel plates (0.6 mm). Ventilators and others will be furnished.

4) Outer Wall Construction

The wall will be made of corrugated galvanium steel plates (0.5 mm). The part of the wall 1 to 1.5 meters above the foundation will be made of concrete blocks or bricks.

5) As the ground is soft, foundation piles will be driven by an piling machine.

Powerhouse extension and power generation equipment will be built on these foundation piles.

6) The following construction works will be provided by the Guyanese side.

- Leveling and preparation of the ground for powerhouse extension.
- Preparation of access road inside the power plant.
- Demolition and removal of the existing southern powerhouse wall.

CHAPTER 3

IMPLEMENTATION PLAN

Chapter 3 Implementation Plan

3-1 Implementation Plan

3-1-1 Implementation Concept

This Project is to be implemented in Demerara of the Co-operative Republic of Guyana under the Japanese Grant Aid system. The implementation principles will be worked out with due consideration given to the time schedule of the grant aid system so that an appropriate implementation set-up and schedule will be defined corresponding to the work volume of the entire Project.

The implementing agency of this Project is the Guyana Electricity Corporation (GEC), with its General Manager assuming the total responsibility of the Project implementation. The practical details of the Project will be implemented solely by engineers of the Project Management Unit under the direction of Senior Manager of GEC's Corporate Planning and Projects. At the same time, all functions of the GOE Power Station will support the Project implementation as required.

In implementing this Project, the total support and cooperation of GEC will be required for ensuring that the Project can be completed and that the necessary technical qualities can also be achieved.

The Japanese consultant engaged in this Project will perform detailed design, preparation of tender documents and management of bidding procedures, supervision of material/equipment procurement and construction work after E/N is signed by the Governments of both countries.

Supply and construction of the power facilities are to be undertaken by Japanese contractors comprised of corporations chosen by the bidding. The Japanese contractors will construct the power generating facilities according to the contract, contract specifications and drawings under the general supervision and support of GEC and under the construction supervision of the

Japanese consultant.

The site office(s) of the Japanese contractor will be located within the GEC headquarters and the compound of the GOE Power Station and will be engaged in all required tasks including construction schedule management and quality control under the supervisory personnel of the contractor. Site resident technical persons deputed by the contractor will be assigned to the GOE Power Station, who will establish a site construction office staffed with its dispatched technical personnel including technicians.

The construction work of this Project shall include the foundation piling work, powerhouse building extension work, and installation & erection works of mechanical and electrical equipment. As there are local Guyanese contractors experienced in the installation of diesel engine generating sets at the GOE Power Station and the GEC-owned Versailles Power Station, it is recommended to make use of them as far as is deemed technically and economically viable.

However, the foundation pile works which constitute a base for the new equipment must be performed by a construction method which will not interfere with the operation of the existing other generating units. This method involves the use of an auger drilling machine and steel reinforced concrete piling technique. No local contractor is capable of performing these works.

It is, therefore, deemed necessary to depute electrical, mechanical and architectural personnel having such expertise so that the Project can be accomplished to a high standard of quality within the limited period of the construction schedule by such experts and under competent supervision systems.

3-1-2 Implementation Conditions

(1) Status of Local Construction Business

The relatively large local construction/installation constructors have shops equipped with welding and machining

facilities as well as medium sized construction machines. Some of these constructors also have experience in the installation/erection work for small diesel power plant facilities. Such contractors may be employed.

There are, however, only a few skilled local construction workers. No local contractors have practical experience with auger drilling machines. It is necessary, therefore, to bring these machines and technical personnel and foremen experienced in the said work from Japan.

(2) Procurement of Construction Materials/Equipment

Concerning the construction materials required for this Project, conventional cement, ready-mixed concrete, aggregates (sand and gravel), crushed stone used in the structural foundations, oxygen, acetylene and rinsing oil are available locally. Steel foundation reinforcing bar, H-section steel, roofing materials and outer wall materials are locally procurable.

Concerning leased heavy equipment, crane vehicles, concrete mixers, trucks, unloaders, etc. are locally available. It is considered necessary that the auger machine should be procured from Japan.

(3) Transport of Construction Materials/Equipment

The construction materials/equipment will have to be unloaded at George Town Harbor and then transported overland for approximately 22 km to the construction site. As the transportation route is on public highways, adequate care must be exercised to arrange the trips, including transportation during night when the traffic is not so congested.

3-1-3 Scope of Works

In implementing this Project, the Japanese and Guyanese sides shall share the construction work items as stated below:

(1) Works to be Performed by Japanese Side

(a) Procurement of materials/equipment in Japan and Guyana

(b) Marine and inland transportation of materials/equipment of Item (a) above procured in Japan.

(c) Powerhouse building expansion and foundation works

(d) Installation and adjustment/test of diesel engine generating set

(2) Works to be performed by Guyanese Side

(a) Provision of site to install the diesel engine generating set and site preparation

(b) Preparation of access road for transport of the diesel engine generating set to the site

(c) Demolition and removal of the wall on the south side of the powerhouse building

(d) Provision of space required for the construction work (material/equipment storage yard, temporary office building, etc.)

(e) Supply of electric power, water, sewage facility and telephone facility in the power plant premises

(f) Assurance that all import taxes and other levies/duties on the materials/equipment supplied from Japan as well as services by Japanese personnel are to be exempted smoothly by the Guyanese Government with sufficient promptness.

3-1-4 Construction Supervision

This Project is an undertaking to be implemented under the Japanese Grant Aid, and detailed design and construction supervision are to be performed by a Japanese consulting firm.

(1) Services to Be Rendered by the Consultant

	Stage	Services
1.	Before construction	Preparation of detailed design Preparation of tender documents Administration of bidding procedures representing the Implementing Agency for selection of a Contractor Evaluation of tenders Assistance in concluding a Contract with a Japanese Contractor Examination and approval of manufacturing drawings Witnessing shop tests
	During construction	Construction supervision at Project site Reporting on the progress of work Inspection of and guidance in foundation and building Power plant operation guidance Witness and approval of power generating facility acceptance test Report preparation

In developing the detailed design, the facility plan and material/equipment procurement design shall be determined in reference to detailed studies on the Project site. The tender documents will be prepared based on the detailed design, and the tender date shall be determined upon consultation with the Japanese competent government offices concerned. In the tendering process, the Consultant will represent the duties of the Implementing Agency as an agent, evaluate tenders, and will assist the Implementing Agency in concluding a contract with a Japanese Contractor.

During the construction work, the Consultant shall supervise the quality assurance work and control the construction schedule concerning the items relevant to the satisfactory implementation of this Project while maintaining close coordination with competent government offices as well as the Implementing Agency. Upon completion of the diesel power generating facility, the Consultant shall inspect the facility/equipment and provide technical guidance to plant operators on its operation and maintenance. The Consultant will prepare a completion report upon completion of the Project.

(2) Construction Supervision System

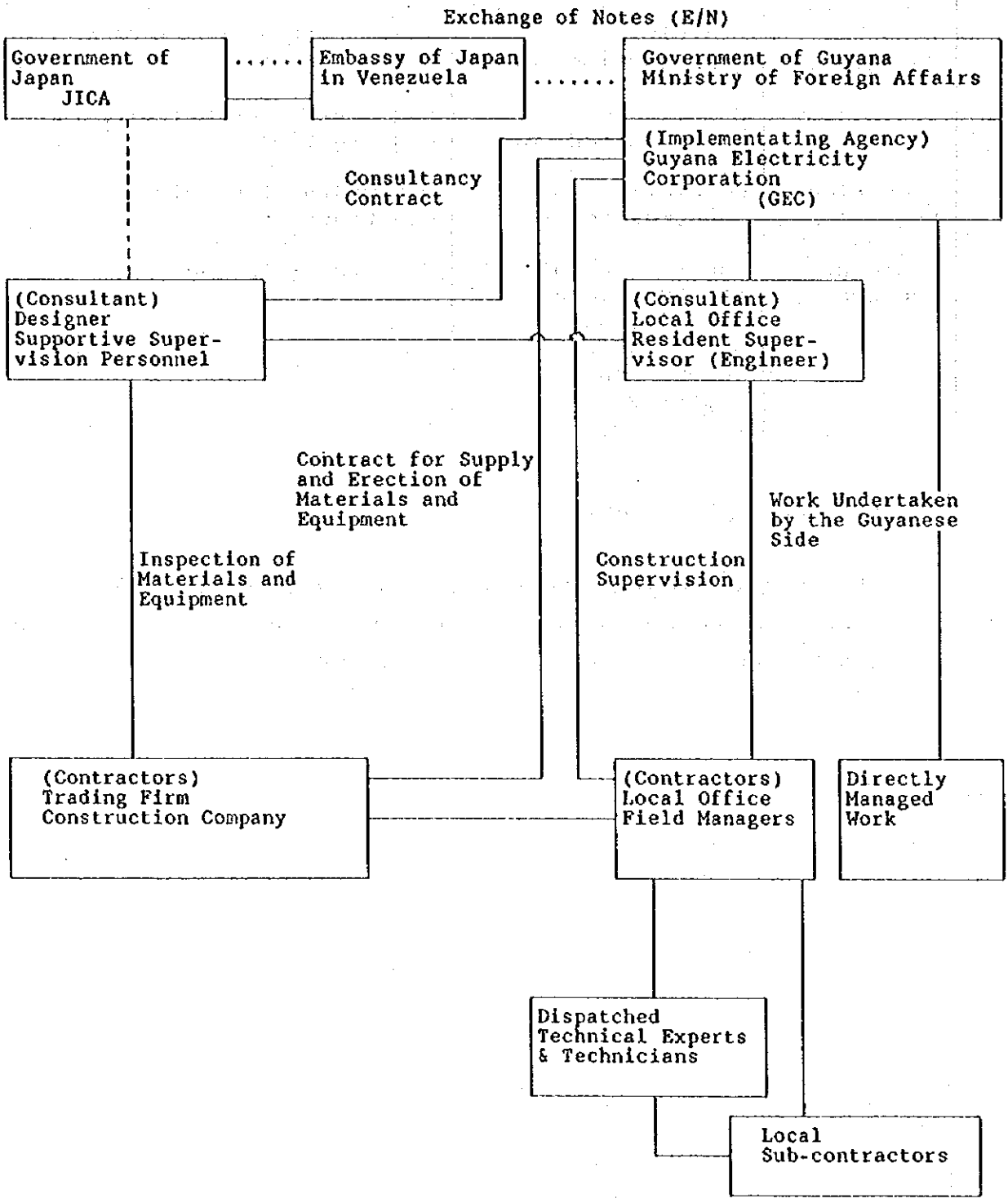
As this Project requires engineering expertise concerning powerhouse expansion, foundation work and power generating facility, the Consultant will dispatch the following expert engineers. The respective experts to be deputed are to be stationed at the Project site to render comprehensive construction supervision services. The contents of the on-site duties by the construction supervision engineers are as presented below:

