第９章　結論及び提言

第9章　結論及び提言

9－1　結　論

パラオに於ける既設電力系統，将来の開発予定地域及び新発電所の建設状況等の現地調査，先方政府との協議結果等を検討して基本設計調査報告書として取りまとめたが，結論として次のことが挙げられる。

(1)　現状の発電設備は設備が老朽化している為，故障が多く安定供給が困難と判断される。

(2)　長期的な視点より見て，新設発電所より供給した方が発電コストの低減が可能で政府の財政負担の大巾な軽減が可能となる。

(3)　新発電所の建設は，英国よりの政府借款によりIPSECO社が実施しており，発電所の運転開始予定時期は1985年6月である。そのため，新発電所からコロールの需要地まで電気を送電する送電線をなるべく早く建設する必要がある。

(4)　現地調査の結果，本送電線の建設は技術的に問題なく実施できる。

(5)　安定的な電力の供給により産業，経済活動の活発化，住民の福祉，民生の安定が図られる。

上記を総合的に勘案すると，本計画の実施は意義深いものであり日本国政府が無償資金協力を行うことは充分妥当なものと判断される。

9－2　提　言

本プロジェクトで建設される送配変電設備は，パラオの将来の発展の基礎をなすものであり，長期的にその機能を維持する為に，下記の2点についての検討が必要と考えられる。

(1)　建設時に実施される日本側の技術研修と，その後のIPSECO社の技術サービスを通して保守運転技術を習得することにより，計画的な保修計画を実施して信頼性の高い電力の供給ができる体制を整備する。

(2)　電力供給体系については，現在の逆ざやの解消を図ることが必要と感じられるものであり，発電コスト相当の電力料金収入を得られる程度までの料金改訂が望ましいと考えられる。また，その際に消費者の形態別に料金体系を設定すること，及び政府使

用電力については，帰属する財源が同一であるとしても事例別会計管理が望ましいと考えられることから，これも料金徴収対象とすること等を検討する必要があると思料される。

但し，料金改訂に際しては，それが企業誘致等産業・経済の開発との関係から阻害要因とならないよう留意する必要があろう。

資　料　編

資　料

章	資料番号	
1	1－1	主要面談者
	1－2	調査団員構成
	1－3	調査日程
	1－4	打合せ議事録（写）
3	3－1－(1)～(4)	気象統計
	3－2－(1)～(2)	地質資料
4	4－1	アイメリーク発電所主回路接続図
	4－2	アイメリーク発電所一般平面図
5	5－1－(1)～(2)	電化計画実地調査結果
6	6－1	塩分付着量測定結果
	6－2	装柱図
	6－3	昇圧変電所　単線結線図
	6－4	降圧変電所　単線結線図
	6－5	昇圧変電所　一般平面図
	6－6	降圧変電所　一般平面図
	6－7	暫定運転システム
	6－8	暫定運転単線結線図
8	8－1	新発電所発電コスト内訳
	8－2	新発電所借入金明細

1. 主要面談者

(1) パラオ政府

Mr. Alfonso R. Oiterong	副大統領
	兼国務大臣

(2) 国家資源省

Mr. Koichi L. Wong	大臣
Mr Marselino Melairei	公共企業庁長官
Mr Juan F. Polloi	公共企業庁設計技術部
	企画官

(3) 国務省

Mr. Ramon Rechebei	外務部国際貿易部長

(4) IPSECOインターナショナル パワーシステムス社（コロール市駐在）

Mr. Mark Kaye	プロジェクトマネージャー
Mr. Doug F. Dulcamara	〃 （電気）

(5) アガナ日本国総領事館

永島 可進 総領事

2. 連絡方法

Mr. Juan F. Polloi

Physical Planner

Division of Design and Engineering

P.O. Box 100

Koror, Republic of Palau 96940

TEL:Koror 431

TELEX : 728-8914 VPROPKF （副大統領府）

調査団員構成メンバー

氏　　名	分　　担	所　　属
黒木　利知	総　　括	通商産業省　資源エネルギー庁 公益事業部　技術課
佐々木直義	計画監理	国際協力事業団 無償資金協力部　基本設計課
市川　武司	送変電計画	㈱ＥＤＰＣインターナショナル
堀　　隆雄	配電計画	㈱ＥＤＰＣインターナショナル
小島　弘司	変電設計	㈱ＥＤＰＣインターナショナル
満田　稔彦	土木・地質	㈱ＥＤＰＣインターナショナル
石井　成夫	経済財務分析	㈱ＥＤＰＣインターナショナル

調　査　日　程

日順	月日	曜日	調　査　項　目
1	1月9日	水	東京発グアム着　総領事館　表敬訪問 事前調査報告書，インセプションレポートにより調査内容を説明
2	1月10日	木	グアム発コロール着，副大統領，国家資源大臣にインセプションレポートにより，調査目的の説明，質問状の提示，調査日程等につき打合せ
3	1月11日	金	前日に引続き質問状を中心に，国家資源大臣と協議　既設マラカル発電所調査
4	1月12日	土	マラカル発電所の運転記録整理
5	1月13日	日	アイライ州の既設電気設備調査
6	1月14日	月	国家開発計画について調査 送電線Aルート踏査及び新設アイメリーク発電所調査
7	1月15日	火	送電線Bルート調査
8	1月16日	水	現地調査結果に基づき国家資源大臣と協議
9	1月17日	木	負荷想定，送電系統の構成につき協議
10	1月18日	金	質問事項に関する回答及び議事録につき協議
11	1月19日	土	送電線ルート及び関連電化地域調査
12	1月20日	日	議事録準備
13	1月21日	月	議事録調印 （黒木，佐々木） コロール発グアム着　総領事館に調査概要報告 （市川他）新設アイメリーク発電所調査
14	1月22日	火	（黒木，佐々木）グアム発　東京着 （市川他）モガミ村　ネッケン，オイスカ他の電化地域調査 建設関連状況，経済情勢一般につき調査
15	1月23日	水	ガスパン，メドーム，イメルスベッチ村の電化地域及び建設関連資料調査
16	1月24日	木	調査結果につき打合
17	1月25日	金	送電線ルート調査 建設工事につき打合せ
18	1月26日	土	資料整理
19	1月27日	日	マラカル発電所運転状況調査

日順	月日	曜日	調　　査　　項　　目
20	1月28日	月	国家資源大臣と質問状につき打合せコロール発グアム着
21	1月29日	火	グアム発　東京着

REPUBLIC OF PALAU
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MINISTRY OF NATIONAL RESOURCES

MINUTES OF DISCUSSIONS

In response to a request made by the Government of the Republic of Palau, the Government of Japan through Japan International Cooperation Agency (JICA), dispatched from January 10 to 29, 1985 to the Republic of Palau a Basic Design Study Team, headed by Mr. Toshichika Kuroki to gather pertinent information necessary for the design of the Babelthaup Electrical Power Transmission Line Phase I Project. The Team while in Palau, conducted field surveys to ascertain field conditions of the proposed electrical transmission line corridor, discussed with cognizant officials and reviewed existing reports and statistical data to develop design criteria applicable to the project, made projection of future electrical power demand for the proposed electrification area within the design period and cost estimate for the project.

As a result of the study, both parties have agreed to recommend to their respective Governments to further consider the attached statements of understanding toward the realization of the project.

Toshichika Kuroki
Toshichika Kuroki
Team Leader, JICA's
Basic Design Study Team

Koichi L Wong
Koichi L. Wong
Minister of National Resources
Republic of Palau

Date Jan. 21. 1985

Date JANUARY 21, 1985

REPUBLIC OF PALAU

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MINISTRY OF NATIONAL RESOURCES

STATEMENTS OF UNDERSTANDING

1. The design period for Babelthaup Electrical Power Transmission Line Phase I Project covers ten years from 1985 to 1995.

2. Based on a study conducted by JICA's Basic Design Study Team which took into consideration the estimated population growth, potential commercial and industrial developments and social advancement in the Republic of Palau during the design period, it is concluded that the electrical power demand in the country will reach no less than 9,000 KW by 1995. See Annex I.

3. From preliminary indications, Route B seem most preferable for part of the main electrical power transmission line. See Annex II.

4. The scope of the Babelthaup Electrical Power Transmission Line Phase I Project includes the following: An appropriately sized transformer substation (13.8 KV step-up to 34.5 KV) to be located at the Aimeliik power station; electrical power transmission lines originating at the step-up substation and extended through the Nekken Forestry station where one of the feeder terminates and the other continues through (possibly Route B) where the voltage drops through an appropriately sized transformer substation (34.5 KV step-down to 13.8 KV) and integrated with the existing Koror-Airai power system; provision of appropriate electrical power transmission lines (probably at a lower voltage than the proposed 34.5 KV main power transmission line) to the community of Mechebechubl in Ngatpang State and the communities of Mongami, Ngchemiangel, Medorm, Nekken, OISCA Training Center and Elechui, all of Aimeliik State; and, provision of certain electrical equipment and materials to be installed by the Republic of Palau.

5. Typical design criteria applicable to the project are shown in Annex III, IV and V.

6. The Government of the Republic of Palau shall be responsible for upgrading the existing Koror-Airai 13.8 KV electrical power transmission system to be compatible with the 34.5 KV Aimeliik-Airai power transmission line when the demand for electrical power approaches 9,000 KW which is estimated to take place by 1995.

7. The JICA Basic Design Team will convey to the Government of Japan that the Government of Palau will cooperate to the fullest by providing services and/or undertakings outlined in Annex VI to ensure that the project will be implemented in the most economical and expeditious manner.

Annex I

ELECTRIC POWER REQUIREMENTS IN THE PROJECT AREA BY 1995

A.	Use excluding residential in Koror	2580 KW
B.	Residential use in Koror	2920 KW
C.	New electrification area	130 KW
D.	Additional requirements except for residential use	3370 KW
	Total	9,000 KW

(Note)

1. Present electric power use ..... 4,000 KW
2. Assumption of residential use by 1995:
   - (a) Population projection (present) 12,180
     (by 1995) 12,725
     (increase) 545
   - (b) Average residents per house in Palau:
     (population) 12,180
     (number of houses) 2,265
     (average residents per house) 5.4
   - (c) Increase of houses in Palau: 110 (545/5.4)
   - (d) Increase of houses in the project area: ..... 75 (2/3 of 110)
     (Koror) 40
     (other area) 35
   - (e) Average electric power usage:
     (Koror) ..... 2 KW per house
     (other area) ..... 1 KW per house
3. Item B and C above include the increase of houses - 40 houses in Koror and 35 houses in the electrification area.
4. Item D includes the present power requirements not receiving power from the Government system and the estimated demands in future, such as the increase of demands except for residential use and and the requirements from Grace Hotel, Airport terminal, MIC, Van Camp, Palau Pacific Resort, New National Hospital, new sewage lift stations and so on.

Annex II

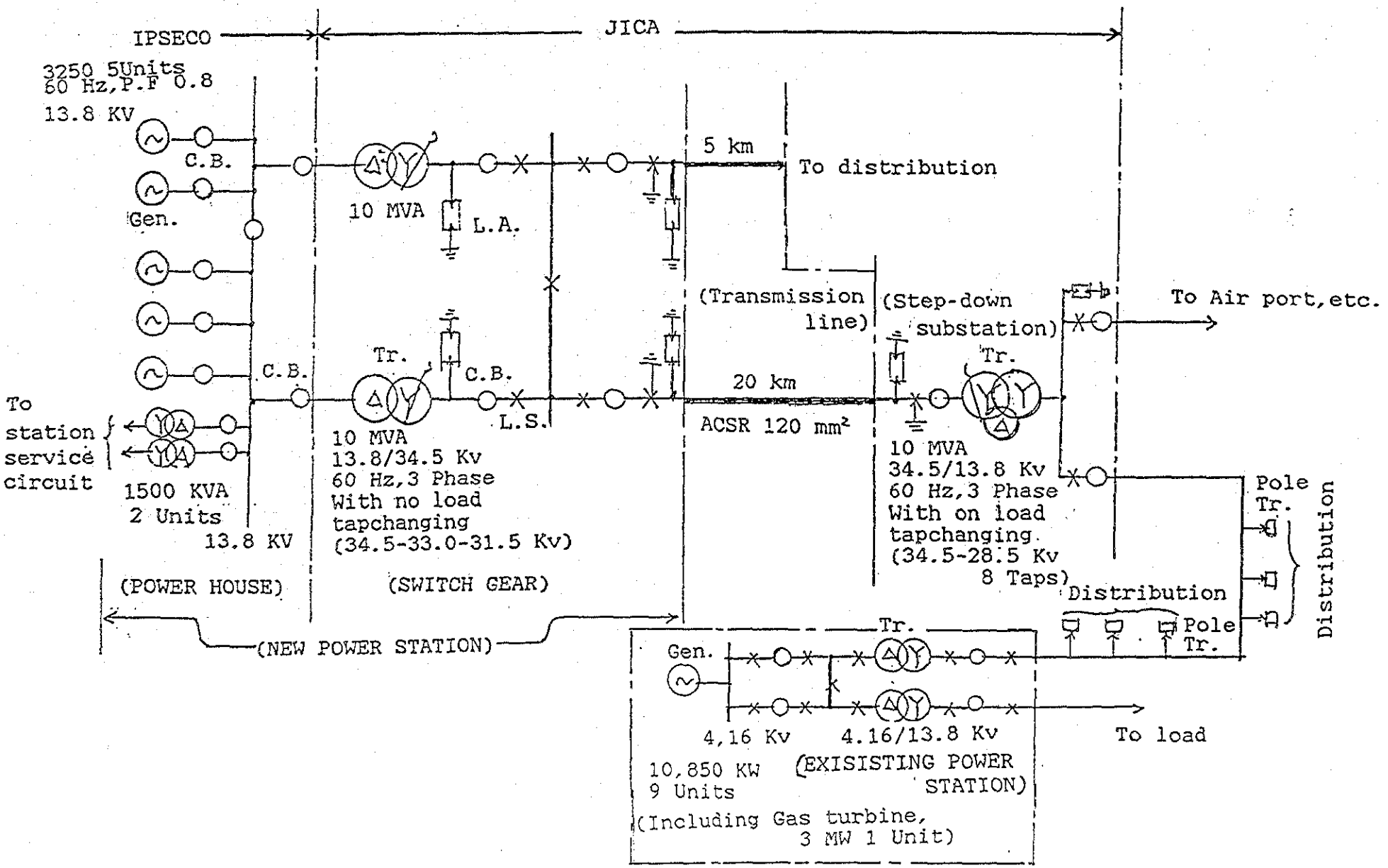
COMPARISON TABLE OF TRANSMISSION ROUTES

Items \ Route		A	B	C
(1)	Length (KM)	20	20	11
(2)	Construction cost (%)	130	100	not less than 500
(3)	Maintenance and repair	easy	easy	difficult
(4)	Construction work	easy	easy	difficult
(5)	Relation with electrification	2	1	3
(6)	Transmission loss	3	2	1
(7)	Total judgement	2	1	3

Note: Numerical order in items (5), (6) and (7) indicate order of priority.

