TASK ORDER 40
PHASE III

ENGINEERING AND FEASIBILITY ANALYSIS REPUBLIC OF VIETNAM RURAL ELECTRIC COOPERATIVE PILOT PROJECTS

TASK ORDER 40
CONTRACT AID/csd - 225
PIO/T 430-295-3-50136
VIETNAM - PHASE III REPORT

VOLUME III OF FINAL REPORT

Prepared By

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INTRODUCTION

I. SUMMARY PHASE III REPORT

Vietnam required an entirely different approach and procedure to the normal task order under Contract AID/csd-225. Many of the normal methods used in other countries were impractical, undesirable, unsafe and could not be accomplished fast enough to be effective.

A. EFFECT OF WAR SITUATION

The entire Republic of Vietnam is engaged is a war of aggression involving Vietnamese nationals on both sides between the Republic of Vietnam, Government forces aided by United Nations troops, mainly United States personnel, and the Viet Cong aided by the Communistic, Democratic Republic of North Vietnam, and Red China.

The majority of the land area is controlled by the Viet Cong, particularly is this true during periods of darkness. Heavy jungle, high country forest, rubber, banana, coffee and other fruit plantations give almost complete coverage to the Viet Cong during the daylight hours.

It is almost impossible, and often entirely impossible, to distinguish in any physical way a difference between the loyal Vietnamese and the Viet Cong.

Only in secure or reasonably secure areas can public works of this nature be accomplished. These areas are visited only by flying over many kilometers of Viet Cong held territory. No roads, including the super highway running north east from Saigon to near the Bien Hoa Airfield are safe for travel by Americans or Vietnamese Government troops during the night. Most are equally dangerous during the day.

In recent months the great influx of United Nations troops, and U. S. and

other allied non-military advisors has made almost impossible the task of supplying complete and satisfactory logistical support to the AID contractor.

The lack of security made impossible complete reconnaissance of the proposed pilot project areas, and undoubtedly some changes, additions and deletions will be necessary as the field engineering and construction take place. The inability to travel freely and easily prevented the team from accomplishing some of the detailed field inspection and test area engineering. Greater reliance, therefore, had to be placed upon experience in other countries, probabilities, and calculated assumptions, than the engineering section of the team would have normally used.

B. RURAL ELECTRIC COOPERATIVES -- A WEAPON OF COUNTERINSURGENCY

It became apparent early in the study that Rural Electric Cooperatives in the secure areas of Vietnam would be politically a weapon of counterinsurgency, equal or excelling in effectiveness any of the programs presently in use. These cooperatives could be a very strong incentive to encourage infiltered hamlets and villages to rid themselves of the unwelcome but tolerated Viet Cong. They will encourage these and other villages to defend their properties and improve the faltering morale. They will provide lighting for hamlet and village perimeters, that will give the advantage to the defending village guards by dispelling the darkness.

They will provide the working experience of democratic action, as the members select by ballot the people to represent them. Gradually the members will achieve pride in their ownership of this collective and joint venture. It is hoped that a democratic action pattern will be established and repeated in many other areas of endeavor.

As a result of the obvious potential of Rural Electric Cooperatives as counterinsurgency weapons, it was decided by USOM, U. S. Embassy, and the Government of Vietnam's highest officials that these Pilot Rural Electrification Projects be given every consideration in order that they might be placed in operation at the earliest moment.

C. EFFECT OF UNDERDEVELOPED STATUS OF VIETNAM AND THE RELATIVELY UNSTABLE CENTRAL GOVERNMENT OF THE REPUBLIC

Vietnam is relatively underdeveloped in nearly every aspect. This is particularly true of individuals trained for leadership; probably a result of many years of rule by the French when all leadership was provided and held by nationals of that country.

The rural areas were developed primarily for the purpose of exporting the products of the soil, produced mainly by human toil. Water buffaloes, oxen, elephants, and small ponies, according to the area, are used in tilling the soil and for hauling carts. The main highways are fairly good, many are bituminous surfaced. The mountain roads are quite crooked and the grades sometimes exceedingly steep. The roads in the more rural areas are dirt and natural gravel. The rural roads in the delta area are impossible to traverse during much of the monsoon period. However, in the delta area, the French dug canals for drainage of the swamp areas. These main canals and many of their laterals are navigable by sampans and small barges - all during high tide and many even at low tide condition. These canals and rivers form the principal method of transportation for the low land people. As a result, most of the hamlets and villages are found along these waterways. The lack of development of leadership plus the rather rapid changes in the control of the Central Government have

prevented the development and accumulation of accurate statistical data in any of the areas that could have been extremely helpful to us.

The lack of general and basic information by the Department of Electricity of Vietnam made this analysis particularly difficult. This deficit of information resulted partially from the many changes in the department heads after each change in government, and from the lack of information regarding the operations of the several French-owned companies. These companies are operating on franchises given by previous governments and show some understandable reluctance to turn over operating figures to Electricity of Vietnam.

Nearly all of the franchises will expire during the next few years and it is apparent that the properties will be turned over to Electricity of Vietnam to own and operate.

Another factor, clearly demonstrated by the recent take-over of the government by the military, is the unwillingness of government officials to commit themselves or their particular office on any major and many minor questions. This indecisiveness is understandable, as there is no pattern or guide lines established for the official to follow. It did, however, present serious difficulties, and often resulted in delay.

D. THE PHASE III STUDY OF FEASIBILITY AND PRELIMINARY ENGINEERING

The normal sequence of instigating Electric Cooperatives in underdeveloped countries is to make first a Phase I study of the potential of the entire country. Later this study is followed by a Phase II study of several areas of greatest potential. Specific information is obtained regarding the area, number of members, uses of electricity, probable load growth, sources of power and tentative cost of power. The laws, decrees and regulatory commissions are examined and

required changes are instigated. The cooperatives are organized and become legal entities if all of the requirements can be met.

It is then with this background of preparation, that the Phase III Engineering and Feasibility studies are made. These are normally the basic data required for a loan application to provide the funds for construction of the cooperative lines.

As the last step, Phase IV covers Engineering, Construction and a two year program of assistance in training the personnel in the operation of their cooperative electric system.

Vietnam with its unusual problems and the very unique aspect of using Rural Electric Cooperatives as a weapon of counterinsurgency required the speeded up, intensified, condensed and simultaneous production of Phase I, Phase II and Phase III studies covered in the Task Order, plus much of the detail produced only in the Phase IV portion of a normal development program.

Certain data produced as a result of long study in Phase I and II must be used as basic information for the Phase IV report.

As a result of the necessity of speeding up, condensing, and trying to produce simultaneously the three reports, the engineering section made many assumptions as to the data that would be developed during the courses of the first two reports. Many changes became necessary in the Phase III report as this data became available.

Under the circumstances already described, the engineering section produced this Phase III report on the several proposed Vietnam Rural Electric Pilot Projects.

II. GENERAL SUMMARY

The NRECA team in their Phase I and II reports recommend the development of the Tuyen Duc, An Giang, and Nha Trang areas. Two areas, Phan Rang and Ho Nai, were considered as alternates or additional areas for development.

Security in the Nha Trang area has become less certain. Development of this area will be in three sections. The first section serving approximately 5315 households can be built under present conditions. The second section mainly lying North of the Cat river can be considered only after the Viet Cong are cleared out of the area. The third section lies to the west and south of the first two, although partially secure, it cannot be built until security is achieved in the intervening areas of the second section. The second and third sections will serve 3760 members.

The Ho Nai area is compact, relatively secure, located near Saigon. The power supply is almost immediately available, and its construction would serve as a demonstration to Government officials and other interested Vietnamese and foreigners. The Ho Nai project will serve 7500 members.

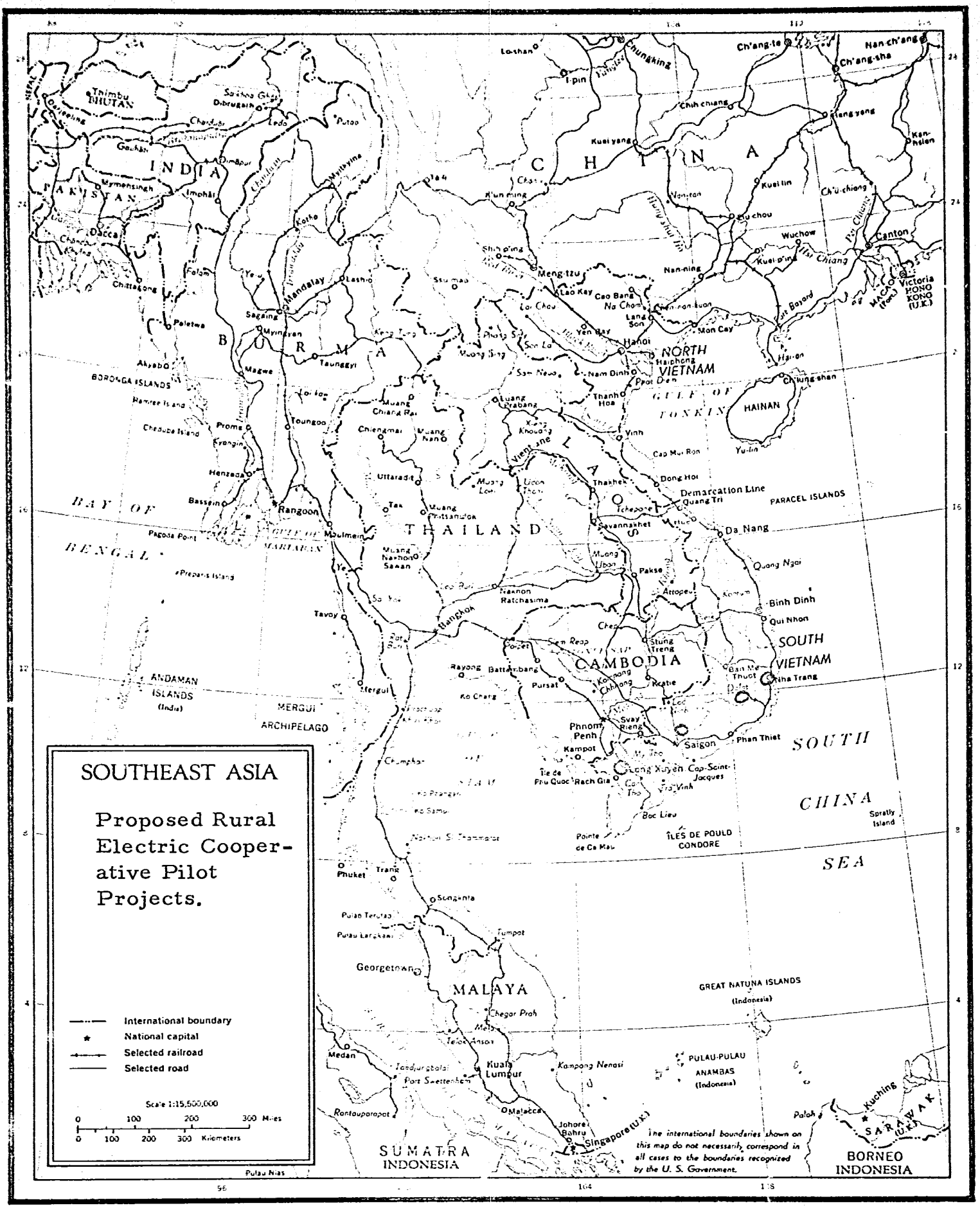
In view of the present inability for construction of the second and third sections in the Nha Trang area, and considering the compact area and relatively simple construction required for Ho Nai, it is the NRECA's Teams consensus, that the first section of Nha Trang and Ho Nai should be considered for immediate engineering and construction. The pilot project cost will not exceed the originally anticipated total.

III. SCOPE OF PHASE III REPORT

Each of the four recommended pilot projects are covered in individual sections of this report.

Complete engineering data is given for the Tuyen Duc Electric Cooperative, including required material lists.

Incomplete engineering data is given for Khanh Hoa and Ho Nai, lacking in part material lists, construction details and definite descriptions of area, principle crops, and details of power use. General descriptions are given. In general this is assumed to be sufficient for project determination.


SOUTHEAST ASIA
Proposed Rural Electric Cooperative Pilot Projects.
International boundary
National capital
Selected railroad
Selected road
Scale 1:15,500,000
0 100 200 300 Miles
0 100 200 300 Kilometers
INDIA
PAKISTAN
BURMA
CHINA
NORTH VIETNAM
SOUTH VIETNAM
LAOS
THAILAND
CAMBODIA
MALAYA
SUMATRA
INDONESIA
BORNEO
INDONESIA
BAY OF BENGAL
GULF OF TONKIN
SOUTH CHINA SEA
HAINAN
ANDAMAN ISLANDS (India)
MERGUI ARCHIPELAGO
PARACEL ISLANDS
SPRATLY ISLAND
ILES DE POULD CONDORE
GREAT NATUNA ISLANDS (Indonesia)
PULAU-PULAU ANAMBAS (Indonesia)
BORONGA ISLANDS
Hanoi
Haiphong
Saigon
Phnom Penh
Bangkok
Rangoon
Singapore (U.K.)
Kuala Lumpur
Victoria HONG KONG (U.K.)
MACAO (Port.)
SARAWAK (U.K.)
The international boundaries shown on this map do not necessarily correspond in all cases to the boundaries recognized by the U. S. Government.

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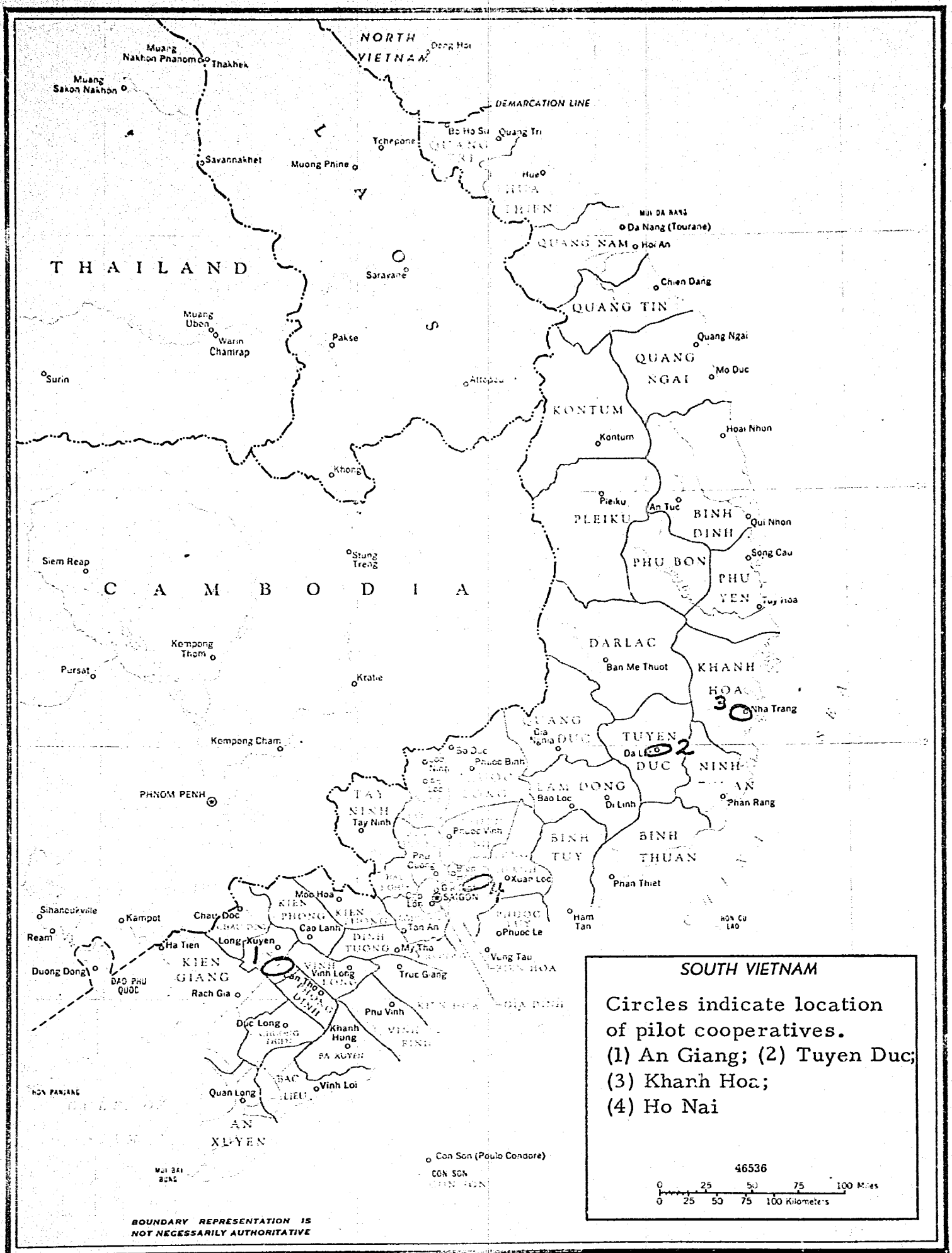

NORTH VIETNAM
DEMARCATION LINE
THAILAND
CAMBODIA
Muang Nakhon Phanom
Thakhek
Muang Sakon Nakhon
Savannakhet
Muong Phine
Tchepone
Quang Tri
Hue
Da Nang (Tourane)
Hoi An
Chien Dang
Saravane
Muang Ubon
Warin Chamrap
Pakse
Surin
Attopeu
Quang Ngai
Mo Duc
Kontum
Hoai Nhon
Khong
Pleiku
An Tuc
Qui Nhon
Siem Reap
Stung Treng
Song Cau
Kompong Thom
Pursat
Kratie
Ban Me Thuot
Nha Trang
Kompong Cham
Da Lat
Phuoc Binh
Bao Loc
Di Linh
Phan Rang
PHNOM PENH
Tay Ninh
Phuoc Vinh
Xuan Loc
Phan Thiet
Sihanoukville
Kampot
Chau Doc
Moc Hoa
Ream
Ha Tien
Cao Lanh
Long Xuyen
Tan An
My Tho
Ham Tan
Phuoc Le
Vung Tau
Duong Dong
Vinh Long
Truc Giang
Rach Gia
Phu Vinh
Duc Long
Khanh Hung
Quan Long
Vinh Loi
Con Son (Poulo Condore)
KIEN GIANG
AN XUYEN
DARLAC
KHANH HOA
TUYEN DUC
LAM DONG
BINH TUY
BINH THUAN
PLEIKU
PHU BON
PHU YEN
KONTUM
QUANG NGAI
QUANG TIN
QUANG NAM
THUA THIEN
DAO PHU QUOC
SAIGON
BOUNDARY REPRESENTATION IS NOT NECESSARILY AUTHORITATIVE
SOUTH VIETNAM
Circles indicate location of pilot cooperatives.
(1) An Giang; (2) Tuyen Duc;
(3) Khanh Hoa;
(4) Ho Nai
46536
0 25 50 75 100 Miles
0 25 50 75 100 Kilometers

IV. SUMMARY PROJECT BUDGET REQUIREMENTS

4 PILOT PROJECTS

TUYEN DUC	$ 521,000	US	$ 17,193,000	VN
AN GIANG	819,000	US	61,366,000	VN
KHANH HOA	287,635	US	13,452,000	VN
HO NAI	255,800	US	14,295,000	VN
	$1,883,435	US	$106,306,000	VN
House Wiring			46,000,000	VN
An Giang Power Plant	300,000	US		
TOTAL	$2,183,435	US	$152,306,000	VN

Conversion at official rate of exchange of VN dollars to US dollars of 73 to 1

VN $152,306,000 = $4,269,772 US

US Dollar requirement		$2,183,435
VN " "	in US$	$2,086,337
Total 4 project cost in US Dollars:		$4,269,772

Mr. Hubert Bush
NRECA
SAIGON

July 8, 1965.

Subject: Pilot Electric Cooperatives

Dear Mr. Bush:

Following our talks yesterday, we would like to explain to you our position regarding the Pilot Electric Cooperatives to be set up in Vietnam:

(1) The objectives of the Electricity of Vietnam (E.O.V.) are: a) to serve the people with electricity with progressively improved quality and at a reasonable but realistic rate. b) to promote the use (or the sale) of electricity for economic development and general well-fare of the people.

As we understand the proposed Pilot Electric Cooperatives (COOP) have these same objectives, we hereby fully support the establishment of such cooperatives.

(2) The relation between EOV and COOP will be exactly the same as that between the R[illegible] and the NRECA Cooperatives in U.S.A. except that EOV also supplies wholesale power to the Cooperatives. In other words, EOV will play the role exactly the same as REA does in the U.S.

(3) All Capital funds (Grant or else) will flow through GVN, PWM (PUBLIC WORKS MINISTRY) and EOV to the Cooperatives as suggested in your chart.

(4) The GVN will regulate the power rates over the whole country. Therefore, the retailing rates of the Cooperatives may have to be subject to such regulation.

(5) Each Coop will operate in a well defined area to be determined upon negotiation between EOV & COOP.

(6) All production, transmission and subtransmission facilities are to be owned and operated by EOV.

(7) To avoid unnecessary investment on the part of EOV, each COOP will have to guarantee a minimum amount of consumption proportional to its demand.

(8) Electricity of Vietnam will sell to the TUYEN DUC Electric Cooperative all of the distribution facilities owned and operated by Electricity of Vietnam and located along their 30 kv subtransmission line between and including the village of Trai Mat and including the village of Dran, but excluding the 30 kv subtransmission line, the tea plantation located at Cau Dat and the porcelain plant located in Trai Mat. (to be shown on a map)

The sale price of these facilities shall be determined by the original cost less the proper depreciation.

The Cooperative will pay Electricity of Vietnam by one lump sum payment.

Electricity of Vietnam will provide suitable circuit diagrams and/or maps showing the location, type and amount of equipment involved in each hamlet or village.

Electricity of Vietnam will provide a complete list of all facilities and equipment giving the quantity, originally installed cost and a complete description of the facilities or equipment to be sold to the Cooperative.

the NRECA team will inspect, tabulate the proposal of sale and recommend to the Cooperative board the purchase of these facilities.

Electricity of Vietnam will supply to the Tuyen Duc Electric Cooperative all the required electric energy.

One point of sale shall be the high voltage side of the Cooperative's proposed 1500 kva 30/15 kv substation located in the village of Dran. The exact location of the substation is to be concurred by EOV.

Other points of sale will be located as required along the existing Electricity of Vietnam kv line including points within the boundaries at the city of Dalat to serve the hamlet of Trai Mat located within the boundaries of the city of Dalat and to serve the hamlet of Thai Phienl, Thai Phien II, Darchoa A, and Darchoa C located without the boundary of Dalat but requiring lines to be connected within the City of Dalat boundaries.

The area to be served by the 'Cooperatives' will be shown on a map. The Electricity of Vietnam will sell to the Tuyen Duc Electric Cooperative all the electrical energy as required by the cooperative at a rate of VN$ 1.3 per KWH net to EOV. The taxes are not included.

(9) Electricity of Vietnam will supply the proposed Ho Nai Electric Cooperative all the electric energy required.

The point of sale shall be at the north bay of the Electricity of Vietnam 20 MVA 66/15 kv Dong Nai Substation.

Electricity of Vietnam will grant all right of way inside the substation necessary to make the required connection.

Electricity of Vietnam will sell the proposed Ho Nai Electric Cooperative energy as required by the cooperative at a tentative rate of VNS 1.80 per kwh. This rate is subject to adjustment pending results of study by a rate-specialist.

(10) The rural Electric Cooperative of Vietnam shall have the right to negotiation with EOV to construct the 66 kv subtransmission lines whenever EOV is not able to do it by itself.

(11) Any customer inside the operating area of the COOP should have the right to apply directly to EOV for bulk power supply of 1,000 kw and up.

Sincerely,

Nguyen Huu Minh
General Director,
Electricity of Vietnam

P.S. The contents of this letter will be subject to approval by the Minister of the Public Works and Communications.

VI. FINANCING THE CONSTRUCTION OF THE PILOT RURAL ELECTRIC COOPERATIVES

The general understanding of the NRECA team is that all monies required to construct the pilot projects are to be provided from the Counter-Insurgency fund.

Discussions to this end were held with Mr. Allen Strachan.

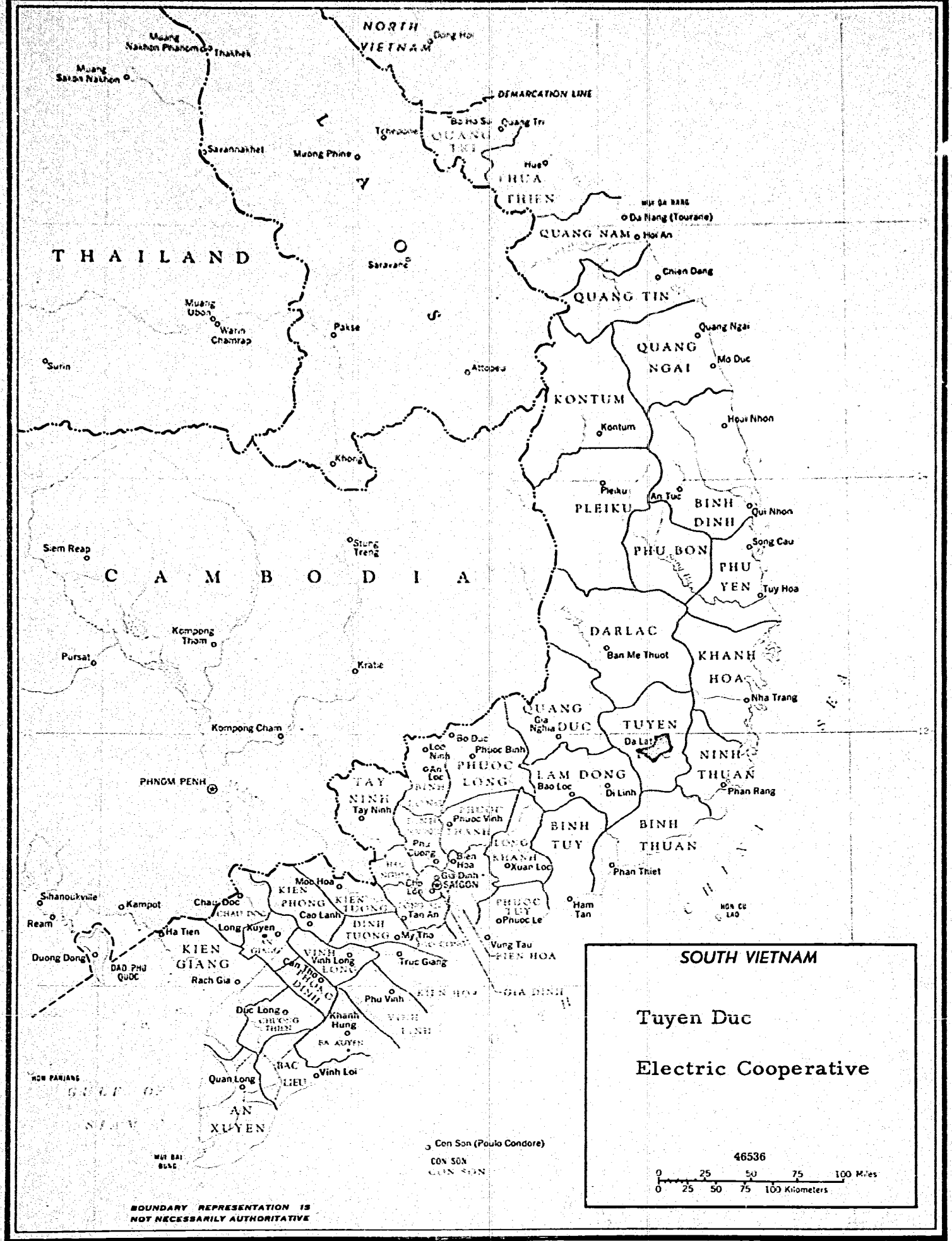
AID Program Officer, Mr. Gardner, stated that the program office will work out the details of providing the required capital.

