REPORT ON THE SURVEY FOR SOUTHEAST ASIA AND FAR EAST COAXIAL SUBMARINE CABLE PROJECT IN THE REPUBLIC OF THE PHILIPPINES

SEPTEMBER 1964

OVERSEAS TECHNICAL COOPERATION AGENCY OF JAPAN

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FOREWORD

The Government of Japan, at the request of the Government of the Republic of the Philippines, has decided to undertake a basic survey in the Philippines for the Southeast Asia and the Far East Submarine Cable Project, and entrusted the Overseas Technical Cooperation Agency of Japan with the task of conducting the field survey.

The Agency, in view of the importance of constructing international communication links by means of coaxial submarine cable to cope with the rapidly increasing demand for international communication services, has dispatched to the Philippines a four-member survey team headed by Mr. Atsushi Watanabe, Councilor of Telecommunications, Ministry of Posts and Telecommunications.

The survey team stayed in the Philippines for twenty days, commencing its work on February 20, 1964, and successfully completed the field survey with the assistance and cooperation of the Philippine Government, resulting in the submission of this report.

The Agency, which is the executive organ of the overseas technical cooperation program adopted by the Japanese Government, sincerely hopes that the present report will prove to be a contribution toward completion of the Southeast Asia and the Far East Submarine Cable Project.

In closing, the Agency hereby expresses its deepest sense of gratitude for the earnest support and cooperation extended by the Philippine Government authorities, especially by the Director of the Bureau of Telecommunications and his staff.

September 1964

S. Shibusawa

Shinichi Shibusawa

Director General
Overseas Technical Cooperation Agency
of Japan

CONTENTS

I INTRODUCTION

1. Purpose of Survey

The purpose of this survey was to cooperate with the Philippine Government in its various field surveys necessary to materialize the Southeast Asia and the Far East Submarine Cable Project, which is to connect such countries as Japan, Republic of China, the Philippines, Viet-nam, Cambodia, Thailand, Malaysia and Indonesia by means of coaxial submarine cables.

The survey included the following subjects:

(a) Selection of cable landing sites

(b) Connecting link between the cable landing station and the gate office

(c) Estimation of traffic demand

(d) Legal aspects in the domestic laws in relation to the conclusion and performance of the agreement on the construction and maintenance of the submarine cable system

2. Summary

(a) The survey was conducted in order to clarify the existence of various problems involved in each subject rather than establish a final conclusion.

(b) The survey was smoothly carried out in close cooperation with the Bureau of Telecommunications, Department of Public Works and Communications.

3. Period of Survey

Twenty days, commencing on February 25, 1964 and closing on March 15, 1964.

4. Member of Survey Team

Atsushi Watanabe (Chief)	Representative of the Ministry of Posts and Telecommunications, the Government of Japan
Junkichi Okada	"
Takuji Ezoe	Representative of the Kokusai Denshin Denwa Co., Ltd.
Kenzo Tsukada	"

The survey team takes this opportunity to express its deepest appreciation for the assistance and courtesy extended during its stay in the Philippines by

His Excellency Brigido Vallencia, Secretary of the Department of Public Works and Communications,

Hon. Antonio Gamboa Jr., Director of the Bureau of Telecommunications,

Staff Officers of the Bureau of Telecommunications,

His Excellency Osamu Itagaki, Japanese Ambassador to the Republic of the Philippines.

II SELECTION OF SUBMARINE CABLE LANDING SITE

1. General Considerations in the Selection of Cable Landing Site

In selecting the landing site of submarine cable, careful consideration has to be given to the following factors.

1.1 Construction Cost

The total construction cost of submarine cable including connection link between the landing station and the gate office (main exchange) should be kept to the minimum.

The coaxial submarine cable is quite expensive; approximately US$10,000 per nautical mile including the cost of repeaters as well as the laying cost. Therefore, a shortest possible route between the two landing sites should be chosen in order to minimize the construction cost. The construction cost of communication link between the landing site and the main exchange has also to be taken into consideration.

1.2 Uninterrupted Services & Maintenance Cost

In order to maintain uninterrupted services of telecommunication as well as to minimize the maintenance cost, the cable route and the landing site should be avoided where troubles are likely to occur in the future.

1.3 Ocean Survey & Landing Site Survey

To find out the safest and shortest route of the submarine cable, it is necessary to carry out ocean survey and landing site survey.

(1) Deep Sea Survey

When the deep sea survey is made, the following factors have to be carefully examined in order to avoid possible cable troubles in the future.

a) Submarine topography & sea bottom material

b) Crustal deformation

c) Ocean Current

If a cable trouble should occur in the deep sea, not only telecommunication services will be interrupted for about three weeks but also the repair cost of nearly US$500, 000 will become necessary.

$400, 000 for replacement of cable (40 n. m.) and repeater

$100, 000 for repair work

a) Submarine Topography & Sea Bottom Material

A flat sea bottom is preferable as a submarine cable route. If the inclination of rises and falls on the rocky bottom of the sea exceed a certain degree, the laid cable might be damaged due to heavy residual cable tension. These places are of course to be avoided as a cable route. Canyons are also to be avoided because they might be the result of turbidity current with the possibility of recurrence in the future.

(The turbidity current is a flow of sediment-laden water which occurs when an unstable mass of sediment at the top of a relatively steep slope is jarred loose and slides down the slope.)

b) Crustal Deformation

Such sea bottom should be avoided where the statistic shows frequent occurrece of crustal deformation by the following causes:

a. Submarine Volcano

b. Earthquake

c. Landsliding

d. Turbidity Current

c) Ocean Current

A strong ocean current might give damage to the cable when it is laid under a relatively shallow water of less than several hundred meters in depth. In such cases, the cable route should be selected as deep as possible.

(2) Shallow Water Survey

According to the statistics, the troubles of trans-oceanic submarine cables occurred more frequently in the shallow water portion than in the deep water portion although the length of cable is much shorter in the shallow water portion.

These troubles are mostly caused by tidal waves, typhoons, and fisheries. Therefore, the following factors have to be examined in addition to the various factors mentioned in the Deep Sea Survey.

a) Violent Waves

Violent waves caused by typhoons and tidal waves will give damage to the cable if it is laid on the following sea bottom.

a. Coral

b. Rocks

c. Stones

Therefore, the cable route should be chosen along the sea bottom with the sediments of sand or mud where few violent typhoons or tidal waves are recorded.

b) Fishery & Anchor

Such shallow water should be avoided where certain types of fishing gears like Otter Trawl are used because they will give damage to the laid cable.

There is a relatively high percentage of troubles caused by anchors. Therefore, the cable route should be chosen along the shallow water where there is no frequent casting of anchors either by fishing boats or any other ships.

In the case of the trans-Atlantic submarine cable, almost all troubles have so far been caused by Otter Trawl, which shows the importance of avoiding the shallow water mentioned above in choosing the cable route.

In order to minimize the possibility of troubles during the long period in future, it is very important to choose the cable route along the shortest possible shallow water area.

c) Turbidity Current

At places near river mouths there is a great quantity of sediment of sand and mud which often causes turbidity current in the offing. These places should be avoided as a cable route.

(3) Landing Site Survey

The landing site should be chosen at a place where the following conditions can be satisfied.

a) The vertical crustal deformation near the shore should be small, that is, a very little or no change of the coast line is expected in the future.

b) The site of landing station should be as close to the sea shore as possible so that the land portion of submarine cable can be made shorter in length. This is to minimize the possibility of damages which might be caused by either natural forces or human activities.

c) It is desirable that the landing station site is at the sea level of more than ten meters in order to protect the landing station equipment from high tides, as well as to make the construction possible of an under-ground antiearthquake landing station in which the main equipment is installed.

d) The landing station site should have the area of about 3, 000 square meters in consideration of future expansion.

e) Stable power supply should be easily obtained.

f) The landing station should not be too remote from the local community so that a reasonable good living conditions of maintenance personnel can be maintained.

2. Selection of Cable Landing Site by Map Survey

2. 1 General Conditions

The projected S. A. F. E. Submarine Cable will run from China (Formosa) to the Philippines, and then from the Philippines to Vietnam (Rep. of).

One cable landing site in Luzon Island is to be used for the landing of both portions mentioned above. It is also assumed that the Gate Office (main exchange) is to be situated in Manila. Keeping these two conditions in mind, map surveys were conducted with a view to selecting suitable cable landing sites in Luzon Island.

2.2 Selection of Landing Sites by Map Survey

In selecting the landing sites by map survey, considerations were given to the following factors.

(1) The submàrine cable should not pass through the volcanic zone north of Luzon Island.

