第6章　結　論

6－1　計画の意義、効果

本計画の実施によって以下の効果が期待される。

①ガーナ国南東部の３郡都の電化完成による、全国電化計画の促進

②アダ・フォア地域の経済開発及び産業振興

③電力供給による、同地域の住民の日常生活の安定、商工業の活性化、並びに病院や郵便局等の公共施設の安定した運用、夜間における治安の維持

④ボルタ川流域からの移住者に対するアコソンボダム建設の利益還元及び民生向上

⑤トーゴーからの電力逆輸入の解消

6－2　調査団の見解

（１）アダ・フォアはアクラ広域州の郡都の中で唯一電力の供給がなく、経済的ポテンシャリティーが高いにもかかわらず、電力が供給されていないことが隘路となってその発展が疎外されている。これにより同地域の住民生活、社会公共施設の運営、商工業活動等は、すべて低調なものとなっている。また、ボルタ川流域からの移住者に対する利益還元も重要である。このため同地域に対する電力供給は急務である。

（２）技術的には、送電線ルートに関し、ソガコフェ橋をボルタ川横断に利用でき、また、アシェクペ変電所の既存設備が有効利用できるため妥当である。

（３）維持管理面においては、送電線ルートを１級道路もしくは２級道路沿いに設定でき、またECG(電力公社)は、技術的能力も高く、問題はない。

以上より本計画が日本国政府の無償資金協力により実施される意義は大きく、その妥当性も高いと判断される。

6－3　基本設計調査に関する提言

（１）ボルタ川の送電線横断

33KV送電線のソガコフェ付近におけるボルタ川横断にソガコフェ橋を利用することに関して、ECGとGHAとの間で合意が成立している。

しかし、ソガコフェ橋はその橋脚部のリハビリテーションが予定されており、その工事はドイツ援助資金(DM 20.6million)をもって1993年から2～3年を要して実施される予定であり、こ

れに携わるドイツのコンサルタントが最近決定したばかりである。

従って、電力ケーブル付設の具体的方法については、同リハビリ工事の工法の確認を行い、同工事に支障を与えない方法を検討する必要があろう。

（２）低圧配電線の資機材及び付設工事

低圧配電線に関しては、我が国からは所要資機材のみを供与し、敷設工事はECG が実施することになっているので、ECG側の低圧配電線計画を確認し、供与資機材の種類及び数量をECGと協議する必要がある。

また、低圧配電線の敷設工事費を主体とする「ガ」側費用については、ECGは¢500million (1.5億円)を自己負担することを予定しているが、供与実施予定時の会計年度のECG予算を再確認する必要があろう。

ガーナ共和国

アダフォア電化計画

事前調査報告書

付　属　資　料

A．討議議事録

B．収集資料リスト

C．質問状及び回答

A．討議議事録

MINUTES OF DISCUSSIONS
OF
PRELIMINARY STUDY ON THE PROJECT FOR
ELECTRIFICATION
OF
ADA FOAH, CAPITAL OF DANGBE EAST DISTRICT
IN
THE REPUBLIC OF GHANA

In response to a request from the Government of the Republic of Ghana, the Government of Japan decided to conduct a preliminary study on the Project for Electrification of Ada Foah, Capital of the Dangbe East District (hereinafter referred to as "the Project"), and entrusted the study to the Japan International Cooperation Agency (JICA).

JICA sent to Ghana a study team, which is headed by Mr.Tetsuro TANIUCHI, Officer, Evaluation Division, Economic Cooperation Bureau, Ministry of foreign Affairs and is scheduled to stay in the country from July 17th to August 3th 1992.

The team held a series of discussions with the officials of the Government of Ghana and conducted field surveys at study areas.

As a result of the discussions and field surveys, both parties confirmed that the main items of the Project are described on the attached sheets. On condition that the Government of Japan approves the implementation of Basic Design Study on the Project, JICA will prepare the study, including dispatch of survey teams.

Accra, July 31, 1992

Tetsuro Taniuchi

Mr. Tetsuro TANIUCHI
Leader
Preliminary Study Team
JICA

Mr. Charlse ABAKAH
Ditector International
Economic Relation
Division
Ministry of Finance &
Economic Planning

Witness

Y.N.OPONG
Director Power Division
Ministry of Energy

ATTACHMENT

1. Objective
The objective of the Project is to provide electricity to three district capitals in the Project area by connection to national hydro-power grid system and thus contributing to the improvement of the quality of life and health of the inhabitants.

2. Project site
The site of the Project is Tongu North and South Districts and Dangbe East District (Site map is attached as Annex I)

3. Excecuting Agency
The Ministry of Energy (MEn) is responsible for the administration and execution of the Project.

4. Items requested by the Government of Ghana
After discussions with the Preliminary study team, the following items were requested by the Ghana side:
   (1) Expansion of 161/69kv Substation at Asiekpe
   (2) Supply and installation of 40km of 69kv line from Asiekpe to Sogakofe
   (3) Supply and installation of a 69/33kv Substation and associated switchgear and protection
   (4) Supply and installation of 85km of 33kv line (Sogakofe-Adidome, Sogakofe-Kasseh, Kasseh-Ada Foah, Ada Foah-Pute, Tefle-Battor)
   (5) Supply of low voltage distribution network materials in the Project area

   However, the final components of the Project may differ from the above items, if it is found necessary after further studies in Japan.

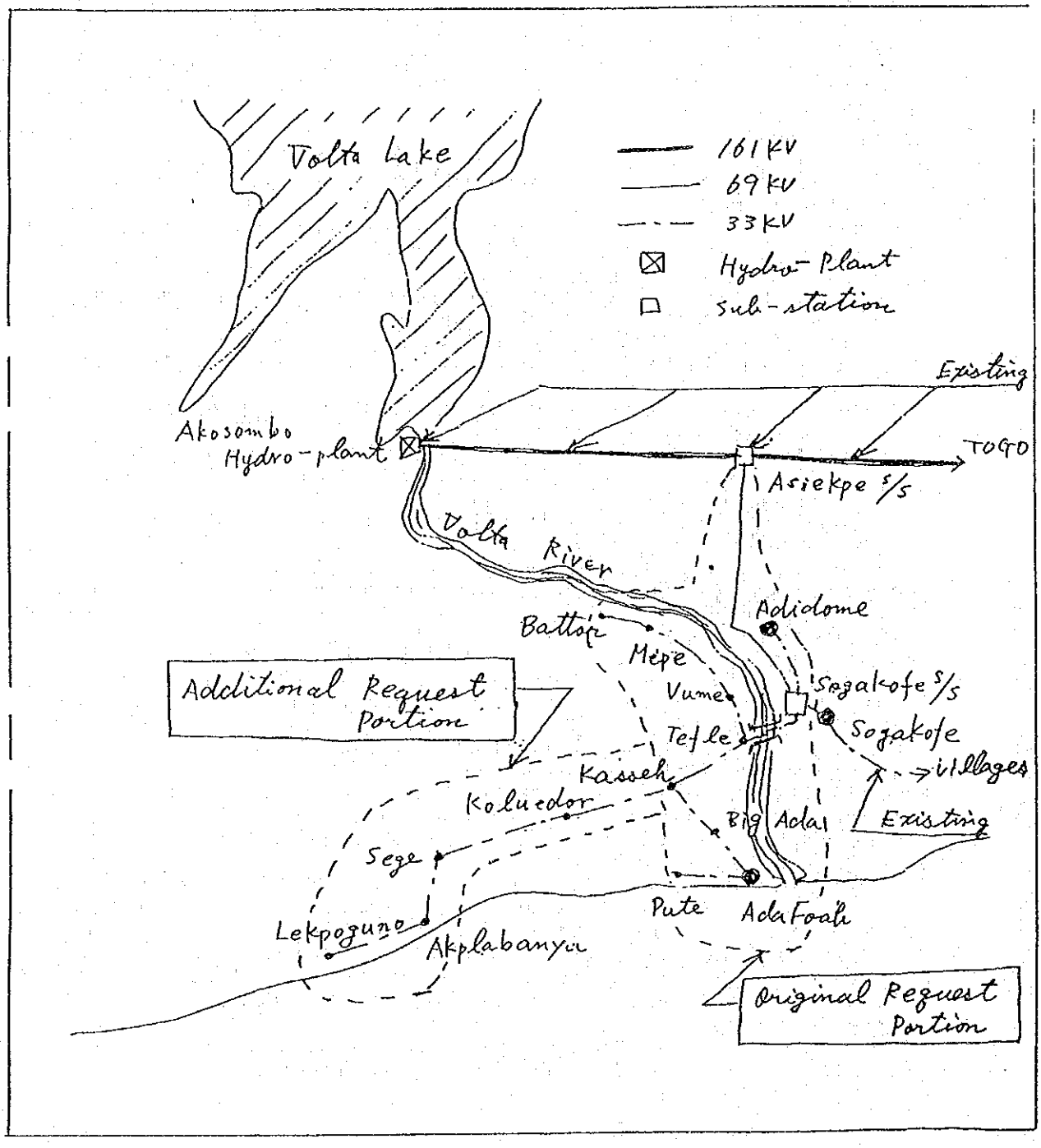
5. Additional request
The Ministry of Energy(MEn) requested that the additional electricity installation from Kasseh to Lekpoguno through Sege is of such economic importance to Ghana and in particular the people of the Dangbe East District, that it should be considered within the request as one of the top priorities.

6. Crossing point of the Volta river
Electricity Corporation of Ghana (ECG) and Ghana Highway Authority (GHA) reached the agreement that the Sogakofe bridge can be used as the installation route of power cable.

7. Japan's Grant Aid system
   (1) The Government of Ghana has understood the system of Japan's Grant Aid explained by the team.
   (2) The Government of Ghana will take the necessary measures, described in Annex II, for smooth implementation of the Project on condition that the Grant Aid assistance by the Government of Japan is extended to the Project.

8. Further schedule
If the Project is found feasible as a result of the Preliminary Study, JICA will consider the Basic Design Study.

ANNEX I Site Map



ANNEX II

Undertaking by the Government of the Republic of Ghana

1. To secure necessary lands for the Project, and to clear, fill and level the sites as needed before the start of the works.

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

3. To ensure speedy unloading, tax exemption, customs clearance at the port of disembarkation and prompt inland transportation, of products purchased for the Project.

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

5. To exempt Japanese nationals engaged in the Project from customs duties, internal taxes and other fiscal levies which may be imposed in Ghana with respect to the supply of equipment/machines and services under the verified contracts.

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

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

8. To assign exclusive and responsive engineers/technicians, for the Project.

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

10. To ensure that the necessary budget and personnel for the proper and effective operation and maintenance of the equipment and facilities are provided under the Grant Aid.

B．収集資料リスト

－Quarterly Digest of Statistics (December 1991)

－Economic Recovery Programme 1984-86

－Progress of Economic Recovery Programme 1984-86 and Framework 1986-88

－Volta River Authority(VRA) 29th the Annual Report and Accounts 1990

－Electricity Corporation of Ghana(ECG) Accounts 31st, Dec. 1991

－National Electrification Project Feasibility Study, June 1992

－プロジェクトサイト地図(1／50,000)

－質問書に対する回答資料

－The World Bank in GHANA

C．質問状及び回答

THE PRELIMINARY STUDY ON THE PROJECT FOR ELECTRIFICATION OF ADA FOAH, CAPITAL OF THE DANGBE EAST DISTRICT IN THE REPUBLIC OF GHANA

QUESTIONNAIRE

JULY, 1992

JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)

質　問　事　項	回　答
1. General Information for the REPUBLIC OF GHANA (1)Area of country (GHANA)_____ (Districts for the Project)_____ km² (2)Situation of ADA FOAH Latitude _____ Longitude _____ (3)National Development Plan Title _____ (4)Relevance between the Plan mentioned in (3) above and the requested Project (5)Economic Indices	別冊 ANNEX 1-(5)

	1987	1988	1989	1990	1991
1 Population					
2 The Rate of increase of Population					
3 GNP(×1,000,000US$)					
4 National Budget (×1,000,000US$)					
5 Foreign Trade (×1,000,000US$) - Export - Import					
6 Foreign-exchange Holding(×1,000,000US$)					
7 Debt of Foreign-exchange (×1,000,000US$)					
8 Electric Energy Consumption(GWH)					
9 Electric Energy Exported(GWH)					

質　問　事　項	回　　答
(6)Industrial statistics of Agricultual, Mining, Fishery, Commercial Industry and etc. in GHANA	ANNEX 1-(5)
(7)National Electrification Programme	F／S報告書(June' 92)を基に現在作成中
(8)Electrification ratio(for Reconfirmation), and State/District capitals without electricity supply	全国平均約15％
(9)Climatic condition of ADA FOAH (for Reconfirmation)	ANNEX 1-(9)
a. Temperature, humidity and rainfall	

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.
Temperature(℃)												
Average Humidity(%)												
Rainfall(㎜)												

b. Recorded max. wind velocity in Typhoon	
c. Earthquake	
d. IKL(Isokelannic Level), Thunders	
2. Formation of the execution of the Project	ANNEX 2
(1)Structure of the government of GHANA	〃 2-(1)
(2)Organization for electric power service in GHANA, and role of each (ECG, VRA, and others, if any)	〃 2-(2)
(3)Position of ECG in the GHANA government organization and others	
(4)Law for ECG established on	

質　問　事　項	回　　答
(5)Organization of ECG(for Reconfirmation)	ANNEX 2-(5)-a
a. Organization and Nos. of staff	
b. Location of head office	
c. Location of local office	
d. Supporting organization for ECG, if any	
(6)Administration of ECG	
a. Annual report	
b. Accounting report	ANNEX 2-(6)-b
c. Tariff system	
(7)From(1)to(6) above, if any future reform (organizational, structual or juridical and etc.) is planed, please specify respectively	
3. Information for Power Supply System in the REPUBLIC OF GHANA	
(1)System diagram of National Grid	ANNEX 3-(1)
(2)Class of system voltage(High tension, Low tension), and system frequency	〃 2
(3)Supply voltage to CONSUMERS	
(4)Main Facilities	ANNEX 3-(4)
a. Generator plant(Named capacity and Actual capacity for Hydro/Thermal plants, and constructed year)	
b. Transmission/Distribution line (Length for each voltage classes)	
c. Main substation	
(5)Nos. of consumers, and their category in terms of KW or KWH	ANNEX 3-(5)

質　問　事　項	回　　答
4. Information for the Proposed Project	
(1)Contents and materials of the Proposed Project	ANNEX 4-(1)
(2)Estimated electric demand in the Proposed Project area for a few future years (for each Districts)	
(3)Route plan of transmission line(for Reconfirmation)	ANNEX 4-(3)
(4)ASIEKPE s/s	〃 4-(4)
a. Expansion plan and single line diagram	
b. Peak load-flow	
c. Capacity of 161KV transmission line coming to ASIEKPE s/s from AKOSOMBO hydro-plant	
(5)Plan of SOGAKOPE s/s(Single line diagram, Equipment layout and etc.)	
(6)VOLTA river	ANNEX 4-(6)
a. Map of the river	
b. Historical record of flood	
c. Max. wind velocity at the river side	33m／秒
d. Geographic chart/data at the river side	
(7)SOGAKOPE bridge (for Reconfirmation)	ANNEX 4-(7)
a. Plan (Figure, Structure, Dimension and etc.)	
b. Constructed year	1967年
c. Rehabilitation plan	
(a)Contents of rehabilitation	
(b)Time schedule	
(c)Budget	DM 20.6million
(8)ECG's organization to carry out the Project, and budget	ANNEX 4-(8) ¢ 500million

質　問　事　項	回　　答
(9)Budget plan for maintenance after completion of the Project	
(10)Organization for maintenance at the present and in the future plan	ANNEX 2-(5)-a
(11)List of international assistance project in VOLTA state related to the Project, and outline of them	ANNEX 2
(12)Your hope/requirement based on the experience of the Japanese Grant Aid in 1989, if any	
5. Others	
(1)Applicable Industrial Standards in GHANA, especially in the field of electric engineering, mechanical engineering and civil engineering	ANNEX 2

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REPUBLIC OF GHANA

QUARTERLY DIGEST OF STATISTICS

（抜　粋）

DECEMBER 1991

STATISTICAL SERVICE
P. O. BOX 1098
ACCRA, GHANA

Table 1 - Selected Economic Indicators

INDICATOR	Unit	1986	1987	1988	1989	1990+	% Change *	Latest Monthly Figure		
								Month	Data	% Change **
Population (mid-year)	Million	13.05	13.39	13.74	14.10	14.47	2.6	..	..	..
Gross National Product										
1. At Current Prices	Million Cedis	498797	725476	1024670	1389026	1995007	43.6	..	..	..
2. At Constant Prices of 1975	" "	5601	5866	6206	6545	6724	2.7	..	..	..
3. At Current Prices	Cedis Per Capita	38222	54180	74576.0	98512	137872	40.0	..	..	..
4. At Constant Prices of 1975	" "	429	438	452	464	465	0.2	..	..	..
National Income										
1. At Current Prices	Million Cedis	469530	677796	955929	1302884	1884306	44.6	..	..	..
2. At Constant Prices of 1975	" "	5307	5511	5848	6186	6325	2.2	..	..	..
3. At Current Prices	Cedis Per Capita	35979	50620	69573	92403	130222	40.9	..	..	..
4. At Constant Prices of 1975	" " "	407	412	426	439	437	-0.5	..	..	..
Agricultural Production										
1. Cereals	Thousand Tonnes	867	1057	1146	1177	845.0	-28.2	..	..	..
2. Starchy Staples	" "	6017	6001	6815	6840	5208.0	-23.9	..	..	..
3. Cocoa	" "	226.4	205.2	246.6	296.1	284.4	-4.0	..	..	..
Mineral Production										
1. Gold	Thousand Kilograms	99.0	10.2	11.6	13.3	16.6	25.1	Jun '91	1.4	-
2. Diamonds	Thousand Carats	599.2	442.0	215.9	171.2	150.3	-12.2	Jun '91+	44.6	333.0
3. All Minerals	Index 1977 = 100	60.3	64.6	69.2	80.7	98.8	22.4	Dec '90	86.2	-23
Industrial Production										
1. Wheat Flour	Thousand Tonnes	62.8	71.4	95.2	88.1	108.4	23.0	..	..	..
2. Milk Reconstituted (1)	Million Litres	7.7	23.4	27.5	22.1	20.8	-5.9	..	..	..
3. Beer	Million Litres	54.6	58.9	61.4	63.9	62.8	-1.7	..	..	..
4. Cloth	Million Metres	15.2	19.2	22.7	24.7	29.5	19.4	..	..	..
5. Laundry Soap (including guardian soap)	Thousand Tonnes	19.3	28.9	35.1	39.4	34.1	-13.5	..	..	..
6. Petrol	Thousand Tonnes	200	155.0	142.4	252.0	203.6	-19.2	..	..	..
7. All Manufacturing	Index 1977 = 100	49.3	54.2	56.8	63.0	63.5	0.8	..	..	..
Electricity										
1. Energy Generated	Million kWh	4405	4676	4808	5231	5801	8.8	Sep '91	486	4
Transport										
1. Railway Passenger Journeys	Thousand	2608	3486	3268	2890	1897	-34.4	Sep '91+	128	-26.1
2. Railway Freight Traffic	Thousand Tonnes	599	639	744	751	724	-3.6	"	53	-17
3. New Registration of Motor Vehicles	Thousand	11.9	14.9	21.5	19.6		-8.8	..	..	..

* Percentage Change In The Latest Annual Figure Compared With The Immediately Proceeding Year.