PROPOSED

TUYEN - DUC

ELECTRIC

COOPERATIVE


NORTH VIETNAM
DEMARCATION LINE
THAILAND
CAMBODIA
Muang Nakhon Phanom
Thakhek
Muang Sanan Nakhon
Savannakhet
Muong Phine
Tchepone
Quang Tri
Hue
THUA THIEN
Da Nang (Tourane)
QUANG NAM
Hoi An
Chien Dang
QUANG TIN
Saravane
Muang Ubon
Warin Chamrap
Surin
Pakse
Attopeu
Quang Ngai
QUANG NGAI
Mo Duc
KONTUM
Kontum
Hoai Nhon
Khong
Pleiku
An Tuc
PLEIKU
BINH DINH
Qui Nhon
Siem Reap
Stung Treng
PHU BON
PHU YEN
Song Cau
Tuy Hoa
Kompong Thom
Pursat
Kratie
DARLAC
Ban Me Thuot
KHANH HOA
Nha Trang
Kompong Cham
QUANG DUC
Gia Nghia
TUYEN
Da Lat
LAM DONG
Bao Loc
Di Linh
NINH THUAN
Phan Rang
Bo Duc
Loc Ninh
An Loc
Phuoc Binh
PHUOC LONG
PHNOM PENH
TAY NINH
Tay Ninh
Phuoc Vinh
BINH TUY
BINH THUAN
Phan Thiet
Xuan Loc
Bien Hoa
Gia Dinh - SAIGON
Cho Lon
Moc Hoa
KIEN PHONG
KIEN TUONG
Cao Lanh
Tan An
Sihanoukville
Kampot
Chau Doc
Ream
Ha Tien
Long Xuyen
My Tho
Ham Tan
Phuoc Le
Vung Tau
BIEN HOA
Duong Dong
DAO PHU QUOC
KIEN GIANG
Rach Gia
VINH LONG
Vinh Long
Can Tho
Truc Giang
PHONG DINH
Phu Vinh
Duc Long
CHUONG THIEN
Khanh Hung
BA XUYEN
BAC LIEU
Vinh Loi
Quan Long
AN XUYEN
Con Son (Poulo Condore)
CON SON
HON KHOAI
HON CO LAO
HON PARIANG
MUI BAI BANG
SOUTH VIETNAM
Tuyen Duc
Electric Cooperative
46536
0 25 50 75 100 Miles
0 25 50 75 100 Kilometers
BOUNDARY REPRESENTATION IS NOT NECESSARILY AUTHORITATIVE

SUMMARY

TUYEN DUC ELECTRIC COOPERATIVE

1. Borrower: Government of Vietnam will receive a grant to loan to Tuyen Duc Electric Cooperative of Dalat, South Vietnam.
2. Amount: $521,150.00 US Dollars plus 17,192,525.00 $ VN.
3. Total cost of project: (VN $ 73/1 US $) $756,663.00 US.
4. Purpose: To extend and improve electrical facilities for the distribution of electricity to the rural areas of Tuyen Duc province of South Vietnam to be used as a Pacification project.
5. Background: AID/Washington signed a contract with National Rural Electric Cooperative Association (NRECA) to provide technical advisory services for the rural electrification in the developing countries of the Free World.

Clyde Ellis, General Manager of NRECA, and Tom Venables, NRECA/AID Global Contract Coordinator, visited Vietnam at invitation of A.I.D. and after consultation with officials, it was decided to start immediately with a program to set up rural electrification in South Vietnam.

The work to be done should be viewed as a pilot project and be moved as rapidly as possible. The success or failure depends on the speed at which this work can be started.

The Cooperative in Tuyen Duc province near Dalat, is moving rapidly. Organization was completed and it became a legal entity on June 22, 1965.

6. Project description: The electric system to be financed will belong to a member-owned cooperative composed of the people of Tuyen Duc province, serving an area that has a population of approximately 60,000 people.

The system will consist of a 1500 KVA substation and buy power from Electricity of Vietnam, at 30 KV and step down to 15/8.6 KV. It will have approximately 125 miles of secondary and services to serve 8000 plus consumers with transformers and meters and meter loops. The system is designed to handle 8000 plus consumers with an average KWH usage in ten years of 50 KWH per meter.

Included in the loan is money to relend to consumers for wiring of houses and buying of electrical equipment, and to train personnel in operation, and management. NRECA personnel will be retained for consultative work for at least two years.

PROPOSED PROJECT TUYEN-DUC

The project comprises:

1. Construction of one 1500 KVA step down substation - 30/8.6/15 KV.
2. Construction of approximately 25 miles of 3 ∅ 8.6/15 KV line.
3. Construction of approximately 100 miles of 1 ∅ 8.6/15 KV lines.
4. Construction of approximately 126.5 miles of secondary, underbuild and services to serve approximately 74 villages with an estimated 8356 houses.

5. Installation of:

8.6/15	300 - 5 KVA	=	1500 KVA
"	75 - 10 KVA	=	750 KVA
"	10 - 15 KVA	=	150 KVA
"	5 - 25 KVA	=	125 KVA
	Low voltage - 2 bushing - 230 volts		2525 KVA

30 KV/230?280 - 3 phase (for villages)

4.	75 KVA	300
4.	150 KVA	600
		900 KVA
	Total installed	3425 KVA

LOCATION AND DESCRIPTION OF AREA TO BE SERVED BY THE TUYEN-DUC SYSTEM

I. Size of project is approximately 1000 Sq. miles. In Dalat area, about 180 miles N.E. of Saigon.

II. According to history and legend people have lived in the area since time began. In some of the area live the Montagnard villagers. In other areas large villages of North Vietnamese have moved in. These refugees are very progressive people.

III. Population: Vietnamese census data indicates approximately 10 to 12,000 families live in the area. Using 6 per family this would give approximately 65 to 70,000 people in the area. In the Tuyen Duc area the people live in hamlets of 20 to several hundred households. A number of physically connected or non-connected hamlets in the area are joined together administratively to form a village.

IV. Economics of area - The area is a farming community. Villages or hamlets being along the highways or a short distance therefrom. All activity is centered around the village or hamlet. All trading is transacted in the market places and these are the centers of community life.

V. Communications with the outside world are largely by transistor radios. There is telephone service between the larger cities. There is no commercial television in South Vietnam at this time - 5/30/65. Newspapers are delivered from Saigon to villages along highways.

VI. Hydrology of area. The area is one of high rainfall in monsoon seasons. Being approximately 60 to 70 inches per year.

The most important river in the area is the Da Nhim. Much study has been done on the utilization of the rivers for irrigation and hydro electric development.

VII. Land use. The land is farmed in basically small tracts.

The Government now controls all forest and surplus land. What land reforms have been initiated are not known.

VIII. Principal products of the economy:

Rice	Cabbage	Tea
Sugar cane	Onions	Coffee
Mais (maize)	Garlic	Cotton
Pineapple	Mangustan	Kenaf
Soya beans	Rubber	Tobacco
Sweet potatoes	Bananas	Ramie
Cassava	Sereology	Jute
Peanuts	Coconut	Lumber

IX. Industries that can be developed:

1. Sawmills capacities increased
2. Porcelain plants capacities increased and quality improved
3. Pineapple cannery
4. Rubber processing plant
5. Instant coffee plant
6. Instant tea plant
7. Vegetables canning plant
8. Jute & ramie mill
9. Small machine shops
10. Cabinet & furniture shop
11. Automotive repair shops
12. Movie houses
13. Irrigation
14. Creosoting plant for timber, primarily power line poles

Many of these small family type industries exist but adequate and dependable power is needed at reasonable cost.

X. Justifications for rural electrification of the area.

1. Low cost - Plentiful hydro electric power - in fact an excess.

2. People who have desire for electric service and willingness to pay for dependable service.

3. A high degree of willingness to cooperate between hamlets, villages and the provincial authorities.

4. People who have a basic knowledge of cooperative work and the ability to carry the program to reality.

5. A basic land owner type of service (i.e.: Consumer = land owner).

6. A program of powerful political impact.

7. Great agricultural and industrial potential.

8. Increased security through adequate lighting.

T U Y E N D U C

PROSPECTIVE CONSUMER LIST

Village or Hamlet	Prospective Consumers	Estimated KW
Quang Lac	91	20.4
Can Rang .	400	77.9
Tram Hanh	110	24.2
Phat Chi	150	31.8
Truong Son	80	18.1
Xuan Truong	140	30.1
Xuan Son	98	21.7
Xuan Thuong	445	85.9
Xuan Thuong II	140	30.1
Tuy Son	87	19.5
Da Tho	105	23.1
Da Loc	140	30.1
Da Quy	23	6.2
Tri Mot	205	42.1
Xuan Thanh	99	21.9
Phung Son	22	6.0
Thai Phien I	78	17.7
Thai Phien II	80	18.1
Darchoa C	140	30.1
Darchoa A	220	45.0
Lam Tuyen	140	30.1
Phu Thuan	109	24.0
Duong Moi	89	20
Hoa Binh	57	13.5
Lac Thien	230	46.7
Lac Quang	74	17.0
Lac Xuan	92	20.6
La Bouye	37	9.2
Lac Binh	42	10.3
Diem B	15	4.3
B Ke	22	6.0
Lac Vien	204	42.0
Diem A	45	10.9
Xuan Truong	140	30.1
Yen Khe Ha	160	33.6
Quynh Chau Dong	165	34.6
Dong Thanh	80	18.1
Lac Thanh	30	7.7
Kado	25	6.6
Lac Lam	57	13.5

Village or Hamlet	Prospective Consumers	Estimated KW
Hai Duong	166	34.8
M Rang	25	6.6
Lac Son	30	7.7
M Lon A	25	6.6
Thanh Nghia	190	39.3
M Lon B	15	4.3
Tung Nghia	250	50.5
Drong	20	5.5
Petautadah	22	6.0
Coffee & Rubber	-	200.0
Bac Hoi	78	17.7
Quang Hiep	79	17.9
K' Long A	17	4.8
Klong Kil	13	3.8
Dinh An	99	21.9
Finnon	75	17.2
Tan Hiep	70	16.1
Military Camp	-	-
An Hiep	168	35.2
Refuge in Old Reg. Fore	300	59.5
Kog Lam	15	4.3
Dame	234	47.4
Nho Hong	18	5.0
Klong Toum	20	5.5
Thanh Binh	195	40.3
Binh Hai	133	28.5
Lien Binh	58	13.7
Kim Phat	72	16.6
Souane	15	4.3
Da Huynh	30	7.7
Koya	15	4.3
Gia Thanh	34	8.6
Riong Bolieng	18	5.0
Riong Sereigne	17	4.8
Riong Serignac	149	31.6
Dabrach	105	23.1
B Neur Rhin & SS	57	13.5
Dampao	227	46.1
Da Nung	107	23.5
Datonac	420	81.6
	15	4.3
R Lom	65	15.1
Ngoc Son	78	17.7
Bang Thien	75	17.2
Lac Son	71	16.4

Village or Hamlet	Prospective Consumers	Estimated KW
Lien Hiep	79	17.9
Nghia Iam	70	16.1
Cao Thai Son	89	20.0
Nam Son	335	66.0
Thai	301	59.9
Cao Bac Lang	554	104.8
Luc Nam	202	41.6
Phu Hoi	197	40.7
Pre Rion	27	7.0
Pre Boyan	24	6.4
Tchirong Tamboren	29	7.5
GROSS TOTAL	10,468	2,410.2

220 Watts per Cons.

10,258 Cons. @ 50 KWH/mth	1890
	52
KW Demand	1942
Less	539
Size of Sub needed in KW	(1403)

Use 1500 KVA - Sub.

TUYEN DUC ELECTRICAL COOPERATIVE

6/7/65
LMR

ESTIMATED PEAK KW DEMAND REQUIREMENTS BY YEARS

	66	67	68	69	70	71	72	73	74	75
No. of cons.	2000	3000	4000	4700	5400	6100	6800	7200	7400	7600
KWH / Cons. / MTH	25	28	30	33	35	38	40	42	45	50
KW Demand	314	471	628	737	846	942	1065	1126	1159	1436
2 Large Loads KW Demand*	200	200	200	250	250	250	275	275	300	300
Total Demand	514	671	828	987	1096	1192	1340	1401	1459	1736

All consumers are considered in one category except as noted.

No diversity factor was considered. But estimated line losses are approximately 15%.

*Large Loads

Airport	50	KW
Porcelain plant	150	KW

BUDGET ANALYSIS

TUYEN DUC RURAL ELECTRIC COOPERATIVE

		Material Off Shore US Dollars	Material Local VNS	Labor & Overhead VN $
1.	DISTRIBUTION			
	a. Right of way Procurement & Clearing			839,500
	b. Poles & Pole Top fixtures	161,000		912,000
	c. Conductor	56,400		335,000
	d. Transformers (Line)	68,700		100,000
	e. Services	21,000	7,775,320	1,600,000
	f. Metering	38,400		50,000
	g. Sectionalizing equipment	6,500		10,000
	h. Regulators	7,000		10,000
2.	SUBSTATIONS			
	a. Land and land rights		10,000	
	b. Structure	14,000	60,000	150,000
	c. Conduit & Wiring	4,700	20,000	40,000
	d. Reclosers (6)	2,600	2,500	5,000
	e. By pass switches	1,200	2,500	5,000
	f. Grounding	1,000	2,500	50,000
	g. Transformers	29,000	20,000	5,000
	h. Air Break switches	1,400	2,500	5,000
	i. Lightning Arrestors	2,000	2,500	5,000
	j. Fence		68,255	15,000
3.	GENERAL			
	a. Office equipment & furniture		365,000	
	b. Transportation	14,000		
	c. Tool & Work equipment		127,750	
	d. Two way radio	5,250		
	e. Maintenance material	10,000		
4.	OFFICE & WAREHOUSE		1,000,000	600,000
5.	ACQUISITION			
6.	ADMINISTRATION			
	a. Legal fees			91,250
	b. General overhead			606,000
	c. Operating capital		3,650,000	
7.	HOUSE WIRING FUND (for reloan)		*10,000,000	
8.	CONTINGENCY	77,000		2,299,950
		521,150	9,458,825	7,733,700
	VN S 50 to 1 US	26,058,000	9,458,825	7,733,700

*Not Capitalized — Total Piasters nearest 1000 - VN $ 43,251,000

ASSUMPTIONS FOR FINANCIAL PROJECTION ESTIMATE

TUYEN DUC

1. In lieu of power plant - A substation of 1500 kva will be built.

2. Monies for relending will be 10,000,000 Piasters.

3. Contingency cost and Miscellaneous will be $77,000 US plus 2,299,950 Piasters.

4. Relending & Contingency is not included as part of original capital cost.

5. That consumers will be added as shown but largest portion of system must be built first year.

6. That power will be purchased from E.O.V. at 1.3 piasters per KWH.

7. That G.V.N. will agree to the rental rates used in the study.

8. That there will be no production tax charged to the cooperative for "wholesale for resale" energy purchased.

SIMPLE BASIC DATA ACQUIRED FOR ESTIMATING KWH CONSUMPTION FOR DESIGN. TUYEN DUC.

From the many areas visited and many bills that we looked at, the studies of Ebasco, Scharff, Schobinger, Leer Burger, Day & Zimmerman, visiting with personnel of the Power Office of Public Works Division, Mr. Pike, Sanger, Sparks, Fong and any other people about usages and trends we arrived at the following assumptions :

1. The average monthly usage per consumer would be 10 KWH initially.
2. The total number of consumers initially would be one-fourth (1/4) of estimated total.
3. The average KWH usage per consumer per month would increase to 50 KWH usage per month in 10 years.

NOTE : A. That at the end of 10 years 95% of 8,356 total estimated consumers would be connected.

4. No assumption was made to differentiate between a small commercial and a rural consumer of village.
5. Where a large concentrated load existed it was treated as such.
6. Design data on line construction is as per REA Specification U. S. A. See specifications in study.

T U Y E N D U C

BALANCE SHEET AND CASH FLOW

Proposed by Ham, June 25
Approved H. Bush, 1965

	1st. year	2nd. year	3rd. year	4th. year	5th. year	6th. year	7th. year	8th. year	9th. year	10th. year
1 : Total connected consumers	2,000	3,000	4,000	4,700	5,400	6,100	6,800	7,040	7,380	7,600
2 : Average monthly sales/ consumer	25	28	30	33	35	38	40	44	47	50
3 : Total annual sales/cons.	300	336	360	396	420	456	480	528	564	600
4 : Total annual sales	600,000	1,008,000	1,440,000	1,860,000	2,268,000	2,784,000	3,264,000	3,720,000	4,785,000	5,244,000
5 : Average sales price/KWA	3.70	3.57	3.50	3.41	3.36	3.29	3.25	3/18	3.14	3.10
6 : Total annual revenue	2,220,000	3,598,600	5,040,000	6,342,600	7,620,000	9,159,400	10,608,000	11,829,600	15,024,900	16,256,400
9 : Annual purchase sales + 15%	690,000	1,159,000	1,656,000	2,114,000	2,608,000	3,202,000	3,754,000	4,278,000	4,785,000	5,244,000
10 : Annual cost at 1.3/KWH	897,000	1,506,700	2,152,800	2,748,200	3,390,400	4,162,600	4,880,200	5,561,400	6,220,500	6,817,200
11 : Labor and overhead	2,520,000	2,595,600	2,673,000	2,752,500	2,835,000	2,940,500	3,007,500	3,037,500	3,067,800	3,097,500
12 : Total operating expense	3,417,000	4,101,700	4,825,800	5,500,700	6,225,400	7,103,100	7,887,700	8,598,900	9,288,300	9,914,700
13 : Gross operating margin 6-12	(1,197,000)	(503,100)	214,200	841,900	1,394,600	2,056,300	2,720,300	3,230,700	5,736,600	6,341,700
14 : Electric plant in service	31,541,000	32,884,000	34,230,000	35,195,000	35,245,000	37,021,000	38,108,000	38,311,000	38,740,000	39,083,000
15 : Depreciation at 3.3%	1,041,000	1,085,000	1,130,000	1,161,000	1,163,000	1,222,000	1,257,000	1,264,000	1,278,000	1,289,000
16 : Reserve for replacement	315,400	328,800	342,300	352,000	352,500	370,200	381,100	383,100	387,400	422,100

	1st. year	2nd. year	3rd. year	4th. year	5th. year	6th. year	7th. year	8th. year	9th. year	10th. year
17: Interest at 2% and Misc. Cost	703,800	730,600	757,600	777,000	777,000	813,400	815,200	839,200	847,800	854,200
18: Depreciation + Interest	1,744,800	1,815,600	1,887,600	1,938,000	1,940,000	2,035,400	2,072,200	2,103,200	2,125,800	2,243,200
19: Total expense 12 + 18	5,161,800	5,917,300	6,713,400	7,472,500	8,165,400	9,138,500	10,059,900	10,702,100	11,414,100	12,157,900
20: Net margin	(2,941,800)	(2,318,700)	(1,673,400)	(1,129,900)	(545,400)	20,900	548,100	1,127,500	3,610,800	4,098,500
21: Operating loan	3,650,000	3,650,000	3,650,000	3,650,000	3,650,000	3,650,000	3,650,000	3,650,000	3,650,000	3,650,000
22: Total loan	35,191,000	36,534,000	37,880,000	38,845,000	38,895,000	40,671,000	41,758,000	41,961,000	42,390,000	42,713,000
23: Interest Acc. 1st.-5 yrs.	703,800	1,434,400	2,192,000	2,969,000	3,746,000					
24: Pay ment on acc. interest: 30 annual payments						124,900	124,900	124,900	124,900	124,900
25: Loan payments including current interest 4.3%						1,748,800	1,795,600	1,804,300	1,822,800	1,836,700
26: Total loan payments						1,873,700	1,920,500	1,929,200	1,947,700	1,961,600
27: Accumulated loan payments						1,873,700	3,794,200	5,723,400	7,671,100	9,632,700
28: Accumulated reserve for rep.	315,400	644,200	986,500	1,338,500	1,691,000	2,061,200	2,442,300	2,825 400	3,212,800	3,634,900
29: Cash accumulated from Op. + Op. loan (13 + 3,650,000)	2,453,000	1,949,900	2,164,100	3,006,000	4,400,600	6,456,900	9,177,200	12,407,900	16,144,500	24,436,200
30: Cash available for other purposes 29 - (28+27)	2,137,600	1,305,700	1,177,600	1,667,500	2,709,600	2,522,000	2,940,700	3,359,100	7,260,600	11,210,600

VOLTAGE REGULATION STUDY

TUYEN DUC

The voltage regulation study of the distribution line of Tuyen Duc electric co-op has been calculated for 5610 consumers & 300 KWH concentrated using an average of 50 KWH per month in ten years. The method used is taken from R. E. A. Bulletin 45-1, Guide for making voltage drop calculations. The kilowatt demads used are from R. E. A. Bulletin 45-2 demand tables. With modifications using A & B factors for lower KWH usage than predicted by tables. It is estimated that a ten year growth (1976) will be needed for the system to reach this load level with these consumers.

The difference in number of consumers (8356 - Pot.) (7938 EST. connected in 10 years) and 5610 mentioned above lies in the fact that small villages will be connected from 30 KV and serve the difference in consumers.

Two circuits are proposed:

1. A South West circuit into Airport
2. A South East circuit to 3 villages

The maximum volt drop calculated on 120 volt base is 19.21 volt. This will be adequate as voltage regulators will be installed. This will be adequate voltage regulation until these loads develop and will not impose on the initial co-operative excessive capital or fixed cost.

Included are voltage drop sheet for circuit ABC. The form used is as per REA standards.

U. S. DEPARTMENT OF AGRICULTURE
RURAL ELECTRIFICATION ADMINISTRATION

VOLTAGE DROP SHEET

SYSTEM DESIGNATION: TUYEN-DUC
SUBSTATION: DA NHIN
SYSTEM DESIGN: 50 KWH/MTH/CONS.
SYSTEM ENGINEER: NRECA Ham, Robinson
CIRCUITS: ABC
DATE: 5/24/65

SECTION		LOAD									LINE						VOLTAGE DROP		
		CONSUMERS					CONCENTRATED												
SOURCE END	LOAD END	WITHIN THIS SECTION	BEYOND THIS SECTION	EQUIV. THIS SECTION	KWH PER MONTH	PEAK KW	WITHIN THIS SECTION	BEYOND THIS SECTION	EQUIV. THIS SECTION	TOTAL KW	CONDUCTOR SIZE CU. EQUIV.	ϕ	KV	VOLTAGE DROP FACTOR	LENGTH OF SECTION IN MI.	KW MILES	THIS SECTION	TOTAL	AT POINT
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
ABC-4	A5	129	0	65	50	15	--	0	0	15	6	1	8.6	5.0	6.0	90	.45	12.61	A5
ABC-3	ABC4	79	129	167		35	200	0	200	235	2	3	8.6	0.6	1.5	352	21	12.16	ABC4
ABC-6	B7	1342	0	671	50	129	0	0	0	129	6	1	8.6	5.0	9.1	1123	5.86	14.13	B7
ABC-6	C8	1907	0	954	50	183	0	0	0	183	6	1	8.6	5.0	6.5	1189	5.94	19.21	C8
ABC-3	ABC6	254	3254	3381	50	634	100	0	100	734	2	3	8.6	0.6	3.0	2202	1.32	13.27	ABC6
ABC-2	ABC3	600	3661	3991	50	750	200	300	400	1150	2	3	8.6	0.6	7.0	8050	4.83	11.95	ABC3
ABC-1	ABC2	1371	4289	4724	50	893	0	500	500	1393	2	3	8.6	0.6	7.0	9751	5.85	7.12	ABC2
SUB	ABC1	0	5610	5610	50	1060	0	500	500	1060	2	3	8.6	0.6	2.0	2120	1.27	1.27	ABC1

REA FORM 239 REV 3-57

RURAL ELECTRIFICATION - TUYEN DUC PROVINCE/DALAT

DANHIM POWER STATION	2 generators	40,000 ea.	- total 84 KW - average 80 M/W - present prod. 30,000 KW
	2 generators	40,000 ea.	Under construction
ANKRÒET POWER STATION	2 generators	1,250 ea.	Total 3,250 KW
	2 generators	375 ea.	
DALAT DIESEL PLANT (CEE)	4 Units		Total 1,800 KW
LIEN KHANG GENERATION	_____		
TUNG NGHIA GENERATOR	_____		

GVN POWER SUPPLIED IN DALAT

- Da Thanh Hamlet
- Tri Mat Hamlet
- Da Loi Hamlet

GVN POWER IN TUYEN DUC

- Tea Plantation - Entre Raye
- Xuan Truong - Cau Dat
- Tram Hanh
- Dran - Can Rang
- Lac Thien (near Dran)

CEE to be sold to GVN in December of 1967
All equipment to be sold - all lines and distribution will revert to GVN

DISCUSSION OF SECTIONALIZING

TUYEN DUC

1. It is assumed that power will be supplied from Ankroet hydroelectric plant a distance of approximately 21 miles and later from Da Nhim hydroelectric plant a distance of 7 miles.

   a. The capacity of the Ankroet hydroelectric plant is 3,250 kw. Presently available surplus is approximately 1,100 kw. By requiring the French owned SIPEA to operate their diesel generators in Dalat, the surplus can be increased to approximately 2,000 kw.

   b. Present capacity of Da Nhim is approximately 84,000 KVA. Presently being used about 30,000 KVA demand according to reports of officials. Future provisions have been made for an ultimate capacity of 168,000 KVA.

2. No fault currents were available at proposed sub station locations. (But due to size of conductor No. 2 cu (Approx.) on 30 KV line and the later condition of a relative short distance from large source), the short circuit analysis was predicated on transformer size.

3. Fault currents are calculated on short method R.E.A. Bulletin 61-2 and are adequate in our opinion for preliminary work.

SUBSTATION AND STEP DOWN TRANSFORMERS

ESTIMATE OF MATERIAL

All equipment 50 cycle operation 1500 KVA 4 single phase transformers (includes one spare) 30,000 volt primary to 8600/15,000 volts secondary with taps two 2-1/2% above and two 2-1/2% below nominal voltage.

3 single Ø regulators - 32 step 157.3 Amp. 8600/15,000 volt rating ML 32 G.E. or equivalent.

Equipped with two incoming 30,000 volt circuits 30,000 volt air break switches four outgoing 3 Ø 8600/15,000 volt circuits complete with all necessary busses, arresters, cut outs and switches. Including space for oil circuit reclosers.

Estimated cost delivered $50,000.00

Transformers required in hamlets to be served direct from 30,000 volt line.

30,000 volt primary 230/380 3 Ø

Delta - Y connected with taps

4 - 75 KVA transformers

Total $4,500.00

Transformers required to serve hamlets distant enough from 30,000 volt line to necessitate construction of short 15,000 volt lines

30,000 volt primary 8600/15,000 volt

Delta - Y connected

4 - 150 KVA transformers with taps

Total $7,200.00

U. S. Department of Agriculture
Rural Electrification Administration
Short Circuit Current Data Sheet

Date 6/2/65 | Sheet 1 of 1

System designation VN-1 | System line to gr. voltage

Instructions - See REA Bulletin 61-2 and supplement | Prepared by Engrs. | Checked by

1.	Point	SUB	ABC2	ABC3	ABC4	A5	ABC6	C8	B6-1	B-7
2.	Preceding point on line toward substation		SUB	ABC2	ABC3	ABC4	ABC4	ABC6	ABC6	B61
3.	Miles from previous point on line toward substation		8	8	1.5	6	1.5	6.5	5	5.1
4.	Copper conductivity size section from previous point		2	2	2	6	2	6	6	6
5.	Type of fault calculated	LINE TO GROUND								
6.	Maximum fault current, read on current diagrams (Simplified method)	1250	340	200	180	127	170	120	127	96
7.	Minimum fault current, read on current diagram (Simplified method)	170	128	100	98	78	94	76	78	60

RATE USED FOR STUDY
TUYEN DUC ELECTRIC CO-OP

FIRST	10 KWH	4.0 PIASTERS/KWH
NEXT	15 "	3.5 " "
MEXT	75 "	2.5 " "
ALL OVER	100 "	2.0 " "

The above does not include any taxes. As they are all of a sales type tax it was assumed they would be added on and the Co-op would only be acting as a tax collector.