POWER SYSTEM DIAGRAM

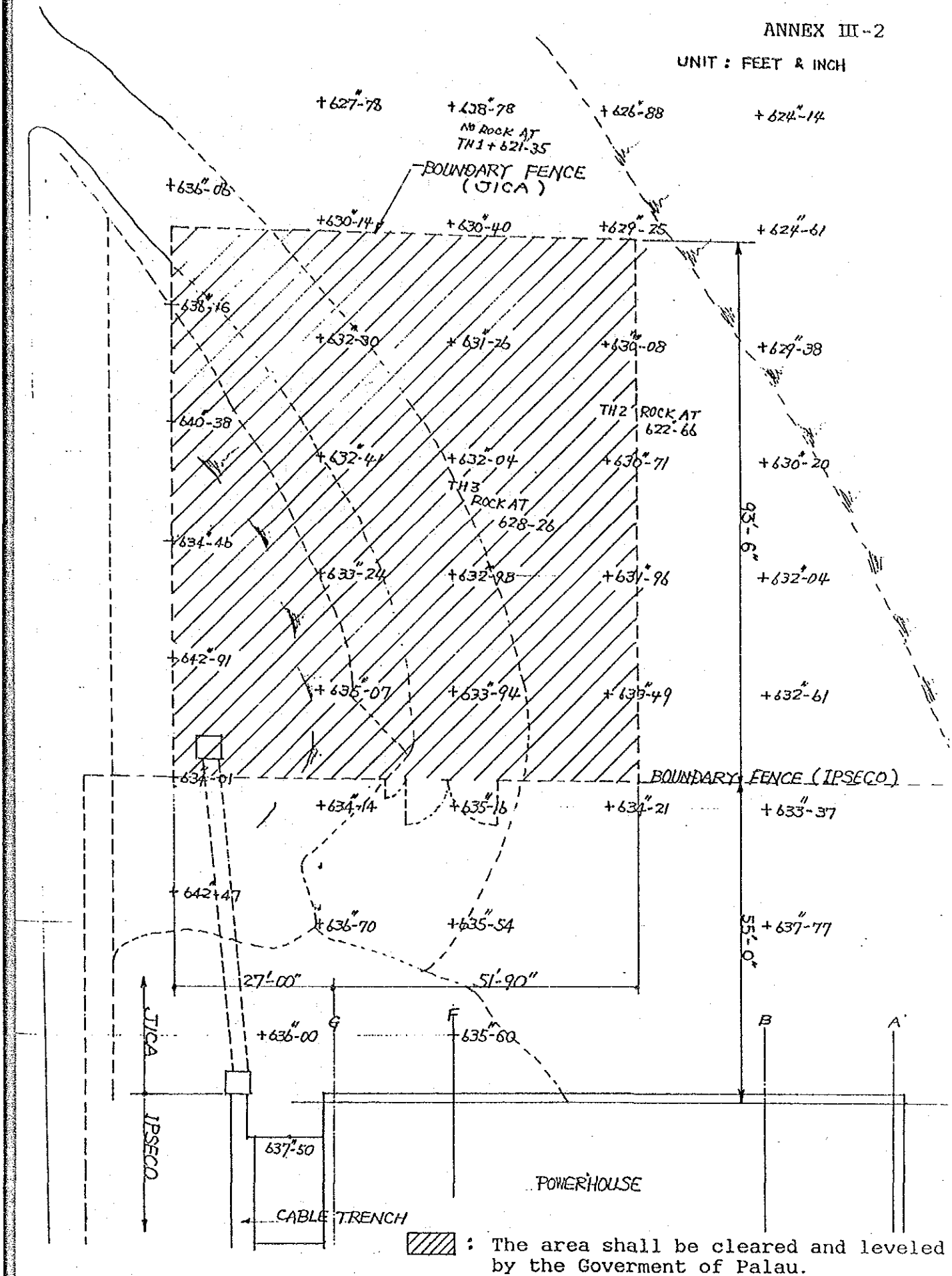
ANNEX III-1



STEPUP SUBSTATION LOCATION

ANNEX III-2

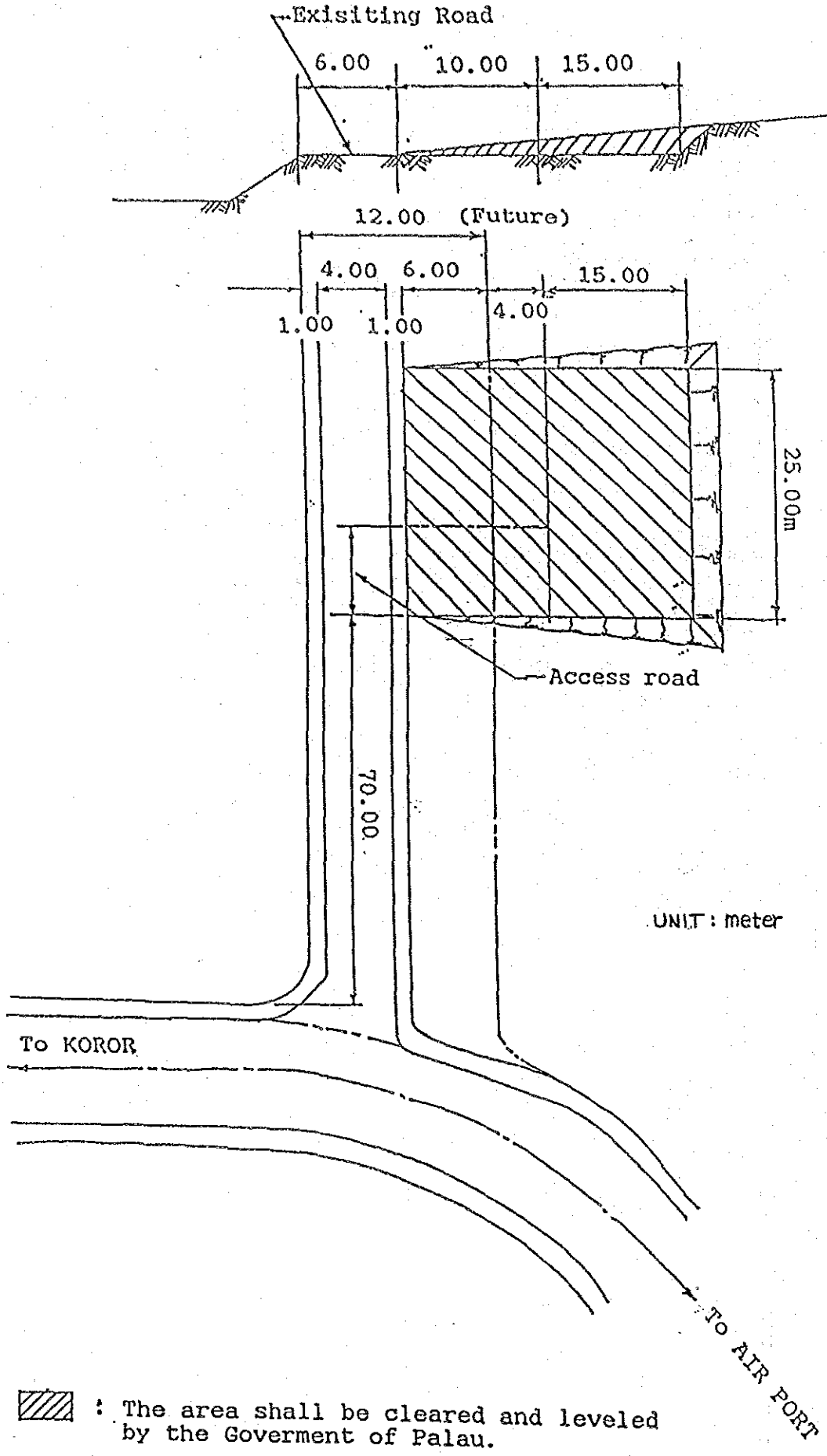
UNIT : FEET & INCH



: The area shall be cleared and leveled by the Goverment of Palau.

ANNEX III-3

STEPDOWN SUBSTATION LOCATION



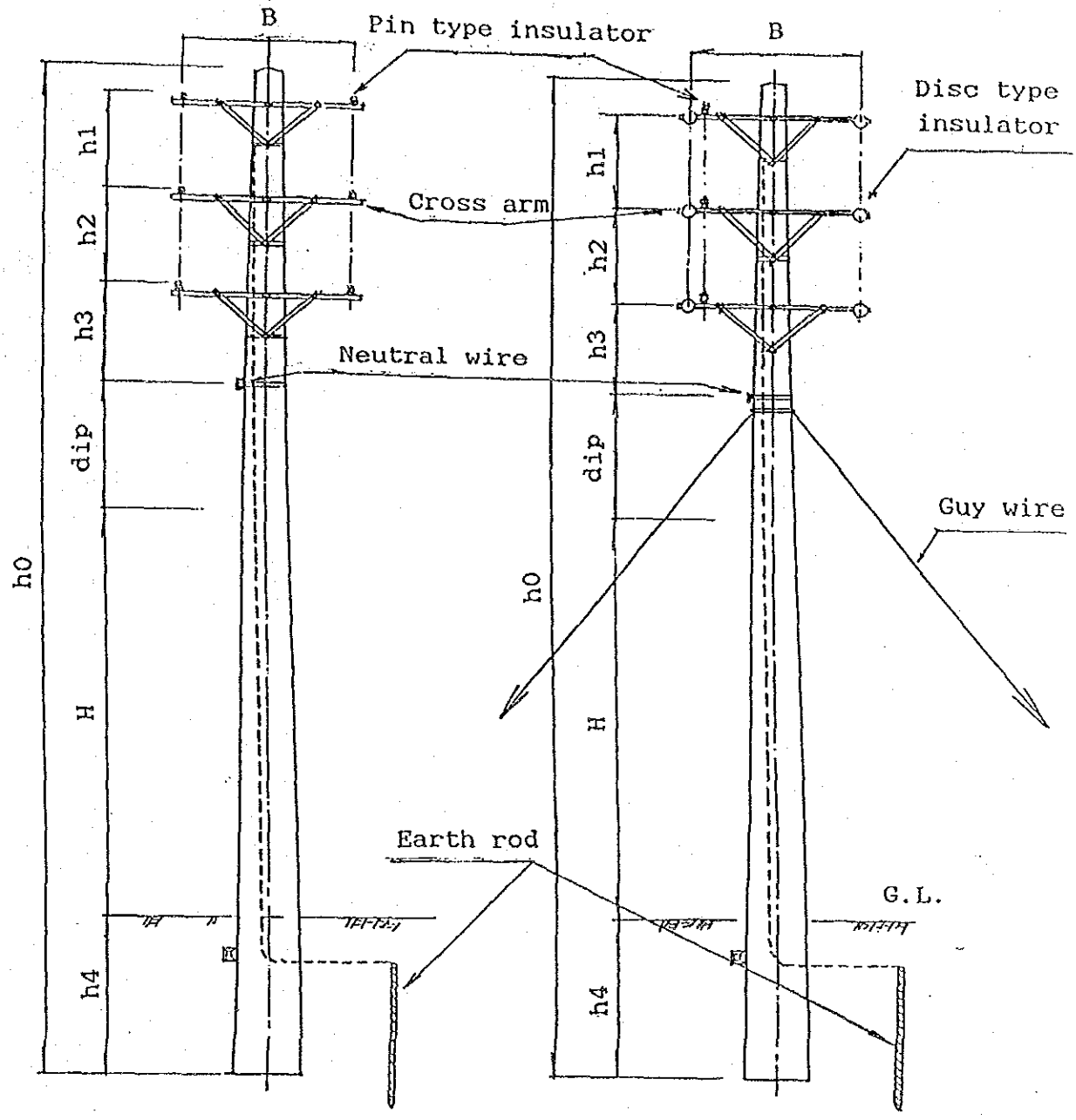
: The area shall be cleared and leveled by the Goverment of Palau.

34.5 KV TRANSMISSION LINE

(2 Cots)

SUSPENSION POLE

SECTION POLE



NOTE: These types are applied to the transmission line from Imelsubech to Nekkeng.

ANNEX IV-2

34.5 KV TRANSMISSION LINE

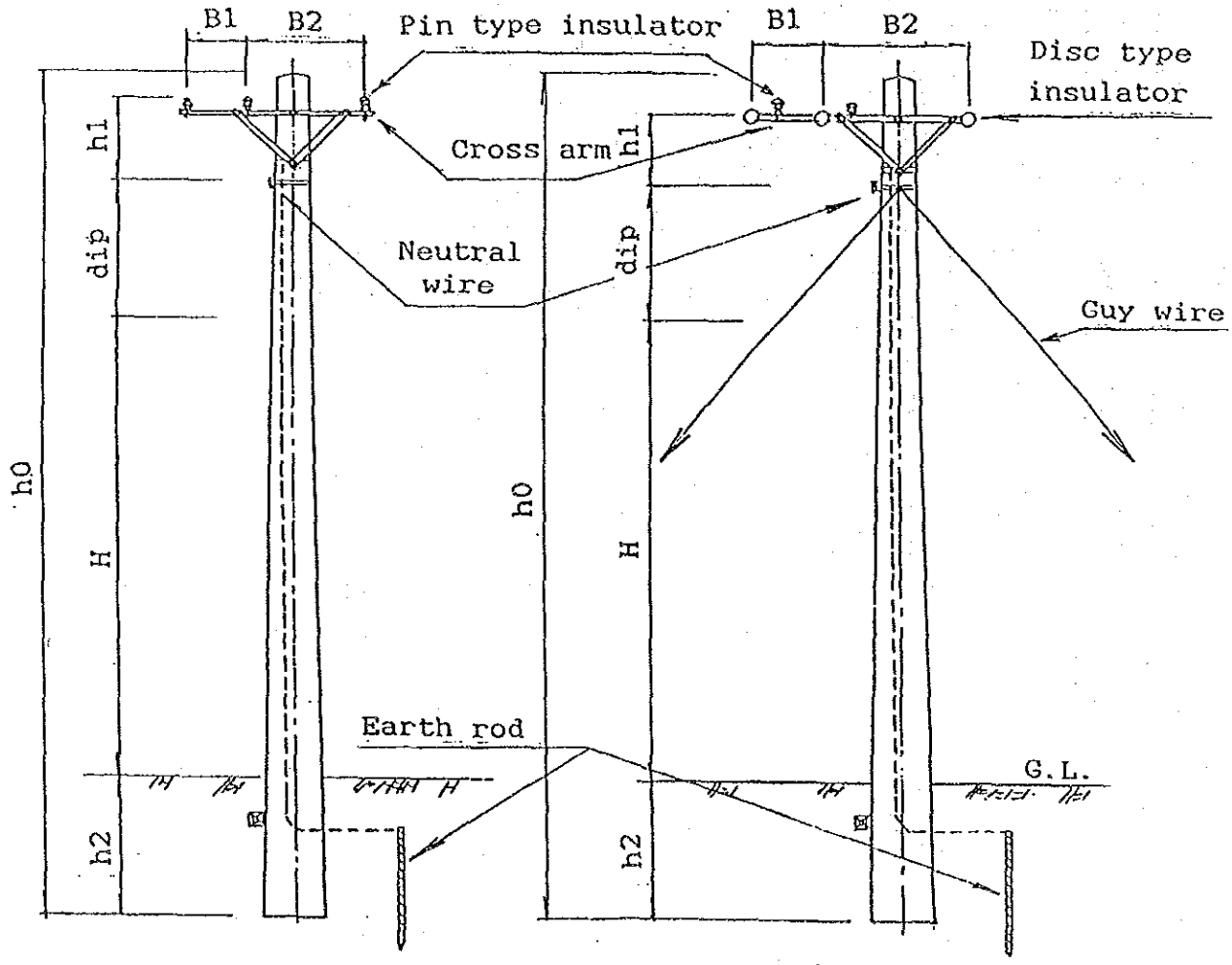
OR

13.8 KV DISTRIBUTION LINE

(1 Cct)