Supervisory Engineers	Duties	Term of Dispatch
Project Manager	Starting construction work Completing construction work	Half month at start of construction One month at completion of construction
Electrical Engineer	Completing construction work	One month at completion of construction
Resident Engineer	Supervision of all constructions (foundation, building, power generation facility)	8 months (stationed)

(3) Project Implementation System

The Project implementation system shown in Fig. 3-1 is a schematic illustration of job flows. The function of the Consultant is illustrated in the figure.

Fig. 3-1 Project Implementation System



Japanese side <——|——> Guyanese side

————: Contractual Obligations and Duties

.....: Liaison and Coordination

3-1-5 Procurement Plan

(1) Procurement Plan

The materials and equipment required for this Project will be basically those products from Japan or Guyana. These materials and equipment will be procured by a Japanese Contractor according to the design and supervision services to be rendered by a Japanese Consultant.

Major materials/equipment required for this Project are presented in Table 3-1 below. The major supplying countries will be as follows for the reasons stated below:

<1> Materials and equipment for the power generating facility shall be procured in Japan.

<2> Basic materials such as cement, aggregates and ready-mixed concrete shall be procured in Guyana.

<3> Other than certain units, construction machines shall be procured in Guyana.

The potential suppliers of materials and equipment for the power generating facility are from Japan and a third country(ies) other than Japan and Guyana. However, as the power generating facilities currently in operation at the GOE Power Station were supplied by Japan and UK, and these sources have been studied in view of the ease of operation and maintenance and the exchange of spare parts. This study indicated that procurement from Japan is best in terms of pricing, ease of inspection and the delivery schedule.

Most construction machines can be leased in Guyana. However, auger drilling machine(s) required for the foundation construction are to be brought into Guyana from Japan as they are not locally available.

(2) Procurement of Materials/Equipment and Construction Machines

The supplying countries of materials/equipment and construction machines are presented in the following table.

Table 3-1 Supplying Countries of Materials/Equipment and Construction Machines

Item	Supplying Country			Construction machine	Specification	Supplying country		
	Guyana	Japan	Third party country			Guyana	Japan	Third party country
Cement	O			Crane vehicle	30 tons	O		
Aggregate	O			Crane vehicle	50 tons	O		
Reinforcing steel bar	O			Concrete mixer	0.3 m^3	O		
Steel forms	O			Truck	4 tons	O		
H-section steel	O			Back-hoe	0.25 m^3	O		
Roofing material	O			Belt conveyer	5 M	O		
Cutter wall material	O			Auger machine	45 tons dia 450-1000 mm length 21 m			O
Building materials	O							
Oxygen and acetylene	O							
Diesel engine and auxiliary equipment		O						
Generator and auxiliary equipment		O						
Electrical protection/control board		O						
Auxiliary transformer		O						

3-1-6 Implementation Schedule

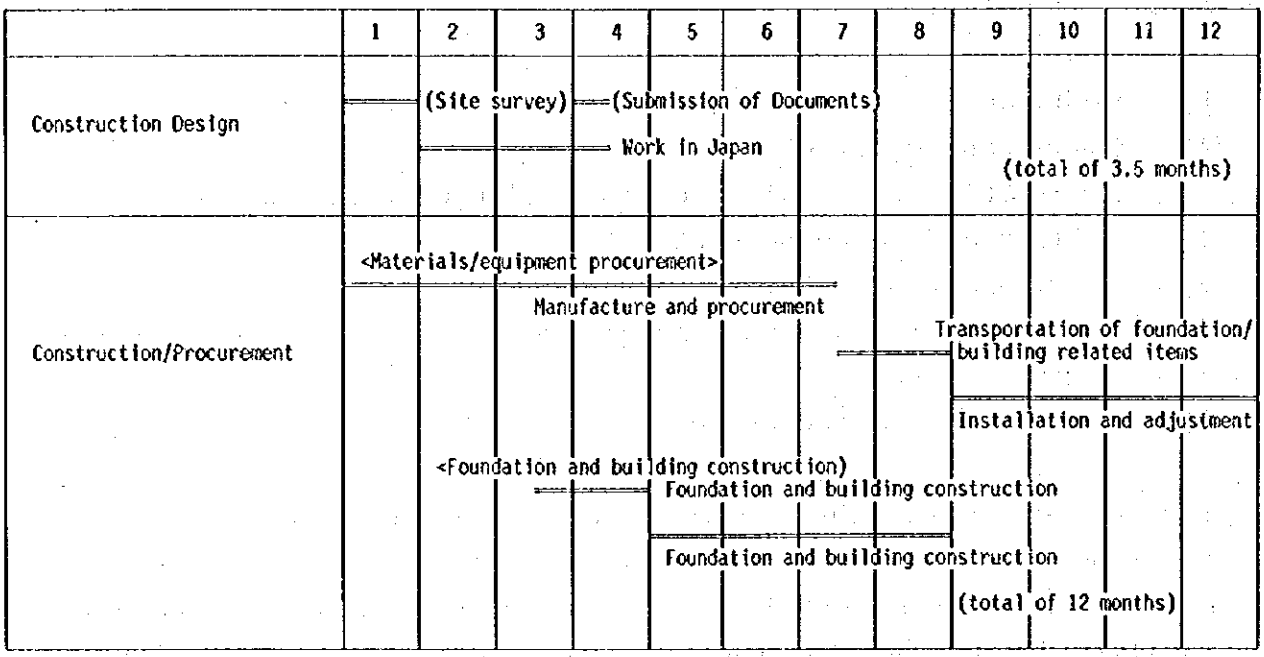
The implementation schedule of this Grant Aid Project is as presented below:

1) Exchange of Notes (E/N) between the Governments
2) Consultant contract
3) Preparation of detailed design and tender documents
4) Bidding and awarding contract
5) Procurement of materials/equipment
6) Transportation and customs clearance of materials/equipment
7) On-site works
8) Completion and acceptance

The complete work schedule of this Project has been estimated in reference to the period required for the procurement of materials/equipment and the installation of the power generating facility during the construction work as well as the conditions of the construction site and the scale and contents of the construction work. This schedule is presented in Table 3-2.

The design and the preparation of tender documents will take approximately 3.5 months. The construction schedule will extend to approximately 12.0 months, including the foundation and building constructions, manufacture of materials/equipment, transportation and installation/adjustment.

Table 3-2 Implementation Schedule



3-1-7 Obligations of Recipient Country

The costs of the following provisions shall be borne by the Coopeerative Republic of Guyana.

(1) Removal of the southern wall of the existing power plant building

(2) Preparation and cleaning of the land on which the diesel power generation facility will be installed in implementing this project

(3) Preparation of the access road for the acceptance of the diesel power generation facility to the power plant premises

(4) Provisions of power supply facilities, water supply facilities, sewage facilities and telephone facilities inside the power plant premises

(5) Exemption of all import duties and other taxes/charges on the equipment/materials supplied from Japan and services rendered by the Japanese citizens engaged in the construction work

(6) Expedience on entrance permission and visa issuance to the Japanese citizens to be engaged in this project

(7) Assurance of the supplies of construction equipment/materials to be locally procured

3-2 Operation and Maintenance Plan

(1) Operation and Maintenance System

In operating and maintaining a diesel power generating facility, it is required to perform both routine inspection during plant operation and periodical inspections with the power plant shut- down.

The detailed inspection items will be presented in manuals submitted by manufacturers. The period of plant shut-down for periodical inspection depends on the length of time in which the power plant has been operated. Planning for periodical repair must be formulated by reference to the supply capacity of other generators and the demand/supply balance of the power system.

Each component of a diesel engine generator has a different inspection period. The time periods required for partial inspection and full inspection depends on the cumulative operating hours. When the time availability factor of the facility is estimated at 70% or so, the inspection frequency will be twice a year. A full periodical inspection must be performed once every two years.

