

5-3 Basic Design

(1) Planning of Facilities

(A) Line Routes

As a result of the field Survey Report, the line routes planned are as follows:

Line Routes	22 kV	22kV/LV	LV	Location
<u>Upolu island</u>				
Tanugamanono-Siumu	16 km	9 km	3 km	(1)
Lotofaga-Amaile	7 km	15 km	21 km	(2)
Saluafata-Sauniatu	3 km	4 km	7 km	(3)
Siusega-Tamumalala	13 km	6 km	9 km	(4)
Aleisa-Saleimoa	4 km	3 km	3 km	(5)
Nuu-Faleula	0 km	3 km	2 km	(6)
Lepale-Fasitoota	4 km	3 km	3 km	(7)
Satuimalufilufi-Satapuala	5 km	8 km	7 km	(8)
Total Upolu Island	52 km	51 km	55 km	
<u>Savaii island</u>				
Puapua-Samalaeulu	10 km	7 km	1 km	(9)
Sasina-Matavai	16 km	9 km	1 km	(10)
Tafutafoe	5 km	2 km	1 km	(11)
Tafuauta-Tafuatai	3 km	12 km	4 km	(12)
Total Savaii Island	34 km	31 km	7 km	
Ground Total	86 km	82 km	62 km	

22 kV Lines : About 168 km

LV Lines : About 144 km

The locations of the respective lines are as shown on map
Appendix 3-1 "Planned Lines"

(B) Power Demand Forecast

(i) Power Demand Forecast on Upolu Island

Generated energy, sold energy and numbers of consumer in Upolu island from 1982 to 1988 are as shown on Appendices 5-1 "Generated Power", 5-2 "Sold Energy" and 5-3 "Numbers of Consumers". Generated energy and sold energy in 1988 were 40.6 GWh and 35.1 GWh respectively and the peak demand was 8,137 kW on the assumption that the load factor in 1988 was 57 %.

The power demand in 2000, 10 years after the completion of the Project in 1991, has been forecast using the following assumptions;

Domestic demand

Annual increment of population	1.0%
Electrification ratio of First Phase	88.8%
Electrification ratio of Second Phase	92.0%
Numbers of families per consumer	11

Industrial demand

Annual average demand increase	6.6%
Increment ratio of consumers	1.0%
Annual demand increase per consumer	5.6%

Commercial demand

Annual average demand increase	5.6%
Increment ratio of consumer	1.2%
Annual demand increase per consumer	3.4%

Hotel demand

Annual average demand increase	5.0%
Increment ratio of consumers	1.0%
Annual demand increase per consumer	4.0%

Religious demand

Annual average demand increase	11.9%
Increment ratio of consumers	1.2%
Annual demand increase per consumer	10.6%

School demand

Annual average demand increase	5.5%
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Increment ratio of consumers	1.9%
Annual demand increase per consumer	3.6%
Lighting demand	
Average demand increase	3.4%

The annual average demand increases except for domestic demand have been estimated by reference to the records from 1982 to 1988.

The power demand in Upolu island in 1995 and 2000 (5 and 10 years after completion of the Project) are forecast as follows:

Years	Energy Demand (MWh)	Peak Demand (kW)
1995	64.7	12,500
2000	87.4	16,600

Details of the above demand forecast are given in Appendix 5-4 "Power Demand Forecast on Upolu Island".

(ii) Power Demand Forecast on Savaii Island

Generated energy and sold energy in 1988 were only 2.1 GWh and 1.6 GWh respectively and the peak demand was 690 kW on the assumption that the load factor in 1988 was 35 %.

Up till now there has been no industrial demand in Savaii island but this has been assumed to commence in 1991. The power demand in 2000 has been forecast using the following assumptions;

Domestic demand	
Annual increment of population	1.0%
Electrification ratio of First Phase	78.9%
Electrification ratio of Second Phase	90.0%
Numbers of families per consumer	18

Industrial demand	
Annual average demand increase	6.6%
Initial number of consumers	2
Increment ratio of consumers	2.0%
Annual demand increase per consumer	3.0%
Commercial demand	
Annual average demand increase	4.0%
Increment ratio of consumers	1.0%
Annual demand increase per consumer	3.0%
Hotel demand	
Annual average demand increase	7.1%
Increment ratio of consumers	3.0%
Annual demand increase per consumer	4.0%
Religious demand	
Annual average demand increase	11.1%
Increment ratio of consumers	1.0%
Annual demand increase per consumer	10.0%
School demand	
Annual average demand increase	5.1%
Increment ratio of consumers	2.0%
Annual demand increase per consumer	3.0%
Lighting demand	
Average demand increase	3.5%

The power demand in Savaii island in 1995 and 2000 are forecast as follows:

Years	Energy Demand (MWh)	Peak Demand (kW)
1995	3.3	887
2000	4.4	1,090

Details of the above demand forecast are given in Appendix 5-5 "Power Demand Forecast in Savaii Island".

(iii) Power Demand Forecast for Each Line

The power demand forecast for each line has been estimated to determine the design capacities and numbers of distribution transformers required.

There are no past records of power consumption because the distribution lines to be constructed under the Project are located in the areas not electrified. The power demand is therefore based on census records taken in 1986 for each village to be electrified, adjusted for population increases and demand per person estimated from the demand forecasts for Upolu and Savaii islands as appropriate. The transformer capacities and numbers required are designed so as to meet the demand in 1996, 5 years after the completion of the Project. Further transformers will have to be provided by EPC when demand increases. The initial demand in the Project areas, however, may be smaller than the forecast demand because the estimation of demand is based on the demand increase per consumer in the electrified area on Upolu. The demand forecasts for the each line are summarized below:

Upolu Island

1. Tanugamanono-Siumu	360kW+370kW+750kW=1,450kW
2. Lotofaga - Amaile	750kW
3. Saluafata-Sauniatu	90kW
4. Siusega-Tanumalala	150kW
5. Aleisa-Saleimoa	15kW
6. Nuu-Faleula	35kW
7. Lepale-Fasitoota	20kW
8. Satuimalufilufi-Satapuala	35kW

Savaii Island

9. Puapua-Samalaeulu	180kW+260kW=440kW
10. Sasina-Matavai	140kW
11. Tafutaoe	160kW
12. Tafuauta-Tafuatai	40kW

Details of the above demand forecast are given in Appendices 5-6 and 5-7 for Upolu and Savaii Islands respectively.

(D) Distribution Line Materials and Equipment

The materials required for the Project are supports, conductors, insulators, accessories and equipment. The following study is made for selection of the materials.

(i) Supports

Wooden poles imported from Australia are being used by EPC. There are alternative supports such as concrete poles and steel poles. Comparison of merits of these poles are as summarized below;

Comparison Items	Wooden	Concrete	Steel
Cost	Cheapest	Costly	Costly
Weight	Heavier	Heaviest	Light
Life Time	Longer	Longest	Short
Handling	Easier	Difficult	Easiest
Outside View	Not good	Good	Good

Cost, life time and handling are important items in selection of the supports. On such terms concrete poles are the most economical taking into account their potential life time of 42 years as compared to 15 years for the wooden poles. However, for the following two reasons wooden poles were selected for the Project.

a. Initial Investment

The total cost of the concrete poles would be about 250 million yen, while that for wooden poles is about 190 million yen. The initial investment for the wooden poles is therefore less by about 60 million yen.

b. Maintenance

Although normally no maintenance work is required on the concrete poles, poles may be damaged by traffic accidents etc., and the maintenance will have to be done by EPC. The supports should therefore be of materials familiar to EPC maintenance team and be easily procurable by EPC's own funds.

(ii) Conductors

The conductors used by EPC are All Aluminium Conductors "FLY" and "WASP" based on British Standard (BS-215). WASP conductor will be applied to the line from Tanugamanono to Siumu and FLY conductor to all other lines under the Project.

The line from Tanugamanono to Siumu will have heavy demand especially at Siumu, Lotofaga and Amaile. The demand of the line five (5) years after completion of the Project is estimated at 1,450 kW in total consisting of 360 kW from the section of Tanugamanono - Siumu, 370 kW from the section of Siumu - Lotofaga and 750 kW from the section of Lotofaga - Amaile. Because the load current of the demand is about 50A against 120A of the allowable current carrying capacity of conductor WASP, the selected conductor will be able to be used until 10 years after completion of the Project. When Afulilo Hydropower Station is realised, electric power will be supplied directly to Lotofaga and Amaile which are located close by.

Among the other lines, the line with the heaviest demand will be that from Puapua to Samalaeulu, the demand of which will be 500 kW (current :about 15A) while the allowable current of the conductor FLY is 100 A which will be sufficient enough for future demand increase.

(iii) Insulators

22 kV pin type insulators and strain insulators are proposed. No detailed study for the insulators is required.

(iv) Distribution Transformers

The capacity and numbers of distribution transformers have been selected by reference to the forecast demand summarised above. The distribution transformers have been selected on the basis of the following basic criteria:

- a. At least one distribution transformer is to be installed in each village.
- b. The distribution transformer capacities will be classified into three categories: 15 kVA, 25 kVA and 50 kVA as at present.
- c. 50 kVA three-phase transformers will be installed at villages where churches and hospital are located. If the demand is more than 50 kVA, single-phase 15 kVA and 25 kVA transformers will be also installed after confirming the demand in the villages.

The required distribution transformers for the Project have been selected, as summarized below, on the basis of the above criteria:

Transformers	Upolu	Savaii	Total
1-P, 15 kVA	81	29	110 (1,650 kVA)
1-P, 25 kVA	24	11	35 (875 kVA)
3-P, 50 kVA	19	3	22 (1,100 kVA)
Total	124	43	167 (3,625 kVA)

(v) Air Break Switches

When any fault is occurs in a distribution line, air break switches isolate the faulty section from

the healthy sections without interrupting the power supply to the healthy sections. The switches will be installed at (a) branch points and (b) every 2 km on a distribution line. The required air break switches are as follows:

<u>Lines</u>	<u>Length</u>	<u>Branch</u>	<u>Section</u>	<u>Total</u>
<u>Upolu Island</u>				
Tanugamanono-Siumu	25 km	2	11	13
Lotofaga-Amaile	22 km	1	9	10
Salafata-Sauniatu	7 km	1	2	3
Siusega-Tanumalala	19 km	2	8	10
Aleisa-Saleimoa	7 km	1	2	3
Nuu-Faleula	3 km	2	0	2
Lepalu-Fasitoota	7 km	2	1	3
Sauimalufilufi-Satapuala	13 km	2	5	7
<u>Savaii Island</u>				
Puapua-Samalaeulu	17 km	3	7	10
Sasina-Matavai	25 km	2	11	13
Tafutafoe-Falearupotai	15 km	1	6	7
Tafutauta-Tafuatai	7 km	1	2	3
Total		20	64	84

(vi) Cutout Switches

Cutout switches are provided on both primary and secondary sides of the distribution transformers and the required numbers of such switches are as follows:

<u>Transformers</u>	<u>Upolu</u>	<u>Savaii</u>	<u>Total</u>
1-P, 15 kVA	162	58	220
1-P, 25 kVA	48	22	70
3-P, 50 kVA	57	9	66
Total	267	89	356

(vii) Lightning Arresters

Lightning arresters are installed on the primary side of the distribution transformers, the numbers of which are same as the primary cutout switches.

(viii) Step up Transformers

The distribution line from Salelologa power station on the east coast of Savaii island is at 6.6 kV at present. The line from Puapua at the end point of the 6.6 kV to Samalaeulu will be constructed under the Project. There are two ways to connect the existing lines and the lines to be constructed. One is for the existing 6.6 kV line to be replaced by a 22 kV line and other is for the existing line voltage of 6.6 kV is to be graded up to 22 kV by a step up transformer. The first way is proposed for the Project, because it would otherwise be necessary to install step-up transformer to 22kV at the power station and to replace all the existing 6.6kV distribution transformers with the 22kV step up transformers when upgrading the existing 6.6kV distribution line to 22kV. Moreover, the cost of replacing the transformers will be higher than that of the second way.

(ix) Watthour Meters

It was originally proposed that watthour meters be provided by EPC, but EPC requested the Government of Japan to provide watthour meters for the Project. The number of such meters required is estimated at 1,500 by reference to the number of consumer under the Project. However, on the assumption that consumers will be connected to the EPC's distribution system gradually, only about 1,000 to 1,200 watthour meters will be required initially.

(D) Specification of Equipment and Materials

Western Samoa has close relations politically and economically with New Zealand and Australia and EPC is also influenced by these countries. Accordingly, equipment and materials for distribution lines are imported from these countries in large volume and the applicable standards and regulations on power facilities are also same as these countries. Procurement method for equipment and materials must be decided after taking into account of this situation.

The following criteria are proposed for the specifications for the equipment and materials under the Project.

(i) Design standards and regulations in Australia and New Zealand to be applied to the distribution facilities under the Project .

(ii) British standards for the distribution line equipment and materials are to be applied to the Project, however, Japanese manufacturers can cope with these easily. Standards to be applied to the Project will be as summarized below;

Equipment/Materials	Applied Standards
Supports	AS-2209
Insulators	AS-1137 or equivalent standards
Insulator accessories	AS-1154 or equivalent standards
Conductors	BS-215
Conductor accessories	AS-1154 or equivalent standards
Transformers	BS-171 or equivalent standards
Switches	BS-5419 or equivalent standards
Lightning arresters	BS-2914 or equivalent standards

(E) Basic Design Drawings

The basic design drawings showing all materials necessary for finding material quantities were provided for each type of distribution line to be constructed under the Project. The basic design drawings are reproduced in Appendix 5-8 "Distribution Line Supports".

(2) Implementation Plan

(A) Implementation Plan

From the site investigation, it was confirmed that EPC, the executing agency in Western Samoa, has the capability to erect the distribution lines if a Japanese Consultant will assist them on the route survey, planning and design. Erection works of the Project will be executed by EPC themselves. The implementation plan for the Project will be as given below;

(i) Procurement of Equipment and Materials

It was decided that the wooden poles should be used as supports for the Project because about Yen60 million would be saved. Wooden poles are not available in Japan and shall therefore be procured from third countries. The cost of conductors made in New Zealand will be about Yen40 million which is less than for those made in Japan according to estimates received.

Under these circumstances, it is expected that supports and conductors will be procured from third countries.

(ii) Work of the Japanese Consultant

As stated above, EPC has the capability for erection of the distribution lines, but the Government of Western Samoa has requested the Government of Japan to provide technical assistance for survey, planning and design. There are no

consultants or construction companies who can do such work in Western Samoa, since the country is very small. Accordingly no local consultant can be utilized for the Project.

It is essential therefore to provide a Japanese consultant for route survey, planning, design and some construction supervision under the Project. Two consulting engineers will be required for the Project, one as the representative, and the other is an engineer and survey expert for the route survey, taking into account the fact that the site is spread over two islands.

(iii) Construction Works

All the erection works including unloading of the equipment and materials at the port of Apia, inland transportation, and clearing of trees along the planned lines is to be carried out by EPC.

EPC will have responsibility for the following;

- a. Assistance to the Japanese Consultant to help in their preparatory work to establish office and living accommodation at the sites
- b. Right of way of line routes and clearing of trees along the lines
- c. A person for public relations
- d. Unloading and storage of plant and materials.
- e. Inland transportation from the port to the construction sites
- f. Erection of the lines
- g. Manpower for the erection works
- h. Selection of engineer in charge of erection team
- i. To provide funds for taxes, duties and bank charges for the plant
- j. Others matters not covered under the Japanese Grant Aid

(B) Construction Situations and Points for Erection Works

Because the alignments of the distribution lines in Upolu and Savaii islands are covered by lava, it is very difficult to excavate holes for installing poles. At present this lava is blasted but this gives rise to unnecessarily large holes and the progress of the erection works is disturbed by the blasting which is very dangerous for the public. It is proposed therefore that a special hole drilling machine be used to make uniform holes of about 500 mm in diameter. One drilling machine will, therefore, be procured for the Project so that the erection works can be carried out safely and smoothly. In procurement of the machine, it is essential that a manufacturer's guidance engineer train local operators in operation and maintenance of the machine for at least one month in every construction phase and that nominal spare parts be procured for the first phase. In addition, special parts are to be included in the second phase after confirming operation of the machine during the first phase.

(C) Plan of Supervision Work

Erection will be done by EPC's own erection gang. The person in charge of the erection works is the Chief of Distribution Line in accordance with EPC's organization chart as shown in Appendix 4-2 "EPC Organization". However, it was decided between EPC and the study team during site investigation that the engineer in charge of the erection works should be selected by EPC for good communication and liaison between EPC and the Japanese Consultant.

(D) Implementation Schedule

Taking into account of work volume of about 168 km of 22kV and 22kV/LV lines and of about 62 km of low voltage lines mentioned in Chapter 4-3(3) "Project Scale" and the erection capability of EPC, the Project

is proposed to be implemented in two phases. The works to be implemented in each phase will be as summarized below;

First Phase		Second Phase	
<u>Upolu Island</u>			
Tanugamanono-Siumu	25 km	Lotofaga-Amaile	22 km
Siusega-Tanumalala	19 km	Nuu-Saleula	3 km
		Saluafata-Sauniatu	7 km
		Aleisa-Saleimoa	7 km
		Lepale-Fasitoota	7 km
		Satuimalufilufi-Satapuara	13 km
<u>Savaii Island</u>			
Tafutafoe-Falearupotai	15 km	Puapua-Samalaeulu	17 km
Tafuauta-Tafuatai	7 km	Sasina-Matavai	25 km
<u>Total</u>	<u>66 km</u>		<u>101 km</u>

From past experience of erection work by EPC's own erection gangs, the gangs are capable of erecting about 3.5 km/month/gang. The working periods of first and second phases are estimated at 9 months and 12 months respectively, as mentioned below;

First Phase 22 kV Lines 66km
 Low Voltage Lines 14km
 Total 80km
 Erection Period:

$$80\text{km}/3.5\text{km}/3\text{gangs}=7.6\text{months}$$

Second Phase 22 kV Lines 101km
 Low Voltage Lines 48km
 Total 149km
 Erection Period :

$$149\text{km}/3.5\text{km}/3\text{gangs}=14.2\text{months}$$

The implementation schedule of the Project is shown in Appendix 5-9 "Implementation Schedule for Western Samoa Rural Electrification Project".

Erection of the distribution lines, whose costs were estimated at about WS\$1,908,000 (equivalent to Yen118,300,000:WS\$1.0=Yen61.96), will be undertaken by the Government of Western Samoa.

CHAPTER 6

**PROJECT EVALUATION AND
CONCLUSION**

CHAPTER 6 PROJECT EVALUATION AND CONCLUSION

Since there are no noteworthy industries to employ the local people in the rural areas in Western Samoa, they concentrate in the capital of Apia for obtaining employment.

It is a major objective of the Government of Western Samoa to settle the local people in the rural areas by means of increasing their employment opportunities by developing and promoting rural industries and by improvement of living standards.

The Government of Western Samoa has been promoting rural electrification for the purpose of improving infrastructure, the livelihood of the local people and developing rural industries. In consequence, the electrification ratio of both Upolu and Savaii islands in 1989 reached 75% and 70% respectively. This Project is also planned as a part of the said rural electrification scheme. The electrification ratio is expected to be further increased after completion of the Project, as summarized below.

		<u>Upolu Island</u>			<u>Savaii Island</u>		
	Year	Population	E/R	Consumers	Population	E/R	Consumers
	1989	112,500	75.0%	84,400	44,900	70.0%	31,430
1st Ph.	1991	118,200	75.0%	88,650	47,200	70.0%	33,040
			New	16,300		New	4,200
		Total	88.8%	104,950	Total	78.9%	
2nd Ph.	1993	120,600	88.8%	106,128	48,200	78.9%	38,030
			New	4,800		New	5,300
		Total	92.0%	110,950	Total	90.0%	43,350

Note E/R: Electrification Ratio

Upon completion of the Project, the electrification ratio of both Upolu and Savaii islands will be increased to 92% and 90% from 75% and 70% respectively. Consequently, about 30,000 people (about 18% of total population) will receive electric power. This means that total electrification ratio of Western Samoa will reach 91% and development of essential infrastructure aimed as the principal objective of the Sixth Development Plan of Western Samoa will be completed.

Thus, substantial benefits are expected to result from implementation of the Project and the Project will have great significance if implemented under the Grant Aid Program of the Government of Japan. However, there will be some problems, as mentioned below, in implementing the Project. It is judged that these problems will affect operation of the distribution lines after completion of the Project and erection works being done by EPC, if these problems are not solved. Therefore, prior to make deciding to implement the Project, it is necessary to confirm the prospects of solutions to these problems.

Problems :

- (1) In Western Samoa, the Afulilo Hydroelectric Project has been promoted with finance from ADB, IDA and EEC, but the Project is suspended at present, for reasons explained in Chapter 2. Under these circumstances, it is expected that a shortage of electric power supply of about 3,000kW will occur by the time the Project is completion in 1993, if Afulilo project is not restarted. If this happens diesel power plants having output of about 4,000kW(4MW) in total will be required as an alternative power source.
- (2) A severe cyclone visited Western Samoa at the beginning of February 1990. The said cyclone inflicted great damage to the electricity and communication facilities, roads, other infrastructure and the people. Restore the damaged

infrastructure is heavy burden for the Government of Western Samoa. The government is therefore apprehensive of insufficiency of the funds for erection works to be done by the Government of Western Samoa under the Project. It is therefore necessary to reconfirm the prospect of preparing the required funds for the expenditure to be born by the Government of Western Samoa for implementation of the Project.