U.S. LINE MATERIAL REQUIREMENTS

TUYEN DUC PROJECT

ITEM	Manufacturer	Cat. No.	Total Quantity	Required Delivery Date by percentage of quantity									
				11-1-65	1-66	3-66	3-67	3-68	3-69	3-70	3-71	3-72	3-73	3-74
A. Insulator Pin Type	Ohio Brass	38143	2860	70	30									
k. Insulator Suspension 6"	" "	32433	590	70	30									
b. Pin Pole Top Steel	Hubbard	3162	2020	70	30									
c. Bolts Machine 5/8" x 9	"	9809	9226	70	30									
" " 5/8" x 10	"	9810	100	70	30									
" " 5/8" x 14	"	9814	20	70	30									
d. Washers square	"	7814	16780	70	30									
f. Pins Cross Arms	"	981	840	70	30									
h. Cross Arm Braces	"	8128	860	70	30									
i. Bolts carriage	"	9643½	860	70	30									
j. Lagg screws	"	9754	920	70	30									
o. Eye Bolts 5/8" x 8"	"	39958	8000	70	30									
" " 5/8" x 10"	"	39960	1300	70	30									
u. 3-Bolt Guy Clamp	"	7450	900	70	30									
aa. Eye nuts	"	7502	675	70	30									
u. 3-Bolt Guy Clamp	"	7461	180	70	30									

ITEM	Manufacturer	Cat. No.	Total Quantity	Required Delivery Date by percentage of quantity									
				11-1-65	1-66	3-66	3-67	3-68	3-69	3-70	3-71	3-72	3-73	3-74
V. Guy attachment	Hubbard	6004	420	70	30									
X. Anchor rods 5/8	"	8417	570	70	30									
" " 3/4	"	8528	20	70	30									
" " 3/4	"	8428	75	70	30									
z. Anchors screw 8000L5	ChanCe	11B1	-	-	-									
Anchors Expansion	Chance	1085	215	70	30									
" "	"	88135	450	70	30									
bj. Guy Hooks	"	7584	490	70	30									
bk. Shim Plates	"	7575	490	70	30									
BO. Shakel Anchors	"	6801	90	70	30									
ek. MF Locknuts 3/8"	"	4510	2000	70	30									
bs. Bolt single upset	"	8" 8741½	1000	70	30									
		10" 8742	2372	70	30									
d. Bolt double upset	"	8" 8826	700	70	30									
		10" 8830	1000	70	30									
as. Service swinging	"	2947	8700	70	30									
da. Bracket	"	1328	160	70	30									
ci. Clevis thumble side opening	"	674	40	70	30									
l. Clamp deadend	Alcoa	302	400	70	30									
s. Clevis swinging 3"	Hubbard	1355	400	70	30									
s. " " 1-3/4"		1353	3900											

ITEM	Manufacturer	Cat. No	Total Quantity	Required Delivery Date by percentage of quantity									
				11-1-65	1-66	3-66	3-67	3-68	3-69	3-70	3-71	3-72	3-73	3-74
Sc. Insulators spool 3"	Hubbard	1716	3900	70	30									
s. Insulators spool 1-3/4		455												
m. Clamp suspension	Chance	A2270	50	70	30									
c. Bolts ½" x 6"	Hubbard	9706	100	70	30									
ck. Anchor rod bonding clamp	Chance	G5060	600	70	30									
ei. Ground rods galvanized & Clamp	Hubbard	2668	5000	70	30									
bn. Loup dead end	Betha	ALD23w	2000	70	30									
n. Bolts D.A. 5/8" x 16"	Hubbard	9866	50	70	30									
" " 5/8" x 18"	"	9868	50	70	30									
Staples			1600 lb	70	30									
Nails 8 penny galv.			100 lb	70	30									
ap. Hot line clamps	Chance	S5130AA	600	70	30									
Guy strand 3/8'			20500 ft	70	30									
Seiemen martin 7/16"			3000 ft	70	30									

U.S. LINE MATERILA REQUIREMENTS

TUYEN DUC PROJECT

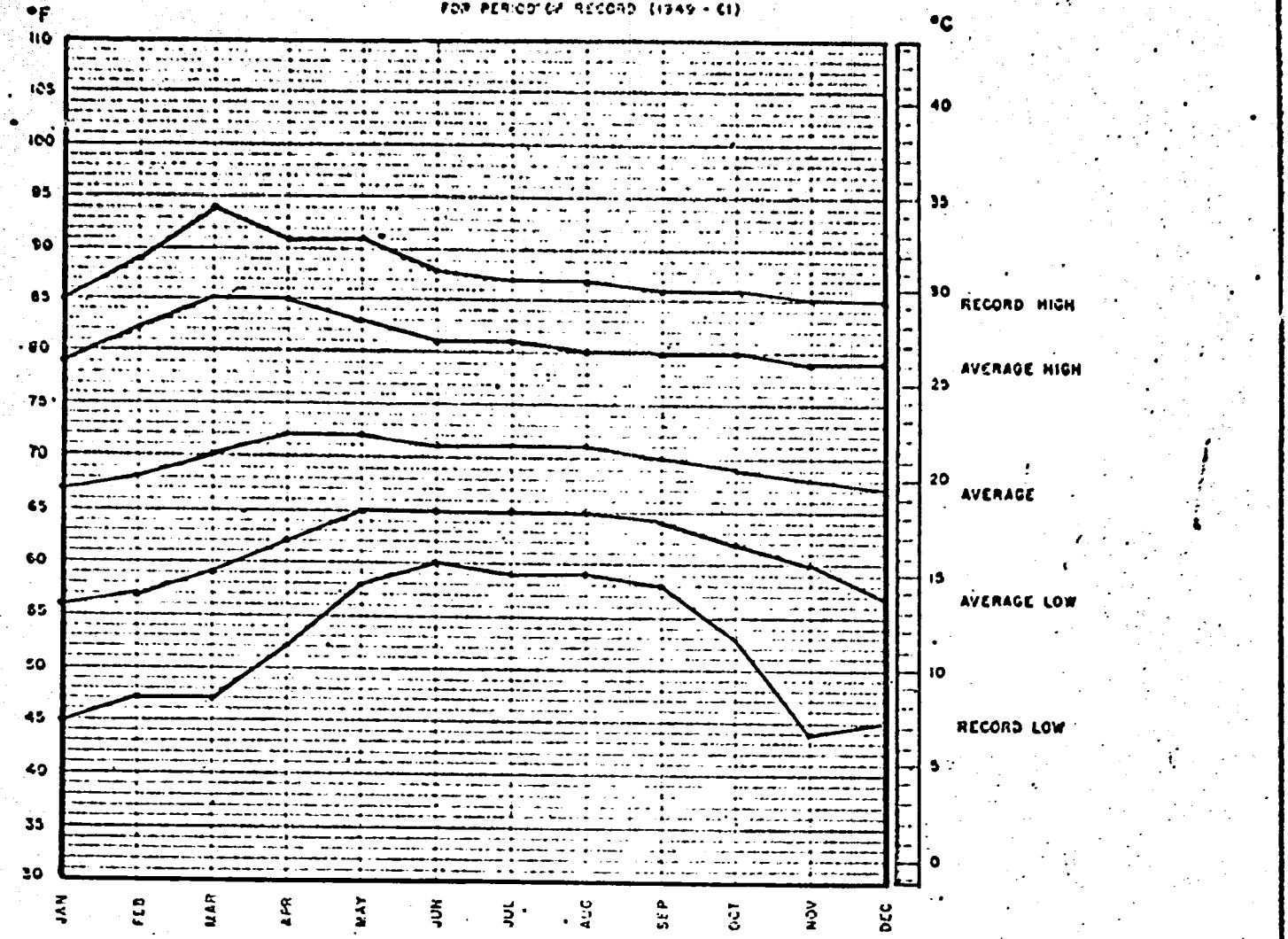
ITEM	Total quantity	Required Delivery Date by percentage of quantity											
		11-1-65	1-66	3-66	3-67	3-68	3-69	3-70	3-71	3-72	3-73	3-74	3-75
Cross Arms	430	100											
Conductor 1/0 6/1 ACSR	61000 lb	50	50										
" 2 6/1 ACSR	315001b	50	50										
" 2 7/1 "	150001b	50	50										
" 4 7/1 "	750001b	50	50										
#6 CU. Soft drawn	40001b	100											
#2 Al Duplex #2 6/1 Bare Neutral	41800ft	50	50										
#4 Al Duplex #4 6/1 Bare Neutral	250000 ft	20	20	20	10		10		10		10		
*Connectors Burndey 325-81	14000	70	30										
" " 340-8	4000	70	30										
Preformed Armor Rod AR0110	3500 sets	50	50										
" " " " 0114	5500 "	50	50										
" " " " 0118	1300 "	50	50										

* include appropriate tool or gun for applying connectors

ITEM	Total quantity	Required Delivery Date by percentage of quantity									
		11-1-65	1-66	3-66	3-67	3-68	3-69	3-70	3-71	3-72	3-73	3-74	3-75
Transformer single phase 5 KVA	300	30	20	10	10		10		10		10		
" " 10 "	75	30	20	10	10		10		10		10		
" " 15 "	10	30	20	10	10		10		10		10		
" " 25 "	5	30	20	10	10		10		10		10		
Transformers 3 H													
-30Kv Delta - to 8.6/15KV 150KVA	4	100											
-30Kv Delta - Y connec ted 230/350 3P 75KVA	4	100											
Line splices Burndey full tension #4 7/1	600	50	50										
" " " #2 6/1	100	50	50										
" " " #1/0 61	255	50	50	50									

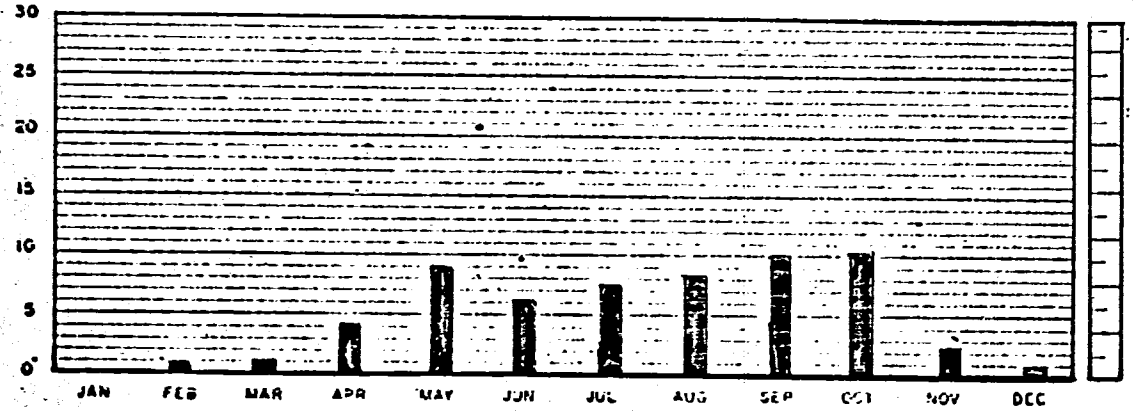
TEMPERATURE

FOR PERIOD OF RECORD (1949 - 61)



AVERAGE RAINFALL

FOR PERIOD OF RECORD (1949 - 61)



	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUAL
AVERAGE (IN)	.22	106	1 27	4 59	9 04	6 30	7 68	8 32	10 15	10 51	2 46	82	62 22
RECORD HIGH (IN)	1 46	3 54	5 51	8 39	17 91	11 14	15 89	14 45	15 59	23 74	7 64	3 50	73 07
RECORD LOW (IN)	0	0	04	39	4 64	3 03	3 19	5 98	3 23	5 43	04	Trace	39 02
24-HOUR RECORD (IN)	91	3 54	3 03	1 93	3 35	2 52	3 78	2 91	3 15	7 28	1 81	1 06	7 28
DAYS OF RAIN (AVG)	1	2	3	10	16	21	23	24	24	20	9	4	160

* The City of Dalat is at nearly 5000 feet MSL so the weather conditions are somewhat different than at Lien Khuong Airport. Average temperatures in the City are about 9°F cooler than at the Airport and average rainfall in the City is about 10% more than at the Airport.

A PLAN FOR FUTURE REQUIREMENTS

TUYEN DUC

The system will be located in an area of plentiful hydro power. Any requirement for future growth can be met by additional substation capacity or by installing a new substation in the vicinity of the airport.

As per voltage drop calculations as shown on circuit diagram, Appendix No. 4, when the load reaches approximately the sixth year regulators will need to be installed in the Airport vicinity. The use of regulators will carry this system as calculated to its tenth year of operation, or 50 KWH/MTH/Cons. with approx. 8000 consumers. All power will be 50 cycle with voltages as per Government decree.

There is 230 KV transmission in the immediate area and if large loads develop the co-op can buy power from this source. These transmission lines are owned by the Government.

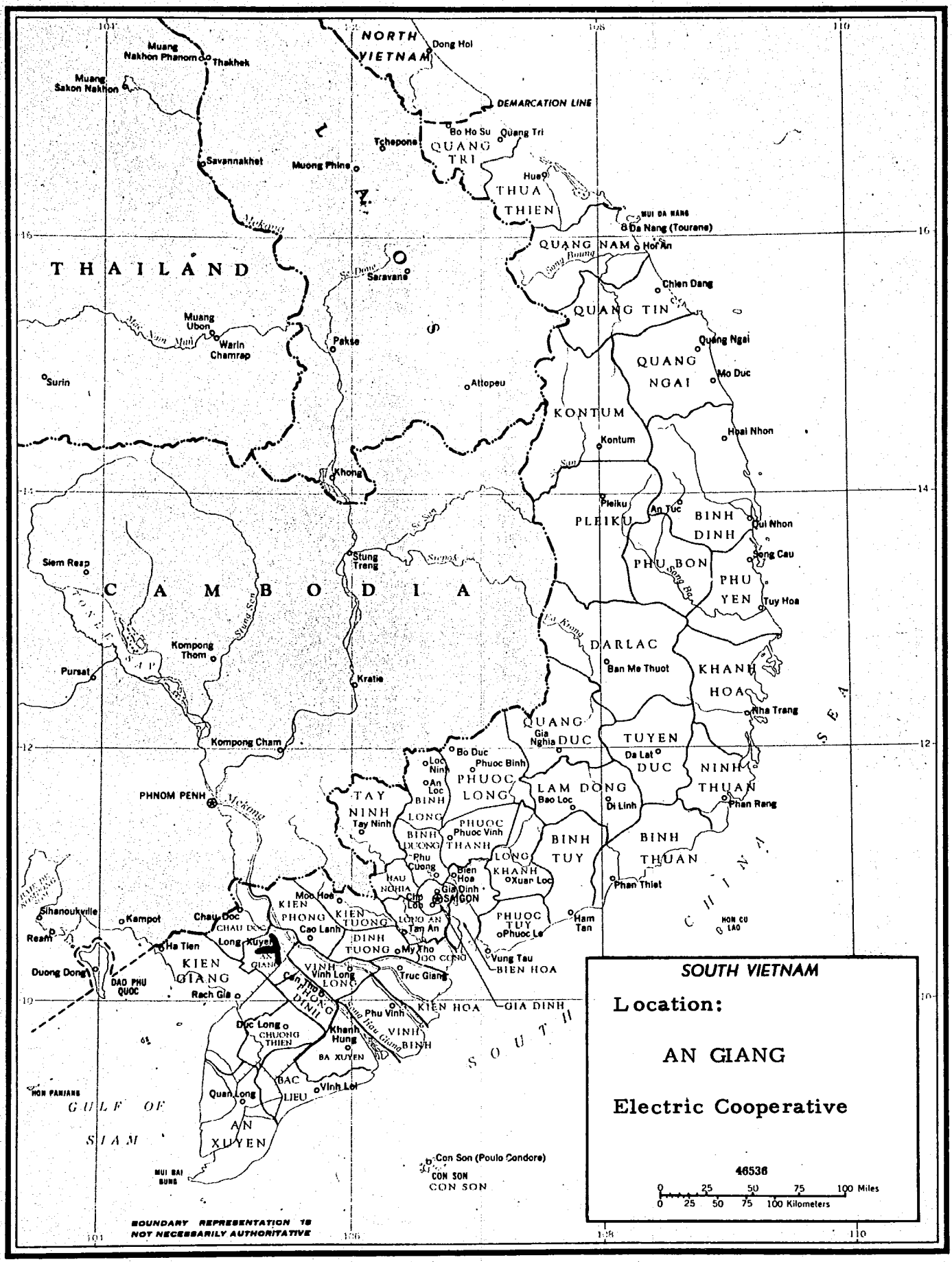
There is no data available to project future requirements. REA methods and demand tables were used throughout.

PROPOSED

AN GIANG

ELECTRIC

COOPERATIVE


NORTH VIETNAM
Dong Hoi
DEMARCATION LINE
Bo Ho Su
Quang Tri
Tchepone
QUANG TRI
Savannakhet
Muong Phine
Hue
THUA THIEN
MUI DA NANG
Da Nang (Tourane)
QUANG NAM
Hoi An
Song Vu Gia
Chien Dang
QUANG TIN
THAILAND
Mekong
Se Done
Saravane
Muang Nakhon Phanom
Thakhek
Muang Sakon Nakhon
Muang Ubon
Mae Nam Mun
Warin Chamrap
Pakse
Surin
Attopeu
Quang Ngai
QUANG NGAI
Mo Duc
KONTUM
Kontum
Hoai Nhon
Khong
Se San
Pleiku
An Tuc
PLEIKU
BINH DINH
Qui Nhon
Song Cau
Siem Reap
Stung Treng
Sesan
CAMBODIA
PHU BON
Song Ba
PHU YEN
Tuy Hoa
Tonle Sap
Song Se
Kompong Thom
Pursat
Kratie
Ea Krong
DARLAC
Ban Me Thuot
KHANH HOA
Nha Trang
Kompong Cham
QUANG DUC
Gia Nghia
TUYEN DUC
Da Lat
Bo Duc
Loc Ninh
Phuoc Binh
PHUOC LONG
LAM DONG
Bao Loc
Di Linh
NINH THUAN
Phan Rang
PHNOM PENH
Mekong
TAY NINH
Tay Ninh
An Loc
BINH LONG
PHUOC THANH
Phuoc Vinh
BINH DUONG
Phu Cuong
Bien Hoa
HAU NGHIA
Cho Lon
Gia Dinh
SAIGON
LONG KHANH
Xuan Loc
BINH TUY
BINH THUAN
Phan Thiet
Ham Tan
PHUOC TUY
Phuoc Le
Vung Tau
BIEN HOA
Sihanoukville
Kampot
Ream
Chau Doc
CHAU DOC
Moc Hoa
KIEN PHONG
KIEN TUONG
Cao Lanh
LONG AN
Tan An
Ha Tien
Long Xuyen
AN GIANG
DINH TUONG
My Tho
CUU LONG
Truc Giang
Duong Dong
DAO PHU QUOC
KIEN GIANG
Rach Gia
VINH LONG
Can Tho
VINH BINH
Phu Vinh
KIEN HOA
GIA DINH
Duc Long
CHUONG THIEN
Khanh Hung
BA XUYEN
BAC LIEU
Vinh Loi
Quan Long
AN XUYEN
HON PANJANG
GULF OF SIAM
SOUTH CHINA SEA
HON CU LAO
Con Son (Poulo Condore)
CON SON
MUI BAI BUNG
BOUNDARY REPRESENTATION IS NOT NECESSARILY AUTHORITATIVE
SOUTH VIETNAM
Location:
AN GIANG
Electric Cooperative
46536
0 25 50 75 100 Miles
0 25 50 75 100 Kilometers

SUMMARY

AN GIANG

(1) Borrower: Government of Vietnam will receive a grant to loan to An Giang Electric Cooperative of Long Xuyen, South Vietnam.

(2) Amount: 819,000 US Dollars 61,366,000 VN $

(3) Total cost of project: (conversion rate VN $ 73/1 US $) 1,659,631 US $

(4) Purpose:

To extend and improve electrical facilities for the distribution of electricity to the rural areas of AnGiang province of South Vietnam to be used as a Pacification Project.

(5) Background:

AID/Washington signed a contract with National Rural Electric Cooperative Association (NRECA) to provide technical advisory services for the rural electrification in the developing countries of the Free World.

Clyde Ellis, General Manager of NRECA, and Tom Venables, Co-ordinator visited Vietnam at invitation of AID and after consultation with officials it was decided to start immediately with a program to set up rural electrification in South Vietnam.

The work to be done should be viewed as a pilot project and be moved as rapidly as possible. The success or failure depends on the speed at which this work can be started.

The Cooperative in An Giang Province near Long Xuyen was organized and became a legal entity on June 29th, 1965.

(6) Project Description:

The electric system to be financed will belong to a member owned cooperative composed of the people of An Giang province, serving an area with a population of approximately 120,000 people.

The system will consist of a 2500 KW generating plant, to be financed through this program but owned and operated by the EOV. Technical assistance and supervision of the plant operation to be furnished by AID/Washington.

The project will have approximately 35 miles of three phase, 230 miles of single phase and of secondary and services to serve 24,000 consumers with transformers, meters, meter loops; and related service equipment to be furnished by the cooperative. The system is designed to serve 24,000 consumers with an average KWH usage in 10 years of 50 KWH per month.

Included in the loan is money to reloan to the consumers for wiring of houses and purchase of electrical equipment. Money is included for training personnel in operations and management. Money is included to cover deficits of early years of operations.

NRECA personnel will be retained for consultative work for two years.

PROPOSED PROJECT

AN GIANG

1. Construction of a 25.00 KW diesel generating plant and substation.
2. Construction of approximately 35 miles of 3 ∅ 8.6/15 KV lines.
3. Construction of approximately 100 miles of 1 ∅ 8.6/15 KV lines.
4. Construction of approximately 130 miles of secondary, underbuild and services to serve an estimated 24,000 houses.
5. Installation of 8.6/230 V 2 bushing transformers

120 - 5 KVA	600
480 - 10 "	4800
30 - 15 "	450
15 - 25 "	375
Total installed KVA	6225

AN GIANG

VILLAGES, HAMLETS		NO. OF HOUSEHOLDS
66	Vinh Thanh	225
62	Vinh Thuan	485
43	Vinh Tho	135
45	Vinh Hoa B	145
44	Vinh Hoa A	215
60	Can Yhanh	507
61	Can Thoi	275
59	Binh An	625
52	Phu Hoa	1316
46	Hoa Long	545
47	Hoa Phu	410
50	Hoa Hao	222
48	Ca Lau	60
49	Hoa Thanh	211
38	Binh Thanh	500
37	Binh Thoi	936
36	Binh Khanh	1193
39	Tay Khanh	840
39	Binh Hoa	440
12	Tay Hue	497
21	Phu Huu	377
32	Dong Binh I	295

		VILLAGES, HAMLETS	NO. OF HOUSEHOLDS
	33	Dong Binh II	224
A	27	Tay Binh	205
	24	Dong An	174
	22	Phu Thien	125
	23	Hoa Dong	166
	35	Dong Binh Trach	215
	30	Trung Binh	509
	31	Trung Binh	225
	34	Tay Binh	355
	22	My Thanh	275
	21	My Thoi	155
	16	Dong Phu	95
	15	Thung Phu	105
	17	Tan Phu	107
	18	Dong Phu	120
	19	Tan Phu Tay	60
	10	Dong Thinh A	920
	11	Dong Thinh B	640
	13	My Quoi	380
	18	Tay An	286
	19	Tay Thanh	267
	17	Long Hung	500
	15	Dong Thanh	270

		VILLAGES, HAMLETS	NO. OF HOUSEHOLDS
	16	Thoi An	280
	20	Thoi Thanh	167
	13	Thoi Hoa A	263
	14	Thoi Hoa B	64
C	31	Vinh Qui	123
	30	Vinh Lan	500
C	15	Thoi Thanh C	140
		Thoi Binh	360
		Vinh Phung	151
		Vinh Long	90
C	34		106
C	16	Thoi An	117
		Thoi Thanh	365
C	4	Phung Thanh 2	320
		Long Thanh	325
		Phung Thang	270
		Thang Thra A	315
		Thang Thra B	274
		Lan Thanh	340
		Qui Thanh i	278
		Qui Thanh 2	316

AN GIANG ELECTRIC COOPERATIVE

Estimated Peak KW Demand Requirements by Years

	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975
Number of Consumers	6,000	9,000	12,000	14,150	16,300	18,450	20,600	21,330	22,060	22,800
KWH/Consumer/Month	10	13	19	25	28	32	38	42	46	50
KW Demand	828	1278	1788	2215	2560	2790	3220	3330	3535	4309

All customers are considered in one category

No diversity factor was considered. Line losses estimated 15%

No investigation of potential large loads was made

BUDGET ANALYSIS

AN GIANG RURAL ELECTRIC COOPERATIVE

	MATERIAL OFF SHORE US DOLLARS	MATERIAL LOCAL VN $	LABOR & OVERHEAD VN $
1. DISTRIBUTION			
a. Right of way Procurement & Clearing			500,000
b. Poles & Pole top fixtures	179,800		12,400,000
c. Conductor	69,100		459,000
d. Transformers (Line)	215,349		313,000
e. Services	-	31,109,000	6,400,000
f. Metering	96,000		150,000
g. Sectionalizing equipment	6,500		15,000
g. Regulators	7,000		7,000
2. SUBSTATIONS			
a. Land & Land rights		10,000	
b. Structure	14,000	60,000	150,000
c. Conduit wiring	4,700	20,000	40,000
d. Reclosers (6)	2,600	2,500	5,000
e. By pass switches	1,200	2,500	5,000
f. Grounding	1,000	2,500	50,000
g. Transformers	29,000	20,000	5,000
h. Air break switches	1,400	2,500	5,000
i. Lightning Arrestors	2,000	2,500	5,000
j. Fence		68,300	15,000
3. GENERAL			
a. Office equipment & furniture		500,000	
b. Transportation	30,000		
c. Tool & Work equipment		250,000	
d. Two way radio	10,000		
e. Maintenance material	20,000		
4. OFFICE & WAREHOUSE		1,500,000	700,000
4A. ENGINEERING	50,000		
5. ACQUISITION			
6. ADMINISTRATION			
a. Legal fees			92,000
b. General overhead			1,500,000
c. Operating capital		4,500,000	500,000
7. HOUSE WIRING FUND (for reloan)		*30,000,000	
8, CONTINGENCY	80,000		
	819,000	38,549,800	22,816,000
VN $ 50 to 1 US	40,950,000	38,550,000	22,816,000

*Not Capitalized

Total Piasters nearest 1000 - VN $ 102,316,000

ASSUMPTIONS FOR FINANCIAL PROJECTION ESTIMATE

AN GIANG

1. A diesel generating plant of 2500 KW capacity will be built. Ownership and cost to be under the Electricity of Vietnam.