(2) The west coast of Luzon is preferable for the cable landing in order to minimize the total cable length of China (Formosa) - Philippine - Vietnam portion.

(3) Also from the view point of land topography and population density, the west coast is more suitable than the east coast for the cable landing.

(4) Manila Bay, which is nearest to the gate office, would be unsuitable for the cable landing because it has a shallow water of great distance and consequently is being used for anchorage as well as otter trawl fishing.

(5) The west coast between Manila Bay and Lingayen Gulf is generally Liassic and abounds with coral reefs throughout the coast. It would therefore be unsuitable for the cable landing.

(6) Lingayen Gulf would be unsuitable because it has a shallow water of great distance and would become an ideal fishing ground.

(7) San Fernando port should also be avoided because of anchorage.

After eliminating the above-mentioned areas, the following three places were chosen as likely cable landing sites, and a field survey was conducted at each place.

a) Nasugbu beach (about 20 kilometers south of Manila Bay)

b) San Juan beach (about 8 kilometers north of San Fernando)

c) Luna beach (about 40 kilometers north of San Fernando)

3. Field Survey at Nasugbu

The following is a report of the field survey conducted at Nasugbu on the 4th of March 1964.

3.1 Sea Shore

There is a sand beach of approximately 4 kilometers in length and 50 meters in width at Nasugbu sea shore. As far as the shore is concerned, this sand beach is considered suitable for the cable landing with the exception of the area near Lian River and the anchorage area of fishing boats in the offing of Wawa.

3.2 Fishing Activities on the Continental Shelf

According to the information obtained from Mr. Enrique V. Relevo, Chief Instructor of Nasugbu Fishery School, fishing gears currently used in the offing of Nasugbu shore are bag nets, beach seines and trawl lines. These fishing gears are not considered to be harmful to the laid cable. The fishermen are reluctant to go for fishing in the offing of this area because of very high waves. However, there also lives flat fish in the offing and Otter Trawling method is sometimes employed.

As the continental shelf extends 12 nautical miles from the sea shore according to the chart available, this area might be considered to be ideal for Otter Trawling in future.

Therefore, if the submarine cable is to be laid along this continental shelf, some kind of action will be necessary to prohibit otter trawling in this area. It may also become necessary to bury the cable under the sea bottom.

3.3 Profile from Sea Shore to Nasugbu Town

The profile from the sea shore to the town of Nasugbu is as follows; a gentle slope of fine sand extends about 50 meters from the sea shore to the bank which has the width of several meters at above the sea level of 4 to 5 meters. From the bank a gentle slope continues slightly downward and then upward for 500 to 600 meters until it reaches to the western edge of Nasugbu town.

3.4 Site of Landing Station

If the landing station is to be constructed within the radius of 100 kilometers from Manila, somewhere near Nasugbu would be a most suitable place as the landing site, although the fishing activities (especially Otter Trawling) may become a matter of concern in the future because of a relatively long shallow water portion of 12 nautical miles.

(1) Landing Point

As mentioned above, any place within 2 kilometers along the shore of Nasugbu is considered to be suitable as the landing point.

(2) Site of Landing Station

Since nothing was recorded of the damages to the people or animals in this area caused by high tides (typhoons or tidal waves), it is not imperative to construct the landing station at the height of 10 meters above the sea level, provided the anti-earthquake construction can be adopted for the station.

It is also considered better if the landing station is constructed somewhere between the sea shore and the town of Nasugbu, preferably nearer to the beach, to make the land portion of the submarine cable as short as possible.

(3) Connecting Link

If a micro-wave connection is to be made between the landing station and Tagaytay, it will be necessary to construct a repeater station on top of the nearby hill.

4. Field Survey at San Juan

The following is a report of the field survey conducted at San Juan, about 8 kilometers north of San Fernando, on the 11th of March 1964.

4.1 Sea Shore & Profile of Surrounding Area

San Juan beach consists of fine sand approximately 30 meters in width and

4 kilometers in length stretching in between two capes and forming a gentle curve from north to south. At the center of this beach, there stands the half-ruined Old Tower. There is sand dune 7 to 8 meters high and about 30 meters wide running along the sea shore. On the east side of the sand dune, there is a low area of about 200 meters in length, and then the land extends slightly upward for 200 to 300 meters till it reaches the western edge of San Juan town.

4. 2 Submarine Topography near Shore

The sea bottom near the central part of San Juan beach seems to be consisting mostly of sand, although there are rocky areas covered with coral around both capes in the north and the south.

The continental shelf of this area extends only 3 nautical miles to the north-west and 2 nautical miles to the west. The continental slope appears to be rather gentle with maximum inclination of 15 degrees. Therefore, the submarine topography of this area seems to be very preferable for the cable landing.

4. 3 Fishing Activities on Continental Shelf

According to the information obtained from Mr. Geronimo Gaerlan, Mayor of San Juan, there is only a small scale fishing activity at present, employing hook and line and beach seine methods, which will not be harmful to the laid cable.

In view of the relatively narrow continental shelf of 2 to 3 nautical miles and the Mayor's further statement that no Otter Trawling is planned in the foresseable future, this area is considered to be very good for cable landing.

4. 4 Site of Landing Station

(1) Landing Point

The sea shore close to the Old Tower or any place within one kilometer north or south from the Old Tower will be suitable as a landing point. However, in order to avoid the rocky part of the sea bottom, it is necessary to acertain the bottom material and formation by echo-sounding or a dredge before the final selection of the exact route is made.

(2) Site of Landing Station

According to the Mayor of San Juan, there is a plan to construct a road from the town to the Old Tower on the sea bank. Therefore, it would be advisable to choose the site of landing station close to the Old Tower, provided the landing station can be constructed on the firm foundation and at the elevation of the sea bank. If not, the site has to be chosen closer to the town.

(3) Connecting Link

As a multi-channel microwave link is expected to be constructed in the near future connecting Sto. Tomas with Manila, it will not be too difficult to make a connecting link from the landing station to the main micro route.

5. Field Survey at Luna

The following is a report of the field survey conducted at Luna on the 11th of March 1964.

5.1 Sea Shore & its Landing Site Profile

The sea shore of Luna, situated between Ambrayan River and Darigayos point, about 40 kilometers north of San Fernando, is covered with gravels and pebbles for the distance of 8 kilometers.

The profile from the sea shore toward the inland is as follows; there runs a sea bank of 10 meters high, at the distance of 20 meters from the beach. From the sea bank a grass plain extends about 200 meters, and then shrubs continue.

5.2 Submarine Topography near Shore

The sea shore of Luna is covered with gravels and pebbles supplied from Ambrayan River. However, the sea bottom at the depth of 15 to 20 meters consists of sand. It appears, therefore, that the gravels and pebbles are scattered only along the coast line.

The continental shelf is relatively narrow; it extends only 1 to 2 nautical miles from the shore. The maximum inclination of the continental slope at this place is approximately 20 degrees, which is within the limit of permissible inclination for the laid cable.

5.3 Fishing Activity on Continental Shelf

As present the fishing activity in Luna is on the same scale as in San Juan and will not be hamful to the laid cable. In view of the narrowness of the continental shelf along Luna coast, the fishing activities in future are expected to remain on a smaller scale, and the laid cable will be free of troubles along this coast.

5.4 Site of Landing Station

(1) Landing Point

There is no great difference in coastal conditions throughout Luna sea shore for the distance of 8 kilometers. However, the southern part of the sea shore, where the continental shelf is narrower, is preferable as a landing point. If the gravels and pebbles on the shore are those supplied from Ambrayan River, the farther to the south, the better suited for a landing point.

(2) Site of Landing Station

The elevated ground about 100 meters from the sea shore, where high tides are said to have never reached in the past, would be suitable as a site of the landing station provided a firm foundation can be obtained for its construction.

(3) Connecting Link

If a microwave system is to be adopted for a connection link between the landing station and the main national network, it may be necessary to construct a non-attended microwave repeater station on top of the nearby hill.

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It would be advisable to make a final selection of the cable landing site from among the three places mentioned above.

The following two reports are attached for reference.

1) Report on Troubles of the Existing Submarine Cable in the Western Pacific Area (Annex 1)
2) Reference Data of the Oceanic Survey for Decision of a Transpacific Submarine Cable Route (Annex 2)

6. Designing of Cable Laying

The designing of cable laying is usually carried out in the following order.

6. 1 Collection of Pertinent Information

Collect information concerning the deep sea, the shallow water, the landing point, etc. by the study of detailed charts and other available data. Necessary information on the landing point can easily be obtained by field survey of the area. Therefore, it is desirable to conduct its field survey prior to the ocean survey.