A P P E N D I X

APPENDIX 1

Basic Design Study on the Project
for
Rural Electrification in Western Samoa

MEMBERS OF THE STUDY TEAM

Team Leader	Munekazu URANO	Ministry of International Trade and Industry
Engineer for Network Planning	Yasuhiro HARADA	Nippon Koei Co., Ltd.
Engineer for Design	Kazuhiko KATO	Nippon Koei Co., Ltd.
Engineer for Survey	Masahiro TANAKA	Nippon Koei Co., Ltd.
Engineer for Survey	Hiroyuki MORITA	Nippon Koei Co., Ltd.

SCHEDULE OF THE BASIC DESIGN STUDY TEAM

Oct. 9	(mon.)	Departed by JL773
10	(tue.)	Courtesy call to the Embassy of Japan in New Zealand
11	(wed.)	Left Auckland for Western Samoa by PH417
10	(tue.)	Arrived at Faleolo airport in Western Samoa. (Arrived on Oct. 10 after passing the international date line.)
11	(wed.)	Courtesy call to EPC, MOFA and JICA offices. Discussion with EPC
12	(thu.)	Site survey of east coastal areas in Upolu island
13	(fri.)	Site survey of north coastal areas in Savaii island
14	(sat.)	Site survey of south coastal areas in Savaii island

Notes :

EPC : Electric Power Corporation
P/S : Power station
MOFA : Ministry of Foreign Affairs
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Date	Mr. M. Urano	Mr. Y. Harada	Mr. K. Kato	Mr. M. Tanaka	Mr. H. Morita
15(sun.)	Market survey	Same as left	Same as left	Compiling data	Same as left
16(mon.)	Site survey of north-west areas in Upolu island	Same as left	Same as left	Same as left	Same as left
17(tue.)	Discussion with EPC on the minutes of meeting	Same as left	Same as left	Compiling data collected	Same as left
18(wed.)	Signing the minutes of meeting	Preparation of the minutes of meeting	Compiling data collected	Site survey of Aleisa area in Upolu island	Compiling data and preparing site survey schedule
19(thu.)	Returned to Japan by PH741	Power demand analysis	Study on distribution line material	Site survey of Aleisa area in Upolu island	Compiling data
20(fri.)		Preparation of power system drawing Power demand analysis	Study on distribution line material	Site survey of Sauniatu area in Upolu island	preparing site survey schedule
21(sat.)		Compiling data collected	Preparation of spec. for distribution line materials	Compiling data collected	Compiling data
22(sun.)		Compiling data collected	Compiling data collected	Compiling data collected	Compiling data
23(mon.)		Power demand analysis	Preparation of cost estimate for line materials	Site survey of Aleisa area in Upolu island	Left for Savaii island for site survey
24(tue.)		Collection of data for Afuillo project	Preparation of cost estimate for line materials	Site survey of Siusega area in Upolu island	Site survey of east area in Savaii island

Notes :

EPC : Electric Power Corporation
P/S : Power station
MOFA : Ministry of Foreign Affairs
JICA : Japan International Corporation Agency

Date	Mr. M. Urano	Mr. Y. Harada	Mr. K. Kato	Mr. M. Tanaka	Mr. H. Morita
25(wed.)		Collection of data for Afullio project	Preparation of drawings of pole fittings	Site survey of Lotofaga area in Upolu island	Site survey of east area in Savaii island
26(thu.)		Preparation of field survey report	Preparation of drawings of pole fittings	Site survey of Sauniatu area in Upolu island	Site survey of north area in Savaii island
27(fri.)		Compiling data collected	Preparation of drawings of pole fittings	Site survey of Sauniatu area in Upolu island	Site survey of west area in Savaii island
28(sat.)		Preparation of field survey report	Preparation of drawings of pole fittings	Compiling data collected	Returned from Savaii island
29(sun.)		Compiling data collected	Compiling data collected	Compiling data collected	Compiling data collected
30(mon.)		Reporting to Mr. Mikami, diplomatic official, MOFA of Japan	Preparation of cost estimate for line materials	Field observation of EPC's stringing work	Same as left
31(tue.)		Construction cost estimate for distribution line	Preparation of cost estimate for line materials	Field observation of EPC's stringing work	Same as left
Nov. 1(wed.)		Construction cost estimate for distribution line	Preparation of cost estimate for line materials	Survey for EPC store and P/S	Compiling data collected
2(thu.)		Preparation of field survey report	Meeting on spec. of line materials	Assist to prepare field survey report	Compiling data collected
3(fri.)		Compiling data collected	Meeting on spec. of line materials	Site survey of north area in Savaii island	Same as left

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JICA : Japan International Corporation Agency

Date	Mr. M. Urano	Mr. Y. Harada	Mr. K. Kato	Mr. M. Tanaka	Mr. H. Morita
4 (sat.)		Compiling data collected	Meeting on spec. of line materials	Site survey of north area in Savaii island	Same as left
5 (sun.)		Market survey	Market survey	Site survey of north area in Savaii island	Same as left
6 (mon.)		Field survey of Tanaganono P/S	Same as left	Field observation of EPC's stringing work	Same as left
7 (tue.)		Preparation of field survey report	Meeting on spec. of line materials	Field observation of EPC's excavation work	Same as left
8 (wed.)		Preparation of field survey report	Compiling data collected	Compiling data collected	Compiling data collected
9 (thu.)		Left Apia by PH741	Left Apia by PH741	Left Apia by PH741	Left Apia by PH741
10 (fri.)		Arrived at Auckland by PH741	Arrived at Auckland by PH741	Arrived at Auckland by PH741	Arrived at Auckland by PH741
11 (sat.)		Left Auckland by JL774	Left Auckland by JL774	Left Auckland by JL774	Left Auckland by JL774

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MOFA : Ministry of Foreign Affairs
JICA : Japan International Corporation Agency

List on Collected Materials, Data and Information

- 1 Map of Upolu island, scale 1/20,000,Nos.17-28
- 2 Map of Savaii island, scale 1/20,000,Nos.1-16
- 3 Map of Samoa island (issued by the University of Hawaii)
- 4 Map of Upolu island, Scale 1/100,000
- 5 Map of Savaii island, Scale 1/100,000
- 6 Price list of wooden poles
Australian Heavy Hardwoods Pty Ltd.
- 7 Price list of conductors, Midlink Marketing Ltd.
- 8 Price list of conductors, Olex Ltd.,Australia
- 9 Price list of conductors
International Wire Cable Co.Ltd.,N.Z.
- 10 Construction Schedule for Afulilo Hydroelectric Project
- 11 Australian NSW Hardwood Pole Technical Guide
- 12 EPC Annual Report 1984
- 13 EPC Lelumoeaga - Siumu 22 kV Line Construction Schedule
- 14 Tentative construction schedule for Fusi - Vaiola line
- 15 Australian Standard for Wooden poles AS2209 - 1979
- 16 Australian Standard for Insulators AS1137
- 17 Australian Standard for Insulator and Conductor Fittings
AS1154,Part -1

- 18 EPC Organization Chart
- 19 Organization chart for distribution section of EPC
- 20 Technical specifications for distribution line materials
- 21 Tender documents for transmission line materials under Afulilo Hydero Project
- 22 EPC's drawings for distribution line construction
- 23 Annual Statistical Abstract 1988

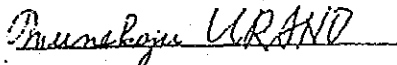
MINUTES OF MEETING
ON
RURAL ELECTRIFICATION PROJECT
IN WESTERN SAMOA

In response to the request of the Government of Western Samoa for a grant aid of the rural electrification project (hereinafter referred to as the Project) the Government of Japan has dispatched, through the Japan International Cooperation Agency (JICA), a survey team headed by Mr. Munekazu URANO, Electric Power Technology Div., Agency of Natural Resources and Energy, Ministry of International Trade and Industry from Oct. 9, 1989 to Nov. 11, 1989.

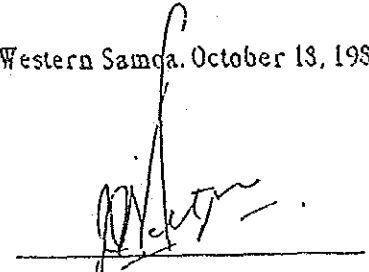
The Team had a series of discussion with the officials concerned of the Government of Western Samoa headed by Mr. Eric J. Hussey and carried out a field survey at the Project areas.

As a results of the survey, discussion and study, both parties agreed to recommend to their respective Government that the results of the survey, discussions and study attached herewith should be examined towards the realization of the Project.

Apia, Western Samoa, October 13, 1989



Mr. MUNEKAZU URANO
Leader
Basic Design Study Team
JICA


MR. HON JACK NETZLER
Acting Minister of Work and
Electric Power Corporation

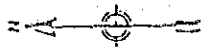
ATTACHMENT

1. The both parties confirm that items from 1 to 10 mentioned on the ATTACHMENT of the Minutes of Meeting signed between the Government of Western Samoa and Preliminary Study Team, JICA dated June 22, 1989 are remained unchanged, and further confirmation are as mentioned hereunder:
 - a. The following sections of the lines are excluded in the Japanese Grant Aid and built by EPC;
 - Upolu Island: Siumu to Sopoaga (Ref. attached Plate-1)
 - Savaii Island: Fusi to Vaiola, Vai'a'ata and Tapu'ele'ele (Ref. attached Plate-2)
 - b. The construction methods and completion period of the above lines shall be coordinated with the lines under the Japanese Grant Aid.
2. The following materials, equipment and erection tools (hereinafter referred to as the Plant) for the Project will be provided under the Japanese Grant Aid.
 - Distribution line poles
 - Conductors
 - Insulators
 - Distribution transformers
 - Switches
 - Construction equipment and tools
 - Miscellaneous materials and equipment
3. The Consultant will provide the following services for the implementation of the Project;
 - Detailed design of the distribution system
 - Preparation of the tender document for procurement of the Plant
 - Technical assistances for erection works
 - Administrative services for the implementation of the Project
 - Other assistances

4. The basic design report will be submitted to the Government of Western Samoa by the middle of Mar. 1990.
5. The minutes of meeting signed between the Government of Western Samoa and the Preliminary Study Team is attached herewith for confirmation.

A handwritten signature in black ink, appearing to be 'M. CURRAN', written in a cursive style.

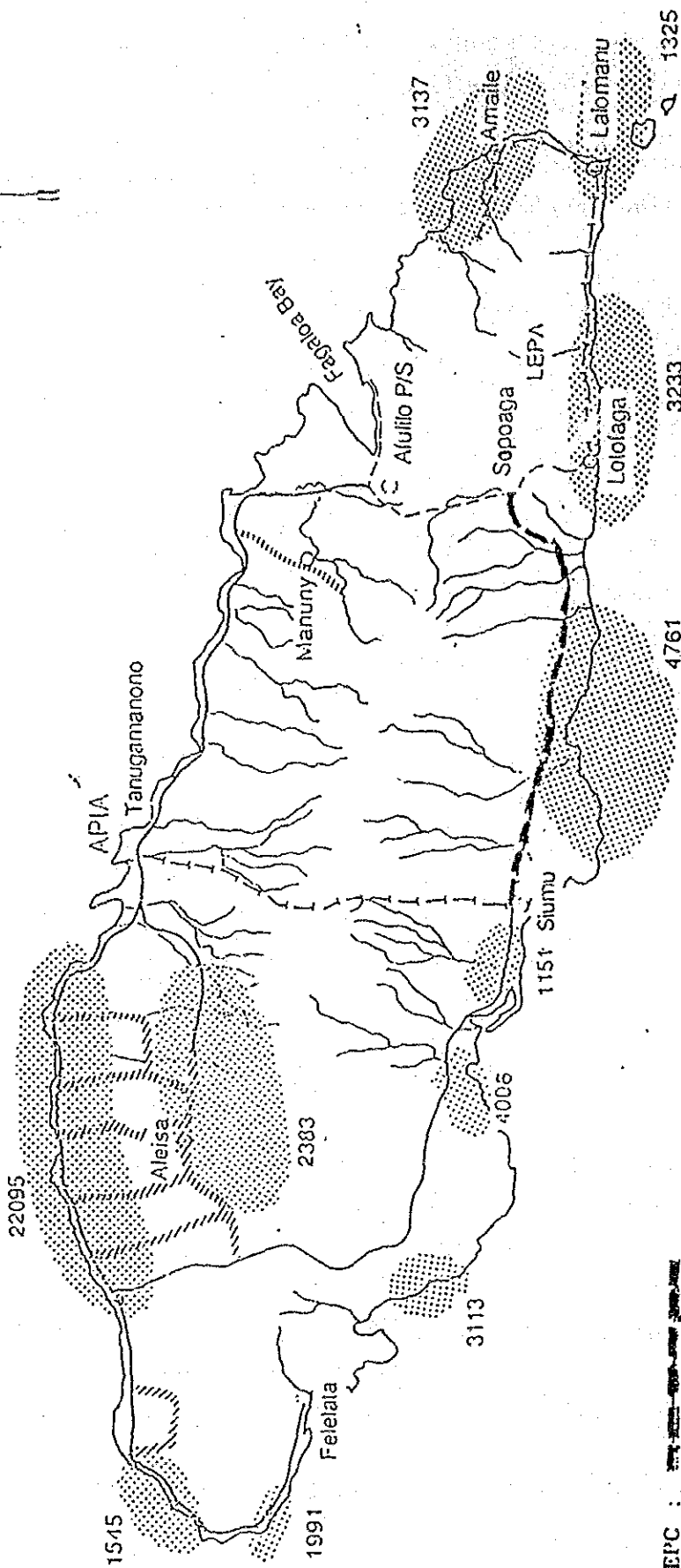
M. CURRAN



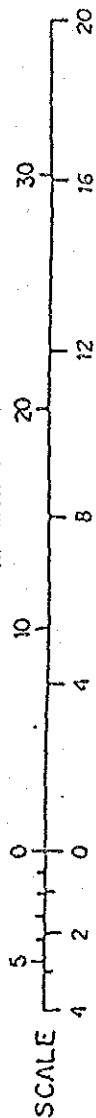
UPOLU ISLAND

NORTH PACIFIC OCEAN

SOUTH PACIFIC OCEAN



Kilometres



Undertaken by EPC :

Priority - 1 : [Symbol]

- 2 : [Symbol]

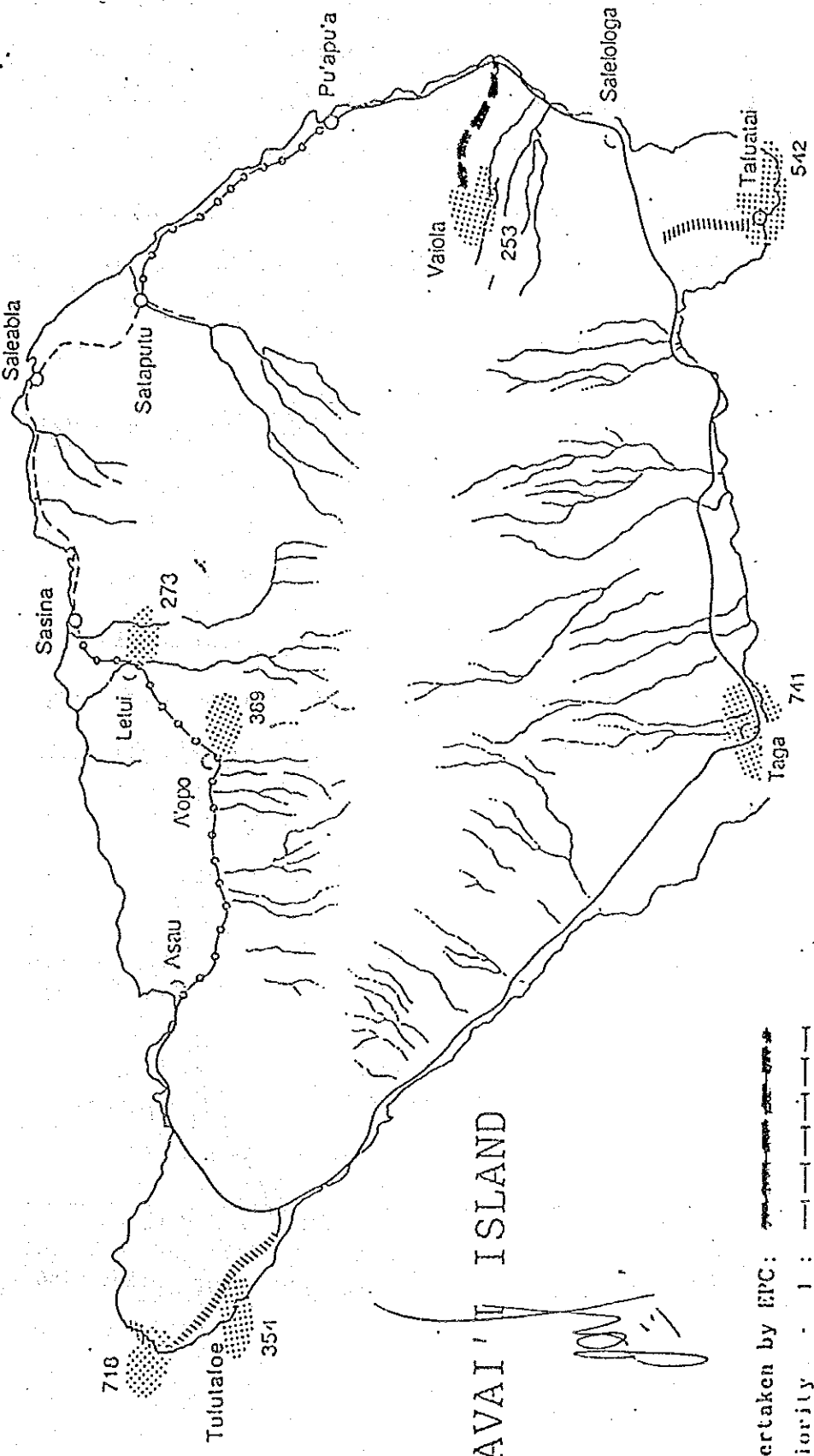
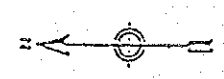
- 3 : [Symbol]

Existing or EPC project : [Symbol]

Non-electrified : [Symbol]

M. CERANO

NORTH PACIFIC OCEAN

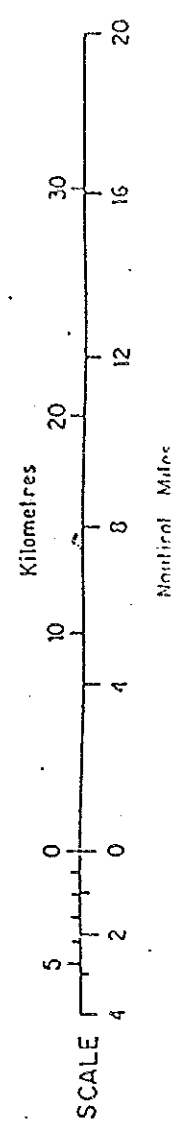


SAVAI' ISLAND

M. W. R. S. I. O

- Undertaken by EPC:
- Priority - 1:
- 2:
- 3:
- Existing or EPC project:
- Non-electrified area:
- Population:

SOUTH PACIFIC OCEAN



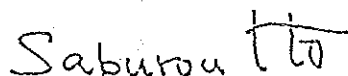
MINUTES OF MEETING ON THE PROJECT FOR
RURAL ELECTRIFICATION IN
WESTERN SAMOA

In response to the request of the Government of Western Samoa, the Government of Japan decided to conduct a Preliminary Study on the project for Rural Electrification and entrusted the study to the Japan International Cooperation Agency (JICA). JICA sent to Western Samoa the study Team headed by Mr Saburo ITO, Deputy Director, Electric Power Technology Div., Agency of Natural Resources and Energy, Ministry of International Trade and Industry from June 12 to June 27, 1989.

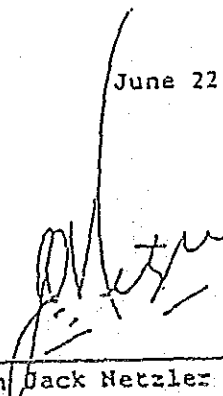
The Team had a series of discussion on the Project with the officials concerned of the Government of Western Samoa headed by Mr Eric J Hussey and conducted a field survey in the Proposed area.