SUSPENSION POLE

SECTION POLE

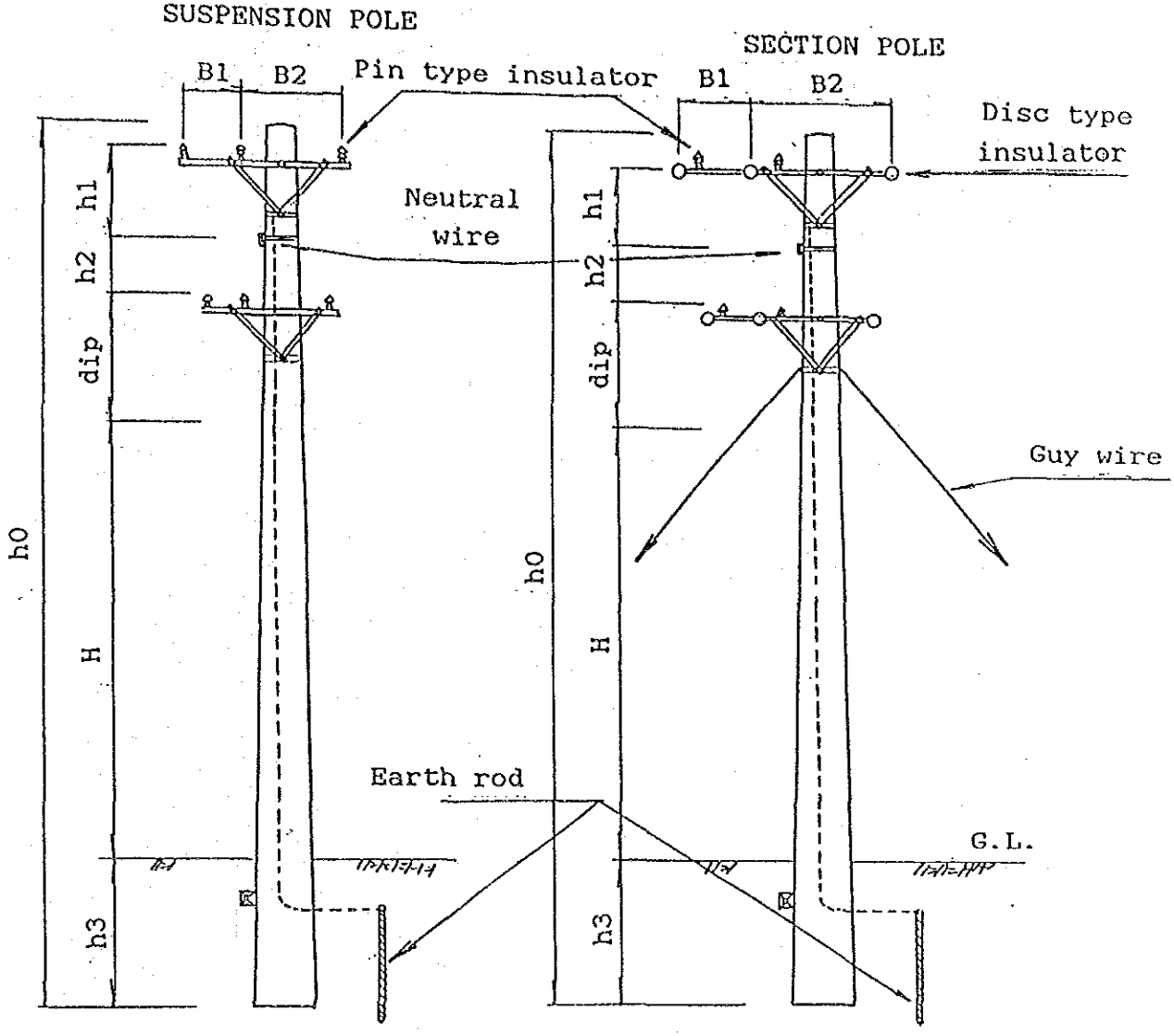


34.5 KV TRANSMISSION LINE

AND

13.8 KV DISTRIBUTION LINE

(2 Ccts)

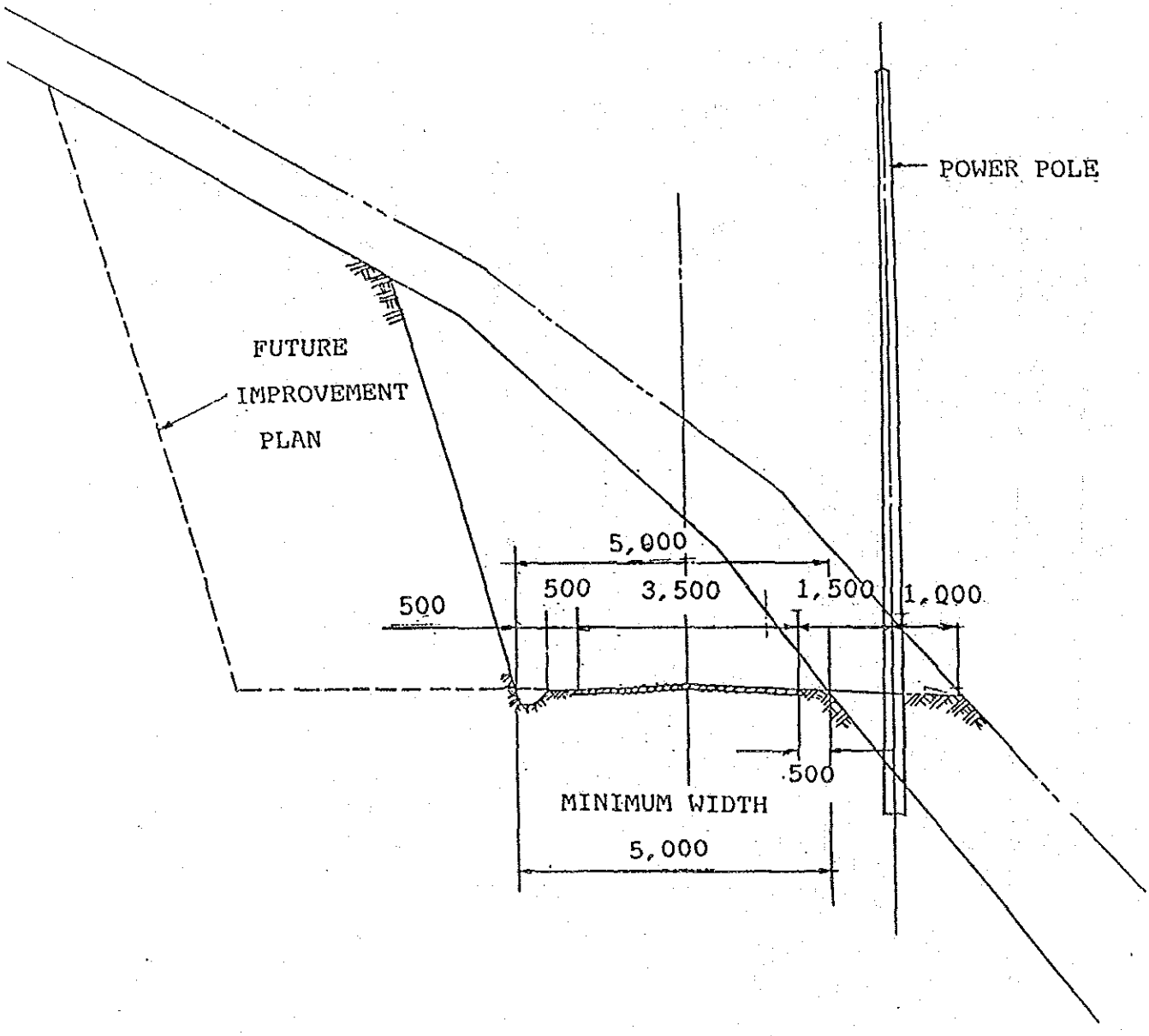


NOTE 1: It is possible to be mounted the transformer on the pole, if necessary.

NOTE 2: These types are applied to the "B" Route.

TYPICAL CROSS SECTION
ROAD ROUTE "B"

UNIT : millimeter



Annex V

PROJECT DESIGN CRITERIA

1. The drawing point between the power station and the project lies on the terminal board of the cubicle for the out-going feeder in the power station.

2. The main cable between CB for the out-going feeder and transformers for 13.8KV/34.5 KV and the control cables for AC 110V and DC 110V are design along the existing cable duct in the power station.

3. The control panel for switchboard is designed along with the main unit of control panel in the power station.

4. The CB's for transmission lines are designed to be automatically reclosed in case of a fault in the transmission line.

5. DC electric source is supplied by DC 30V in the power station. Since only DC 110V is adopted in the Japanese standard, DC 110V battery and changer are to be specifically designed to meet the need.

6. The earth wire in the switch yard is designed with meshed components and is connected to the earth of the power station, and the earth resistivity is designed within one ohm.

7. The Japanese standard is adopted for the entire design and procurement of machines based on S.I. Unit in their measurement.

8. The tranformer substations are to be designed to provide for catchment of spilled transformer oil, and proper fencing to protect people and animals from high voltages.

9. The control panel for the switch yard is to be compatible with that in the power station in size and color.

10. Additional space for tansformer to be used in conjunction with future additional generation capacity (beyond 16 megawatt) is not considered at this time; however, a bus arrangement is to be properly designed.

11. Wind velocity is 40 m/s as a 10-minute average, corresponding to a maximum wind velocity of 52 m/s.

12. Seismic intensity. Horizontal is 0.4G and vertical is 0.25G.

13. Temperature: 35 degrees C maximum ambient temperature.
    28 degrees C average ambient temperature.
    20 degrees C minimum ambient temperature.

14. Lightning: 37 days/year

15. Earth of neutral wire: Required at each pole.

16. ACSR inner creased conductor is recommended by JICA's Basic Design Study Team but Government of Palau recommends either bare copper conductor and/or all aluminum conductor (AAC) of proper sizes.

17. Clearance and height of the transmission and distribution line are to be based on REA rules and regulations in general.

18. Poles are to be located no less than 1.5 meters from the edge of the existing road in Route B, but should be at least 20 feet from the center line of the road at other areas in general.

19. Voltage drop in the transmission and distribution lines shall not be more than 10 percent.

20. Electric poles are to be prestressed concrete with galvanized steel rungs in general.

21. Cross arms and other hardwares are to be heavy galvanized steel.

22. Voltage fluctuation of service wire drops shall be within plus or minus 10 percent. Conforming to standard design.

Annex VI

UNDERTAKINGS OF THE GOVERNMENT OF PALAU

1. To secure the necessary real estates and right of ways for the project.

2. To clear and level the sites for the transformer substation.

3. To clear and improve the road along Route B ready for power transmission line construction.

4. Designate a place where a 24-hour watch can be maintained so that the alarm for transmission line fault can be received.

5. Exempt tax and provide for immediate custom clearance for commodities necessary for project implementation.

6. Accord Japanese nationals whose services may be required in connection with the supplying of products and services under the verified contract such facilities as may be necessary for their entry into the Republic of Palau and stay therein for the performance of the required work under the project.

7. To maintain and use properly and effectively the facilities constructed and equipment purchased under the Grant Aid.

8. To bear all the expenses other than those to be borne by the Grant Aid, that is to receive, transport, store and install only those equipment and materials necessary for the hook-up of individual facility and/or home, as distinguished from those responsibilities to be assumed by the Contractor of this project.

9. To coordinate with the inhabitants living in the project areas to ensure expediency of the project implementation.

10. To maintain the present pier at Aimeliik in good repair so that the Contractor can utilize same for the implementation of the project.

Appendix 3-1-(1) Monthly Temperature, Precipitation, Humidity (2-1)

KOROR (1983)

MONTH	TEMPERATURE (°C)				MONTHLY AVERAGE	PRECIPITATION		MEAN RELATIVE HUMIDITY	
	AVERAGE		EXTREME			TOTAL	DAYS	09:00 am	15:00 pm
	Max.	Min.	Max.	Min.	(°C)	(mm)	—	(%)	(%)
JANUARY	30.3	23.6	31.1	22.2	27.0	87	19	75	72
FEBRUARY	30.9	23.7	31.7	22.2	27.3	16	12	73	66
MARCH	31.1	24.1	31.7	22.8	27.6	43	10	72	66
APRIL	31.7	24.1	32.2	22.8	27.9	79	12	72	67
MAY	31.8	24.8	32.8	22.8	28.3	146	20	75	71
JUNE	31.2	24.2	32.8	22.2	27.7	469	27	81	77
JULY	30.3	24.2	32.8	22.2	27.3	538	26	82	81
AUGUST	31.1	24.5	32.8	22.8	27.8	456	25	80	77
SEPTEMBER	30.6	24.6	32.8	22.8	27.6	298	19	82	78
OCTOBER	31.2	24.3	32.8	22.8	27.8	361	24	80	78
NOVEMBER	31.3	24.7	32.8	23.3	28.0	290	27	79	79
DECEMBER	31.1	24.4	32.2	22.8	27.8	266	26	80	78
TOTAL									
AVERAGE	31.1	24.3	32.3	22.7	27.7	254	21	78	74

SOURCE: NATIONAL WEATHER SERVICE OFFICE, PALAU

Appendix 3-1-(2) Monthly Temperature, Precipitation, Humidity (2-2)

KOROR (1984)

MONTH	TEMPERATURE (°C)				MONTHLY AVERAGE	PRECIPITATION		MEAN RELATIVE HUMIDITY	
	AVERAGE		EXTREME			TOTAL	DAYS	09:00 am	15:00 pm
	Max.	Min.	Max.	Min.	(°C)	(mm)	—	(%)	(%)
JANUARY	30.8	23.7	32.2	22.8	27.3	472	28	81	79
FEBRUARY	30.6	23.7	31.7	22.8	27.2	275	25	82	77
MARCH	31.2	24.1	32.2	22.2	27.6	345	25	79	76
APRIL	31.3	24.6	32.2	22.8	27.9	184	24	78	73
MAY	31.8	24.5	32.0	22.8	28.2	276	27	78	75
JUNE	30.9	23.8	31.7	22.8	27.3	419	25	81	79
JULY	31.4	23.6	32.8	22.2	27.5	326	22	78	75
AUGUST	30.5	23.9	32.2	21.1	27.2	444	22	78	77
SEPTEMBER	31.1	24.1	32.8	22.2	27.6	264	21	76	75
OCTOBER	30.1	24.2	32.2	22.8	27.2	405	26	82	78
NOVEMBER					No Data				
DECEMBER					No Data				
TOTAL	—	—	—	—	—	—			
AVERAGE	31.0	24.0	32.3	22.5	27.5	341	24.5	79	76

SOURCE: NATIONAL WEATHER SERVICE OFFICE, PALAU

Appendix 3-1-(3)