6. 2 Local Field Oceanic Survey

Based on the above information, write on a chart the predicted cable laying routes, and then conduct the local field oceanic survey using an observation ship at places where careful examination is needed, such as the shore, the continental slope, the ridge-crossing points, etc. on each route.

This local survey may be spared if all the necessary data are available from the collected information mentioned in Item 1.

6. 3 Predicted Cable Laying Routes

After careful examination of the survey results mentioned above, select at least two cable routes.

6. 4 Overall Oceanic Survey

Conduct overall field oceanic survey along the two predicted cable routes using an observation ship. These two routes can be surveyed by one return voyage.

If new data are obtained during the survey concerning unknown sea mountains, canyons, ridges, etc., then examine carefully around those areas, and continue the field survey along the route.

Submarine topography, bottom temperature, bottom materials and other necessary data can be obtained during the field oceanic survey by the following means.

a) Topography by continuous echo-sounding along the route

b) Bottom temperature by a submarine thermometer

c) Bottom material by a dredge or a core sampler

6.5 <u>Final Selection of Cable Route</u>

Make the final selection of a most suitable cable route after examining the following:-

a) New data mentioned in Item 4.

b) Overall construction cost described in the separate report

c) Various conditions for the landing site selection also mentioned in the separate report

6.6 <u>Designing of Cable Laying</u>

(1) Determine the cable slack to be laid at each place; the slack can be calculated from the record of echo-sounding.

(2) Determine the each length of

a) Deep sea cable (Armorless Cable)

b) Shalow water cable (Armored Cable)

c) Land cable (Armored Cable)

considering the depth of water and the condition of sea bottom.

(3) Thus, the total cable length as well as the cable route can be determined.

7. Connecting Link between Landing Site and Manila

The direct line distance between each of the proposed landing sites and Manila Gate Office is as follows:-

Nasugbu - Manila	70 km
San Juan - Manila	230 km
Luna - Manila	260 km

According to the five-year expansion program of the Bureau of Telecommunications, the following microwave main route (initial capacity 60 ch, ultimate capacity 600 ch) is to be constructed.

Tagaytay - Manila - Malolos - San Fernando - Tarlac - Villasis - Sto. Tomas

Both of the proposed landing sites, Nasugbu and San Juan, are situated within 50 kilometers from Tagaytay and Sto. Tomas respectively, and microwave connection will be possible either directly from the landing station or through a repeater station on top of the nearby hill.

If Nasugbu is chosen as the landing site, the most economical way to connect between the landing station and Tagaytay will be to construct a repeater station either on top of the 435 meter high mountain about 7.7 kilometers north of Nasugbu or on one of the suitable mountains further north. In case a repeater station is constructed on top of 147 meter high hill near San Diego, the antenna of that repeater station as well as the antenna on Mt. Sungay (720 meters) will have to be at least 480 feet high in order to have necessary clearance, which will be a more expensive construction.

If San Juan is chosen as the landing site, a direct connection will be possible from the landing site to Sto. Tomas by constructing a landing station with an antenna several meters high at a position 100 to 200 meters north of the Old Tower on the bank.

III ESTIMATION OF TELEPHONE TRAFFIC DEMAND

1. Method of Estimation

The following estimation of the telephone traffic demand in 1976 was made on the basis of the actual traffic volume handled in 1963.

2. Estimated Telephone Traffic Demand from the Philippines

to \ year	1963	1966	1971	1976
Japan	62,833 min.	206,000 min.	330,000 min.	535,000 min.
Hongkong	52,646	127,420	205,209	330,488
China (Formosa)	3,988	9,652	15,545	25,037
Thailand	224	542	873	1,406
Viet-Nam	143	346	558	899
Malaysia	696	1,686	2,717	4,377
Indonesia	150	364	585	943

Note: Annual increase from 1963 to 1976 has been estimated at 10 per cent and as an effect of the introduction of cable service, 100 per cent increase of traffic has been added to the figures in 1966.

3. The survey team has, in cooperation with the Bureau of Telecommunications, sought in the records of the past for indications which might forecast some trend of the future traffic demand. However, this study has produced no quantitative clues

predicting the future situation. The following table shows the past record obtained from the study.

Telephone Traffic from the Philippines

Note: The INDEX figures in the parenthesis refered with the traffic in 1961.

year / to	1958	1959	1960	1961	1962	1963
	min.	min.	min.	min.	min.	min.
Japan	39,256 (66)	67,221 (114)	59,416 (101)	59,154 (100)	57,987 (98)	62,833 (106)
Hongkong	32,253 (70)	44,807 (97)	44,823 (97)	46,343 (100)	51,692 (110)	52,646 (112)
China (Formosa)	1,874 (41)	4,611 (104)	3,566 (78)	4,486 (100)	3,573 (78)	3,988 (88)
Thailand	341 (120)	197 (67)	204 (71)	288 (100)	53 (18)	224 (78)
Viet Nam	562 (175)	403 (125)	430 (135)	324 (100)	170 (52)	143 (44)
Malaysia	2,367 (630)	1,439 (380)	640 (170)	375 (100)	621 (165)	696 (185)
Indonesia	344 (110)	458 (145)	731 (230)	314 (100)	150 (48)	150 (48)
(Korea)	5,467 (1050)	1,671 (350)	1,334 (260)	517 (100)	913 (175)	526 (102)

IV SOME LEGAL ASPECTS WITH REGARD TO THE CONSTRUCTION OF SUBMARINE CABLE SYSTEM

Generally speaking international submarine cables have hitherto been owned and maintained solely by the enterprise which has laid them. Consequently agreements on such cable system have usually been limited to the tariff and other business matters between and among the parties who make use of it. It is needless to say that in a case of this kind such agreement presupposes the authorization to the enterprise by the country which approves of the cable landing site to be located in its territory. However, in case of the latest system of international submarine cables, it has become a customary rule for the parties concerned to enter into the so-called "Agreement on the Construction and Maintenance of Submarine Cable System", which determines the legal relationship of the parties with each other by placing the cable system under their co-ownership and which provides for their joint action in constructing, making use of, making a profit of, and disposing of the system.

Such agreement, so to speak, corresponds to the "Special Agreement" provided for in Article 43 of the International Telecommunication Convention (Geneva, 1959) whose legal character, being different from the so-called multilateral treaty under international law, may be deemed to be an international private contract.

The "Transpacific Construction and Maintenance Agreement" dated February 14, 1962 to which Japan is a party is also in accordance with this new type of international agreement, which will be required to apply in principle to the Southeast Asia and Far East Submarine Cable System.

Notwithstanding that this kind of agreement is considered to be a private contract between private persons on the one hand, we must, on the other hand, point out that it deals with a communication business which has much to do with public interests. That is the reason why such agreement in any country is, as a matter of course, subject to its domestic laws - that is, such laws as concerning telecommunications, industrial activities and acquisition of properties by alien persons, taxation, foreign exchange control, fishery control for the protection of submarine cable system; all of which are supposed to give rise to various problems in the process of concluding and performing such agreements.

None of such problems as necessitating the amendment of domestic laws was experienced by Japan when laying the Transpacific Submarine Cable System. As regards the Philippine Government's participation in the construction of the Southeast Asian submarine cable system, the survey team is of the opinion that there will not be any legal problem of particular difficulty after having studied the foregoing subjects.

1. Co-ownership of Cable System

1.1 Outline of the ownership of the cable system in the "Transpacific Cable Construction and Maintenance Agreement"

According to the Transpacific Cable Construction and Maintenance Agreement (hereinafter called the "Agreement"), the ownership of the submarine cable system is provided for as follows:

(1) Such properties as "land and buildings appropriate for the cable landing and for the cable station equipment on the landing site, and power equipment (other than power equipment associated solely with the cable) at that location" are owned solely by the persons who is engaged in the communication service in that country.

(2) Such properties as "submarine cable, equipped with intermediate cable repeaters, connecting Japan and Guam, together with associated cable station

equipment in Japan and Guam" constitute the co-ownership of the persons who make use of the cable circuits between the points concerned.

In concrete it follows that the submarine cable system between Japan and Guam constitutes the co-ownership shared by the persons of Japan and the United States who are engaged in the communication service over the cable system, while that part of the submarine cable system between Guam and Hawaii is placed under the co-ownership of the persons of the United States.

Such is the case with the right of ownership of the submarine cable system. In addition to this, the parties to the Agreement, for the purpose of securing the right of use of the submarine cable system for the duration of the Agreement, has acquired the indefeasible right of its use by paying part of the capital cost to the owner; this means a right substantially equal to the co-ownership shared by the co-owners.

Furthermore, the Agreement provides for the indefeasible right of use by persons other than the parties to the Agreement and engaged in communication service. These persons may, in case they so desire, acquire the indefeasible right of use of the submarine cable system by paying a certain portion of the capital costs of the system in proportion to the number of circuits offered for their use.