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

June 22, 1989



Mr Saburo ITO
Leader
Preliminary Study Team
JICA



Hon Jack Metzler
Acting Minister of Works and
Electric Power Corporation

1. The objective of the project is to improve the living standards of people who live in rural areas, by means of Rural Electrification.
2. The site of the Project is both islands, UPOLU and SAVAII. (Site map is attached as Annex II and III)..
3. The request of the Government of Western Samoa made on the Project for Japanese Grant Aid is as follows:
 - (1) Provision of materials for the construction of 22 kV trunk line and low voltage line, (excluding service line for house connection) networks on UPOLU and SAVAII Islands: Cables, poles, transformers and others. (Priority of line route are indicated on the site map).
 - (2) Provision of construction machinery and vehicles: Drilling Machine, pick-up truck and others.
 - (3) Consultant Services for Detail Design and Construction Supervision.
4. The Government of Western Samoa requested the Team to convey their proposal to the Government of Japan in addition to the above items, that specification of electric poles for the line between Apia and Afulilo by way of south coast will be of sufficient height for future line addition of 66 kV.
5. Electric Power Corporation is responsible for the administration of the Project.
6. The Government of Western Samoa has understood Japanese Grant Aid System explained by the Team which includes a principle for the use of Japanese Consultancy Firm and General Contractors for the detail design, construction supervision and supply of materials.
7. The Government of Western Samoa will undertake items listed in Annex I when the Government of Japan decides to extend Grant Aid for the said Project.
8. The Government of Western Samoa in view of the priority of the rural electrification programme stressed the importance of implementing the physical construction work for the project in the 1990 calendar year and requested the Team to convey the same to the Government of Japan.
9. If it is found feasible as a result of the Preliminary Study, the Government of Japan will send the Basic Design Study Team in order to collect further information and data.
10. The Government of Western Samoa shall provide all necessary information and data when the Basic Design Study Team visit Western Samoa.

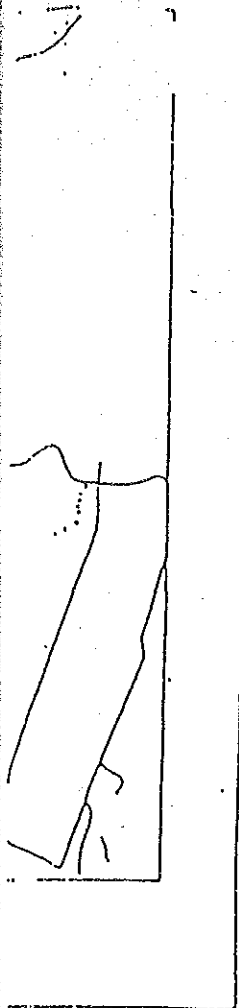
SIT

ANNEX I

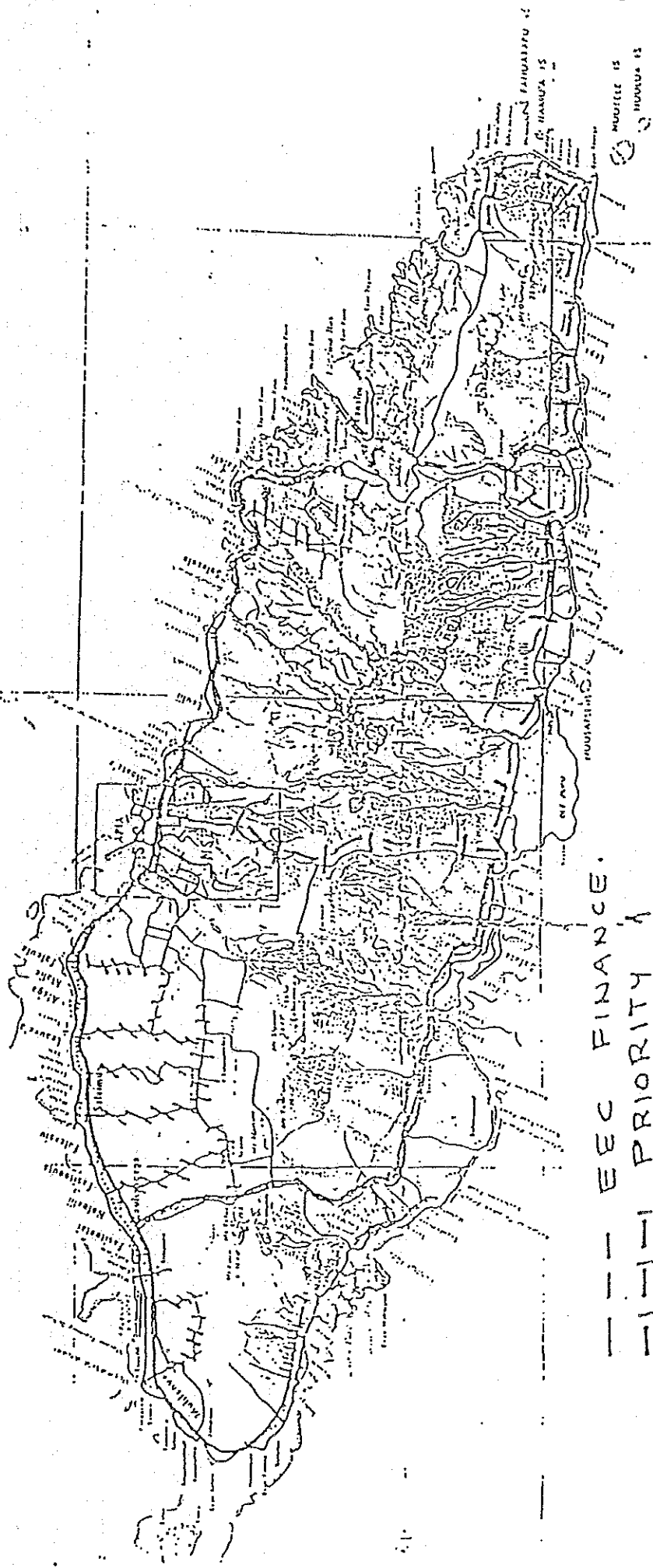
UNDERTAKINGS BY THE GOVERNMENT OF WESTERN SAMOA

1. To secure and clear the lands for the construction.
2. To secure the temporary yard to store the material provided under Grant Aid.
3. To secure all local costs for the works: Labour cost, fuel for machines and vehicles, administration and others, not covered by Grant Aid.
4. To ensure prompt unloading of material provided under Grant Aid.
5. To meet customs duties for materials.
6. To grant exemption to Japanese nationals who will serve under the Project from local tax and other fiscal levies.
7. To bear the expense for banking services.
8. Others in accordance with principle of Japan's Grant Aid Program.

5/16



UPOLU

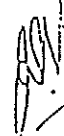


--- EEC FINANCE.

-|-|-| PRIORITY 1

\\ \\ \\ \\ PRIORITY 2

— ALREADY ARTICULATED OR PLANNED E.P.C.


 SFC

It is intended to confirm the following results of field survey based on which the basic design will be carried out.

1. FINDINGS IN THE ROUTE SURVEY

(1) Right of Way

Result of site survey for the new line under construction for rural electrification (about 12 km extension from Lcolumoega) revealed that habitants who possess land space for the new line route cooperated with EPC in clearing the way in cutting thick trees by themselves to such extent that erection of pole and stringing works were smoothly carried out. The fact is a symbolic outcome which supports urgent need of electrification for habitants and brings about speedy and economical electrification as a result. EPC is confident of this status to be sustained in new line routes which are indicated in the minutes in order of priority.

(2) Private Diesel Power Lines

Three low voltage private diesel power lines, Letui, Manase and Matautu were located along north east coast of Savaii, each of which has a diesel generator (approx 20 kVA), and supply power to each village in the night time.

In the case that rural electrification work proceed to those areas, the existing facilities may be utilized (i.e. poles, conductors, insulators) if they are in good conditions and if villages agree.

(3) Access Routes to Villages

Result of route survey for spur line to Falealupo and Tufutafoe village revealed the following:

- 1) On route to the villages, no development and very few houses were found.
- 2) There are two (2) routes to the villages, but south route will be easy in access thereto (i.e. Tufutafoe route).
- 3) Numbers of people are 1550 and two (2) primary schools are there.

Above factors shall be considered economically at the time of final selection of areas to be electrified at the basic design stage.

(4) Supply to Areas from Saleaula to Sasina

There are two (2) alternatives, that is, one is by an isolated system with a diesel power plant to be newly provided and the other is by supply from Salelologa

ST

through 22 KV line. However the route from Puapua to Saleaula pass through lava area where pole erection may require drilling and compressor machine.

The basic design should be carried out in consideration of:

- 1) Confirmation of applicability of tools above mentioned for pole erection.
 - 2) Economic comparison of two (2) alternatives and others.
- (5) Afulilo Hydropower Project

Result of survey revealed:

- 1) Investigation into the scheme is complete.
- 2) Tenders has been opened for civil works and machinery.
- 3) Funding agency approval of the tender yet to be received. Actual work is expected to start in early 1990.
- 4) Cost for the line from the existing Lalomauga Power Station to the new Ta'elefaga power station; the Fagaloa Bay line and the line from Ta'elefaga to Lotofaga are covered by this project.

2. MATERIAL

(1) Type of Poles

It was found that EPC has used wooden poles because the poles are procurable from neighbouring countries like New Zealand and Australia and easy for erection in mountainous areas in Western Samoa. Wooden poles will be convenient also in this project.

However study is required for comparison with concrete pole taking into account that prestressed concrete poles will be also procurable in neighbouring countries and their life is more than twice the wooden poles.

(2) Other material

It was found that EPC had used other material also from neighbouring countries (so called third countries), thus it is probable that procurement of this project is made from those countries. As a result price estimate in the basic design stage shall be made considering the recent actual prices of those material.

3. SPECIFIC CONDITION IN BASIC DESIGN

(1) Wind Pressure

Wind velocity : 35 m/sec

[Handwritten signature]
ST/GO

Safety factor to the wind pressure applied:

Steel and concrete pole	-	2
Wooden pole (hard)	-	4
Wooden pole (soft)	-	6

(2) Insulator Contamination by Salt

No special insulator for salt contamination required.

(3) Basic Impulse Level of 22kV Line

125 kV.

(4) Lightning Stroke to the Ground

Seldom inspite of high IKL of 60.

(5) Sag and Tension of Conductor

Maximum tension less than 20% of UTS.
(Temperature 25°C and light wind).

FIELD SURVEY REPORT
ON
RURAL ELECTRIFICATION PROJECT
IN WESTERN SAMOA

It is intended to confirm the following results of the site survey and study made by the Basic Design Study Team of JICA on the Rural Electrification Project.

1. Scope of Project

During site survey of the proposed Project areas with EPC Engineers, it has been found that the following distribution lines in Upolu and Savaii islands will be undertaken by the Japanese Grant Aid, the length of the lines are provisional length which will be finalized referring to the 1/20,000 maps during basic design study:

a. Upolu Island	22 kV Lines	HV/LV Lines	LV Lines	Priority
Tanugamanono - Siumu	16 km	9 km	3 km	1
Lotofaga - Amaile	7 km	15 km	21 km	2
Saluafata - Sauniatu	3 km	4 km	7 km	5
Siusega - Tanumafala	13 km	6 km	9 km	3
Aleisa Road - Saleimoa	4 km	3 km	3 km	6
Nuu - Faleula	0 km	3 km	2 km	4
Lepale - Fasitoouta	4 km	3 km	3 km	7
Satuimalufulufi - Satapuata	5 km	8 km	7 km	8
Total Upolu Island	<u>52 km</u>	<u>51 km</u>	<u>55 km</u>	

b. Savaii Island	22 kV Lines	HV/LV Lines	LV Lines	Priority
Puapua - Samalaeulu	10 km	7 km	1 km	11
Sasina - Matavai	16 km	10 km	1 km	12
Tafutafoe	5 km	2 km	1 km	9
Tafuaufa - Tafuatai	3 km	12 km	4 km	10
Total Savaii	<u>34 km</u>	<u>31 km</u>	<u>7 km</u>	

c. Total Length of Lines	22 kV Lines	HV/LV Lines	LV Lines
	<u>86 km</u>	<u>82 km</u>	<u>62 km</u>
22 kV Lines	15 km		
LV lines	140 km		

The Project may be undertaken into two phases, the selection of the lines in the each phase will be made referring to the priority mentioned above, the lines have prior numbers will be included in the first phase, the remaining lines will be in the second phase.

2. The following materials, equipment and erection tools for the Project will be provided under the Japanese Grant Aid.

Distribution line poles, crossarms and fittings
Conductors, joints, preformed grips and fittings
Insulators, clamps and fittings
Distribution transformers and accessories
Switches lightning arresters and accessories
Construction equipment (Drilling machine)
Pickup trucks
Construction tools
Miscellaneous materials and equipment

It is noted that the Watt-Hour Meters and the step up transformer to be installed at Puapua will be studied during the basic design.

3. The Terms of Reference of the Consultant are as mentioned below;

Home Works

- Detailed design of the distribution system
- Preparation of the bid document for procurement of the Plant
- Administrative works for bidding, evaluation and contract
- Checking of drawings for approval and comment on it
- Pre-shipment inspection and issuing inspection certificates

Field Works

- Pre-shipment inspection and issuing inspection certificates, when required
- Preparation of construction drawings such as route maps, pole and insulator configuration
- Preparation of implementation schedule
- Supervising construction works
- Assist to EPC for the commissioning test of the completed lines

- Providing monthly progress reports
- Provision of foremen for additional working gangs, if required

4. The Government of Western Samoa will provide the followings:

- To assist provision of site accommodation for the consultant at Apia and Lanomanu in Upolu, Salelologa and Vaisala
- To secure right of way and clearing of the line routes
- To provide a personnel of Public Relation to solved trouble with local peoples
- To provide stock yards for the imported materials for the Project and to secure those materials in stores
- To unload all materials arrived at Western Samoa and clear it from the custom security
- To transport the materials from the port of Apia to construction sites via depots including transport to Savaii island
- To construct all distribution lines
- To provide all erection forces for the construction works
- To nominate a person in charge to control construction gangs for implementation of the Project
- To provide all local fund including custom duties and taxes for the imported materials if required and the banking charges for the banking arrangement required under the Japanese Grant Aid
- Others not covered by Japanese Grant Aid

5 Technical Confirmation

a. 66 kV design of poles

Taking into account of the future reinforcement of the power system in Upolu island, the poles from Tanugamanono to Lotofaga via Siumu are requested to have sufficient height to add a 66 kV line at the top of the poles. Therefore, the lines from Siumu to Lotofaga and Lotofaga to Afulilo power station, which are scheduled to be undertaken by EPC and EEC respectively, are also designed to have such sufficient pole height.

b Design concept

The design of the distribution lines shall basically be made in accordance with [CORD OF PRACTICE FOR OVERHEAD LINE CONSTRUCTION] established by Electricity Supply Association of Australia: No. C(b) 1, 1974 superseding 1962.

The main design criterion are as mentioned below;

Maximum ambient temperature 34 deg. C (M/Record)

Average (Every day) temperature of conductor

Minimum temperature of conductor: 15deg. C (M/Record)

Maximum Conductor Temperature for Max. sag

Every day stress: 18 % at 15deg. in still air (Cord C(b) 1)

Recorded Max. Wind velocity: 82 Knot (41 m/sec) (M/Record)

Wind loads On conductors 500 Pa (Cord C(b) 1)

On Poles 750 Pa (Cord C(b) 1)

Safety factor Conductors 18 % at 15deg. in still air (Cord C(b) 1)

50 % at 15deg. C with wind (Cord C(b) 1)

Poles Wooden poles:

Concrete poles:

Steel poles:

Steel structures

Ground clearance a. Over road: 6.7 m (Cord C(b) 1)

b. Over other road: 6.7 m (Cord C(b) 1)

c. Over field not negotiable by vehicles: 5.5m (Cord C(b) 1)

Clearance for rural area may be 0.6 m less than above c.

Spacing Between phase conductor: (Cord C(b) 1)

$S = 0.0076 \text{ m/kV} \cdot 0.37 \times (S)^{1/2}$ where S=dip in m

Between phase and neutral:

Other structures and building: (Cord C(b) 1)

Vertical over floor 5.5 m

Vertical over roof 4.6 m

In any direction from walls 3.0 m

In any direction from structure 3.0 m

Equipment basic insulation level (Cord C(b) 1) (M/Record)

22 kV 125.0

c. Distribution Line Materials

Conductors	High voltage	AAC FLY
		AAC WASP
	Line from Tanugamanono to Siumu	AAC WASP
	Other lines	AACFLY
Low voltage	Phase conductor	PVC Covered AAC FLY
	Neutral wire	AAC Bare FLY
	Applied Standard	BS-215
Insulators	High voltage 22 kV	Pin type insulator
		Strain. Ball socket type suspension discs
	Low voltage 400V	Pin
	Color of Insulators and Bushing	
	Applied Standard	

Poles Poles will be specified in accordance with AS 2209 and NSW Overhead Line Construction and Maintenance Regulations 1962 as follows:

<u>Length</u>	<u>Stress Group</u>	<u>Treatment</u>	<u>Top Load</u>
9 m (LV)	A (F=100 MPa)	Full length	6 kN
		Preservative	8 kN
		Treated	
12.5 m (22kV)	A (F=100 MPa)	Full length	6 kN
		Preservative	8 kN
		Treated	12 kN
14 m (66/22kV)	A (F=100 MPa)	Full length	8 kN
		Preservative	12 kN
		Treated	

Applied Standard AS-061, 0117-1970, 2209-1979

d. Distribution transformers are installed on the basis of the following conditions

- i Each village shown on the attached map is provided at least one distribution transformer
- ii Single phase transformers 15 kVA and 25 kVA are basically provided in rural area

- iii Three phase transformers will be installed at the village where demand is expected to be more than 50 kVA.
 - iv The demand in each village is estimated on the basis of population and demand per capita (about 30 to 40 W per Capita) obtained from the past record for keeping the same life level as the habitants in electrified area. The list of transformers estimated in accordance with the above conditions is attached for reference.
- e. The section switches will basically be provided at the following points
- i Branch points of the 22 kV lines
 - ii Every 2 km but it's interval will be decided taking into account location of villages on line routes.
- f. Selection of Poles
- The wooden poles will basically be used for the Project, however, concrete poles and steel poles are also studied for the economical comparison. If concrete or steel poles is economical, these will be selected for the supports of the Project.
- g. Step up transformer 6.6/22 kV at Savaii Island
- The voltage of the existing line from Salelologa power station in Savaii island toward Puapua is 6.6 kV, the voltage of the line from Puapua to North coast to be constructed under the Project will be designed with 22 kV. Therefore, a step up transformer from 6.6 kV to 22 kV will be required to be installed at Puapua.

EPC has a plan to,up grade the existing 6.6 kV line into 22 kV which has been discussed in the Committee of Rural Electrification Programme and mentioned on the Report issued on May, 1988. The step up transformer will be required till the existing 6.6 kV line is up graded, the capacity of the transformer, therefore, is estimated for covering the demand of villages at North coast up to Aopo, but less than the capacity of the existing step up transformer installed at the Salelologa power station.

h. Feeder from Tanugamanono power station

The existing outgoing feeders at the Tanugamanono power station are four (4) 6.6 kV feeders and three (3) 22 kV feeders, one 6.6 kV feeder named Alaoa feeder out of four will be up graded to 22 kV feeder when the line from Tanugamanono to Siumu is completed

EPC intends to provide a new outdoor switchyard outside the power station at his own cost taking into account of the expansion of 22 kV feeders and 66 kV feeders for the 66 kV transmission system in future. The outdoor switchyard shall have to be completed by the commencement of the 22 kV line for Siumu under the Project.

No equipment and materials for the 22 kV feeder for the outdoor switchyard at the power station, therefore, is required to be provided under the Japanese Grant Aid Project.

i. Provisional Pole Arrangement

The provisional pole arrangement for the 22/LV distribution lines to be constructed under the Project are attached herewith for reference.

6. Capability of EPC erection gangs

a. Work progress undertaken by EPC erection gang

The erection gangs (two gangs) of EPC have completed the line from Leulumoega to Siumu about 35 km in length for five months with two gangs, the work progress is, therefore, calculated to be 35 km/month/gang.

The stringing work for low voltage single phase line is being carried out at the South coast, the progress is calculated to be 35 km/day (stringing work is being carried out in night time, since no traffic on the road).

b. EPC organization for the Project

All construction works of the distribution lines under Japanese Grant Aid will be undertaken by EPC's own construction gangs. A person in charge to control the construction gangs is required to be nominated by EPC for the proper implementation of the Project.

7. Tentative Implementation Schedule

Referring to the Item 17 Reference in page 14 in [Japan's Grant Aid Program] the Tentative Implementation Schedule for the Project is estimated to be as shown on the attached Schedule provided that all construction gangs under EPC are placed for the Project.