Yearly and Monthly Average Temperature

KOROR
1978-1984

MONTH	AVERAGE TEMPERATURE (°F)						
	1978	1979	1980	1981	1982	1983	1984
JANUARY	81.3	81.4	80.8	81.1	81.7	80.5	81.1
FEBRUARY	80.1	81.3	80.2	80.4	81.7	81.2	80.9
MARCH	82.0	81.3	81.4	81.2	81.1	81.7	81.7
APRIL	81.9	81.3	81.8	82.0	81.7	82.2	82.3
MAY	82 6	81.4	82.5	82.6	81.8	83.0	82.7
JUNE	81.8	81.0	81.8	80.9	81.5	81.9	81.2
JULY	82.3	81.1	81.1	81.2	81.1	81.1	81.5
AUGUST	80.8	81.6	80.9	81.7	81.1	82.0	81.0
SEPTEMBER	80.9	82.1	81.6	81.6	82.4	82.0	81.7
OCTOBER	81.4	82.0	82.3	81.2	81.8	82.0	80.9
NOVEMBER	81.7	82.2	83.0	82.5	82.3	82.4	—
DECEMBER	81.8	81.5	82.3	82.1	81.7	82.0	—
TOTAL							
AVERAGE	81.6	81.6	81.7	81.5	81.7	81.8	—

Yearly and Monthly Precipitation

KOROR
1978-1984

MONTH	PRECIPITATION (INCH)						
	1978	1979	1980	1981	1982	1983	1984
JANUARY	10.34	6.98	8.72	11.32	5.79	3.44	18.57
FEBRUARY	22.46	6.47	16.01	15.00	6.81	.64	10.81
MARCH	6.02	7.96	5.53	4.49	9.90	1.71	13.58
APRIL	8.98	27.69	18.80	3.00	9.45	3.12	7.23
MAY	12.52	11.26	10.02	9.66	19.12	5.73	10.85
JUNE	16.04	22.84	19.50	29.17	22.41	18.48	16.49
JULY	9.13	17.79	12.40	21.14	19.40	21.20	12.82
AUGUST	20.36	11.69	15.26	6.89	10.94	17.96	17.47
SEPTEMBER	10.85	12.29	13.60	16.70	4.04	11.73	10.39
OCTOBER	20.06	11.97	17.11	14.30	8.82	14.23	15.94
NOVEMBER	17.66	11.57	12.17	11.37	9.92	11.40	—
DECEMBER	10.33	11.57	19.95	9.81	13.71	10.48	—
TOTAL	164.75	160.08	169.07	132.83	137.31	120.12	
AVERAGE	13.73	13.34	14.09	12.74	11.44	10.01	—

SOURCE: NATIONAL WEATHER SERVICE OFFICE, PALAU

Appendix 3-1-(4)
Max. and Min. Precipitation

(Unit : mm)

Items / Month	Monthly Precipitation		Monthly Precipitation		Daily Precipitation	
	Max.	Year	Min.	Year	Max.	Year
January	714	1974	54	1973	352	1974
February	570	1978	31	1973	214	1980
March	558	1972	62	1955	157	1953
April	703	1979	42	1948	431	1979
May	697	1954	206	1974	209	1958
June	580	1979	150	1976	148	1972
July	884	1962	105	1964	209	1962
August	626	1952	210	1975	208	1962
September	528	1962	171	1967	215	1949
October	571	1974	172	1951	157	1957
November	560	1958	119	1957	131	1967
December	536	1975	161	1969	164	1974

——— Shows Max. (Min) Value for Past 10 Years.

Max. Wind Speed

Items / Month	Max. for Past 10 Years		
	Speed m/s	Direation	Year
January	19.1	NW	1975
February	13.3	SE	1968
March	32.4	S	1967
April	26.7	SW	1976
May	15.5	SW	1976
June	17.8	SW	1967
July	15.1	W	1969
August	15.1	SW	1978
Sepember	15.1	N	1969
October	16.0	SW	1968
November	26.2	SE	1964
December	22.2	N	1972

——— Shows Max.(Min) Value for Past 10 Years.

Source : National Wether Service Office, Palau

U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
FOREST SERVICE
U.S. DEPARTMENT OF INTERIOR
OFFICE OF THE HIGH COMMISSIONER
TRUST TERRITORY OF THE PACIFIC ISLANDS
UNIVERSITY OF HAWAII AT MANOA
COLLEGE OF TROPICAL AGRICULTURE AND HUMAN RESOURCES

GENERAL SOIL MAP

ISLANDS OF PALAU,
FEDERATED STATES OF MICRONESIA

MAP UNITS

SOILS ON BOTTOM LANDS

1 — *Dechel-Mesei-Ngersuul:* *Very deep, very poorly drained, and somewhat* poorly drained, level and nearly level soils; on valley and coastal bottom lands

2 — Ngerungor Variant-Ngerungor: Very deep, very poorly drained, level and nearly level soils; on bottom lands and in depressional areas

3 — *Ilachetomel: Very deep, very poorly drained, level soils;* in the intertidal zone adjacent to the shoreline

SOILS ON MARINE TERRACES

4 — Tebecheding-Ngatpang: Very deep, somewhat poorly drained and moderately well drained, nearly level to steep soils; on dissected terraces

SOILS ON VOLCANIC UPLANDS

5 — Aimeliik-Palau: Very deep, well drained, nearly level to very steep; on hills

6 — Babelthuap-Aimeliik-Ngardmau: Very deep, well drained, nearly level to very steep soils; on hills and ridges

7 — *Ngardok-Babelthaup:* Very deep, well drained, nearly level to very steep soils; on ridgetops and side slopes

8 — Ollei-Nekken-Rock outcrop: Shallow and moderately deep, well drained, strongly sloping to very steep soils, and Rock outcrop; on hills and ridgetops

SOILS ON LIMESTONE

9 — Rock outcrop-Peleliu: Rock outcrop, and shallow, well drained, very steep soils; on uplands

10 — *Peleliu-Rock outcrop: Shallow, well drained, nearly level to moderately* steep soils, and Rock outcrop; on low-lying coral islands

SOILS THAT FORMED IN CORAL SAND

11 — Ngedebus: Very deep, somewhat excessively drained, nearly level to gently sloping soils; on raised beach deposits

Compiled 1981

Each area outlined on this map consists of more than one kind of soil. The map is thus meant for general planning rather than a basis for decisions on the use of specific tracts.

PHILIPPINE SEA

PACIFIC OCEAN

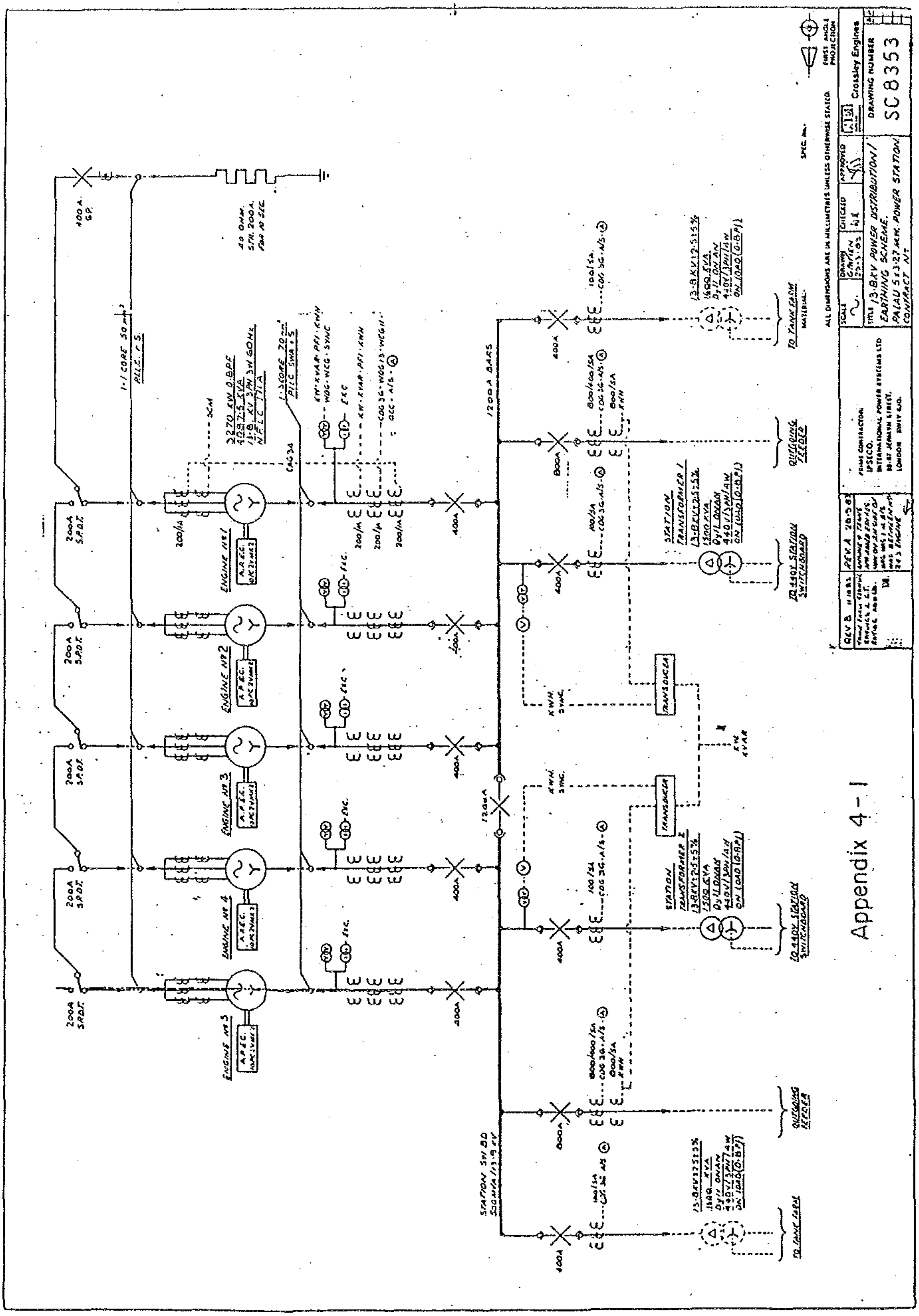
N

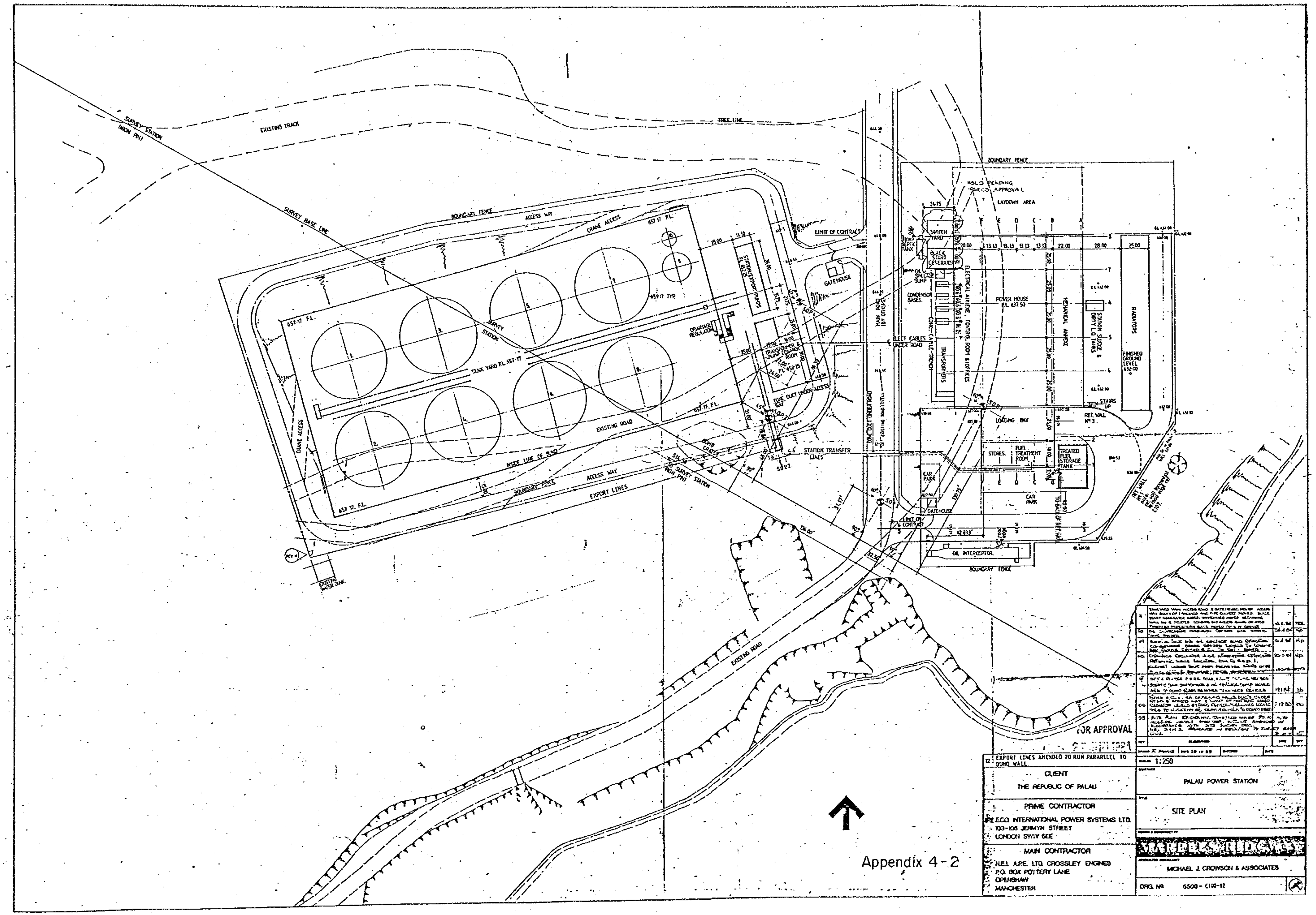
Mt. Ebiru-Mayahan
Mt. Meglion
Mt. Guiltel
Mt. Arubon
Mt. Unkeshu
Mt. Elsum
Mt. Ketteluel
Mt. Etekkueiku
Mt. Tamaire
BABELTHUAP ISLAND
Mt. Aben
Mt. Arurukoku
Mt. Tuns
Mt. Marakulabeshiku
ARAKABESAN I.
KOROR I.
MALAKAL I.
Ngaikol

7°40'
7°30'
7°25'
7°20'
134°30'
134°35'
134°40'
134°45'