1.2 In connection with the above-mentioned instance, the following questions present themselves for our consideration regarding the construction of the submarine cable system;

(1) Is it possible for a country to approve of alien ownership in its territory?

To this question the answer is quite simple and clear, because in the case of the Agreement the land, buildings and power equipment (1. 1 (1)) in a country are owned solely by the party to the Agreement who belongs to the country and even when the other party to the Agreement who belongs to the other country acquires the indefeasible right of use of the cable system, no problems of complicated nature will be presented.

As regards the submarine cable system laid in the territorial waters, which in this case means the presence of alien co-ownership shared by alien persons in the territory of the Republic of the Philippines, there exist no such laws in the country as prohibit the alien ownership of property in this form; especially in the case where the Philippine Government itself plays the role of the constructor of the submarine cable system, there will be no difficulty at all concerning this question.

(2) Question of long duration of co-ownership.

In view of the long durability, which extends over twenty-five years, of the coaxial cables employed in the submarine cable system, the Agreement provides for its duration to be as long as twenty-five years (Agreement 18 (a)) and for the co-ownership of the cable to be indivisibly shared by the parties to the Agreement as long as the Agreement lasts.

However, the Civil Code of the Republic of the Philippines stipulates in Article 494, " No co-owner shall be obliged to remain in the co-ownership. Each co-owner may demand the partition of the thing owned in common insofar as his share is concerned. Nevertheless,. an agreement to keep the thing undivided for a certain period of time not exceeding 10 years shall be valid. " According to this Article any special agreement on the indivisibility of a co-owned thing over a period of twenty-five years is held invalid. A similar restrictive provision is also found in the Civil Code of Japan, which has induced the Kokusai Denshin Denwa Co., Ltd., a party to the Agreement, to get round the restriction by entering into the " Addendum to the Agreement " with the other parties to the Agreement. Therefore, we believe that a similar measure may be possible to be taken in this case.

On the ground of Article 256 of the Civil Code of Japan which stipulates, " Each co-owner may demand at any time a partition of the thing jointly owned, but the co-owners may agree not to partition it for a period not exceeding five years.

Such agreement may be renewed, but its duration cannot exceed five years from the time of renewal. " , the Addendum provides for the substantial duration of the Agreement to be as long as twenty-five years by stipulating as follows:

" Notwithstanding the effective period of the Agreement provided for in subparagraph 18 (a) thereof, the agreement not to divide (that is, the provision for ownership in common in undivided shares) that part of segment Two located in Japan (including its territorial waters) which is contained in subparagraph 7 (a) of the Agreement shall remain in force for a period of five (5) years from the date of the Agreement, and thereafter such agreement shall be automatically renewed for successive additional periods of five (5) years each (unless otherwise requested in writing by the American Company or KDD to the other co-owner at the end of the original period or any additional period of five (5) years ".

As a matter of fact it is anticipated that the Philippine Government will be a party to the agreement on the construction and maintenance of the Southeast Asian submarine cable system. In this case a question will be presented as to whether the Philippine Government will be subject to the Civil Law of the country, as the legal status of the Government is different from that of Kokusai Denshin Denwa Co., in relation to the Agreement. The survey team finds it difficult to give a definite answer to this question as it did not have sufficient time for the detailed study of the question. In the opinion of the survey team, such agreement may be considered to be a kind of international private contract. At any rate it will be necessary for the question to be examined by the Philippine Government.

2. Protective Measures of the Submarine Cable System

Of a number of submarine cable troubles, the most serious one is caused by otter trawling and other methods of fishery. Regarding this matter the survey team has made oral explanations to the Bureau of Telecommunications based on the data collected in Japan and submitted to the Philippine Government. In the case of the projected submarine cable system using high-quality equipments, it is quite conceivable that any one damage given to it may sometimes incure a large sum of repairing costs amounting to as much as US$500, 000, interrupting at the same time important international communication services. Therefore, it is necessary to take preventive measures against cable troubles by using every conceivable means such as employing armored cables, prohibiting certain methods of fishery which might cause damage to the cable, or restricting the right of fishery in the area where the submarine cables are laid.

The Republic of the Philippines has no such special law as the Japanese "Public Telecommunication Law", which contains articles (from Article 100 to Article 106, Chapter Six) providing for the protection of submarine cables. However, according to the "Fisheries Act", which is a general law concerning fishery, the Secretary of Agriculture and Natural Resources has the competence to establish a "closed season" for a duration not exceeding five years. The Act has other provisions which make it also possible for the Secretary to prohibit the fishery of some special kind of fish when such measure is deemed necessary for the public interests. Therefore, it is quite possible to take legal measures for the protection of the submarine cable system against the troubles which might be caused by certain fishing activities.

3. Means to Secure Cable Landing Site

The location of the cable landing site is determined by the cable route, which, in turn, depends on the submarine topography along the route. In addition, the connecting link between the landing station and the internal communication network has to be considered in selecting the cable landing site. Consequently, suitable places for the cable landing are liable to be limited to a comparatively small number of areas. This sometimes leads to a difficult situation where the selection and securing of the land appropriate for the cable landing are not easy.

However, in the Philippines no great difficulty is foreseeable, except in certain military areas, in securing the appropriate land, especially in view of the existence of "the Expropriation Proceedings" by which the necessary land may be expropriated by paying reasonable prices.

According to the Philippine Government authorities concerned, there will be no difficulties in securing the land in the areas where the landing site survey were conducted by the survey team.

4. Passage of Submarine Cable through Territorial Waters

As stated above, no problem is foreseen with regard to the co-ownership of the submarine cable system; similarly, regarding the landing of the cable after its passage through the territorial waters there will be no problem when the construction is made with the permission of the government authorities concerned. It is especially so in the case where the Government assumes the responsibility of construction under the Presidential authorization. Therefore, the survey team is of the opinion that any legal problem or difficulty would be obviated if dealt with within the government framework.

Annex 1

REPORT ON TROUBLES OF THE EXISTING SUBMARINE CABLES IN THE WESTERN PACIFIC AREA

Report on Troubles of the Existing

Submarine Cables in the Western Pacific Area

April 1960

Transpacific Cable Project Department, KDD

Japan has, at present, about 400 submarine cables, but very few of them are laid in the Pacific area. Investigations were made into troubles of the following eight submarine cables:

Kawazuhama (Izu Peninsula) - Osima, #1 and #2

" " " - Nii Sima

Nii Sima - Miyake Sima, #1 and #2

Miyake Sima - Hatizyo Sima

Kamakura - Titi Sima (ceased service)

Titi Sima - Guam (ceased service)

1. Statistics Classified by Cause of Troubles

The time of laying varies with each section, so the period taken in our investigation varies accordingly, from 15 to 58 years. According to the records, troubles can be classified according to causes as shown in Table 1.

The troubles called "mechanical chafe and electrolytic corrosion" are considered to be those which are caused by the chafe of steel armor by waves mainly near the landing point, and by the natural corrosion of steel armor owing sometimes to tidal electromotive force in the offing.

Troubles called "eccentricity and degeneration of G. P." are as follows: Cable used for those sections at that time is G. P. cable with Gutta Percha as insulator, and it is apt to be eccentric and to degenerate by oxidization mainly at the landing point. The troubles are caused by lowering of insulation resistance owing to those phenomena.

The cable is occasionally cut off with an axe by the crews of a fishing boat to free the anchor or fishing net from tangled cable. In the "anchor and fishing" troubles, troubles of this kind are included.

In the "others", troubles by teredos and by other causes are included. However, the causes of the most part of them are unknown. This is unique phenomena in the submarine cables. When a cable is hooked up for repair, it is occasionally cut off at a certain weak point, and the other end of the cable can not be found, and, accordingly, the cause of the trouble could not be confirmed. These troubles are considered to be included in "mechanical chafe and electrolytic corrosion."

Generally speaking, by reviewing Table 1, more than 70% of total troubles, 110 in number, and the most part of "others", 26 in number, are considered to be "mechanical chafe and electrolytic corrosion" troubles. "Eccentricity and degeneration of G.P." troubles are counted to only 12.

In the case of P. E. coaxial cable, the latter troubles would not happen. Therefore, it may be concluded that the cause of troubles in these sections excepting the former cause is only "anchor and fishing" troubles which is counted to only 6 cases.