Normally, a plant life of 20 years is expected when adequate maintenance and management are provided. However, the plant will require replacing thereafter. Four (4) units having an

installed capacity of 5.7 MW each have been in operation up to present in this Power Station (the GOE Power Station). Hence a satisfactory operation and maintenance plan can be retained without increasing the present number of personnel and the budget.

(2) The energy generation and revenue to be acquired by completion of this Project are expected to be as follows:

Generator output	5.7 MW
Annual energy generation (at bus bar)	34,950 MWh
Annual energy sale	26,034 MWh
Annual energy sales revenue	¥284 million (448 million G$)
Annual maintenance cost	¥215 million (339 million G$)

(At rate of G$17.2/kWh = ¥10.97/kWh)

The maintenance cost of this power generation facility includes fuel cost, labor cost, operation/repair cost and all other overheads.

The items constituting the maintenance cost of the GOE Power Station are presented below and these represent average annual cost over the 20 year plant life.

Fuel cost	¥113 million	(177 million G$)
Labor cost	¥ 2.5 million	(4.04 million G$)
Repair cost	¥ 30 million	(47 million G$)
Overheads	¥ 19.5 million	(31 million G$)
Depreciation	¥ 50 million	(78 million G$)
Total	¥215 million	(337 million G$)

As stated on the previous page, the annual maintenance cost is estimated at ¥215 million equivalent to G$337 million whereas it is expected that the amount of the annual energy sales revenue will be ¥284 million equivalent to the amount of G$448 million. Consequently, it will be possible that the annual maintenance cost

required for the maintenance and operation of the new 5.7 MW generating set will be appropriated out of the annual energy sales revenue without any difficulty.

CHAPTER 4

PROJECT EVALUATION

AND

RECOMMENDATION

Chapter 4 Project Evaluation and Recommendation

4-1 Project Effect

4-1-1 Present Situation and Points in Electric Power Sector

Guyana's present population is 768,000. The total installed capacity of GEC-owned power station 78.4 MW. The greater part of the population is distributed in Georgetown, the capital of Guyana, and along the coastal areas. In 1994, the generating facility capacity of the Demerara and Berbice power systems was 67.3 MW, about 86% of the entire GEC. Power is supplied to these areas, indicating that the Guyanese population and the generating facilities are concentrated in the vicinity of the capital.

The growth rate of the maximum demand is an average of 5.9% per year, increasing from 39.8 MW in 1989 to 53.1 MW in 1994 in the Demerara and Berbice power system. As described above, numerically, the generating installed capacity does presently exceed the maximum demand and there is sufficient power for the very immediate future. In actual fact, however, many stations become superannuated and their facility capacities cannot be fully displayed. Also, the actual generating capacity drops further due to delays in the power facility rehabilitation programme and unexpected accidents, etc.

This being the case, power supply is extremely short and there are frequent power stoppages in the Georgetown area, averaging 3.2 hours per day. Domestic power consumption in the Demerara and Berbice systems represents more than 50% of the total consumption. This is an extremely high ratio in comparison to other countries, directly and adversely affecting domestic life and causing undue inconvenience and suffering for the people.

4-1-2 Benefit Effect by Execution of This Project

(1) Direct effect

According to the representative results of May 12, 1995, the power stoppage time in the Demerara system averaged 3.2 hours per day in 27 districts. The execution of this Project will serve to increase the power supply, thereby balancing the power supply and demand to improve the 56% of suspended electric energy. It is planned to reduce the average stoppage time to 1.4 hours per day, less than half that at present.

The annual electric energy generation will be increased by about 35,000 MWh (availability factor, 70%) due to decreased power stoppage. This increase is equivalent to power consumption by 12% of the population of the Demerara and Berbice power system (approx. 660,000). Power sales revenue is expected to increase by 284 million (G$445 million). The thermal efficiency of the new generation facilities is high at 43% compared to that of existing generation facilities and yearly fuel cost amounting to 87 million (G$156.45 million) could be saved in comparison with the past standard.

(2) Indirect effect

This Project will increase supply by 5.7 MW. Although the generation scale is not large, it does represent 8.5% of the present possible station capacity (67.3 MW), and its increase rate is high. By elevating the availability factor of the new generation facilities with high supply reliability, the existing old facilities can be used as reserves and their service lives can be extended. Combinations of the new and old facilities will enable economic facility management and a stable power supply will serve to stabilize the living standards of the people and activate local industries.

4-1-3 Proof and verification of appropriateness

The financial condition of Guyana and GEC which is the state undertaking of the Guyanese power sector, now takes a slow turn for the better. However, the country still has enormous overseas debts and the rehabilitation of her existing electric facilities cannot be satisfactorily done. This also includes the development of new electric power sources. Planned power stoppage is done regularly and chronic power shortage continues.

This being the situation, this Project has paramount urgency to improve the civic life which is presently very adversely affected by power supply shortage.

Concerning management, maintenance and control of the generating facilities after completion of this Project, as GEC has managed generating facilities of the same scale for many years, it is felt that there will be no problems with mobilization of GEC personnel and outlay for maintenance and control.

The execution of this Project which will serve to improve civic life will, therefore, be a most effective endeavor. It is believed that the execution of this Project by means of grant aid will be appropriate and proper.

The direct benefit effect by execution of this Project is verified as below:

(1) Improved power stoppage time

According to the typical/actual records of May 12, 1995, the regular stoppage time in the Demerara system averages 3.2 hours per day in 27 districts. The suspended power supply totals 168,463 kwh.

Power supply increase per day after completion of this Project is shown below when the availability factor is set at 70%.

5,700 kW x 24 hours x 0.7 = 95,760 kWh

95,760 kWh/168,463 kWh = 0.56

56% of the suspended power supply is improved.

The average planned power stoppage time of 3.2 hours per day is subsequently improved to 1.4 hours per day.

{3.2 hours x (1 -0.56) = 1.4 hours}

(2) Increase in power sales revenue

The execution of this plan will decrease stoppage time and increase power supply. 284 million per year is expected as power sales revenue as detailed below:

Generated power

5,700 kw x 365 days x 24 hours x 0.7 (availability factor) = 34,950 MWh. Power consumed within the station (auxiliary consumption) and transmission loss rate are set at 26%.

Power sold per year

34,950 MWh x (1 -0.26) = 25,863 MWh

Average sale rate per kWh

G$ 17.2/kWh (Average unit sale rate of GEC electricity charges in 1995)

25,863 MWh x 17.2 G$/kWh = G$ 444,800 (x1000)

G$ 1 = ¥0.6376

G$ 444,800,000 x 0.6376 = ¥283,600,000 ≒ ¥284,000,000

(3) Saving of fuel cost

The fuel cost per annum, in case a standard (normal) thermal efficiency is taken, will be saved as given hereunder in comparison with existing power stations. The details are shown below:

Thermal efficiency: 26.2% 43%

860/0.262=2,282 860/0.43=2,000

Fuel consumption rate (kg/kwh)

3882/10,200=0.322 2000/10,200=0.196

The fuel consumption rate is thereby improved.

0.322 -0.196 = 0.126 (kg/kwh)

The availability factor of the existing old power stations is approx. 42% per year and the fuel cost is compared with that of a machine providing the same output as shown below:

5.7MW x 365 days x 24 hours x 0.42 (availability factor) = 20,971 MWh

= 21,000 MWh

Unit price of fuel oil in 1995 - US$49.1/BBL

1 BBL = 34.0727 gal. 1 gallon = 4.546 liters

US$49.1/BBL = US$0.31/liter

US$1 = ¥92.0

US$0.31/liter = ¥28.52/liter

Specific gravity of fuel oil = 0.8667

¥28.52/liter = ¥32.9/kg

Fuel cost is saved by;

0.126 x 21,000,000 x 32.9 = 87,053,000 ¥87 million

4-2 Recommendation

4-2-1 Problems

Field investigations showed no important external conditions liable to be adverse toward the ultimate realization of this Project. However, in view of the difficult power condition in the Demerara district, full cooperation, budgetary procedures for the allotted work, strict adherence to work schedules, etc. by GEC are necessary in order to complete the Project within the time limit.

4-2-2 Recommendation

(1) The GEC Demerara system was previously linked with the Versailles Power Station across the Demerara River by marine cable. Due to damage to this cable, the linkage is now disabled and it is an independent system. GEC must budget for the immediate recovery of the underwater cable to establish linkage of the Demerara system with the same emphasis as on the execution of this Project.

(2) The facilities under this Project are to be installed in the place of the retired #3 machine. This does, however, constitute a great hindrance in the removal of the #3 unit and in the installation of a new unit. A retirement plan for worn-out generating facilities in the GOE Power Station must be drawn up in order to prevent interference with the operation of existing machines when they are renewed in the

future.

(3) Guyana's power supply is entirely dependant on thermal power generation with the greater part being generated by diesel engine sets. No oil is produced in Guyana and all fuels depend on their importation. This situation has pressed the nation's finances. As Guyana does, however, have abundant water resources, the implementation of hydroelectric power generation is a very rational concept. However, a long 10-year period is required before hydro-power generation can be realized and, therefore, study must be started immediately toward that end.

(4) Approximately 50% of GEC's annual expenditure is for fuel, followed by repair and maintenance costs and personnel expenses. The business management departments of GEC's head office are staffed with a considerable number of people. These departments must be computerized to improve efficiency, cut labor cost and to rationalize GEC management so that GEC may be prepared for future private operation.