2. A per kilowatt energy cost of not exceeding 1.8 Piasters will be achieved in the plant operation.

3. Monies for relending will be 30,000,000 Piasters.

4. Contingency cost and Miscellaneous will be $80,000 US.

5. Relending and Contingency is not included as part of original capital cost.

6. That consumers will be added as shown however majority of system will have to be constructed in first year.

7. That GVN will agree to the rental rate used in the study.

8. That there will be no production tax charged to the cooperative for "wholesale for resale" energy purchased.

A N G I A N G

BALANCE SHEET AND CASH FLOW

Prepared by Ham June 25
Approved by H. Bush 1965

	1st. year	2nd. year	3rd. year	4th. year	5th. year	6th. year	7th. year	8th. year	9th. year	10th. year
1: Total connected cons	6,000	9,000	12,000	14,150	16,300	18,450	20,600	21,330	22,060	22,800
2: Ave. monthly sales/ consumer	10	13	19	25	28	32	38	42	46	50
3: Total annual sales/ consumer	120	156	228	300	336	384	456	504	552	600
4: Total annual sales	720,000	1,404,000	2,736,000	4,245,000	5,477,000	7,085,000	9,394,000	10,750,000	12,177,000	13,680,000
5: Average sale price/ KWH	4.50	4.304	4.263	4.20	4.07	3.930	3.736	3.71	3.65	3.60
6: Total annual rev.	3,240,000	6,155,000	11,664,000	17,829,000	22,291,000	27,991,000	35,096,000	39,883,000	44,446,000	49,248,000
9: Annual purchase sales + 15%	828,000	1,815,000	3,146,000	4,382,000	6,209,000	8,148,000	10,803,000	12,363,000	14,000,000	15,732,000
10: Annual cost 1.8 VN $ /KWH	1,490,000	2,907,000	5,663,000	8,788,000	11,338,000	14,666,000	19,445,000	22,734,000	25,20 ,000	28,318,000
11: Labor & overhead	3,732,000	3,844,000	3,959,000	4,171,000	4,200,000	4,326,000	4,456,000	5,590,000	5,758,000	5,931,000
12: Total operating expense	5,222,000	6,751,000	9,622,000	13,658,000	15,538,000	18,992,000	23,901,000	28,324,000	30,958,000	34,249,000
13: Gross operating margin	(1,982,000)	(596,000)	2,042,000	5,602,000	6,753,000	8,999,000	11,195,000	11,595,000	13 488,000	14,999,000
14: Electric plant in service	98,312,000	102,272,000	106,232,000	109,070,000	111,900,000	114,796,000	117,594,000	118,546,000	119,511,000	120,300,000

	1st, year	2nd. year	3rd. year	4th. year	5th. year	6th. year	7th. year	8th. year	9th. year	10th. year
15: Depreciation 3.3%	3,244,000	3,309,000	3,599,000	3,599,000	3,693,000	3,788,000	3,880,000	3,912,000	3,944,000	3,973,000
16: Reserve for repla.	983,000	1,023,000	1,062,000	1,091,000	1,119,000	1,148,000	1,176,000	1,185,000	1,195,000	1,204,000
17: Interest 2%	1,976,000	2,046,000	2,124,000	2,182,000	2,238,000	2,296,000	2,252,000	2,270,000	2,290,000	2,408,000
18: Depreciation + Interest	5,220,000	5,435,000	5,630,000	5,781,000	5,931,000	6,084,000	6,132,000	6,182,000	6,234,000	6,381,000
19: Total Expense 12+18	10,442,000	12,186,000	15,252,000	19,439,000	21,469,000	25,076,000	30,033,000	34,506,000	37,192,000	40,630,000
20: Net Margin 6 - 19	(7,202,000)	(6,031,000)	(3,588,000)	(1,610,000)	822,000	2,915,000	5,063,000	5,377,000	7,254,000	8,618,000
21: Operating Loan	4,500,000	4,500,000	4,500,000	4,500,000	4,500,000	4,500,000	4,500,000	4,500,000	4,500,000	4,500,000
22: Total Loan 14 + 21	102,812,000	106,772,000	110,732,000	113,570,000	116,400,000	119,296,000	122,084,000	123,040,000	124,001,000	124,888,000
23: Interest accumulated 1st 5 years	2,056,000	4,192,000	6,406,000	8,677,000	110,006,000					
24: Payment on accumulated interest 30 yearly payments						367,000	367,000	367,000	367,000	367,000
25: Loan payments 4.3% loan						5,010,000	5,250,000	5,291,000	5,332,000	5,370,000
26: Total loan payment						5,377,000	5,617,000	5,658,000	5,699,000	5,739,000
27: Accumulated debt payments						5,377,000	9,994,000	15,652,000	21,351,000	27,090,000
28: Reserve for replacement acc.	983,000	2,006,000	3,068,000	4,159,000	5,278,000	6,426,000	7,602,000	8,787,000	9,982,000	11,186,000

	1st. year	2nd. year	3rd. year	4th. year	5th. year	6th. year	7th. year	8th. year	9th. year	10th. year
29: Acc. from operation plus op. loan cash 13 + 4,500,000	2,518,000	1,922,000	3,964,000	9,566,000	16,319,000	25,318,000	36,513,000	48,108,000	61,596,000	76,595,000
30: Available Cash 30 - (27+28)	1,735,000	(34,000)	896,000	5,407,000	11,041,000	13,920,000	18,917,000	23,609,000	30,263,000	38,319,000

ALL FIGURES IN VN. $

Sample Basic Data Acquired for Estimating KWH Consumption for Design

Long Xuyen area:

A family with electricity at edge of town

One 20 watt light

Power at hours as shown

5-7 AM

7-11 PM

Use 6 KWH per month - Cost 70 Piastres

Drug store - 11 KWH per month - 110 Piastres

Family use of charcoal to iron with the family says cost approximately 100 Piastres per month.

Typical bills in Nha-Trang S.I.P.E.A. 24 hour service:

KWH used:

20

Cost 1644.99 Piastres

Av. Cost 7.38 Piastres

KWH used

6

Cost 70.77 Piastres

Av. Cost 6.36 Piastres

All areas visited had similar bills and similar inadequate service.

VOLTAGE REGULATION STUDY

AN GIANG ELECTRIC COOPERATIVE

The voltage regulation study of the distribution line of An Giang Electric Cooperative has been calculated for 24,000 consumers using an average of 50 KWH per month in ten years.

The method used is taken from REA Bulletin 45-1, Guide for Making Voltage Drop Calculations. The kilowatt demands used are from REA Bulletin 45-2 Demand Tables. With modifications using A & B factors for lower KWH usage than predicted by tables, it is estimated that a ten year growth (1976) will be needed for the system to reach this load level with this number of consumers.

Three circuits are proposed:

1. A North Northwest circuit along Bassac River
2. A West Circuit along Long Xuyen River
3. A South Southeast circuit along Bassac River

The maximum voltage drop calculated on 120 volt base is 13.216 volts and is located on the third circuit. The maximum voltage drop on the other circuits is 5.89 volts. This will be adequate until loads build along the third circuit. At that time regulators may be installed to give proper voltage, thereby not imposing the expenditure of excessive capital on the developing cooperative.

Included are voltage drop sheets for Circuits ABC, 2ABC, and 3ABC. The standard REA form was used.

U. S. DEPARTMENT OF AGRICULTURE
RURAL ELECTRIFICATION ADMINISTRATION

VOLTAGE DROP SHEET

SYSTEM DESIGNATION: AN GIANG COOP
SUBSTATION: LONG XUYEN
SYSTEM DESIGN: 50/KWH/CONS/MONTH
SYSTEM ENGINEER: Bush
CIRCUITS: ABC - 2ABC - 3ABC
DATE: 6-15-65

SECTION		LOAD									LINE						VOLTAGE DROP		
		CONSUMERS					CONCENTRATED												
SOURCE END	LOAD END	WITHIN THIS SECTION	BEYOND THIS SECTION	EQUIV. THIS SECTION	KWH PER MONTH	PEAK KW	WITHIN THIS SECTION	BEYOND THIS SECTION	EQUIV. THIS SECTION	TOTAL KW	CONDUCTOR SIZE CU. EQUIV.	ϕ	KV	VOLTAGE DROP FACTOR	LENGTH OF SECTION IN MI.	KW MILES	THIS SECTION	TOTAL	AT POINT
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
3ABC-6	3A8	934	0	467	50	90.4				90.4	4	1	8.6	3.8	2.5	226	.859	5.84	3A8
3ABC-6	3C7	914	0	457	50	88.8				88.8	4	1	8.6	3.8	2.7	240	.912	5.89	3C7
3ABC-4	3ABC6	1072	1848	2384	50	451				451	2	3	8.6	.6	2.5	1127	.676	5.20	3ABC-6
3ABC-4	3A5	707	0	353	50	70				70	4	1	8.6	3.8	3	210	.798	5.82	3A5
3ABC-2	3ABC4	140	3627	3697	50	699				699	2	3	8.6	.6	2.3	1608	.965	4.52	3ABC4
3ABC-2	3B3	1117	0	558	50	108				108	4	1	8.6	3.8	2.6	281	1.068	4.62	3B3
3ABC-1	3ABC2	3543	4744	6465	50	1234				1234	2	3	8.6	.6	4.8	5923	3.554	3.55	3ABC2
2ABC-4	2C6	487	0	243	50	48.9				48.9	6	1	8.6	5.0	3.6	176	.880	4.16	2C6
2ABC-4	2A5	430	0	215	50	44.0				44.0	4	1	8.6	3.8	1.9	84	.319	3.60	2A5
2ABC-2	2ABC4	2611	917	2222	50	420				420.0	2	3	8.6	.6	5.1	2142	1.285	3.28	2ABC4
2ABC-2	2C3	291	0	145	50	30.8				30.8	6	1	8.6	5.0	2.2	68	.340	2.33	2C3
2ABC-1	2ABC2	1777	3819	4707	50	722				722.0	2	3	8.6	.6	4.6	3321	1.993	1.99	2ABC2
B5	B8	1205	0	602	50	116.3				116.3	6	1	8.6	5.0	3.7	430.3	2.152	13.000	B8
B5	B7	980	0	490	50	94.7				94.7	6	1	8.6	5.0	5.0	473.5	2.368	13.216	B7
B5	B6	782	0	391	50	76.3				76.3	6	1	8.6	5.0	2.4	183.1	.916	11.764	B6
ABC-4	B5	0	1987	1987	50	372.0				372.0	2	1	8.6	3.02	3.9	1450.8	4.381	10.848	B5
ABC-4	ABC9	1941	0	870	50	166.5				166.5	2	3	8.6	.6	2.2	366.3	.220	6.687	ABC 9
ABC-2	ABC4	565	3928	4210	50	796.0				796.0	2	3	8.6	.6	4.3	3422.8	2.054	6.467	ABC 4
ABC-2	C3	903	0	451	50	87.5				87.5	6	1	8.6	5.0	4.6	402.5	2.013	6.426	C 3
ABC-1	BBC-2	2629	5396	6711	50	1868.0				1268.0	2	3	8.6	.6	5.8	7354.4	4.413	4.413	ABC 2

REA FORM 239 REV 3-57

Power Supply Long Xuyen 2500 K. W. firm capacity 80% Power factor consisting of:

I. Three Generator Sets, diesel operated, 2 - 1000 K. W. units and 1-500 K.W., 3 phase, 50 cycle, specification as follows:

A. ENGINES:

Each engine shall be the standard design and current model of the builder. Preference will be given to lower speed units and to lower fuel and lub oil consumptions. Each engine shall be furnished with at least the minimum equipment according to DEMA STANDARD PRACTICES where applicable. The DSP rating, required auxiliaries, the guarantees of fuel consumption, parallel operation, governor performance, torsional vibration, and materials and workmanship shall be in accordance with DEMA STANDARD PRACTICES where applicable. The engine shall be capable of operating at ten (10%) percent overload for one hour in any eight (8) hour period, or for a two hour period in any twenty-four hours, without overheating or distress in any of its parts. The engine shall be water-cooled by forced circulation by means of a separately mounted heat exchanger complete with electricity driven pumps and complete with necessary valves and fittings.

Each engine generator set shall preferably be mounted as a Unit on a structural steel fabricated base to insure proper alignment and to provide a skid for ease of transportation. The engine shall be coupled directly to the generator by a coupling.

Each engine shall be air started. An air compressor, auxiliary

gasoline driven air-compressor, air bottles and starting valve shall be furnished.

Each engine shall be equipped with the following accessory equipment:

a) A device to give audible signals in the event of low oil pressure or excess cooling water temperature.

b) Cleanable or replaceable type lubricating oil filter.

c) Lub. oil pressure gauge and cooling water temperature gauge.

d) Lubricating oil cooler if required.

e) Duplex cleanable type fuel oil filter or equivalent.

f) Residence area type exhaust muffler.

g) Cleanable type intake air filter.

h) Oil level indicator for installation in fuel oil service tank to be furnished by the Purchaser.

i) Hand pump for filling fuel oil service tank from Purchaser's storage tank.

j) The engine shall be equipped with a generator and shall be provided with manual adjustment of load limit, speed setting and speed droop, all of which adjustments may be made with the engine in operation. The governor shall be capable of controlling the engine speed within 3 1/2% of its nominal operating speed as the load of the main generator varies from no load to full load and vice versa. Governor to be woodward insochronous or equal.

k) Emergency over-speed governor, to stop engine in case speed exceeds manufacturers maximum.

l) The fuel oil to be used by the engine will be similar to ASTM designation D - 975 - 53T, Grade 2-D, as supplied by the Standard Vacuum Oil Co., The Shell Co. of Asia, or Caltex Ltd. in Viet Nam.

B. GENERATORS

The electric generator shall be of the revolving field type with rotating exciter preferably direct connected. Each generator shall be 3 phase, 50 cycle, Delta connected 2300 volt, 4 wire. The generator units shall be designed for and guaranteed to successfully operate in parallel.

The insulation of the generator and exciter shall be Class B. The generator and exciter shall be designated and constructed in accordance with the latest NEMA and AIEE Standards.

The temperature rise in the generator and exciter, at continuous full load shall not exceed 50° C above an ambient temperature of 40° C. The generator and exciter shall be capable of carrying the overload previously described for the engine without excessive, or dangerous overheating and stress in any of its parts.

C. ELECTRICAL CONTROL PANEL

An electrical control panel shall be furnished for operation at (127/200) volts. On the panel shall be furnished and mounted the following devices.

For each unit:

a) 3 phase circuit breaker with overload trip.

b) AC Voltmeter with 3 phase switch.

c) AC ammeter with current transformers and 3 phase switch.

d) Exciter voltmeter and ammeter.

e) Field rheostats and field switch.

f) Frequency meter.

g) KW meter

h) Synchronizing switch synchroscope and lamps.

i) KWH meter.

j) Voltage regulator capable of regulating voltage within 1% of rated from no load to full load mounted on control panel.

k) Speed control switch for governor mounted on control panel; Additional specifications on control panel which shall be for separate mounting.

l) Material of panel steel.

m) Panel height 2 meters

n) Type of mounting floor

D. OPERATING INSTRUCTIONS

The Contractor receiving the award shall furnish four (4) complete sets of operating and maintenance instructions and parts catalogue for each engine generator set.

E. GUARANTY

The Contractor shall guarantee the performance characteristics such as rating, size, efficiency, voltage regulation, etc... The Contractor shall also gurantee the fuel consumption at full, three-fourths and half-load and lubricating oil consumption at full-load with equipment in good operating condition. The Contractor shall also guarantee

the equipment he is furnishing against faulty materials or workmanship for a period of one year from date of delivery in Saigon and the Contractor shall promptly replace any faulty parts at his own expense, including transportation by the most expeditious method.

The Contractor shall guarantee to furnish spare parts required for the operating and maintenance of these generating units during a 10 year period from the date of delivery of equipment.

F. INFORMATION TO BE FURNISHED WITH BIDS:

Bidders shall furnish with their bids and shall guarantee the following information, which if not furnished before the opening of the bids will invalidate the bids.

a) Make and type and model of engine.

b) BHP rating of engine.

c) Whether of 2 or 4 cycle.

d) Number of cylinders and whether vertical, horizontal or "V" type.

e) Bore and stroke.

f) RPM and piston speed in FPM.

g) Make and type designation of governor

h) Make of generator and exciter and type of drive of exciter.

i) KW and KVA rating of generator (See level rating).

j) Fuel consumption is lbs per net KWH output at 1/2, 3/4 and full load and 80% P. F. with equipment in good operating condition. (Basis sea level).

k) Lub oil consumption in U. S. gals per hour at full load and 80% P. F. with equipment in good operating condition,

l) Description of equipment with outline drawing showing principal dimensions (printed circulars satisfactory).

m) List of recommended spare parts for 2 years operation.

n) Net and shipping weight and weight of heaviest shipping price.

o) Number of days for delivery at port of embarkation, after notification of award.

p) Price FAS port of embarkation, and cost of freight to Saigon in U. S. flag ships shown separately; show cost of spares separately.

II. D. C. station and emergency supply.

III. Cooling tower and or river or well supply for cooling water with necessary pumps etc. capable of full load operation of 110%.

IV. Building to house units equipment with proper foundation for three units large enough to contain a future 1000 K. W. unit of similar design, maintenance shop, small office, and sanitary equipment.

V. Movable bridge crane large enough to maintain units.

VI, Fuel supply system with necessary pumps filters etc. with capacity to be determined at least 15,000 gallons.

DISCUSSION OF SECTIONALIZING

AN GIANG

(1) Power will be supplied from a diesel generating plant consisting of two 1000 KW units and one 500 KW unit. Provision should be made for a future 1000 KW unit.

This plant will be constructed under supervision of a NRECA supplied plant engineer. Technical training and initial supervision will be given operators. The plant will be constructed by the cooperative for Electricity of Vietnam. Ownership will be transferred to Electricity of Vietnam and the operation as well as future expansion of the plant will be Electricity of Vietnam's responsibility.

(2) Line to Ground fault currents Maximum and Minimum were calculated, and the initial plant installation findings were used. Calculations of fault current are attached.

(3) Fault currents are calculated on short method REA bulletin 61-Z and are adequate, in our opinion, for preliminary work.

U. S. Department of Agriculture
Rural Electrification Administration
Short Circuit Current Data Sheet

Date

System designation An Giang V. N-2

Sheet 1 of sheet 1

System line to ground voltage

Instructions- See REA Bulleting 61-2 & supplement

Prepared by Ham& Bush

Checked by H. L. Bush

1. Point	SUB	ABC-2	C-3	ABC2A	ABC-4	ABC-9	B-5	B-8	2ABC4	206	3ABC2	3B3	3ABC4	3ABC6	3AB
2. Preceding point to line toward subs.		SUB	ABC2	ABC-2	ABC2A	ABC-4	ABC-4	B-5	SUB	2ABC4	SUB	3ABC2	3ABC2	3ABC4	3ABC
3. Miles from previous point on line toward substation		5.8	4.6	.2	4.4	2.2	3.9	3.7	9.7	3.6	4.8	2.6	2.3	2.5	2.5
4. Copper conductivity size section from previous point.		2	6	2	2	2	2	6	2	6	2	4	2	2	4
5. Type of fault calculated	LINE TO GROUND														
6. Max. fault current - from simplified form circuit diagram	194	143	-	142	113	105	101	-	115	-	150	-	130	115	-
7. Minimum fault current from simplified form Circuit diagram.	85	72	60	71	67	63	60	54	66	54	75	69	70	66	58

SEE CIRCUIT DIAGRAM

RATE FOR STUDY

AN GIANG CO-OP

FIRST	10 KWH	4.5 PIASTERS/KWH
NEXT	15 "	4.0 " "
NEXT	75 "	3.0 " "
ALL OVER	100 "	2.5 " "

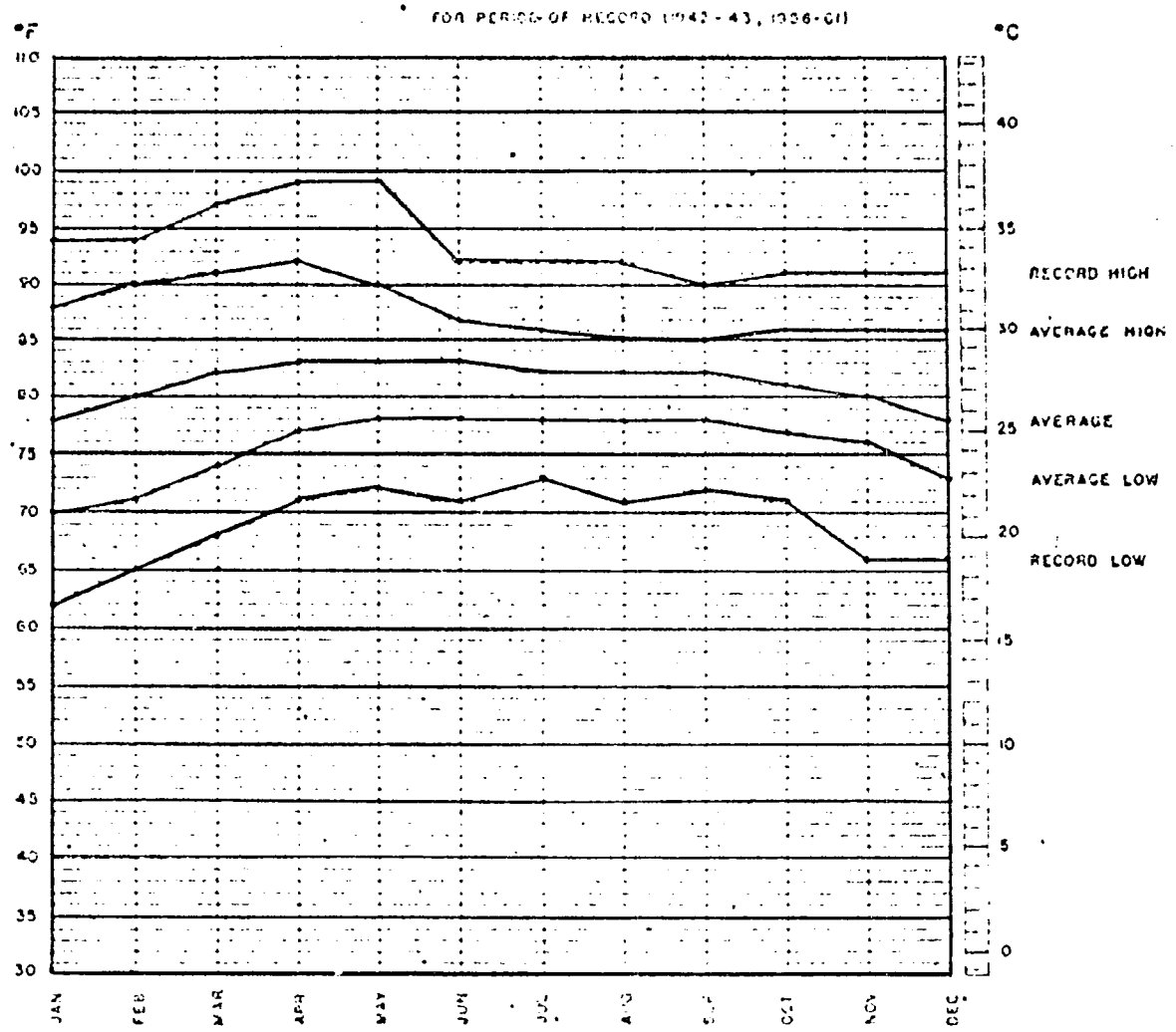
The above does not include any taxes as they are all of a sales type tax it was assumed they would be added on and the Co-op would only be acting as a tax collector.

RACH GIA AN GIANG AREA

(LATITUDE 10°00' N, LONGITUDE 105°05' E; ELEVATION 5 FEET MSL)

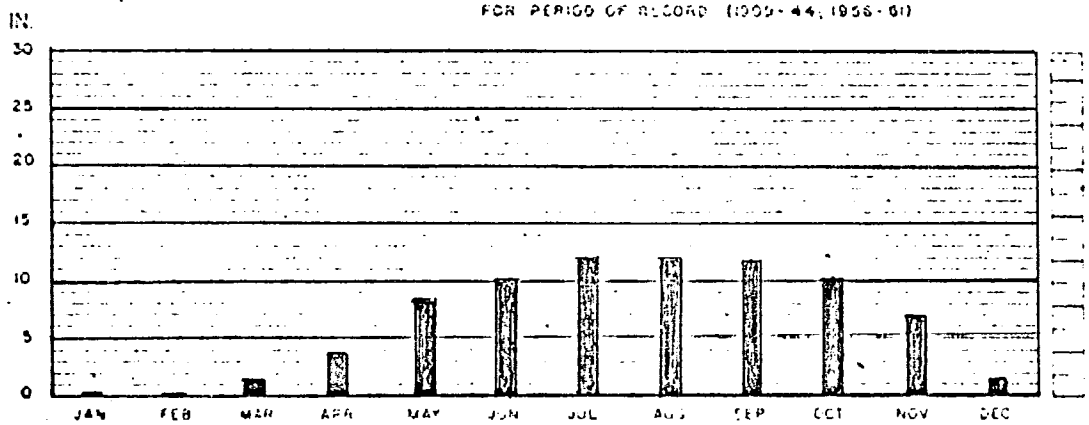
TEMPERATURE

FOR PERIOD OF RECORD (1942-43, 1956-61)



AVERAGE RAINFALL

FOR PERIOD OF RECORD (1909-44, 1956-61)



JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC		ANNUAL
.44	.31	1.49	3.89	8.46	10.26	11.95	12.02	11.84	10.30	6.94	1.74	AVERAGE (IN)	79.62
2.76	3.82	10.35	13.58	18.98	17.60	23.27	26.60	20.31	16.26	30.75	6.58	RECORD HIGH (IN)	108.15
0	0	0	0	1.93	3.31	2.60	2.91	4.61	4.33	1.18	0	RECORD LOW (IN)	39.63
2.05	1.77	4.25	3.23	5.28	3.54	4.45	3.66	5.07	2.95	5.55	2.35	24-HOUR RECORD (IN)	5.67
1	1	3	7	13	16	18	17	17	16	12	4	DAYS OF RAIN (AVG)	125

U.S. LINE MATERIAL REQUIREMENTS

AN GIANG PROJECT

ITEM	Manufacturer	Cat. No.	Total quantity	Required Delivery Date by percentage of quantity									
				11-1-65	1-66	3-66	3-67	3-68	3-69	3-70	3-71	3-72	3-73	3-74
a. Insulator pin type	Ohio Brass	38148	3604	60	20	20								
k. Insulator suspension	" "	32433	972	60	20	20								
b. Pin pole top steel	Hubbard	3162	2378	60	20	20								
c. Bolts machine 5/8" x 9"	"	9809	6000	60	20	20								
" " 5/8" x 10"	"	9810	200	60	20	20								
" " 5/8" x 14"	"	9814	40	60	20	20								
d. Washer square	"	7814	10814	60	20	20								
f. Pins cross arms	"	981	1256	60	20	20								
h. Cross arm braces	"	8128	1312	60	20	20								
i. Bolts carriage	"	9634½	1312	60	20	20								
j. Lagg screws	"	9754	620	60	20	20								
o. Eye bolts 5/8' x 8"	"	39958	800	60	20	20								
" " 5/8' x 10"	"	39960	730	60	20	20								
u. 3-bolt guy clamp	"	7450	1000	60	20	20								
" " "	"	7461	440	60	20	20								
v. Guy attachement	"	6004	650	60	20	20								

U.S. LINE MATERIAL REQUIREMENTS

AN GIANG PROJECT

I T E M	Manufacturer	Cat. No.	Total quantity	Required Delivery Date by percentage of quantity									
				11-1-65	1-66	3-66	3-67	3-68	3-69	3-70	3-71	3-72	3-73	3-74	3-75
cm. Insulator spool 3"	Hubbard	1716	1356	60	20	20									
Insulator spool	"	455	4000												
m. Clamp suspension	Chance	A2270	114	60	20	20									
c. Bolts ½" x 6"	Hubbard	9706	100	60	20	20									
ck. Anchor rod bonding clamp	Chance	G5060	650	60	20	20									
" " "	"	G5065	80			20									
ai. Ground rod galvanized & clamp	Hubbard	2668	5000	60	20	20									
bn. Loup dead end	Betha	ALD23w	2000	60	20	20									
n. Bolts D.A. 5/8" x 16"	Hubbard	9866	50	60	20	20									
" " 5/8" x 18"		9863	50	60	20	20									
Staples			600 lb	60	20	20									
Nails 8 penny galv.			100 lb	60	20	20									
ap. Hot line clamps	Chance	S5130AA	800	60	20	20									
Guy strand 3/8" Seimen martin grade			25000 ft	60	20	20									
Guy strand 7/16" Seimen martin grade			5000 ft	60	20	20									

ITEM	Manufacturer	Cat.No.	Total quantity	Required Delivery Date by percentage of quantity									
				11-1-65	1-66	3-66	3-67	3-68	3-69	3-7-	3-71	3-72	3-73	3-74	3-75
aa. Eye nuts	Hubbard	7502	260	60	20	20									
X. Anchor rods 5/8"	"	8417	500	60	20	20									
" " 3/4"	"	8528	30	60	20	20									
z. Anchors screw 8000L5	Chance	11B1	150	60	20	20									
" " 10000L5	Conditional "	13C1	50	60	20	20									
" expansion	8000 Hubbard	322088	450	60	20	20									
" rod extension 8000	Chance	88135 402	50	60	20	20									
bj. Guy hooks	Hubbard	7584	140	60	20	20									
bk. Shim plates	"	7575	140	60	20	20									
bo. Shakel anchors	"	6801	106	60	20	20									
ek. MF Locknuts 5/8"	"	4510	8000	60	20	20									
bs. Bolt single upset	" 8"	8741	3900	60	20	20									
bs. Bolt " "	"10"	8742	3900	60	20	20									
q. Bolt double upset	" 8"	8826	800	60	20	20									
q. " " "	"10"	8830	800	60	20	20									
as. Service swinging	"	2947	800	60	20	20									
da. Bracket	"	1328	250	60	20	20									
ci. Clevis thimble side opening	"	674	54	60	20	20									

U.S. LINE MATERIAL REQUIREMENTS

AN GIANG PROJECT

ITEM	Manufacturer	Cat.No.	Total quantity	Required Delivery Date by percentage of quantity										
				11-1-65	1-66	3-66	3-67	3-68	3-69	3-70	3-71	3-72	3-73	3-74	3-75
1. Clamp dead end	Alcoa	302	800	60	20	20									
s. Clevis swinging 3"	Hubbard	1355	456	60	20	20									
s. " " 1-3/4" "		1353	4000												
Cross Arms	--	--	656	100											
Conductor 1/0 6/1 ACSR	--	--	82000 lb	50	25	25									
" 2 7/1 ACSR	--	--	20000 lb	50	25	25									
" 4 7/1 ACSR	--	--	72000 lb	50	25	25									
" #6 Cu. Soft drawn	--	--	4000 lb	100											
" #2 Al Duplex #4 6/1 Bare Neutral	--	--	686000ft	50	25	25									

An Giang Project

ITEM	Total quantity	Required Delivery Date by percentage of quantity										
		11-1-65	1-66	3-66	3-67	3-68	3-69	3-70	3-71	3-72	3-73	3-74	3-75
*Connectors Burndey 325 -81	20000	60	20	20									
" " 340 - 8	6000	60	20	20									
Preformed Armor Rod AR 0110	3000 sets	50	25	25									
" " " " 0114	200 "	50	25	25									
" " " " 0118	1000 "	50	25	25									
Transformers single Phase													
- 5 KVA	120	30	20	10	10		10		10		10		
- 10 KVA	480	30	" 20	10	10		10		10		10		
- 15 KVA	30	30	20	10	10		10		10		10		
- 25 KVA	15	30	20	10	10		10		10		10		
Line splices Burndey full tension													
- #4 7/1	570	50	25	25									
- #2 6/1	770	50	25	25									
- #1/0 61	315	50	25	25									

* Include appropriate gun or tool for applying connectors.