Table 1 Troubles Classified by Cause

Name of Section	Length of Section in n. m.	Period for Investigation	No. of Trouble Classified by Cause				Total
			Mechanical Chafe & Electrolytic Corrosion	Eccentricity & Degeneration of G. P.	Anchor & Fishing	Others	
Kawazuhama - O Sima No. 1	20. 4	58 years (1902-1960)	16	4	1	5	26
Kawazuhama - O Sima No. 2	20. 5	15 " (1945-1960)	5	1	0	0	6
Kawazuhama - Nii Sima	31. 2	29 " (1928-1957)	19	0	0	2	21
Nii Sima - Miyake Sima No. 1	20. 7	51 " (1906-1957)	22	1	2	3	28
Nii Sima - Miyake Sima No. 2	36. 4	16 " (1944-1960)	2	1	0	0	3
Miyake Sima - Hatizyo Sima	85. 8	46 " (1906-1952)	29	4	2	8	43
Kamakura - Titi Sima	663. 4	33 " (1906-1939)	17	1	1	4	23
Titi Sima - Guam	899. 4	33 " (1906-1939)	0	0	0	*4	4
Total			110	12	6	26	154

* Causes are unknown for Titi Sima - Guam cable, so they were classified in "Others."

2. Relation between Lapse of Time after Laying and Frequency of Troubles

Table 2 shows that the more year elepses after laying, the more troubles occur. It is a matter of course that as the degree of deterioration of a cable progresses, so the cable is apt to be in trouble.

Each section in Table 2 not only differs in its length, its route and accordingly, the depth, sea current and nature of soil at the bottom respectively, but also the period for our investigation varies each other. Especially, the cable between Kawazuhama and Niisima had been used for 25 years between Osima and Niishima before laid in that section. Therefore, the lapse of year in this section would exceed the listed figure.

This table must be examined by each section, but, taking the others aside, consideration was given to five sections which have been in service for more than 30 years. The sums of the number of trouble are 9, 16 and 44 for less than 10 years, 10 - 20 years and 20 - 30 years respectively. It may be concluded that the practical life of armored G. P. cable would be around 20 years, and the first trouble would be found after about 7 years and thereafter, though there was a section (Kawazuhama - Osima) in which a trouble was found only one year after laying.

Judging from these figures in those tables, there might be few troubles caused by enormous natural forces, for example, large turbidity current, landslide etc.

3. Relation between Troubles and Sea Depth

To investigate sea depth in relation to troubles is, so to speak, to investigate rises and falls and condition of inclination of the sea bottom, not sea depth itself. Especially, in the area which is in the limit of effect of the Black Current (area from the coast of Japanese Islands and Bonin Islands), we must investigate relations between depth and speed of the Black Current. In the area near the coast, the effect of billows caused by typhoons must also be taken into consideration.

Fig. 3 - Fig. 9 show relations between the order of occurred troubles after laying and sea depth.

Table 2 Lapse of year and Frequency of Trouble

Name of Section	Length of Section in n. m.	Period for investi-gation in year	Lapse of year till the first trouble	No. of Trouble: Less than 10 years	10-20 years	20-30 years	More than 30 years	Total
Kawazuhama - O Sima No. 1	20.4	*58	10	0	3(1)	5	18	26
Kawazuhama - O Sima No. 2	20.5	15	1	4	2(1)	-	-	6
Kawazuhama - Nii Sima	31.2	29	7	4(1)	11	6	-	21
Nii Sima - Miyake Sima No. 1	20.7	*51	3	4(1)	6(2)	10	8	28
Nii Sima Miyake Sima No. 2	36.4	16	10	1(1)	2	-	-	3
Miyake Sima - Hatizyo Sima	85.8	*46	7	4	3	14	22	43
Kamakura - Titi Sima	663.4	*33	7	1	2	14	6	23
Titi Sima - Guam	899.4	*33	17	0	2	1	1	4
Total				9(1)	16(3)	44		

(Note) 1. The figures with brackets in the columns "Less than 10 years" and "10 - 20 years" show only the number of troubles due to the causes other than "mechanical chafe and electrolytic corrosion."

2. The figures at the bottom of the columns "Less than 10 years" to "20 - 30 years" show the total number of the troubles of those five sections with the elapsed period of over 30 years after laying which are marked with asterisks.

Excepting above mentioned Kawazuhama - Niisima section, we may conclude as follows:

a. Number of troubles near the shore is especially great.

b. Many troubles occurred in the offing where the bottom become suddenly shallower.

c. Troubles are found very rarely at a depth of more than 1,000 meters.

d. However, natural trouble could occur in such "stratosphere of the sea" (the sea at a depth of more than 800 meters where the Black Current is not flowing).

We may point out the four points mentioned above regarding the relations between troubles and sea depth.

Troubles occurred in the land portion of the "near the shore" mentioned in paragraph a. are, for the most part, due to eccentricity and degeneration owing to exidization of G. P. which are attributable to the nature of G. P., but there exist mechanically wear-out troubles caused by repetition of shore waves in the sea portion. Further, it may be assumed that there exist troubles caused by corrosion of armoring steel wire by electrolytic corrosion due to electromotive force of sea current besides mechanical wear-out troubles in the sea portion at a depth of about 100 meters to 500 meters. Generally speaking, corrosion of armoring wire itself will not mean cable trouble, but a mechanical force to cut off center conductor is necessary; in some cases, it may be tidal current, and in the other, it may be tensile strength of its own weight when the cable was laid in the bottom where rises and falls are remarkable. Thus, cable would be in trouble with these external causes. The tensile strength of G. P. center conductor (5.5 mm^2) is 110 kilogram.

In relation to paragraph b., frequent variation of sea-depth means that there are rises and falls in the sea bottom, and the cable is subject to be effected mechanically and electrically by the Black Current in the shallow water area. By these considerations, we may understand the reason why there exist many troubles in those offing areas.

Paragraph c. indicates that the sea bottom at a depth of more than 1,000 meters, generally speaking, has little rises and falls, that is to say, the bottom is relatively plain, and the Black Current is not flowing there.

Paragraph d. shows that even in the deep sea where the Black Current is not flowing, there exists a natural force to cut off center conductor of G. P. cable. The appearance of the tip of the cut-off cable is the same as the case in shallow water. That is to say, there may be rises and falls to some extent at the bottom, and sometimes the direct effect of earthquake and landslide might also be taken into consideration.

As an example of the latter, we experienced two or three troubles in the cable to Titi Sima at the time of the Great Earthquake of Kanto District in 1923. However, the landing point of the cable was moved to Kamakura in 1931, and no record is available for those troubles.

Attached chart #6077 & #6080 show the route of the above mentioned section, and x marks show the points where troubles occurred within 20 years after laying.

4. The Investigation and the Armorless Cable

We have investigated troubles of the existing submarine cables. Before utilizing these results for the laying route investigation of the new armorless cable, we must consider the difference between the conventional cable and the new armorless coaxial cable.

Conventional submarine cable is, mainly, of single core, 5.5 sq. mm G. P. insulated cable. As an example, the necessary items of those cables used in shallow water and deep sea are:

	Armoring wire	Outer diameter	Weight in the sea	Tensile strength
Shallow water cable	8 mm x 10	45 mm	3. 8 ton/km	17. 5 ton
Deep sea cable	2. 9 mm x 15	26 mm	0. 8 ton/km	12. 5 ton

The shallow water cable is laid in the sea shallower than 50 meters, while the deep sea cable is laid at a depth of more than 400 meters. As a reference, the items of the armorless cable which is to be used for the Transpacific cable are:

Armoring wire	Outer diameter	Weight in the sea	Tensile strength
None	32 mm	0. 5 ton/km	7. 3 ton

This cable is said to be used in the sea deeper than 800 meters.

Comparing old and new cables, in connection with the case of deep sea portion, it is clear that the tensile strength of the new cable is far more smaller than that of the conventional cable, though the latter is armored while the former is not. The reason why Bell Laboratory recommends this new type is considered to be true as far as the "stratosphere of the sea" is concerned. Though the absolute value of the tensile strength is smaller, the value will be retained for a long period of time because the strand is located in the center of the cable and therefore it does not receive any external effect such as corrosion. While that of the old cable is 12. 5 tons at first but it would become zero if it is corroded in the long-lapse of time. Therefore, the new cable is considered to be superior to the old one in regard to the tensile strength. It may be concluded that troubles caused by the corrosion of armoring wire in the deep sea portion mentioned in the preceding paragraph can be avoided by using the new cable.