APPENDICES

Appendices

Appendix-1 Member List of the Survey Team

I. Members of the Basic Design Study Survey Team

(1) Team Leader		
	Mr. Katsumi Itagaki	Official, Grand Aid Div., Economic Cooperation Bureau Ministry of Foreign Affairs.
(2) Project Manager		
	Mr. Tetsuo Yabe	Official, First Basic Design Study Div., Grand Aid Study and Design Dept., Japan International Agency
(3) Chief Consultant		
	Mr. Masashi Mikuni	EPDC International Limited
(4) Equipment Planning		
	Mr. Yasuo Onda	EPDC International Limited
(5) Facilities Planning		
	Mr. Shoichi Ito	EPDC International Limited
Joined in Guyana		
	Mr. Morihiro Yoshida	First Secretary of the Japanese Embassy in Venezuela

II. Members of the Explanation for the Basic Design Study Report

(1) Team Leader		
	Mr. Tetsuo Yabe	Official, First Basic Design Study Div., Grand Aid Study and Design Dept., Japan International Cooperation Agency
(2) Chief Consultant		
	Mr. Masashi Mikuni	EPDC International Limited
(3) Equipment Planning		
	Mr. Yasuo Onda	EPDC International Limited
Joined in Guyana		
	Mr. Morihiro Yoshida	First Secretary of the Embassy of Japan in Venezuela

Appendix-2 Survey Schedule

I. Basic Design Study Survey Team

Mr. Katsumi Itagaki, Mr. Tetsuo Yabe	30, May 1995 to 12, June 1995
Mr. Masashi Mikuni, Mr. Shoichi Ito, Mr. Yasuo Onda	30, May 1995 to 02, July 1995
Mr. Morihiro Yoshida	01, June 1995 to 08, June 1995

Date	Activities
30, May (Tue.)	Lv. Tokyo Ar. New York
31, May (Wed.)	Lv. New York (Via Miami)
01, June (Thu.)	Ar. Caracas Ar. Georgetown Meeting of Survey Schedule
02, June (Fri.)	Courtesy call at GEC Submission and Explanation of Inception Report. Survey of Kingston Power Station.
03, June (Sat.)	Survey of GOE Power Station. Survey of Versailles Power Station.
04, June (Sun.)	Internal Meeting.
05, June (Mon.)	Courtesy call on the Prime Minister and Ministry of Foreign Affairs.
06, June (Tue.)	Discussion of Minutes of Discussion. Survey of Spare Parts at GOE Power Station.
07, June (Wed.)	Signing of Minutes of Discussion. Explanation of Questionnaire and Discussion of Plan of collectable Data.
08, June (Thu.)	Lv. Georgetown (Mr. K. Itagaki, Mr. T. Yabe). Survey of Present and Future Plan for Transmission and Substation.
09, June (Fri.)	Survey of Diesel Generation Facilities, Rehabilitation and Future Plan.
10, June (Sat.)	Data sorting
11, June (Sun.)	Data sorting
12, June (Mon.)	Study and data Collection regarding Electricity Tariffs.
13, June (Tue.)	Survey of Harbour Facilities and Transport Routes. Survey of Procurements for Constructors, Market Prices of Locally Available Materials and Labour Cost.
14, June (Wed.)	Survey of Facilities of Sophia Frequency Convertor and Load Dispatching Office. Inquiry about Financial Situation of GEC.

Date	Activities
15, June (Thu.)	Survey of Communication Facilities of Each Power Station and Substation.
16, June (Fri.)	Survey of Linden Power Station. Survey of Harbour Facilities and Transport Roots.
17, June (Sat.)	Internal Meeting.
18, June (Sun.)	Data Sorting.
19, June (Mon.)	Survey of Forecast on Power Demand and Development Plan(s).
20, June (Tue.)	- ditto -
21, June (Wed.)	- ditto -
22, June (Thu.)	Survey of Foundation of GOE Power Station. Preparation of Minutes of Discussions
23, June (Fri.)	Visit to IDB Guyana Office. Discussion of Minutes of Discussion.
24, June (Sat.)	Inquiry about Training System(s) for Personnel Engaged in Operation and Maintenance.
25, June (Sun.)	Data Sorting.
26, June (Mon.)	Signing of Minutes of Discussion.
27, June (Tue.)	Lv. Georgetown (via Port of Spain) Ar. Caracas
28, June (Wed.)	Report on Embassy of Japan in Venezuela the Outcome of the Team's Visit to Guyana.
29, June (Thu.)	Lv. Caracas (via Miami) Ar. Washington
30, June (Fri.)	Report to JICA U.S.A. Office concerned on the Outcome of the Team's Visit to Guyana.
01, July (Sat.)	Lv. Washington
02, July (Sun.)	Ar. Tokyo

II. Basic Design Study Explanation Team

Mr. Tetsuo Yabe (Project Manager)
Mr. Masashi Mikuni (Chief Consultant),
Mr. Yasuo Onda (Equipment Planning)
Mr. Morihiro Yoshida (First Secretary)

Date	Activities
03, Sep. (Sun.)	Lv. Tokyo Ar. New York
04, Sep. (Mon.)	Lv. New York Ar. Georgetown
05, Sep. (Tue.)	Courtesy call at GEC and relevant Authorities Concerned.
06, Sep. (Wed.)	Submission and Explanations of Draft Basic Design Study Report.
07, Sep. (Thu.)	Discussion of the Basic Design Study Report.
08, Sep. (Fri.)	Discussion of Minutes of Discussions in Draft Form.
09, Sep. (Sat.)	Survey of the GOE Power Station.
10, Sep. (Sun.)	Data sorting and Internal Meeting.
11, Sep. (Mon.)	Signing of Minutes of Discussions and Report to be Authorities Concerned on the Outcome of the Team's Visit to Guyana.
12, Sep. (The.)	Lv. Georgetown Ar. New York
13, Sep. (Wed.)	Lv. New York
14, Sep. (Thu.)	Ar. Tokyo
Mr. Morihiro Yoshida (First Secretary)	
02, Sep. (Sat.)	Lv. Caracas (via Port of Spain)
03, Sep. (Sun.)	Ar. Georgetown
04, Sep. (Mon.)	Preparations for Meeting with Government Officials Concerned.
05, Sep. (The.)	Courtesy call at GEC.
06, Sep. (Wed.)	Submission and Explanations of Draft Basic Design Study Report.
07, Sep. (Thu.)	Explanation and Consultation of Draft Basic Design Study Report.
08, Sep. (Fri.)	Lv. Georgetown (via Port of Spain) Ar. Caracas

Appendix-3 List of Party Concerned in the Recipient Country

Prime Minister of Guyana	
Hon. Samuel A. Hinds	Ministry of Public Works Communication and Regional Development
Ministry of Foreign Affairs	
Mrs. Cherryl Miles	Director General
Mr. Keenan Eliot	Head of Section
GEC	
Mr. Raymond Gaskin	Chairman
Mr. Robin Singh	Deputy General Manager
Mr. Wilfred Leander	Divisional Manager (Production)
Mr. Carlton de Haijle	Manager, System Planning Dept.
Mr. Munaf Hussein	Manager, Diesel Dept.
Mr. Ayubu Bacchus	Manager, GOE Power Station
Mr. V. Sampson	Kingstone B Power Station
Mr. A. Roache	Kingstone B Power Station
Mr. C. Standford	Manager, Commercial Dept.
Mr. Ken Kloss	Manager, System Control Dept. (SOFIA)
Mr. Georg Gllford	Manager, Trainning Dept.
GNRA (Guyana Natural Resources Aengcy)	
Mr. Joseph O' Lall	Executive Chairman
Guyana National Engineering Co.	
Mr. Albert Smith	Trafic Manager
IDI Engineering Co.	
Mr. Harish Persaud	Production Manager
IDB Guyana Office	
Mr. Charles Greenwood	Representative
Mr. Cristval Silva	Sectorial Specialist
IDB Washington Head Office	
Mr. Roberto Manrique	Economist, Finance and Basic Infrastructure Division 3
Embassy of Japan	
Mr. Heisuke Shinomiya	Councillor
Mr. Morihiro Yoshida	First Secretary
JICA U.S.A. Office	
Mr. Kouichi Miyoshi	Resident Representative
Mr. Kouichi Anada	Dupty Resident Representative
Mr. Shuichi Ideda	Dupty Resident Representative
Mrs. Wako Takahashi-Welch	Project Coordinator

Appendix-4 MINUTES OF DISCUSSIONS

4-1 Basic Design Study on the Project for the Improvement of Electricity in Demerara in the Co-operative Republic of Guyana

4-2 Basic Design Study on the Project for the Improvement of Electricity in Demerara in the Co-operative Republic of Guyana (Consultation on Draft Report)

4-3 Basic Design Study on the Project for the Improvement of Electricity in Demerara in the Co-operative Republic of Guyana (Discussions between GEC and EPDC International Ltd.)

Appendix 4-1

MINUTES OF DISCUSSIONS
BASIC DESIGN STUDY ON THE PROJECT FOR THE IMPROVEMENT OF ELECTRICITY GENERATION IN DEMERARA IN THE CO-OPERATIVE REPUBLIC OF GUYANA

In response to a request from the Government of the Co-operative Republic of Guyana, the Government of Japan decided to conduct a Basic Design Study on the Project for the Improvement of Electricity Generation in Demerara (hereinafter referred to as "the Project"), and entrusted the study to the Japan International Cooperation Agency (JICA).

JICA sent to Guyana a study team, which is headed by Mr. Katsumi ITAGAKI, Grant Aid Division, Economic Cooperation Bureau, Ministry of Foreign Affairs, and is scheduled to stay in the country from June 1st to June 27th, 1995.