A PLAN FOR FUTURE REQUIREMENTS

AN GIANG

The system is located in the delta area where there has existed little or no generation of electricity. A French owned company SCEE operated in the City of Long Xuyen. However, they serve only a small percentage of the households within the city limits. Other larger communities in the delta area have similar limited power production and distribution.

Agreement with Electricity of Vietnam was reached to build a small 1000 KW Generating Station to serve the cooperative area. EOV is to own this plant and after training of manpower to assume the operation of the plant.

Electricity of Vietnam has agreed to increase the capacity of the plant as the cooperative needs increase. It is extremely important the contractual agreements be drawn to insure the cooperative that either EOV does install this equipment when needed or that they allow the cooperative to install the equipment, and that the wholesale rate will be just. That EOV does not usurp the production of the plant in their efforts to serve the urban residents of Long Xuyen and surrounding large communities.

It is assumed that Electricity of Vietnam will build a high voltage transmission line to this area whenever the war ends. This line will be initially an extension of the 230 KV line from Da Nhim to Saigon, but not necessarily at that voltage. It is assumed that other thermal plants will be constructed on either the Bay of Siam or the South China Sea Coast where port facilities will allow the transport of fuel.

The construction of these facilities will of necessity take a number of years following the peace, and for this reason the Long Xuyen generating plant will require fairly large capacity additions even without lateral expansion of service.

All conductor sizes were suggested with some lateral expansion in areas now drained and heavily populated. As a result voltage drops on the system were held to a minimum.

There is little available information to project industrial of either sizable plants or cottage industry.

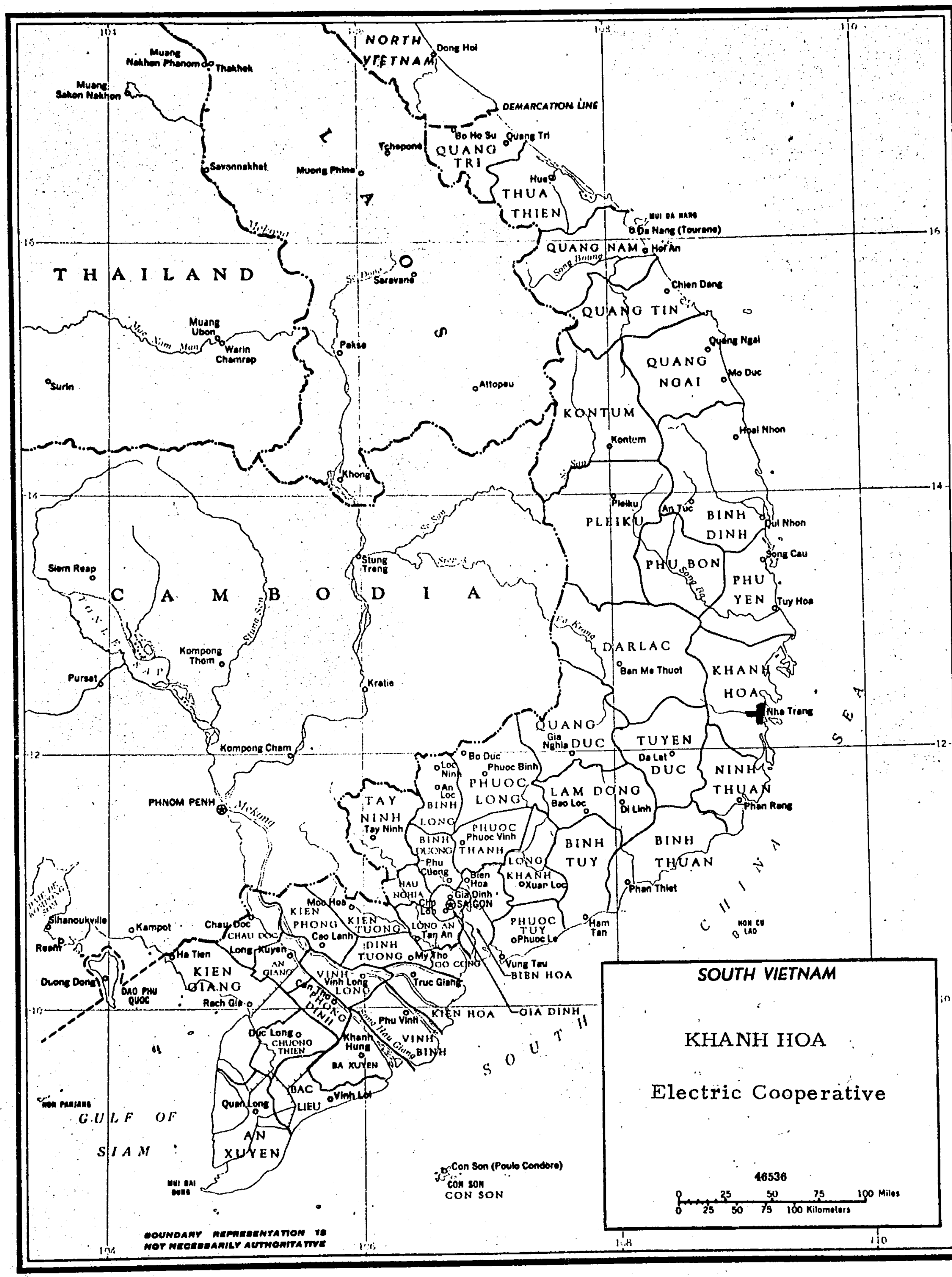
REA methods and demand charts were used throughout the study.

PROPOSED

KHANH HOA

ELECTRIC

COOPERATIVE


SOUTH VIETNAM
KHANH HOA
Electric Cooperative
46536
BOUNDARY REPRESENTATION IS NOT NECESSARILY AUTHORITATIVE

SUMMARY

KHANH HOA ELECTRIC COOPERATIVE

1. Borrower: Government of Vietnam will receive a grant to loan to Khanh Hoa Electric Cooperative of Nha Trang South Vietnam.

2. Amount: 287,635 US Dollars plus 13,452,000 VN Dollars.

3. Total cost of Project: (Exchange $73 VN$/ 1 US $) - 471,909.00 US $

4. Purpose:

   To extend and improve electrical facilities for the distribution of electricity to the rural areas of Khanh Hoa province of South Vietnam to be used as a Pacification Project.

5. Background:

   AID/Washington signed a contract with National Rural Electric Cooperative Association (NRECA) to provide technical advisory services for the rural electrification in the developing countries of the Free World.

Clyde Ellis, General Manager of NRECA, and Tom Venables, Co-ordinator visited Vietnam at invitation of AID and after consultation with officials it was decided to start immediately with a program to set up rural electrification in South Vietnam.

The work to be done should be viewed as a pilot project and be moved as rapidly as possible. The success or failure depends on the speed at which this work can be started.

The Cooperative area in Khanh Hoa has been inspected and some contacts made with the District Chief, District Engineer and other Vietnamese.

No organization work has been performed. Preliminary engineering, mapping, including all studies have been made and are included in this report.

6. Project description:

The electric system to be financed will belong to a member owned cooperative composed of the people of Khanh Hoa province; serving an area that has a population of approximately 60,000 people.

The system will consist of a 1500 KVA 6.6/15-8.6 KV substation. Power will be purchased from the French owned electric company in Nha Trang S.I.P.E.A. It will have approximately 13 miles of single phase, 22 miles of three phase, and approximately 55 miles of secondary and services to serve 10,000 plus consumers. Transformers, meters, and meter loops with service entrance equipment will be provided by the cooperative. The system is designed to handle 10,000 consumers with an average KWH usage in 10 years of 50 KWH per meter per month.

Due to poor security, the project has been divided into three parts. One to be built at the present time consisting of 5.5 miles of single phase, 30.8 miles of three phase, and 29 miles of secondary to serve 5315 consumers, all design based on the entire system as to be eventually constructed.

Included in the loan is money to relend to consumers for wiring of houses and purchase of electrical equipment. To train personnel in operation and management, NRECA personnel will be retained for consultative work for two years.

PROPOSED PROJECT

KHANH HOA

The project will be built in three sections A, B, and C. Time of construction of sections B & C will depend on security and developments.

The project comprises:

1.A. Construction of one 1500 KVA 6.6/15 KV

2.A. Construction of approximately 10.8 miles 3 ∅ 8.6/15 KV line

2.B. Construction of approximately 7 miles 3 ∅ 8.6/15 KV line

2.C. Construction of approximately 4.5 miles 3 ∅ 8.6/15 KV line

Total construction 3 ∅ 8.6/15 KV line 22.3 miles

3.A. Construction of approximately 5.5 miles 1 ∅ 8.6 line

3.B. Construction of approximately 2.0 miles 1 ∅ 8.6 line

3.C. Construction of approximately 5.6 miles 1 ∅ 8.6 line

Total construction 1 ∅ 8.6 KV line 13.1 miles

4.A. Construction of approximately 28.9 miles of secondary underbuild, and secondary.

4.B. Construction of approximately 19.2 miles of secondary underbuild, and secondary.

4.C. Construction of approximately 6.7 miles of secondary underbuild, and secondary.

Total construction of approximately 54.8 miles of secondary and secondary underbuild.

5.A. Construction of services to 5315 houses.

5.B. Construction of services to 3528 houses.

5.C. Construction of services to 1230 houses.

Total construction of services to 10,023 houses.

6.A. Installation of 8.6/230 V 2 bushing transformers

80	10KVA	800
50	15KVA	750
Total installed KVA		1550

6.B. Installation of 8.6/230 V 2 bushing transformers

50	10 KVA	500
40	15 KVA	600
Total installed KVA		1100

6.C. Installation of 8.6/230 V 2 bushing transformers

10	10 KVA	100
20	15 KVA	300
Total installed KVA		400

Total transformers to be installed on all sections

140	10 KVA	1400
110	15 KVA	1650
Total installed KVA		3050

POPULATION FACTS

(West of Nha Trang)

I. PHASE I:

A. District: Dien Khanh

Village	Hamlet	Population		No. of Families	
		Village	Hamlet	Village	Hamlet
Dien An		4,467		705	
	Phu An Nam		3,566		549
	An Ninh		392		69
	Ve Kien		509		87
Dien Lac		3,839		576	
	Thanh Minh		2,785		403
	Truong Lac		1,054		173
Dien Thuy		4,171		653	
	Phu Loc		4,171		653
Dien Toan		4,615		782	
	Phuoc Thanh		3,975		675
	Phuoc Trach		640		107
Dien Thanh		4,017		665	
	Khanh Thanh		454		68
	Truong Thanh		1,051		177
	Phu Khanh		2,512		420

B. District: Vinh Xuong

Vinh Miep		3,693		639	
	Vinh Diem Thuong		958		163
	Vinh Diem Ha		1,454		220
	Vinh Chau		401		103
	Vinh Diem Trung		880		153
Vinh Thanh		3,635		742	
	Phu Vinh		1,256		195
	Phu Trung		734		223
	Phu Binh		647		113
	Phu Thanh		998		193
Vinh Trung		2,547		441	
	Vo Canh		774		145
	Vo Dong		725		142
	Vo Cang		949		132
	Xuan Son		99		22
T O T A L		30,984	30,984	5,185	5,185

POPULATION FACTS

Khanh Hoa Province - Dien Khanh District

II. PHASE II:

Serial No.	Village	Hamlet	Population		No. of Families	
			Village	Hamlet	Village	Hamlet
1.	Dien Dien		5,717		886	
		Dai Dien Trung		2,682		421
		Dai Dien Dong		3,035		465
2.	Dien Binh		1,252		239	
		Nghiep Thanh		466		92
		Luong Phuoc		160		34
		Hoi Phuoc		626		113
3.	Dien Son		4,559		723	
		Dai Dien Nam		2,245		342
		Dai Dien Tay		2,314		381
4.	Dien Thuy		4,171		653	
		Phu Loc		4,171		653
5.	Dien Hoa		1,947		312	
		Lac Loi		443		73
		Quang Thanh		848		128
		Binh Khanh		656		111
6.	Dien Phu		4,304		715	
		Phu Cap		1,724		271
		Phu Nam		798		127
		Phu An Bac		1,782		317
TOTAL			21,950	21,950	3,528	3,528

Inc. "C"

POPULATION FACTS

Khanh Hoa Province — Dien Khanh District

III. PHASE III:

Serial No.	Village	Hamlet	Population		No. of Families	
			Village	Hamlet	Village	Hamlet
1.	Dien Lam		1,528		286	
		Phu Coc		1,204		212
		Khanh Xuan		229		55
		Xuan Lam		95		19
2.	Dien Tho		2,128		404	
		Cam Son		164		30
		Le Thanh		445		70
		Phuoc Luong Thuong		1,519		304
3.	Dien Loc		988		183	
		My Loc		578		102
		Danh Thanh		302		58
		Dai Huu		108		23
4.	Dien Phuoc		2,164		352	
		Phuoc Tuy		1,675		269
		An Dinh		184		31
		Pho Thien		305		52
T O T A L			6,808	6,808	1,225	1,225

INCL. "D"

KHANH HOA ELECTRIC COOPERATIVE

Estimated Peak KW Demand Requirements By Years

	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975
Number of Consumers	1330	1994	2658	3038	3418	3798	4178	4558	4938	5315
KWH/Consumer/ Month	25	28	30	33	35	38	40	44	47	50
KW Demand	208	313	400	476	539	595	657	735	800	1010

All consumers are considered in one category

No diversity factor was considered - Line losses estimated 15%

No investigation of potential large loads was made

BUDGET ANALYSIS
KHANH HOA RURAL ELECTRIC COOPERATIVE

		Material Off Shore US Dollars	Material Local VN$	Labor & Overhead VN$
1.	DISTRIBUTION			
	a. Right of way			200,000
	b. Pole structures & fixtures & conductor	46,200		2,350,000
	c. Transformers	28,257		37,000
	d. Services	55,818	4,784,000	1,435,000
	e. Metering	21,260		32,000
	f. Sectionalizing Eqpt.	1,200		5,000
	g. Regulators	7,000		10,000
2.	SUBSTATIONS			
	a. Land & land rights		10,000	
	b. Structures	14,000	60,000	150,000
	c. Conduit & Wiring	4,700	20,000	40,000
	d. Reclosers	2,600	2,500	5,000
	e. By pass switches	1,200	2,500	5,000
	f. Grounding	1,000	2,500	50,000
	g. Transformers	29,000	20,000	5,000
	h. Air break switches	1,400	2,500	5,000
	i. Lightning Arrestors	2,000	2,000	5,000
	j. Fence		68,000	15,000
3.	GENERAL			
	a. Office Eqpt. & furniture		350,000	
	b. Transportation	12,000		
	c. Tool & work eqpt.		110,000	
	d. Two way radio			
	e. Maintenance	10,000		
4.	OFFICE & WAREHOUSE		800,000	400,000
5.	ADMINISTRATION			
	a. General overhead			470,000
6.	HOUSE WIRING (for reloan)		*8,000,000	
7.	CONTINGENCY	50,000		
		287,635	6,234,000	5,218,000
			**2,000,000	
8.	OPERATING LOAN			
	VN$ 50/1	14,381,000	8,234,000	5,218,000
	PIASTER NEAREST	1,000	27,833,000	

* Not Capitalized self-liquidating loan

** Not Capitalized But Used in Loan Amortization

ASSUMPTION FOR FINANCIAL

PROJECTION ESTIMATE

KHANH HOA

1. That the SIPEA French owned utility in Nha Trang will have the new 5000 KW Nordberg units installed by March 1966.

2. That SIPEA's wholesale rate will not exceed 1.8 P. per KWH.

3. Monies for relending will be 8,000,000 Piasters.

4. Contingency and Miscellaneous cost will be $50,000 US. Relending and contingency is not included as a part of original capital cost.

5. That consumers will be added as shown. However, majority of system will have to be constructed in the first year.

6. That there will be no production tax charged to the cooperative for "wholesale for Resale" energy purchased.

K H A N H - H O A

BALANCE SHEET AND CASH FLOW

Prepared by Him, June 25, 19[illegible]
Approved by H. Bush, June 25, 19[illegible]

	1st Year	2nd. year	3rd. year	4th. year	5th. year	6th. year	7th. year	8th. year	9th. year	10th. year
1: Total connected consumers	1,330	1,994	2,658	3,038	3,418	3,798	4,178	4,558	4,938	5,315
2: Average sales cons/yr	300	336	360	396	420	456	480	528	564	600
3: Total annual sales 1 x 2 K.W.H.	399,000	670,000	957,000	1,203,000	1,436,000	1,729,000	2,005,000	2,407,000	2,785,000	3,211,000
4: Average sale price VN$/KWH	470	457	450	441	436	429	425	418	414	410
5: Total annual revenue	1,875,000	3,062,000	4,307,000	5,305,000	6,261,000	7,413,000	8,521,000	10,061,000	11,529,000	13,165,000
7: Annual purchases power	459,000	770,000	1,101,000	1,383,000	1,651,000	1,987,000	2,303,000	2,768,000	3,203,000	3,693,000
8: Annual cost 1.8 VN$/KWH	823,000	1,386,000	1,982,000	2,489,000	2,972,000	3,577,000	4,151,000	4,982,000	5,765,000	6,647,000
9: Labor and overhead	1,630,000	1,687,000	1,730,000	1,790,000	1,843,000	1,898,000	1,956,000	2,015,000	2,075,000	2,137,000
10: Total operative expense 8 + 9	2,464,000	3,073,000	3,720,000	4,279,000	4,815,000	5,475,000	6,107,000	6,997,000	7,840,000	8,784,000
11: Gross operating margin 5 - 10	(589,000)	(11,000)	587,000	1,026,000	1,446,000	1,938,000	2,414,000	3,064,000	3,689,000	4,381,000
12: Electric plant in service	19,189,000	20,613,000	22,050,000	22,883,000	23,709,000	24,535,000	25,360,000	26,187,000	27,013,000	27,883,000
13: Depreciation at 3.3%	633,000	680,000	728,000	755,000	782,000	810,000	837,000	864,000	891,000	920,000
14: Interest at 2% 18 x .02	423,000	452,000	481,000	498,000	514,000	531,000	547,000	564,000	580,000	597,000

	1st. year	2nd. year	3rd. year	4th. year	5th. year	6th. year	7th. year	8th. year	9th. year	10th. year
15: Total depreciation & Interest 13 ÷ 14	1,055,000	1,132,000	1,209,000	1,253,000	1,296,000	1,341,000	1,384,000	1,428,000	1,471,000	1,617,000
16: Net margin 11 - 15	(1,645,000)	(1,143,000)	(622,000)	(227,000)	150,000	597,000	1,030,000	1,636,000	2,218,000	2,764,000
17: Operating loan	2,000,000	2,000,000	2,000,000	2,000,000	2,000,000	2,000,000	2,000,000	2,000,000	2,000,000	2,000,000
18: Total loan 12 ÷ 17	21,169,000	22,613,000	24,056,000	24,883,000	25,709,000	26,535,000	27,360,000	28,187,000	29,013,000	29,883,000
19: Interest accumulated 1st. 5 years.	423,000	875,000	1,356,000	1,854,000	2,368,000					
20: Payment or Acc. Interest 30 year payment						79,000	79,000	79,000	79,000	79,000
21: Loan payments 18 x .043 after 5 year grace						1,055,000	1,090,000	1,126,000	1,161,000	1,198,000
22: Total debt service						1,134,000	1,169,000	1,205,000	1,240,000	1,277,000
23: Accumulated debt service						1,134,000	2,303,000	3,508,000	4,748,000	6,025,000
24: Reserves 1% Plant in service	192,000	206,000	220,000	229,000	237,000	245,000	253,000	262,000	270,000	278,000
25: Accumulated reserves	192,000	398,000	618,000	847,000	1,084,000	1,329,000	1,582,000	1,844,000	2,114,000	2,392,000
26: Accumulated gross reserves plus operating loan of 2,000,000	1,411,000	1,400,000	1,987,000	3,013,000	4,459,000	6,397,000	8,811,000	11,875,000	15,564,000	19,945,000
27: Cash available 26 - (25 + 23)	1,219,000	1,002,000	1,369,000	2,166,000	3,375,000	3,934,000	4,926,000	6,523,000	8,702,000	11,528,000

VOLTAGE REGULATION STUDY

KHANH HOA ELECTRIC COOPERATIVE

The voltage regulation study of the distribution line of Khanh Hoa Electric Cooperative has been calculated for 10,000 consumers using an average of 50 KWH per month at the end of the tenth year.

The method used was taken from REA Bulletin 45-1, Guide for Making Voltage Drop Calculations. The kilowatt demands used are from REA Bulletin 45-Z, Demand Tables. With modifications using A & B factors for lower KWH usage than predicted by the tables. It is estimated that a ten year growth (1976) will be needed for the system to reach this load level with these consumers.

The Khanh Hoa system is divided into a three phase development due to lack of necessary security in the second and third phases. All calculations are based on the total development of the system.

One three phase circuit is proposed running from the substation at the Nha Trang SIPEA generating plant west along or near the principal highway to Dalat and south of the Cat River.

The maximum voltage drop calculated on 120 volt base is 7.83 volts. If unknown industrial loads develop along the principal highway it may be necessary to install voltage regulators. Information regarding future industrial development is inadequate to make a forecast.

Included is the voltage drop sheet for circuit ABC. The standard REA form is used.

U. S. DEPARTMENT OF AGRICULTURE
RURAL ELECTRIFICATION ADMINISTRATION

VOLTAGE DROP SHEET

SYSTEM DESIGNATION	SUBSTATION	SYSTEM DESIGN
Khanh Hoa Electric Coop	Nha Trang	50 KWH / Memb / month
SYSTEM ENGINEER	**CIRCUITS**	**DATE**
Bush	ABC	July 3, 1965

SECTION		LOAD									LINE						VOLTAGE DROP		
		CONSUMERS					CONCENTRATED												
SOURCE END	LOAD END	WITHIN THIS SECTION	BEYOND THIS SECTION	EQUIV. THIS SECTION	KWH PER MONTH	PEAK KW	WITHIN THIS SECTION	BEYOND THIS SECTION	EQUIV. THIS SECTION	TOTAL KW	CONDUCTOR SIZE CU. EQUIV.	φ	KV	VOLTAGE DROP FACTOR	LENGTH OF SECTION IN MI.	KW MILES	THIS SECTION	TOTAL	AT POINT
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
ABC-7	A8	155	0	77	50	18				18	6	1	8.6	5.0	3.2	57.6	.29	7.83	A8
ABC-6	ABC-7	887	155	599	50	116				116	2	3	8.6	.6	2.4	278.4	.17	7.54	ABC-7
ABC-3	ABC-6	1065	1042	1574	50	300				300	2	3	8.6	.6	3.0	900.0	.54	7.37	ABC-6
ABC-4	ABC-5	422	0	211	50	43				43	2	3	8.6	.6	3.2	137.6	.08	7.52	ABC-5
ABC-3	ABC-4	1202	422	1023	50	196				196	2	3	8.6	.6	1.3	254.8	.15	6.98	ABC-4
ABC-1	ABC-3	68	3731	3765	50	711				711	2	3	8.6	.6	1.2	853.2	.51	6.83	ABC-3
ABC-1	ABC-2	3052	0	1525	50	288				288	2	3	8.6	.6	2.5	720.0	.43	6.75	ABC-2
ABC	ABC-1	2494	7574	8821	50	1672				1672	2	3	8.6	.6	6.3	10533.6	6.32	6.32	ABC-1

DISCUSSION OF SECTIONALIZING

KHANH HOA

1. Power will be supplied by SIPEA, a French owned and operated electric utility in Nha Trang. The present capacity will be increased 5000 KW early in 1966 by the addition of two Nordberg units.

   Substation requirements will be similar to the addition required on the Tuyen Duc System.

2. Line to Ground fault currents. Maximum and Minimum were assumed to be the same as the Tuyen Duc Project.

3. Fault currents are calculated on the short method REA Bulletin 61-Z and are adequate, in our opinion, for preliminary work.

U. S. DEPARTMENT OF AGRICULTURE Rural Electrification Adm. Short Circuit Current Data Sheet	Date 7/3/65								Sheet 1 of 1
	System/designation KHANH HOA								System line to ground voltage
	Prepared by HAM & BUSH								Checked by H. L. Bush
1. Point	SUB	ABC1	ABC2	ABC3	ABC4	ABC5	ABC6	ABC7	A8
2. Preceding point to line toward subs.		SUB	ABC1	ABC1	ABC3	ABC4	ABC3	ABC6	ABC7
3. Miles from previous point on line toward substation		6.3	2.5	1.2	1.3	3.2	3.0	2.4	3.2
4. Copper conductivity size section from previous point		2	2	2	2	2	2	2	6
5. Type of fault calculated	LINE TO GROUND								
6. Max fault current from simplified form Circuit diagram	1250	216	180	194	184	148	174	140	123
7. Minimum fault current from simplified form (Circuit diagram)	170	87	82	85	88	78	80	72	69

A PLAN FOR FUTURE REQUIREMENTS

KHANH HOA

The system is located in the area immediately west of Nha Trang.