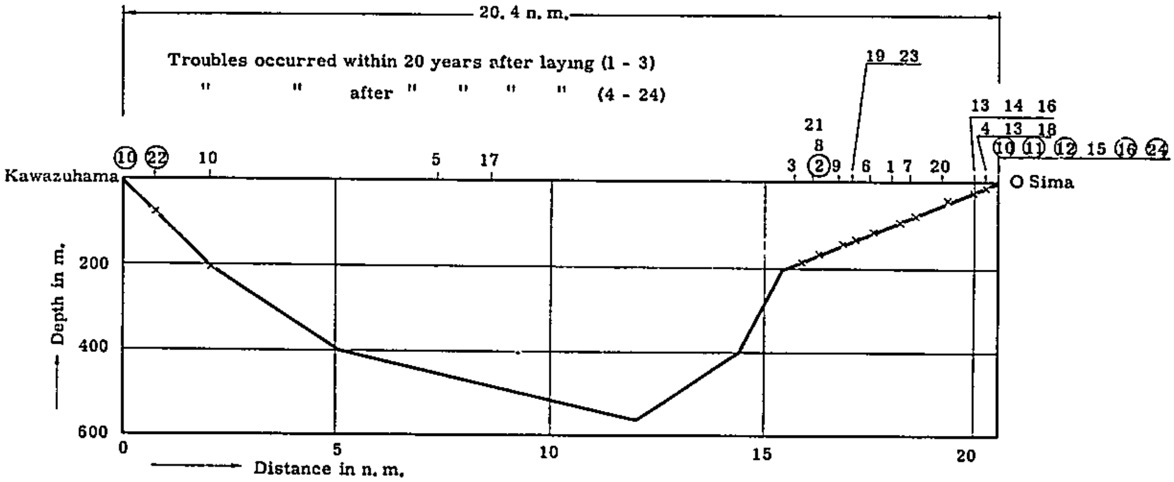
When we consider troubles in the deep sea portion of the Bonin cable, of 23 troubles occurred during 33 years (from 1906 to 1939), 21 troubles were caused by "mechanical chafe and electrolytic corrosion" besides one each by "fishing" and "eccentricity." However, only three of them occurred during 20 years after laying, and the rest occurred thereafter. It is considered to be unnatural to think that "mechanical chafe" caused many troubles occurred after 20 years after laying. It must be understood that electrolytic corrosion progressed calmly at the bottom of the sea.

If the armorless cable is laid on the same route as this section (examinations are necessary as to the shallow water portion near the coast), it can not be concluded that there would be a danger to experience the same number of troubles as occurred in the conventional cable. At present, it is possible to measure sea depth by means of supersonic wave, and moreover, the cable laying technique is far more progressed than the time of laying of old cable, and it has become possible, to some extent, to lay cables along rises and falls of the sea bottom. That is to say, we have become controllable against causes of troubles.

Fig. 3

Kawazuhama - O Sima (No. 1)

Laid in August, 1902



(Note) 1. Number shows the order of occurred troubles.

2. The cause of troubles expressed as encircled number is other than "mechanical chafe and electrolytic corrosion."

Fig. 4

Kawazuhama - O Sima (No. 2)

Laid in January, 1945

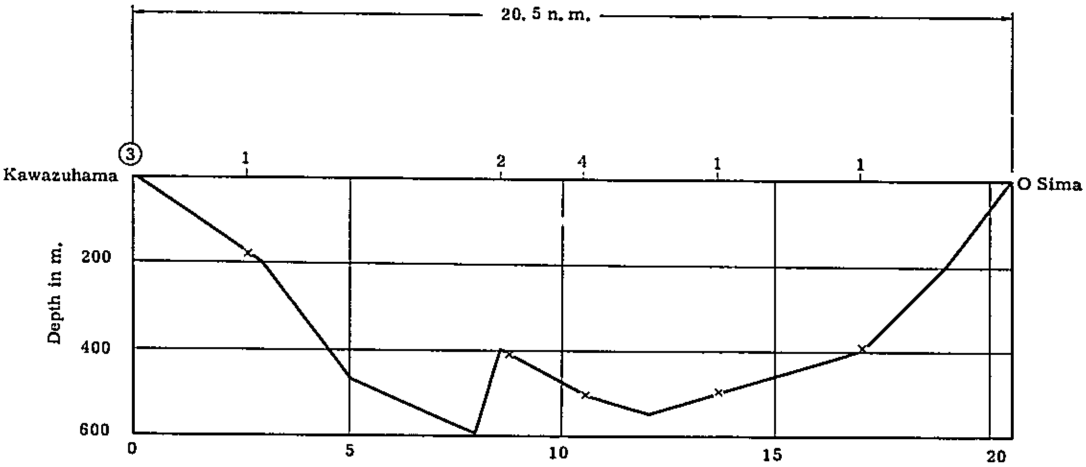


Fig. 5

Kawazuhama - Nii Sima

Newly laid between 0 Sima and Nii Sima in 1903;
Replaced between Kawazuhama and Nii Sima in 1928

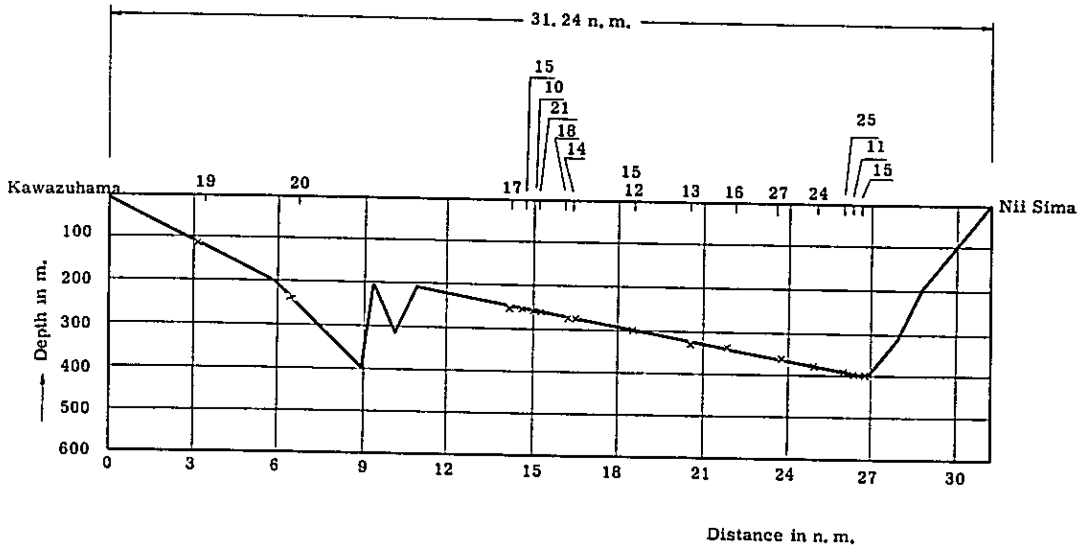
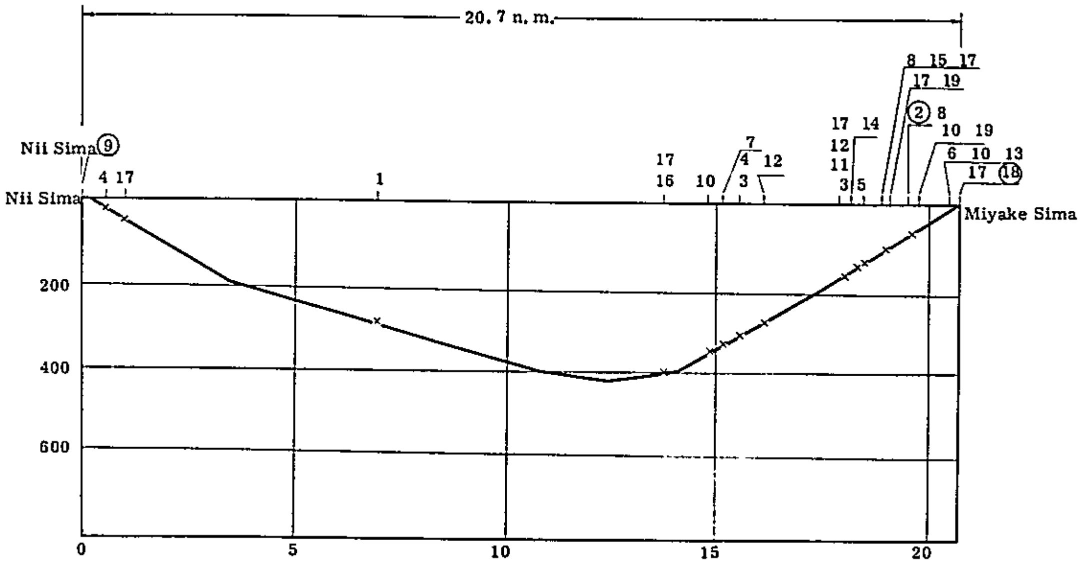


Fig. 6

Nii Sima - Miyake Sima (No. 1)

Laid in October, 1906



Troubles occurred within 20 years after laying (1 - 8)
" " after " " " " (9 - 19)