The team held discussions with the officials concerned of the Government of The Co-operative Republic of Guyana and conducted a field survey at the study area.

In the course of discussions and field survey, both parties have confirmed the main items described on the attached sheets. The team will proceed to further works and prepare the Basic Design Study report.

Georgetown, June 7, 1995

Mr. Katsumi ITAGAKI
Leader
Basic Design Study Team
JICA

Mr. Rabindranauth SINGH
Deputy General Manager
Guyana Electricity Corporation

ATTACHMENT

1. Objective

The objective of the Project is to improve power generating facilities in the Demerara Area.

2. Project Site

The Project site is located at the Garden-of-Eden Power Station.

3. Executing Agency

Guyana Electricity Corporation (GEC) is responsible for the administration and execution of the Project.

4. Items requested by the Government of the Co-operative Republic of Guyana

After discussions with the Basic Design Study Team, the following item was finally requested by the Guyanese side.

One (1) unit of diesel alternator (5.7MW) along with auxiliary equipment, materials and their installation for the improvement of power generating facilities.

However, the final components of the Project will be decided after further studies.

5. Japan's Grant Aid System

(1) The Government of the Co-operative Republic of Guyana has understood the system of Japan's Grant Aid explained by the team, as described in ANNEX-I.

(2) The Government of the Co-operative Republic of Guyana will take the necessary measures described in ANNEX-II for the smooth implementation of the Project, on condition that the Grant Aid Assistance by the Government of Japan is extended to the Project.

6. Schedule of the Study

(1) The Consultants will proceed to further studies in Guyana until June 27, 1995.

(2) Based on the Minutes of Discussions and technical examination of the study results, JICA will prepare the draft report and dispatch a team to Guyana in order to explain its contents September 1995.

ANNEX-I

Japan's Grant Aid Scheme

1. Grant Aid Procedures

(1) Japan's Grant Aid Program is executed through the following procedures.

Application	(Request made by a recipient country)
Study	(Basic Design Study conducted by JICA)
Appraisal & Approval	(Appraisal by the Government of Japan and Approval by Cabinet)
Determination of Implementation	(The Notes exchanged between the Governments of Japan and the recipient country)

(2) Firstly, the application or request for a Grant Aid project submitted by a recipient country is examined by the Government of Japan (the Ministry of Foreign Affairs) to determine whether or not it is eligible for Grant Aid. If the request is deemed appropriate, the Government of Japan assigns JICA (Japan International Cooperation Agency) to conduct a study on the request.

Secondly, JICA conducts the study (Basic Design Study), using (a) Japanese consulting firm(s).

Thirdly, the Government of Japan appraises the project to see whether or not it is suitable for Japan's Grant Aid Program, based on the Basic Design Study report prepared by JICA, and the results are then submitted to the Cabinet for approval.

Fourthly, the project, once approved by the Cabinet, becomes official with the Exchange of Notes signed by the Governments of Japan and the recipient country.

Finally, for the implementation of the project, JICA assists the recipient country in such matters as preparing tenders, contracts and so on.

2. Basic Design Study

(1) Contents of the Study

The aim of the Basic Design Study (hereafter referred to as "the Study"), conducted by JICA on a requested project (hereafter referred to as "the Project") is to provide a basic document necessary for the appraisal of the Project by the Japanese Government. The contents of the Study are as follows:

a) Confirmation of the background, objectives, and benefits of the requested Project and also institutional capacity of agencies concerned of the recipient country necessary for the Project's implementation.

b) Evaluation of the appropriateness of the Project to be implemented under the Grant Aid Scheme from a technical, social and economic point of view.

c) Confirmation of items agreed on by both parties concerning the basic concept of the Project.

d) Preparation of a basic design of the Project

e) Estimation of costs of the Project

The contents of the original request are not necessarily approved in their initial form as the contents of the Grant Aid project. The Basic Design of the Project is confirmed considering the guidelines of Japan's Grant Aid Scheme.

The Government of Japan requests the Government of the recipient country to take whatever measures are necessary to ensure its self-reliance in the implementation of the Project. Such measures must be guaranteed even though they may fall outside of the jurisdiction of the organization in the recipient country actually implementing the Project. Therefore, the implementation of the Project is confirmed by all relevant organizations of the recipient country through the Minutes of Discussions.

(2) Selection of Consultants

For the smooth implementation of the Study, JICA uses (a) registered consultant firm(s). JICA selects (a) firm(s) based on proposals submitted by interested firms. The firm(s) selected carry(ies) out a Basic Design Study and write(s) a report, based upon terms of reference set by JICA. The consulting firm(s) used for the Study is(are) recommended by JICA to the recipient country to also work on the Project's implementation after the Exchange of Notes, in order to maintain technical consistency and also to avoid any undue delay in implementation should the selection process be repeated.

Japan's Grant Aid Scheme

(1) What is Grant Aid?

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

(2) Exchange of Notes (E/N)

Japan's Grant Aid is extended in accordance with the Notes exchanged by the two Governments concerned, in which the objectives of the Project, period of execution, conditions and amount of the Grant Aid, etc., are confirmed.

(3) "The period of the Grant Aid" means the one fiscal year which the Cabinet approves the Project for. Within the fiscal year, all procedures such as exchanging of the Notes, concluding contracts with (a) consultant firm(s) and (a) contractor(s) and final payment to them must be completed. However in case of delays in delivery, installation or construction due to unforeseen factors such as weather, the period of the Grant Aid can be further extended for a maximum of one fiscal year at most by mutual agreement between the two Governments.

(4) Under the Grant Aid, in principle, Japanese products and services including transport or those of the recipient country are to be purchased.

When the two Governments deem it necessary, the Grant Aid may be used for the purchase of the products or services of a third country.

However the prime contractors, namely, consulting constructing and procurement firms, are limited to "Japanese nationals". (The term "Japanese nationals" means persons of Japanese nationality or Japanese corporations controlled by persons of Japanese nationality.)

(5) Necessity of "Verification"

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

(6) Undertakings required of the Government of the Recipient Country

In the implementation of the Grant Aid project, the recipient country is required to undertake such necessary measures as the following:

1) To secure land necessary for the sites of the Project and to clear, level and reclaim the land prior to commencement of the construction.

2) To provide facilities for the distribution of electricity, water supply and drainage and other incidental facilities in and around the sites.

3) To secure buildings prior to the procurement in case the installation of the equipment.

4) To ensure all the expenses and prompt execution for unloading, customs clearance at the port of disembarkation and internal transportation of the products purchased under the Grant Aid.

5) To exempt Japanese nationals from customs duties, internal taxes and other fiscal levies which will be imposed in the recipient country with respect to the supply of the products and services under the Verified Contracts.

6) To accord Japanese nationals whose services may be required in connection with the supply of the products and services under the Verified Contracts, such facilities as may be necessary for their entry into the recipient country and stay therein for the performance of their work.

7) "Proper Use"

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

8) "Re-export"

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

9) Banking Arrangements (B/A)

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

b) The payments will be made when payment requests are presented by the Bank to the Government of Japan under an authorization to pay issued by the Government of the recipient country or its designated authority.

ANNEX-II

Necessary measures to be taken by the Government of the Co-operative Republic of Guyana in case Japan's Grant Aid is extended to the Project.

1. To provide data and information necessary for the Project.

2. To secure land for the sites of the Project.

3. To clear the sites prior to commencement of the construction.

4. To provide facilities for distribution of electricity, water supply, drainage and other incidental facilities outside the site.

5. To bear commissions to the Japanese foreign exchange bank to execute the banking services based upon the Banking Arrangement.

6. To ensure prompt unloading and customs clearance at port(s) of disembarkation in Guyana and facilitate internal transportation therein of the products purchased under the Grant.

7. To exempt Japanese nationals from customs duties, internal taxes and other fiscal levies which may be imposed in Guyana with respect to the supply of the products and services under the Verified Contract(s).

8. To accord Japanese nationals whose services may be required in connection with the supply of the products and the services under the Verified Contract(s), such facilities as may be necessary for their entry into Guyana and stay therein for the performance of their work.

9. To assign the necessary staff and secure the necessary budget for operation and maintenance of the equipment purchased under the Grant.

10. To maintain and use properly and effectively the equipment and materials purchased under the Grant.

11. To purchase necessary spare parts by GEC's own budget after one (1) year of completion of the Project and to execute periodical overhaul.

12. To maintain the control of funds and spare parts purchased under the Grant.

13. To bear all the expenses other than those to be borne by the Grant Aid, necessary for construction of the facilities as well as for the transportation and the installation of the equipment in the Project site.

14. To improve management and administration of GEC.

Appendix 4-2 MINUTES OF DISCUSSIONS

BASIC DESIGN STUDY ON THE PROJECT FOR THE IMPROVEMENT OF ELECTRICITY GENERATION IN DEMERARA IN THE CO-OPERATIVE REPUBLIC OF GUYANA

(CONSULTATION ON DRAFT REPORT)

In June 1995, the Japan International Cooperation Agency (hereinafter referred to as "JICA") dispatched a Basic Design Study team on the Project for the Improvement of Electricity Generation in Demerara (hereinafter referred to as "the Project") to the Co-operative Republic of Guyana, and through discussions, field survey, and technical examination of the results in Japan, has prepared the draft report of the study.