Population and Transformer Capacity for Villages to be Electrified

Districts	Villages	Population in 1986	Population in 1990	30W/Cap	Demand (kW) 40W/Cap	50W/Cap	Tr Capa (kVA)	15 kVA	25 kVA	50 kVA	100 kVA
UPOLUISLAND											
VAIMAUGA WEST	Moataa	1,363	1,447	43	58	72		0	0	0	0
	Vaivase-Tai	1,344	1,426	43	57	71		0	0	0	0
	Vaivase-Uta	542	575	17	23	29		0	0	0	0
	Magiagi-Tai	1,419	1,506	45	60	75		0	0	0	0
	Magiagi-Uta	56	59	2	2	3		0	0	0	0
	Toomatagi	286	304	9	12	15		0	0	0	0
	Tanoalei'a	719	763	23	31	38		0	0	0	0
	Faatoialemanu	965	1,024	31	41	51		0	0	0	0
	Vaiala-Tai	481	511	15	20	26		0	0	0	0
	Vaiala-Uta	236	250	8	10	13		0	0	0	0
	Vinifou	131	139	4	6	7		0	0	0	0
	Vaipuna	591	415	12	17	21		0	0	0	0
	Levili	203	215	6	9	11		0	0	0	0
	Matautu-Uta	511	542	16	22	27		0	0	0	0
	Matautu-Tai	872	926	28	37	46		0	0	0	0
	Leonc	581	617	18	25	31		0	0	0	0
	Vaisigano	432	459	14	18	23		0	0	0	0
	Niuc	233	247	7	10	12		0	0	0	0
	Maluafoa	120	127	4	5	6		0	0	0	0
	Malifa	258	274	8	11	14		0	0	0	0
	Lelata	196	208	6	8	10		0	0	0	0
	Leififi	239	254	8	10	13		0	0	0	0
	Motootua	1,131	1,200	36	48	60		0	0	0	0
	Leufisas	255	271	8	11	14		0	0	0	0
	Tanugamanon	654	694	21	28	35		0	0	0	0
	Papauta	504	535	16	21	27		0	0	0	0
	Vailima	790	838	25	34	42		0	0	0	0
	Avele	371	394	12	16	20		0	0	0	0

Districts	Villages	Population in 1986	Population in 1990	30W/Cap	40W/Cap	50W/Cap	Tr. Capa (kVA)	15 kVA	25 kVA	50 kVA	100 kVA
	Letava	264	280	8	11	14	15	1	0	0	0
	Vaoala	503	534	16	21	27	50	0	0	1	0
	Tiapapata	112	119	4	5	6	15	1	0	0	0
	Aliamalu East	74	79	2	3	4	15	1	0	0	0
	Aliamalu West	40	42	1	2	2	15	1	0	0	0
	Apia	358	380	11	15	19		0	0	0	0
	Tauese	236	250	8	10	13		0	0	0	0
	Tufuiopa	370	393	12	16	20		0	0	0	0
	Lalovaca	815	865	26	35	43		0	0	0	0
	Palisi	671	712	21	28	36	50	0	0	1	0
	Matafele	53	56	2	2	3	15	1	0	0	0
	Mulivai	66	70	2	3	4	15	1	0	0	0
	Tulolo	541	574	17	23	29		0	0	0	0
	Togafuaafua	389	413	12	17	21		0	0	0	0
	Taufusi	716	760	23	30	38		0	0	0	0
	Alamagoto	611	648	19	26	32		0	0	0	0
	Vaimca	426	452	14	18	23		0	0	0	0
	Fugalci	868	921	28	37	46		0	0	0	0
	SalcuFi	516	548	16	22	27		0	0	0	0
	Savalalo	396	420	13	17	21	25	0	1	0	0
	Gogi	314	333	10	13	17	25	0	1	0	0
	Mulinuu	194	206	6	8	10	15	1	0	0	0
	Ani-o-Fiti	282	299	9	12	15	15	1	0	0	0
	Sub-Total	24,098	25,577					8	2	2	0

Districts	Villages	Population in 1985	Population in 1990	30W/Cap	40W/Cap	50W/Cap	Demand (kW)	Tr. Capa (kVA)	15 kVA	25 kVA	50 kVA	100 kVA
SIUMU	Maninoa	320	340	10	14	17		25	0	1	0	0
	Siumu	561	595	18	24	30		50	0	0	1	0
	Siumu-Uta	590	626	19	25	31		50	0	0	1	0
	Saaga	407	432	13	17	22		25	0	1	0	0
	Sub-Total	1,878	1,993						0	2		
FALEALILI	Togitogiga	45	48	1	2	2		15	1	0	0	0
	Ihili	77	82	2	3	4		15	1	0	0	0
	Saleilua	549	583	17	23	29		50	0	0	1	0
	Poutasi	462	490	15	20	25		25	0	1	0	0
	Vaovai	638	677	20	27	34		50	0	0	1	0
	Hatautu	296	314	9	13	16		25	0	1	0	0
	Tafatafa	275	292	9	12	15		15	1	0	0	0
	Malaemalu	239	254	8	10	13		15	1	0	0	0
	Satalo	302	321	10	13	16		25	0	1	0	0
	Piu	74	79	2	3	4		15	1	0	0	0
	Sapunaoa	387	411	12	16	21		25	0	1	0	0
	Salwsatele	368	391	12	16	20		25	0	1	0	0
	Siuniu	116	123	4	5	6		15	1	0	0	0
	Salani	631	670	20	27	33		50	0	0	1	0
	Utulaelae	171	181	5	7	9		15	1	0	0	0
Sapee	131	139	4	6	7		15	1	0	0	0	
Sub-Total	4,761	5,053						8	5	3	0	
LOTOFAGA	Matatufu	475	504	15	20	25		25	0	1	0	0
	Lotofaga	916	972	29	39	49		50	0	0	1	0
	Vavau	387	411	12	16	21		25	0	1	0	0
	Sub-Total	1,778	1,887						0	2	1	0

Districts	Villages	Population in 1986	Population in 1990	30W/Cap	Demand (kW) 40W/Cap	50W/Cap	Tr. Capa (kVA)	25 kVA	35 kVA	50 kVA	100 kVA
LEPA	Aufaga	511	542	16	22	27	50	0	0	1	0
	Vaigalu	124	132	4	5	7	15	1	0	0	0
	Lepa	318	338	10	14	17	25	0	1	0	0
	Siupapa	198	210	6	8	11	15	1	0	0	0
	Saleapaga	304	323	10	13	16	25	0	1	0	0
	Sub-Total	1,455	1,544					2	2	1	0

ALEIPATA	Satitea	481	511	15	20	26	50	0	0	1	0
	Malaela	123	131	4	5	7	15	1	0	0	0
	Lepue	258	274	8	11	14	15	1	0	0	0
	Mutiotele	252	267	8	11	13	15	1	0	0	0
	Saleaumua	572	607	18	24	30	50	0	0	1	0
	Utufa'alalafa	90	96	3	4	5	15	1	0	0	0
	Samusu	517	549	16	22	27	50	0	0	1	0
	Amaille	260	276	8	11	14	15	1	0	0	0
	Tiavea	584	620	19	25	31	50	0	0	1	0
	Lalomanu	748	794	24	32	40	50	0	0	1	0
	Vailoa	376	399	12	16	20	25	0	1	0	0
	Ulutogia	201	213	6	9	11	15	1	0	0	0
		Sub-Total	4,462						6	1	5

ANOAMAA EAST	Saletetele	198	210	6	8	11		0	0	0	0	
	Sauano	221	235	7	9	12	15	1	0	0	0	
	Falevao	423	449	13	18	22	25	0	1	0	0	
	Lalemauga	327	347	10	14	17		0	0	0	0	
	Manunu	177	188	6	8	9	15	1	0	0	0	
	Sauniatu	133	141	4	6	7	15	1	0	0	0	
	Lufilufi	896	951	29	38	48		0	0	0	0	
	Falefa	1,356	1,439	43	58	72		0	0	0	0	
		Sub-Total	3,731	3,960					3	1	0	0

Districts	Villages	Population in 1986	Population in 1990	30W/Cap	Demand (kW) 40W/Cap	50W/Cap	Tr. Capa (kVA)	15 kVA	25 kVA	50 kVA	100 kVA
FALEATA EAST	Sinamoga	1,119	1,188	36	48	59		0	0	0	0
	Moamoa	1,007	1,069	32	43	53		0	0	0	0
	Vaimoso	1,290	1,369	41	55	68		0	0	0	0
	Pesaga	254	270	8	11	13		0	0	0	0
	Lotopa	1,802	1,913	57	77	96		0	0	0	0
	Alafua	884	938	28	38	47		0	0	0	0
	Tuafefu	54	57	2	2	3	15	1	0	0	0
	Tuanaimato East	325	345	10	14	17		0	1	0	0
	Seese	234	248	7	10	12		0	1	0	0
	Lepea	670	711	21	28	36		0	0	0	0
	Vaitoloa	459	487	15	19	24		0	0	0	0
	Sub-Total		8,098	8,595					1	2	1

FALEATA WEST	Tulaele	292	310	9	12	15		1	0	0	0
	Talimalau	781	829	25	33	41		0	0	0	0
	Vailoa	1,153	1,224	37	49	61		0	0	0	0
	Vaiusu	1,371	1,455	44	58	73		0	0	0	0
	Vigaga	724	768	23	31	38		0	0	0	0
	Elisefou	217	230	7	9	12		0	0	0	0
	Vaitele	391	415	12	17	21		0	0	0	0
	Saina	198	210	6	8	11		0	0	0	0
	Toamua	582	618	19	25	31		0	0	0	0
	Safune	221	235	7	9	12		0	0	0	0
	Puipaa	623	661	20	26	33		0	0	0	0
	Falelauniu	53	56	2	2	3	15	1	0	0	0
	Leaupuni	169	179	5	7	9		1	0	0	0
	Tapatapae	117	124	4	5	6		1	0	0	0
	Tanumapua	374	397	12	16	20		0	1	0	0
	Tafaigata	278	295	9	12	15		1	0	0	0
	Siusega	729	774	23	31	39		0	0	0	0
Tuanaimato West	248	263	8	11	13		1	0	0	0	
Sub-Total		8,521	9,044					6	1	1	0

Districts	Villages	Population in 1986	Population in 1990	30W/Cap	Demand (kW) 40W/Cap	50W/Cap	Tr. Capa (kVA)	15 kVA	25 kVA	50 kVA	100 kVA
SAGAGA USOGA	Malie	1,572	1,668	50	67	83		0	0	0	0
	Afega	1,708	1,813	54	73	91		0	0	0	0
	Tuanai	1,102	1,170	35	47	58		0	0	0	0
	Sub-Total	4,382	4,651					0	0	0	0
GAGAEMAUGA I	Leauvaa	2,244	2,382	71	95	119		0	0	0	0
SAGAGA FALEFA	Faleula	1,631	1,731	52	69	87		0	0	0	0
	Alamutu	224	238	7	10	12		0	0	0	0
	Levi	885	939	28	38	47		0	0	0	0
	Lotosoa	572	607	18	24	30		0	0	0	0
	Salepcua'e	624	662	20	26	33		0	0	0	0
	Nonoa	434	461	14	18	23		0	0	0	0
	Malua	297	315	9	13	16		0	0	0	0
	Utualii	478	507	15	20	25		0	0	0	0
	Tufulele	703	746	22	30	37		0	0	0	0
	Aleisa East	344	365	11	15	18	25	0	1	0	0
	Aleisa West	610	647	19	26	32	50	0	0	1	0
	Aele	326	346	10	14	17	25	0	1	0	0
	Nuu	257	273	8	11	14	15	1	0	0	0
	Sub-Total	7,385	7,838					1	2	1	0
ALOFI I	Falcasio	2,894	3,072	92	123	154		0	0	0	0
	Fasitoo-Uta	1,837	1,950	58	78	97		0	0	0	0
	Lepale	43	46	1	2	2	15	1	0	0	0
	Sub-Total	4,774	5,067					1	0	0	0
ALOFI II	Nofoalii	1,716	1,821	55	73	91	50	0	0	2	0
	Leulumoea	1,200	1,274	38	51	64	50	0	0	2	0
	Sub-Total	3,095	3,095					0	0	4	0

Districts	Villages	Population in 1986	Population in 1990	30W/Cap	Demand (kW) 40W/Cap	50W/Cap	Tr. Capa (kVA)	15 kVA	25 kVA	50 kVA	100 kVA
ALOFI III	Fasitootai	1,254	1,331	40	53	67		0	0	0	0
	Vailuutai	738	783	23	31	39		0	0	0	0
	Faleatiu	474	503	15	20	25		0	0	0	0
	Faleele	26	28	1	1	1	15	1	0	0	0
	Satapuata	1,296	1,376	41	55	69		0	0	0	0
	Afia.	163	173	5	7	9	15	1	0	0	0
	Vaipapa	126	134	4	5	7	15	1	0	0	0
	Satimaluifilii	543	576	17	23	29		0	0	0	0
	Afolau	65	69	2	3	3	15	1	0	0	0
	Sina	150	159	5	6	8	15	1	0	0	0
	Sub-Total	4,835	5,132					5	0	0	0

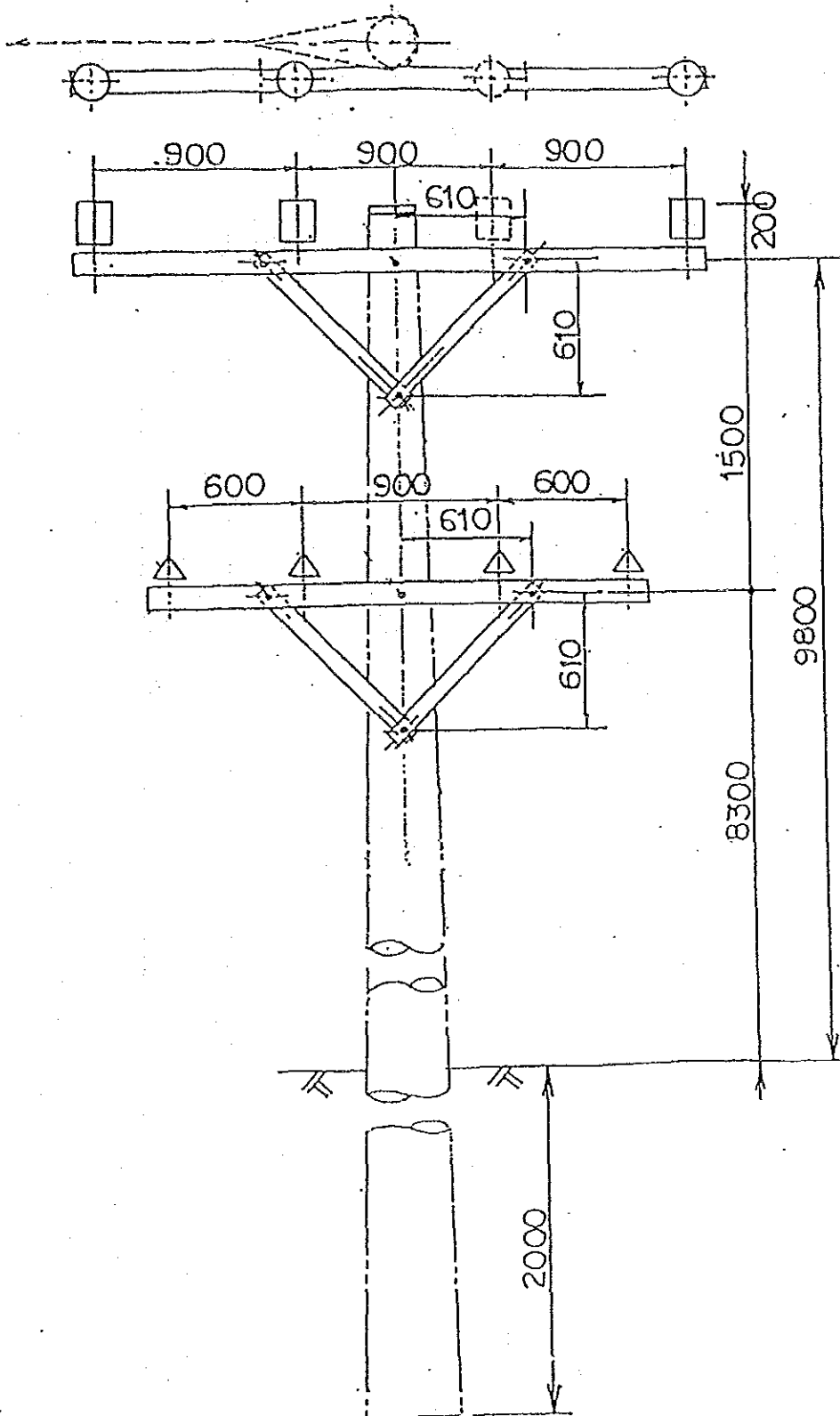
Districts	Villages	Population in 1986	Population in 1990	30W/Cap	Demand (kW) 40W/Cap	50W/Cap	Tr. Capa (kVA)	15 kVA	25 kVA	50 kVA	100 kVA
TOTAL TRANSFORMERS IN UPOLU ISLAND								41	20	18	0

Districts	Villages	Population in 1986	Population in 1990	30W/Cap	Demand (kW) 40W/Cap	Demand (kW) 50W/Cap	Tr. Capa (kVA)	15 kVA	25 kVA	50 kVA	100 kVA
ALATAUA WEST	Tufutafoe	354	376	11	15	19	25	0	1	0	0
	Neiafu-Tai	506	537	16	21	27	50	0	0	1	0
	Neiafu-Uta	603	640	19	26	32	50	0	0	1	0
	Falelima	555	589	18	24	29	50	0	0	1	0
	Sub-Total	2,018						0	1	3	0
PALAUJI FALEFA	Gataivai	1,006	1,068	32	43	53		0	0	0	0
	Gaulavai	285	302	9	12	15		0	0	0	0
	Vaiala	291	309	9	12	15		0	0	0	0
	Sili	870	923	28	37	46		0	0	0	0
	Puleia	281	298	9	12	15		0	0	0	0
	Papa	235	249	7	10	12		0	0	0	0
	Tafua-Tai	357	379	11	15	19	25	0	1	0	0
	Tafua-Uta	185	196	6	8	10		0	0	0	0
	Sub-Total	3,510	3,725					0	1	0	0

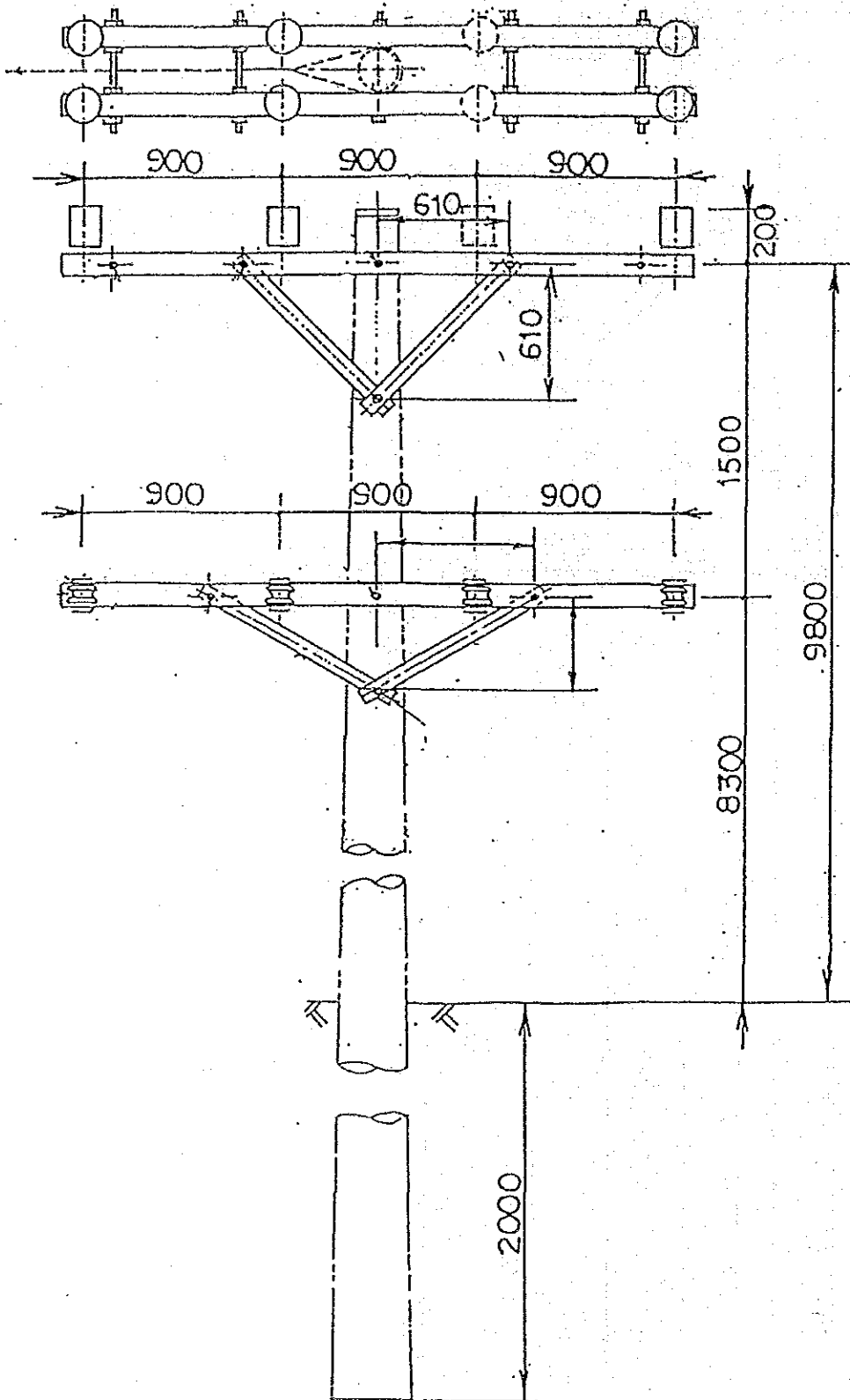
Districts	Villages	Population in 1986	Population in 1990	30W/Cap	Demand (kW) 40W/Cap	Demand (kW) 50W/Cap	Tr. Capa (kVA)	15 kVA	25 kVA	50 kVA	100 kVA
TOTAL TRANSFORMERS IN UPOLU ISLAND								4	4	5	0
TOTAL TRANSFORMERS IN UPOLU ISLAND								41	20	18	0
GROUND TOTAL								45	24	23	0