Appendix 3-2-(2) Grading Analysis and Physical, Chemical Properties

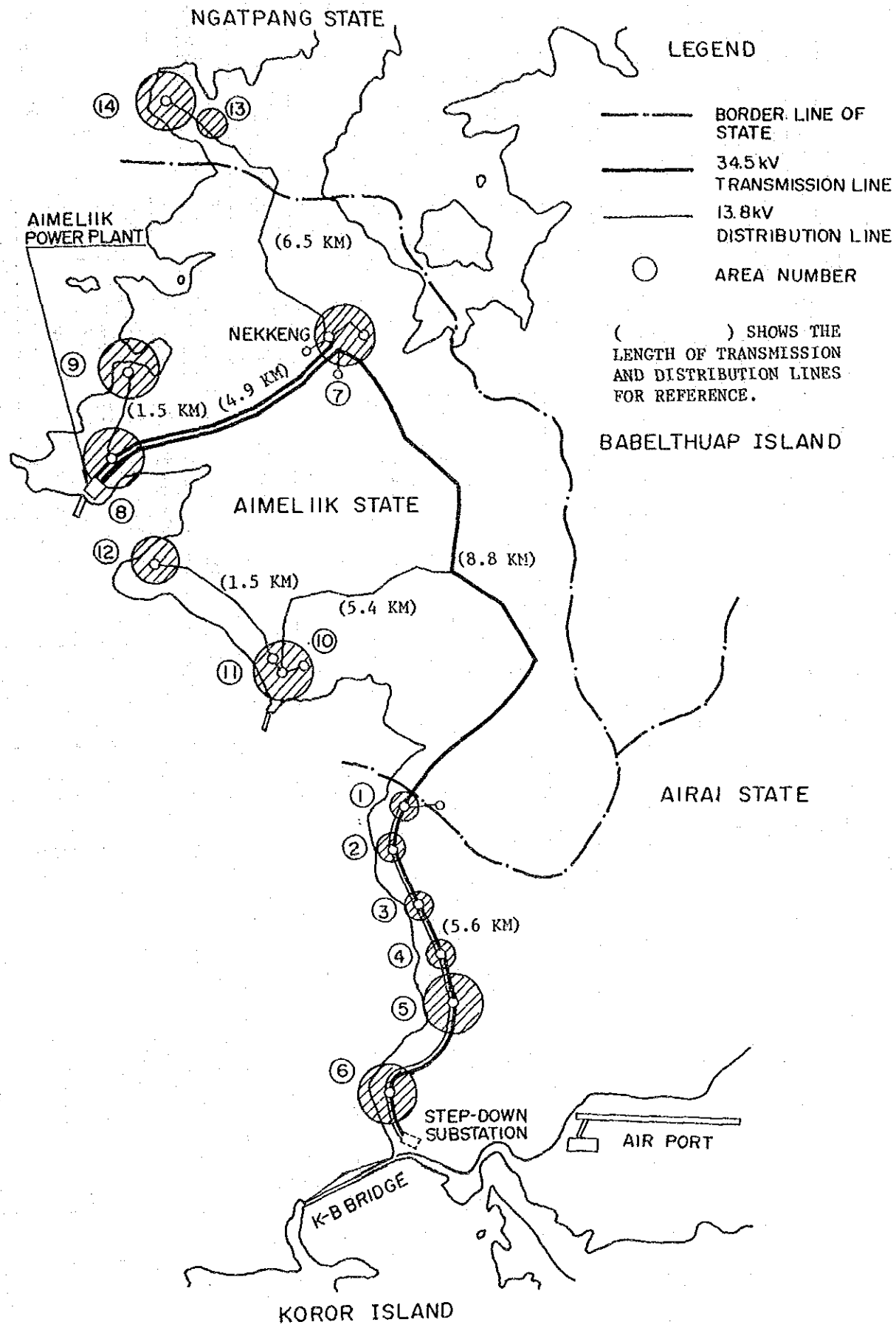
SOIL NAME AND MAP SYMBOL	SAMPLING DEPTH	CLASSIFICATION	FRAG-MENTS	PERCENTAGE PASSING SIEVE NUMBER				PERMEABILITY	pH	LIQUID LIMIT
			>76mm	4# mm (5)	10# mm (1.5)	40# mm (0.5)	200 mm (0.074)			
	(cm)		(%)	(%)	(%)	(%)	(%)	(cm/hr)		(%)
⑤ Aimeliik	0 – 10	Silt loam	0	85-100	85-100	75-100	60-90	5 -15	3.6-5.0	80-90
	10 – 86	Silt loam, Silty clay clay	0	95-100	90-100	85-100	75-90	5 -15	4.5-5.5	75-85
	86-150	Silt loam, Silty clay loam	0	100	100	90-100	80-95	5 -15	4.5-5.5	75-85
⑤ Babelthuap	0 – 10	Very gravelly loam	0-15	80-90	20-50	20-50	15-40	15 -50	3.6-5.5	35-60
	10 – 64	Silty clay loam, Silty clay	0	95-100	75-90	70-90	65-85	5 -15	3.6-5.5	65-85
	64-150	Silty loam, Silty clay loam	0	95-100	75-90	70-85	65-85	5 -15	4.5-5.5	80-95
⑧ Nakken	0 – 20	Very gravelly silt loam	10-20	30-55	25-50	25-45	20-35	5 -15	5.6-6.5	25-35
	20 – 46	Very gravelly clay loam	10-20	30-55	25-50	25-50	20-45	1.5 – 5	5.1-6.0	35-45
	46 – 56	Very gravelly silt loam	10-20	40-60	35-55	30-50	25-40	1.5 – 5	5.1-6.0	25-35
	56-150	Unweatherd bedrock	—	—	—	—	—	—	—	—
⑤ Ngatpang	0 – 15	Silty clay loam	0	80-100	75-100	70-100	65-95	1.5 – 5	4.5-5.5	80-90
	15 – 28	Gravelly silty clay Gravelly clay loam Very gravelly clay loam	0	45-80	35-75	30-75	25-70	1.5 – 5	3.6-5.0	75-85
	28-114	Clay, silty clay	0	95-100	90-100	80-100	70-95	0.5 – 1.5	3.6-5.0	75-85
	114-150	Clay, silty clay	0	100	100	90-100	75-95	0.2<	3.6-5.0	80-100
① Dechel 408	0 – 10	Mueky silt loam	0	100	100	90-100	70-100	5 -15	5.1-7.3	75-100
	10-102	Silty clay loam	0	100	100	90-100	85-100	0.5 – 1.5	5.1-7.3	65-75
	102-109	Very gravelly silty clay loam	10-15	35-60	30-55	30-55	25-55	1.5 – 5.0	5.1-7.3	65-75
	109-168	Silty clay loam, Silty loam	0	100	100	90-100	85-100	0.2 – 0.6	5.1-7.3	65-75
③ Llachetomel	0-150	Peat	—	—	—	—	—	15 -50	5.6-6.0	—
④ Tabecheding	0 – 18	Silty clay loam	0	100	100	95-100	90-95	1.5 – 5.0	3.6-5.0	50-60
	18 – 51	Clay, Silty clay	0	80-100	75-100	70-100	60-95	0.2 – 0.5	3.6-4.4	80-100
	51-158	Clay, Silty clay	0	80-100	75-100	70-100	60-95	<0.2	3.6-4.4	90-115


Appendix 4 - 1
ENGINE No 1
ENGINE No 2
ENGINE No 3
ENGINE No 4
ENGINE No 5
1200A BARS
STATION TRANSFORMER 1
STATION TRANSFORMER 2
TRANSDUCER
TO TANK FARM
OUTGOING FEEDER
TO 440V STATION SWITCHBOARD
13.8KV POWER DISTRIBUTION/ EARTHING SCHEME.
PALAU 5x3.27 MW. POWER STATION
Crossley Engines
SC8353


SURVEY STATION (IRON PIN)
EXISTING TRACK
TREE LINE
SURVEY BASE LINE
BOUNDARY FENCE
ACCESS WAY
CRANE ACCESS
TANK YARD FL 657.17
SURVEY STATION
DRAINAGE REGULATOR
EXISTING ROAD
INSIDE LINE OF BUND
EXPORT LINES
LIMIT OF CONTRACT
GATEHOUSE
CONDENSOR BASES
MAIN ROAD
ELECT CABLES UNDER ROAD
TRANSFORMERS
POWER HOUSE FL 637.50
MECHANICAL ANNEXE
RADIATORS
FINISHED GROUND LEVEL
LOADING BAY
STORES
FUEL TREATMENT ROOM
TREATED FUEL STORAGE TANK
CAR PARK
OIL INTERCEPTOR
STATION TRANSFER LINES
SWITCH TANK
BLACK START GENERATOR
SEPTIC TANK
LAYDOWN AREA
HOLD PENDING APPROVAL
EXISTING WATER TANK
EXISTING ROAD
FOR APPROVAL
12 EXPORT LINES AMENDED TO RUN PARARLLEL TO BUND WALL
CLIENT
THE REPUBLIC OF PALAU
PRIME CONTRACTOR
P.E.C.O. INTERNATIONAL POWER SYSTEMS LTD.
103-105 JERMYN STREET
LONDON SW1Y 6EE
MAIN CONTRACTOR
N.E.I. A.P.E. LTD. CROSSLEY ENGINES
P.O. BOX POTTERY LANE
OPENSHAW
MANCHESTER
1:250
PALAU POWER STATION
SITE PLAN
MICHAEL J. CROWSON & ASSOCIATES
DRG. No 5500 - C100-12

Appendix 4－2

Appendix 5-1-(1) ELECTRIFICATION AREA MAP



Appendix 5-1-(2) Detail of Electrification Plan (1)

No	State	Area	Houses						Others				Total kVA	Remarks
			Existing		Future		Total		Items	kVA				
			No.	kVA	No.	kVA	No	kVA		Exsit.	Future	Total		
①	Airai	Zone 1	—	—	10	13	10	13					13	
②	〃	〃 2	—	—	5	6	5	6					6	
③	〃	〃 3	—	—	10	13	10	13					13	
④		〃 4	—	—	10	13	10	13					13	
⑤	〃	〃 5	1	1	2	3	3	4					4	
⑥	〃	〃 6	2	3	—	—	2	3					3	Seven (7) houses already receive the power of Airai State.
⑦	Aimeliik	NEKKENG	3	4	—	—	3	4	Forestry Stn.	12.5	—	12.5		
									OISCA	12.5	—	12.5		
												25	29	
⑧	〃	Imelsubech	11	14	—	—	11	14	IPSECO	13	—	13	27	
⑨	〃	Medorm	13	16	—	—	13	16	Communi. Center	4	—	4	20	
⑩	〃	Imul	24	30	—	—	24	30					30	
⑪	〃	Ngelkeai	8	10	—	—	8	10	Goverment. Office	6		6		
									Elementary School	4		4		
									Kindergarten	4		4		
									Billiards	1		1		
									Repair Shop	4		4		
									Ice Plant	24		24		220V, 3φ
												43	53	

Appendix 5-1-(2) Detail of Electrification Plan (2)

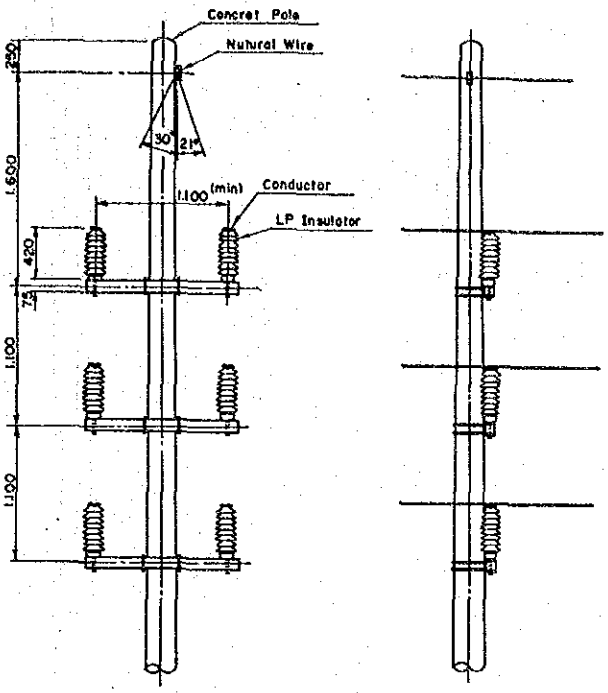
No.	State	Area	Houses						Others				Total	Remarks
			Existing		Future		Total		Items	kVA				
			No.	kVA	No.	kVA	No.	kVA		Exsit.	Future	Total		
⑫	Aimeliik	Elechui	5	6	—	—	5	6	Communi. Center	4	—	4	10	Becanse rood condition is very bod , Construction of distribution line is very difficult.
⑬	Ngatpang	Housing area	—	—	30	38	30	38					38	
⑭	〃	Ngatpang	11	14			11	14	Goverment Office	6	—	6		
									Communi. Center	6	—	6		
									Meeting Place	3	—	3		
									Elementary School	4	—	4		
									Pier	0.5	—	0.5		
									Ice Plant	24	—	24		220V, 3φ
									Dock House	0.5	—	0.5		
									Public Works	—	6	6		
												50	64	
Total			78	98	67	86	145	184				139	323	

Appendix 6 - 1 Measurement of Salt Contamination

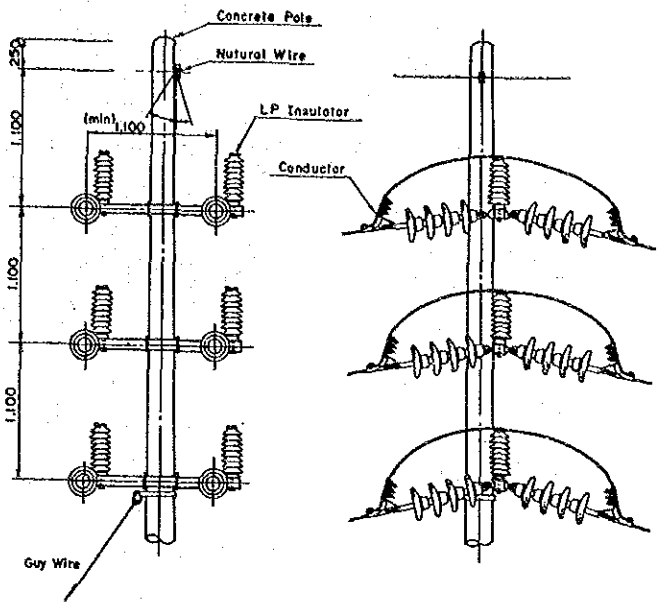
Test No.	Kind of Insulator	Dia. x Height (mm)	Insulation Mark	Insulation Color	Exposed Term	Surface of Measurement	Salt Contamination
1 - 1	Pin Type	135ø x 110	1973 ME	Gray	1/17 ~ 1/19 (3 days)	All	Less Than 0.01%
1 - 2	〃	〃	〃	〃	1/20 ~ 1/25 (6 days)	〃	〃
2	〃	〃	〃	〃	1/17 ~ 1/25 (9 days)	〃	〃
3	〃	〃	〃	〃	〃	〃	〃
4	〃	〃	1970 ME	Brown	More Than 10 Years	〃	〃
5	High - Voltage Pin Type	168ø x 145	CHANCE' 1968	〃	1/17 ~ 1/25 (9 days)	〃	〃
6	Dead End Type	155ø x 128	LOCKE 1951EU	〃	More Than 10 Years	Under	〃
						Under + Upper	〃
7	〃	〃	〃	〃	〃	〃	〃
						〃	〃
8 - 1	Suspension	254 x 140	(Nichigai) 1950-10	Gray	1/17 ~ 1/19 (3 days)	〃	〃
						〃	〃
8 - 2	〃	〃	〃	〃	1/20 ~ 1/25 (6 days)	〃	〃
						〃	〃
9	〃	〃	〃	〃	1/17 ~ 1/25 (9 days)	〃	〃
						〃	〃
10	〃	〃	〃	Brown	〃	〃	〃
						〃	〃
11	〃	〃	〃	〃	〃	〃	〃
						〃	〃

※ Salt Contamination ; Measured it by washing surface of the insulator with 150 ml - water.