** Percentage Change In The Latest Reported Monthly Figure Compared With Corresponding Month Of Previous Year.

Table 1 (contd) - Selected Economic Indicators

	Unit	1984	1985	1986	1987	1988	1989	1990	% Change	Latest Monthly Figures		
										Month	Data	% Change
VIII. Money and Banking (End of period)												
1. Assets of Bank of Ghana	Million Cedis								(A)			(A)
(i) Gold and Foreign Exchange	" "	19,550	31,703	91,837	57,665	77,082	145,584	172,678	3.7	Jun '91	189,012	10.7
(ii) Treasury Bills and other Government Securities	" "	17,221	16,646	16,365	15,036	17,093	13,687	13,691	0.0	"	19,061	21.0
(iii) All Assets	" "	65,504	92,084	185,493	160,513	275,465	408,087	498,149	22.1	"	624,756	43.1
2. Commercial & Secondary Banks												
(i) Loans and Advances	" "	12,220	22,499	40,927	54,748	66,229	78,338	72,559	(7.4)	Jun '91	82,786	10.1
(ii) Balances with Bank of Ghana	" "	7,088	10,603	20,570	20,484	26,792	29,496	27,066	(8.2)	"	16,845	(26.8)
(iii) All Assets	" "	41,750	64,611	112,298	177,349	230,075	315,614	394,338	24.9	"	408,053	27.7
(iv) Demand Deposits	" "	13,427	22,048	33,301	44,871	61,645	104,503	137,371	31.5	"	132,419	28.4
(v) Savings Deposits	" "	6,050	8,833	14,145	20,386	31,754	44,196	55,721	26.1	"	65,795	37.2
(vi) Time Deposits	" "	1,179	2,849	5,986	15,486	17,724	10,722	10,564	(1.5)	"	11,059	26.2
3. Money Supply												
(i) Currency Outside Banks	" "	13,943	21,897	31,240	46,116	64,467	82,916	85,045	2.6	Sep '91	82,662	5.2
(ii) Total Money Supply	" "	26,643	43,471	64,620	91,852	134,031	186,392	216,417	21.1	"	213,448	23.8
(iii) Quasi Money Supply	" "	7,193	11,565	19,984	35,365	48,036	53,348	65,199	22.2	"	86,677	48.2
4. Cheques Cleared												
(i) Number (Average of months)	Thousand	106.9	118.9	120.8	108.2	92.7	108.9	130.3	19.7	Dec '91	142.7	11.8
(ii) Value (Average of months)	Million Cedis	7,877	14,814	27,667	41,303	64,084	144,784	249,586	72.4	"	442,676	18.0
5. Debits to Current Accounts with Commercial Banks - (Average of months)	" "	11,625	19,079	30,545	44,101	77,825	94,904	147,341	55.3	"	246,588	58.8
6. Interest												
(i) Bank Rate	% Per Year	18.0	18.5	20.5	23.5	26.0	26.0	33.0	7.0	Dec '91	20.0	(13.0)
(ii) Advance Rate of Commercial Banks on Stock in Trade	" " "	22.5	23.0	23	26.00-30.00	23.00-30.25	22.5-30.25	22.5-30.25	-	"	23.0-31.50	0.5-1.3
7. Exchange Rate (Average)	Cedis/One US $	36	54.37	89.21	162.37	202.34	270.00	326.33	20.9	"	388.06	1.3

(A) Percentage Change Based on Equivalent Dollar Amounts (see footnote on p.24)

Table 1 (contd) - Selected Economic Indicators

	Unit	1984	1986	1987	1988	1989	1990	% Change *	Latest Monthly Figure		
									Month	Data	% Change **
IX. Central Government Finances (Year Ending December)											
(i) Revenue Receipts	Million cedis	22,641	73,625	111,046	153,791	214,513	267,347	24.6	..	..	..
(ii) Deficit Current Accounts	" "	(59)	+12,792	+30,463	42,787	+65870	+69154	5.0	..	..	..
(iii) Capital Expenditure	" "	3,994	9,826	21,552	32,893	47,823	56,280	17.7	..	..	..
(iv) Total Budget Deficit (ii) + (iii)	" "	(4,053)	2,966	+ 8,911	+ 9,894	18,047	12,874	(28.7)	..	..	..
X. Prices (Average of months/ Monthly)											
(i) Consumer Price Index (National)	1977 = 100	3,304.2	4,543.1	6,352.0	8,343.9	10,449.3	14,341.5	37.2			
(ii) Consumer Price Index (Accra city)	"	2,729.8	4,262.8	6,156.0	8,073.9	10,320.9	14,593.0	41.4			
(iii) Wholesale Price Index	"	2,958.6	7,564.0	10,692.0	14,405.4	18,084.5	23,747.0	31.3	Jun '90	23,370.2	32.3
(iv) Prime Building Cost Index	"	3,835.2	8,170.0	11,546.7	14,265.8	18,345.8	22,425.3	22.2	May '91	23,411.0	-
(v) Cocoa Price in London	£ per tonne	2,071	1,567	1,320	1,146	911.0		(20.5)	Mar '90	807	(20.0)
XI. Foreign Trade and Balance of Payments			++	++	++	++					
(i) Imports of Merchandise	Million cedis	21,887.3+	69,881.0	145,319.0	185,605.0	346,983.0		86.9	..	..	..
(ii) Exports of Merchandise	" "	47,155.3+	76,948++	147,275++	205,705.0	275,290.0		33.8	..	..	..
(iii) Net Current Account of Balance of Payments	" "	(2,738.8)	++ (10,236.0)	++ (16,368.4)	(20,841.0)	(25,245.0)		..	..	..	..

* Percentage Change In The Latest Annual Figure Compared With Immediately Proceeding Year.

** Percentage Change In The Latest Reported Monthly Figure Compared With Corresponding Month Of Previous Year.

(1) Evaporated (Ideal) Milk Converted To Normal Density

++ Provisional.

IV - FUEL AND POWER

Table 12 - Electricity Generation

(Thousands of kWh)

Year/Month	Total Generated	Akosombo Hydro-Electric	Kpong Hydro-Electric
1985	2,996,191	2,461,370	534,821
1986	4,405,026	3,677,780	727,246
1987	4,676,301	3,880,560	795,741
1988	4,807,849	3,996,490	811,359
1989	5,230,508	4,383,240	847,268
1990	5,801,363	4,907,880	893,458
1991	6,108,668	5,149,840	958,828
1990 Jan	495,359	419,370	75,989
Feb	444,711	376,080	68,631
Mar	495,618	419,020	76,573
Apr	462,669	390,400	72,269
May	562,074	486,880	75,194
Jun	467,735	394,770	72,965
Jul	463,690	390,290	73,400
Aug	475,163	399,990	75,173
Sep	466,512	393,020	73,492
Oct	495,422	417,920	77,502
Nov	469,215	395,960	73,255
Dec	503,195	424,180	79,015
1991 Jan	515,520	436,260	79,260
Feb	477,995	405,360	72,635
Mar	527,389	444,430	82,959
Apr	506,162	424,590	81,572
May	521,958	438,640	83,318
Jun	492,312	417,440	74,872
Jul	502,051	417,990	84,061
Aug	490,442	410,000	80,442
Sep	485,672	409,420	76,252
Oct	511,428	432,030	79,398
Nov	528,423	447,600	80,823
Dec	549,316	466,080	83,236

Table 31 - Exchange Rates *

Year/Month	Cedis Per													
	U.S. Dollar	Canadian Dollar	Pound Sterling	French Franc	Swiss Franc	Deutsche Mark	Norwe-gian Kroner	Swedish Kroner	Danish Kroner	Nether-lands Guilder	Belgium Franc	Italian Lire	Japanese Yen	C.F.A. Franc
1986	89.21	64.22	130.81	12.91	49.91	41.29	12.08	12.56	11.07	36.61	2.0100	0.0594	0.5236	0.2415
1987	162.37	122.47	266.51	27.05	109.21	90.61	24.16	25.62	23.78	80.43	4.3500	0.1248	1.1300	0.5319
1988	202.35	164.71	360.03	33.95	138.27	115.17	31.02	33.01	30.04	102.34	5.5050	0.1553	1.5792	0.6063
1989	270.00	228.14	441.84	42.31	165.40	143.86	39.07	41.89	37.00	127.62	6.8400	0.1965	1.9500	0.8264
1990	326.33	278.77	583.53	60.21	236.56	202.76	52.34	56.15	52.97	179.97	9.7800	0.2710	2.2700	1.2100
1991	367.78	321.01	649.53	65.38	257.31	223.26	56.87	60.95	57.66	197.33	10.8000	0.2959	2.7400	1.3200
1990 Apr	314.16	269.75	514.31	55.37	210.90	186.03	47.97	51.33	48.77	165.26	9.0100	0.2538	1.9800	1.1000
May	322.27	262.03	540.12	57.63	227.05	193.91	50.03	53.27	50.93	172.55	9.4000	0.2646	2.1100	1.1500
Jun	327.70	279.33	555.31	57.85	229.91	194.50	50.65	53.87	51.13	172.90	9.4700	0.2653	2.1300	1.1600
Jul	330.67	285.58	596.70	60.03	237.11	201.40	52.40	55.86	52.90	178.76	9.7800	0.2755	2.2100	1.2000
Aug	333.96	291.82	634.25	63.32	254.67	212.41	54.83	57.75	55.50	188.52	10.3300	0.2890	2.2600	1.2600
Sep	337.50	291.47	634.56	64.19	258.28	214.89	55.64	58.57	56.28	190.66	10.4500	0.2882	2.4300	1.2900
Oct	339.83	293.16	661.11	66.58	265.27	222.80	57.40	60.16	58.32	197.26	10.8300	0.2967	2.6200	1.3400
Nov	342.91	294.80	673.09	68.53	272.70	230.59	59.05	61.52	60.26	204.64	11.1900	0.3049	2.6600	1.3700
Dec	344.93	297.12	664.95	68.24	270.01	230.96	58.87	61.40	59.99	204.92	11.1700	0.3067	2.5900	1.3700
1991 Jan	345.41	298.89	667.06	67.30	271.34	228.60	58.46	61.21	59.39	202.75	11.1000	0.3040	2.5800	1.3500
Feb	349.85	302.90	688.07	69.50	276.41	236.53	60.46	63.23	61.55	209.89	11.4900	0.3145	2.6900	1.3900
Mar	359.00	309.01	657.30	65.95	259.65	224.31	57.44	61.06	58.45	198.95	10.8900	0.3003	2.6300	1.3200
Apr	362.48	314.31	635.76	63.11	251.89	213.26	54.90	59.34	55.75	189.47	10.3700	0.2873	2.6500	1.2700
May	365.37	317.85	630.55	62.74	251.11	212.75	54.62	59.38	55.69	188.77	10.3500	0.2857	2.6500	1.2600
Jun	366.79	320.70	604.06	60.59	239.58	205.56	52.66	57.02	53.32	182.47	9.9900	0.2762	2.6300	1.2200
Jul	369.18	321.30	608.31	60.82	238.77	206.44	52.91	57.00	58.38	183.21	10.0200	0.2778	2.6700	1.2100
Aug	371.37	324.34	624.71	62.61	244.13	213.57	54.47	58.60	55.04	189.27	10.3400	0.2841	2.7200	1.2600
Sep	374.90	329.80	647.14	65.02	253.30	221.34	56.56	60.81	57.32	196.40	10.7500	0.2959	2.7900	1.3000
Oct	377.65	334.49	650.36	65.57	255.56	223.49	57.09	61.38	57.85	198.39	10.8600	0.2985	2.9000	1.3200
Nov	383.29	339.13	680.90	69.06	267.22	235.98	60.14	64.64	60.77	209.37	11.4600	0.3125	2.9600	1.3900
Dec	388.06	339.40	705.05	72.22	278.76	246.80	62.71	67.59	63.42	218.99	11.9800	0.3257	3.0200	1.4500

* The Rates Are Average Rates For The Period

X - EXTERNAL TRADE AND BALANCE OF PAYMENTS

Table 55 - External Trade of Ghana: Summary

(Million Cedis)

Year/Month	Imports	Exports			Balance of Trade
		Total	Exports of Domestic Produce	Exports of Foreign Produce	
1984	21,887.3	19,396.0	19,274.6	121.4	(2,491.3)
1985	47,155.3	33,489.8	33,169.4	320.4	(13,665.5)
1986	93,358.0	78,179.9	76,729	1,451	(15,178.1)
1987*	174,779.8	143,303.9	140,284.2	3,019.7	(31,475.9)
1988*	185,605.0	205,705.0	-	-	20,100.0
1989*	346,983.0	275,290.0	-	-	(71,693.0)
1988* Jan	10,965	11,667	-	-	702
Feb	16,013	13,778	-	-	(2,235)
Mar	15,406	22,373	-	-	6,967
Apr	13,290	19,018	-	-	5,728
May	1,565	14,160	-	-	12,595
Jun	15,928	11,491	-	-	(4,437)
Jul	14,068	9,119	-	-	(4,949)
Aug	18,590	18,644	-	-	54
Sep	18,572	19,073	-	-	501
Oct	16,527	11,957	-	-	(4,570)
Nov	24,544	37,540	-	-	12,996
Dec	20,137	16,885	-	-	(3,252)
1989* Jan	19,605	13,084	-	-	(6,521)
Feb	23,075	22,531	-	-	(544)
Mar	17,259	28,208	-	-	10,949
Apr	31,348	25,848	-	-	(5,500)
May	27,031	22,547	-	-	(4,484)
Jun	34,136	28,613	-	-	(5,523)
Jul	27,950	17,699	-	-	(10,251)
Aug	29,139	30,944	-	-	1,805
Sep	29,139	23,220	-	-	(5,919)
Oct	34,554	15,247	-	-	(19,307)
Nov	37,036	21,553	-	-	(15,483)
Dec	35,946	25,290	-	-	(10,656)

* Provisional

XII - NATIONAL ACCOUNTS

Table 86 - Gross National Products

Year	G N P at 1975 Prices		Per Capita National Income at 1975 Prices	
	Million Cedis	% Change Over Previous Year	Cedis	% Change Over Previous Year
1979	5,489	(2.6)	479	(2.2)
1980	5,453	(0.7)	465	(2.9)
1981	5,302	(2.8)	435	(6.5)
1982	4,935	(6.9)	391	(10.1)
1983	4,717	(4.4)	363	(7.2)
1984	5,103	8.2	391	7.7
1985	5,345	4.7	397	1.5
1986	5,601	4.8	407	2.5
1987	5,866	4.7	412	1.2
1988	6,206	5.8	426	3.4
1989	6,545	5.5	439	3.1
1990*	6,724	2.7	437	(0.5)

* Provisional.

XIII - POPULATION

Table 94 - Population in March 1970 and 1984

and Average Annual Growth Rates by Region

Region	Population		Percentage Increase	Growth Rate ++
	1970	1984		
ALL REGIONS	8,559,313	12,296,081	43.7	2.6
1. Western	770,087	1,157,807	50.3	3.0
2. Central	890,135	1,142,335	28.3	1.8
3. Greater Accra	903,447	1,431,099	58.4	3.3
4. Eastern	1,209,828	1,680,890	38.9	2.4
5. Volta	947,268	1,211,907	27.9	1.8
6. Ashanti	1,481,698	2,090,100	41.1	2.5
7. Brong-Ahafo	766,509	1,206,608	57.4	3.3
8. Northern	727,618	1,164,583	60.1	3.4
9. Upper West	319,865	438,008	36.9	2.3
10. Upper East	542,858	772,744	42.3	2.6

++ Average Compound Rate of Increase Per Year.

Source: Population Census of Ghana, 1984.

Table 95 - Density of Population in March 1970 and 1984 by Region

Region	Area (sq. km)	1970		1984	
		Population (000's)	Density*	Population (000's)	Density*
ALL REGIONS	238,533	8,559.3	36	12,296.0	52
1. Western	23,921	770.1	32	1,157.8	48
2. Central	9,826	890.1	91	1,142.3	116
3. Greater Accra++	3,245	903.4	278	1,431.1	441
4. Eastern++	19,323	1,209.8	63	1,680.9	87
5. Volta	20,570	947.3	46	1,211.9	59
6. Ashanti	24,389	1,481.7	61	2,090.1	86
7. Brong-Ahafo	39,557	766.5	19	1,206.6	31
8. Northern	70,384	727.6	10	1,164.6	17
9. Upper West	18,476	319.9	17	438.0	24
10. Upper East	8,842	542.9	61	772.7	87

++ The Figures Published Earlier Relating to Population & Area for 1970 Have Been Adjusted for the Transfer of Ada Local Council From the Eastern Region to the Greater Accra Region.

* Number of Persons Per Sq. Km.

Source: Population Census of Ghana, 1984.

Table 96 - Rural and Urban* Population in March 1984, by Region

Region	Total	Rural	Urban	As Percentage of Total Population	
				Rural	Urban
ALL REGIONS	12,296,081	8,361,285	3,934,796	68.0	32.0
1. Western	1,157,807	896,041	261,766	77.4	22.6
2. Central	1,142,335	813,139	329,196	71.2	28.8
3. Greater Accra	1,431,099	242,821	1,188,278	17.0	83.0
4. Eastern	1,680,890	1,214,614	466,276	72.3	27.7
5. Volta	1,211,907	964,001	247,906	79.5	20.5
6. Ashanti	2,090,100	1,410,350	679,750	67.5	32.5
7. Brong-Ahafo	1,206,608	885,502	321,106	73.4	26.6
8. Northern	1,164,583	871,121	293,462	74.8	25.2
9. Upper West	438,008	390,459	47,549	89.1	10.9
10. Upper East	772,744	673,237	99,507	87.1	12.9

* Towns With Population 5000 & Above

Source: Population Census of Ghana, 1984.

Table 97 - Population in March 1984, by Region and Sex

Region	Total	Male	Female	Sex* Ratio
ALL REGIONS	12,296,081	6,063,848	6,232,233	97.3
1. Western	1,157,807	586,288	571,519	102.6
2. Central	1,142,335	559,312	583,023	95.9
3. Greater Accra	1,431,099	700,952	730,147	96.0
4. Eastern	1,680,890	834,962	845,928	98.7
5. Volta	1,211,907	586,940	624,967	93.9
6. Ashanti	2,090,100	1,028,904	1,061,196	97.0
7. Brong-Ahafo	1,206,608	613,721	592,887	103.5
8. Northern	1,164,583	576,825	587,758	98.1
9. Upper West	438,008	207,752	230,256	90.2
10. Upper East	772,744	368,192	404,552	91.0

* Males as Percentage of Females

Source: Population Census of Ghana, 1984.

JAPANESE GRANT FOR ELECTRIFICATION

CLIMATIC CONDITIONS IN THE AREA - ABA-ROAD, ABIBONI, SOGABOPO

MONTH	MONTHLY RAINFALL TOTALS (mm)	MEAN MONTHLY TEMPERATURE (Celsius)	SOLAR RADIATION (SUNSHINE DURATION) (hours)	WIND SPEED (K./hr)
JAN	6.70	28.01	6.6	2.950
FEB	17.08	29.03	6.7	3.360
MAR	65.23	29.02	7.0	3.340
APR	102.80	29.06	6.9	3.475
MAY	155.80	28.43	6.1	3.500
JUN	146.30	27.20	4.5	4.075
JUL	49.55	25.91	5.2	3.725
AUG	20.85	25.43	5.5	3.725
SEP	59.80	25.81	6.0	4.500
OCT	75.04	27.43	7.2	4.525
NOV	34.57	28.43	7.7	3.367
DEC	7.03	27.54	7.0	3.030

JAPANESE SURVEY TEAM
QUESTIONNAIRE RESPONSE FROM ECG

SECTION 2
Que 2

The electric power service in Ghana is managed at governmental levels by the Ministry of Energy (MEn). There are two electric power utilities which answer to the MEn. These utilities are the Electricity Corporation of Ghana (ECG) and the Volta River Authority (VRA).

The VRA is solely responsible for the generation and transmission of electric power in the country. After the extension of the grid to the northern sector, which was funded through the VRA, it was decided that the VRA should in the interim, take over the LV distribution. For this reason, it has a separate department known as Northern Electricity Department (NED).

ECG, consequently, is responsible for distribution in the southern sector of the country.

Que 3

ECG is wholly Ghana Government owned and it is hence a public utility. As explained above, it answers to the Ghana Government through the MEn.

Que 4

ECG is an autonomous entity established by the National Liberation Council (NLC); the then government of Ghana) Decree No. 125 issued on 20th January, 1967. By executive instrument No. 59 dated 29th June 1967 all assets and liabilities of the former Electricity Division from which it was established were rested in the Corporation as from 1st July 1967. Under the Decree No 125, the Corporation is required to conduct its affairs on a sound commercial basis and is charged with the responsibility for public electricity supply in the country.

Que 5

ECG has one head office located in Accra. Further more, ECG operates in all the seven regions in the southern sector of the country. Consequently, it has regional offices. Accra Region has two regional offices, bringing the total number of regional offices to eight (8). Each of these regional offices has a number of district offices associated it. The number of district offices is dependent on the extent of area covered by the electric network in the region.

(a) See attached chart.

(b) Head Office is located in Accra in the Electro-Volta House.

(c) For the purposes of the project, the local office is located at Ho in the Volta Region.

(d) N/A

SECTION 3

(1) See Attachment

(2) 161, 69, 33, 11 and 0.43kV are the System Voltages
System Frequency - 50HZ

(3) Consumer voltage supply is 230V ± 10%

SECTION 4

Que 11: 1. Volta Region Electrification: Phase 1 - German Funding.