2,425 kVA

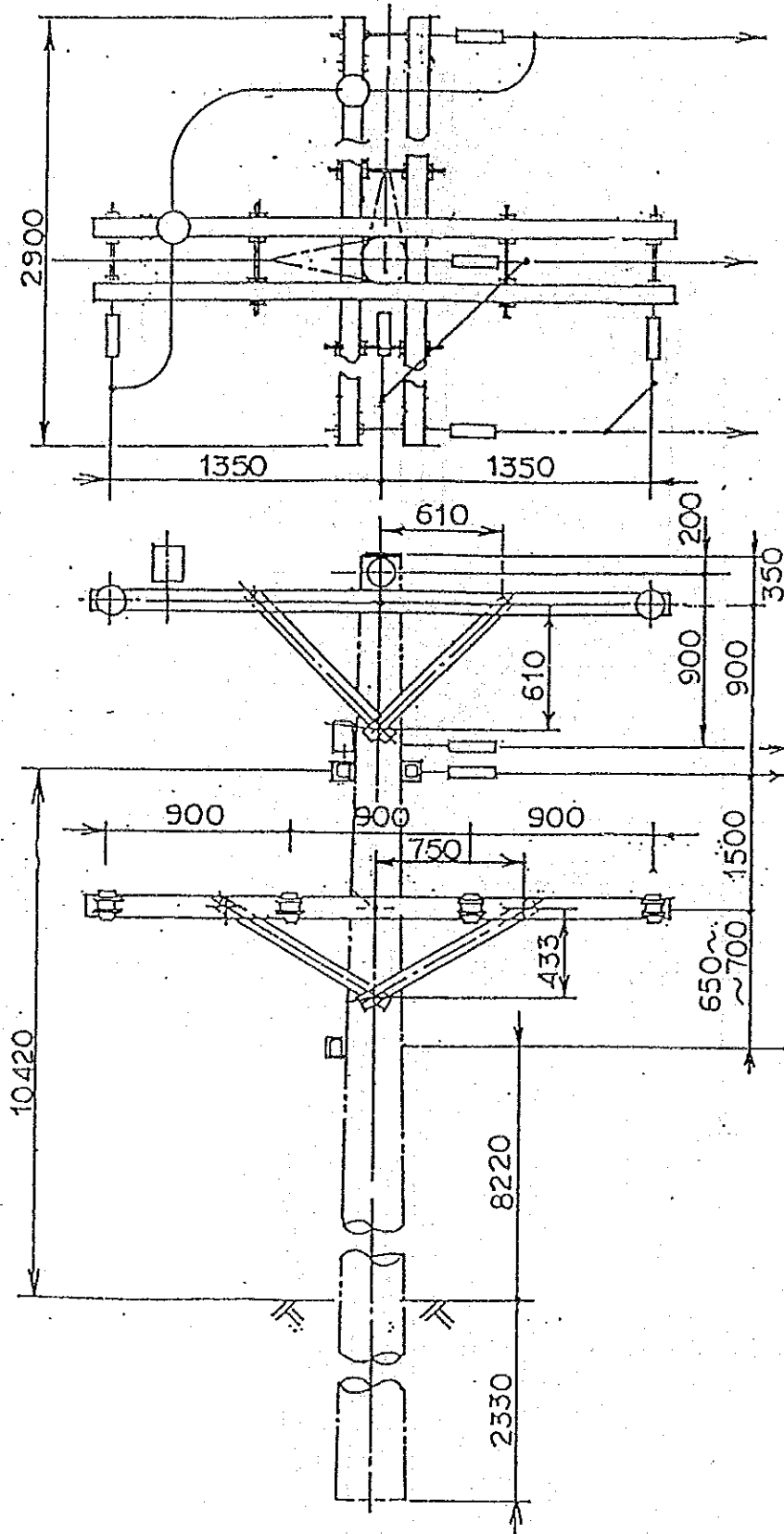
1. STRAIGHT LINE POLES



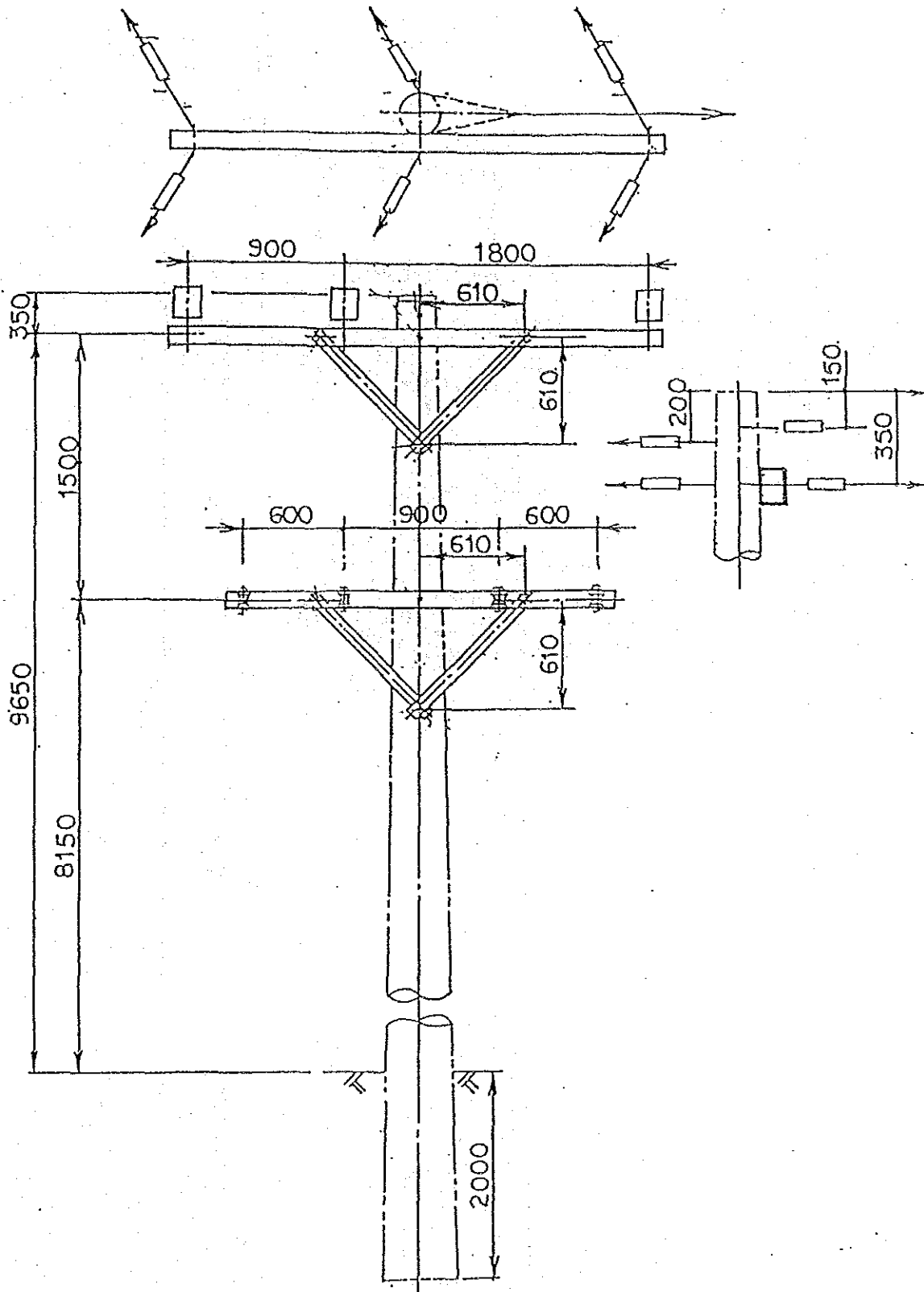
2. LIGHT ANGLE POLE (DOUBLE PIN)



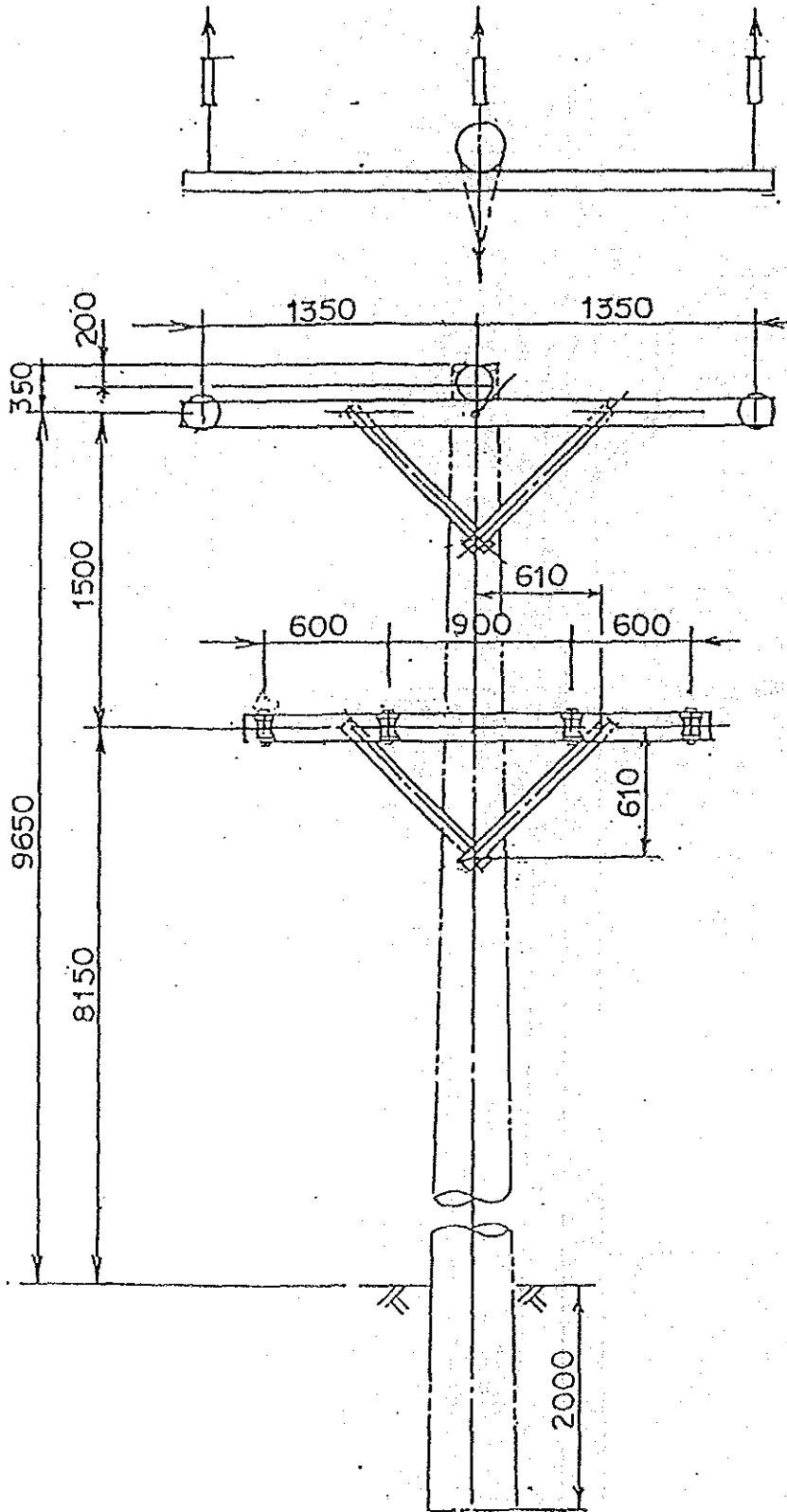
4. ANGLE LINE POLE (DOUBLE AR)



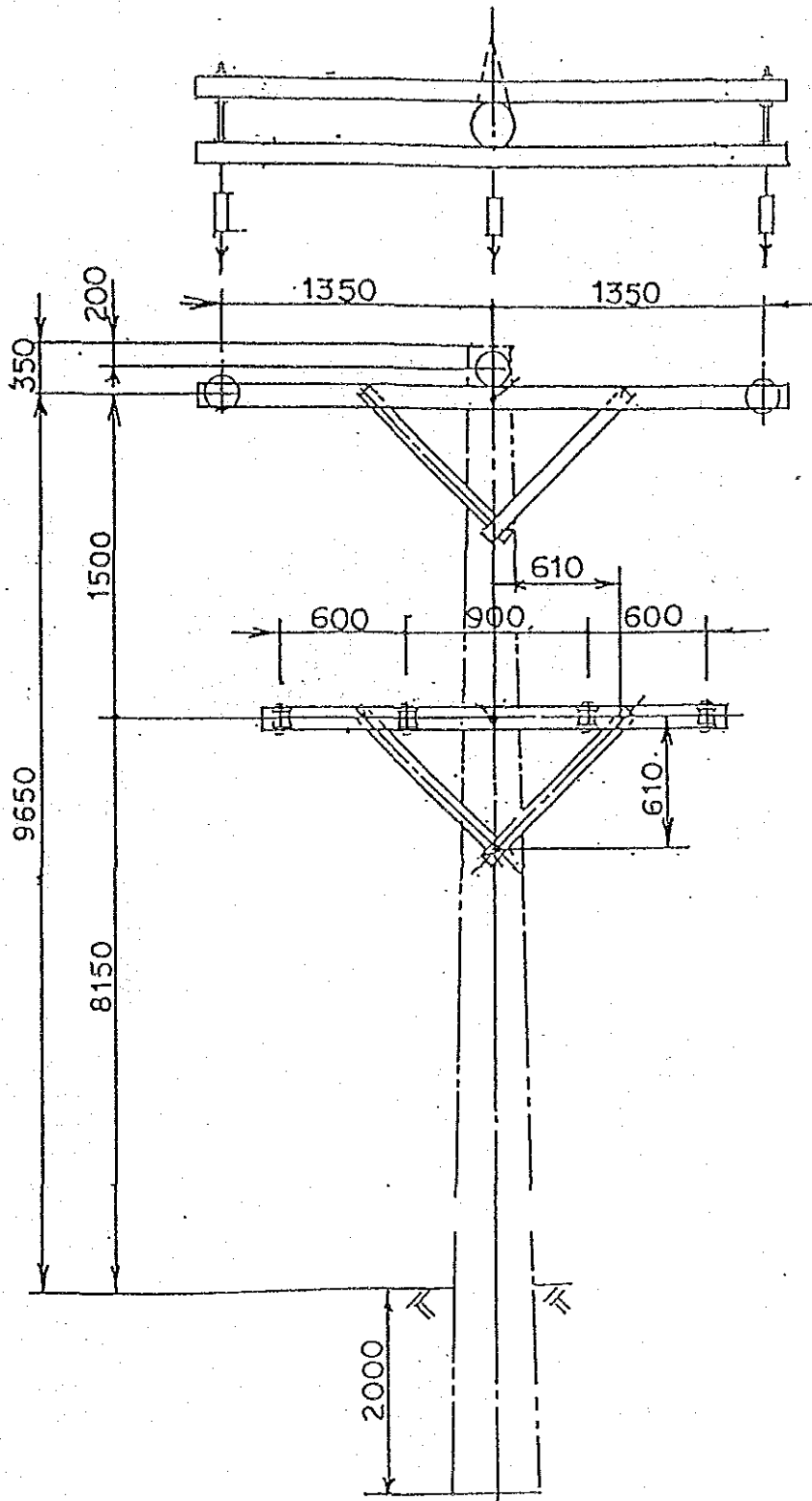
5. ANGLE LINE POLES STRAIN (SINGLE ARM)



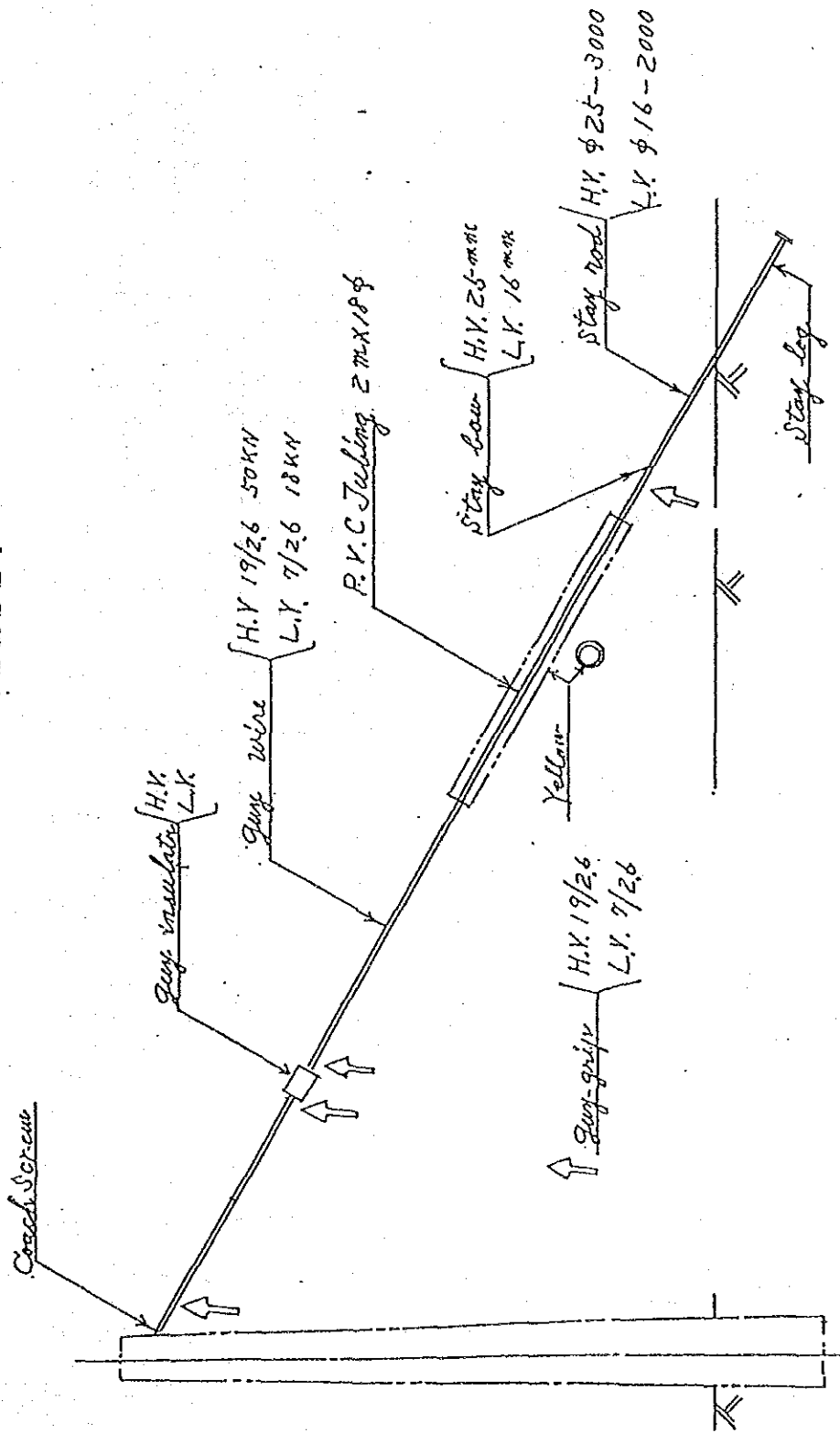
6. TERMINAL POLE (SINGLE ARM)



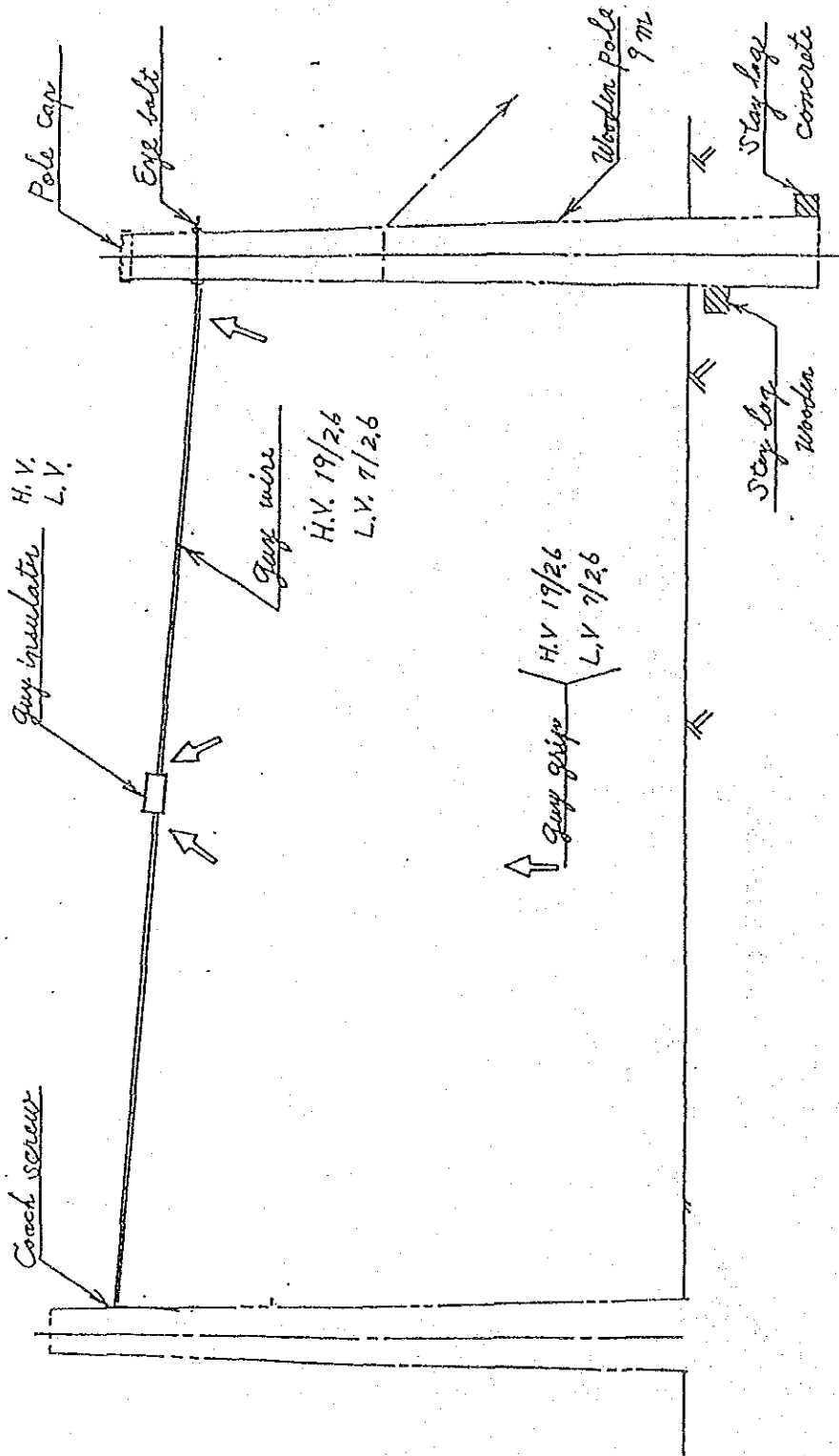
7. TERMINAL POLE (DOUBLE ARM)



9. STAY ASSEMBLY



10. FLYING STAY ASSEMBLY



ELECTRIC POWER CORPORATION

COMMENTS ON "FIELD SURVEY REPORT ON
RURAL ELECTRIFICATION PROJECT IN WESTERN SAMOA"

1. Item 1(b) - Page 1:

It was anticipated that the reticulation of the Island of Savaii would be carried simultaneously with that of Upolu Island. The priorities allocated indicate that Savaii will be last to be reticulated.