In order to explain and to consult the Guyanese side on the components of the draft report, JICA sent to Guyana a study team, which is headed by Mr. Tetsuo Yabe, First Basic Design Study Division, Grant Aid Study & Design Department, JICA, and is scheduled to stay in the country from September 4 to 12, 1995.

As a result of discussions, both parties confirmed the main items described on the attached sheets.

Georgetown, September 11, 1995

Mr. Tetsuo Yabe
Leader
Draft Report Explanation Team
JICA

Mr. Rabindranauth SINGH
Deputy General Manager
Guyana Electricity Corporation

ATTACHMENT

1. Components of draft report

The Government of Guyana has agreed and accepted in principle the components of the draft report proposed by the team.

2. Japan's Grant Aid System

(1) The Government of Guyana has understood the system of Japanese Grant Aid explained by the team, as described in ANNEX-I.

(2) The Government of Guyana will take the necessary measures, described in ANNEX-II for the smooth implementation of the Project on condition that the Grant Aid assistance by the Government of Japan is extended to the Project.

3. Further Schedule

The team will make the Final Report in accordance with the confirmed items, and send it to the Government of Guyana by the end of December, 1995.

ANNEX-I

Japan's Grant Aid Scheme

1. Grant Aid Procedures

(1) Japan's Grant Aid Program is executed through the following procedures.

Application	(Request made by a recipient country)
Study	(Basic Design Study conducted by JICA)
Appraisal & Approval	(Appraisal by the Government of Japan and Approval by Cabinet)
Determination of Implementation	(The Notes exchanged between the Governments of Japan and the recipient country)

(2) Firstly, the application or request for a Grant Aid project submitted by a recipient country is examined by the Government of Japan (the Ministry of Foreign Affairs) to determine whether or not it is eligible for Grant Aid. If the request is deemed appropriate, the Government of Japan assigns JICA (Japan International Cooperation Agency) to conduct a study on the request.

Secondly, JICA conducts the study (Basic Design Study), using (a) Japanese consulting firm(s).

Thirdly, the Government of Japan appraises the project to see whether or not it is suitable for Japan's Grant Aid Program, based on the Basic Design Study report prepared by JICA, and the results are then submitted to the Cabinet for approval.

Fourthly, the project, once approved by the Cabinet, becomes official with the Exchange of Notes signed by the Governments of Japan and the recipient country.

Finally, for the implementation of the project, JICA assists the recipient country in such matters as preparing tenders, contracts and so on.

2. Basic Design Study

(1) Contents of the Study

The aim of the Basic Design Study (hereafter referred to as "the Study"), conducted by JICA on a requested project (hereafter referred to as "the Project") is to provide a basic document necessary for the appraisal of the Project by the Japanese Government. The contents of the Study are as follows:

a) Confirmation of the background, objectives, and benefits of the requested Project and also institutional capacity of agencies concerned of the recipient country necessary for the Project's implementation.

b) Evaluation of the appropriateness of the Project to be implemented under the Grant Aid Scheme from a technical, social and economic point of view.

c) Confirmation of items agreed on by both parties concerning the basic concept of the Project.

d) Preparation of a basic design of the Project

e) Estimation of costs of the Project

The contents of the original request are not necessarily approved in their initial form as the contents of the Grant Aid project. The Basic Design of the Project is confirmed considering the guidelines of Japan's Grant Aid Scheme.

The Government of Japan requests the Government of the recipient country to take whatever measures are necessary to ensure its self-reliance in the implementation of the Project. Such measures must be guaranteed even though they may fall outside of the jurisdiction of the organization in the recipient country actually implementing the Project. Therefore, the implementation of the Project is confirmed by all relevant organizations of the recipient country through the Minutes of Discussions.

(2) Selection of Consultants

For smooth implementation of the Study, JICA uses (a) registered consultant firm(s). JICA select (a) firm(s) based on proposals submitted by interested firms. The firm(s) selected carry(ies) out a Basic Design Study and write(s) a report, based upon terms of reference set by

JICA. The consulting firm(s) used for the Study is(are) recommended by JICA to the recipient country to also work on the Project's implementation after the Exchange of Notes, in order to maintain technical consistency and also to avoid any undue delay in implementation should the selection process be repeated.

3. Japan's Grant Aid Scheme

(1) What is Grant Aid?

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

(2) Exchange of Notes (E/N)

Japan's Grant Aid is extended in accordance with the Notes exchanged by the two Governments concerned, in which the objectives of the Project, period of execution, conditions and amount of the Grant Aid, etc., are confirmed.

(3) "The period of the Grant Aid" means the one fiscal year which the Cabinet approves the Project for. Within the fiscal year, all procedures such as exchanging of the Notes, concluding contracts with (a) consultant firm(s) and (a) contractor(s) and final payment to them must be completed. However in case of delays in delivery, installation or construction due to unforeseen factors such as weather, the period of the Grant Aid can be further extended for a maximum of one fiscal year at most by mutual agreement between the two Governments.

(4) Under the Grant Aid, in principle, Japanese products and services including transport or those of the recipient country are to be purchased.

When the two Governments deem it necessary, the Grant Aid may be used for the purchase of the products or services of a third country.

However the prime contractors, namely, consulting constructing and procurement firms, are limited to "Japanese nationals". (The term "Japanese nationals" means persons of Japanese nationality or Japanese corporations controlled by persons of Japanese nationality.)

(5) Necessity of "Verification"

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

(6) Undertakings required of the Government of the Recipient Country

In the implementation of the Grant Aid project, the recipient country is required to undertake such necessary measures as the following:

1) To secure land necessary for the sites of the Project and to clear, level and reclaim the land prior to commencement of the construction.

2) To provide facilities for the distribution of electricity, water supply and drainage and other incidental facilities in and around the sites.

3) To secure buildings prior to the procurement in case the installation of the equipment.

4) To ensure all the expenses and prompt execution for unloading, customs clearance at the port of disembarkation and internal transportation of the products purchased under the Grant Aid.

5) To exempt Japanese nationals from customs duties, internal taxes and other fiscal levies which will be imposed in the recipient country with respect to the supply of the products and services under the Verified Contracts.

6) To accord Japanese nationals whose services may be required in connection with the supply of the products and services under the Verified contracts, such facilities as may be necessary for their entry into the recipient country and stay therein for the performance of their work.

7) "Proper Use"

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

8) "Re-export"

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

9) Banking Arrangements (B/A)

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

b) The payments will be made when payment requests are presented by the Bank to the Government of Japan under an authorization to pay issued by the Government of the recipient country or its designated authority.

ANNEX-II : Necessary Measures to be taken by the Government of the Co-operative Republic of Guyana in case Japan's Grant Aid is extended to the Project

(1) To provide data and information necessary for the Project.

(2) To secure land for the sites of the Project.

(3) To clear the sites prior to commencement of the construction.

(4) To provide facilities for distribution of electricity, water supply, drainage and other incidental facilities outside the site.

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

(6) To ensure prompt unloading and customs clearance at port(s) of disembarkation in Guyana and facilitate internal transportation therein of the products purchased under the Grant.

(7) To exempt Japanese nationals from customs duties, internal taxes and other fiscal levies which may be imposed in Guyana with respect to the supply of the products and services under the Verified Contract(s).

(8) To accord Japanese nationals whose services may be required in connection with the supply of the products and the services under the Verified Contract(s), such facilities as may be necessary for their entry into Guyana and stay therein for the performance of their work.

(9) To assign the necessary staff and secure the necessary budget for operation and maintenance of the equipment purchased under the Grant.

(10) To maintain and use properly and effectively the equipment and materials purchased under the Grant.

(11) To purchase necessary spare parts by GEC's own budget after one (1) year of completion of the Project and to execute periodical overhaul.

(12) To maintain the control of tools and spare parts purchased under the Grant.

(13) To bear all the expenses other than those to be borne by the Grant Aid, necessary for construction of the facilities as well as for the transportation and the installation of the equipment in the Project area.

(14) To improve management and administration of GEC.

(15) To bear all the expenses associated with the following tasks and to complete these same tasks by the end of June 1996:

(a) Preparation and clearing of the land for the new expansion unit

(b) Preparation of the access road on the power station premises and

(c) Demolition and removal of the southern wall, with exception to the main supportive beams, of the existing power station.

Appendix 4-3

MINUTES OF DISCUSSIONS
BASIC DESIGN STUDY ON THE PROJECT FOR THE IMPROVEMENT OF ELECTRICITY GENERATION IN DEMERARA IN THE CO-OPERATIVE REPUBLIC OF GUYANA.

A Consultant Team held discussions with Guyana Electricity Corporation (GEC) and conducted a field survey at the study area from June 8th to June 26th, 1995.

In the course of discussion and field survey, both parties have confirmed the main items described on the attached sheets.

The team will proceed to further works and prepare the Basic Design Study report.

Georgetown, June 26th, 1995.

Mr. Masashi Mikuni
Chief Consultant
Basic Design Study Team
JAPAN INTERNATIONAL
COOPERATION AGENCY

Mr. Rabindranauth Singh
Deputy General Manager
GUYANA ELECTRICITY
CORPORATION

ATTACHMENT

1. One (1) unit of Diesel Alternator (5.7 MW) along with auxiliary equipment shall be installed at a new position that is south of the existing unit No.5 at the Garden-of-Eden power station.

2. GEC shall be responsible for removing the southern wall at the Garden-of-Eden power station to facilitate the extension southwards for the new equipment from GEC's own budget.

3. The GEC shall be responsible for the construction of an access road to the new place for the 5.7MW set from the GEC's own budget.