2. Volta Region Electrification: Residual Fund - German Funding.

3. Southern Volta Electrification: - Ghana Government Funding.
4. Hohoe/Jasikan Project - Canadian Govt.

I. Volta Region Electrification Phase 1

This project involved the construction of about 85km of 69kV line, km of 33kV and the erection of a number of distribution and main substation transformers in the towns of Ho, Kpeve, Kpandu, Hohoe, Awudome and Peki, all in the Volta Region. This project was initiated in 1984 and completed in 1988. The project was completed at a cost of DM 38.24m and ¢23.83m.

II. Volta Region Electrification: Residual funding

This project is a continuation of the previous one. It was started in 1990 and completed in 1991. It consisted mainly in provision of LV distribution networks in some of the towns which were left out from the previous program and extension of the national grid together towns inthe project area.
The total cost of the project was $40.5,000 and 213.38 substations and 125km of LV distribution networks. The project is estimated to cost $1.5m, with an additional local component of ¢800m.

III. Southern Volta Region Electrification

This project which was fully Govt financed involved the extension of the 33kV network from Aflao to Keta, covering a total distance of about 115km. It also involved the provision

of LV distribution transformers and networks in all the major towns along the route. Additionally, a 5MVA, 33/11kV substation was provided at Anloga. The total cost of the project is ....

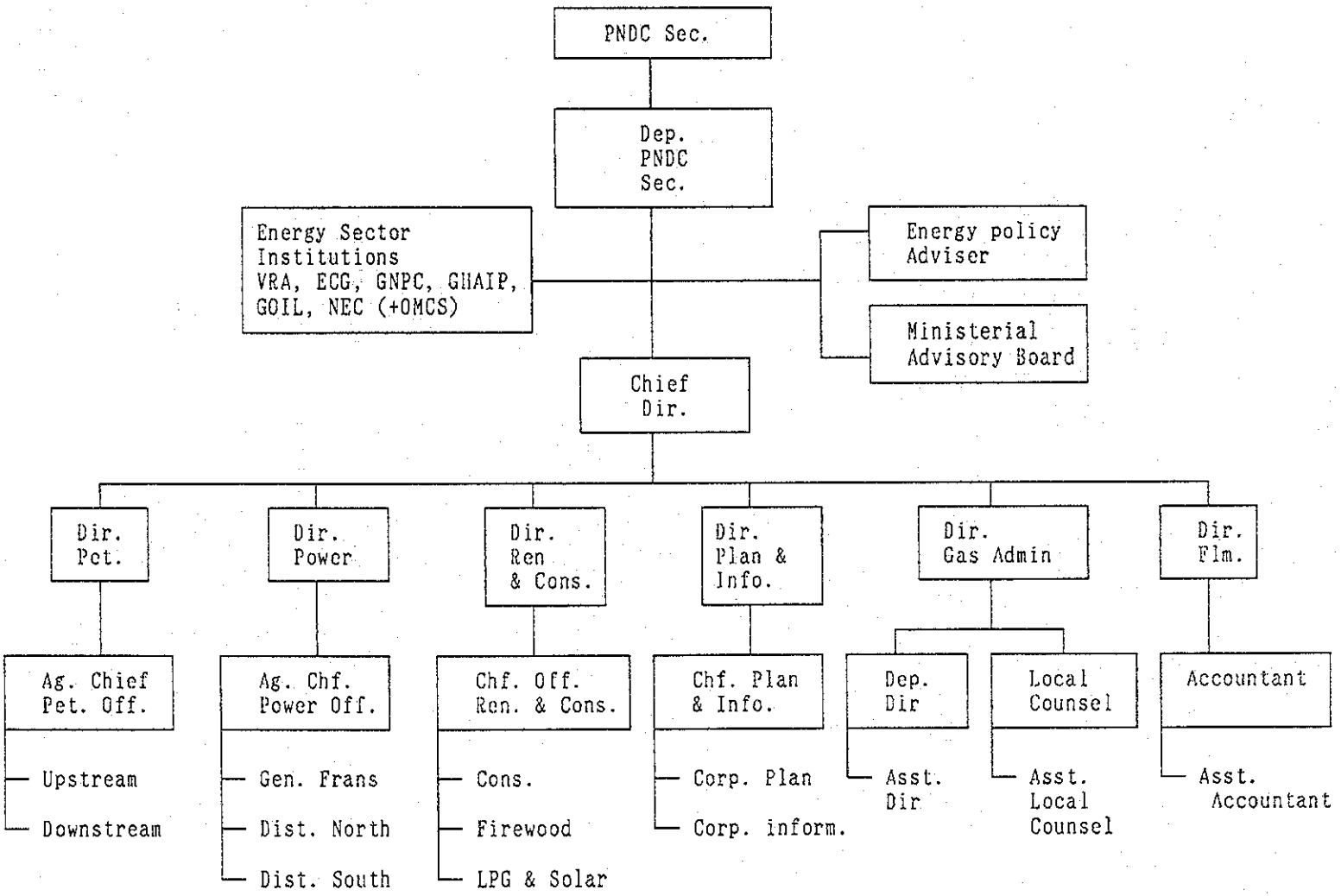
The Hohoe/Jasikan Project

This is a Canadian Government financed work, aimed at proving the efficacy of the M.A.L.T system and at the same time extending power to the District Capital of Jasikan. The work scope varies from the construction of 168km of H.V line (both three and single phase) to the erection of 39 no. LV.

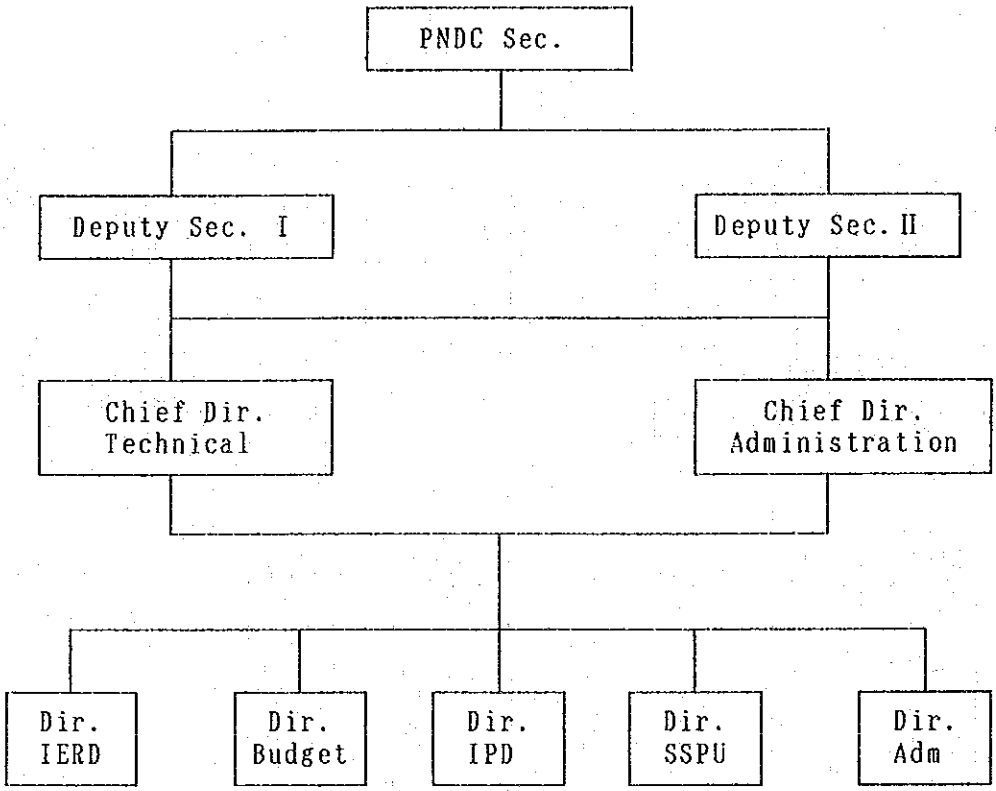
SECTION 5

(1) The applicable industrial standards in Ghana are the British Standards (BS) and the international Electrotechnical Commission (IEC) standards.

Ministry of Energy Organisation

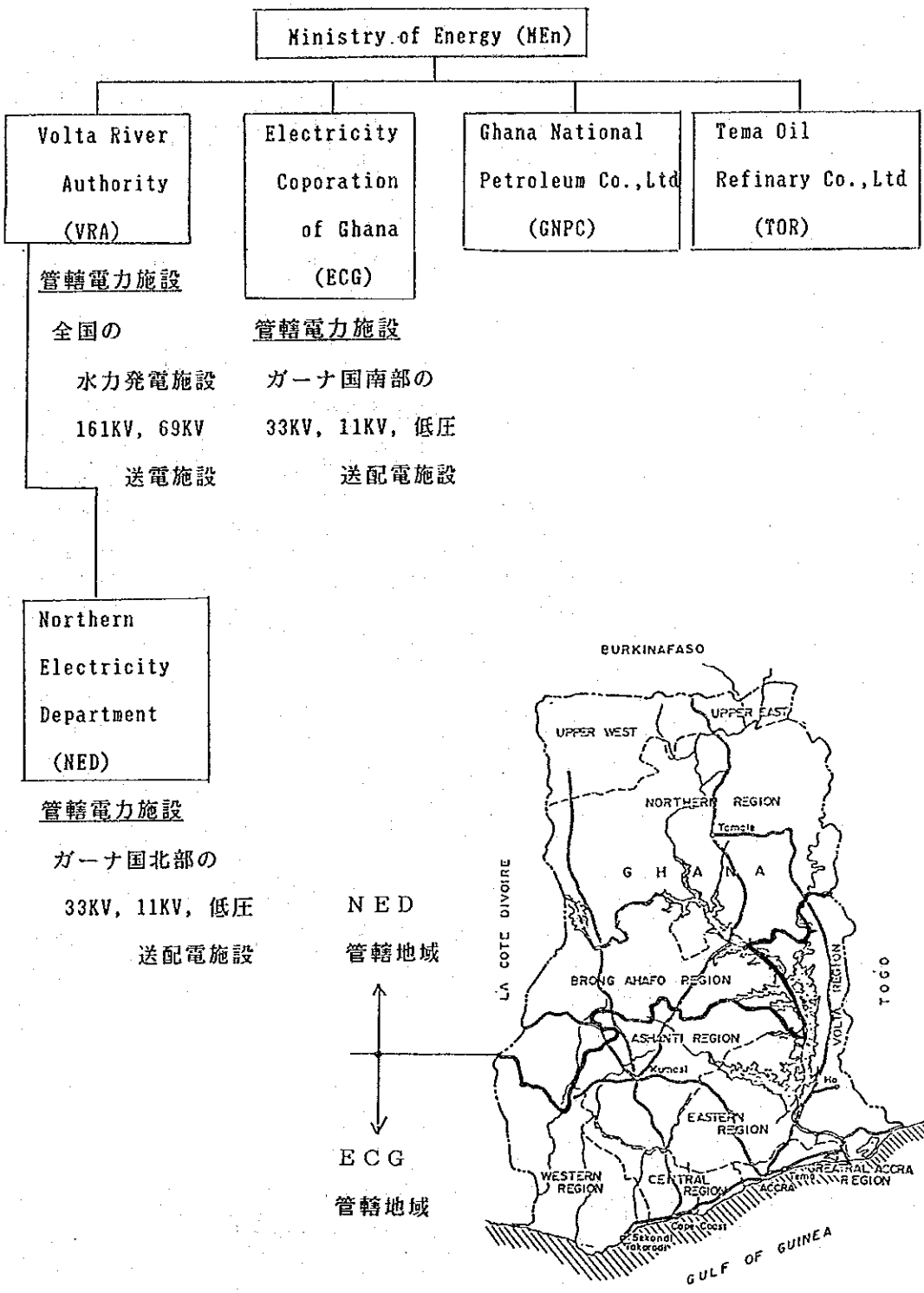


Ministry of Finance Organisation

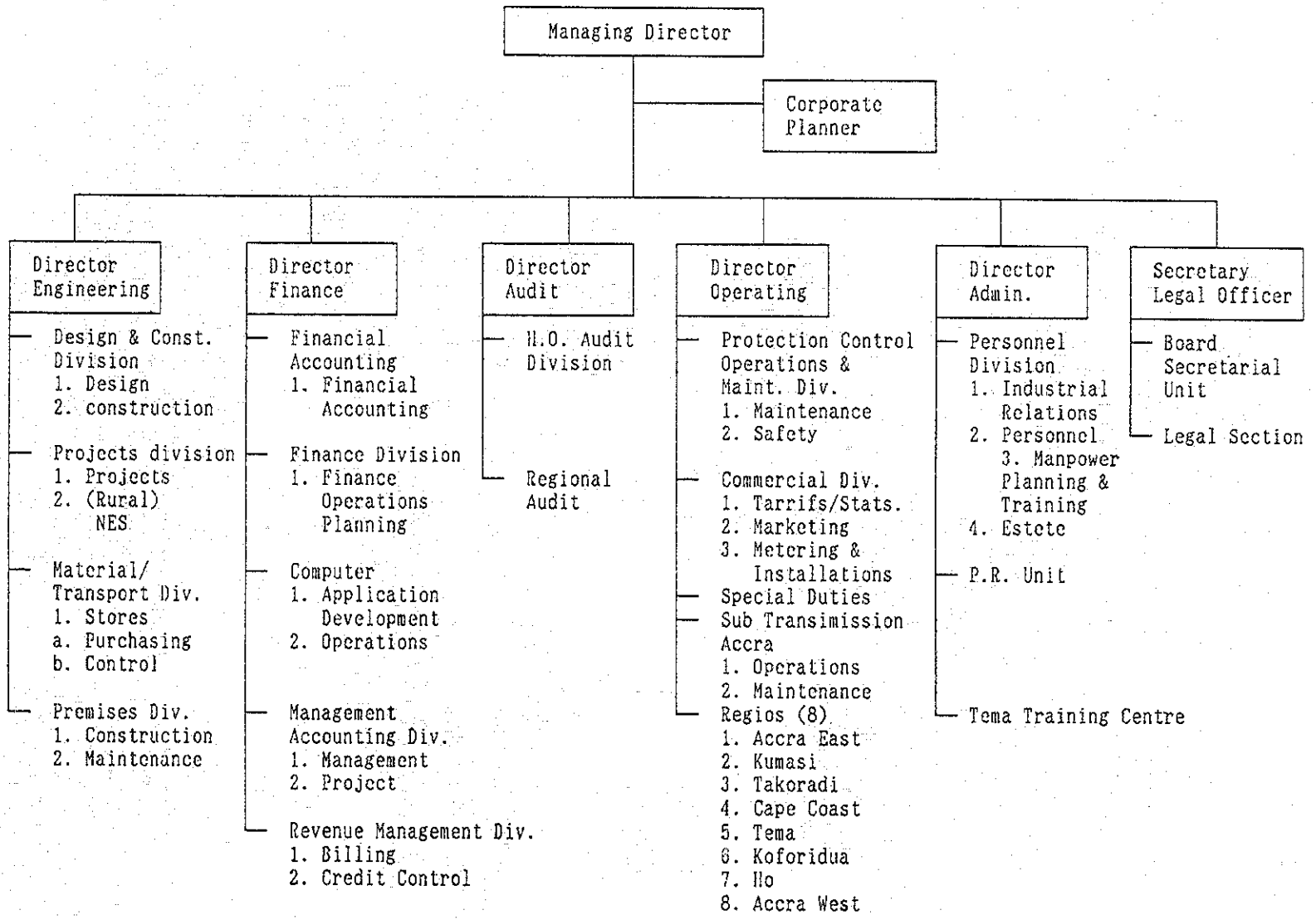


PNDC : Provisional National Defence Council
IERD : International Economic Relation Division
IPA : Investment and Project Analysis
SSPU : Social Secure and Policy Unit
Adm : Administration department

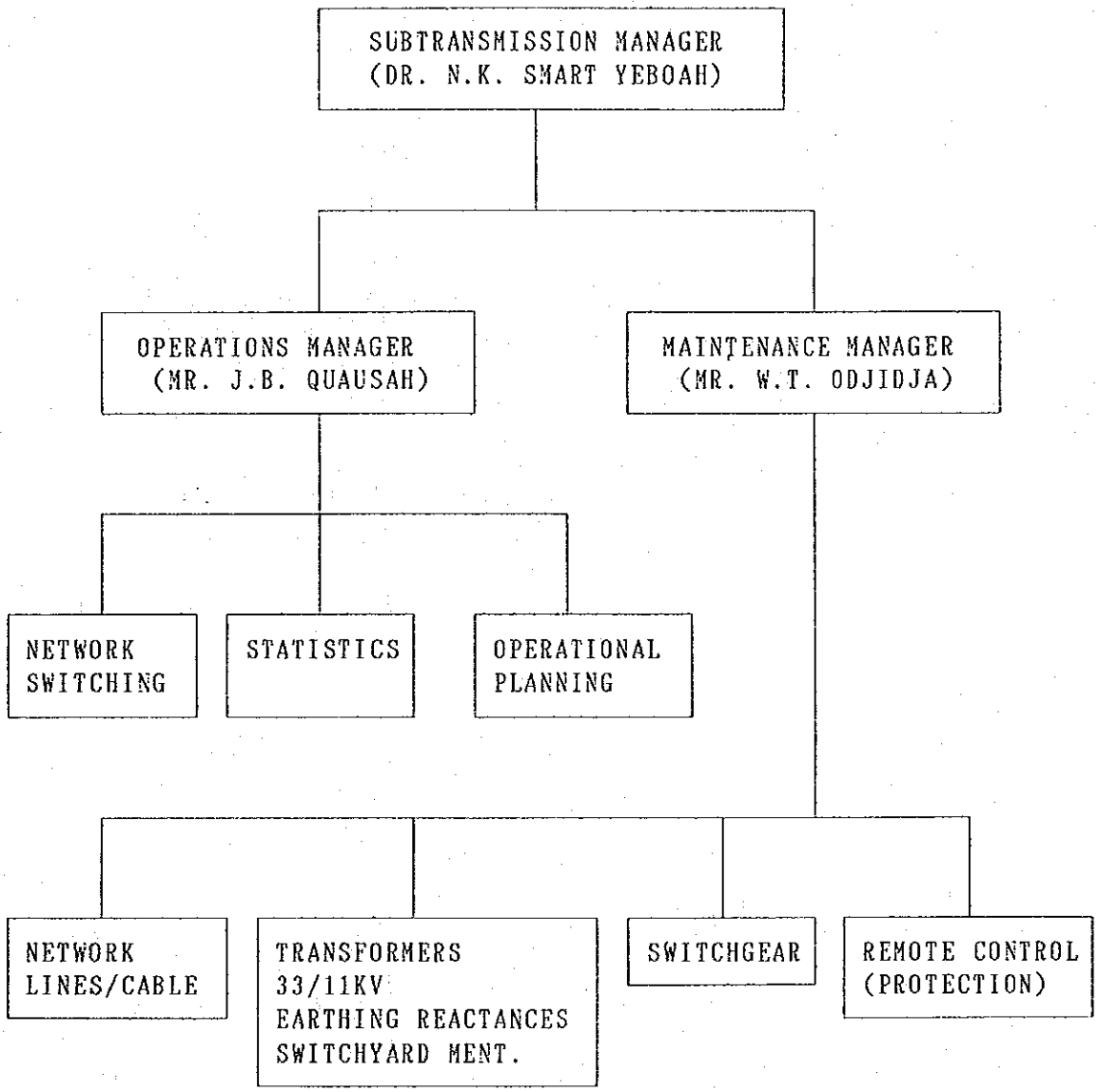
ガーナ国電力事業組織


Ministry of Energy (MEn)
Volta River Authority (VRA)
Electricity Coporation of Ghana (ECG)
Ghana National Petroleum Co.,Ltd (GNPC)
Tema Oil Refinary Co.,Ltd (TOR)
管轄電力施設
全国の
水力発電施設
161KV, 69KV
送電施設
管轄電力施設
ガーナ国南部の
33KV, 11KV, 低圧
送配電施設
Northern Electricity Department (NED)
管轄電力施設
ガーナ国北部の
33KV, 11KV, 低圧
送配電施設
NED
管轄地域
ECG
管轄地域
BURKINAFASO
UPPER WEST
UPPER EAST
NORTHERN REGION
Tamale
G H A N A
LA COTE DIVOIRE
BRONG AHAFO REGION
ASHANTI REGION
Kumasi
VOLTA REGION
Ho
TOGO
EASTERN REGION
WESTERN REGION
CENTRAL REGION
Cape Coast
Sekondi Takoradi
GREATER ACCRA REGION
Tema
ACCRA
GULF OF GUINEA

Electricity Corporation of Ghana Outline Organisational Structure



ECG SUBTRANSMISSION ORGANISATION



ELECTRICITY CORPORATION OF GHANA

ACCOUNTS

31ST DECEMBER, 1991

(抜　粋)

Coopers
&Lybrand

ELECTRICITY CORPORATION OF GHANA

ACCOUNTS - 31ST DECEMBER, 1991

REPORT OF THE AUDITORS

We have audited the accounts on pages 2 to 18 in accordance with Auditing Standards. The accounts are in agreement with the books which in our opinion have been properly kept and proper returns have been received from branches not visited by us. We obtained the information and explanations we required.