Development is anticipated to be average and requirement for power to be average.

The project will be served from SIPEA's generating Station in Nha Trang. This station and related facilities will be acquired by EOV within a few years. The massive military build up in this area will require the expansion of this plant several times. After peace returns to Vietnam we anticipate a surplus of generating capacity.

It is the intent of Electricity of Vietnam to build a high voltage transmission line from Da Nhim hydro plant to the Cam Ranh Bay area. This will ensure the Cooperative of lower cost hydro produced electricity in the future.

All conductor sizes were selected with anticipation of increased population and average lateral expansion to the west and to the south. All conductor sizes were selected on the basis of the entire system rather than the separate phases that security dictates it will be built under. As a result, voltage drops at maximum anticipated usage are held at a minimum.

REA methods and demand charts were used throughout the study.

RATE USED FOR STUDY

KHANH HOA ELECTRIC COOPERATIVE

FIRST	10 KWH	5.0 PIASTERS/KWH
NEXT	15 "	4.5 " "
NEXT	75 "	3.5 " "
ALL OVER	100 "	3.0 " "

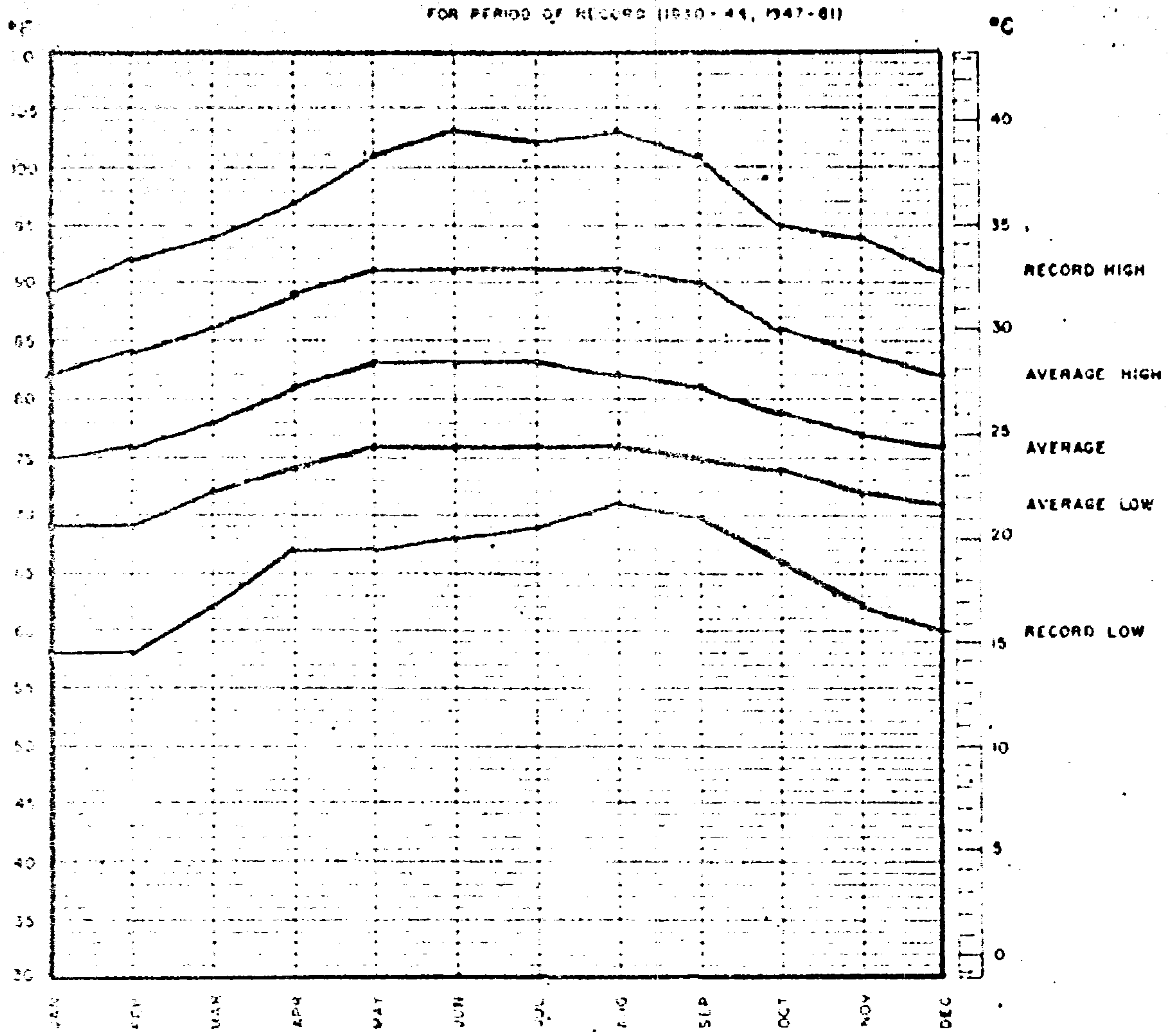
The above does not include any taxes as they are all of a sales type tax. It was assumed they would be added on and the Co-op would only be acting as a tax collector.

NHA TRANG

(LATITUDE 12°15' N, LONGITUDE 109°12' E, ELEVATION 16 FEET MSL)

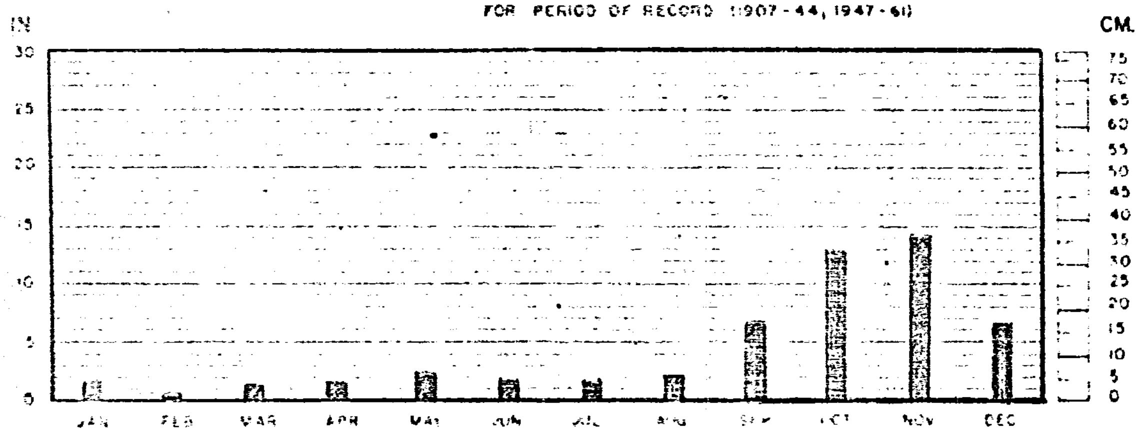
TEMPERATURE

FOR PERIOD OF RECORD (1930-44, 1947-61)



AVERAGE RAINFALL

FOR PERIOD OF RECORD (1907-44, 1947-61)



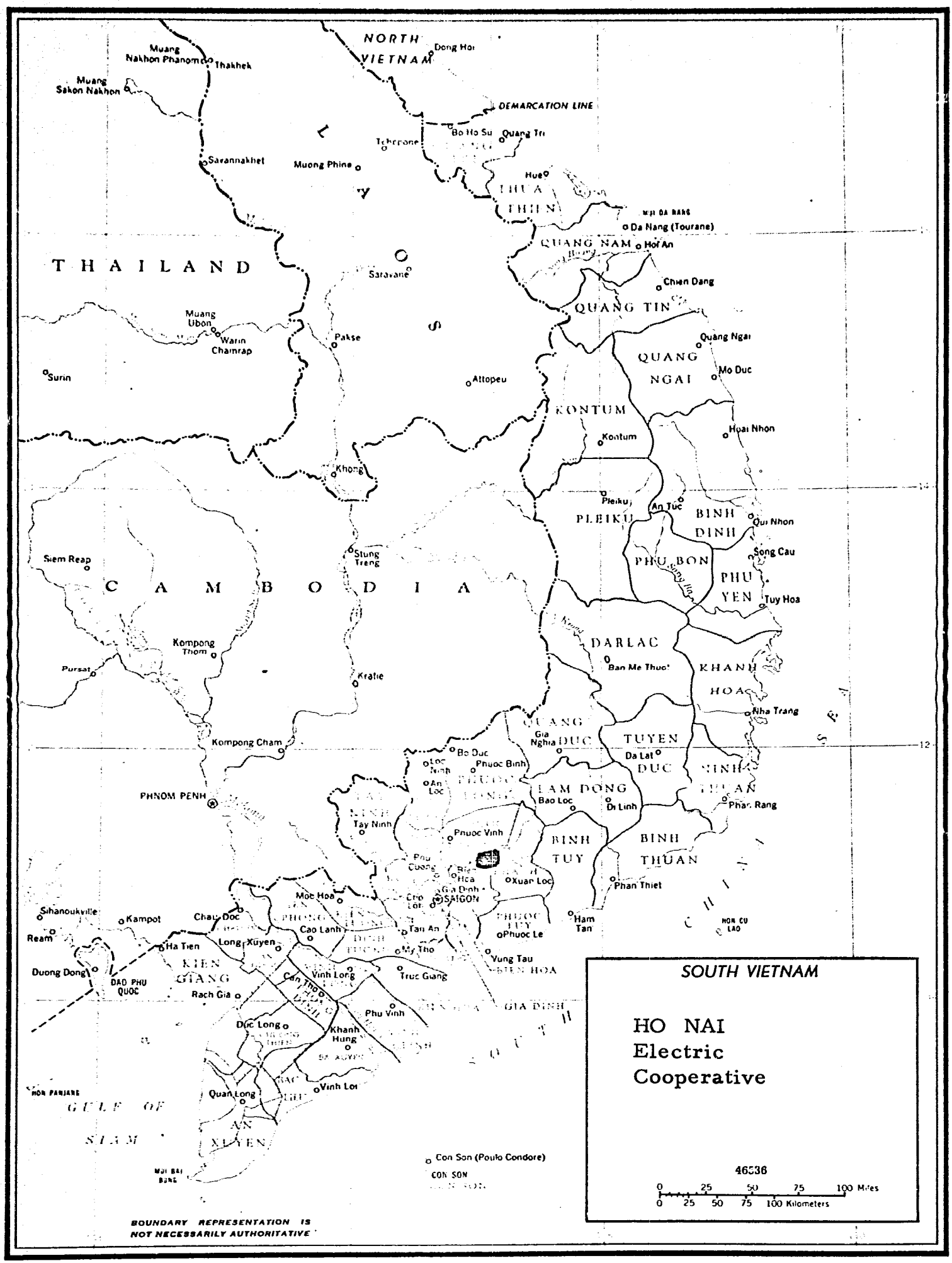
	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC		ANNUAL
	[illegible]	.74	1.26	1.52	[illegible]	1.66	1.69	[illegible]	6.40	12.78	14.25	6.67	AVERAGE (IN)	53.59
	[illegible]	4.52	[illegible]	12.28	[illegible]	7.01	6.46	7.36	[illegible]	35.51	41.77	34.65	RECORD HIGH (IN).........	88.39
	[illegible]	0	0	Trace	Trace	.04	.04	.04	.16	1.85	1.22	.04	RECORD LOW (IN).........	26.65
	[illegible]	[illegible]	[illegible]	4.21	[illegible]	2.32	3.50	[illegible]	5.32	9.66	10.15	11.42	24-HOUR RECORD (IN)	11.42
	9	4	3	4	7	6	9	8	[illegible]	19	17	14	DAYS OF RAIN (AVG.).......	116

PROPOSED

HO - NAI

ELECTRIC

COOPERATIVE


NORTH VIETNAM
Dong Hoi
DEMARCATION LINE
Muang Nakhon Phanom
Thakhek
Muang Sakon Nakhon
Savannakhet
Muong Phine
Tchepone
Bo Ho Su
Quang Tri
Hue
THUA THIEN
MUI DA NANG
Da Nang (Tourane)
QUANG NAM
Hoi An
THAILAND
Saravane
Chien Dang
QUANG TIN
Muang Ubon
Warin Chamrap
Pakse
Attopeu
Surin
Quang Ngai
QUANG NGAI
Mo Duc
KONTUM
Kontum
Hoai Nhon
Khong
Pleiku
An Tuc
PLEIKU
BINH DINH
Qui Nhon
Siem Reap
Stung Treng
PHU BON
Song Cau
PHU YEN
Tuy Hoa
CAMBODIA
Kompong Thom
DARLAC
Ban Me Thuot
Pursat
Kratie
KHANH HOA
Nha Trang
Kompong Cham
QUANG DUC
Gia Nghia
TUYEN DUC
Da Lat
Bo Duc
Loc Ninh
Phuoc Binh
An Loc
PHNOM PENH
LAM DONG
Bao Loc
Di Linh
Phan Rang
Tay Ninh
Phuoc Vinh
BINH TUY
BINH THUAN
Xuan Loc
Phan Thiet
Moc Hoa
SAIGON
Sihanoukville
Kampot
Chau Doc
Ream
Cao Lanh
Tan An
Ha Tien
Long Xuyen
My Tho
Phuoc Le
Ham Tan
Vung Tau
Duong Dong
KIEN GIANG
Vinh Long
Can Tho
Truc Giang
DAO PHU QUOC
Rach Gia
Phu Vinh
Duc Long
Khanh Hung
GIA DINH
Vinh Loi
HON PANJANG
Quan Long
GULF OF SIAM
AN XUYEN
Con Son (Poulo Condore)
CON SON
MUI BAI BANG
SOUTH VIETNAM
HO NAI
Electric
Cooperative
46536
0 25 50 75 100 Miles
0 25 50 75 100 Kilometers
BOUNDARY REPRESENTATION IS NOT NECESSARILY AUTHORITATIVE

SUMMARY

HO NAI ELECTRIC COOPERATIVE

1. Borrower: Government of Vietnam will receive a grant to loan to the Ho Nai Electric Cooperative.

2. Amount: 255,800 US Dollars plus 14,295,000 VN $.

3. Total Cost of Project: Exchange (73 $ VN to 1 US $) US $ 451,620.00

4. Purpose:

To extend and improve electrical facilities for the distribution of electricity to the rural hamlets of Ho Nai, located approximately 25 kilometers North East of Saigon and 5 kilometers east of Bien Hoa, Vietnam. This project will be used as a pacification project.

5. Background:

AID/Washington signed a contract with National Rural Electric Cooperative Association (NRECA) to provide technical advisory services for the rural electrification in the developing countries of the Free World.

Clyde Ellis, General Manager of NRECA, and Tom Venables, Co-ordinator visited Vietnam at invitation of AID and afterconsultation with officials it was decided to start immediately with a program to set up rural electrification in South Vietnam.

The work to be done should be viewed as a pilot project and be moved as rapidly as possible. The success or failure depends on the speed at which this work can be started.

The Cooperative area in Ho Nai Village has been inspected and many contacts made with the District Chief and Catholic fathers. No organization

work has been performed. Considerable effort has been made by the inhabitants through their Catholic leaders to ensure this area will be the site of one of the pilot projects constructed - Mapping and Preliminary Engineering including all studies have been made and are included in this report.

6. Project Description:

The electric system to be financed will belong to a member owned cooperative composed of the people of Ho Nai Village. This village consists of sixteen hamlets and includes a population of approximately 40,000 people.

These villagers are entirely refugees from North Vietnam who started moving to this area approximately 10 years ago. The villagers are entirely Catholic and each hamlet has a church, school and priest. The villagers are farmers born and raised. They are engaged in farming and handicraft works.

The system will consist of equipment required to take off of the 15 KV line of the Electricity of Vietnam Don Nai substation located about four miles from Ho Nai Village.

The system will have approximately 4 miles of single phase, 11 miles of three phase and approximately 40 miles of secondary and services to serve 7500 plus consumers. Transformers, meters, meter loops and associated entrance equipment will be furnished by the Cooperative.

The system is designed to handle 7500 plus consumers with an average KWH usage in ten years of 66 KWH per meter.

Included in the loan is money to reloan to the consumers for wiring of houses and purchase of electrical equipment. Money is included for training personnel in operations and management. Money is included to cover deficits of early years of operations.

 NRECA personnel will be retained for consultative work for two years.

PROPOSED PROJECT

HO NAI

The project comprises:

1. Addition of take off material and reclosers on the north 15 KV bay of Electricity of Vietnam's 66/15 KV Dong Mai substation.
2. Construction of approximately 11 miles of 3 ϕ 8.6/15 KV lines.
3. Construction of approximately 4 miles of 1 ϕ 8.6 KV lines
4. Construction of approximately 40.5 miles of secondary underbuild and services to serve an estimated 7500 houses.
5. Installation of 8.6/230 V 2 bushing transformers

80	10 KVA	800
190	15 "	1350
20	25 "	500
	Total installed KVA	2650

LIST OF NEW LIFE HAMLETS IN HO NAI VILLAGE
DUC TU DISTRICT, BIEN HOA PROVINCE

Hamlet	Coordinate	Population	Total of Families
TAN BAC	YT.150.117	1109	212
BAC HOA	YT.146.117	1009	202
BUI CHU	YT.120.125	1854	371
THANH HOA	YT.132.120	1442	288
NGU PHUC I	YT.097.127	1714	351
VAN COI	YT.093.127	3337	667
HOA BINH	YT.088.126	1438	287
LO DUC I	YT.078.130	734	147
LO DUC 2	YT.100.145	400	80
DONG HAI 2	YT.105.145	726	145
THANH TAN	YT.071.131	2236	447
HA NOI	YT.066.131	1880	376
DONG HAI I	YT.062.132	4140	968
NAM HAI	YT.095.131	9991	1998
BAC HAI	YT.054.131	1570	314
TAY HAI	YT.050.130	2956	591

HO NAI ELECTRIC COOPERATIVE

Estimated Peak KW Demand Requirements By Years

	66	67	68	69	70	71	72	73	74	75
Number of Consumers	1866	2799	3732	4265	4798	5331	5864	6397	6930	7464
KWH/Consumer/ Month	20	25	28	32	37	42	46	52	55	66
KW Demand	233	292	439	648	720	832	940	1254	1423	1815

All customers are considered in one category

No diversity factor was considered. Line losses estimated 15%

No investigation of potential large loads was made

BUDGET ANALYSIS

HO NAI ELECTRIC COOPERATIVE

	Material Off Shore US Dollars	Material Local VN$	Labor & Overhead VN$
1. DISTRIBUTION			
a. Right of way			200,000
b. Poles, structures & fixtures & conductor	54,400		2,876,000
c. Transformers	67,100		52,000
d. Services	39,200	4,852,000	2,015,000
e. Metering	29,900		45,000
f. Sectionalizing Eqpt.	1,200		5,000
g. Regulators	7,000		10,000
2. CONNECTION TO EOV	5,000	10,000	100,000
3. GENERAL			
a. Office Eqpt. & furniture		350,000	
b. Transportation	12,000		
c. Tool & Work Eqpt.		110,000	
d. Two Way radio			
e. Maintenance material	10,000		
4. OFFICE & WAREHOUSE		800,000	400,000
5. ADMINISTRATION			
a. General overhead			470,000
6. HOUSE WIRING (for reloan)		*8,000,000	
7. CONTINGENCY	30,000		
	255,800	6,122,000	6,173,000
		**2,000,000	
8. OPERATING LOAN			
VN$ 50/1	12,790,000	8,122,000	6,173,000
Piaster Nearest		27,085,000	

* Not Capitalized Self-Liquidating Loan

** Not Capitalized But Used in Loan Amortization

ASSUMPTION FOR FINANCIAL

PROJECTION ESTIMATE

H O - N A I

1. That the Electricity of Vietnam will charge the cooperative 1.5 P. per KWH. Restoration of peace in Vietnam will enable the Electricity of Vietnam to reduce this price considerably.

2. Monies for relending will be 8,000,000 Piasters.

3. Contingency cost and Miscellaneous will be $30,000 US.

4. Relending and Contingency is not included as a part of the original capital cost.

5. That consumers will be added as shown. However, the majority of the system will have to be constructed in the first year.

6. That there will be no production tax charged to the cooperative "wholesale for resale" energy purchased.

M O N A I

BALANCE SHEET AND CASH FLOW

	1st. year	2nd. year	3rd. year	4th. year	5th. year	6th. year	7th. year	8th. year	9th. year	10th. year
1: Total connected consumers	1,866	2,799	3,732	4,265	4,798	5,331	5,864	6,864	6,930	7,464
2: Average sales cons/yr	240	300	336	384	444	504	552	624	660	720
3: Total annual sales 1 x 2 K.W.H.	448,000	840,000	1,254,000	1,638,000	2,130,000	2,687,000	3,237,000	3,992,000	4,574,000	4,574,000
4: Average sale price VN$ KWH	375	370	357	344	331	321	315	307	304	295
5: Total annual revenue	1,680,000	3,108,000	4,477,000	3,635,000	7,050,000	8,625,000	10,197,000	12,255,000	13,905,000	15,853,000
7: Annual purchases Power 3 x 1.15	515,000	966,000	1,442,000	1,884,000	2,450,000	3,090,000	3,723,000	4,590,000	5,260,000	6,180,000
8: Annual cost 1.5 VN$/KWH	773,000	1,449,000	2,163,000	2,826,000	3,675,000	4,635,000	5,585,000	6,885,000	7,890,000	9,270,000
9: Labor and overhead	1,438,000	1,487,000	1,538,000	1,590,000	1,643,000	1,698,000	1,756,000	1,815,000	1,875,000	1,937,000
10: Total operative expense 8 + 9	2,211,000	2,936,000	3,701,000	4,416,000	5,318,000	6,333,000	7,341,000	8,700,000	9,765,000	11,207,000
11: Gross operating margin 5 -10	(531,000)	172,000	776,000	1,219,000	1,732,000	2,292,000	2,856,000	3,555,000	4,140,000	4,646,000
12: Electric plant in service	14,405,000	16,518,000	18,631,000	19,833,000	21,045,000	22,252,000	22,459,000	24,666,000	25,873,000	27,085,000
13: Depreciation at 3.3%	475,000	546,000	615,000	655,000	721,000	734,000	774,000	814,000	854,000	894,000
14: Interest at 2% 18 x .02	328,000	370,000	413,000	437,000	461,000	485,000	489,000	533,000	557,000	581,000
15: Total depreciation & Int. 13 + 14	803,000	916,000	1,028,000	1,092,000	1,182,000	1,219,000	1,263,000	1,347,000	1,411,000	1,475,000

	1st. year	2nd. year	3rd. year	4th. year	5th. year	6th. year	7th. year	8th. year	9th. year	10th. year
16: Net margin 11 - 15	(1,334,000)	(744,000)	(252,000)	127,000	550,000	1,073,000	1,593,000	2,208,000	2,729,000	3,171,000
17: Operating loan	2,000,000	2,000,000	2,000,000	2,000,000	2,000,000	2,000,000	2,000,000	2,000,000	2,000,000	2,000,000
18: Total loan 12 + 17	16,405,000	18,518,000	20,631,000	21,833,000	23,045,000	24,252,000	24,459,000	26,666,000	27,873,000	29,085,000
19: Interest accumulated 1st. 5 years										
20: Payment on Acc. interest: 30 year payments	328,000	698,000	1,111,000	1,548,000	2,009,000	67,000	67,000	67,000	67,000	67,000
21: Loan payments 18 x .043 after 5 year grace						1,043,000	1,052,000	1,147,000	1,199,000	1,251,000
22: Total debt service						1,110,000	1,119,000	1,214,000	1,266,000	1,318,000
23: Accumulated debt service						1,110,000	2,229,000	3,443,000	4,709,000	6,027,000
24: Reserve 1% plant in service	144,000	165,000	186,000	198,000	210,000	223,000	235,000	247,000	259,000	271,000
25: Accumulated reserve	144,000	309,000	495,000	693,000	903,000	1,126,000	1,361,000	1,608,000	1,867,000	2,138,000
26: Accumulated gross Rev. plus operating loan of 2,000,000	1,469,000	1,641,000	2,417,000	3,636,000	5,368,000	7,660,000	10,516,000	14,071,000	18,211,000	22,857,000
27: Cash available 26 - (25 + 23)	1,325,000	1,332,000	1,922,000	2,943,000	4,465,000	5,424,000	6,926,000	9,020,000	11,635,000	14,692,000

VOLTAGE REGULATION STUDY

HO NAI ELECTRIC COOPERATIVE

The voltage regulation study of the distribution line of Ho Nai Electric Cooperative has been calculated for 7500 consumers using an average of 66 KWH per month at the end of the tenth year.

The method used was taken from REA Bulletin 45-1 Guide for Making Voltage Drop Calculations. The kilowatt demands used are from REA Bulletin 45-2 Demand Tables. With modifications using A & B factors for lower KWH usage than predicted by the tables. It is estimated that a ten year growth (1976) will be required for the system to reach this load level with this number of consumers.

One circuit is proposed - branching into a circuit running west and one running east along the principal highway.

The maximum volt drop is calculated on 120 volt base 6,397 volt. This will be adequate voltage regulation until average usage exceeds the design level.

Included is the voltage drop sheet for Circuit ABC. The Standard REA form is used.

U. S. DEPARTMENT OF AGRICULTURE
RURAL ELECTRIFICATION ADMINISTRATION

VOLTAGE DROP SHEET

SYSTEM DESIGNATION	SUBSTATION	SYSTEM DESIGN
HO NAI	EOV-Dong Mai Substation	66 KWH/cons/month
SYSTEM ENGINEER	**CIRCUITS**	**DATE**
NRECA Bush	ABC	7-2-65

SECTION		LOAD									LINE						VOLTAGE DROP		
		CONSUMERS					CONCENTRATED												
SOURCE END	LOAD END	WITHIN THIS SECTION	BEYOND THIS SECTION	EQUIV. THIS SECTION	KWH PER MONTH	PEAK KW	WITHIN THIS SECTION	BEYOND THIS SECTION	EQUIV. THIS SECTION	TOTAL KW	CONDUCTOR SIZE CU. EQUIV.	ϕ	KV	VOLTAGE DROP FACTOR	LENGTH OF SECTION IN MI.	KW MILES	THIS SECTION	TOTAL	AT POINT
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
ABC3	ABC5	2111	0	1055	66	256	-----	-----	-----	256	2	3	8.6	.6	4.2	1075.2	.645	5.782	ABC-5
ABC3	A4	225	450*	563	66	140				140	6	1	8.6	5.0	1.8	252.0	1.260	6.397	A4
ABC1	ABC3	881	2786	3226	66	780				780	2	3	8.6	.6	1.6	1248.0	.748	5.137	ABC-3
ABC1	ABC2	3575	0	1786	66	422				422	2	3	8.6	.6	1.4	590.8	.355	4.744	ABC-2
ABC	ABC-1	672	7242	7578	66	1829				1829	2	3	8.6	.6	4.0	7316.0	4.389	4.389	ABC-1

* Potential consumers in hamlets. Xom Thien Quan, Xom Binh Trung. Not included in load at this time. Hamlets are non-refugee inhabitants at area.

DISCUSSION OF SECTIONALIZING

H O N A I

(1) Power will be supplied from the 20 MVA Dong Nai substation located on the Electricity of Vietnam 66 KV transmission line. This substation is approximately 8-1/2 miles north of the Saigon substation on the Saigon Da Nhim 230 KV transmission line. It is also 8 miles north of the construction site of the Thu Duc thermal generating plant.

(2) Electricity of Vietnam engineers have been unable to supply information on the substation regarding maximum or minimum fault currents at the substation. It is assumed that these values will be exceptionally high when all generating facilities are feeding into the 66 KV system.

Further study of size and type of oil circuit breakers to be installed at the substation should be made when Electricity of Vietnam can supply the required information.