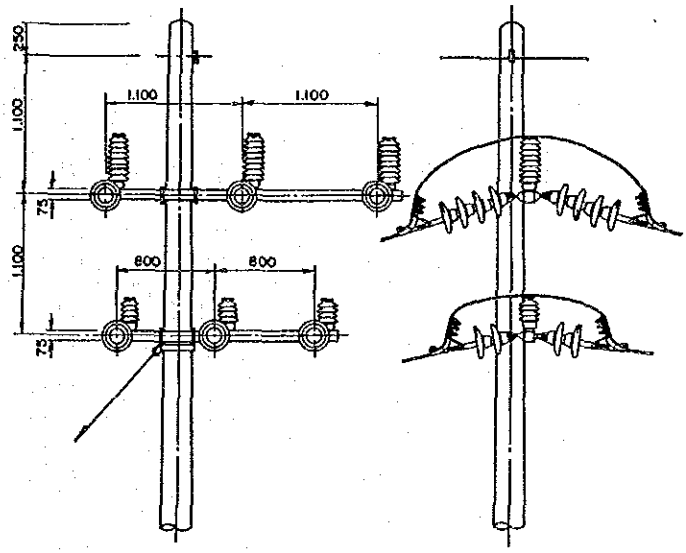
Appendix 6 - 2 - (1) Example of Support Structure Arrangement



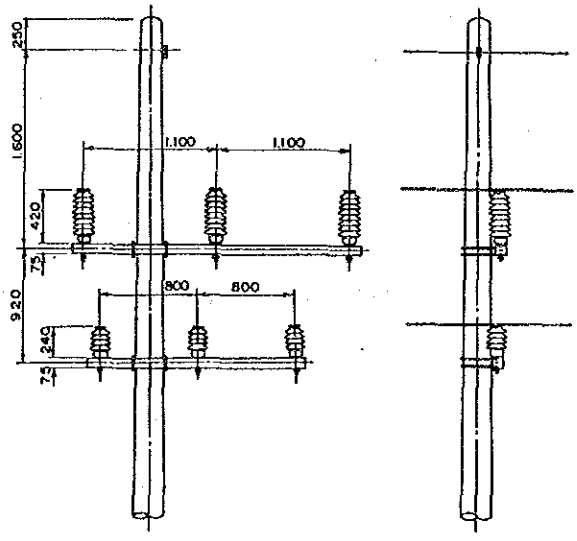
Suspention Pole 34.5 kV 2cct



Section Pole 34.5kV 2cct

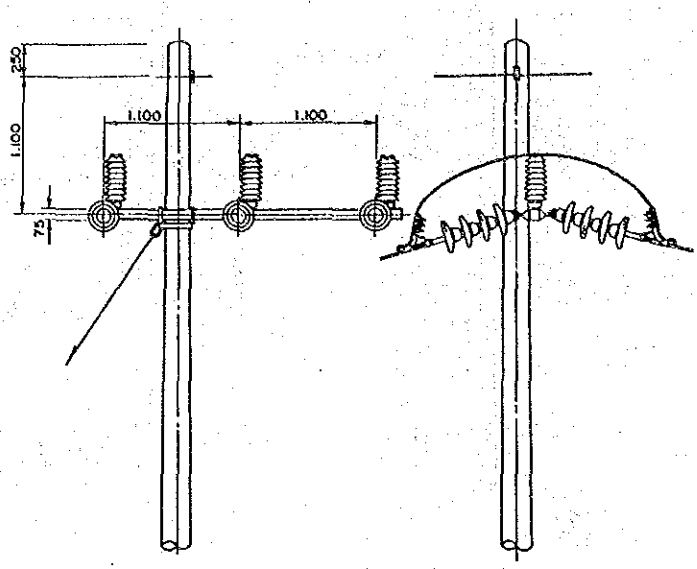


Section Pole 34.5 kV 1cct
13.8 kV 1cct

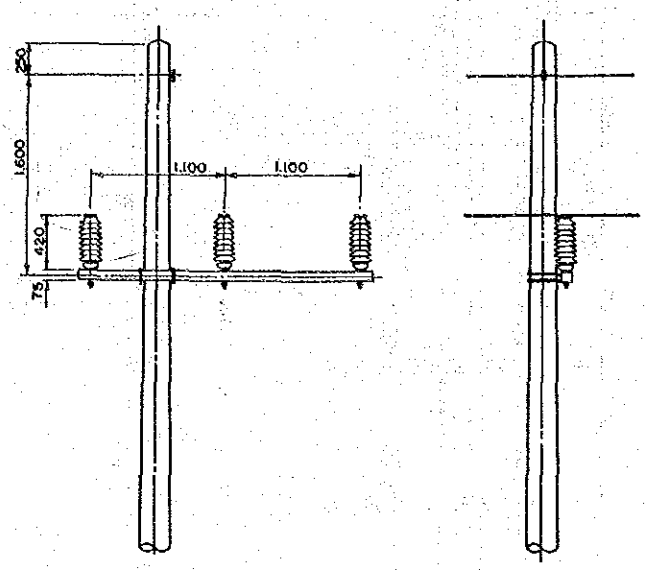


Suspention Pole 34.5 kV 1cct
13.8 kV 1cct

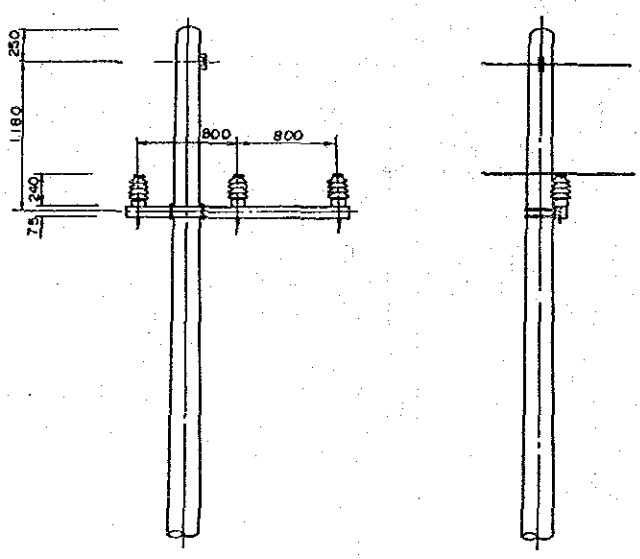
Appendix 6 - 2 - (2) Example of Support Structure Arrangement