In our opinion, the accounts give a true and fair view of the state of affairs of the Corporation at 31st December, 1991 and of its loss and source and application of funds for the year then ended and have been properly prepared in accordance with the Electricity Corporation of Ghana Decree, 1967.

Accra,

30 JUN 1992

Chartered Accountants

ELECTRICITY CORPORATION OF GHANA
BALANCE SHEET - 31ST DECEMBER, 1991

	NOTE	1991 ¢'000	1991 ¢'000	1990 ¢'000	1990 ¢'000
ASSETS EMPLOYED					
FIXED ASSETS IN SERVICE	5		70,938,537		24,603,873
CAPITAL WORK IN PROGRESS	6		2,579,209		2,842,894
LONG TERM RECEIVABLE	20		416,357		668,357
INVESTMENT	13		480		480
CURRENT ASSETS					
Stocks	7	2,957,095		3,032,132	
Debtors	8	7,002,557		5,996,053	
Prepayments	9	6,901,643		933,361	
Bank Balances and Cash	10	2,449,708		2,307,077	
		19,311,003		12,268,623	
Less:					
CURRENT LIABILITIES					
Creditors	11	6,757,260		6,999,515	
Long Term Loans	23(b)	1,717,968		1,379,512	
		8,475,228		-	
				8,379,027	
NET CURRENT ASSETS			10,835,775		3,889,596
NET ASSETS			84,770,358		32,005,200
DEFERRED CREDIT	12		(4,587,890)		(2,182,461)
			80,182,468		29,822,739
EXCHANGE FLUCTUATION DEBT ACCOUNT	17		10,458,838		9,017,404
DEFERRED REVENUE EXPENDITURE	21		1,373,337		1,111,963
TOTAL NET ASSETS			92,014,643		39,952,106
CAPITAL EMPLOYED					
Government Equity	16	10,766,167		10,766,167	
Income Surplus Account		(2,634,502)		(18,671,256)	
Capital Surplus	19	54,404,155		26,610,010	
			62,535,820		18,704,921
LONG TERM LOANS	23(a)		29,478,823		21,247,185
			92,014,643		39,952,106

Director of Finance

Managing Director

The notes on pages 6 to 18 form part of these accounts.

Auditors' Report - page 1

ELECTRICITY CORPORATION OF GHANA
REVENUE ACCOUNTS FOR THE PERIOD ENDED
31ST DECEMBER 1991

	NOTE	1991 ¢'000	¢'000	1990 ¢'000	¢'000
REVENUE					
Sale of Electricity			14,130,182		10,793,721
Public Lighting Levy			113,076		86,293
			14,243,258		10,880,014
Deduct:					
OPERATING EXPENSES					
Purchased Power		6,309,996		4,816,875	
Generation and Standby		86,164		107,719	
Distribution Operations/ Maintenance		1,538,933		1,016,348	
Transport		620,923		471,052	
Other Administrative expenses		1,070,815		1,927,703	
		9,626,831		8,339,697	
Depreciation of Fixed Assets in Service	5	7,662,187		2,292,841	
Less:					
Consumer Contribution to Assets	12	(87,299)		(28,149)	
		7,574,888		2,264,692	
			17,201,719		10,604,389
OPERATING (LOSS)/PROFIT BEFORE EXCHANGE FLUCTUATION DEBT AMORTISATION AND INTEREST			(2,958,461)		275,625
Deduct:					
Amortisation of Exchange Fluctuation Debt	17	(930,172)		(777,023)	
Loan Interest		(398,921)		(437,329)	
Exceptional Item		—		(383,692)	
			(1,329,093)		(1,598,044)
NET OPERATING (LOSS)			(4,287,554)		(1,322,419)
OTHER INCOME	4		222,479		200,836
NET (LOSS) FOR THE YEAR TRANSFERRED TO INCOME SURPLUS ACCOUNT			(4,065,075)		(1,121,583)

The notes on pages 6 to 18 form part of these accounts.

Auditors' Report – page 1

ELECTRICITY CORPORATION OF GHANA
INCOME SURPLUS ACCOUNT FOR THE YEAR ENDED
31ST DECEMBER, 1991

	NOTE	1991 ¢'000	1990 ¢'000
Balance at 1st January(Deficit)		(18,671,256)	(14,114,449)
		(18,671,256)	(14,114,449)
Prior Year Adjustment	22	20,101,829	(3,435,224)
		1,430,573	(17,549,673)
(Loss) for the year		(4,065,075)	(1,121,583)
Balance at 31st December (Deficit)		(2,634,502)	(18,671,256)

The notes on pages 6 to 18 form part of these accounts.

Auditors' Report - page 1

ELECTRICITY CORPORATION OF GHANA
STATEMENT OF SOURCE AND APPLICATION OF FUNDS

	1991	1990
	¢'000	¢'000
SOURCES OF FUNDS		
Net (Loss)	(4,065,075)	(1,121,583)
Adjustment for items not involving the movement of funds:		
Depreciation of Fixed Assets in Service	7,662,187	2,292,841
Exchange Fluctuation Amortisation	930,172	777,023
Consumer Contribution to Assets	(87,299)	(28,149)
Profit on Sale of Fixed Assets	(7,298)	(3,255)
TOTAL GENERATED FROM OPERATIONS	4,432,687	1,916,877
FUNDS FROM OTHER SOURCES		
Proceeds from Sale of Fixed Assets	7,298	6,235
Long Term Loans	6,896,193	1,869,755
Consumer Contribution to Assets	2,354,470	1,088,550
Long Term Receivable	252,000	252,000
	13,942,648	5,133,417
APPLICATION OF FUNDS		
Purchase of Fixed Assets	(6,100,877)	(4,613,376)
Capital Work-in-Progress	263,686	2,668,140
Long Term Loan Repayment	(1,043,958)	(1,122,985)
Deferred Expenditure	(261,374)	(1,111,963)
	(7,142,523)	(4,180,184)
INCREASE IN WORKING CAPITAL	6,800,125	953,233
REPRESENTING:		
INCREASE/(DECREASE) IN WORKING CAPITAL		
Stocks	(75,036)	1,211,370
Accounts Receivable and Prepayments	6,974,787	943,054
Accounts Payable and Accruals	(242,257)	(2,159,265)
Movement in Net Liquid Funds:		
Increase in Cash and Bank Balances	142,631	958,074
	6,800,125	953,233

The notes on pages 6 to 18 form part of these accounts.

Auditors' Report - page 1

ELECTRICITY CORPORATION OF GHANA, Electrovolta House,
P.O. Box 521, Accra, Ghana

Dear Consumer,

TARIFF ADJUSTMENT

The rates of charge for electricity supply have been revised with effect from 1st January, 1992 as follows:

TARIFF CATEGORY	CONSUMPTION	TARIFFS
RESIDENTIAL	0-100 Units 101 and above	¢450.00 (Block Charge) ¢ 11.80 / Unit
NON-RESIDENTIAL	Energy Service Charge	¢ 30.00 / Unit ¢300.00 / Monthly
H V SUPPLIES (Above 415 Volts)	Maximum Demand Energy Service Charge	¢1,300.00 / KVA Monthly ¢ 14.00 / Unit ¢3,000.00 /Monthly
L V SUPPLIES (415 Volts & Below)	Maximum Demand Energy Service Charge	¢1,400.00 /KVA Monthly ¢ 15.00 / Unit ¢3,000.00 / Monthly

A Unit of Electricity = 1 Kilowatt Hour (Kwh)

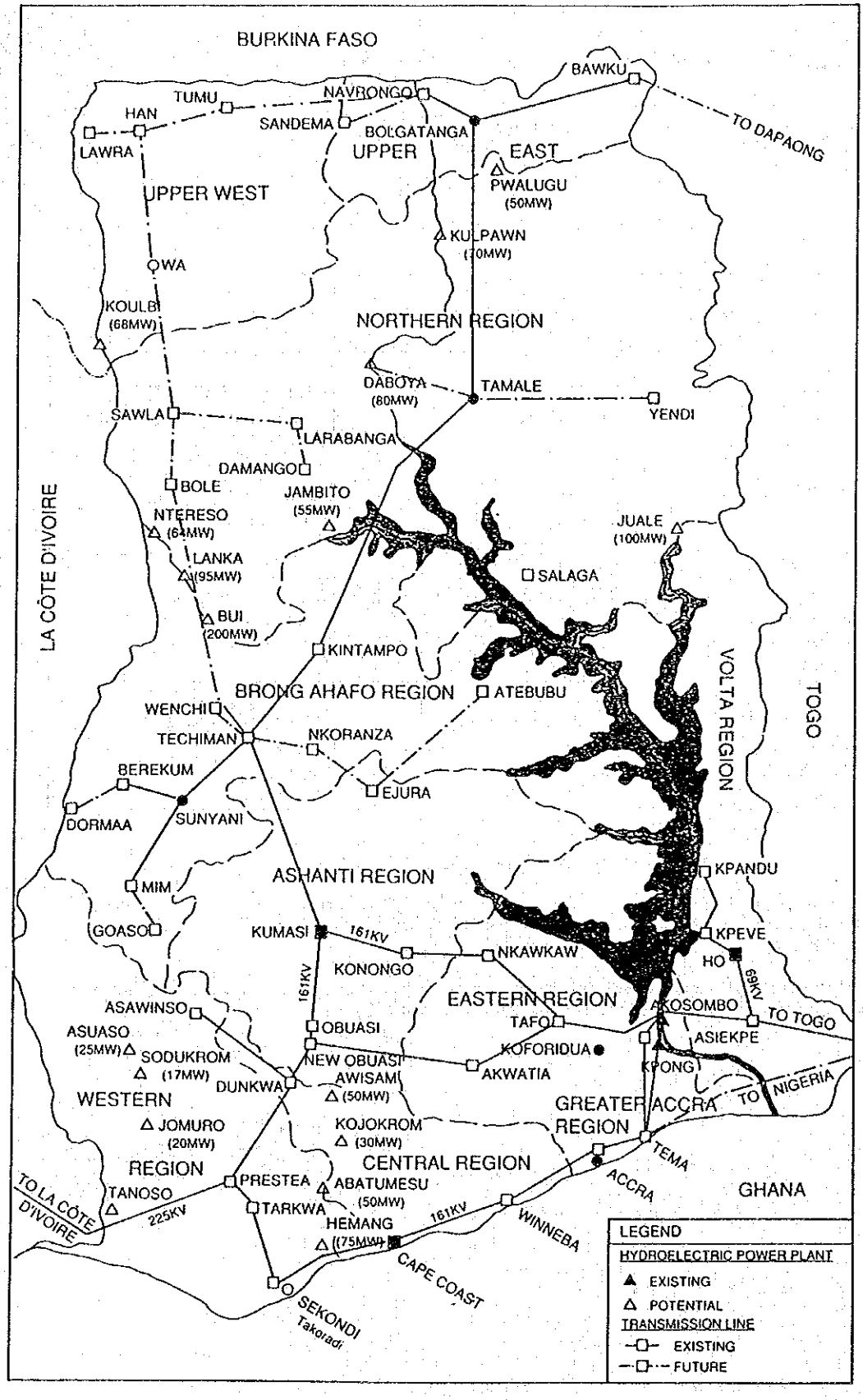
The existing charges of 1% for National Electrification and 1% for Street Lighting are being replaced by a charge of 1 Cedi/Kwh for National Electrification and 0.20 Cedis/Kwh for Street Lighting and would be additional to the Energy charges for all categories of consumers.

This new tariff has been necessitated by our concern with covering as much of our costs as possible to enable us offer better service as well as extend our services to the rural areas.

Yours faithfully,

(A. Kan-Dapaah)
Director of Finance

Telephone: 664941, 221124, Accra Telex :ECG 2107 GH Telegrams:Headtric Accra


BURKINA FASO
BAWKU
TO DAPAONG
TUMU
NAVRONGO
HAN
SANDEMA
BOLGATANGA
LAWRA
UPPER
EAST
PWALUGU
(50MW)
UPPER WEST
KULPAWN
(70MW)
WA
KOULBI
(68MW)
NORTHERN REGION
DABOYA
(80MW)
TAMALE
YENDI
SAWLA
LARABANGA
DAMANGO
BOLE
JAMBITO
(55MW)
NTERESO
(64MW)
JUALE
(100MW)
LANKA
(95MW)
SALAGA
BUI
(200MW)
LA CÔTE D'IVOIRE
KINTAMPO
VOLTA REGION
TOGO
BRONG AHAFO REGION
ATEBUBU
WENCHI
TECHIMAN
NKORANZA
BEREKUM
EJURA
DORMAA
SUNYANI
KPANDU
ASHANTI REGION
MIM
GOASO
KUMASI
161KV
NKAWKAW
KPEVE
HO
KONONGO
69KV
EASTERN REGION
ASAWINSO
AKOSOMBO
TO TOGO
OBUASI
TAFO
ASUASO
(25MW)
ASIEKPE
KOFORIDUA
SODUKROM
(17MW)
NEW OBUASI
AKWATIA
KPONG
AWISAM
(50MW)
DUNKWA
TO NIGERIA
WESTERN
GREATER ACCRA
REGION
JOMURO
(20MW)
KOJOKROM
(30MW)
TEMA
REGION
CENTRAL REGION
PRESTEA
ABATUMESU
(50MW)
ACCRA
GHANA
TO LA CÔTE D'IVOIRE
TANOSO
225KV
TARKWA
HEMANG
(75MW)
161KV
WINNEBA
CAPE COAST
SEKONDI
Takoradi
LEGEND
HYDROELECTRIC POWER PLANT
EXISTING
POTENTIAL
TRANSMISSION LINE
EXISTING
FUTURE

MAIN FACILITIES

A Generator Plants

1. Akosombo Generators

Generator Units	Year of Commission	Name Plate Capacity(MW)	Actual Capacity (MW)
1	1966	147.5	145
2	1966	147.5	145
3	1966	147.5	145
4	1966	147.5	145
5	1972	151.5	148
6	1972	151.5	148

2. Kpong Generators

Generator Units	Year of Commission	Name Plate Capacity(MW)	Actual Capacity (MW)
1	1982	40	37
2	1982	40	37
3	1982	40	37
4	1982	40	37

3 Tema Diesel Plant

It consists of 10 units of 3 MW each with a total capacity of 30 MW. The plant is now under rehabilitation and would be integrated into the VRA transmission network on completion.

B LENGTH OF TRANSMISSION LINES

Voltage Level	km
225 kV	86
161 kV	2,907
69 kV	102
34.5 kV*	338

*This includes lines insulated at 161 kV but operated at 34.5 kV.

C MAIN SUBSTATIONS

There are 31 main substations and are listed below:

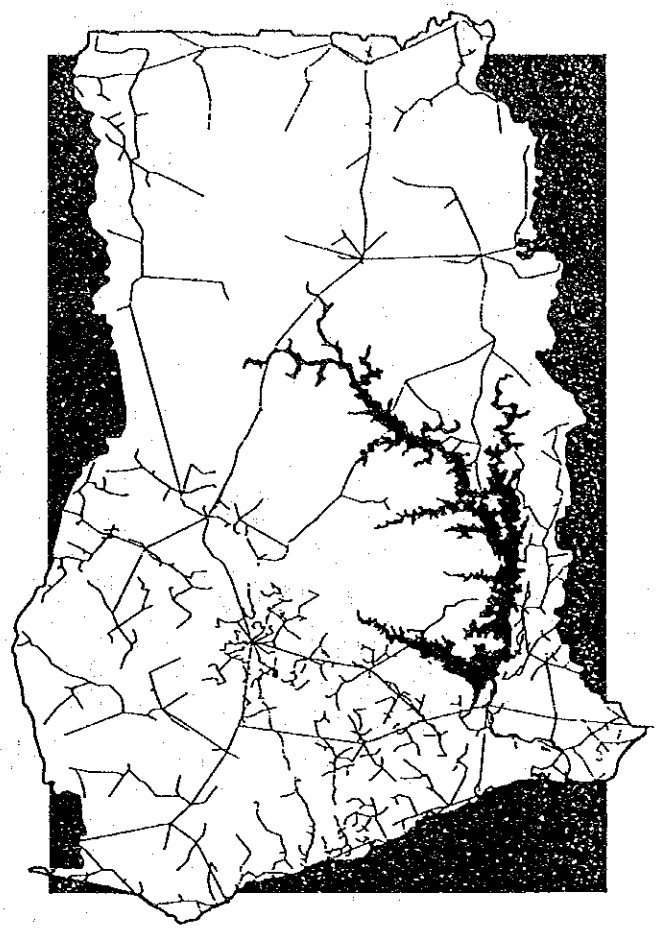
AKOSOMBO G.S
VOLTA
SMELTER (VALCO)
NEW TEMA
ACHIMOTA
WINNEBA
CAPE COAST
TAKORADI
TARKWA
PRESTEA
BOGOSO
KPONG G.S
KPONG
SUNYANI
TAMALE
BAWKU
DUNKWA
ASAWINSO
NEW OBUASI
OBUASI
KUMASI
KONONGO
NKAWKAW
TAFO
AKWATIA
ASIEKPE
HO
KPANDU
KPEVE
TECHIMAN
BOLGATANGA