U.S. Department of Agriculture
Rural Electrification Administration

Short Circuit Current Data Sheet

Date 7/2/65

System/designation: HO NAI

Prepared by H. L. Bush

Sheet 1 of 1

System line to ground voltage

Checked by Bush

Instructions See bulletin 61-2 & supplement

1. Point	SUB	ABC1	ABC2	ABC3	A4	ABC5	
2. Preceding point to line toward substation		SUB	ABC1	ABC1	ABC3	ABC3	
3. Miles from previous point on line toward substation		4.0	1.4	1.6	1.8	4.2	
4. Copper conductivity size section from previous point		2	2	2	6	2	
5. Type of fault calculated	LINE TO GROUND						
6. Max fault current from simplified form Circuit diagram							
7. Minimum fault current from simplified form (Circuit diagram)							

RATE USED FOR STUDY

HO NAI ELECTRIC COOP

FIRST	10 KWH	4.0 Piasters/KWH
NEXT	15 "	3.5 " "
NEXT	75 "	2.5 " "
ALL OVER	100 "	2.0 " "

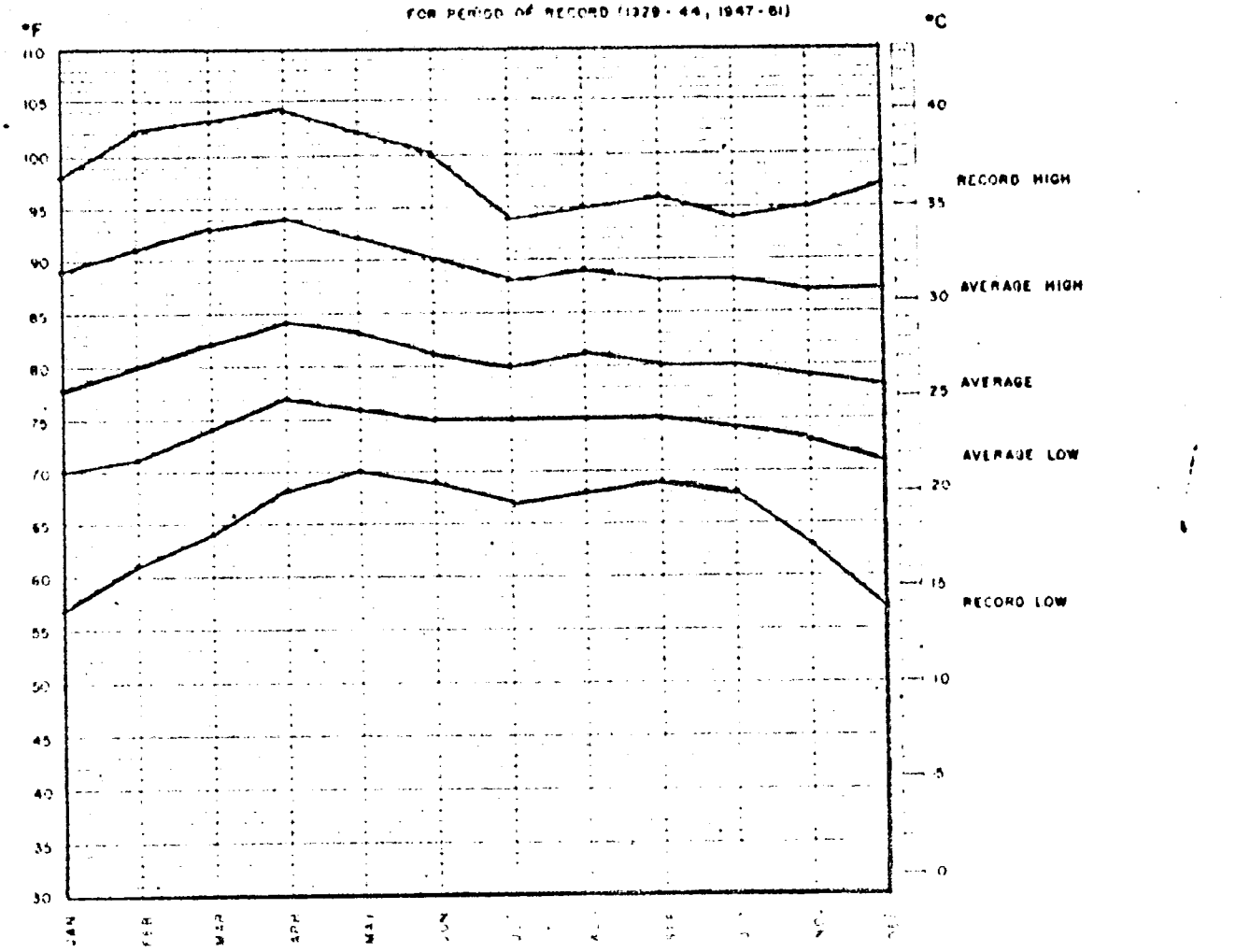
The above does not include any taxes as they are all of a sales type tax. It was assumed, they would be added on and the Co-op would only be acting as a tax collector.

SAIGON - TAN SON NHUT AIRPORT

(LATITUDE 10°49' N, LONGITUDE 106°40' E, ELEVATION 29 FEET MSL)

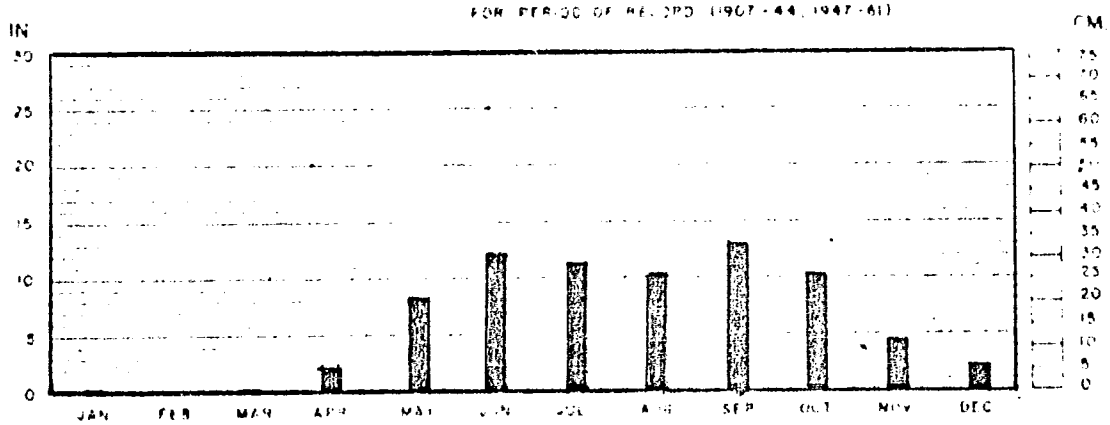
TEMPERATURE

FOR PERIOD OF RECORD (1929-44, 1947-61)



AVERAGE RAINFALL

FOR PERIOD OF RECORD (1907-44, 1947-61)



	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUAL
AVERAGE (IN)	.54	.21	.44	2.12	8.47	[illegible]	[illegible]	[illegible]	13.06	10.29	4.67	2.17	76.26
RECORD HIGH (IN)	4.37	2.43	5.08	7.01	22.09	30.55	23.43	19.65	26.89	25.74	11.26	12.09	106.72
RECORD LOW (IN)	0	0	0	Trace	1.93	5.95	5.86	4.65	5.47	3.23	.12	0	54.80
24-HOUR RECORD (IN)	2.72	1.54	4.06	3.50	4.21	5.39	5.31	6.97	7.05	5.12	5.16	3.03	7.05
DAYS OF RAIN (AVG)	0	1	2	6	17	22	24	22	23	21	12	7	157

A PLAN FOR FUTURE REQUIREMENTS

HO NAI

The system is located in the area east of Bien Hoa and North east of Saigon approximately 28 kilometers. It is located at the terminal end of the Saigon - Bien Hoa superhighway, and along a main east-west highway.

Development is anticipated to be fairly rapid and requirements for power to be large.

The project will be served from a 20,000 KVA substation located within 5 miles of the center of the project. It is anticipated that a higher voltage line will be built by EOV whenever necessary and additional substations installed on this high voltage line.

All conductor sizes were selected in anticipation of increased population in the area as more North Vietnamese refugees are taken in, and with some lateral expansion, as a result voltage drops at maximum anticipated usage are held to a minimum.

REA methods and demand charts are used throughout the study.

MAN POWER ORGANIZATION AND REQUIREMENTS

To Be Provided Under NRECA Contract

GENERAL

TITLE	Length of Assignment	Starting Date	Salary Per Year	*Per Diem & exp	Total Per Year	Total
Vietnam US Supervisor	24	Jul 15, 65	20,000	9,000	29,000	58,000
Vietnam US Chief Engineer	18	Sep 1, 65	18,000	9,000	27,000	54,000
Vietnam US Secretary	24	Jul 15, 65	8,000	6,400	14,400	28,800
Vietnam US Power Plant Engineer	3 mos.	Oct 1, 65	20,000	9,000	29,000	6,125
Vietnam US Pole Plant Advisor	24	Oct 1, 65	15,000	7,000	22,000	44,000
TUYEN DUC						
Coordinator	24	Sep 1, 65	18,000	8,000	26,000	52,000
Resident Engr.	9	Jul 15, 65	15,000	7,000	22,000	16,500
Staking Engineer	6	Jul 15, 65	14,000	7,000	21,000	10,500
AN GIANG						
Coordinator	24	Sep 1, 65	18,000	8,000	26,000	52,000
Resident Engr.	9	Jul 15, 65	15,000	7,000	22,000	16,500
Staking Engr.	6	Jul 15, 65	14,000	7,000	21,000	10,500

*NOTE - This figure does not include NRECA Washington office overhead expense.

1. PHASE 3A - STAKING & DESIGN

Refer to Item No. 1 and Item No. 2

TIME: 1 Week

A. In country - Orientation

B. Obtain maps if possible

C. Meet USOM Provincial Personnel

D. Meet Provincial Chiefs

E. Commence physical staking*

1. Obtain local instrument man

2. Obtain rod & chain man

3. Begin training-on-job of locals

F. Prepare work schedules

G. Prepare staking sheets daily

H. Maintain daily time sheets

I. Maintain daily staking tabulation

J. Tabulation of Units

K. Prepare material breakdown - for material requisition

L. Work with local people for training

M. Any other work that might be required for a rapid & orderly finish to the objective of rural electricity for Vietnam

TIME: 90 to 120 days

*Rodman or instrument man should also double as assistant & interpreter

2. TRAINING LOCAL PERSONNEL

1. Training staking crew

   Done locally by staking engineer on the job after 1st 1/2 day

2. Training line crew

   Done locally by construction supt. on the job after 1st day

3. Easement man - local

4. Office personnel

   Done locally by Cooperative training center (Elec. Coop oriented)

5. Vietnam counterpart of Supervisor

   To be trained - (U.S. ?)

6. U. S. Management team of two

   To come to Vietnam for 75 days with Vietnamese personnel on problems of Rural Electric Cooperatives

7. Power Use education for Vietnam

   By U. S. Management personnel

   TIME: One year

Training Program proposed for each category included

.3. CONSTRUCTION PERSONNEL

See Items No. 1 & 2

TIME: 1 Week

A. In country orientation

B. Engineer of project introduction

C. Meet all local personnel & Vietnamese counterpart

D. Ride area with engineer and locals

E. Present to engineer plan of accomplishment

F. Inventory working equipment with VN assistant and establish warehouse

G. Hire personnel through Vietnamese assistant

a. Start training school

1. Hole diggers (Poles & anchors)
2. Pole haulers
3. Use top men of these crews to check & inventory material
4. Framing crew
5. Pick top man for material man & time keeper (possibly)
6. Pick men to climb & start training them
   a. wire stringing
   b. transformers
   c. services
7. Pick men to set poles
8. Pick men to tamp poles
9. Pick men to pull guys & set & backfill anchors
10. Pick men for wire stringing
11. Sagging & tying
12. Set transformers
13. Run services
14. Clean up
15. Set meters
    a. permanent men on this
    b. help establish records
16. Coordinate all activity through engineer & coordinator

TIME: 90 - 150 days

4. SUPERVISION PERSONNEL

See Items 1 & 2

TIME: 1 Week

1. Personnel in country

A. Staking engineer - Become resident engineer & assumes responsibility for construction of line to be constructed properly. Local engineer to also be in training on this.

B. Supervisory engineer on executive level will have ultimate responsibility of final inspection for acceptance by NRECA subject to USOM's final O.K. along with board president, manager, and Co-op engineer.

TIME: 120 days to 365 days - possibly 2 years or as required

5. ENGINEERING CLOSE OUT

See Items 1 & 2

1. Personnel in country

A. Staking engineer - and/or resident engineer

Assumes close out duties

Completes construction inventory

Completes cost records & closes out accounts for all monies spent.

6. ENGINEERING FINAL REPORT

1. Personnel in country

A. Supervisory engineer will finalize engineering & economic feasibility reports and will submit to USOM prior to final printing by NRECA.

7. PHASE 4. COORDINATION & SUPERVISION

A. In country orientation - by personnel of Phases 1, 2, & 3.

B. U.S. NRECA Supervisor

1. Responsible point for all personnel & functions of NRECA contract personnel & persons under their control (i.e. Construction Co.)

2. Responsible to U.S AID Mission Director (directly)

TIME: 1 to 2 years.

C. US NRECA Engineer (Chief)

1. Responsible for enginnering functions & coordination of all activities consistent with the establishment of rural electric Co-ops.

2. Responsible to supervisor

TIME : 1 to 2 years

D. Construction Engineer

1. See phase 3A - Description & time

2. Responsible to NRECA Engineer (Chief)

3. Works with coordinator

E. Operations Coordinator

1. Responsible to Engineer Chief

2. Work with engineer (Staking, Resident).

3. Purpose: to be on pilot project when project starts and to coordinate, train, and establish cooperative principles and stewardship responsible of local people.

TOUR OF DUTY: 1 to 2 years

Country orientation by Phase 1, 2 & 3 personnel

GENERAL MATERIAL SPECIFICATIONS FOR RURAL ELECTRIFICATION IN VIETNAM

Poles: Pine - Southern yellow (VN) original project - 12 lb. treatment creosote - Inspected and conform to REA specifications Each pole bored for penetration.

Cross Arms: Douglas fir - U.S.A. - REA specifications - treated pentachlorophenol

Conductor: ACSR - Aluminum conductor - Steel reinforced (ASTM specs) B 232 - 64T - Copper conductors (ASTM as existing) - Multi-conductors (Duplex - Triplex etc.) To conform to REA specifications & ASTM

Guy Wire: S.M. 7 strand - Galvanized to REA specifications (ASTM) Spec. No. A 475 - 62T (Class A coating)

Hardware: All galvanized & tested to meet REA specifications as per ASTM recommendations.

Ground Rods: To be galvanized.

SOME BASIC ASSUMPTIONS ON MATERIALS FOR 4 RURAL ELECTRIC COOPERATIVES FOR SOUTH VIETNAM

1. GENERATORS

As indicated for AN GIANG area.

2. TRANS. STATION - SUB STATION

Install 2 - 1500 Kva Sub & Power Plant
Consisting 3 - 500 Kva (1) Spare - Single phase delta/Wye - 2300/8660/15,000
3 - 500 Kva (1) Spare - Single phase delta/Wye - 6600/8660/15,000

3. POLES

Base pole on 3 ϕ 30-6 12# Creos. S.Y.P.
Base pole on 1 ϕ 30-6
All poles checked by boring for retention

4. CONDUCTORS

Primaries - ACSR - Neutral Duplex
Secondaries - ACSR - Duplex - & Triplex & Quadri-plex
Services No. 6 - ACSR Duplex - (#8 cu. Conductivity)

5. INSULATORS

Porcelain (1) Pin Type - EEI-NEMA - 55-4 - 70 kv. Bil.
Porcelain (2) Pin Type - EEI-NEMA - 55-3 - 65 Kv. Bil.
Glass (3) Pin Type - EEI - NEMA - 55-3 - 65 Kv. Bil.

6. INSULATOR - SUSPENSION

6" Bells - Slim Type - O.B. 42399

INSULATOR - SPOOL

Secondary - O.B. 36361 - 1.3/4"

POLE TOP PINS

15" - 1" lead tops

CROSS ARM PINS

5/8 Shank x 5. 3/4 Hubbard No. 981

MACHINE BOLTS

5/8 x Galvanized
Carriage

SQ. WASHERS

Hubbard - 7814 - 2-1/4 x 2-1/4 x 3/16 x 13/16 Hole

LOCK NUTS - M.F. TYPE

Hubbard - 4512 5/8 or as required

CROSS ARM BRACE - HUBBARD - 8128

1-1/4 x 1/4" x 28 - Flat brace

COMPRESSION FITTINGS

Exclusive of dead ends

DEAD ENDS - PRI. & NEUTRAL

Alcoa No. 302

GUY WIRE S.M. 7 STRAND

3/8" & 1/2"

GROUND RODS GALVANIZED

5/8 x 8' - Hubbard - 2668 with clamp

ANCHOR

8" Expansion)
15" Screw)

BASIC ASSUMPTION ON SERVICE & SECONDARY FOR 1 PILOT PROJECT, SOUTH VIETNAM. ALSO TRANSFORMERS & LOADING

1. Line transformers 15/8.6 KV
   Single bushing 15/8.6/230 two lowside bushings

   Assume 8356 houses

2. Assume each house needs

		Wire Mi		Pole Line Mi.
8356 x 10 x 2	= 167,120	= 31.8 Mi	1/1 2	= 15.9 Mi 10 Ft of 2W Sec
8356 x 5 x 3	= 125,340	= 23.2 Mi	1/1 3	= 7.7 Mi 5 Ft of 3W Sec
8356 x 60	= 501,360	= 95.0 Mi	1/1 1	= 95.0 Mi 60 Ft of Duplex
8356 x 5	= 41,780	= 7.9 Mi	1/1 1	= 7.9 Mi 5 Ft of Triplex

3. Assume that each house needs 1/5 of a pole

   30-7 = $\frac{8356}{5}$ = 1675 Poles secondary

   Assume 10% = (167 Poles = 30.6 Dead ends
   Assume 5% = (88 Poles = 35.6 Dead ends
   Assume 2% = (35 Poles = 35.7 High blocks
   Based on 150 (290
   feet apart (

   and 20 Mi. of Sec.
   Duplex 1.6 Triplex 1385 Poles

(1736) Assume 10 Mi 3W Underbuild = -0-
(Poles)

158,400 No. 2 6/1 ACSR

MATERIAL FOR SERVICES & SECONDARY

EI-2	100	=	4000'	E3-2 170
c.	Bolt, Machine 5/8 x 9"	100		170
d.	Washer, 2-1/4 x 2-1/4 x 3/16 - 13/16 hole	100		-0-
u.	Clamp 3 Bolt M.O.	200		340
v.	Guy attachment	100		-0-
y.	Guy wire, S.M. 7 Strand 3/8	4000'		8500
p.	Connector, Single bar Bonding	200		340
Ck.	Clamp Anchor Rod Bonding	100		170
ag.	Jumper #6 S.D. Cu or Equiv.	150		255
bj.	Guy Hook, J	-0-		340
bk.	Guy Plate, 4" x 8", if guage	-0-		340
bp.	Nail 8 Penny Galy	-0-		1360
ek.	Lock Nuts	100		170

ANCHORS

FI-2 - 150 8" Expandable Anchor
FI-3 - 120 10" Expandable Anchor
FI-2 - 150 5/8" x 8" Galvanized Single Eye Rods
FI-3 - 120 5/8" x 8" Galvanized Single Eye Rods

LIST OF MATERIALS FOR SERVICES

AN GIANG PROVINCE (LONG XUYEN)

Assumptions: 20,000 underground services
21 m (70 ft) per service

1 meter enclosure for each 5 houses
4000 meter loops

ITEM	No. Required	Unit Price	Total Cost $	Total Cost P
Weatherhead 1-1/4" 2 cond. 4 m @ 48 p/m	4,000	.95	3,800	
PVC Conduit 34 mm dia.	4,000	192		768,000
1-1/4" watertite Connector	4,000	.75	3,000	
Meter & Disconnect Sw. Enclosure 60 mm dia.	4.000	1200		4,800,000
PVC Conduit 1.5 m @ 1.20 5 m @ 77.22	4,000	180		720,000
#2 Stranded TW Cu. cond. 8 m @ 55	4,000	361		1,444,000
#2 Stranded Bare Cu. "	4,000	440		1,760,000
#10-3 UF Cable 21 m @ 38.94 p/m 27 mm dia.	20,000	818		16,360,000
PVC Conduit House riser 3 m @ 36	20,000	108		2,160,000
House Service Ent. Enc.	20,000	150		3,000,000

RURAL ELECTRIFICATION OF SOUTH VIETNAM

SPECIFICATIONS FOR CONSTRUCTION OF POWER LINES

1. General

All construction work shall be done in a thorough and workmanlike manner in accordance with the Staking Sheets, Plans and Specifications, and the Construction Drawings.

The Sixth Edition of the USA National Electrical Safety Code shall be followed except where local regulations are more stringent, in which case local regulations shall govern.

2. Distributing Poles

In distributing the poles, large choice, close-grained poles shall be used for transformer, deadend, angle and corner poles.

3. Pole Setting

The minimum depth for setting poles shall be as follows:

Length of Pole (feet)	Setting in Soil (feet)	Setting in All Solid Rock (feet)
20	4.0	3.0
25	5.0	3.5
30	5.5	3.5
35	6.0	4.0
40	6.0	4.0
45	6.5	4.5
50	7.0	4.5
55	7.5	5.0
60	8.0	5.0

"Setting in Soil" specifications shall apply:

a. Where poles are to be set in soil.

b. Where there is a layer of soil of more than two (2) feet in depth over solid rock.

c. Where the hole in solid rock is not substantially vertical or the diameter of the hole at the surface of the rock exceeds approximately twice the diameter of the pole at the same level.

"Setting in all Solid Rock" specifications shall apply where poles are to be set in solid rock and where the hole is substantially vertical, approximately uniform in diameter and large enough to permit the use of tamping bars the full depth of the hole.

Where there is a layer of soil two (2) feet or less in depth over solid rock, the depth of the hole shall be the depth of the soil in addition to the depth specified under "Setting in All Solid Rock" provided, however, that such depth shall not exceed the depth specified under "Setting in Soil".

On sloping ground, the depth of the hole always shall be measured from the low side of the hole.

Poles shall be set so that alternate crossarm gains face in opposite directions, except at terminals and deadends where the gains of the last two poles shall be on the side facing the terminal or deadend. On unusually long spans, the poles shall be set so that the crossarm comes on the side of the pole away from the long span. Where pole top pins are used, they shall be on the opposite side of the pole from the gain, with the flat side against the pole.

Poles shall be set in alignment and plumb except at corners, terminals, angles, junctions, or other points of strain, where they shall be set and raked against the strain so that the conductors shall be in line.

Poles shall be raked against the conductor strain not less than one inch for each ten feet of pole length nor more than two inches for each ten feet of pole length after conductors are installed at the required tension.

Pole backfill must be thoroughly tamped the full depth. Excess dirt must be banked around the pole.

4. Grading of Line

When using high poles to clear obstacles such as buildings, foreing wire crossings, railroads, etc., there shall be no upstrain on pin-type insulators in grading the line each way to lower poles.

5. Guys and Anchors

Guys shall be placed before the conductors are strung and shall be attached to the pole as shown in the Construction Drawings.

All anchors and rods shall be in line with the strain and shall be so installed that approximately six inches of the rod remains out of the ground. In cultivated fields or other locations, as deemed necessary, the projection of the anchor rod above earth may be increased to a maximum of 12 inches to prevent burial of the rod eye. The backfill of all anchor holes must be thoroughly tamped the full depth.

When a cone anchor is used, the hole, after the anchor has been set in place, shall be backfilled with coarse crushed rock for two feet above the anchor, tamping during the filling with the remainder of the hole to be backfilled and tamped with dirt.

6. Locknuts

A locknut shall be installed with each nut, eyenut or other fastener on all

bolts or threaded hardware such as insulator pins, upset bolts, double arming bolts, etc.

7. Conductors

Conductors must be handled with care. Conductors shall not be tramped on nor run over by vehicles. Each reel shall be examined and the wire shall be inspected for cuts, kinks, or other injuries. Injured portions shall be cut out and the conductor spliced. The conductors shall be pulled over suitable rollers or stringing blocks properly mounted on pole or crossarm if necessary to prevent binding while stringing.

The neutral conductor should be maintained on one side of the pole (preferably the road side) for tangent construction and for angles not exceeding 30 degrees.

With pin-type insulators the conductors shall be tied in the top groove of the insulator on tangent poles and on the side of the insulator away from the strain at angles. Pin-type insulators shall be tight on the pins and on tangent construction the top groove must be in line with the conductor after tying in.

For neutral and secondary conductors on poles, insulated brackets (Material Item da) may be substituted for the single and double upset bolts on angles of 0° to 5° in locations known to be subject to considerable conductor vibration.

All conductors shall be cleaned thoroughly by wirebrushing before splicing or the installation of a connector or clamp. A suitable inhibitor shall be used before splicing or applying connectors over aluminum conductor.

8. Splices and Deadends

Conductors shall be spliced and deadended as shown on the Construction Drawings. There shall be not more than one splice per conductor in any span and

splicing sleeves shall be located at least ten feet from the conductor support. No splices shall be located in Grade B crossing spans and preferably not in the adjacent spans.

9. Taps and Jumpers

Jumpers and other leads connected to line conductors shall have sufficient slack to allow free movement of the conductors. Where slack is not shown on the Construction Drawings it will be provided by at least two bends in a vertical plane, or one in a horizontal plane, or the equivalent. In areas where aeolian vibration occurs, special measures to minimize the effects of jumper breaks shall be used as specified.

All leads on equipment such as transformers, reclosers, etc., shall be a minimum of #6 copper conductivity. Where aluminum jumpers are used, a connection to an unplated bronze terminal shall be made by splicing a short stub of copper to the aluminum jumper using a suitable aluminum compression sleeve.

10. Hot-line Clamps and Connectors

Comnectors and hot-line clamps suitable for the purpose shall be installed as shown on Guide Drawings. On all hot-line clamp instal lations, the clamp and jumper shall be so installed so that they are permanently bonded to the load side of the line, allowing the jumper to be de-energized when the clamp is disconnected. This applies in all cases, even where the line layout is such that the tap line is in actuality the main back to the power source.

11. Lightning Arrester Gap Settings

The external gap electrodes of lightning arresters, combination arrester-cutout

units, and transformer mounted arresters shall be adjusted to the manufacturers' recommended spacing. Care shall be taken that the adjusted gap is not disturbed when the equipment is installed.

12. Conductor Ties

Ties shall be in accordance with Construction Drawings. Hot-line ties shall not be used at Grade "B" crossings.

13. Sagging of Conductors

Conductors shall be sagged in accordance with the conductor manufacturers' recommendation. All conductors shall be sagged evenly. The air temperature at the time and place of sagging shall be determined by a certified etched glass thermoneter.

The sag of all conductors after stringing shall be in accordance with the conductor manufacturers' recommendations, except that a maximum increase of three inches of the specified sag in any span will be acceptable. However, under no circumstances will a decrease in the specified sag be allowed.

14. Secondaries and Service Drops

Secondary conductors may be bare or covered wires or multi-conductor service cable. The conductors shall be sagged in accordance with the manufacturers' recommendations.

Conductors for secondary underbuild on primary lines will normally be bare except in those instances where prevailing conditions may limit primary span lengths to the extent that covered wires or service cables may be used. Service drops shall be covered wire or service cable.

Secondaries and service drops shall be so installed as not to obstruct climbing

space. There shall not be more than one splice per conductor in any span, and splicing sleeves shall be located at least ten feet from the conductor support. Where the same covered conductors or service cables are to be used for the secondary and service drop, they may be installed in one continuous run.