It was expected there would be separate priorities - 1 to 4 allocated to Savaii replacing priorities 9 to 11 in the report.

2. Item 2 - Page 2:

Under the item "Construction Equipment (Drilling Machine)", it makes no mention of a crane truck for erection of poles. Is it intended that a crane will be sent out to perform the erection? It will be needed.

3. Item 2 - Page 2:

No mention is made of stay wire, stay wire bows, and anchoring equipment.

4. Item 4 - Page 3:

"To construct all distribution lines" should read: To "erect" all distribution lines.

5. Item 4 - Page 3:

To provide all erection forces for the construction works is too sweeping in the light of "Field Works" in Item 3. Suggest rewording to:

"To provide the erection gang of labourers and linemen (with the exception of additional foremen under Item 3 above).

6. Item 5(b) - Page 4:

Average everyday temperature of conductor. Allow 30°C.

7. Item 5(b) - Page 4:

Maximum Temperature of Conductor (for maximum sag). Allow for 50°C.

- 2 -

8. Safety Factors: Item 5b - Page 4:

- Wooden Poles: 4 (or preferably purchase poles with a strength rating (eg, 4, 6 or 8 kN) set by the Standard Specification AS 2209)
- Concrete Poles) 2 based on actual test results to establish
Steel Poles) crippling load
- Steel Structures: 2 (if based on actual crippling load tests)
4 (if based on design calculations only) and the design includes long members with compressive loads. These safety factors based on yield point

9. Item 5(b) - Page 4:

Ground Clearances - Please use the following clearances:

- (a) 66 kV and 22 kV (EHV) 6.7m at any place
- (b) 400/230 Volts Distribution lines 5.5m across or along roads, and any other place used by vehicles
- (c) 400/230V Service Lines (last span to house):
- 5.5m across any part of a road
 - 3.5m across any private property where vehicles will be used
 - 2.7m at point of connection

10. Item 5(b) - Page 4:

The formula for spacing is confusing:

$$S = 0.0076m/kV + 0.37(S)^{\frac{1}{2}} \text{ where}$$

S = dip in m

Suggest the formula be rewritten.

$$\text{Spacing } S = 0.0076m/kV + 0.37(d)^{\frac{1}{2}} \text{ where}$$

S = Spacing in metres

d = dip or sag in metres

11. Item 5(c) - Page 5:

Colour preferred for insulators and bushings is Munsell grey, sometimes also known as "Sky glaze".

12. Item 5(d) - Page 6:

Suggest reword:

"Three phase transformers will be installed at villages where demand exceeds the largest size single phase transformer (25 kVA).

13. Item 5(h) - Page 7:

It is not necessary to have the 22kV outdoor switch yard completed before the commencement of the 22kV line from Tanugamanono to Siumu. It will be possible to connect the Siumu line to one of the 22kV lines at the gate of Tanugamanono - (preferably the West Coast Feeder) by a short 22kV cable link.

Otherwise it is accepted that the Japanese Aid does not include the outdoor switching yard.

14. Item 6(b) - Page 7:

It is suggested this be reworded more in line with the spirit of Items 3 and 4 as follows:

EPC Organization for the Project:

EPC will arrange a competent engineer to implement the project and a public relations officer to negotiate land use for the proper implementation of the project before commencement of construction in Samoa.

EPC will, provide the erection work force so that the work can be implemented promptly, in accordance with the following tentative implementation schedule and in accordance with clauses 3 and 4 of this report".

It is considered that the original wording is too broad, and is, as a result, in conflict with the wording of the other clauses relating to staffing the project.

In all other respects the report is considered adequate.

Regarding the skeleton diagram for Poles etc.


Please refer 66kV line - Pages 1 and 2:

It is considered 2.000m bolt hole spacing for the 66kV arm to 22kV arm is excessive.

In view of a gain in height of about 400mm due to the difference in height of the 66kV post (about 600mm height) to that of a 22kV pin insulator (about 250mm) there is no reason why the spacing should not be 1.5m.

This will also make the 66kV wires within reach for a man standing on the 22kV arm.

The distances between arms above the LV arm is so great as to need "step bolts" for a worker to climb within reach of the wires - suggest these be shown at about 300 to 350mm spacing.


Eric J Hussey
GENERAL MANAGER

8 November 1989

8 November 1989

COMMENTS ON FIELD SURVEY REPORT ON
RURAL ELECTRIFICATION PROJECT IN WESTERN SAMOA

1. SCOPE OF PROJECT

(a) Upolu Island

This looks all right in that priority is given to the Tanugamanono - Siumu major link which by the time of the construction in 1990 will be very much needed to reinforce the voltage as the 22kV distribution around Leulumoega through Lefaga to Safata and Falealili, from the Control Station in Apia will have covered about 50 miles (80km).

The priority rating 1 to 5 for areas covered is all right too. I have swapped Aleisa Road - Saleimoa to rating 8 with Satuimalufilufi - Satapuata to 10 and Lepale - Fasitoo-uta to 9.

(b) Savaii Island

This part of the Project may be done simultaneously with Upolu at an independent priority rating from that of Upolu with the preferred ratings as followed:

Tufutafoe - Falealupotai	- 6
Tafuauta - Tafuatai	- 7
Puapua - Samalaeulu	- 11
Sasina - Matavai	- 12

2. Equipment and materials stated under this clause should include light trucks, heavy trucks of 6 tons type, compressure complete hammer dynamites (if required in place of a Koken-Down-the-hole drill type).

-2-

The vehicle and equipment essentials are given on a separate sheet attached. Crossarms if wooden and line construction hardware should also where required be standard to ones (or equivalent) used currently by EPC.

It is worth noting also that the 6.6kV/22kV step up transformer to be installed at Puapua will be temporary until conversion of the existing Salelologa - Puapua 6.6kV to 22kV at a later stage.

3. Home Works and Field Works are all right except that shipment of materials takes about three (3) months from placement of order to be supplied if procured from New Zealand or Australia.
4. Please note that materials are duty free into Apia. At present status the engineers in Charge is Toluono assisted by A. Tiotio.
5. (a) The pole design is the same as in our Construction manual submitted to you.
(b) Design Concept adopted is as in our construction manual submitted, based on the Australian Code of Practice for Overhead Line Construction by the Electricity Supply Association of Australia No. C (b) 1, 1974. All other design factors are all right except we use following safety factors for poles:

Wooden Poles	x 4
Concrete Poles	x 2
Steel Poles	x 2

Ground Clearance for LV (415/240 volts) is 5.5m.

(c) LINE MATERIALS

AAC FLY is hard drawn 7/3.4mm stranded conductors.

AAC WASP is also hard drawn 7/4.39mm stranded conductors.

Colour of Insulators and Bushings: Light Grey

- (d) Distribution transformers sizes in the rural sector are determined mainly by the size of villages in population.
- (f) Wood poles preferred for standardisation and local construction gangs experience with handling.
- (g) A sawmill on this link have asked for a 100kVA substation with probable extension to 200kVA in two years.

-3-

- (h) This clause is agreeable as it is.
 - (i) Provisional Pole Arrangement is ok except for the 14m poles where we have allowed 1.8m spacing between 66kV and 22kV although 1.5m space may be entertained for ease of maintenance.
6. Transformer erecting is still in progress between Lefaga and Siumu but had it not been for vehicle and machine break downs (old ones as no new ones assigned to this project) the whole section Leulumoega to Siumu would have finished by now.



T.F. Toluono
DEPUTY GENERAL MANAGER-ENGINEERING

LINE TOOLS AND MACHINERY FOR THE
RURAL ELECTRIFICATION PROJECT
UNDER JAPANESE AID

Cable Hoist or Puller (3-4 Tons)	36
Compression Tools 12 Tons	10
Wire Grip 1659-40 Klien for 7/3.4 PVC	36
Wire Grip 1628-58 Klien for 19/2.6 steel guy	12
Cable Cutter for Hull	12
Ring Anger Bits 22mm	24
Ring Anger Bits 20mm	24
Ring Anger Bits 18 mm	24
Digging Crawbars 2m	24
Digging spades with 2m galv. handles	30
Digging shovels with 2m galv. handles	30
<hr/>	
Heavy Trucks 6 Ton Flat Deck or Dyna	3
Hiab Cranes 7 Ton with Pole Trailers	3
Air Compressor (complete with hammers) (Rig Crawler type)	2
Toyota Landcruiser S.W.B.	1

APPENDIX 2

OUTLINE OF WESTERN SAMOA

1. Name of contry : THE STATE OF WESTERN SAMOA
2. Location : South latitude 13 deg. - 14 deg.
West longitude 171deg. - 173 deg.
Just to east of the international date line .
Time difference from Japan 20 hours
lagging.
3. Area : 1,934 sq.km
(Upolu island : 1,122 sq.km, Savaii island :
1,714 sq.km, Others : 98 sq.km)
4. Population : Approx.160,000
(Upolu island : 117,800, Savaii island :
41,200, Others : 1,000)
5. Capital : Apia, Population approx.35,000
6. History : 1722 A Dutch explorer visited

1830 A Christian missionary Mr.John
William landed.

1900 Came under the control of
Germany

After World War I
Came under the control of New
Zealand as a territory under the
League of Nations.

After World War II
Come under the control of New
Zealand

1962 Became the first independent
South Pacific nation

7. Language : Samoan and English
8. Climate : Typical tropical and oceanic climate
Mean temperature 26 - 27 deg. C.
Annual rainfall 2,800 - 3,000 mm
The dry season April to October
The rainy season November to March
- 9 Form of politics : Constitutionalism
The National Assembly selects the Prime Minister. He nominates eight Ministers from Members of the National Assembly to form the Cabinet.
- 10 Currency
- Currency : Tala (WS\$)
- Exchange rate : WS\$1 = Yen60 at present
11. Financial aspects : A great part of the annual revenue is assisted by loans and grants from advanced countries and international agencies. The national budget in 1988 was WS\$7,000,000 (equivalent to about Yen 4,200,000,000). The gross national product per head in 1987 was presumed to be US\$660.

13. Industries : An agricultural country

Main products :

Copra, cacao, bananas, taro, papaya,
mangoes, avocados.

Fisheries :

Although the surrounding sea has good fishing banks for oceanic bonito and tuna fish, full-scale fisheries have not yet been developed.

Tourist industries :

There is a remarkable opportunity for the tourist industries and the Government gives emphasis to attraction of foreign tourists. There are about 30,000 visitors to Western Samoa annually consisting mainly of American Samoan, New Zealanders, Australians, Americans and West Germans. There are only about 300 visitors from Japan per annum and these are mainly for business.

14. Trading

Annual gross exports	WS\$25,000,000
Annual gross imports	WS\$92,000,000
Export commodities	Agricultural products such as copra, cocoa, taro, etc..
Import commodities	Machinery, metals, foods, textile, vehicles, petroleum, gasoline, etc..

Trading partners

New Zealand, Australia,
Japan and America

15. Wages

Mean income of civil servant

About
Yen 36,000/month

Expenditure on the Members
of the National Assembly

Prime Minister

About
Yen 1,920,000/annum

Minister

About
Yen 1,500,000/annum

Member

About
Yen 660,000/annum

GENERATING FACILITIES

Designation	Rated Output (kW)	Derated Output (kW)	Location	Comp.Year	Note
UPOLU-DIESEL					
Number 4	1,672	1,200	Tanugamanono	1966	
Number 5	1,672	1,200	Tanugamanono	1966	
Number 6	1,456	1,000	Tanugamanono	1973	
Number 7	1,800	1,200	Tanugamanono	1979	
Number 8	1,800	1,200	Tanugamanono	1979	
Number 9	2,250	2,000	Tanugamanono	1984	
Number 10	1,000	800	Tanugamanono	1986	
Number 11	1,000	500	Tanugamanono	1986	
Total Upolu Diesel	12,650	9,100			
UPOLU-HYDRO					
Fulusaou No.2	370	370	Fulusaou	1985	
Alaaoa	1,000	1,000	Alaaoa	1982	
Falaole Fee	1,600	1,500	Alaaoa	1982	
Samasoni No.1	900	725	Lotosamasoni	1982	
Samasoni No.2	900	725	Lotosamasoni	1982	
Lalomauga No.1	1,750	1,750	Lalomauga	1985	
Lalomauga No.2	1,750	1,750	Lalomauga	1985	
Total Upolu Hydro	8,270	7,820			
TOTAL UPOLU GENERAT	20,920	16,920			
SAVAII-SALELOLOGA-DIESEL					
Number 1	100	80	Salelologa	1978	Broken & removed
Number 2	100	80	Salelologa	1978	
Number 3	100	80	Salelologa	1978	
Number 4	380	380	Salelologa	1985	
Number 5	60	50	Salelologa	1982	
Number 6	60	50	Salelologa	1982	
Number 7	273	200	Salelologa	1986	
Total Savaii Diesel	1,073	920			
SAVAII-ASAU-DIESEL					
Number 1	300	250	Asau	1894	The generators are being overhauled and will be shifted to Salelologa
Number 2	412	412	Asau	1986	
Total Asau Diesel	712	662			
SAVAII-ASAU- CONVERTER					
Number 1	600	600	Asau	1984	The converters are not operating now.
Number 2	600	600	Asau	1984	
Total Asau Convert	1,200	1,200			
TOTAL SAVAII GENERA	2,985	2,782			

Note;

- 1 Derating of diesel generating plant is necessary due either to the age of the plant or to cooling problems. Derated capacity is the maximum continuous output that can be delivered under normal operating conditions
- 2 Penstock losses do not allow full rated output to be achieved when both generators are operating at Samasoni.
- 3 Rating is based on a power factor of 0.8.
- 4 Generation at Asau is carried out by Samoa Forest Product using a Waste Wood Fired boiler and 2,500 kW steam turbo-generator. EPC operates a Frequency Converter Station to convert the generated frequency to 50 Hz.

Source : EPC

DISTRIBUTION TRANSFORMERS

Appendix 2-3

Designation	1981 (kVA)	1982 (kVA)	1983 (kVA)	1984 (kVA)	1985 (kVA)	1986 (kVA)	1987 (kVA)
UPOLU SYSTEM							
Single Phase 6.6 kV	727	552	325	300	300	297.5	345
Three Phase 6.6 kV	6,680	6,750	6,975	6,430	5,330	5,650	5,350
Single Phase 22 kV	1,050	1,300	1,590	1,630	1,680	1,735	1,850
Three Phase 22 kV	5,540	9,170	10,400	12,200	13,250	12,500	14,250
Total Upolu System	13,997	17,772	19,290	20,560	20,560	20,183	21,795

SALELOLOGA SYSTEM							
Single Phase 6.6 kV	333	325	325	325	325	365	365
Three Phase 6.6 kV	150	200	250	250	250	250	250
Single Phase 22 kV					50	50	105
Three Phase 22 kV					150	150	150
Two Phase 22 kV						120	120
Total Salelologa Syst	483	525	575	575	775	935	990
ASAU SYSTEM							
Single Phase 6.6 kV		125	125				
Three Phase 6.6 kV				20	20		
Single Phase 22 kV				150	175	0	95
Three Phase 22 kV				50	150	100	150
Two Phase 22 kV						325	325
Total Asau System	0	125	125	220	345	425	570
TOTAL SAVAII SYSTEM	483	650	700	795	1,120	1,360	1,560

LENGTH OF DISTRIBUTION LINES

UPOLU SYSTEM (Overhead Lines)							
22 KV	97	115	151	158	174	177	182
6.6 KV	69	99	74	73	73	73	73
Low Voltage	217	320	335	350	370	396	419
UPOLU SYSTEM (Underground Lines)							
22 KV	1	3	3	3	3.08	3.33	3.33
6.6 KV	1.45	1.45	1.45	1.50	1.50	1.50	1.50
UPOLU TOTAL	385.30	538.45	564.45	585.50	621.58	650.83	678.83

SALELOLOGA SYSTEM (Overhead Lines)							
22 KV	NA	NA	NA	NA	13	21	21
6.6 KV	23	23	23	23	23	23	23
Low Voltage	30	45	45	53	63	72	72
ASAU SYSTEM (Overhead Lines)							
22 KV	NA	NA	NA	28	40	44	72
2.2 KV	NA	10	15			NA	NA
Low Voltage	NA	12	27	27	32	40	78.37

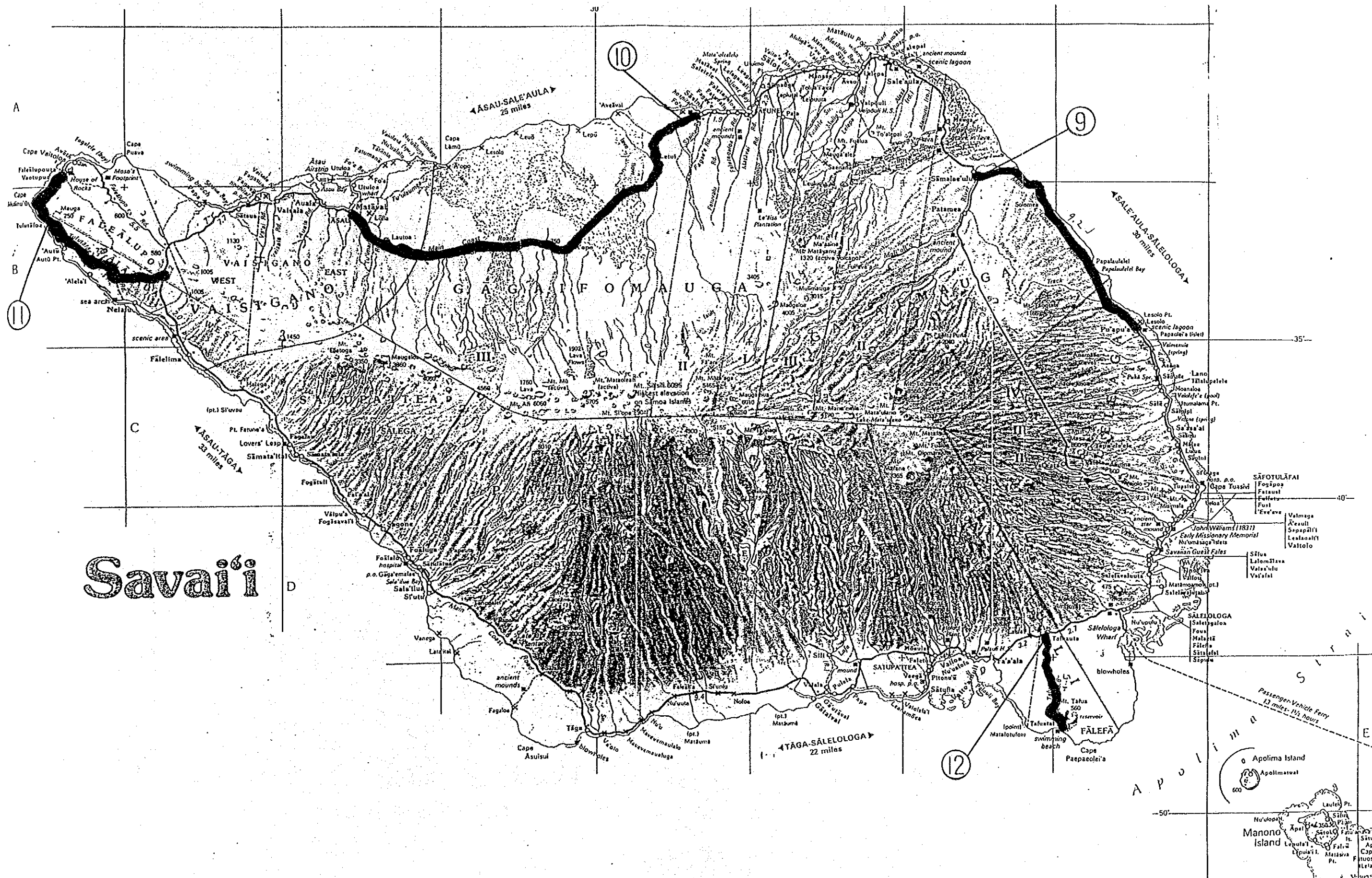
Note;

- 1 6.6 kV overhead lines added during 1982 were constructed for later conversion to 22 kV.
- 2 Power lines at Asau were constructed for 22 kV but were operated at 2.2 kV, 60 Hz from the generator of Samoa Forest Products Asau sawmill until 1984. The lines are being operated due to trouble with local peoples on the land installed EPC diesel generators.