ENERGY SALES AND REVENUE STATISTICS BY STATIONS FOR 12MONTHS TO 31ST DECEMBER 1990

TARIFF CLASS	RESIDENTIAL				NON RESIDENTIAL				INDUSTRIAL				TOTAL			
DISTRICT	GWH	% of Tot	CEDIS 000	% of Tot	GWH	% of Tot	CEDIS 000	% of Tot	GWH	% of Tot	CEDIS 000	% of Tot	GWH	% of Tot	CEDIS 000	% of Tot
ACCRA	300.032	57.2	2,099,406	44.0	87.565	16.7	1,525,903	32.0	137.255	26.2	1,146,241	24.0	524.852	42.0	4,771,550	44.2
Accra reg tot	300.032	57.2	2,099,406	44.0	87.565	16.7	1,525,903	32.0	137.255	26.2	1,146,241	24.0	524.852	42.0	4,771,550	44.2
TEMA	63.593	24.9	448,813	22.4	14.085	5.5	253,256	12.6	177.607	69.6	1,301,960	65.0	255.285	20.4	2,004,029	18.6
Tema reg tot	63.593	24.9	448,813	22.4	14.085	5.5	253,256	12.6	177.607	69.6	1,301,960	65.0	255.285	20.4	2,004,029	18.6
KUMASI/KAMPONG	128.282	66.6	755,237	47.4	22.902	11.9	456,883	28.7	41.455	21.5	380,837	23.9	192.639	15.4	1,592,957	14.8
KONONGO	3.992	52.2	25,563	42.9	1.015	13.3	13,712	23.0	2.647	34.6	20,352	34.1	7.654	0.6	59,627	0.6
OBUASI	12.428	85.5	65,568	73.6	2.107	14.5	23,472	26.4	0.000	0.0	0	0.0	14.535	1.2	89,040	0.8
DUNKWA	2.387	68.0	14,071	24.9	0.970	27.6	17,214	30.5	0.155	4.4	25,112	44.5	3.512	0.3	56,397	0.5
Bekwai ++	0.119	39.9	3,486	61.1	0.166	60.1	2,218	38.9	0.000	0.0	0	0.0	0.276	0.0	5,704	0.1
Ashanti reg tot	147.195	67.3	863,925	47.9	27.160	12.4	513,499	28.5	44.257	20.2	426,301	23.6	218.616	17.5	1,803,725	16.7
TAKORADI	43.087	41.0	282,737	32.5	24.145	23.0	296,027	34.1	37.542	36.1	290,543	33.4	105.174	8.4	869,307	8.1
TARKWA	4.941	33.1	35,708	25.4	1.363	9.1	24,040	17.1	8.604	57.7	80,856	57.5	14.908	1.2	140,604	1.3
ASHANSO/BIBIANI	3.010	28.5	18,593	19.5	0.838	7.9	14,954	15.8	6.705	63.5	61,345	64.7	10.553	0.8	94,802	0.9
Axim ++	0.003	0.0	563	0.0	0.0003	0.0	41	0.0	0.000	0.0	0	0.0	0.003	0.0	604	0.0
Western reg tot	51.041	39.1	337,511	30.5	26.346	20.2	335,062	30.3	53.251	40.8	432,744	39.2	130.638	10.5	1,105,317	10.2
KOFORIDUA/TAFO	16.562	69.1	95,047	43.7	5.829	24.3	109,136	50.2	1.572	6.6	13,242	6.1	23.963	1.9	217,425	2.0
NKAWKAW	7.013	73.3	41,487	50.5	2.275	23.8	37,761	46.0	0.275	2.9	2,873	3.5	9.563	0.8	82,121	0.8
AKRADA/AKIM ODA	8.752	57.6	45,722	34.7	3.400	22.4	63,418	44.2	3.051	20.1	30,282	21.1	15.203	1.2	143,492	1.3
ADEISO	0.014	-	78	-	0.002	-	39	0.0	0.000	0.0	0	0.0	0.016	0.0	117	0.0
Easter reg tot	32.341	66.3	186,394	42.1	11.506	23.6	210,354	47.5	4.898	10.0	46,397	10.5	48.745	3.9	443,145	4.1
CAPE COAST/SALTPO	16.382	54.0	100,209	38.0	8.419	27.7	106,722	40.4	5.556	18.3	57,239	21.7	30.357	2.4	264,250	2.4
SWEDRU/WINNEBA	10.158	55.3	52,756	35.5	4.739	25.8	67,722	45.6	3.471	18.9	27,925	18.8	18.368	1.5	148,403	1.4
Dream Asikuma ++	0.000	0.0	0	0.0	0.000	0.0	0	0.0	0.000	0.0	0	0.0	0.000	0.0	0	0.0
Central reg tot	26.540	54.5	153,045	37.1	13.158	27.0	174,444	42.3	9.027	18.5	85,164	20.6	48.725	3.9	412,653	3.8
HO/ASIEKPE	5.225	54.6	36,545	31.5	4.339	45.4	79,588	68.5	0.000	0.0	0	0.0	9.564	0.8	116,133	1.1
KPANDU/HOHOE	3.268	55.1	20,087	28.7	2.664	44.9	49,867	71.3	0.000	0.0	0	0.0	5.932	0.5	69,954	0.6
DENU/AFLAO	2.988	70.5	16,421	42.8	1.250	29.5	21,958	57.2	0.000	0.0	0	0.0	4.238	0.3	38,379	0.4
KPEVE	1.055	74.5	4,619	31.1	0.309	21.0	9,578	64.4	0.066	4.5	677	4.6	1.470	0.1	14,874	0.1
Keta ++	0.777	70.6	5,180	44.6	0.324	29.4	6,438	55.4	0.000	0.0	0	0.0	1.101	0.1	11,618	0.1
Keta Krachi ++	0.113	69.8	723	30.5	0.049	30.2	1,647	69.5	0.000	0.0	0	0.0	0.162	0.0	2,370	0.0
Volta reg tot	13.466	59.9	83,575	33.0	8.935	39.8	169,076	66.7	0.066	0.3	677	0.3	22.467	1.8	253,328	2.3
Tot grid stations	633.322	50.7	4,163,440	38.6	188.265	15.1	3,172,897	29.4	426.361	34.2	3,439,484	31.9	1247.948	99.9	10,775,821	99.8
Total thermal	0.890	64.5	9,229	51.5	0.490	35.5	8,697	48.5	0.000	0.0	0	0.0	1.380	0.1	17,926	0.2
TOT ALL STATIONS	634.212	50.8	4,172,669	38.7	188.755	15.1	3,181,594	29.5	426.361	34.1	3,439,484	31.9	1249.328	100	10,793,747	100

++ thermal station

* EXCLUDES PUBLIC LIGHTING LEVY



MINISTRY OF ENERGY
GOVERNMENT OF THE REPUBLIC OF GHANA

NATIONAL ELECTRIFICATION PROJECT FEASIBILITY STUDY

JUNE 1992

ACRES

ACRES INTERNATIONAL LIMITED

ASARE TSIBU AND PARTNERS

（抜　粋）

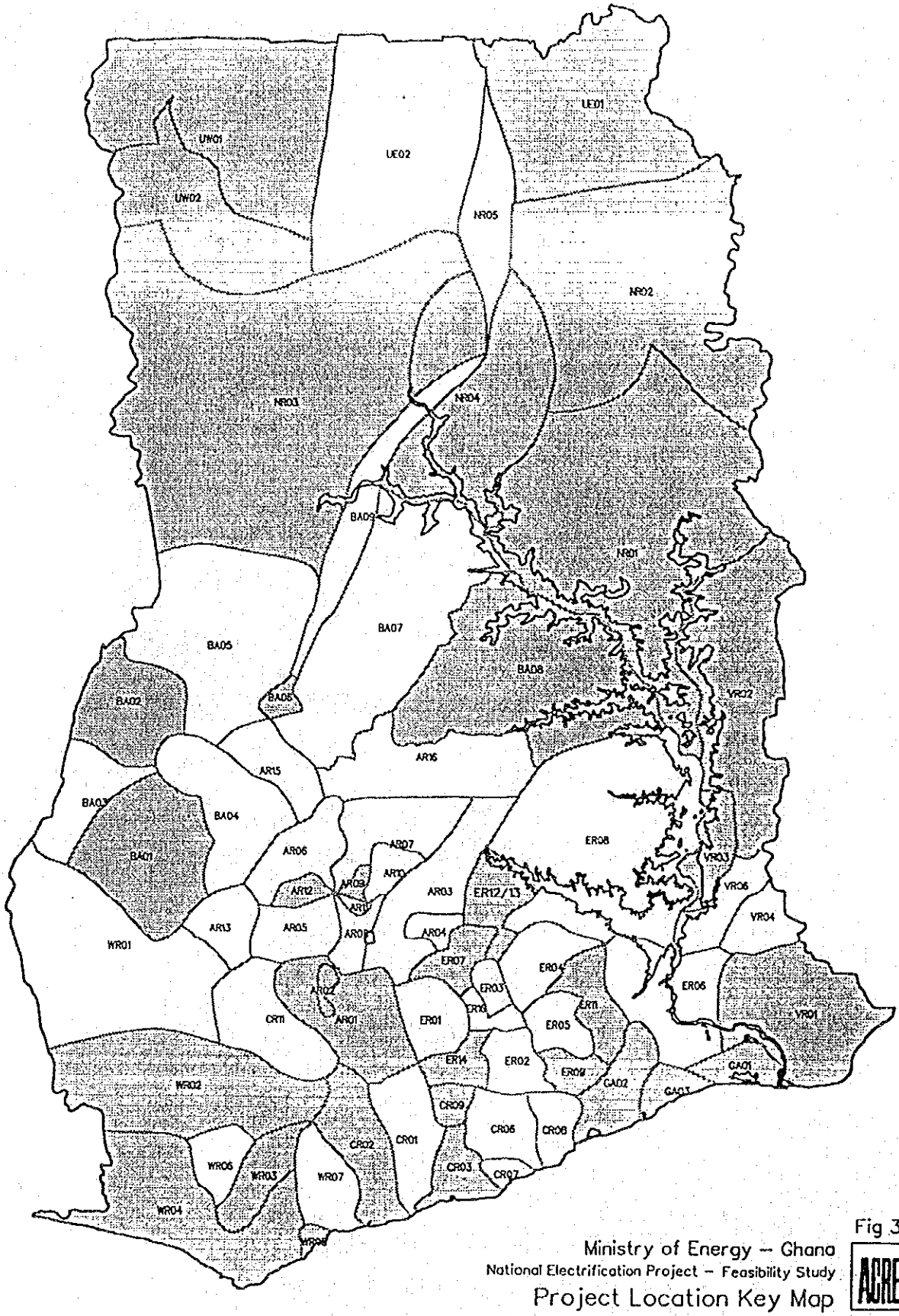


Fig 3.1

Ministry of Energy – Ghana

National Electrification Project – Feasibility Study

Project Location Key Map

ACRES

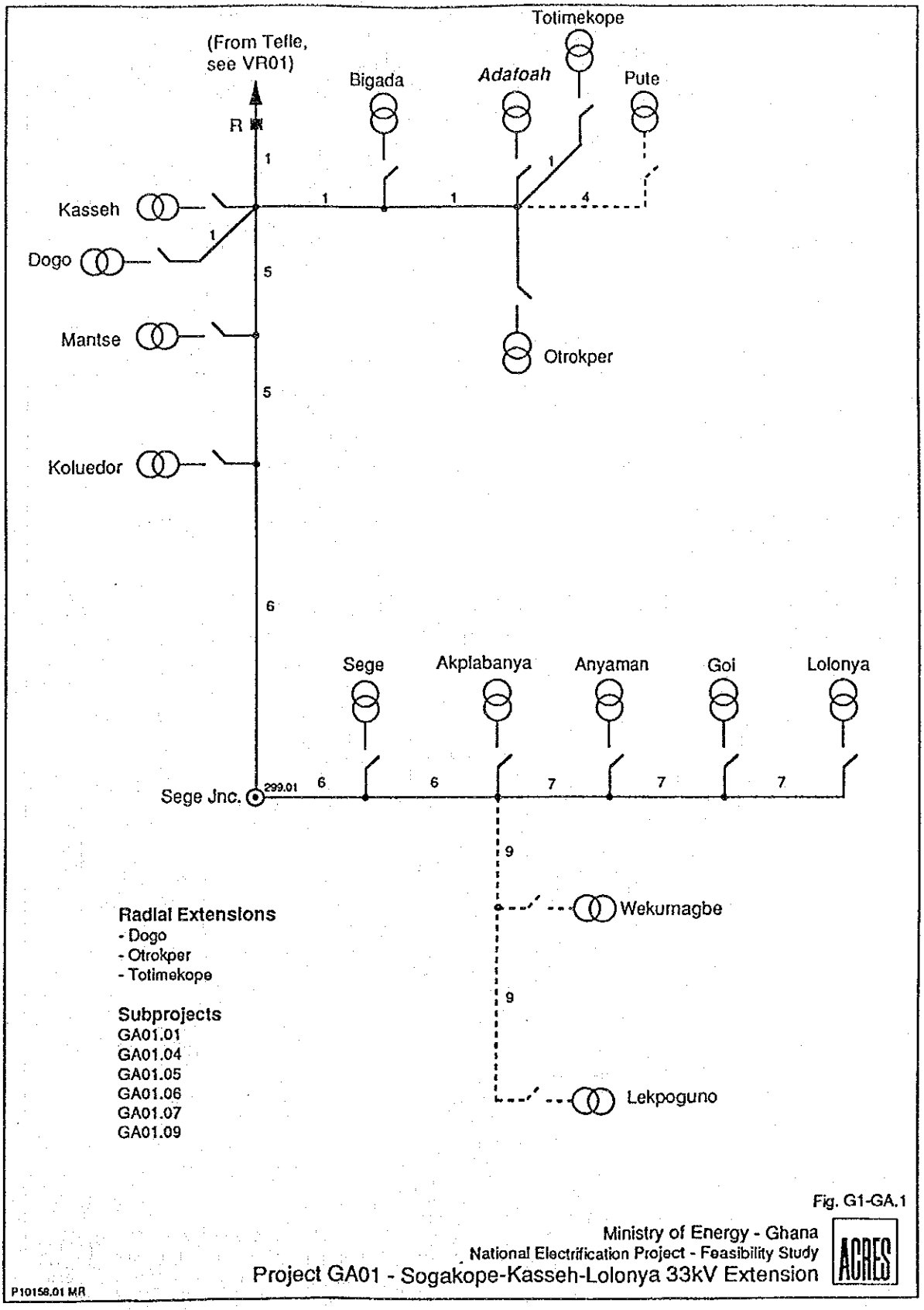


Fig. G1-GA.1

Ministry of Energy - Ghana
National Electrification Project - Feasibility Study
Project GA01 - Sogakope-Kasseh-Lolonya 33kV Extension

P10158.01 MR

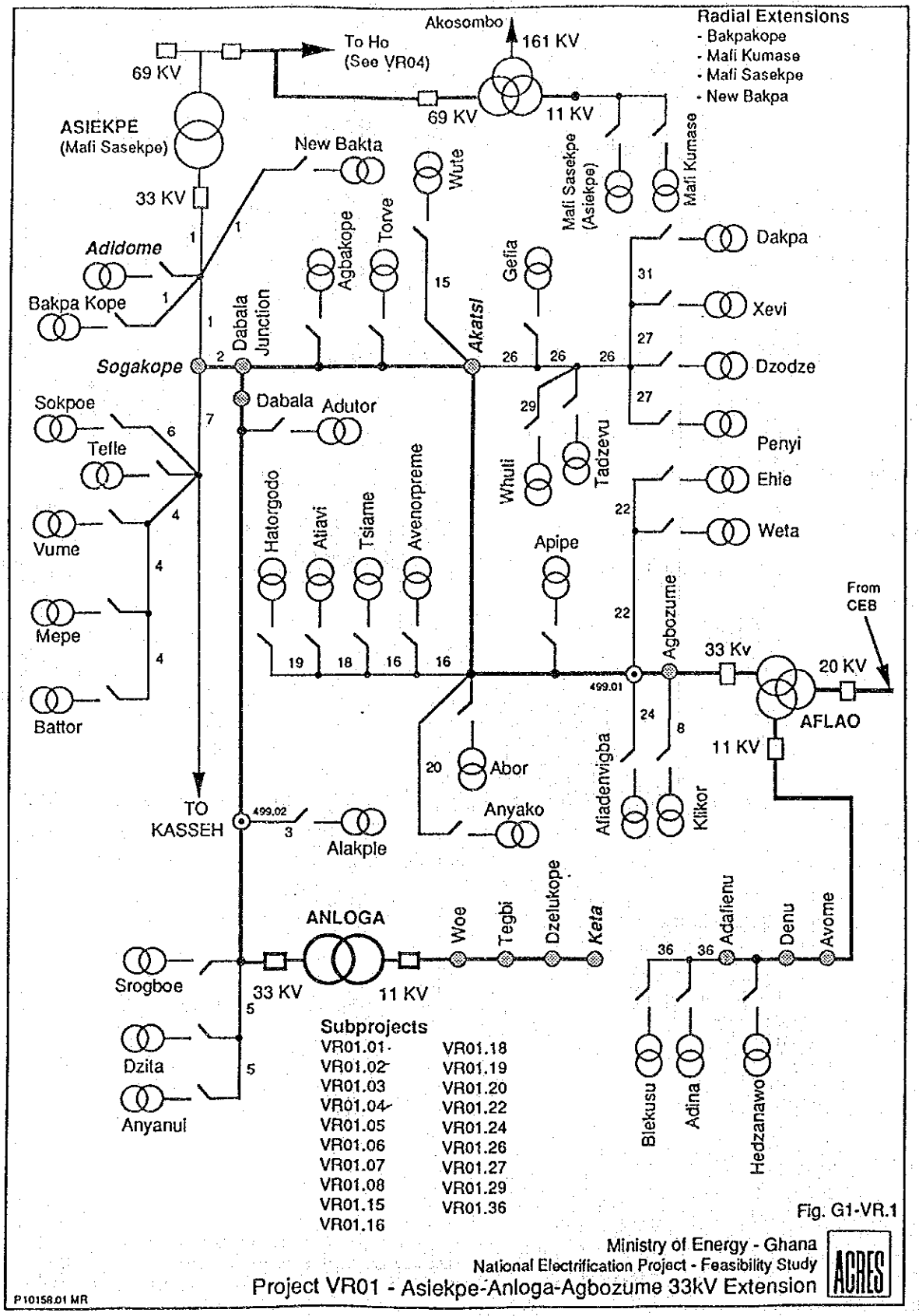

Radial Extensions
- Bakpakope
- Mafi Kumase
- Mafi Sasekpe
- New Bakpa
Akosombo
161 KV
To Ho
(See VR04)
69 KV
69 KV
11 KV
ASIEKPE
(Mafi Sasekpe)
33 KV
New Bakta
Wute
Mafi Sasekpe (Asiekpe)
Mafi Kumase
Adidome
Agbakope
Torve
Gefia
Dakpa
Bakpa Kope
Dabala Junction
Akatsi
Xevi
Sogakope
Dzodze
Sokpoe
Dabala
Adutor
Penyi
Tefle
Whuti
Tadzevu
Ehie
Vume
Hatorgodo
Atiavi
Tsiame
Avenorpreme
Apipe
Weta
From CEB
Agbozume
Mepe
33 Kv
20 KV
AFLAO
Battor
499.01
Abor
11 KV
Afiadenyigba
Klikor
TO KASSEH
499.02
Anyako
Alakple
ANLOGA
Woe
Tegbi
Dzelukope
Keta
Srogboe
33 KV
11 KV
Adaflenu
Denu
Avome
Dzita
Anyanui
Blekusu
Adina
Hedzranawo
Subprojects
VR01.01
VR01.02
VR01.03
VR01.04
VR01.05
VR01.06
VR01.07
VR01.08
VR01.15
VR01.16
VR01.18
VR01.19
VR01.20
VR01.22
VR01.24
VR01.26
VR01.27
VR01.29
VR01.36
Fig. G1-VR.1
Ministry of Energy - Ghana
National Electrification Project - Feasibility Study
Project VR01 - Asiekpe-Anloga-Agbozume 33kV Extension
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Table 8.1

Project Evaluation Summary: Base Case

Projects	Economic Indicators			Project Capital Costs				Project Characteristics			2006 Load Forecast	
	EIRR	NPV ('000 $)	Supply $/kWh	Total ('000 $)	Trans ('000$)	Substn ('000$)	Distrn. ('000$)	# of Towns	1992 Popn.	Total km	Power (kW)	Energy (MWh)
AR01	15%	2011	$0.17	5,480	2,109	1,692	1,300	24	51,642	97	1,618	8,429
AR02	31%	1206	$0.10	692	242		342	6	14,723	13	452	2,340
AR09	22%	1197	$0.12	1,224	642		397	10	26,261	35	524	2,720
AR12	27%	1935	$0.11	1,375	531		578	17	35,291	31	763	3,994
BA01	19%	688	$0.13	1,025	616		303	3	15,583	28	376	1,944
BA02	19%	2183	$0.13	3,139	1,830		961	16	48,499	82	1,196	6,176
BA06	26%	2467	$0.11	1,848	846		784	8	27,243	46	1,033	5,408
BA08	14%	411	$0.16	1,309	795		433	4	11,269	36	369	1,907
CR02	11%	214	$0.21	4,524	1,830	1,692	801	15	27,193	82	998	5,127
CR03	26%	9123	$0.11	7,348	3,492		2,966	51	127,328	160	3,689	19,122
CR09	29%	908	$0.10	603	258		279	3	9,754	12	347	1,771
ER07	5%	-1598	$0.32	3,636	1,290	1,692	476	13	25,505	59	691	3,608
ER09	17%	580	$0.15	1,055	550		383	11	17,182	31	331	1,737
ER11	28%	3586	$0.10	2,413	1,081		1,034	17	42,556	72	1,364	7,087
ER12	21%	987	$0.13	1,129	669		332	9	18,560	40	438	2,296
ER13	22%	623	$0.12	692	408		215	4	10,094	29	283	1,478
ER14	30%	2992	$0.10	1,835	780		851	10	27,920	44	1,122	5,837
GA01	18%	3334	$0.14	5,381	2,226	517	2,256	16	50,881	103	1,928	10,025
GA02	24%	1610	$0.11	1,355	673		561	6	14,489	32	722	3,733
GA03	26%	1331	$0.11	1,081	352		600	5	17,995	19	545	2,824
NR01	18%	6249	$0.15	10,744	4,435	1,359	4,314	22	77,993	198	3,685	19,051
NR02	10%	187	$0.21	6,149	3,672	582	1,645	9	31,402	165	1,404	7,269
NR03	35%	10050	$0.11	5,206	1,826		2,639	17	57,523	82	3,277	16,818
NR04	25%	3361	$0.11	2,919	999		1,677	6	32,216	55	1,545	7,984
UE01	20%	4769	$0.13	6,419	2,866		3,051	38	68,099	134	2,602	13,387
UW01	15%	1279	$0.18	3,566	2,141		1,162	22	32,288	99	976	4,948
UW02	11%	181	$0.21	1,919	1,240		502	14	24,362	57	418	2,188
VR01	22%	12680	$0.12	14,074	4,576	1,550	7,076	40	121,897	224	6,054	31,121
VR02	18%	2769	$0.15	4,851	2,231	388	1,916	22	45,733	100	1,627	8,453
VR03	21%	1054	$0.13	1,312	486	129	576	8	16,924	30	510	2,662
WR02	14%	1193	$0.17	3,904	2,796		879	13	32,289	125	1,092	5,648
WR03	24%	548	$0.12	479	246		186	3	6,593	11	231	1,205
WR04	21%	11710	$0.13	14,403	6,082		7,077	63	163,203	281	6,020	31,097
WR05	34%	1542	$0.09	800	262		431	5	14,804	14	568	2,934

Notes

1). 161 kV line costs in NR03, UW01, UW02 are excluded from the economic evaluation.
The Northwest transmission loop is assumed to be committed.