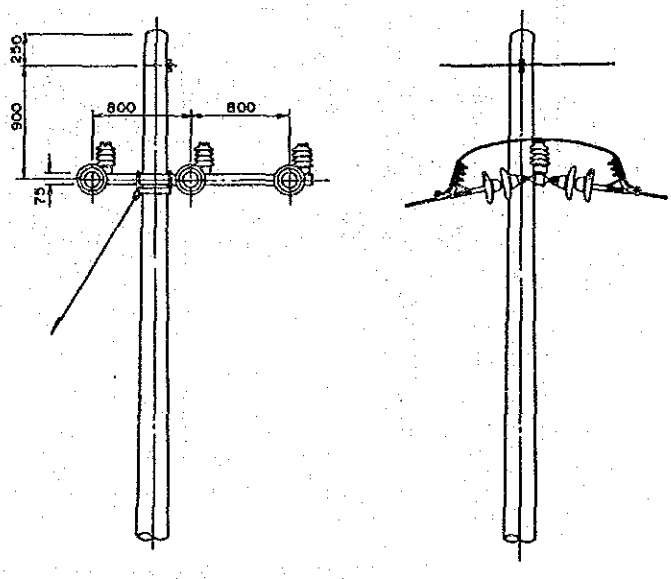
Section Pole 34.5kV 1cct



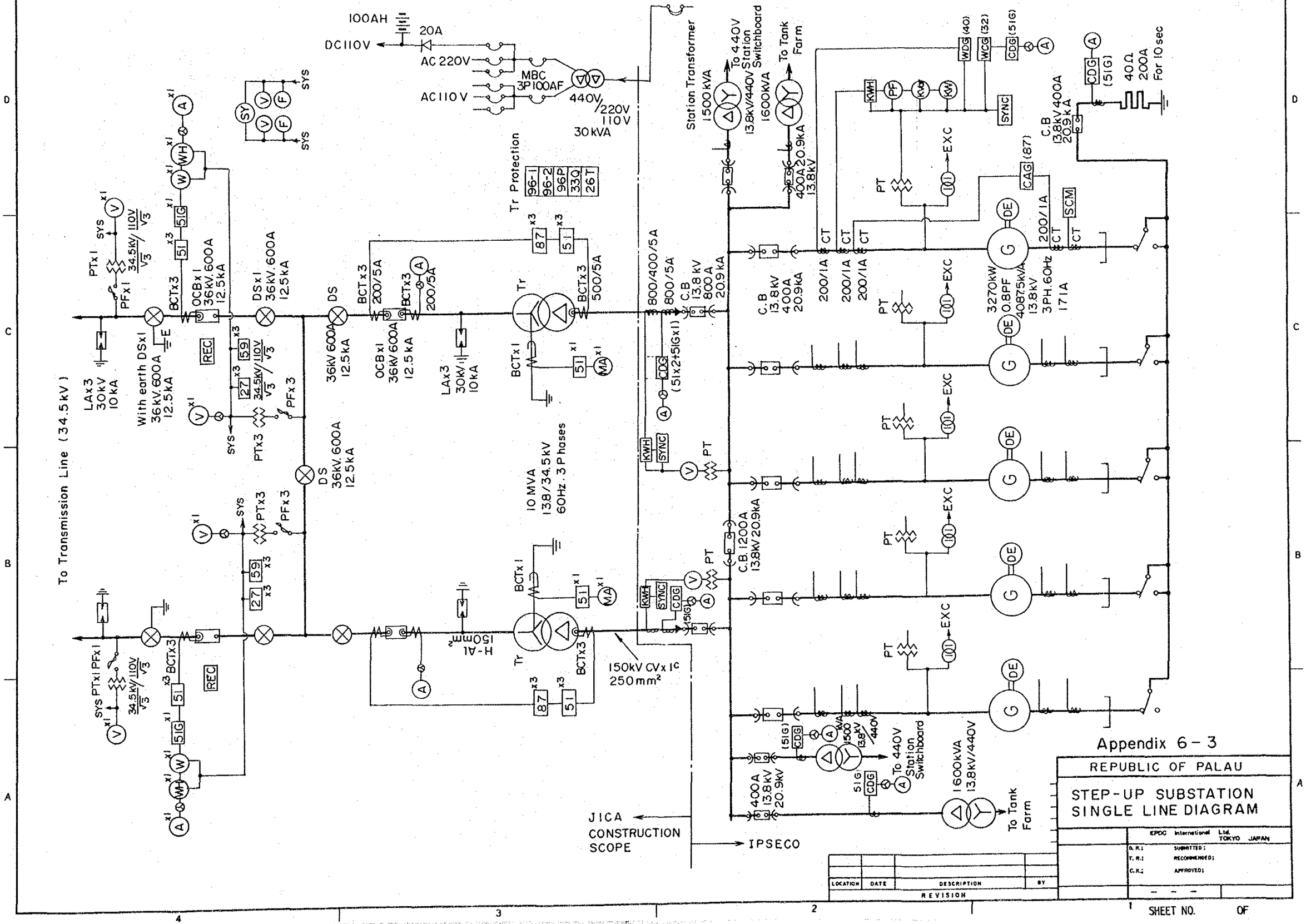
Suspention Pole 34.5kV 1cct



Suspention Pole 13.8kV 1cct



Section Pole 13.8kV 1cct



Appendix 6 - 3

REPUBLIC OF PALAU

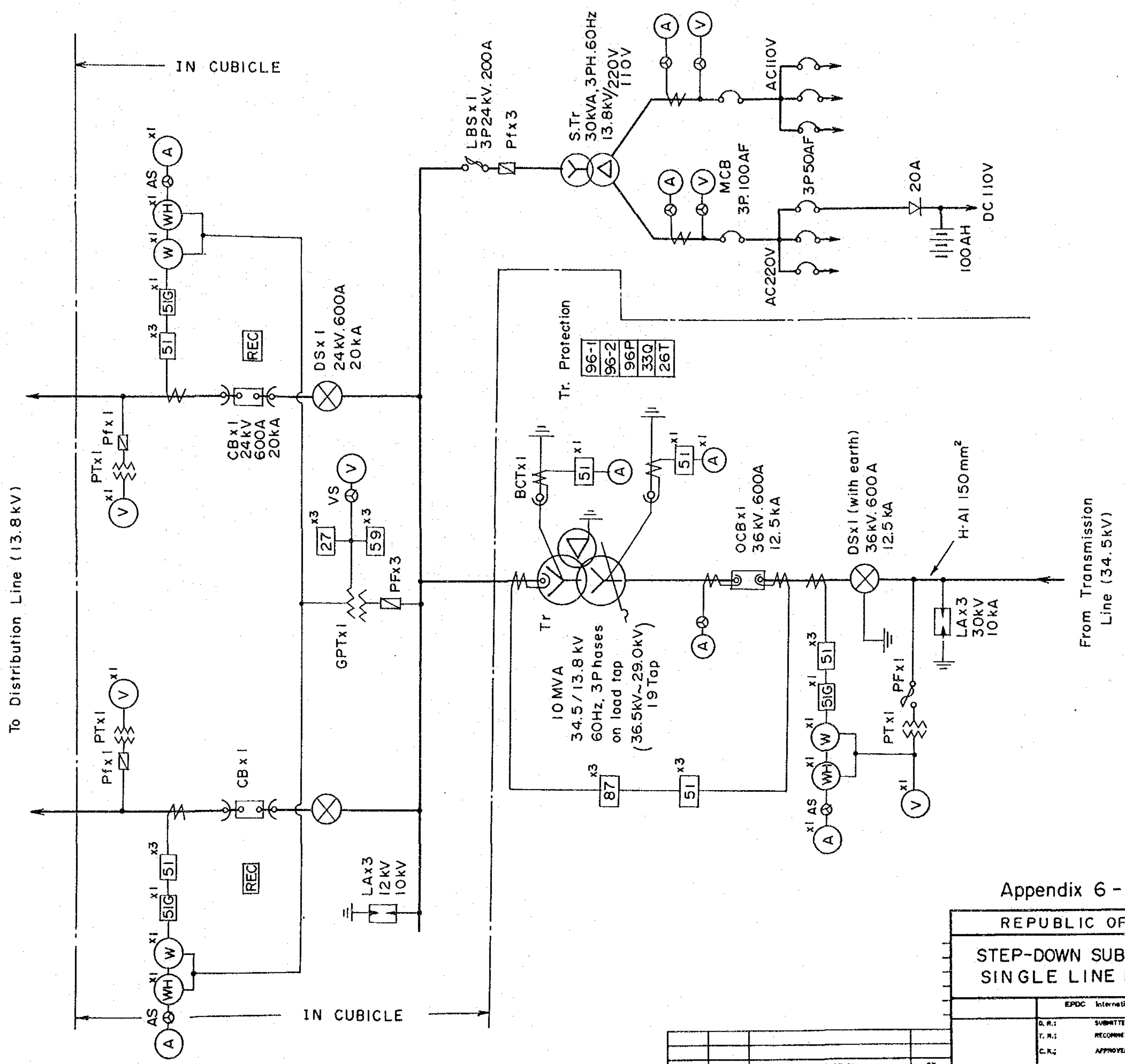
STEP-UP SUBSTATION
SINGLE LINE DIAGRAM

LOCATION	DATE	DESCRIPTION	BY
		REVISION	

EPDC International Ltd. TOKYO JAPAN

D. R.: SUBMITTED:
T. R.: RECOMMENDED:
C. K.: APPROVED:

SHEET NO. OF



Appendix 6 - 4

REPUBLIC OF PALAU

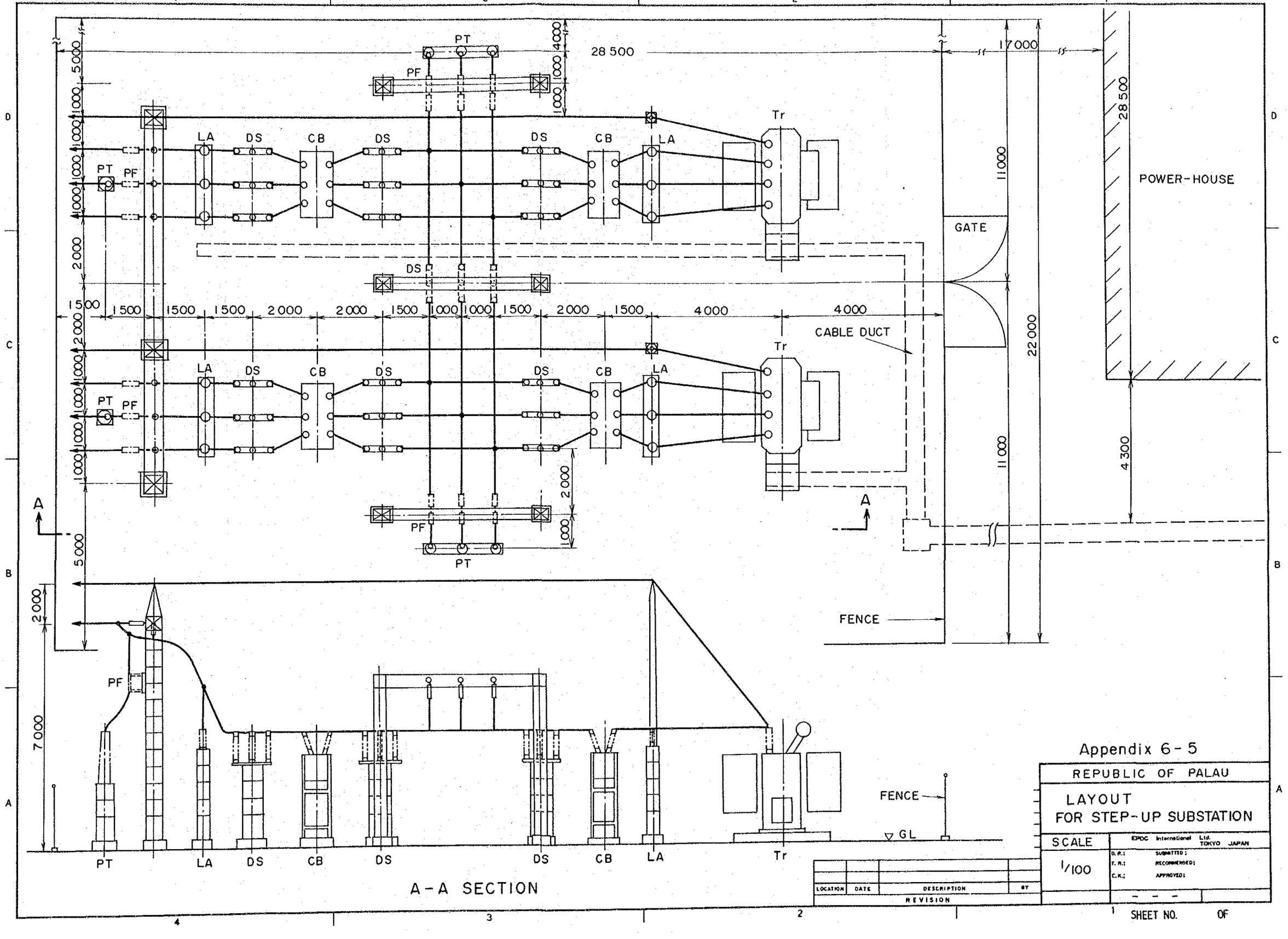
STEP-DOWN SUBSTATION SINGLE LINE DIAGRAM

EPDC International Ltd. TOKYO JAPAN

D.R.:	SUBMITTED:		
T.R.:	RECOMMENDED:		
C.R.:	APPROVED:		

LOCATION	DATE	DESCRIPTION	BY
REVISION			

SHEET NO. OF



A-A SECTION

Appendix 6-5

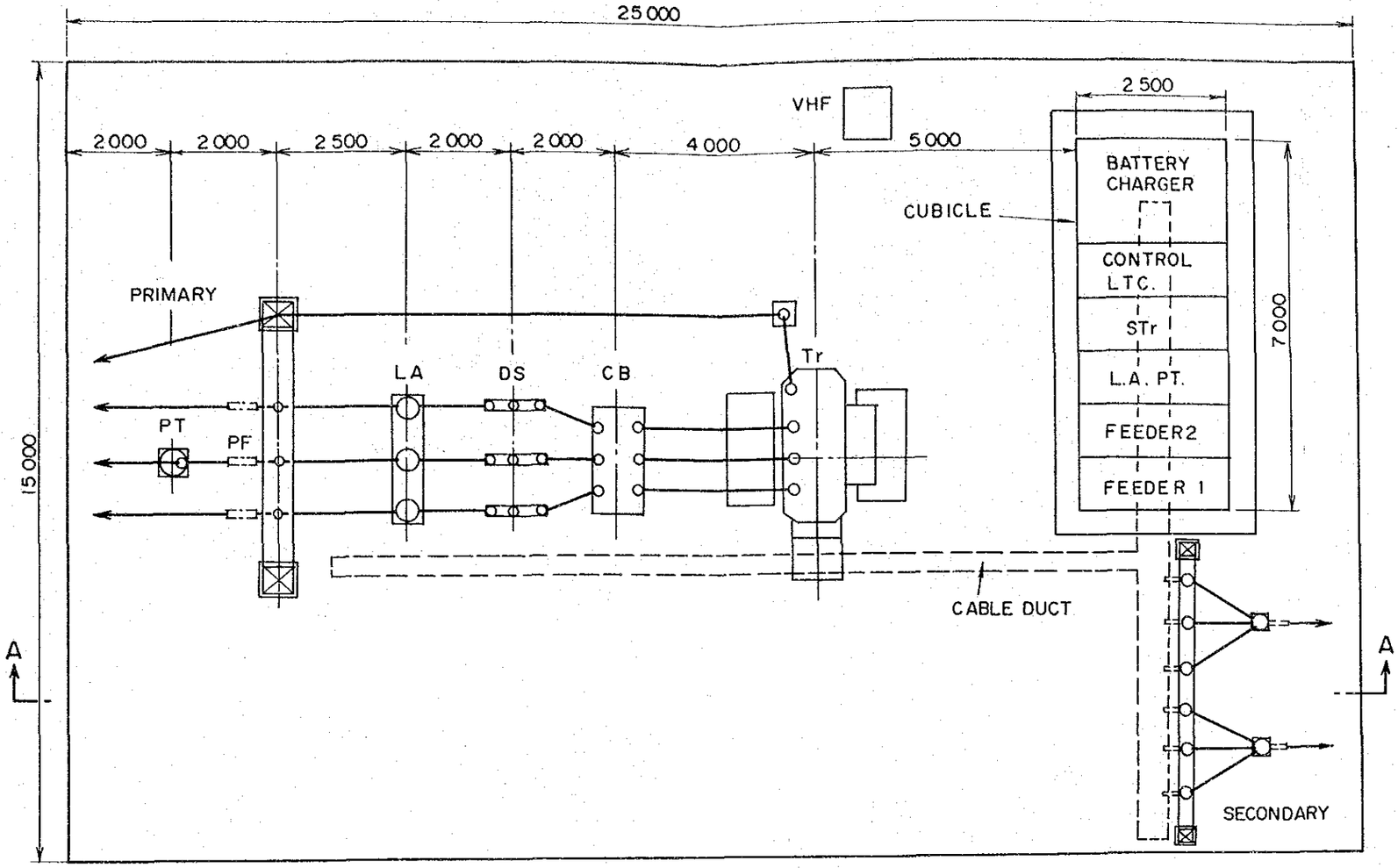
REPUBLIC OF PALAU

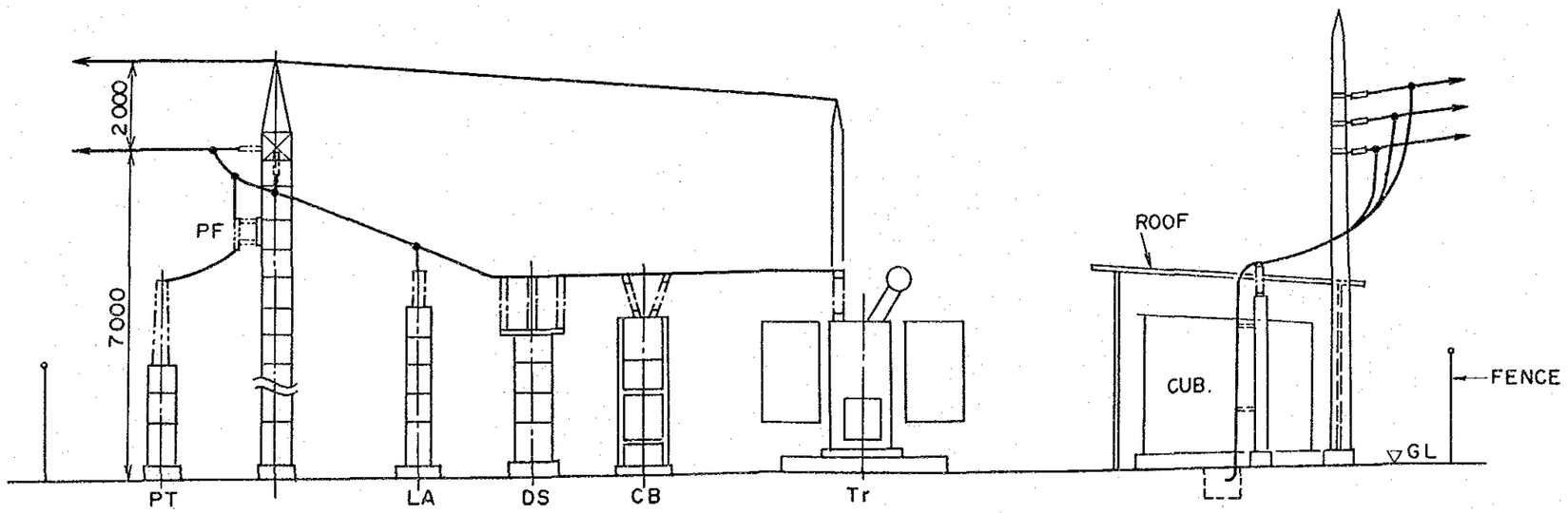
LAYOUT
FOR STEP-UP SUBSTATION

SCALE	EPDC International Ltd. TOKYO JAPAN
1/100	D. R.: SUBMITTED: / T. R.: RECOMMENDED: / C. K.: APPROVED:

REVISION				
LOCATION	DATE	DESCRIPTION	BY	

SHEET NO. OF





A-A SECTION

Appendix 6 - 6

REPUBLIC OF PALAU

LAYOUT
FOR STEP-DOWN SUBSTATION

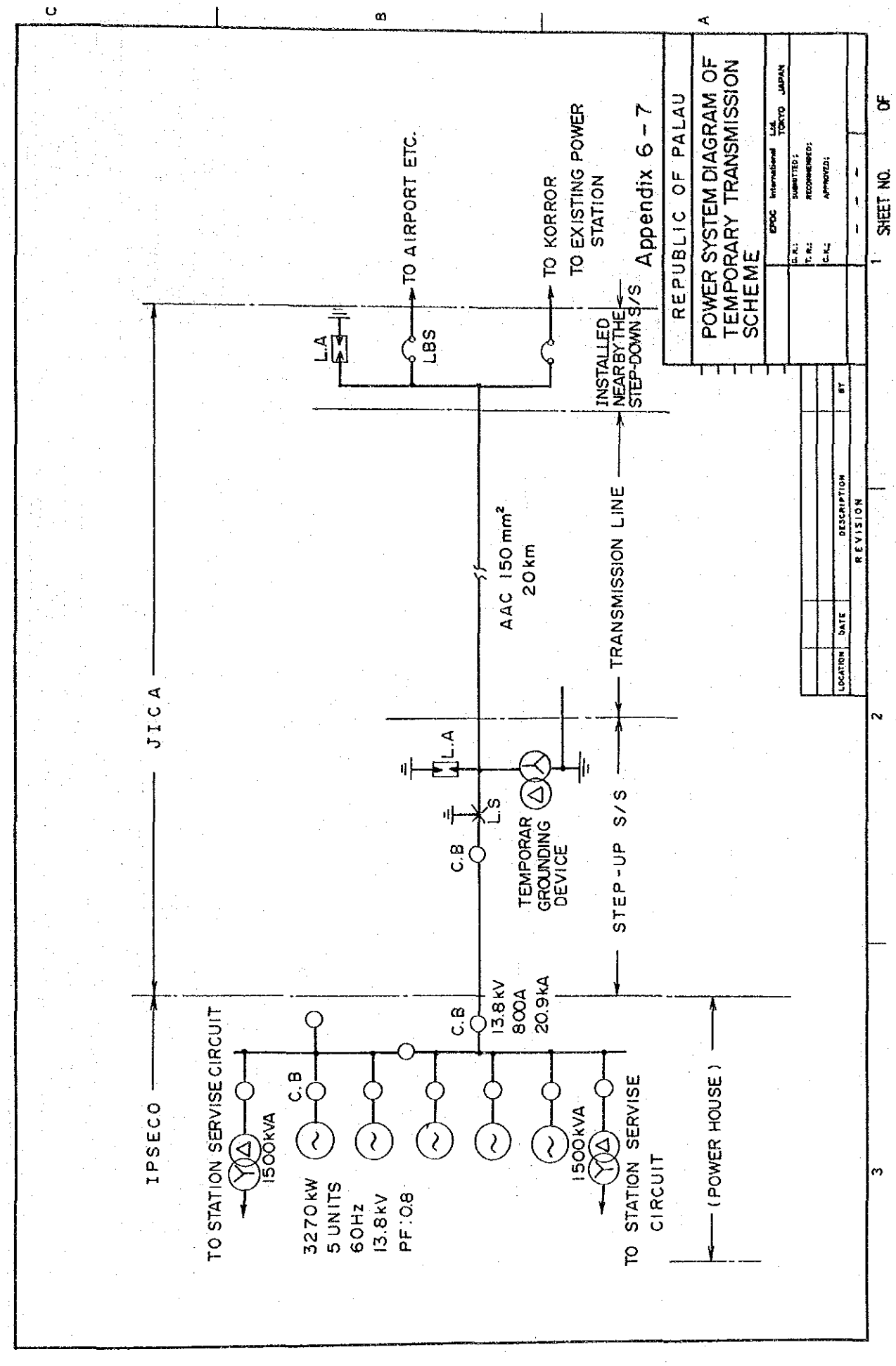
SCALE 1/100

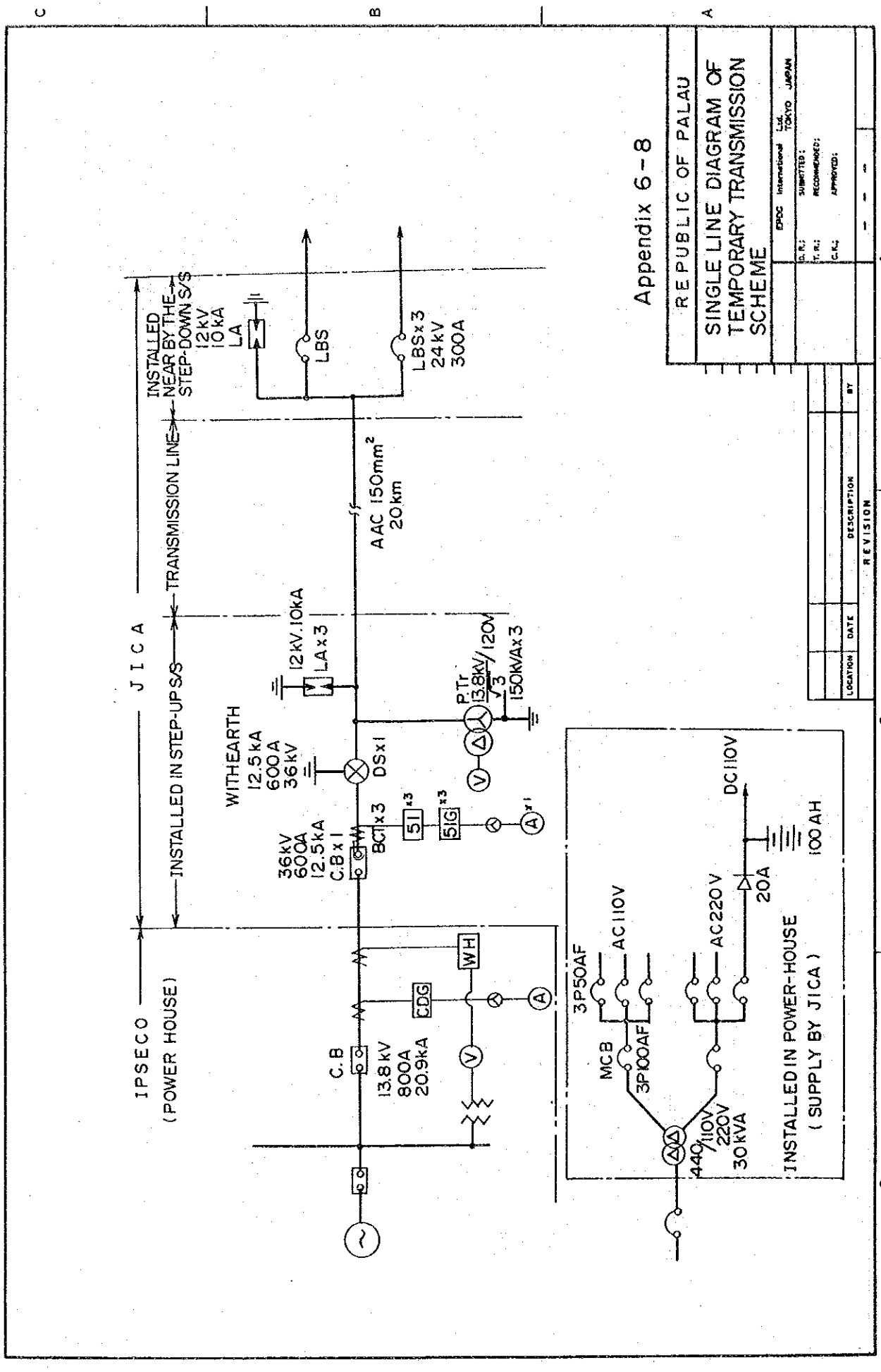
EPDC International Ltd. TOKYO JAPAN

D. R.: SUBMITTED:
T. R.: RECOMMENDED:
C. R.: APPROVED:

LOCATION	DATE	DESCRIPTION	BY
		REVISION	

SHEET NO. OF


REPUBLIC OF PALAU
POWER SYSTEM DIAGRAM OF TEMPORARY TRANSMISSION SCHEME
Appendix 6－7
SHEET NO.
TO AIRPORT ETC.
TO KORROR
TO EXISTING POWER STATION
INSTALLED NEARBY THE STEP-DOWN S/S
L.A
LBS
AAC 150 mm²
20km
TRANSMISSION LINE
JICA
IPSECO
L.A
L.S
C.B
TEMPORAR GROUNDING DEVICE
STEP-UP S/S
C.B
13.8kV
800A
20.9kA
C.B
1500kVA
3270kW
5 UNITS
60Hz
13.8kV
PF:0.8
1500kVA
TO STATION SERVISE CIRCUIT
TO STATION SERVISE CIRCUIT
(POWER HOUSE)
REVISION
DESCRIPTION
DATE
BY
LOCATION


Appendix 6-8
REPUBLIC OF PALAU
SINGLE LINE DIAGRAM OF TEMPORARY TRANSMISSION SCHEME
EPDC International Ltd. TOKYO JAPAN
D.R.; SUBMITTED;
T.R.; RECOMMENDED;
C.K.; APPROVED;
SHEET NO. OF
LOCATION DATE DESCRIPTION BY
REVISION
JICA
IPSECO
(POWER HOUSE)
INSTALLED IN STEP-UP S/S
TRANSMISSION LINE
INSTALLED NEAR BY THE STEP-DOWN S/S
12kV 10kA LA
LBS
LBS×3 24kV 300A
AAC 150mm² 20km
12kV.10kA LA×3
WITHEARTH 12.5kA 600A 36kV
DS×1
36kV 600A 12.5kA C.B×1
BCT×3
51 ×3
51G ×3
A ×1
P.Tr 13.8kV/√3/120V 150kVA×3
V
C.B 13.8kV 800A 20.9kA
EDG
WH
A
3P50AF
AC110V
MCB 3P100AF
AC220V
DC110V
20A
100AH
440/110V 220V 30kVA
INSTALLED IN POWER-HOUSE
(SUPPLY BY JICA)

新発電所発電コスト（内訳）

・　年間発生電力量

以下の算定により機械・設備の耐用年数（15年）の間における，年間平均発生電力量を48,287,700KWH/年とする。

（ｉ）1985年１月の発電実績より平均負荷率を70％とする。

（根拠）休　日；平均　2,274KWH

平　日；平均　3,101KWH

ピーク；　4,110

$$\text{平均負荷率} = \frac{2,274\times 2 + 3,101\times 5}{4,110\times 7} = 70\%$$

（ii）現在の最大電力需要量：　4,000KW，10年後の同量：　9,000KW平均負荷率70％における10年間の平均発電量は　4,550KWH/h　。

（根拠）

1985年：　4,000KW×70％＝　2,800KWH/h

1995年：　9,000KW×70％＝　6,300KWH/h

（iii）設備・機械の耐用年数を15年とし，10年後から15年後の間の電力需要増加を年率5.6％とした場合の同期間の平均発電量は7,437KWH/h。

（増加率　5.6％の根拠）

今後10年間の年間平均増加量：350KWH/h｛＝(6,300－2,800)KWH/h　÷10年｝に基づき，10年後～15年後の増加率を　5.6％／年とする。

350KWH/h÷6,300KWH/h（10年後の平均発電量）＝　5.6％

（10年後～15年後の平均発電量）

｛（　6,300＋　350）＋(6,650×1,056^{1})＋(6,650×1,056^{2})＋(6,650×1,056^{3})＋(6,650×1,056^{4})｝÷５年＝7,437WH/h

（iv）以上から発電コスト算定に当っての平均年間発生電力量は，48,287.7MWH/年とする。

平均発電量：(4,550KWH/h　×10年＋7,437KWH/h×５年）÷15年＝5512.3KWH/h

平均年間発生電力量：5,512.3KWH×24×　365＝48,287,748KWH/年

⇨48,287,700KWH/年

・建設費

建設費総額から燃料油タンク建設費６百万ドルを差し引く。

28,965.8千ドル－ 6,000千ドル＝22,965.8千ドル

・年間経費

資本費： 2,363.5千ドル

パラオ政府には減価償却の概念がないが，借入金のうち発電所建設費充当資金に対応する借入金の元本の返済は，事業収入に依るものではなく，米国の援助資金を原資とするパラオ政府財政の直接的負担となることから，これと同借入金支払利息を資本費とし，対応期間は機械・設備耐用年数の15年とする。

（借入金明細は資料８－２参照）

借入金合計：32,478.7千ドル

支払利息計：17,666.4千ドル

元本・利息合計：50,145.1千ドル

発電所建設費対応分：$50,145.1\text{千ドル} \times \frac{22,965.8\text{千ドル}}{32,478.7\text{千ドル}} = 35,452.6\text{千ドル}$

年間資本費：35,452.6千ドル÷15年＝ 2,363.5千ドル

直接費： 1,115.1千ドル

（修繕費）建設費の２％とする。

22,965.8千ドル×0.02＝ 459.3千ドル

（諸　費）建設費の 0.4％とする。

22,965.8千ドル× 0.004＝91.9千ドル

（人件費）国家資源省公共事業庁所属職員の年間平均給与は，パラオ政府説明から７千ドル前後であることから，1984年度の人件費（推定） 342.6千ドルに人員増加15人＝ 105千ドルを見込むこととする。

342.6千ドル＋ 105千ドル＝ 447.6千ドル

（潤滑油費）消費率 1.6ｇ/KWH，比重0.91，単価1.37ドル／ℓ（＝5.18ドル/gal）とする。

1.6×1/1,000 ×1/0.91×48,287.7千KWH ×1.37＝ 116.3千ドル

燃料費： 2,241.6千ドル

消費率 210ｇ/KWH，比重0.95，単価21セント／ℓ（＝79セント/gal）とする

210×1/1,000 × 1/0.95 ×48,287.7千KWH ×0.21= 2,241.6千ドル

・年間総経費： 5,720.2千ドル

・資本費を除く総経費： 3,356.7千ドル

発電コスト：

資本費を含む場合： 0.118ドル/KWH⇨12セント/KWH

資本費を除く場合：0.0695ドル/KWH⇨ 7セント/KWH

Appendix 8-2-(1) Details of the Loans From British Banks

(Unit: US$ 1,000.-)

Consolidated Basis of Three Loans

Repayment schedules of each loan are as per attached next page, Appendix 8-2-(2)

⊗ "Equivalent to Construction Cost" indicates that a pro-rata portion of the power plant consfruction cost against total repayment amount.

Date	Borrowing	Repayment of Principal Ⓐ	Balance of Borrowing	Interest Payment (Calculated at 11.25% p.a.) Term	Int. Amount Ⓑ	Repayment Amount in Each Fiscal Year Ⓐ+Ⓑ=Ⓒ	Equivalent to Construction Cost (Ⓒ×70.7%) ⊗
1983. 6. 8	32,478.7		32,478.7				
				1983.6.8 - 8.31	862.7	862.7	609.9
9. 1			32,478.7	(85 d/s)			
				1983.9.1-84.2.29	1,847.2		
1984. 3. 1			32,478.7	(182 d/s)			
				1984.3.1 ~ 8.31	1,867.5	3,714.7	2,626.3
9. 1			32,478.7	(184 d/s)			
				1984.9.1~85.2.28	1,837.1		
1985. 3. 1		2,282.0	30,196.7	(181 d/s)			
				1985.3.1 - 8.31	1,736.2	9,994.6	7,066.2
9. 1		4,139.2	26,057.5	(184 d/s)			
				19859.1-86.2.28	1,473.9		
1986. 3. 1		4,139.2	21,918.3	(181 d/s)			
				1986.3.1 - 8.31	1,260.3	8,730.7	6,172.6
9. 1		1,857.3	20,061.0	(184 d/s)			
				1986.9.1-87.2.28	1,134.7		
1987. 3. 1		1,857.3	18,203.7	(181 d/s)			
				1987.3.1 - 8.31	1,046.7	5,896.0	4,168.5
9. 1		1,857.3	16,346.4	(184 d/s)			
				1987.9.1 - 88.2.29	929.7		
1988. 3. 1		1,857.3	14,489.1	(182 d/s)			
				1988.3.1 - 8.31	833.1	5,477.4	3,872.5
9. 1		1,857.3	12,631.8	(184 d/s)			
				1988.9.1-89.2.28	714.5		
1989. 3. 1		1,857.3	10,774.5	(181 d/s)			
				1989.3.1 - 8.31	619.5	5,048.6	3,569.4
9. 1		1,857.3	8,917.2	(184 d/s)			
				1969.9.1-90.2.28	504.4		
1990. 3. 1		1,857.3	7,059.9	(181 d/s)			
				1990.3.1 - 8.31	405.9	4,624.9	3,269.8
9. 1		1,857.3	5,202.6	(184 d/s)			
				1990.9.1-91.2.28	294.3		
1991. 3. 1		1,734.2	3,468.4	(181 d/s)			
				1991.3.1 - 8.31	199.4	3,962.1	2,801.2
9. 1		1,734.2	1,734.2	(184 d/s)			
				1991.9.1-92.3.1	99.2		
1992. 3. 1		1,734.2	0	(183 d/s)		1,833.4	1,296.2
	32,478.7	32,478.7			17,666.4	50,145.1	35,452.6

Appendix 8-2-(2)

(Unit : US$ 1,000.-)

Date	Repayment	Balance	Interest (11.25% fixed)
Amount : US$ 24,278.700 Lender : International Westminster Bank PLC Guaranteed by ECGD			
1983.6.8		24,278.7	
1985.9.1	1,734.2	22,544.5	
1986.3.1	1,734.2	20,810.3	
1986.9.1	1,734.2	19,076.1	
1987.3.1	1,734.2	17,341.9	
1987.9.1	1,734.2	15,607.7	
1988.3.1	1,734.2	13,873.5	
1988.9.1	1,734.2	12,139.3	
1989.3.1	1,734.2	10,405.1	
1989.9.1	1,734.2	8,670.9	
1990.3.1	1,734.2	6,936.7	
1990.9.1	1,734.2	5,202.5	
1991.3.1	1,734.2	3,468.3	
1991.9.1	1,734.2	1,734.2	
1992.3.1	1,734.2	0	
Amount : US$ 1,354.200 out of US$ 8,200.000 Lender : County Bank			
1983.6.8		1,354.2	
1985.9.1	123.1	1,231.1	
1986.3.1	123.1	1,108.0	

(Unit : US$ 1,000.-)

Date	Repayment	Balance	Interest (11.25% fixed)
1986.9.1	123.1	984.9	
1987.3.1	123.1	861.8	
1987.9.1	123.1	738.7	
1988.3.1	123.1	615.6	
1988.9.1	123.1	492.5	
1989.3.1	123.1	369.4	
1989.9.1	123.1	246.3	
1990.3.1	123.1	123.1	
1990.9.1	123.1	0	
Amount : US$ 6,845.800 out of US$ 8,200.000 Lender : County Bank			
1983.6.8		6,845.8	
1985.3.1	2,282.0	4,563.8	
1985.9.1	2,281.9	2,281.9	
1986.3.1	2,281.9	0