Source : EPC

APPENDIX 3

Planned Routes



Savai'i

METEOROLOGICAL DATA IN APIA

MAX. TEMPERATURE

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1941	31.9	31.8	31.3	31.7	31.1	31.6	29.8	30.8	31.0	30.8	32.4	32.4
1942	32.8	32.7	31.6	30.9	31.8	31.1	29.9	30.1	30.9	30.2	30.4	30.5
1943	30.8	30.9	31.2	31.2	30.3	30.2	30.1	30.1	30.2	30.9	32.1	31.0
1944	32.3	30.5	31.0	31.7	30.8	30.3	30.7	30.2	30.3	30.1	30.5	31.2
1945	31.2	31.0	31.0	32.0	30.7	30.9	29.9	30.1	30.0	31.0	31.2	31.2
1946	31.7	31.4	32.1	32.2	32.1	31.2	31.0	30.7	31.5	31.8	31.9	31.9
1947	31.9	32.7	32.8	32.6	32.4	31.6	31.6	31.5	31.4	31.4	31.4	31.1
1948	33.8	31.6	32.2	31.8	32.0	31.8	30.8	30.8	30.7	31.9	31.7	31.1
1949	31.6	31.9	32.2	31.8	31.6	30.9	31.6	30.4	31.3	30.8	31.8	31.0
1950	31.9	31.1	31.6	31.8	31.6	30.3	29.9	30.3	31.1	31.4	31.4	31.3
1951	31.0	31.9	31.3	32.3	31.6	31.1	30.8	31.2	30.9	30.7	31.6	32.2
1952	33.3	32.3	32.3	31.4	31.7	31.3	30.6	30.6	31.0	31.3	31.5	32.4
1953	31.8	32.1	32.8	32.2	32.7	31.2	30.4	30.6	31.6	31.7	32.3	32.2
1954	31.6	32.4	30.7	31.2	31.6	30.9	31.1	31.2	30.6	31.1	31.2	31.1
1955	31.3	31.2	31.0	31.6	31.1	30.6	30.3	29.8	29.9	30.2	31.1	30.4
1956	31.1	30.1	31.0	31.8	31.1	30.8	29.9	30.3	30.6	31.0	31.4	31.7
1957	31.1	31.7	31.8	31.4	31.7	31.2	30.2	31.6	30.8	31.1	31.7	31.1
1958	32.2	32.1	32.8	32.3	32.0	30.7	31.6	31.3	30.7	31.3	31.7	32.2
1959	32.0	32.7	31.8	31.9	32.0	31.8	31.3	30.6	31.4	31.1	31.6	31.6
1960	31.7	31.8	31.7	30.4	32.2	30.9	30.2	30.7	30.8	31.3	31.6	31.3
1961	31.6	31.6	31.8	31.7	31.2	30.4	30.3	30.3	30.5	30.4	30.7	31.2
1962	31.1	31.7	31.9	31.7	31.0	31.1	30.6	30.0	30.5	30.0	31.1	31.4
1963	31.1	31.7	31.2	31.4	31.9	31.6	30.6	31.1	31.1	31.6	31.4	31.7
1964	32.2	32.8	32.2	31.9	30.9	30.7	30.1	30.2	30.5	30.7	30.6	30.3
1965	32.1	30.9	32.3	31.2	31.2	30.5	30.7	30.6	30.8	30.7	31.7	31.9
1966	31.9	31.7	32.8	31.6	31.3	31.0	30.4	30.6	30.4	31.2	31.7	31.5
1967	31.1	31.1	31.6	30.6	30.7	31.0	30.7	29.6	30.6	30.6	30.8	31.2
1968	32.8	31.6	31.9	31.0	30.6	30.7	29.6	30.1	30.0	31.1	31.5	31.7
1969	32.3	32.3	31.7	31.3	30.8	31.6	30.6	30.6	30.6	31.7	31.9	31.7
1970	32.4	32.2	31.6	31.7	32.2	30.8	30.7	30.7	31.2	30.6	30.8	30.6
1971	31.4	31.7	30.5	30.7	30.6	30.7	30.3	29.8	29.9	30.3	32.0	31.5
1972	30.8	31.3	31.5	31.3	31.6	31.1	30.4	30.2	30.2	31.3	31.2	31.2
1973	31.4	31.6	32.0	31.6	31.9	31.2	30.6	30.0	30.8	30.3	30.4	30.5
1974	32.0	31.0	30.6	31.0	30.5	30.1	30.5	30.1	30.4	30.6	30.7	30.7
1975	33.4	30.8	31.3	30.8	30.9	30.1	30.5	30.1	30.4	30.6	30.7	30.7
1976	30.2	31.0	31.7	31.2	30.8	30.9	30.1	31.2	30.4	31.5	31.6	31.4
1977	31.3	31.8	31.9	32.2	31.9	31.3	30.6	30.2	30.6	31.4	31.6	32.4
1978	30.9	33.4	32.1	31.8	31.9	31.0	31.2	31.5	31.4	31.6	31.5	32.0
1979	32.0	32.0	31.8	32.0	32.3	31.9	31.2	32.1	31.4	32.0	31.4	32.2
1980	32.0	32.1	32.0	33.2	31.1	31.6	30.9	30.8	31.0	31.2	32.6	32.8
1981	32.2	32.8	32.1	-	-	-	31.3	31.0	31.3	31.2	32.0	32.0
1982	31.6	31.4	32.8	32.6	32.6	32.2	31.4	30.9	31.8	32.8	31.5	32.4
1983	32.5	33.6	33.0	32.8	32.4	32.1	31.3	30.4	31.2	32.0	32.2	32.4
1984	31.6	32.0	32.3	32.1	32.1	31.9	30.6	30.6	31.0	32.4	32.0	31.5
1985	33.0	31.5	32.9	32.5	32.0	31.5	30.7	31.2	-	-	-	-
Max.	33.8	33.6	33.0	33.2	32.7	32.2	31.6	32.1	31.8	32.8	32.6	32.8

Recorded Max. Temp.: 33.8 Jan. 1948

Source : EPC

METEOROLOGICAL DATA IN APIA

MIN. TEMPERATURE

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec.
1941	21.6	23.1	22.0	22.9	22.0	21.5	20.1	21.6	21.7	19.8	22.2	21.6
1942	22.8	23.9	23.8	21.6	21.8	21.7	20.1	22.0	20.2	21.6	21.2	21.8
1943	22.7	23.0	22.6	23.9	22.7	20.9	20.9	20.0	21.3	21.9	22.5	22.9
1944	22.5	22.7	23.0	22.0	22.0	22.8	20.1	21.0	22.6	20.1	22.2	21.8
1945	21.5	22.9	22.5	22.9	21.8	21.8	22.8	20.0	21.8	22.8	21.8	23.0
1946	22.9	22.8	22.8	22.2	22.6	21.7	19.7	20.8	20.9	20.8	22.9	20.7
1947	22.4	22.9	21.9	22.7	20.8	21.8	21.3	19.5	21.0	20.1	22.6	22.1
1948	21.7	22.9	22.3	22.4	22.7	20.8	19.7	19.7	20.6	21.9	21.3	21.7
1949	21.6	22.7	22.0	22.2	21.7	20.0	18.8	20.6	22.0	20.7	21.9	22.7
1950	22.2	21.9	21.9	21.8	21.7	20.9	20.5	20.8	19.7	20.9	21.3	21.4
1951	22.9	21.9	22.8	23.8	21.1	21.6	17.9	19.4	19.7	19.8	21.1	20.8
1952	22.7	22.6	22.2	20.7	20.6	20.8	20.9	20.0	19.7	20.6	21.7	22.7
1953	22.0	22.6	23.8	22.3	21.1	20.7	19.9	19.8	18.7	21.7	21.9	20.6
1954	21.7	22.3	21.6	21.1	21.1	21.8	19.0	21.6	21.1	21.7	21.6	22.0
1955	21.7	21.7	21.1	21.3	21.5	21.7	21.6	20.3	20.1	21.6	21.0	21.6
1956	20.6	21.6	21.7	21.9	21.0	19.5	19.9	20.6	19.8	20.5	20.8	21.4
1957	21.7	21.8	21.6	22.6	20.5	19.6	19.7	18.7	20.0	20.0	20.7	20.8
1958	21.7	21.8	22.7	23.4	21.6	20.9	17.7	18.9	19.6	20.3	21.9	21.5
1959	21.9	22.9	22.6	22.9	21.9	20.6	19.6	21.0	19.9	22.2	21.9	22.9
1960	21.9	22.6	22.8	23.6	22.1	20.9	19.9	20.7	19.6	20.6	21.5	22.8
1961	22.2	22.1	21.7	21.9	22.7	20.3	19.7	20.8	21.7	20.7	22.7	21.7
1962	22.2	23.6	22.8	22.2	22.0	19.6	20.6	20.6	21.7	20.6	21.7	21.7
1963	21.9	22.8	22.2	21.6	21.7	19.9	20.6	21.9	20.8	21.8	21.2	21.7
1964	21.1	22.8	22.7	22.1	20.4	20.3	19.6	19.4	20.9	21.3	20.6	21.7
1965	21.7	19.4	21.6	22.3	21.8	19.7	18.6	20.0	21.6	21.9	20.1	21.0
1966	22.9	21.6	22.2	21.1	22.3	21.6	20.8	18.6	19.9	21.7	21.7	19.9
1967	20.6	21.2	21.9	21.7	21.1	20.5	20.0	18.3	21.1	20.6	20.8	20.8
1968	21.9	22.3	22.7	19.5	21.0	20.7	21.6	19.4	19.4	21.7	20.8	21.7
1969	22.3	22.8	22.5	22.8	21.0	20.9	20.0	20.8	19.8	22.1	22.8	21.7
1970	21.7	21.1	22.7	22.1	21.5	22.8	19.6	20.4	18.1	21.2	21.6	21.5
1971	21.1	22.0	22.4	22.0	21.6	20.4	19.7	19.6	19.2	21.6	20.8	22.2
1972	21.9	21.9	21.6	22.4	20.8	21.6	20.2	20.3	21.9	20.5	21.6	23.0
1973	21.0	22.6	23.6	22.8	22.1	20.8	20.5	20.4	20.2	20.9	21.4	22.1
1974	22.1	21.1	21.6	21.3	19.6	19.6	19.1	21.4	20.0	20.4	19.3	21.6
1975	21.4	21.6	22.5	22.4	21.1	20.3	20.4	20.3	20.6	21.0	21.4	22.0
1976	20.4	21.5	22.0	22.5	21.6	20.9	20.2	19.8	18.7	21.4	21.8	20.7
1977	20.2	22.4	21.2	21.1	19.5	18.9	19.3	18.9	19.1	21.6	21.7	21.3
1978	22.6	21.4	21.5	22.2	21.6	20.7	19.2	20.7	19.2	21.5	19.2	22.0
1979	21.9	21.9	22.4	21.4	21.2	22.1	24.0	18.1	20.5	21.2	21.5	20.9
1980	21.5	23.2	22.7	21.5	20.5	19.1	21.2	21.9	21.9	21.9	18.5	19.0
1981	19.6	18.1	19.5	-	-	-	17.5	14.7	17.5	20.5	20.1	20.5
1982	23.0	21.4	22.4	23.0	22.0	20.9	20.2	20.4	20.4	20.1	21.4	21.0
1983	21.7	23.5	22.6	20.8	21.7	20.2	20.1	18.5	21.0	22.0	21.1	22.6
1984	20.9	22.5	23.1	22.7	20.8	20.3	19.0	20.4	20.5	20.3	21.8	22.4
1985	21.9	22.9	22.3	21.9	22.1	21.5	20.5	21.3	-	-	-	-
Min.	19.6	18.1	19.5	19.5	19.5	18.9	17.5	14.7	17.5	19.8	18.5	19.0

Recorded Min. Temp. : 14.7 Aug. 1981

Source : EPC

METEOROLOGICAL DATA IN APIA

GUST WIND VELOCITY (Knots)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1941	25	39	55	35	33	30	34	30	35	38	50	33
1942	30	38	36	39	28	43	44	41	41	38	29	33
1943	32	26	41	31	28	20	35	36	38	36	28	33
1944	42	33	35	32	32	29	36	38	42	37	28	29
1945	34	36	40	38	29	37	31	32	41	41	33	30
1946	33	38	26	26	29	38	31	39	32	33	30	46
1947	36	26	36	42	36	36	42	39	45	38	27	36
1948	42	42	42	36	35	41	41	36	37	39	32	49
1949	25	39	41	29	44	38	37	41	39	37	37	37
1950	44	41	38	35	32	43	28	34	35	34	31	44
1951	30	41	32	29	30	36	33	29	38	42	36	29
1952	38	37	36	34	34	43	35	31	43	47	27	39
1953	29	35	29	36	38	33	45	29	29	37	42	25
1954	36	42	39	36	43	34	44	37	41	44	35	34
1955	32	46	33	32	39	35	35	45	51	41	35	42
1956	39	38	33	35	30	39	39	33	37	34	29	34
1957	34	65	31	33	28	42	35	34	30	34	34	47
1958	44	31	44	29	48	33	32	36	32	37	33	27
1959	37	42	37	32	33	33	37	32	38	41	34	39
1960	52	34	39	34	36	38	39	35	34	32	33	38
1961	34	43	53	32	35	45	34	29	41	43	31	28
1962	41	37	38	29	43	35	29	47	42	35	31	46
1963	31	34	42	39	31	39	29	34	31	31	33	33
1964	37	34	40	44	33	39	33	37	37	39	33	28
1965	33	33	31	35	36	44	41	33	36	36	28	30
1966	82	35	33	36	34	43	32	33	41	30	33	35
1967	52	37	35	38	35	36	41	52	36	38	36	42
1968	40	78	34	42	28	37	39	28	32	40	31	31
1969	43	43	39	35	39	28	34	32	33	32	34	36
1970	51	47	41	33	32	38	39	36	35	34	28	30
1971	32	28	38	41	34	44	31	33	39	38	35	41
1972	40	32	30	36	29	36	32	38	38	37	36	51
1973	47	37	30	36	36	38	33	36	34	39	38	33
1974	41	37	45	34	42	41	37	28	39	34	35	44
1975	52	36	38	38	34	38	43	37	38	33	38	40
1976	36	42	39	-	-	-	-	-	28	34	30	40
1977	42	32	34	41	33	37	37	31	40	-	-	43
1978	41	30	35	23	35	31	34	30	37	35	38	43
1979	42	35	32	40	30	39	36	32	35	40	34	37
1980	33	44	42	32	27	41	32	36	36	35	26	32
1981	37	46	45	-	-	-	-	32	33	45	35	30
1982	-	49	-	25	38	33	31	-	29	28	38	22
1983	23	-	28	32	32	43	36	34	36	30	26	35
1984	29	36	33	31	33	38	34	38	31	33	28	38
1985	32	29	35	35	43	33	36	32	-	-	-	-
Max.	82	78	55	44	48	45	45	52	51	47	50	51
m/sec	42	40	28	23	25	23	23	27	26	24	26	26

Recorded Max. Gust Wind Velocity:82Knots(42m/sec)

Source : EPC

Knot=1853M/h= 0.5147 m/sec

METEOROLOGICAL DATA IN APIA

DAYS WITH THUNDER

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
1941	5	5	5	3	2	1	0	1	1	3	2	6	34
1942	7	9	20	10	4	2	1	3	5	4	6	9	80
1943	4	7	6	5	9	0	1	0	2	3	17	13	67
1944	6	5	6	5	4	2	0	1	1	1	0	3	34
1945	5	0	2	2	3	4	1	8	1	4	7	3	40
1946	7	2	13	7	6	1	0	0	0	7	19	14	76
1947	13	10	14	12	8	9	5	2	8	6	8	11	106
1948	7	6	10	9	9	2	1	1	1	6	5	11	68
1949	10	11	3	9	14	3	4	3	5	14	6	9	91
1950	8	13	2	10	14	5	4	2	1	11	15	12	97
1951	6	12	3	15	11	8	0	0	0	8	9	11	83
1952	1	15	9	6	5	3	0	3	2	8	4	12	68
1953	7	7	8	16	7	2	2	0	0	6	5	4	64
1954	8	8	3	11	9	9	2	4	3	17	14	7	95
1955	10	9	4	3	3	2	0	5	3	14	19	19	91
1956	9	5	9	7	1	5	0	0	0	4	3	8	51
1957	5	2	7	9	5	3	3	0	0	0	4	3	41
1958	2	4	13	9	3	0	1	1	3	2	3	4	45
1959	2	2	8	8	8	1	2	3	3	6	6	6	55
1960	1	3	2	6	5	1	0	0	3	3	7	11	42
1961	11	12	5	5	2	6	0	1	1	7	8	7	65
1962	8	3	9	13	11	6	2	8	0	8	6	7	81
1963	10	13	11	12	5	2	3	0	1	6	4	4	71
1964	6	6	9	15	8	13	1	2	5	5	4	6	80
1965	4	4	5	10	10	5	2	0	0	5	3	7	55
1966	8	4	10	9	12	6	3	5	4	5	13	13	92
1967	8	11	9	7	3	4	5	2	1	5	11	5	71
1968	6	8	9	8	10	1	2	1	0	8	4	10	67
1969	6	8	16	6	5	1	4	2	3	11	10	13	85
1970	14	4	7	2	5	4	1	3	3	6	13	3	65
1971	9	7	4	7	7	2	0	0	2	3	12	8	61
1972	5	10	11	11	1	1	1	0	0	6	3	3	52
1973	5	3	5	10	5	3	2	7	6	8	6	5	65
1974	5	3	9	5	10	3	0	0	3	7	7	7	59
1975	4	11	14	6	13	2	6	2	0	5	2	4	69
1976	1	6	7	7	5	2	0	0	0	3	10	8	49
1977	11	7	6	6	4	2	2	0	0	0	4	5	47
1978	12	8	2	3	1	3	3	1	1	2	1	5	42
1979	3	10	4	6	3	0	0	0	4	1	2	3	36
1980	6	5	5	3	3	5	0	0	0	5	0	0	32
1981	11	0	0	-	-	-	1	2	2	0	11	9	36
1982	2	4	3	6	2	0	0	0	1	3	0	2	23
1983	1	0	3	1	0	0	0	0	0	5	3	5	18
1984	4	1	2	3	3	5	0	0	1	0	2	8	29
1985	3	1	3	10	3	1	2	2	-	-	-	-	25

Maximum Thunder Days/year: 106 in 1947

Mean Thunder Days/year: 60

Source : EPC

APPENDIX 4

REASONS FOR EPC CONSTRUCTING IN AREAS PREVIOUSLY ALLOCATED
TO JAPANESE AID

1. General Reasons

- (a) EPC construction gangs are working faster than expected this means they had to carry on into adjacent areas. They are erecting lines at four times the normal pace.
- (b) There is political pressure from the public and politicians.

2. Savaii

- (a) The L.D.S. Church has collected US\$30,000 from U.S.A. to contribute to the cost of the line for an early start to the work from Fusi to Vaiola.
- (b) Rural Electrification Committee decided on 11 October to undertake the work from Fusi to Vaiola.


3. Upolu

- (a) The neighbouring districts having seen the start of our work at Leulumoega directly approached EPC, and also approached their Members of Parliament for power extension. This of course was readily re-enforced by MP's who in turn applied extreme pressure on EPC directly and more effectively through their colleagues in the Rural Electrification Committee and EPC Board.
- (b) EPC was firmly backed by Government financially as evidenced by allocation of a further two (2) million Tala in this year's Supplementary budget. This is in addition to 1.5 million Tala allocated in 1988 for the Rural Electrification budget for 1989.