2). All costs are expressed in Jan. 1992 U.S. $ excluding price escalation and interest during construction.
Costs shown in the summary are financial; EIRR and NPV are based on economic costs.

3). Supply Costs $/kWh indicates the total levelized cost of supply to the town.

4). Total costs include $10.2 million for engineering.

Appendix B: Linkage Tables

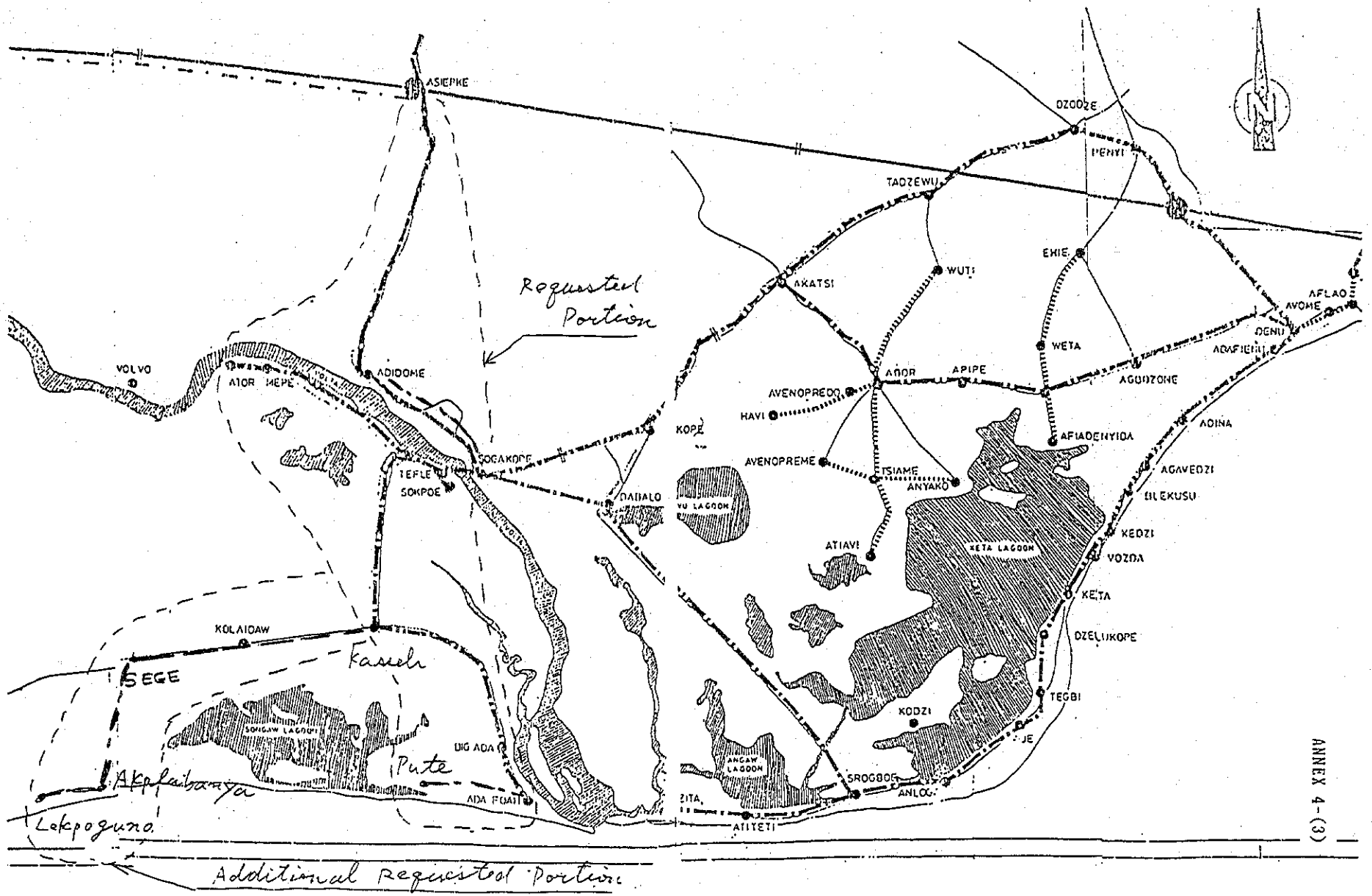
IDCode	Source Town	IDCode	Supplied Town	Sub-Project	Dist. km	Volts (KV)	Connections '000 Res.	Non-Res	Demand MWh	kW	Capital Costs ($1992 '000) Line	S/S	Dist'n	Eng.	Total
Project: ER14															
301.23	Anyinam Kotoku	301.22	Bienne	ER14/01	2.5	11	108	17	155	30	47		22	9	77
301.29	Achiase	301.23	Anyinam Kotoku	ER14/01	6.2	11	139	22	201	38	115		29	11	155
301.22	Bienne	301.36	Anamase	ER14/01	3.7	11	342	70	639	122	69		92	24	185
301.36	Anamase	301.37	Asuboa	ER14/01	4.5	11	466	103	973	187	84		142	30	255
300.10	Oda	310.30	Akim Wenchi	ER14/02	0.0	11	408	91	858	165			125	30	155
301.36	Anamase	301.14	Kokobeng	ER14/03	4.0	11/01	124	20	179	34	57		26	10	93
301.14	Kokobeng	301.15	Osorase	ER14/03	4.5	11/01	264	48	439	84	64		64	19	147
301.29	Achiase	301.17	Nyankumasi	ER14/05	6.0	11	97	15	141	27	112		20	8	140
301.17	Nyankumasi	301.27	Aperade	ER14/05	6.5	11	764	176	1,767	343	121		260	44	426
301.30	Akim Swedru	301.33	Aduasa	ER14/05	6.0	11	282	53	485	92	112		70	20	202
	Total	10			43.9		2,994	616	5,837	1,122	780	0	851	204	1,835
Project: GA01															
230.23	Adofoah	230.07	Otrokper	GA01/01	2.2	33	57	9	83	16	49	7	19	5	81
230.26	Kasseh	230.16	Dogo	GA01/01	4.9	33	59	9	85	16	110	7	20	5	143
230.27	Bigada	230.23	Adafoah	GA01/01	6.8	33	812	187	1,877	364	152	74	425	55	706
230.23	Adofoah	230.24	Totimekope	GA01/01	1.8	33	137	22	197	38	40	17	46	13	116
400.07	Tefle	230.26	Kasseh	GA01/01	14.5	33	326	69	628	120	325	35	140	26	525
230.26	Kasseh	230.27	Bigada	GA01/01	16.3	33	619	143	1,431	278	365	56	324	42	787
230.23	Adofoah	230.22	Pute	GA01/04	12.5	33/01	203	35	319	61	233	24	71	18	346
230.26	Kasseh	230.11	Mantse	GA01/05	5.0	33	90	14	130	25	112	11	31	8	162
230.11	Mantse	230.14	Koluedor	GA01/05	6.5	33	330	70	639	122	146	35	142	26	348
230.25	Sege	230.19	Akplabanya	GA01/06	5.5	33	365	80	733	140	123	38	163	28	352
299.01		230.25	Sege	GA01/06	4.3	33	229	42	379	72	96	27	84	20	227
230.14	Koluedor	299.01		GA01/06	7.5	33	0	0	0		168		0		168
230.21	Goi	230.02	Lolonya	GA01/07	2.3	33	281	56	507	97	52	31	113	23	218
230.19	Akplabanya	230.20	Anyaman	GA01/07	1.5	33	359	78	718	137	34	37	160	27	258
230.20	Anyaman	230.21	Goi	GA01/07	4.5	33	475	107	1,039	201	101	45	234	34	414
30.01	Wekumagbe	221.14	Lekpoguno	GA01/09	3.5	33/01	380	86	840	162	65	44	189	33	331
230.19	Akplabanya	230.01	Wekumagbe	GA01/09	3.0	33/01	247	46	420	80	56	28	93	21	198
	Total	16			102.6		4,968	1,053	10,025	1,928	2,226	517	2,256	382	5,381
Project: GA02															
200.02	Tokuse	200.05	Kokrobite	GA02/01	6.0	11	208	33	301	57	112		43	15	170
200.05	Kokrobite	200.50	Bortianor	GA02/01	3.8	11	809	186	1,870	363	71		276	43	389
200.12	Oblogo	200.10	Kwashiman Bu	GA02/02	7.3	33	383	75	684	130	164		105	25	293
200.50	Bortianor	200.12	Oblogo	GA02/02	7.0	33	112	18	162	31	157		25	8	190
200.54	Amasanman	200.55	Adzen Kotoku	GA02/02	3.5	33	319	58	524	100	78		81	22	181
299.08	Volta SS	299.07	Achimota SS	GA02/02	0.0	161	0	0	0				0		
200.48	Oyibi	200.47	Danfa	GA02/03	4.1	33	113	18	191	41	92		32	8	132
	Total	6			31.7		1,945	388	3,733	722	673	0	561	121	1,355

Appendix B: Linkage Tables

IDCode	Source Town	IDCode	Supplied Town	Sub-Project	Dist. km	Volts (KV)	Connections '000 Res.	Non-Res	Demand MWh	kW	Capital Costs ($1992 '000) Line	S/S	Dist'n	Eng.	Total
Project: VR01															
400.31	Adidome	400.13	New Bakpa	VR01/01	4.4	33	105	17	151	29	99	13	36	7	154
400.31	Adidome	400.17	Bakpakope	VR01/01	2.9	33	81	13	117	22	65	10	27	6	108
332.22	Akosombo	400.22	Mafi Sasekpe	VR01/01	0.0	161	142	23	206	39		18	48	10	76
400.31	Adidome	400.27	Sogakope	VR01/01	7.5	33	0	0	0	0	168		0		168
400.22	Mafi Sasekpe	400.31	Adidome	VR01/01	20.0	33	751	173	1,848	375	448	68	438	38	993
414.03	Torve	400.05	Agbakope	VR01/02	0.0	33	181	29	262	50		22	61	13	97
499.02		410.04	Srogboe	VR01/02	0.0	33	120	19	173	33		14	41	8	63
413.26	Apipe	410.30	Abor	VR01/02	0.0	33	464	102	953	183		46	213	26	285
412.20	Afio	412.29	Agbozume	VR01/02	0.0	33	703	161	1,606	311		65	363	37	465
499.01		413.26	Apipe	VR01/02	0.0	33	343	68	616	118		38	137	21	197
414.08	Akatsi	414.03	Torve	VR01/02	0.0	33	130	21	188	36		16	44	9	69
410.03	Bor	414.08	Akatsi	VR01/02	0.0	33	1,323	305	3,059	594		117	693	66	876
400.26	Adutor	499.02		VR01/02	0.0	33	0	0	0				0		
499.02		410.25	Alakple	VR01/03	9.0	33/01	137	22	197	38	167	17	46	9	240
400.07	Tefle	400.08	Vume	VR01/04	3.5	33	114	18	164	31	78	14	39	8	139
400.30	Mepe	400.29	Battor	VR01/04	3.0	33	209	33	413	96	67	26	118	15	225
400.08	Vume	400.30	Mepe	VR01/04	15.0	33	263	45	413	79	336	31	92	18	477
410.24	Dzita	410.01	Anyanui	VR01/05	5.0	33/01	141	22	204	39	93	17	48	10	168
410.24	Srogboe	410.24	Dzita	VR01/05	7.5	33/01	212	35	316	60	140	25	70	14	249
400.07	Tefle	400.02	Sokpoe	VR01/06	1.5	33	99	16	143	27	34	12	34	7	86
400.27	Sogakope	400.07	Tefle	VR01/07	3.0	33	216	34	314	60	67	27	70	15	179
412.29	Agbozume	413.28	Klikor	VR01/08	0.5	33	565	127	1,222	235	11	55	275	31	372
400.22	Mafi Sasekpe	400.24	Mafi Kumase	VR01/15	0.0	11	167	26	241	46		21	54	12	87
414.08	Akatsi	412.17	Wute	VR01/15	14.0	33/01	115	18	166	32	260	14	39	8	322
414.09	Avenorpeme	410.28	Tsiame	VR01/16	4.5	33	712	164	1,646	320	101	63	373	36	573
410.30	Bor	414.09	Avenorpeme	VR01/16	7.0	33	190	30	274	52	157	23	64	13	257
410.28	Tsiame	410.26	Atiavi	VR01/18	7.0	33/01	221	37	335	64	130	26	74	15	245
410.26	Tiavi	410.27	Hatorgodo	VR01/19	6.0	33/01	150	24	216	41	112	18	51	10	191
0.30	Abor	410.31	Anyako	VR01/20	11.0	33/01	569	129	1,249	241	205	53	281	30	569
412.29	Agbozume	499.01		VR01/21	0.0	33	0	0	0				0		
499.01		413.27	Weta	VR01/22	3.5	33	215	35	317	61	78	27	71	15	191
413.27	Weta	413.30	Ehie	VR01/22	8.5	33	608	138	1,349	261	190	58	304	33	585
499.01		410.32	Afiadenyigba	VR01/24	5.0	33/01	573	130	1,259	243	93	53	284	30	460
413.29	Tadzevu	413.24	Dzodze	VR01/26	13.5	33	2,369	546	5,589	1,102	302	218	1,286	122	1,928
414.06	Gefia	413.29	Tadzevu	VR01/26	7.0	33	340	67	608	116	157	38	135	21	351
414.08	Akatsi	414.06	Gefia	VR01/26	7.0	33	84	13	122	23	157	10	29	6	201
413.24	Dzodze	413.22	Xevi	VR01/27	12.0	33/01	122	19	176	33	223	15	41	9	288
413.24	Dzodze	413.25	Penyi	VR01/27	5.0	33	856	197	1,980	384	112	79	449	44	684
413.29	Tadzevu	410.05	Whuti	VR01/29	6.0	33/01	160	25	231	44	112	19	54	11	196
413.22	Xevi	420.18	Dakpa	VR01/31	10.0	33/01	120	19	173	33	186	23	41	13	262
412.23	Adina	412.21	Blekusu	VR01/36	7.5	11/01	352	69	626	119	107	39	131	22	300
412.24	Adafienu	412.23	Adina	VR01/36	6.5	11	375	75	686	131	121	41	144	23	329
412.26	Denu	412.25	Hedzranawo	VR01/36	0.0	11	605	136	1,314	253		59	278	33	370
400.22	Mafi Sasekpe	499.06		VR01/41		161	0	0	0				0		
	Total	40			223.8		15,199	3,180	31,120	6,054	4,576	1,550	7,076	871	14,074

Table C.2 – Peak Demand Forecast
(Demand kW)

Projects	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2015
AR01	918	977	1,039	1,105	1,177	1,253	1,335	1,423	1,517	1,618	1,618
AR02	263	279	296	314	334	354	376	400	425	452	452
AR09	315	338	356	376	397	419	443	468	495	524	524
AR12	400	429	460	494	530	570	613	659	709	763	763
BA01	254	265	277	289	302	315	329	344	360	376	376
BA02	724	769	812	857	905	957	1,011	1,069	1,130	1,196	1,196
BA06	508	575	617	663	712	766	825	889	958	1,033	1,033
BA08	223	235	249	263	278	294	311	329	348	369	369
CR02	556	606	644	684	728	775	825	878	936	998	998
CR03	2,325	2,449	2,574	2,707	2,848	2,997	3,155	3,323	3,500	3,689	3,689
CR09	234	249	259	270	281	293	306	319	333	347	347
ER07	420	443	468	494	522	552	584	617	653	691	691
ER09	193	204	217	230	244	259	276	293	311	331	331
ER11	841	886	934	985	1,039	1,096	1,157	1,222	1,291	1,364	1,364
ER12	272	286	301	318	335	353	372	393	415	438	438
ER13	180	190	199	209	220	231	243	256	269	283	283
ER14	649	689	731	777	825	877	932	991	1,054	1,122	1,122
GA01	1,071	1,142	1,218	1,299	1,387	1,480	1,581	1,689	1,804	1,928	1,928
GA02	330	364	396	431	469	511	557	607	662	722	722
GA03	329	347	367	388	411	434	460	486	515	545	545
NR01	2,019	2,196	2,342	2,498	2,664	2,842	3,032	3,236	3,453	3,685	3,685
NR02	705	780	837	900	968	1,042	1,122	1,208	1,302	1,404	1,404
NR03	1,532	1,721	1,872	2,034	2,207	2,393	2,591	2,804	3,032	3,277	3,277
NR04	859	923	983	1,048	1,117	1,192	1,271	1,356	1,447	1,545	1,545
UE01	1,457	1,580	1,679	1,786	1,899	2,021	2,151	2,291	2,441	2,602	2,602
UW01	525	585	624	665	708	755	805	858	915	976	976
UW02	237	252	268	285	303	323	345	367	392	418	418
VR01	3,672	3,929	4,141	4,366	4,606	4,861	5,132	5,420	5,727	6,054	6,054
VR02	977	1,036	1,094	1,156	1,222	1,293	1,368	1,449	1,535	1,627	1,627
VR03	304	321	340	360	381	404	428	453	481	510	510
WR02	672	708	747	787	831	877	926	978	1,034	1,092	1,092
WR03	140	148	156	165	174	184	195	206	219	231	231
WR04	3,186	3,449	3,692	3,954	4,237	4,542	4,870	5,225	5,607	6,020	6,020
WR05	345	365	385	407	430	454	480	508	537	568	568
Total	28	30	32	34	36	38	40	43	46	49	49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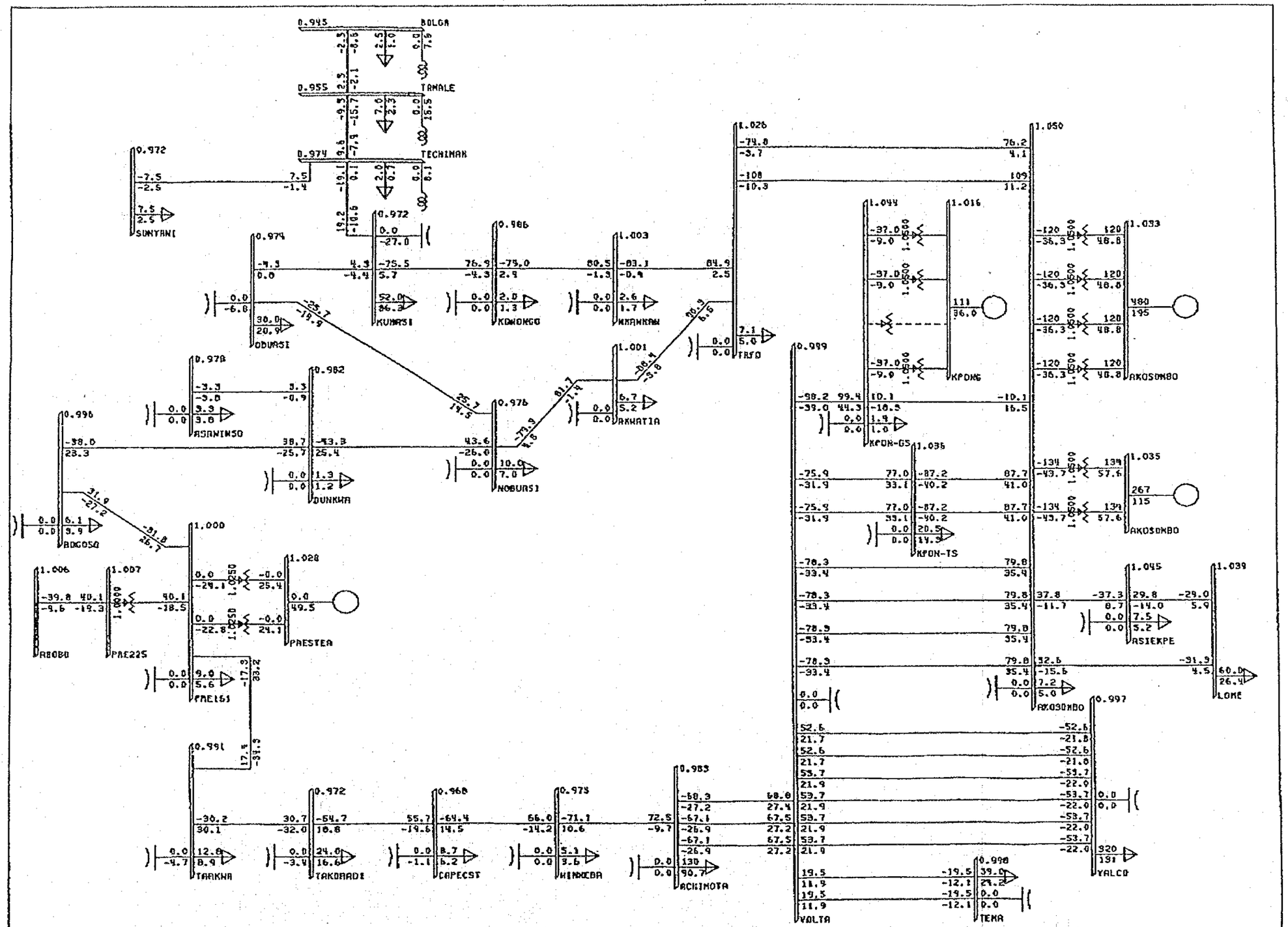
OZOOZE
PENYI
TADZEWU
EHIE
AKATSI
WUTI
AFLAO
AVOME
WETA
AGOZONE
APIPE
AJOR
AVENOPREDO
HAVI
KOPE
AVENOPREME
TSIAME
ANYAKO
AFIADENYIGA
AGAVEDZI
BLEKUSU
KEDZI
VOZDA
KETA
DZELUKOPE
TEGBI
KODZI
SROGBOE
ANLO
ATITETI
ATIAVI
KETA LAGOON
VU LAGOON
ANGAW LAGOON
DAHALO
SOGAKOPE
TEFLE
SOKPOE
ADIDOME
AJOR MEPE
VOLVO
KOLAIDAW
SEGE
SONGAW LAGOON
BIG ADA
ADA FOAH
Requested Portion
Additional Requested Portion
Kasele
Pute
Akplaibaaya
Lekpoguno

ANNEX 4-(3)

ASIEKPE SUBSTATION

b) The VRA system peak load condition loadflow single line diagram is attached.

c) The double circuit transmission line from Akosombo to Asiekpe is a AAAC 177 sq.mm ARVIDAL conductor with a thermal limit of 128 MVA.