4. The GEC shall be responsible for the clearing and levelling of the area where the new 5.7MW Diesel Generator is to be located from the GEC's own budget.

5. The final components and installation of the Project have been decided by both parties as follows:

Requested	Decided
1) 2 Diesel Alternators at 5 MW each.	1) One Diesel Alternator at 5.7 MW.
2) Auxiliaries for Units	2) Auxiliaries for Units
3) Engine Control Equipment	3) Engine Control Equipment
4) Alternator Control Equipment.	4) Alternator Control Equipment.
5) Switchgear & Protection Equipment.	5) Switchgear & Protection Equipment.
6) Step-up Transformer	6) ---
7) 69 KV Circuit Breaker	7) ---
8) Substation Buswork	8) ---
9) Take off Structures	9) ---
10) Communication Sets	10) ---

6. The following items have been discussed by both sides:

(1) THE POSITION AND ITS RELATION WITH HIGHER LEVEL PLANS INCLUDING POWER DEVELOPMENT PLAN(S) ON A NATIONAL LEVEL

The GUYANA ELECTRICITY CORPORATION is the only power utility in Guyana which supplies electricity to the wider communities along the coasts including an island on the Essequibo River. Other electric power producers, namely the Sugar Estates and the Bauxite Mining Industry, produce and distribute electric power only to their operations and immediate environs. In the case of the Linmine Bauxite Industry, the latter distributes electricity to the Linden community and on occasions sell electricity to the GEC System whenever there is a generation shortfall in the latter system.

GEC's immediate generation goals are to rapidly conclude the rehabilitation of its existing plant under an existing rehabilitation programme and to acquire additional generating capacity so that minimum electric power reserve can be attained, thus eradicating planned power outages which currently prevail.

An Integrated Investment Programme Report prepared in 1991 by the Canadian International Power Services, Inc. formed the basis of a 20-year development plan to the year 2000 for the GEC Demerara/Berbice Interconnected System until the advent of the adoption of the Guyana National Energy Policy in 1994. Deliberations are now in progress on coordinating the Integrated Investment Program with Guyana's National Energy Policy.

Actual load growth shall determine timing of the implementation of the Integrated Investment Program.

(2) DEVELOPMENT PLAN(S) FOR HIGH HYDRO-POWER POTENTIALITY IN THE COUNTRY

The Integrated Investment Program prepared for the GEC does not include any investment in hydro-power. However, the Hydro-Power Unit of the Guyana Natural Resources Agency (GNRA) (in coordination with the Guyana National Energy Authority (GNEA) and the National Energy Policy Committee) is currently engaged in the preparation of a hydro-power development plan proposal for subsequent approval by Cabinet. The preliminary proposal (now undergoing a detailed review and scrutiny), shortlists six hyrdo-power development sites and recommends

for first implementation, the site at Tiger Hill on the Demerara River. Source of funding for the latter is yet to be determined.

(3) CONFORMITY OF THE EQUIPMENT AND FACILITIES REQUESTED AND TECHNICAL CAPABILITY OF GEC ENGINEERS TO OPERATE AND MAINTAIN

The existing generator units at the Garden-of-Eden Station are all of rating 5.7 Megawatts. In addition, one of the units is of Japanese manufacture, namely Niigata Engineering Co. Ltd., and was in operation since 1991. As such, GEC engineers and Technicians have by now acquired the ability to operate and maintain such equipment.

(4) HISTORICAL BACKGROUND OF INSTALLATION OF THE EQUIPMENT AND FACILITIES AT THE POWER STATION AND NAME OF DONOR COUNTRY AND DONOR AGENCY

The Garden-of-Eden (GOE) Power Station was established in 1976 during the electricity Power System expansion programme then underway on the Guyana Coast. The station comprised 4 x 5.7 MW Units, namely Nos. 2, 3, 4 and 5. The expansion programme was funded jointly by the Canadian International Development Agency and a British financial Institution.

A GEC rehabilitation program, financed jointly by a loan from the Inter-American Development Bank and counterpart funding from the Government of Guyana commenced in 1988 and only three units at the GOE Power Station, namely the Nos. 2, 3 and 4, were included for rehabilitaion at this station. Only four power stations, inclusive of GOE, were covered under the scope of the rehabilitation programme. The No.5 unit was retired by then.

In 1991, the retired No.5 unit was replaced by a 1 x 5.7 MW Japanese, Niigata unit. This was provided under Grant Aid by the Government of Japan via the Japan International Co-operation Agency.

These four units now comprise the equipment installed at the Power Station.

(5) DEGREE OF DETERIORATION OF THE EQUIPMENT AND FACILITIES

Kingston Gas Turbines

The two 10 MW units are currently out of order due to damage Turbine Blades.

Garden-of-Eden Power Station

The No.2 unit at this station is currently undergoing major rehabilitation. The No.3 unit is out of order due to a saddle alignment defect and has since been cannibalized for spares. The No.4 unit is operable but derated from 5.7 MW to 3.0 MW owing to abnormal exhaust temperatures and an inefficient turbocharger. The No.5 unit is also operable but derated from 5.7 MW to 4 MW owing to a limitation caused by remedial work done to the crankpin.

Versailles Power Station

The three Niigata units at this station are operable and capable of 1.6 MW each.

Ouverwagt Power Station

The sole unit at this station is operable and capable of 2.5 MW.

Canefield Power Station

The two units at this station are operable and capable of 5.7 MW.

(6) REHABILITATION PLAN OF THE FACILITIES WHICH ARE CURRENTLY NOT OPERATIVE

The following facilities are not currently operative:

1. Nos. 1 & 2 Gas Turbines at Kingston Power Station
2. Nos. 2 & 3 Units at Garden-of-Eden Power Station

Kingston Gas Turbines Nos. 1 & 2

The unavailability of funding and the age of the No.2 set has resulted in the GEC not considering the unit's rehabilitation a priority. Final rehabilitation works on the No.1 set are currently in progress. This set is scheduled to be in operation by the latter part of June 1995.

Garden-of-Eden No.2 and No.3 Units

Rehabilitation of the No.2 Unit at this station is currently in progress and is scheduled to be completed in July 1995. The unavailability of funding and the extent of the defect on the No.3 Unit has resulted in the GEC not considering the unit's rehabilitation a priority.

(7) SURVEY ON ENVIRONMENT IMPACT ASSESMENT IN GUYANA

The Government of Guyana are currently deliberating on the enactment of laws governing protection of the environment. As such, no laws exist at present on emmisions, noise and water pollution as such relates to the operation of power plants.

(8) ROAD CONDITIONS - WHETHER IT IS POSSIBLE TO BRING THE EQUIPMENT AND FACILITIES TO GARDEN-OF-EDEN POWER STATION

Existing road conditions satisfactorily permit the transportation of equipment and facilities from Georgetown (or East Bank of Demerara) to the Garden-of-Eden Power Station.

(9) AVAILABILITY AND TECHNICAL LEVEL OF LOCAL CONTRACTORS FOR INSTALLATION OF EQUIPMENT

Engineering and installation/construction contractors of the requisite technical skill level are available locally. Some have even been involved in similar works already.

(10) SURVEY ON MANAGEMENT AND MAINTENANCE SYSTEM OF GUYANA ELECTRICITY CORPORATION

BUDGET
MANAGEMENT SYSTEM (AUTHORIZATION OF APPROVAL AND PERMISSION)
MANAGEMENT CONDITIONS (ELECTRICITY CHARGE COLLECTION SYSTEM: RATIO OF COLLECTION AGAINST BILLING, FINANCIAL SHEETS)
TRAINING PLAN FOR MAINTENANCE STAFF.

Budget

Every department in the GEC prepare estimates of expenditure of a recurrent nature for the following year in the preceding year. These estimates are reviewed and considered in relation to forecasted sales revenue. Subsequent to this review, a final operating budget is prepared.

Copies of Operating Budgets for the years 1993, 1994 and 1995 were made available to the Japanese EPDC|Consultants.

Management System

Copies of the GEC Organisation Structure, recently approved by the GEC Board, were made available to the EPDC|Consultants.

Management Conditions

Financial Statements for the years 1991, 1992, 1993 and 1994 have been made avaialble to the Japanese EPDC/Consultants. Also data on Collection and Billing for the same period was provided to the Consultants. The system of meter reading, consumer account coding and consumption scrutiny, bill preparation, bill issuing, payment locations and payment facilities were explained to the Consultants. An existing Training Plan for Maintenance staff was made available to the Consultants.

(11) SURVEY ON MANAGEMENT AND MAINTENANCE SYSTEM OF GARDEN-OF-EDEN POWER STATION

BUDGET
IN PARTICULAR, THE PRESENT STATUS OF OPERATION AND MAINTENANCE OF 5.7 MW DIESEL GENERATOR WHICH WAS PROCURED AND INSTALLED AT POWER STATION UNDER THE GRANT AID PROGRAM OF JAPANESE GOVERNMENT IN 1989.

Budget

It was explained to the EPDC/Consultants; that the maintenance budgets were compiled from the maintenance plan for each unit at the station; that the maintenance manuals for the units were used to compile the maintenance plan; and these maintenance cost estimates were added to the other operating costs to arrive at the budget for the particular year.

Operating budgets for the years 1991, 1992, 1993 and 1994 for the Garden-of-Eden Power Station were made available to the Japanese EPDC/Consultants.