4. Direction

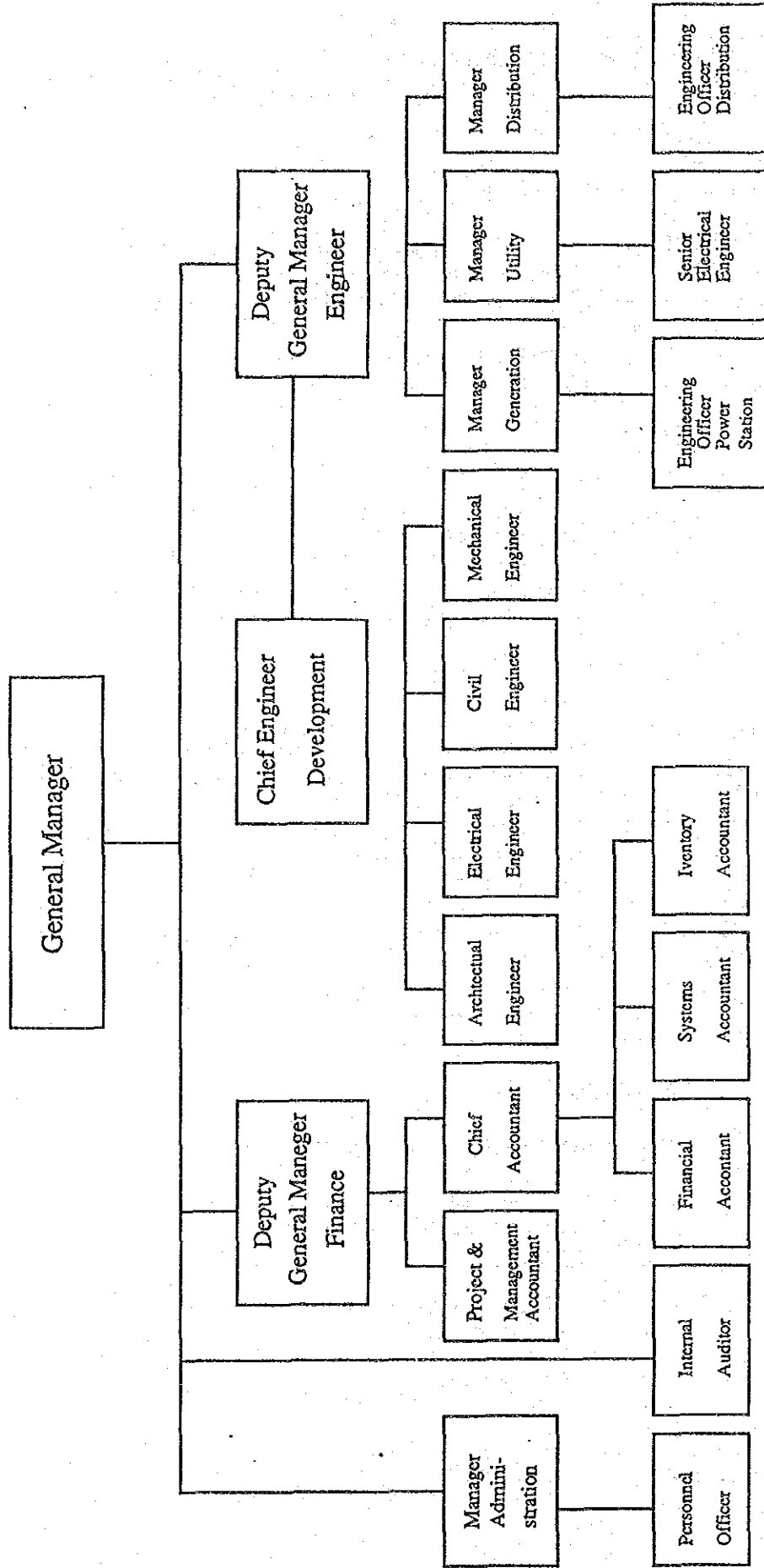
The Rural Electrification Committee decided:

- (a) At its meeting on 12 September 1989 to extend work further along the south coast of Upolu towards Salani (Sopoaga).
- (b) At its meeting on 11 October - to extend lines from Fusi to Vaiola.


E J Hussey
GENERAL MANAGER

18 October 1989.

ELECTRIC POWER CORPORATION
ORGANIZATION CHART



APPENDIX 5

ENERGY GENERATED AND CONSUMED

Years	Unit	1981	1982	1983	1984	1985	1986	1987	1988
UPOLU SYSTEM									
Generated	(GWH)	29.790	30.279	31.104	32.952	34.764	35.950	38.254	41.284
Consumed	(GWH)	24.455	24.478	25.426	27.595	27.712	30.037	32.078	35.144
Auxiliaries	(GWH)	0.336	0.269	0.243	0.253	0.620	0.721	0.642	0.642
Losses	(GWH)	4.999	5.532	5.435	5.104	5.452	5.191	5.534	5.499
	% on gen	16.8	18.3	17.5	15.5	15.6	14.4	14.5	13.3
SAVAH SYSTEM									
<i>Saleologa System</i>									
Generated	(GWH)	0.801	0.898	0.883	0.853	1.017	1.308	1.460	1.401
Consumed	(GWH)	0.748	0.717	0.679	0.660	0.818	1.108	1.144	1.371
Auxiliaries	(GWH)	0.009	0.010	0.010	0.018	0.014	0.019	0.044	0.068
Losses	(GWH)	0.043	0.171	0.194	0.175	0.185	0.181	0.271	-0.038
	% on gen	5.5	19.1	22.0	20.5	18.2	13.8	18.6	-2.7
<i>Asau System</i>									
Generated	(GWH)	0	0	0	0	0	0.557	0.512	0.712
Consumed	(GWH)	0	0	0	0	0	0.342	0.411	0.576
Auxiliaries	(GWH)	0	0	0	0	0	0.000	0.000	0.000
Losses	(GWH)	0	0	0	0	0	0.214	0.101	0.141
	% on gen	0	0	0	0	0	38.4	19.7	19.7
TOTAL ALL SYSTEM									
Generated	(GWH)	30.591	31.177	31.987	33.805	35.781	37.815	40.226	43.463
Consumed	(GWH)	25.203	25.195	26.105	28.255	28.53	31.487	33.633	37.091
Auxiliaries	(GWH)	0.345	0.279	0.253	0.271	0.634	0.74	0.686	0.710
Losses	(GWH)	5.042	5.703	5.629	5.279	5.617	5.586	5.906	5.602
	% on gen	16.48	18.29	17.60	15.62	15.70	14.77	14.70	12.89

Note:

- 1 Commencing 1984 figures for Energy Consumed have been reconciled for the period 1, Jan. to 31, Dec. Energy consumed may therefore differ from energy sold figures shown in Table X. Period to 1984 system loss figures may vary due to the intervals between readings of consumers revenue meters.
- 2 Energy generated by the Asau plant of Samoa Forest Product Ltd. for Public Supply is not yet separated.

Source : EPC

ENERGY SOLD BY CONSUMER CATEGORIES

Years	Unit	1981	1982	1983	1984	1985	1986	1987	1988
UPOLU SYSTEM									
Domestic	(GWH)	9,259	6,514	7,051	7,340	7,404	8,291	8,912	9,986
Industrial	(GWH)	1,626	2,921	3,376	3,887	3,727	3,650	3,798	4,037
Commercial	(GWH)	5,399	11,782	10,098	12,278	12,289	12,688	13,455	15,015
Hotel	(GWH)	1,723	1,554	1,395	1,675	1,684	1,701	1,707	1,788
Religious	(GWH)	-	574	1,006	1,545	2,032	2,188	2,298	2,416
Schools	(GWH)	-	948	1,279	1,313	1,298	1,290	1,398	1,627
Street Lights	(GWH)	176	185	222	228	263	250	281	261
Sub-total		18,183	24,478	24,427	28,266	28,697	30,058	31,849	35,130
Ratio			34.6	-0.2	15.7	1.5	4.7	6.0	10.3

SAVAII SYSTEM

Salelologa System

Domestic	(GWH)	284	292	253	288	367	489	595	743
Industrial	(GWH)	0	0	0	0	0	0	0	0
Commercial	(GWH)	214	382	367	349	389	484	512	513
Hotel	(GWH)	10	8	12	12	10	7	11	9
Religious	(GWH)	0	12	22	23	27	38	42	64
Schools	(GWH)	0	8	10	8	11	17	24	25
Street Lights	(GWH)	13	14	15	15	15	15	12	14
Sub-total		521	716	679	695	819	1,050	1,196	1,368
Ratio			37.4	-5.2	2.4	17.8	28.2	13.9	14.4

Asau System

Domestic	(GWH)	0	31	41	41	91	121	168	289
Industrial	(GWH)	0	0	1	0	0	0	0	0
Commercial	(GWH)	0	16	90	88	135	154	160	194
Hotel	(GWH)	0	1	0	13	31	25	51	45
Religious	(GWH)	0	3	2	3	9	7	11	20
Schools	(GWH)	0	0	0	0	0	0	1	0
Street Lights	(GWH)	0	0	0	0	0	0	0	0
Sub-total		0	51	134	145	266	307	391	548
Ratio				163.5	7.9	83.4	15.4	27.3	40.3

TOTAL ALL SYSTEM

Domestic	(GWH)	9,543	6,836	7,346	7,668	7,862	8,901	9,735	11,018
Industrial	(GWH)	1,626	2,921	3,377	3,887	3,727	3,645	3,798	4,037
Commercial	(GWH)	5,613	12,180	11,555	12,715	12,813	13,324	14,126	15,721
Hotel	(GWH)	1,733	1,563	1,407	1,700	1,725	1,733	1,769	1,842
Religious	(GWH)	0	590	1,030	1,571	2,068	2,234	2,350	2,500
Schools	(GWH)	0	957	1,289	1,320	1,309	1,307	1,422	1,652
Street Lights	(GWH)	188	199	237	243	292	265	293	275
Total		18,703	25,246	26,241	29,104	29,796	31,409	33,493	37,045
Ratio			35.0	3.9	10.9	2.4	5.4	6.6	10.6

Note:

- 1 Energy sold means read from consumer revenue meters for the period of Jan.1 to Dec.31. This may vary from consumption figures shown in Tables VI and VII.
- 2 Consumption on street lighting is an estimate based on the number of lights, rating of the lights and hours of operation.
- 3 Consumers connected to the Public Supply from Asau mill of Samoa Forest Product Ltd. have been included from 1982.

NUMBERS OF CONSUMERS BY CATEGORIES

Year	Unit	1,981	1982	1983	1984	1985	1986	1987	1988
UPOLU SYSTEM									
Domestic	(Nos)	6,319	6,243	6,508	6,869	7,061	7,506	7,708	7,870
Industrial	(Nos)	88	79	82	67	64	68	58	56
Commercial	(Nos)	719	718	761	673	655	707	674	632
Hotels	(Nos)	4	4	5	11	11	12	11	10
Government Dept.		202	0	0	0	0	0	0	0
Religious Bodies	(Nos)	0	207	230	227	233	233	233	232
Schools	(Nos)	0	109	116	93	88	93	96	98
Total	(Nos)	7,332	7,360	7,702	7,940	8,112	8,619	8,780	8,898

SAVAII SYSTEM**Salelologa System**

Domestic	(Nos)	702	684	661	688	978	1,154	1,282	1,419
Industrial	(Nos)	0	0	0	0	0	0	0	0
Commercial	(Nos)	25	41	40	45	52	57	62	67
Hotels	(Nos)	1	1	1	2	2	2	2	2
Government Dept.		17	0	0	0	0	0	0	0
Religious Bodies	(Nos)	0	25	28	31	41	53	64	66
Schools	(Nos)	0	2	2	4	5	8	10	10
Total	(Nos)	745	753	732	770	1,078	1,274	1,420	1,564

Asau System

Domestic	(Nos)	0	55	93	135	224	286	494	738
Industrial	(Nos)	0	0	1	0	0	0	0	0
Commercial	(Nos)	0	2	16	17	24	36	28	31
Hotels	(Nos)	0	1	1	2	2	2	2	2
Government Dept.		0	0	0	0	0	0	0	0
Religious Bodies	(Nos)	0	1	5	7	11	13	21	31
Schools	(Nos)	0	0	0	0	0	1	1	3
Total	(Nos)	0	59	116	161	261	338	546	805

TOTAL ALL SYSTEM

Domestic	(Nos)	7,021	6,982	7,262	7,692	8,263	8,946	9,484	10,027
Industrial	(Nos)	88	79	83	67	64	68	58	56
Commercial	(Nos)	744	761	817	735	731	800	764	730
Hotels	(Nos)	5	6	7	15	15	16	15	14
Government Dept.		219	0	0	0	0	0	0	0
Religious Bodies	(Nos)	0	233	263	265	285	299	318	329
Schools	(Nos)	0	111	118	97	93	102	107	111
Total	(Nos)	8,077	8,172	8,550	8,871	9,451	10,231	10,746	11,267

Notes:

- 1 A consumer is defined as a metering point. Some organisations have more than one metering point. Some apparent reduction in the number of consumers may
- 2 appear as a result of converting consumers to a single point.

In 1982, Government Department were re-classified according to the nature of their function and new categories were introduced for Religious and Charitable Bodies and for Schools.

Consumers connected to the Public Supply from the Asau mill of Samoa Forest Product Ltd have been included from 1982.

In 1984, Guest Houses were re-classified from domestic to Hotels.

Power Demand Forecast in Upolu Island

	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
Domestic																					
Population																					
(Based on the Census in 1988)																					
Electrification Ratio(%)																					
Population in Electrified Areas																					
Number of Consumers	6,319	6,243	6,508	6,869	7,061	7,506	7,701	7,870	8,217	8,432	8,553	8,899	10,086	10,187	10,400	10,504	10,754	10,821	11,025	11,166	11,275
Number of Family per Consumer	9.259	6.514	7.051	7.340	7.404	8.291	8.912	9.986	10.948	12.355	14.018	15.208	16.331	17.322	18.509	19.693	21.109	22.386	23.992	25.444	26.943
Consumed Energy per Consumer(MWh)	1.465	1.043	1.083	1.069	1.047	1.105	1.126	1.209	1.322	1.399	1.469	1.542	1.619	1.700	1.785	1.875	1.968	2.067	2.170	2.279	2.393
Annual Increment per Consumer		0.712	1.038	0.986	0.981	1.053	1.047	1.097	1.030	1.090	1.050	1.050	1.050	1.050	1.050	1.050	1.050	1.050	1.050	1.050	1.050
Annual Increment of Energy Demand		0.704	1.082	1.041	1.009	1.120	1.075	1.121	1.096	1.128	1.135	1.089	1.070	1.061	1.072	1.061	1.072	1.060	1.060	1.060	1.061
Industry																					
Energy Demand(MWh)	1.026	2.921	3.376	3.887	3.727	3.650	3.798	4.037	4.077	4.592	4.898	5.224	5.572	5.943	6.334	6.760	7.210	7.690	8.202	8.747	9.330
Number of Consumer	88	79	82	67	64	68	58	56	57	57	58	58	59	59	60	61	62	62	62	63	64
Annual Increment per Consumer		0.808	1.038	0.817	0.955	1.003	0.853	0.966	1.010	1.010	1.010	1.010	1.010	1.010	1.010	1.010	1.010	1.010	1.010	1.010	1.010
Consumed Energy per Consumer(MWh)	18.477	36.975	41.171	58.015	58.234	53.676	65.433	72.089	76.126	80.388	84.591	89.645	94.666	99.966	105.585	111.476	117.719	124.311	131.223	138.624	146.287
Annual Energy Increment per Consumer		2.001	1.113	1.403	1.004	0.922	1.220	1.301	1.358	1.358	1.358	1.358	1.358	1.358	1.358	1.358	1.358	1.358	1.358	1.358	1.358
Commercial																					
Energy Demand(MWh)	5.399	11.782	10.098	12.278	12.289	12.688	13.455	15.015	15.712	16.441	17.204	18.002	18.838	19.712	20.627	21.584	22.586	23.634	24.731	25.878	27.079
Number of Consumer	713	718	761	673	655	707	707	707	715	724	732	742	750	759	769	778	787	797	806	816	826
Annual Increment per Consumer		1.007	1.060	0.884	0.973	1.079	1.000	1.000	1.012	1.012	1.012	1.012	1.012	1.012	1.012	1.012	1.012	1.012	1.012	1.012	1.012
Consumed Energy per Consumer(MWh)	7.572	16.409	13.269	18.246	18.762	17.946	19.031	21.238	21.960	23.478	24.277	25.102	25.954	26.838	27.750	28.694	29.670	30.678	31.721	32.800	33.900
Annual Energy Increment per Consumer		2.157	0.809	1.375	1.028	0.927	1.060	1.116	1.034	1.034	1.034	1.034	1.034	1.034	1.034	1.034	1.034	1.034	1.034	1.034	1.034
Hotels																					
Energy Demand(MWh)	1.723	1.554	1.395	1.675	1.684	1.701	1.701	1.748	1.842	1.973	2.072	2.177	2.286	2.402	2.523	2.650	2.783	2.924	3.071	3.226	3.383
Number of Consumer	4	4	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
Consumed Energy per Consumer(MWh)	430.750	388.500	279.000	332.273	332.273	332.273	332.273	332.273	332.273	332.273	332.273	332.273	332.273	332.273	332.273	332.273	332.273	332.273	332.273	332.273	332.273
Annual Energy Increment per Consumer		0.902	0.718	0.588	1.003	0.928	1.003	1.003	1.003	1.003	1.003	1.003	1.003	1.003	1.003	1.003	1.003	1.003	1.003	1.003	1.003
Religion																					
Energy Demand(MWh)	574	1006	1545	2072	2184	2184	2294	2416	2704	3.027	3.388	3.792	4.244	4.750	5.317	5.951	6.661	7.455	8.344	9.340	10.453
Number of Consumer	207	230	227	233	233	233	233	238	241	243	246	252	252	252	252	252	252	252	252	252	252
Annual Increment per Consumer		1.111	0.987	1.026	1.000	1.000	1.010	1.010	1.012	1.012	1.012	1.012	1.012	1.012	1.012	1.012	1.012	1.012	1.012	1.012	1.012
Consumed Energy per Consumer(MWh)	2.773	4.374	6.806	8.721	9.391	9.765	11.242	12.434	13.742	15.210	16.822	18.605	20.577	22.754	25.171	27.839	30.790	34.093	37.663	41.506	45.633
Annual Energy Increment per Consumer		1.577	1.556	1.281	1.077	1.077	1.041	1.041	1.041	1.041	1.041	1.041	1.041	1.041	1.041	1.041	1.041	1.041	1.041	1.041	1.041
Schools																					
Energy Demand(MWh)	948	1.279	1.313	1.284	1.294	1.290	1.398	1.627	1.691	1.813	1.914	2.021	2.137	2.222	2.378	2.510	2.630	2.797	2.923	3.117	3.291
Number of Consumer	109	116	93	88	88	99	99	100	102	104	106	108	110	112	114	116	118	121	123	125	128
Annual Increment per Consumer		1.064	0.802	0.946	1.114	1.114	1.010	1.010	1.010	1.010	1.010	1.010	1.010	1.010	1.010	1.010	1.010	1.010	1.010	1.010	1.010
Consumed Energy per Consumer(MWh)	8.697	11.026	14.118	14.730	13.163	14.124	16.275	16.861	17.468	18.097	18.748	19.423	20.122	20.847	21.597	22.375	23.180	24.015	24.879	25.775	26.705
Annual Energy Increment per Consumer		1.268	1.045	0.922	1.073	1.073	1.132	1.132	1.132	1.132	1.132	1.132	1.132	1.132	1.132	1.132	1.132	1.132	1.132	1.132	1.132
Street Lights																					
Energy Demand(MWh)	176	145	222	228	243	250	241	261	270	279	289	298	308	319	330	341	353	365	377	390	403
Number of Consumer	1051	1051	1027	1151	1151	1151	1151	1151	1151	1151	1151	1151	1151	1151	1151	1151	1151	1151	1151	1151	1151
Annual Energy Increment per Consumer		0.051	0.027	0.027	0.027	0.027	0.027	0.027	0.027	0.027	0.027	0.027	0.027	0.027	0.027	0.027	0.027	0.027	0.027	0.027	0.027
Gross Consumed Energy(MWh)	18,183	24,474	24,427	28,266	28,687	30,058	31,849	35,130	37,244	40,440	43,742	46,742	49,715	52,695	56,081	59,483	63,350	67,250	71,670	76,142	80,928
System Loss(MWh)	27.49	32.60	32.25	38.06	38.32	40.17	43.28	46.85	50.92	55.60	60.87	66.74	73.20	79.40	86.35	93.10	100.60	108.70	117.60	127.40	138.00
System Gross Energy(MWh)	23,122	30,010	29,852	33,370	34,139	35,299	37,183	40,629	43,166	46,476	50,656	54,079	57,431	60,811	64,661	68,508	72,810	77,337	82,249	87,411	92,825
Loss Factor	0.35	0.35	0.36	0.36	0.36	0.37	0.37	0.37	0.37	0.37	0.37	0.37	0.37	0.37	0.37	0.37	0.37	0.37	0.37	0.37	0.37
Peak Energy(MWh)	4.812	6.229	6.087	6.802	6.927	7.035	7.403	8.063	8.653	9.226	9.790	10.344	10.989	11.625	12.311	13.039	13.810	14.625	15.485	16.391	17.343
Annual Energy Increment		1.295	0.995	1.171	1.021	1.033	1.061	1.087	1.062	1.086	1.081	1.062	1.062	1.059	1.061	1.060	1.060	1.061	1.061	1.061	1.061

Notes : 1 Consumed energy from 1981 to 1988. Forecast energy demand after 1988.
 2 Energy demand after 1988 was forecast by means of using annual demand increment ratio.
 3 Domestic consumers were forecast by means of using population increment.