VRA SYSTEM 1992 PEAK LOADFLOW BASE CASE

TUE, JUL 21 1992 12:23

BUS - VOLTAGE (PU)
BRANCH - MW/MVAR
EQUIPMENT - MW/MVAR

VOLTA RIVER

a) See attachment.

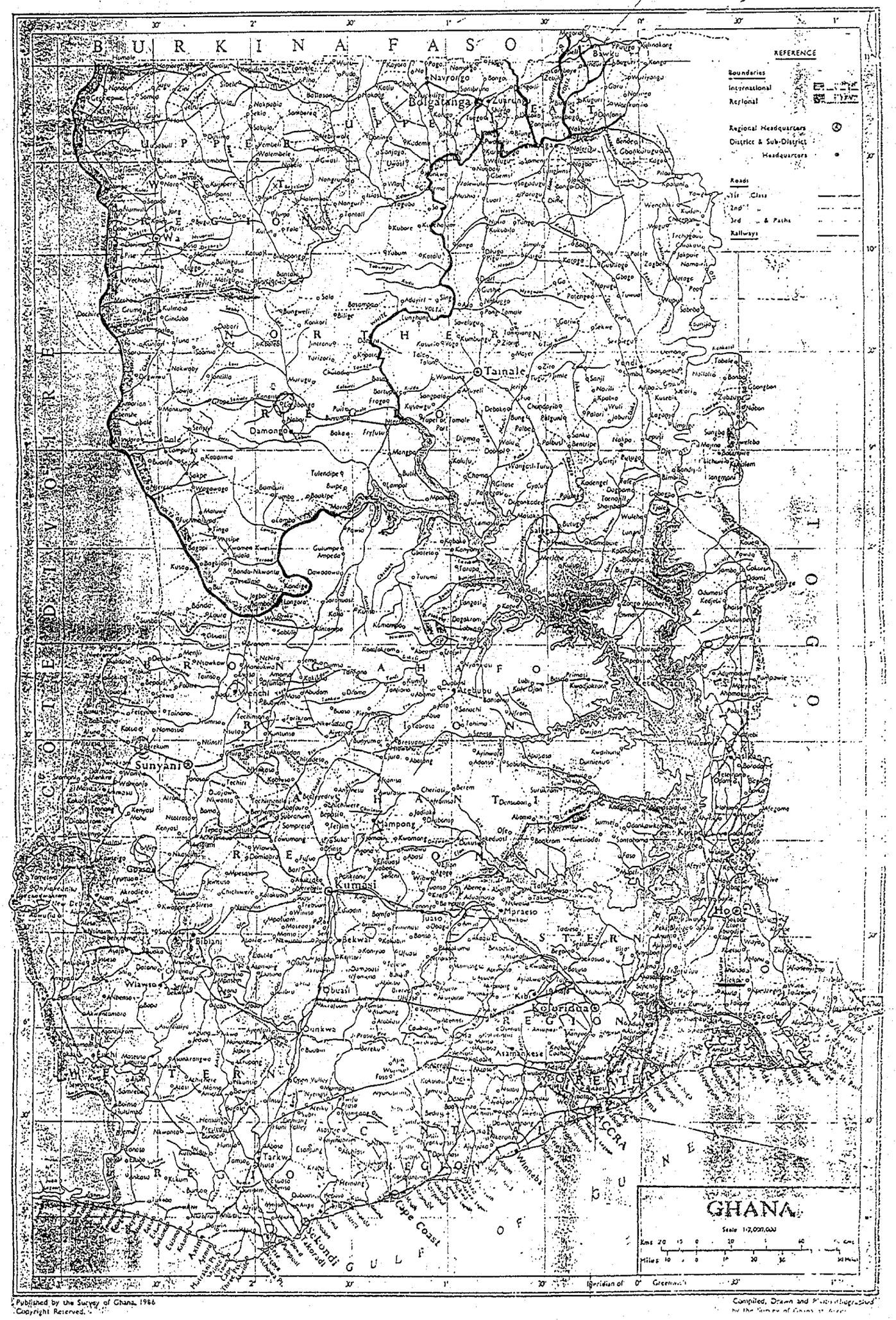
b) See attachment.

c) Maximum wind velocity at river side

90-120 km/h

d) Not available immediately.

ADMINISTRATIVE



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VOLTA RIVER AUTHORITY

ENGINEERING DEPT

VOLTA RIVER FLOWS AT SENCHI/AKOSOMBO

Year	Peak inflow (cfs)	Peak inflow (m^3/s)	Annual Inflow (Maf) #	Annual Inflow (Mcm) ##
1936	266000	7532	26.20	32317
1937	243000	6881	27.64	34093
1938	160800	4553	21.89	27001
1939	263500	7461	33.56	41396
1940	170000	4814	25.30	31207
1941	298500	8453	32.14	39644
1942	120800	3421	13.73	16936
1943	172500	4885	21.19	26137
1944	202500	5734	25.47	31417
1945	318500	9019	39.48	48698
1946	168000	4757	19.89	24534
1947	438000	12403	43.29	53397
1948	231500	6555	22.63	27914
1949	343500	9727	41.86	51633
1950	118000	3341	15.16	18700
1951	351500	9953	46.38	57209
1952	358000	10137	41.10	50696
1953	268000	7589	38.58	47568
1954	186200	5273	24.71	30479
1955	338000	9571	51.94	64067
1956	193000	5465	18.20	22449
1957	350200	9917	54.88	67693
1958	90000	2549	10.31	12717
1959	236000	6683	25.55	31515
1960	321000	9090	33.99	41926
1961	170000	4814	19.43	23967
1962	325500	9217	44.92	55408
1963	504000	14272	78.91	97334
1964	205000	5805	42.09	51917
1965	207000	5862	33.27	41038
1966	230700	6533	31.80	39225
1967	288600	8172	28.18	34759
1968	418100	11839	62.24	76772
1969	393300	11137	44.96	55457
1970	407400	11536	39.64	48895
1971	337800	9565	32.38	39940
1972	170500	4828	16.23	20019
1973	213300	6040	21.67	26730
1974	309200	8756	32.96	40656
1975	217200	6150	22.70	28000
1976	174400	4938	15.90	19612

VOLTA RIVER AUTHORITY

ENGINEERING DEPT

VOLTA RIVER FLOWS AT SENCHI/AKOSOMBO

Year	Peak inflow (cfs)	Peak inflow (m^3/s)	Annual Inflow (Maf) *	Annual Inflow (Mcm) **
1977	217200	6150	15.23	18786
1978	122100	3457	17.10	21093
1979	361000	10222	42.50	52423
1980	311000	8807	29.28	36116
1981	157400	4457	18.13	22363
1982	105900	2999	9.42	11619
1983	95760	2712	6.20	7648
1984	138600	3925	19.61	24189
1985	285000	8070	33.78	41667
1986	191000	5409	17.37	21426
1987	84000	2379	28.76	35475
1988	332000	9401	31.25	38546
1989	510000	14442	53.35	65806
1990	128000	3625	11.00	13568
1991	362000	10251	50.50	62291

Note:

* Maf --- Million acre-feet
** Mcm --- Million cubic metres

VOLTA RIVER AUTHORITY
ENGINEERING DEPARTMENT

VOLTA RIVER INFLOWS (cas) 1936 - 1991

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Avg
1936	116.0	62.0	34.0	37.0	207.0	326.0	355.0	1020.0	3130.0	5215.0	876.0	255.0	969.4
1937	103.0	52.0	35.0	45.0	92.0	201.0	538.0	981.0	4675.0	5264.0	695.0	127.0	1067.3
1938	69.0	30.0	21.0	16.0	108.0	259.0	686.0	981.0	3209.0	3589.0	956.0	217.0	845.1
1939	118.0	51.0	44.0	52.0	129.0	286.0	959.0	1749.0	5092.0	5822.0	1045.0	196.0	1295.3
1940	116.0	62.0	34.0	37.0	85.0	240.0	221.0	1317.0	3937.0	3935.0	1605.0	193.0	981.8
1941	102.0	44.0	21.0	22.0	129.0	463.0	694.0	2655.0	6814.0	3463.0	353.0	170.0	1244.2
1942	97.0	29.0	18.0	18.0	195.0	466.0	471.0	761.0	2846.0	1052.0	334.0	105.0	532.7
1943	28.0	13.0	9.0	33.0	142.0	233.0	379.0	864.0	3040.0	3746.0	1084.0	248.0	818.3
1944	129.9	67.4	77.4	81.7	123.7	199.0	443.2	1642.0	4495.5	3532.8	546.9	157.5	958.1
1945	92.1	23.0	17.8	29.4	53.6	225.0	755.1	2661.4	6523.7	6454.1	932.2	180.1	1498.6
1946	63.3	28.8	28.8	49.0	59.3	175.2	260.0	582.9	1896.5	3950.1	1640.0	199.3	744.4
1947	125.1	92.4	61.5	31.7	86.0	298.6	713.2	2694.6	8305.5	6219.2	893.3	214.8	1644.7
1948	118.6	49.4	56.7	22.9	143.9	497.3	670.3	1035.9	4308.7	2806.9	398.0	103.3	851.0
1949	41.1	22.0	21.0	34.7	41.1	380.2	1031.2	3530.2	8600.1	4321.6	862.4	194.6	1590.0
1950	79.2	44.7	22.1	26.2	81.3	202.0	407.2	933.5	2146.1	2259.0	472.4	109.6	565.3
1951	51.8	24.1	24.1	33.7	113.6	243.1	575.9	1290.5	4870.9	7767.3	5667.0	475.2	1761.4
1952	173.6	94.0	62.4	43.2	96.2	309.3	839.5	1383.6	4494.9	8893.1	2006.1	287.1	1556.9
1953	158.3	98.2	87.7	41.2	97.0	1120.1	1724.6	2608.4	6272.8	4529.3	605.4	181.5	1460.4
1954	127.7	77.8	32.6	20.3	94.3	327.7	299.9	837.5	4067.5	3912.9	964.8	393.8	929.7
1955	211.5	122.4	86.9	48.2	76.0	215.6	1695.1	5083.0	7821.7	6528.9	1305.2	436.0	1969.2
1956	198.1	88.1	48.9	32.6	52.9	112.5	268.6	674.7	3106.5	2887.5	433.5	204.3	675.7
1957	121.9	45.3	20.3	39.3	205.9	780.6	1315.3	3673.4	8612.4	7952.4	1642.6	605.8	2084.6
1958	219.0	89.4	39.2	44.8	54.6	152.5	159.0	476.2	1186.1	1253.9	484.8	331.1	374.2
1959	152.8	77.1	52.7	70.8	158.1	212.8	478.7	1397.1	5067.6	3317.3	368.2	136.8	957.5
1960	39.5	8.6	5.7	20.3	85.4	375.3	972.5	1812.2	5644.5	5584.2	637.3	226.1	1284.3
1961	70.2	24.0	11.4	33.7	90.8	326.7	948.8	1162.1	3584.6	1886.1	360.8	225.1	727.0
1962	91.8	41.1	24.8	80.8	123.6	449.2	1136.2	3085.5	8551.9	5431.3	1084.1	356.6	1704.7
1963	149.2	45.8	28.1	27.2	157.1	118.6	2619.5	8381.0	13690.7	8292.6	2083.9	492.7	3007.2
1964	202.1	74.3	45.2	56.8	88.3	341.0	595.4	2290.3	8083.3	6215.6	909.9	392.1	1607.9
1965	230.4	120.4	55.6	44.3	66.9	457.2	2211.5	2941.6	5353.4	3344.3	687.9	293.6	1317.3
1966	138.4	50.1	28.2	61.8	177.4	323.2	410.2	2536.8	4685.6	4854.3	1103.0	293.5	1221.9
1967	91.6	42.7	26.5	31.3	68.6	122.3	479.6	2565.4	4752.6	3665.6	1441.4	680.7	1164.0
1968	261.8	69.1	55.1	107.6	372.6	1078.8	3455.8	6372.5	9892.1	5304.7	1459.4	529.8	2413.3
1969	156.3	72.7	45.1	57.4	70.1	127.1	1016.2	2754.1	8055.1	5259.7	1591.4	395.1	1633.4
1970	122.3	54.8	35.2	19.6	51.3	71.5	200.8	2245.0	6797.3	4117.2	486.9	233.8	1203.0
1971	164.7	95.5	57.7	54.5	86.0	138.3	984.0	4086.6	7111.8	2404.8	404.3	167.1	1312.9
1972	63.1	31.3	20.9	28.3	96.5	321.3	491.2	1181.0	3372.3	1354.2	310.3	74.8	653.8
1973	49.7	25.9	12.5	15.4	78.6	165.2	480.9	3437.3	4377.4	1614.4	209.9	52.3	876.6
1974	22.8	11.6	15.6	15.1	88.0	137.3	852.7	2519.4	7127.0	3973.4	1176.4	200.1	1345.0
1975	64.8	33.2	18.4	62.4	73.4	192.9	1578.3	2256.4	3431.6	1920.8	441.5	165.5	853.3
1976	80.8	39.0	22.7	51.0	67.5	424.1	595.6	1269.7	1592.9	2029.4	1902.6	297.5	697.7
1977	73.2	39.3	18.9	31.3	74.9	168.3	348.7	1185.5	3334.1	1228.0	258.0	86.7	570.6
1978	40.9	21.0	22.6	42.1	149.8	296.1	1222.9	1816.5	2560.1	1321.9	425.4	141.7	671.8
1979	69.3	31.2	21.6	29.2	195.9	1016.7	2161.6	3854.8	6014.0	3570.0	823.9	277.2	1672.1

VOLTA RIVER AUTHORITY
ENGINEERING DEPARTMENT

VOLTA RIVER INFLOWS (cas) 1936 - 1991

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Avg
1980	88.9	45.2	26.9	20.4	102.3	267.6	387.4	2376.8	6384.7	2247.4	785.4	182.2	1076.3
1981	75.5	36.8	25.5	33.0	146.4	260.2	715.7	2355.4	3110.0	1150.6	362.9	108.7	698.4
1982	43.2	37.3	35.5	61.2	127.9	123.4	289.1	606.8	1707.6	814.6	238.2	95.7	348.4
1983	42.2	21.3	10.9	13.7	38.5	156.4	473.3	770.9	1256.5	393.4	54.8	17.3	270.8
1984	9.5	8.4	11.7	23.0	33.3	192.0	571.8	1480.6	3416.4	2475.6	608.4	161.6	749.4
1985	21.5	10.9	8.1	14.0	33.9	284.0	1519.2	4154.6	5970.0	3046.9	443.6	191.3	1308.2
1986	29.7	14.8	6.4	6.0	11.4	198.4	363.2	1460.7	3041.1	1420.0	447.5	339.8	611.6
1987	54.0	29.6	26.7	24.1	48.2	280.8	650.7	3025.1	6328.3	2235.8	363.3	105.1	1097.6
1988	35.5	15.2	10.0	25.0	85.5	185.4	1066.1	2091.6	6515.3	3494.8	511.3	213.2	1187.4
1989	125.5	40.6	25.4	51.3	129.5	194.6	1798.0	4677.3	10685.4	4824.8	529.4	223.6	1942.1
1990	72.2	56.8	24.1	33.4	58.7	134.9	444	1508.2	1522.1	480.2	105.6	39.6	373.3
1991	31.4	13.5	24.1	28.1	607.8	1575.5	3603.7	4982.35	7629.6	2757.9	766.5	207	1852.3
Max	261.8	122.4	87.7	107.6	607.8	1575.5	3603.7	8381.0	13690.7	8893.1	5667.0	680.7	3007.2
Min	9.5	8.4	5.7	6.0	11.4	71.5	159.0	476.2	1186.1	393.4	54.8	17.3	270.8
Avg	101.6	48.0	32.2	38.6	108.8	332.4	964.2	2453.1	5403.2	3662.5	880.0	243.3	1189.0

Note:
1. 1944-1964 flows are actual (gauged) streamflows.
2. 1965-1991 flows are reconstituted streamflows.

GHANA HIGHWAY AUTHORITY

ANNEX 4-(7)

In case of reply the number and date of this letter should be quoted.

My Ref. No. GHA/BD/27/99

Your Ref. No. .....

Tel. 66591-4
64627-9
64620

Telegrams / Cablegrams | HIGHWAYS

Head Office,
P.O. Box 1641,
Accra, Ghana.

MINISTRY OF ENERGY RECEIVED 30 JUL 1992 1395 ACCRA

29th July, 19 92

PNDC Secretary of Energy,
Thro' PNDC Secretary of Roads
and Highways,
Accra.

P.N.D.C. Secretary
MINISTRY OF ROADS & HIGHWAYS

Dear Sir,

LAYING OF HIGH TENSION TRANSMISSION LINE
ON LOWER VOLTA BRIDGE

Please refer to our meeting on Monday 27th of July 1992 at the Electricity Corporation of Ghana office, Accra where you requested to lay your High Tension Transmission line (electricity cable) on the Lower Volta Bridge.

In principle an approval for the laying of the cable is given. However, we wish to inform you that there is an impending rehabilitation works to be undertaken on the bridge.

During this rehabilitation where we have to reconstruct the piers a provision would be made to incorporate the laying of the cable on the piers.

Yours faithfully,

AG. CHIEF EXECUTIVE
K. ABBEY-SAM

cc: Dy. Chief Executive (Dev.)
Managing Director,
Electricity Corporation of Ghana,
Accra.

LOWER VOLTA BRIDGE AT SOGAKOPE

The Lower Volta Bridge at Sogakope on the Volta River was constructed between 1964 and 1966. The total length of the bridge is 646m consisting of 17 spans of 38m length. The width of the bridge is 12.5m with two walkways and carriageway.

The deck consists of prestressed concrete spans, each span comprises three main I beams connected together with stiffners. The superstructure is supported by abutment on each extremity and by fifteen intermediate reinforced concrete piers. One abutment and two adjacent piers are founded on rocks and the other abutment and piers are founded on 110m diameter reinforced concrete piles.

In 1977 the first reports were received by Ghana Highway Authority from some divers about damages to the piled foundations of the bridge. GHA commissioned two local diving firms to investigate and prepare reports with photographs showing the extent of damages. In 1985 Messrs Cementation International Limited (CIL) conducted further investigations on the bridge. CIL submitted Investigation Report supported with video tapes and still photographs. CIL's report confirmed the surveys which had already been carried out that some of the piles were on deplorable conditionds.

The German Government through K.F.W. has granted a loan of DM 20.6 million for the rehabilitation of the bridge. A German consulting firm has been appointed to do the designs for the rehabilitation works. The works might start by the end of 1993. The exact date of commencement of the rehabilitation will be known after the consultant has finished the designs and prepared the Tender Documents.