Status of No.5 Unit (Grant Aid - 1 x 5.7 MW DG)

This unit is operable at present but has been derated from 5.7 MW to 4.0 MW owing to repair work done to the crankpin.

The report on the necessity for repair work to the crankpin has been made available to the Japanese EPDC/Consultants.

(12) QUESTIONNAIRE AND REQUEST FOR PROVISION OF DATA AND INFORMATION (LATEST)

All information (most recent) requested on the questionnaire have been provided to the Japanese EPDC/Consultants.

Appendix-5 Costs Estimation Borne by the Recipient Country

The estimates costs to be borne by the Guyana Electricity Corporation are as follows:

(1) Preparation and cleaning of the land for the expansion unit

G$176,546 (¥113,324)

(2) Preparation of access road on power stationpremises

G$1,210,254 (¥776,862)

(3) Demolition and removal of southern wall of existing power station

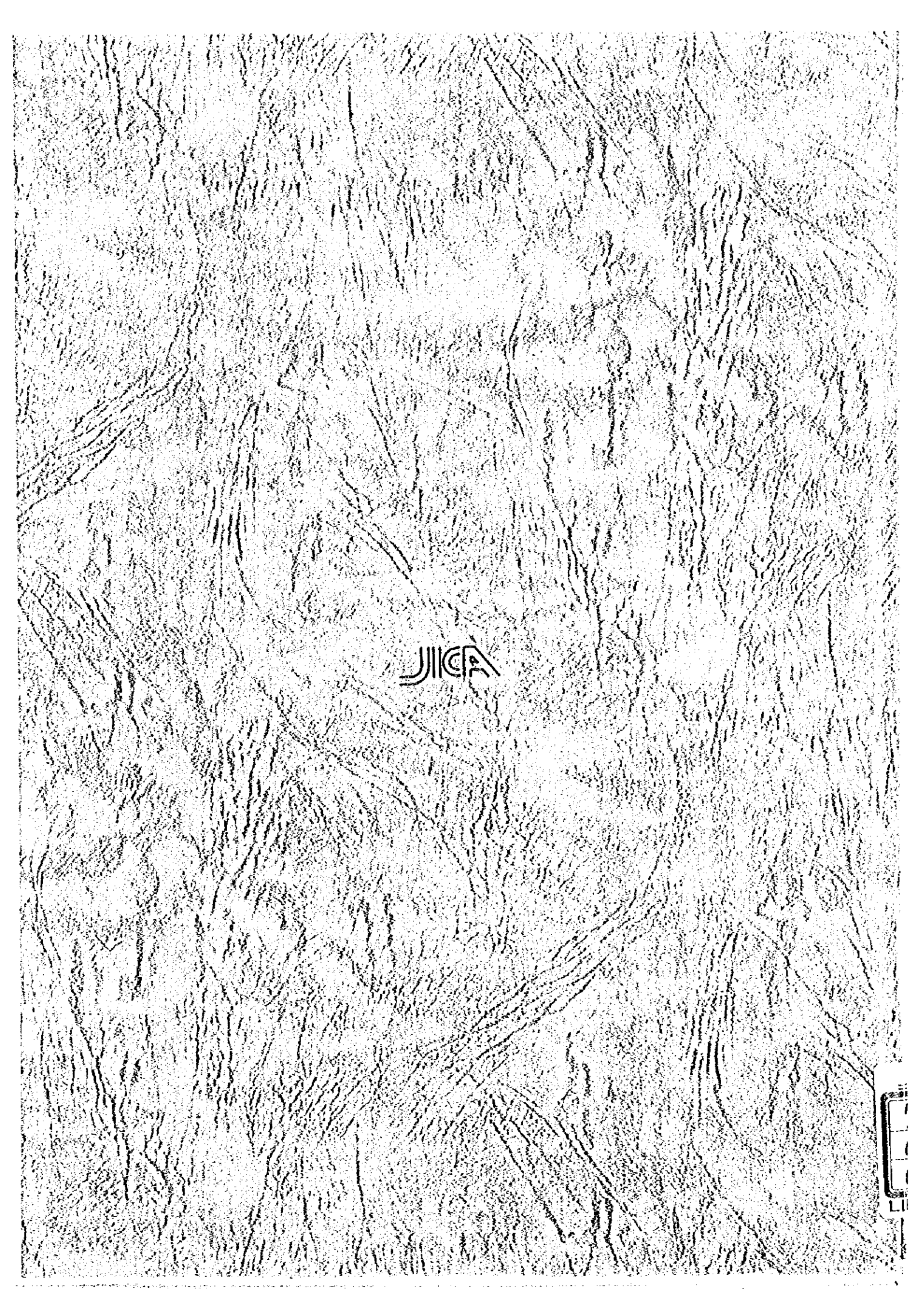
G$160,496 (¥103,022)

Total G$1,547,296 (¥993,208)

Appendix-6 List of Collected Data

No	Name / Title of Data	Issued by	Size	Page	Date
1	LOAN 853/SF-GY-GEC REHABILITATION PROGRAMME-FINACIAL STATUS REPORT		A4	4	5.31.'95
2	GEC/IDB REHABILITATION PROGRAMME-PROJECT EXCUTING UNIT-CONDENSED REPORT FOR THE MONTH OF : MAY 1995		A4	2	6.06.'95
3	ELECTRICAL TARIF	GEC	A4	1	—
4	GEC MANAGEMENT STRUCTURE	GEC	A4	1	3.29.'95
5	GENERATION CAPACITY CAPABILITY FORCAST/ SUPPLY BALANCE	GEC	A4	1	—
6	Transmission Line	GEC	A4	1	—
7	Transformer Capacities of Substation	GEC	A4	1	—
8	Installed Capacity of Existing Power Plant (As of May 1995)	GEC	A4	3	—
9	ORGANISATION STRUCTURE FOR GARDEN OF EDEN POWER STATION	GEC	A4	1	8.23.'95
10	EQUIPMENT/SKILL HIRE RATE	IDI Engineering 10	A4	1	6.13.'95
11	LIST OF PREVIOUS WORK DONE	IDI Engineering 10	A4	1	
12	OUTLINE OF GUYANA NATIONAL ENGINEERING CO.LTD. TRAFIC DEPARTMENT PROFILE	GUYAN NATIONAL ENGINEERING CO.LTD	A4	7	
13	PRODUCTS AND SERVICE OFFERED BY IDI ENGINEERING LTD	IDI Engineering Co.	A4	3	6.13.'95
14	PLAN/ACTUAL ELECTRICITY INTERRUPTION	GEC	A4	1	5.13.'95
15	DAILY LOAD CURVE-INTERCONNECTION SYS.	GEC	A4	1	6.13.'95
16	PLANNED MECHANICAL MAINTENANCE (1990-1995) GARDEN OF EDEN P/S	GEC	A4	7	5.31.'95
17	No. of Employees of GEC	GEC	A4	1	6.14.'95
18	Demerara/Barbice Interconnected System Peak Demand — 1994	GEC	A4	1	
19	MAINTENANCE FORECAST (1991-1994)	GEC	A4	50	2.28.'95
20	SYSTEM DATA FOR PROPOSED PROTECTION STUDY		A4	60	6 -'95

21	DRAFT ENERGY POLICY OF GUYANA	THE NATIONAL ENERGY POLICY COMMITTEE	A4	64	7 - '95
22	OPERATION AND MAINTENANCE EXPENSES POWER PRODUCTION EXPENSES (1991-1994)	GEC	A4		
23	MAINTENANCE BUDGETS & SCHEDULES FOR 1992	GEC	A4	18	10.8.'95
24	STATEMENT OF REVENU AND EXPENDITURE FOR THE YEAR ENDED 31 DEC. 1991-1993	GEC	A4	6	
25	PROFIT AND LOSS STATEMENT FOR THE PERIOD ENDED DEC. 1994	GEC	A4	2	
26	GENERATION EXPENDITURE	GEC	A4	1	
27	DISCUSSION WITH JAPANESE EPDC CONSULTANTS	GEC	A4	2	6.19.'95
28	Price For Construction Materials	IDI ENGINEERING LTD	A4	1	6.21.'95
29	ENGINE/GENERATOR BLOCK FOUNDATION		A1	1	1.15.'70
30	MAIN BUILDING & ENGINE/GENERATOR BLOCK PILING ARRANGEMENT		A1	1	12.21.'70
31	BALANCE SHEET AS AT DECEMBER 1994	GEC	A4	1	
32	GUYANA Statistical Bulletin VOL.3 NO. 4	Bureau of Statistics	A4	72	12 '94
33	STATISTICAL BULLETIN	BANK OF GUYANA	A4	50	12 '94
34	DIESEL POWER PLANT OPERATION & MAINTENANCE COURCE	GEC	A4	4	
35	GENERATION STATISTICS DEM/BER INTER-CONNECTED SYSTEM, ISOLATED SYSTEM (1994)	GEC	A4	3	
36	COLLECTION/REVENUE ANALYSIS	GEC	A4	4	6.22.'95
37	FUEL PURCHASE FOR THE YEARS 1991 TO 1994	GEC	A4	1	6.22.'95
38	1995 OPERATING BUDGET (REVISED)	GEC	A4	31	
39	ACTUAL ADJUSED REVENUE & KILOWATTS 1992-1994		A3	42	
40	ORGANIZATION REPUBLIC OF GUYANA		A4	1	6 '95
41	Petroleum Product Imports & Retail Price				
42	LOAN CONTRACT IDB AND GUYANA (Rehabilitation Program)		A4	50	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