Fig. 7

Nii Sima - Miyake Sima (No. 2)

Laid in July, 1944

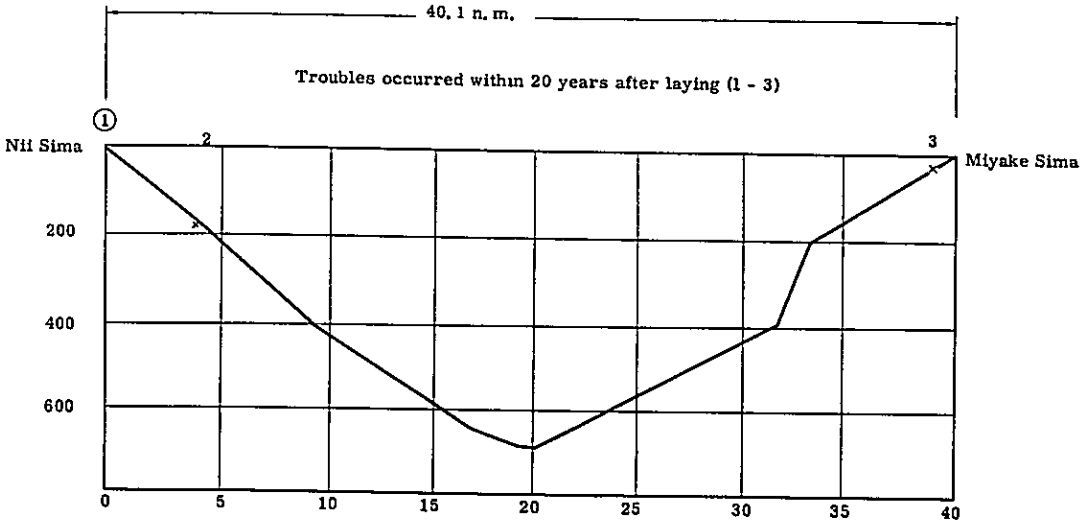
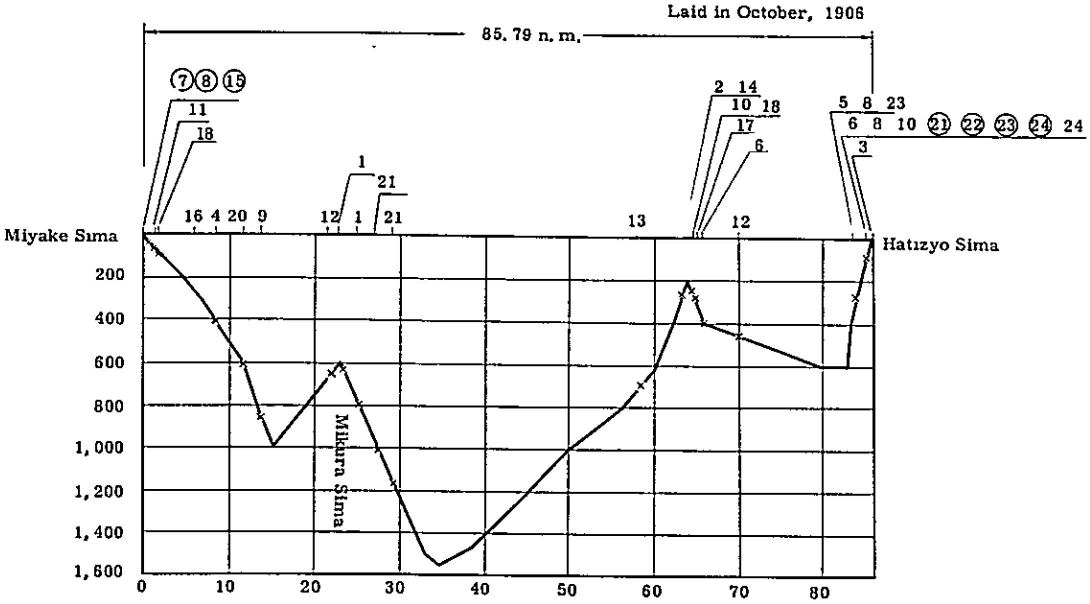


Fig. 8

Miyake Sima - Hatizyo Sima

Laid in October, 1906



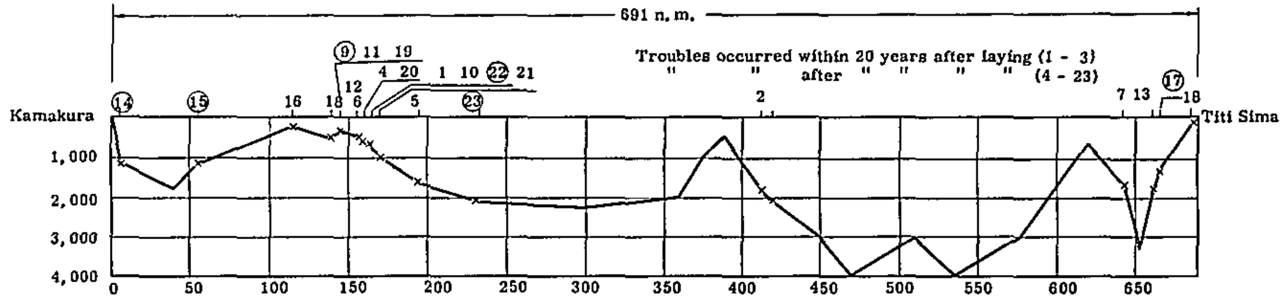
Troubles occurred within 20 years after laying (1 - 6)

" " after " " " " (7 - 24)

Fig. 9

Kamakura - Titi Sima

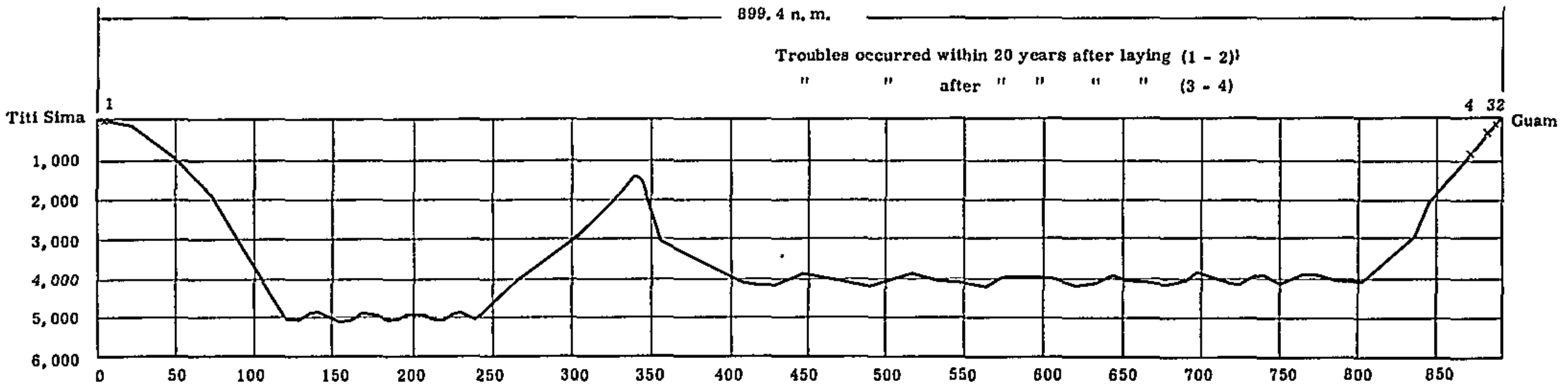
Laid in 1906 (Landed at Etchujima, Tokyo)
Landing point was changed in 1931



The cable was cut in the offing of Boso Peninsula at the time of the Great Earthquake of Kanto District in 1923, but the location is unknown because of the change of route

Titi Sima - Guam

Laid in 1906



Annex 2

REFERENCE DATA OF THE OCEANIC SURVEY

FOR

DECISION OF A TRANSPACIFIC SUBMARINE CABLE ROUTE

Reference Data of the Oceanic Survey

for

Decision of a Transpacific Submarine Cable Route

Report No. 1

July 1960

Transpacific Cable Project Department, KDD

1. Outline:

In constructing the first Atlantic Ocean Cables 1956, the following points were taken into consideration: deformation of the earth's crust, such as earthquakes, volcanos, tsunamis (tidal waves); configuration and sediments of the sea bottom; effects of tsunami upon the landing spot; oceanic weather conditions; fisheries, etc.

In order to decide the route in the Pacific, we think it necessary to consider the same points rather than the other various conditions.