15. Grounds

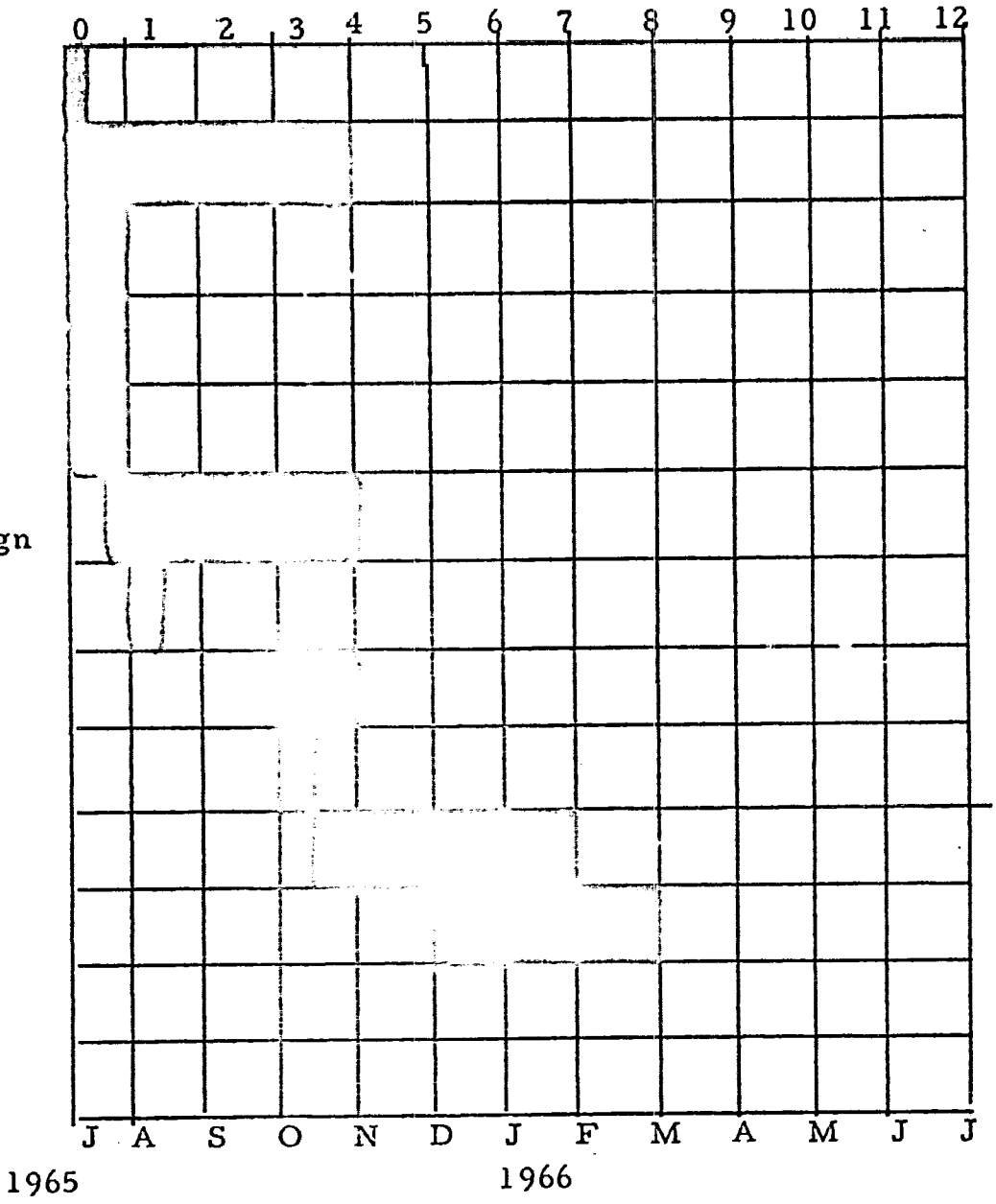
Ground rods shall be driven full length in undisturbed earth in accordance with the Construction Drawings. The top shall be at least 12 inches below the surface of the earth. The ground wire shall be attached to the rod with a clasp and secured to the pole with staples. The staples on the ground wire shall be spaced two feet apart except for a distance of eight feet above the ground and eight feet down from the top of the pole where they shall be six inches apart.

All equipment ground, neutral wires, and lightning-protective equipment shall be interconnected and attached to a common ground wire.

16. Clearing Right-of-Way

In preparing the right-of-way, trees shall be removed, underbrush cleared and trees trimmed so that the right-of-way shall be cleared from the ground up and of the width required. Trees fronting each side of the right-of-way shall be trimmed symmetrically unless otherwise specified. Dead trees beyond the right-of-way which would strike the line in falling shall be removed. Leaning trees beyond the right-of-way which would strike the line in falling and which would require topping if not removed shall either be removed or topped except that shade, fruit, or ornamental trees shall be trimmed and not removed unless otherwise authorized.

CONSTRUCTION SCHEDULE IN MONTHS



*Material ordered from engineering estimate.

CONSTRUCTION SCHEDULE EXPLANATION

The preceding sequence of events graphically illustrated is arranged to orderly complete the construction of the project.

Procedure

1. After the Cooperative is a legal entity.

   A. Obtain member sign up - Time 4 months.

2. Engineering services by USOM-NRECA if advisable and acceptable to co-op and Government of Vietnam. Time 1 month.

3. Co-operative hires manager. Approval subject to Coordinator/USOM Manager hires personnel - Approval of Coordinator/USOM. Time 1 month.

4. Order material: This is done from preliminary estimate of Phase 3 Report. (In order to facilitate speed up of building in times such as these. All pole line material from U.S. on pilot projects). Time 4 months

5. Line layout and design (Staking) and prepare contract: After the member sign up has begun and engineers have been on job - then staking of line should begin and after a reasonable number of miles and units are staked the preparation of contract documents should start. Units of construction should adhere to REA USA standards. Specifications should be translated into Vietnamese for working construction purposes. Approval of USOM will be required. Time 4 months.

6. Receive material: Material from stateside should start to arrive. This will require inventory and warehousing. The engineer will be responsible for this. Material order to material receipt. Time 4 months.

7. Bids on construction: As the documents are being prepared in Item 5 contractors are notified and bids accepted 3-1/2 months after start. Time 4 months approx. USOM/Approval required.

8. Construction: After the necessary approval of bids the contractor will be moving in to start work. Work should be completed from start to finish in about 3-1/2 months.

9. Energization: As soon as sections of line are completed they should be released to cooperative so that consumers can begin to receive electric service.

TAX LEVIED DIRECTLY ON CONSUMER THROUGH HIS ELECTRIC BILL

Typical bill at Dalat on SIPEA system

127 KWH	358.9		or 2.83 P/KWH	US 3.88¢
tax #1	25.12			
tax #2	7.20			
Surtax 3, 4 & 5	59.80			
Total	451.02			
Gov't Stamp	1.00	(Tax 6)		
Grand Total	452.02		or 3.56 P/KWH	US 4.88¢

Explanation of tax imposed on customers and collected by the electric utility.

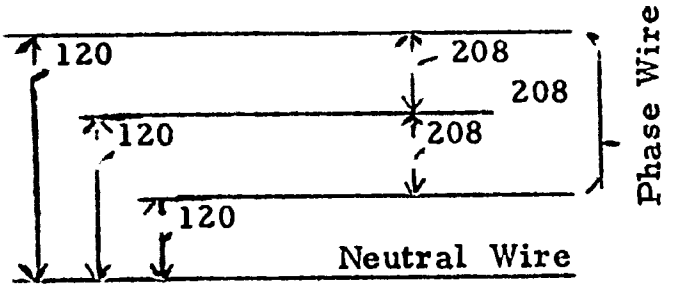
	Name of Tax	Amount	Goes to
#1	Production tax	6% of bill	VN Federal Govt
#2	Meter tax	Depends on meter size, i.e. 1 ϕ 10 amp meter 6 P/Mo. 3 ϕ 50 amp meter 25 P/Mo.	CEE
#3	ONDEE	.2 P/KWH	EOV
#4	City	.2 P/KWH	Dalat or City
#5	Instrument Cost	2.04% monthly bill	Govt.
#6	Govt. Stamp	.20 P/100 P. of bill	Govt.

Apparently none of the taxes are imposed upon the utility. Rather on the customer in the general sense of a sales tax. That is the tax is calculated, billed, and collected by the utility and disbursed by the utility to the proper authority.

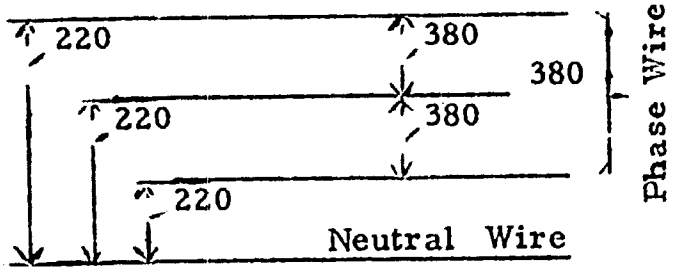
As these taxes are imposed directly on the customer and as it is presently unknown whether the Government of Vietnam will consider certain tax relief measures, it was not necessary to consider taxes in the feasibility studies.

REGULATIONS FOR ELECTRIC SERVICE IN VIETNAM

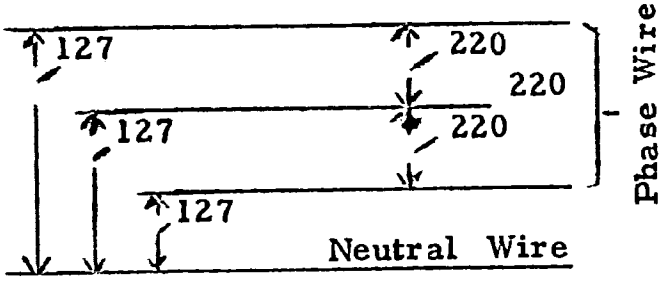
System "A"
120/208 Volts



System "C"
220/380 Volts



System "B"
127/220 Volts



System "A" is in use in Saigon-Cholon except for small areas which have recently been cut over to or installed with the Vietnam Standard System "C".

System "B" is in use in several towns and cities in the provinces.

System "C" is standard by government edict for Vietnam and is in use in small areas of Saigon as well as in several towns and cities in the provinces and eventually will probably be in use in all of Vietnam.

All electric utility service in Vietnam is, and will continue to be, 50 cycle, as contrasted with the U.S. where practically all service is 60 cycle.

3-phase motors must of course be operated from the 3-phase wires at the higher of the voltages in each system. Single phase for lighting, refrigerators, etc., is ordinarily supplied from any one of the 3-phase wires and neutral, at the lower of the voltages in each system. Single phase can of course be also supplied from any 2 of the 3-phase wires. This is done in Saigon where single phase window-type air conditioning units are ordinarily fed at 208 volts from the 120/208 volt "A" system.

Small 60 cycle U.S. manufactured motors will frequently operate satisfactorily on 50 cycles (at 5/6 speed) providing the voltage is not too high, even though under equal load conditions the motors will operate at a higher temperature. The increase in temperature can be overcome by operating at 5/6 of the rated voltage of the motor. U. S. manufacturers some times supply small transformers for 60 cycle domestic refrigerators that reduce the voltage to approximately 5/6, when they are used on 50 cycle.

Because of the change to be made from 120/208 & 127/220 volts to the 220/380 volts Vietnamese standard, there is an advantage where the circuits are available, to install 220 volt lighting and single phase appliances and connect them phase-to-phase where service is now 120/208 or 127/220 volt and later connect them phase-to-neutral after the change to 220/380 volt.

There are several types of fluorescent lamps as follows:

Slimline type, requiring	1 pin sockets, and ballast coil only
Instant start type, requiring	2 pin sockets and ballast coil only
Rapid start type, requiring	2 pin sockets or recessed double contact sockets and ballast coil only
Preheat type, requiring	2 pin sockets ballast coil and starter

Ballast coils for use with fluorescent lamps are available for 50 cycle and for 110 volt (nominal) and for 220 volt and for either 1 or 2 lamps. They can be furnished without or with capacitors. To reduce losses and voltage drop, the latter capacitors are very much preferable.

ESTIMATED COST OF DIESEL ELECTRIC GENERATION

AT INDUSTRIAL DIESEL PLANT NO. 1

Data was taken from
EBS Management Consultants Inc.
Final Report as of
June 30, 1964
Vol II Book B
Electric Power Rates & Related Problems
Vietnam 430-23-170
Contract AID c 2161

Estimated Cost of Diesel Electric Generation at Industrial Plant No. 1

1. Generating Facilities

   (2) 382 KW Klockner - Humboldt - Deutz
   Engine Driven Generators
   380/220 v. 50 cycle, 750 R PM Generators.

2. Operating Schedule: Condition of 100% Reserve

   Twenty four hours/day, 6.1/2 days/week.
   One machine only in operation. Second unit kept on standby.
   Maximum Plant load = 390 kw = 50% of Plant Capacity.
   Working Days per year excluding 10 holidays
   = (365 - 10) x 6.5 - 7 = 329.
   Hours operation per month = 329 x 24 - 12 = 658
   Average Load While Operating ---- 320 kw
   = 320 - 382 = 84% Engine Capacity

3. Monthly KWH Generation

   Computed = 320 kw x 658 = 211,000 kwh
   Reported for 1963 ------ 154,844 kwh

4. Monthly Load Factor

   Computed, 211,000 - (390 x 730) = 74.0%
   Reported 154,844 - (390 x 730) = 54.3%

5. Monthly Fuel Oil Consumption, Liters

   Computed = 77.0 kg/hr x 658 hrs ÷ 0.825 = 61,300
   Reported 45,855

6. Fuel Economy

   Computed. . 211,000 kwh x 3,785 ÷ 61,300 = 13.0 kwh/gal.
   Reported . . 154,844 kwh x 3,785 ÷ 45,855 = 12.7 kwh/gal.

7. Fuel Cost

   Computed. . 61,300 Liters x 3.97 --- VN$ 243,500
   Reported . . 45,855 Liters x 3.97 --- VN$ 182,500

8. Fuel Cost per kwh

Computed	=	243,500	÷ 211,000	= 1,152	P/kwh
Reported (1963)	=	182,500	÷ 154,844	= 1,178	P/kwh

9. Labor Cost, per Month

Diesel Operations

Shift #1 - - - 52 x 6 x $ 125 ÷ 12	3250 Ps
Shift #2 - - - 52 x 6 x $ 125 ÷ 12	3250 "
Shift #3 - - - 52 x 6 x $ 125 x 1.5 ÷ 12	4875 "
Sunday - - - (125 x 3) x 2 x $\frac{52}{12}$ ÷ 2	1626 "
Sub Total, Operators	13001 Ps

Maintenance Men

Regular Shift #1 : 52 x 6 x 125 ÷ 12	3250 Ps

Extra Men:

After 500 hrs. Operation:

Inspection/month = 676 ÷ 500 = 1.352

Man-Days/Inspection = $\frac{2 \text{ men} \times 16 \text{ hrs.}}{8 \text{ hrs}}$ = 4

Man-Days/month = 4 x 1.35 = 5.4

Labor - 5.4 Days @ 125 P =	675 Ps

After 2000 hrs

General Overhauls/month = $\frac{676}{2000}$ = 0.338

Monthly Cost:

0.338 @ 700 Ps ----------	2366 Ps
Total Operations & Maintenance Labor, per Month	19292 Ps

10. Lube Oil Cost per Month

533 Liters @ VN$ 17.20	VNS	9167

11. Spare Parts for Maintenance

Assumed, per Overhaul	VN$	7500
Assumed, per month = 7500 x .338		2500

12. Fixed Charges

Investment

Equipment (2) 362 kw = 764 @ US$ 78.50 - - - - - -		US$ 60,000
Equipment 60,000 x 73.5 =	VN$	4,410,000
Installation		611,880
Sub Total, @ 6570 VN$/kw		5,021,880
Building Cost		159,268
Total Diesel Plant	VN$	5,181,148
Unit, per kw VN$ 6780 = US$ 92.30		
Estimated Life Expectancy	15 years	
Annual Insurance, @ 0.5% of 5,181,148	VN$	25,900
Annual Interest on Investment @ 6%		
Interest 5,181,148 @ .06	VN$	311,000
Annual Sinking Funds Depreciation	-	
$D = \frac{.06 \times \$5,181,148}{(1.06)15 - 1} = .0428 \times 5,181,148 =$		222,000
Total annual Fixed Charges	VN$	558,900
Total monthly Fixed Charges	VN$	46,600

13. Total Cost of Diesel Power, as Operated Per Month

Operating Expenses		
Fuel Oil	VN$	182,500
Lube Oil		9,167
Labor		13,001
Sub Total	VN$	204,668
Maintenance Expense		
Labor	VN$	6,291
Materials		2,500
Sub Total	VN$	8,791
Fixed Charges		
Insurance	VN$	2,200
Interest @ 6%		25,900
Depreciation, 15 year life		18,500
Sub Total	VN$	46,800
Total Monthly Cost	VN$	260,059

14. Unit Cost per kwh

Plant Capacity Factor:
154,844 kwh -I- 764 kw x 730 = 27.7%

Plant Load Factor:
154,844 -I- 390 x 730 = 54.3%

Fuel & Lube Oils	1.233 Piastres
Labor	0.125
Materials	0.016
Interest on Investment	0.167
Depreciation	0.120
Insurance	0.014
Total, per kwh	1.677 Piastres

15. Cost Equations : Per Month

(Based on 6-Day Weeks and Manufacturer's test data)

Case 1 Plant operated at Rated Capacity Without Standby Facilities

Hours Operation per Day	8.5	16.5	24.0
Days Operated per Week	6	6	6
Hours Operation per Week	51	99	144
Hours per Month	221	428	624
Max, kw Demand on Plant, Gross	764	764	764
Less Auxiliaries, kw	20	20	20
Net kw Output	744	744	744
kwh Net Generation	164,500	318,000	465,000
Fuel Consumption			
kg per hour	180	180	180
Liters per hour	218	218	218
Liters/month	48,200	93,400	136,300
Fuel Cost per Month VN$	191,500	371,000	542,000
Net Output, VN$/kwh	1,165	1,165	1,165
Operating Labor Cost per month			
Number of shift Operators	1	2	3
Man-Days per Month	26	52	78
Cost, @ VN$ 125/Day VN$	3,250	6,500	9,750
Graveyard Bonus @ 50%	-	-	1,650
Total Operating Labor	3,250	6,500	11,400

Maintenance Labor Cost			
Regular Man 1 Shift Only	3,250	3,250	3,250
Special 500th Hour Inspection			
per Month	,88	1.72	2.50
Man-Days/Inspection	4	4	4
Man-Days/Month	3.52	6.89	10.00
Labor Costs @ VN$ 125	440	862	1,250
Special 2000th Hour Overhaul			
Number of Overhauls/Month	0.22	0.432	0.624
Unit Cost per Overhaul, VN$	7,000	7,000	7,000
Monthly Cost for Overhauls, VN$	1,540	3,020	4,370
Supplies & Expenses			
Operating			
Lube Oil @ 1.6 Liters/Hr	354	685	1,000
Lube Oil Cost @ VN$ 17.2/Liter	6,090	11,800	17,200
Miscellaneous, Assumed VN$	4,000	8,000	12,000
Maintenance			
Spare parts per Overhaul	7,500	7,500	7,500
Spare parts per Month	1,650	3,240	4,680
Fixed Charges, per Month			
Interest @ 6% Annual	25,900	25,900	25,900
Depreciation, 15 yr, Life	18,500	18,500	18,500
Insurance @ 0.5% Annual	2,200	2,200	2,200
Total Monthly Cost			
Fuel Oil	191,500	371,000	542,000
Lube Oil	6,090	11,800	17,200
Supplies & Expenses	4,000	8,000	12,000
Operating Labor	3,250	6,500	11,400
Maintenance Labor	5,230	7,132	8,870
Maintenance Spare Parts	1,650	3,240	4,680
Sub Total, O & M	211,720	407,672	596,150
Interest	25,900	25,900	25,900
Depreciation	18,500	18,500	18,500
Insurance @ 0.5%	2,200	2,200	2,200
Sub Total, Fixed	46,600	46,600	46,600
Total Cost, Month, VN$	258,320	454,272	642,750

Average Cost per Net kwh, VN$	1.572	1,428	1.384
Avg Cost per net kwh Fuel & Lube Oil Only	1.20	1.20	1.20
Nameplate Capacity Factor	29.4%	57.0%	83.3%

Monthly Cost Equation - 0 % Stand-by

VN$ Cost = 50,000 -I- 1.276 (Net kwh)

= 65.50 (total Nameplate kw) -I- 1.276 (Net kwh)

15. Case II Plant Operated at 50% of Installed Capacity - with 100% Stand-by Facilities

Hours of Operation per Day	6.5	16.5	24.0
Days per Week	6	6	6
Hours per Week	51	99	144
Hours per Month	221	428	624
Max. Demand on Plant, Gross	382	382	382
Less Auxiliaries	10	10	10
Net Kw Output	372	372	372
kwh Net Generation	72,300	159,000	232,000
Fuel Consumption			
kg per hour	90	90	90
Liters per Hour	109	109	109
Liters per Month	24,100	46,700	68,150
Fuel Cost per Month @ 3.97 Piasters/Leter VN$	95,750	185,500	271,000
Fuel Cost per Net kwh	1.162	1.165	1.166
Hours Operation/Day	8.5	16.5	240
Operating Labor Cost			
Per month			
Same as fpr (2) Engines, VN$	3,250	6,500	11,400
Maintenance Labor			
Regular Man, 1 Shift	3,250	3,250	3,250
Special 500th Hour Inspections			
Per month	.44	.86	1.25
Man-Days/Inspection	4	4	4
Man-Days/Month	1.76	3.44	5.00
Labor Cost @ VN$ 125	220	430	625

Special 2000th Hour Overhaul			
One-Half Cost for 2 Engines	700	1,510	2,185
Supplies & Expenses (One-Half Cost for 2 Engines)			
Lube Oil, VN$	3,045	5,900	8,600
Miscellaneous, VN$	2,000	4,000	6,000
Maintenance			
Spare Parts per Month	825	1,620	2,340
Fixed Charges (Same as for 2 Engines)			
Interest @ 6%	25,900	25,900	25,900
Depreciation	18,500	18,500	18,500
Insurance @ 0.5%	2,200	2,200	2,200
Case II Cont.	8.5	16.5	24.0
Total Monthly Cost, VN$			
Fuel Oil	95,750	185,500	271,000
Lube Oil	3,045	5,900	8,600
Supplies & Expenses	2,000	4,000	6,000
Operating Labor	3,250	6,500	11,400
Maintenance Labor	4,240	5,190	6,060
Maintenance Spare Parts	825	1,620	2,340
Sub Total, O & M	109,110	208,710	305,400
Interest	25,900	25,900	25,900
Depreciation	18,500	18,500	18,500
Insurance @ 0.5%	2,200	2,200	2,200
Sub Total, Fixed	46,600	46,600	46,600
Total Monthly Cost, VN$	155,710	255,310	352,000
Average Cost per Net kwh, VN$	1.890	1.605	1.516
Nameplate Capacity Factor	14.8%	28.5%	41.6%

Monthly Cost Equation - 100% Stand-by

VN$ Cost = 45000 + 1.33 (Net kwh Generation)
= 58.90 (Total Nameplate kw) + 1.33 (Net kwh)
= 117.80 (Firm Assured kw)

Case III 50% Reserve Capacity. Three 382 kw Engines Two Operating at Full Load

Hours Operation per Day	8.5	16.5	24.0
Days per Week	6	6	6
Hours per Week	51	99	144
Hours per Month	221	428	624
Total Capability, Nameplate	1,146	1,146	1,146
Max. Demand on Plant, Gross kw	764	764	764
Less Auxiliaries	20	20	20
Net Kw Output	744	744	744
Net Kwh Generation	164,500	318,000	465,000
Total O & M/Month (Same as Case I)	211,720	407,672	596,150
Investment			
Equipment			
(3) 382 kw = 1146	6,620,000	6,620,000	6,620,000
Installation	916,000	916,000	916,000
Building	238,000	238,000	238,000
Total	7,774,000	7,774,000	7,774,000
Unit Investment/kw Cap.	6,780	6,780	6,780
Monthly Interest @ .005	38,820	38,820	38,820
Monthly Depreciation @ .00357	27,750	27,750	27,750
Insurance, @ 0.5%	3,300	3,300	3,300
Total, Fixed	69,870	69,870	69,870
Total Monthly Cost VN$	281,590	477,542	666,020
Avg. Cost per Net Kwh VN$	1.712	1.500	1.435
Nameplate Capacity Factor	19.65%	38.0%	55.5%

Monthly Cost Equation - (50% Reserve)

Cost, VN$ = 77,000 + 1.27 (Net kwh)
= VN$ 67.20 per kw Nameplate + 1.27 (Net kwh)
= VN$ 100.60 per kw Assured capacity

COMPARATIVE COST EQUATION UNITS

	No Reserve Equipment	50% Reserve Equipment	100% Reserve Equipment
Cost per Total Nameplate kw Capacity VN$	65.50	67.20	58.90
Plus Cost per kwh Net Generation	1.276	1.27	1.33
	0% Reserve	50% Res.	100% Res.
Application			
Plant Demand	382 kw	382kw	382 kw
Total Nameplate Capacity	382	573	764
Number of Diesels	1	3	2
Size of Diesels	382	191	382
Monthly Capacity Chg. per kw of Total Nameplate	65.50	67.20	58.90
Monthly Capacity Charge	25,000	38,400	45,100
Load Factor Operation			
2 shifts - 6 Days	57%	57%	57%
Net kwh generation	159,000	159,000	159,000
Monthly Energy chg/kwh	1,276	1,276	1.33
Monthly Energy chg - VN$	203,000	202,000	211,500
Total Monthly Cost	228,000	240,000	256,600
Avg. Cost/kwh	1.435	1.514	1.613
Nameplate Capacity Factor	57.0%	38.0%	28.5%
Avg. Cost/kwh from Curves	1.425	1.50	1.605

Case IV. Plant Operated at Half Nameplate Rating with 100% Spinning Reserve

Hours Operation/Day	8.5	16.5	24.0
Days per Week	6	6	6
Hours Operation/Week	51	99	144
Hours per month	221	428	624
Max Demand on Plant - Gross	382	382	382
Less Auxiliaries	20	20	20
Net kw Output	362	362	362
Net kwh Generation	80,200	155,000	226,000
Fuel Consumption			
Kg per Hour - 2 x 49	98	98	98
Liters/Hour - 98 ÷ 825	118.6	118.6	118.6
Liters/Month	26,200	50,800	74,200
Fuel Cost, Month @ 3.97 Liter	104,000	202,000	295,000
Fuel Cost per Net kwh, VN$	1.30	1.30	1.30
Operating Labor	3,250	6,500	11,400
Maintenance Labor	1,980	3,882	5,620
Lube Oil Cost	6,090	11,800	17,200
Miscl. Operating Supplies	4,000	8,000	12,000
Maintenance Spare Parts	1,650	3,240	4,680
Total Monthly Cost			
Fuel Oil	104,000	202,000	295,000
Lube Oil	6,090	11,800	17,200
Supplies & Expense	4,000	8,000	12,000
Operating Labor	3,250	6,500	11,400
Maintenance Labor	1,980	3,880	5,620
Maintenance Spare Parts	1,650	3,240	4,680
Sub Total, O & M	120,970	235,420	345,900
Total Fixed Charges	46,600	46,600	46,600
Total Monthly Cost	167,570	282,020	392,500
Avg. Cost per Net kwh, VN$	2,090	1,820	1,736
Avg. Cost per kwh - Fuel & Lube Oil, Only	1,37	1,378	1,380
Nameplate Capacity Factor	14.38%	27.7%	40.4%

Monthly Cost Equation

100% Spinning Reserve - Cost = 40,000 + 1.55 (kwh)

= VN$ 52.30 (Kw Nameplate + 1.55 kwh

= VN$ 104.60 (Kw assured capacity) + 1.55 (kwh)