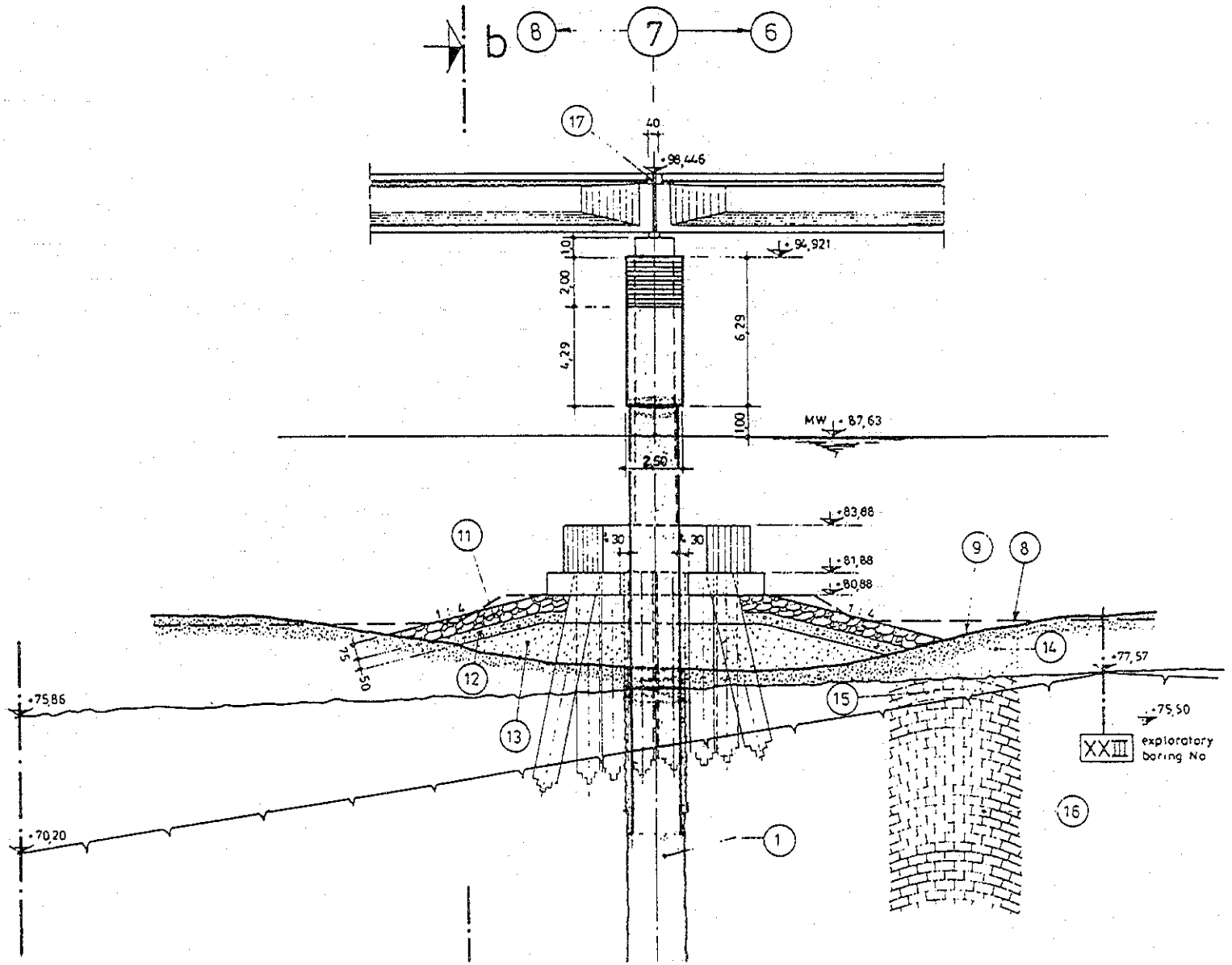
Attachment

a) Cross section of bridge showing proposed new bore piles

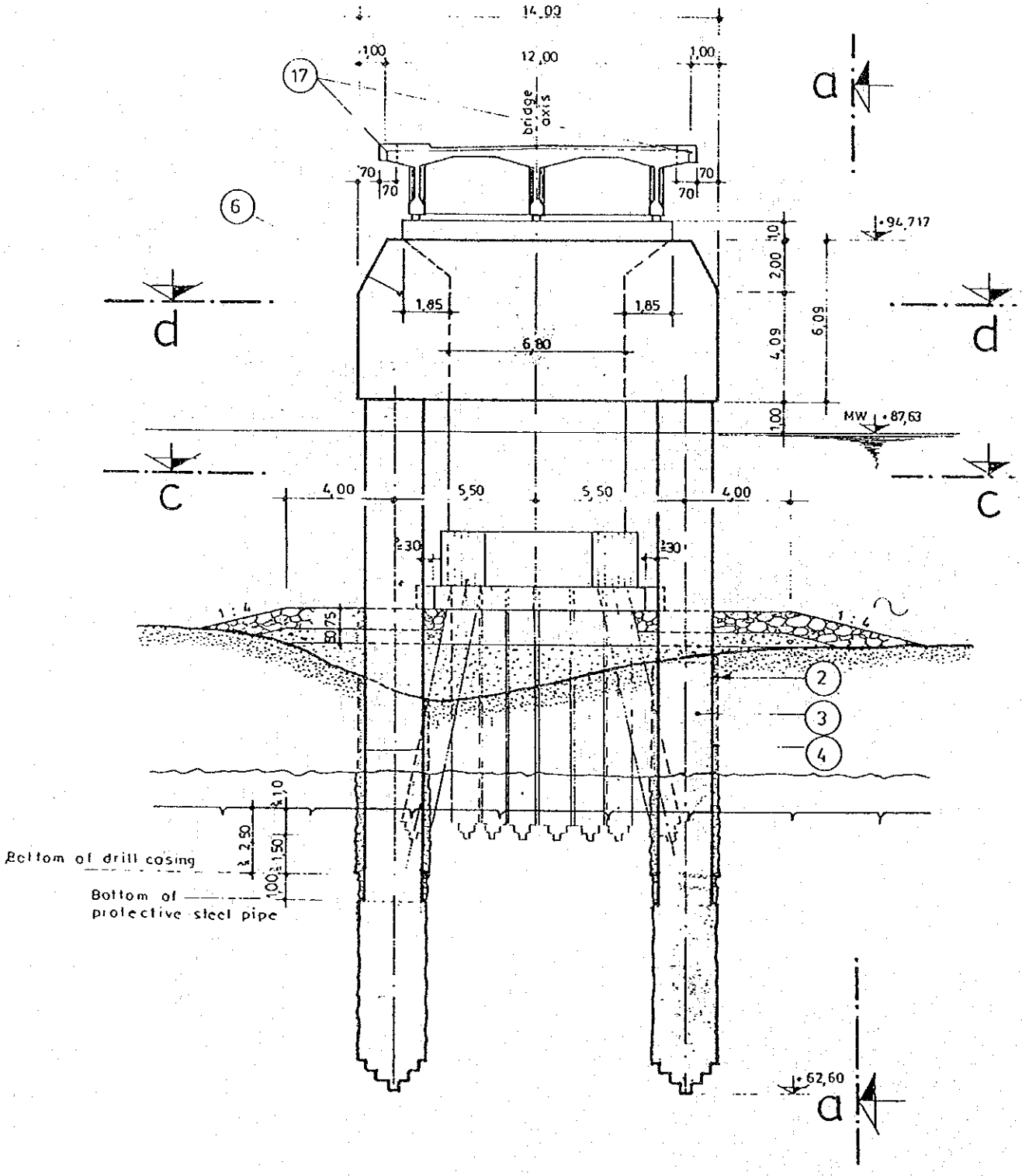
b) Side view of the bridge showing proposed new bore piles

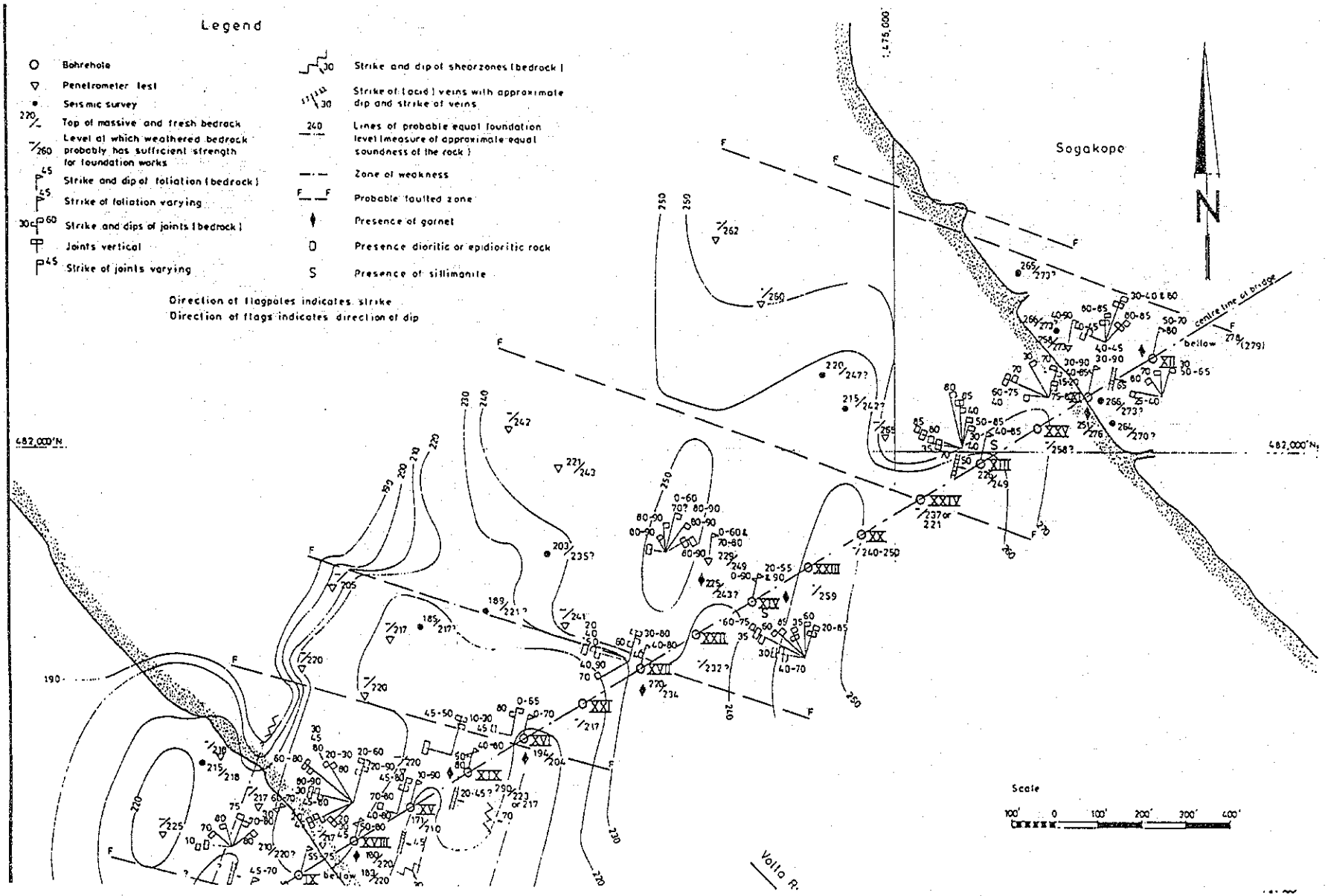
c) Survey plan of river bed along the bridge.

Section a-a

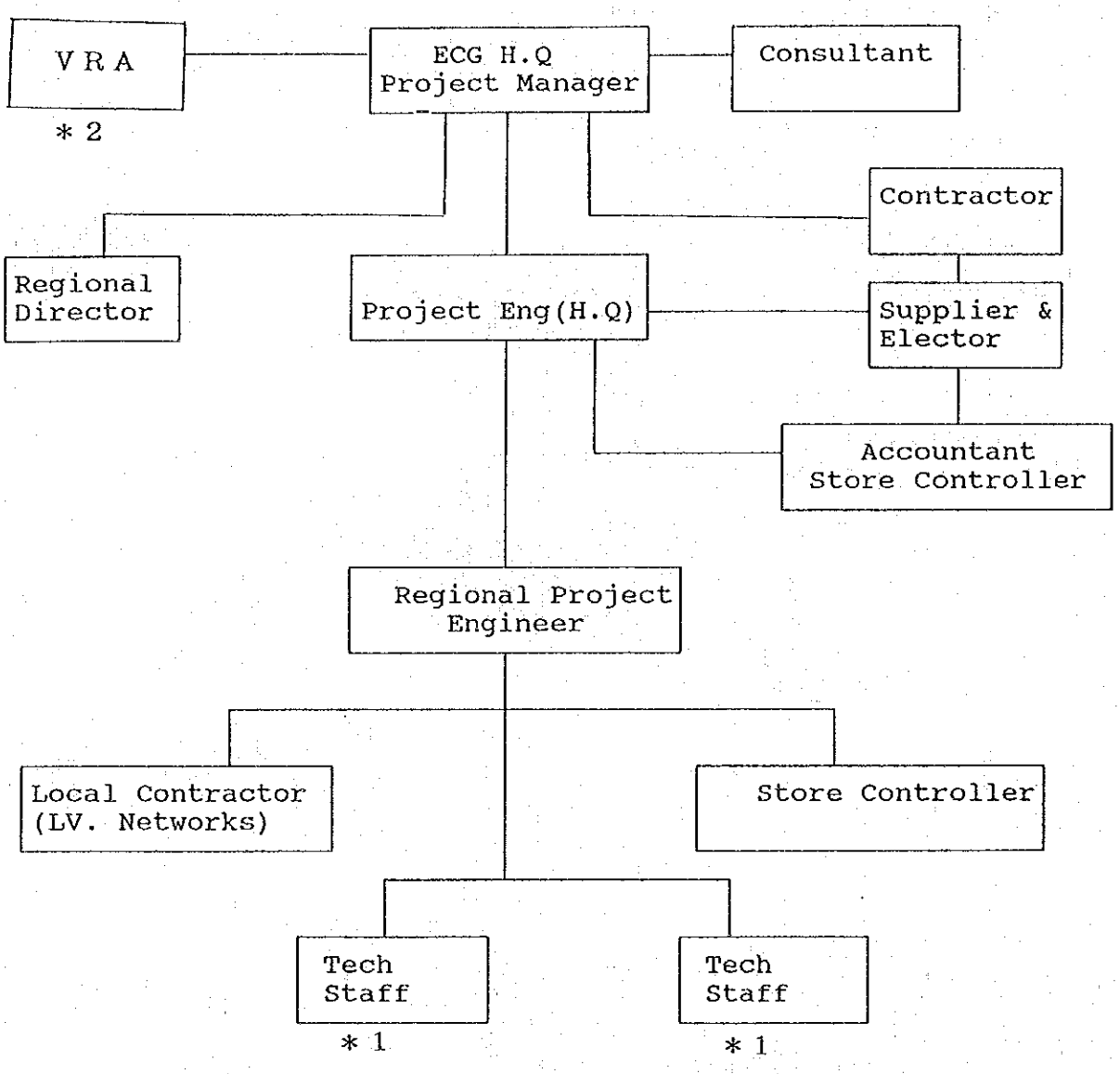

b
8
7
6
17
40
98,446
94,921
10
2,00
4,29
6,29
1,00
MW 87,63
2,50
83,88
30
30
81,88
80,88
11
9
8
14
77,57
75,86
12
13
15
75,50
XXIII
exploratory boring No
16
70,20
1

Section b-b


14,00
1,00
12,00
1,00
17
bridge axis
a
70
70
70
70
6
94,717
10
2,00
4,09
6,09
1,85
1,85
6,80
d
d
1,00
MW 87,63
c
c
4,00
5,50
5,50
4,00
30
30
1 : 4
1 : 4
50/75
2
3
4
≥1,0
≥2,50
≥1,50
100
Bottom of drill casing
Bottom of protective steel pipe
62,60
a

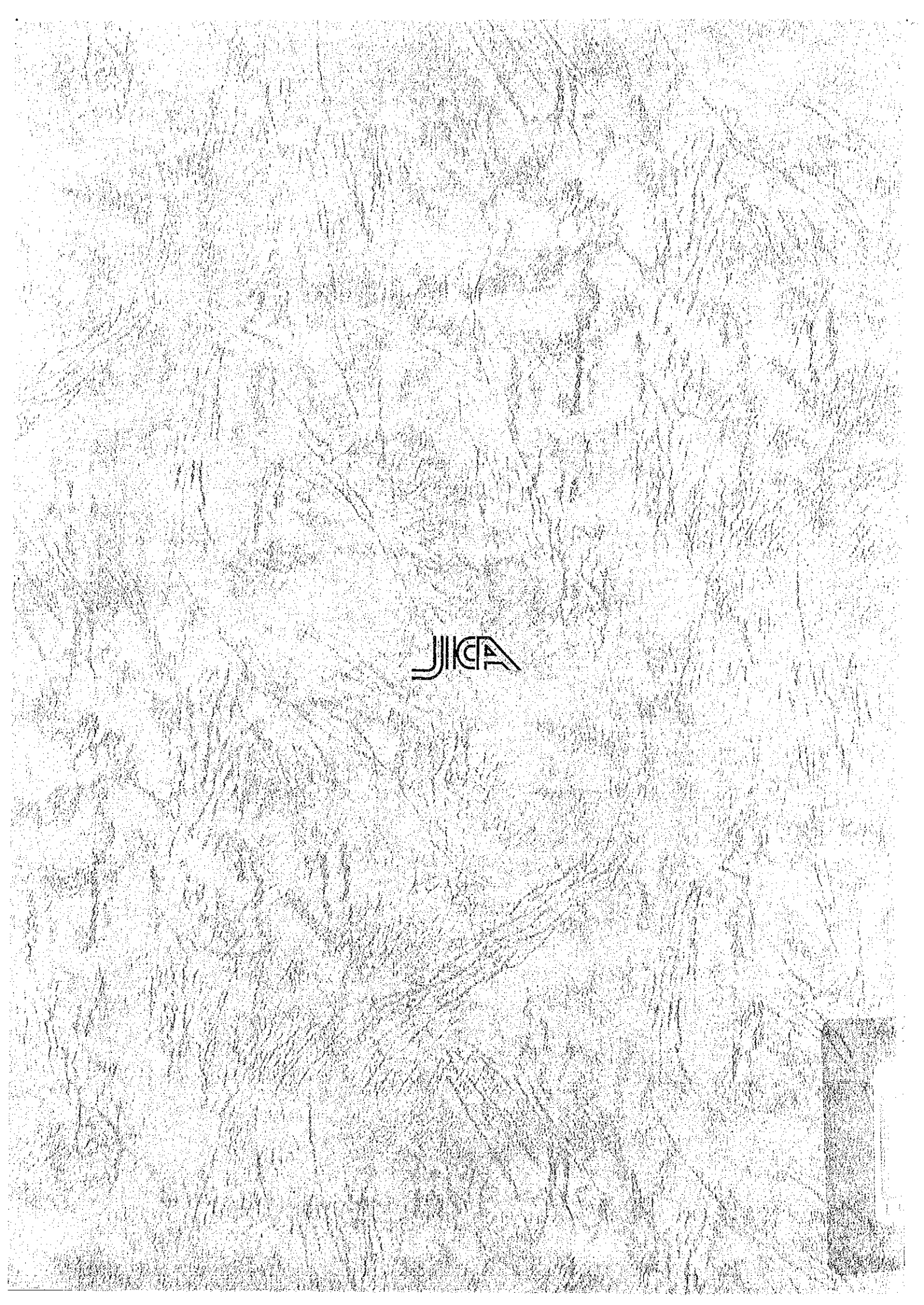

Legend
Bohrehole
Penetrometer test
Seismic survey
Top of massive and fresh bedrock
Level at which weathered bedrock probably has sufficient strength for foundation works
Strike and dip of foliation (bedrock)
Strike of foliation varying
Strike and dips of joints (bedrock)
Joints vertical
Strike of joints varying
Strike and dip of shearzones (bedrock)
Strike of (acid) veins with approximate dip and strike of veins
Lines of probable equal foundation level (measure of approximate equal soundness of the rock)
Zone of weakness
Probable faulted zone
Presence of garnet
Presence dioritic or epidioritic rock
Presence of sillimanite
Direction of flagpoles indicates strike
Direction of flags indicates direction of dip
Sogakope
482,000'N
Volta R.
Scale
100' 0 100' 200' 300' 400'

PROJECT ORGANIZATION OF ECG
FOR JAPANESE GRANT PROJECT



* 1 ; To be attached to the Foreign Contractor for
1. training in installation of s/s and
2. to ensure that line & s/s are erected according to ECG standards.

* 2 ; For 69KV facilities, ECG will receive the cooperation from VRA.


JICA