A great-circle route via the North Pacific Ocean will be better as for the length of the cable but a southern route looks more suitable from the stand points of such other conditions as oceanic weather, location of the repeating stations, future extension of the circuits for the purpose of branching.

On condition that the southern route might be taken as in the case of the old Transpacific Telegraph Cable, we have researched the part of Japan-Guam Island line by examining the data obtainable in Japan. The results are as follows.

East of the strait line which links Japan with Guam Island there are the Japan Trench and the Mariana Trench, forming an arc, which are the deepest part in the world. West of the arc, there is an igneous rock zone that makes a chain with Fuji volcanic zone. Moreover a seismic zone lies west of the igneous rock zone. Therefore, many factors must be taken into account in deciding the route. The following chapters 2, 3 and 4 deal with general examinations of these factors, the chapter 5, their summary.

2. Volcano, Earthquake, Land Slide, Turbidity Current and Tsunami

This area belongs to the circum Pacific volcanic zone, and along with the zone lies a seismic zone. The area itself is a tectonic zone surrounded with a chain of trenches approximately 10,000 meters deep. So the topography from the Ocean to the continent is described as follows: trench, shallow-focus seismic zone, volcanic zone and deep-focus seismic zone. As we see in Figure 1, on the east of the area the Japan Trench, the Ogasawara Trench and the Mariana Trench form an arc north to south. Around and inside the arc there are shallow-focus seismic zones and on the west side of them there are volcanic islands; the Izu Islands, the Iwo Islands, the Ogasawara Islands and the Mariana Islands, the first and second Islands of which are an extension of Fuji volcanic zone. On the west side further, from the west side of the Nanpo Shoto to Ise Bay a deep-focus seismic zone lies. Among them the Ogasawara Islands might have erupted in the Paleogene (old Tertiary, 50 - 70 millions years ago) and they are an extinct volcano now. Mostly they consist of acqueous rocks, so the islands seem now free from the danger caused by volcanism to the cable.

In the cases of a deep-focus earthquake (the depth of its focus is more than 300 kilometers), of a intermediate-focus earthquake (the depth of its focus is between 70 and 300 kilometers), and of a shallow-focus earthquake (the depth of its focus shallower than 70 kilometers), if the earthquake magnitude is less than 8, 7 and 6 respectively, the deformation of the earth's crust is negligible, and the epicenters of the earthquake, the magnitudes of which are larger than 8, 7 and 6 respectively are shown on the chart. It is generally said that the diameter of the focus is about several tens kilometers.

On the volcanic zone many parts such as Mt. Mihara in Oshima Island, the part near the Bayonnase Rocks (eruption at Myojin Reef in 1952), the part near the Smith Reef, Iwo Island (eruption in 1957), the Mariana Islands, the west reef of the Tennian Islands (submarine eruption in 1945) still continue their volcanic activities. The topography in these parts is very complicated.

The land slide and the turbidity current are referred to as follows: the land sliding phenomena might be said to occur due to the unstable upper sediments situated on the steep slope of the surface of the earth's crust. So land slide may seldom occur in the flat part of the ocean bottom except for the surroundings of the trenches. However, the submarine topography with such steep slopes along the Honshu, as at the mouth of the Tokyo Bay, or in the inner part of Suruga Bay, and with big rivers pouring into bays, seems to incur the danger of the turbidity currents caused by the carried sand and mud and other conditions.

As for the damage done by tsunamis the local coastline configuration, the change of the water depth, the frequency of their attack etc. must be taken into account. Tsunami is a compressive wave and it propagates from the surface to the bottom of the sea in an equal magnitude. So tsunami seems to have bad effects on the cables not only on the shore but also on the sea bottom even deeper than 100 meters. Tsunami is different with this point from the waves caused by typhoons.

The figures shown at the intervals of 85 kilometers on the 200 meter depth contour line in Figure 2 indicate the kinetic energies of those tsunamis which passed through the contour line during the past one hundred years.

3. Configuration and Deposit of the Sea Bottom

3. 1 Open Sea

As mentioned above, in the area on the Tokyo-Guam line there is a chain of trenches and, inside this, a chain of islands and reefs lies north to south, parallel with this. Further the latter chain can be divided into two parallel chains. The outer one starts in the Ogasawara Islands and ends in the Mariana Islands. The inner one is a chain which begins in the Nanpo Shoto, and via Iwo Island ends in the oceanic ridges scattering over in the south. There is a probability that such ridges belonging to the outer arc will be found out also in the area from the north of the

Ogasawara Islands to the Boso Peninsula, if exactly surveyed.

In the area between these two chains of islands the configuration rises and falls gently at the depth of 1,000 to 4,000 meters. In this area some quantity of volcanic mud and coarse sand is deposited on a fairly hard rock board. In the west of the inner arc, that is, the opposite part of the trenches the sea bottom is uneven. Judging from the result of echosounding survey there are many ups and downs. To the west of the Smith Reef is a chain of ridges, east to west, and the bottom in the vicinity also may be extremely uneven. On the west further the part deeper than 4,000 meters is flat.

3.2 Coast (Outer Boso Peninsula Coast, Tokyo Bay, Sagami Bay, Suruga Bay, Enshu Gulf)

The northern part of the outer coast of the Boso Peninsula, that is, the vicinity of Kuju-Kuri-Hama, is shallow to a great distance. Even in the part 20 - 30 nautical miles off the shore the depth is about 200 meters. So the area is unsuitable for laying cables, troubles by fisheries being considered. Moreover shallow-focus earthquakes happen frequently off the shore. The coast from the part above mentioned to the tip of the southern part of the peninsula generally consists of rocks but as in Kamogawa Bay, of the sediments of sand and mud to the offshore. Therefore, Kamogawa Bay is better judging from the obtained data. Generally speaking, outer Boshu (Boso Peninsula) is attacked by waves from the Ocean directly, characterized with the roughness and highness of the waves.

South of Tokyo Bay, in the offshore of the southern tip of the Miura Peninsula, there lies Tokyo Submarine Canyon, the bottom of which is deeper than 500 meters. At the bottom of the canyon, rocks and gravels are spread because of collapses of the side walls. This area has many rivers pouring into Tokyo Bay, and therefore, factors of submarine land slides are inherent. The sediments of the coasts of the Miura Peninsula and the Boso Peninsula close to the canyon are composed of sand

and mud.

As for Sagami Bay, in its northeast half, which is divided from the rest by a line drawn at 45° from Odawara to its southeast, the configuration in general makes a gentle slope, which ends in the basin 1,000 - 1,400 meters deep (10 nautical miles off the shore of Oshima Island). But close to the coast, where several sub-canyons are found, the slope becomes fairly steep. The area, generally speaking, is covered with mud, but in the vicinity of Kamakura the base which exposes itself on the shelf and slope at certain spots consists of Tertiary sedimentary rocks, though comparatively soft. In the offshore area along the coast of the Miura Peninsula southeast of Kamakura, there are many submarine canyons accompanied with hard rock exposures. In the vicinity of Oshima Island lava-flows caused by the eruption of Mt. Mihara run into the sea. Generally islands which belong to the arc of volcanic islands have such lava around them.

Suruga Bay is 2,500 meters deep at the mouth of the bay. Thus the sea depth off the coast of Tagono-Ura is 1,000 meters at the distance of 5 n. m. from the coast. It is clear, therefore, that the submarine canyon deeply encroaches upon the bay and its bottom is near by the Izu Peninsula. The west side of the Izu Peninsula is about 15° - 17° steep. On the other hand the west coast of Suruga Bay has a comparatively gentle slope. The northern extreme of the interior of the bay is called Uchiura Bay (near Numazu) and it is fairly shallow to a great distance. The Fuji River pours into the west of Tagonoura. Both the Fuji River and the steep slope off Tagonoura may cause land slide. In the shore line around the Izu Peninsula and in the area shallow to a great distance from Sagara Bay to about 10 nautical miles south of Omaezaki, sediments are composed of sand, gravels, and rocks. In the other areas almost sediments are mud. The rock fragments which are occasionally found out in the submarine canyons suggest the occurrence of submarine land slides.

The sediments within 5 nautical miles from the Omaezaki Pt., are found consisting of sand, gravels or rock exposures in separate groups. From the west of this area to the outlet of the Tenryu River no rocks are found and the sediments are mostly fine sand: the slope to the offshore is gentle. It is 1,000 meters deep, for example, at the spot 20 nautical miles off and south of this spot it becomes gradually deeper; 60 nautical miles off, it becomes 4,000 meters deep. In the vicinity of this part, waves are rough. Perhaps sedimentation of sand and mud may be active there because it is near the mouth of the Tenryu River. The vicinity of Omaezaki may be the eastern end of the sedimentation area.

4. Change of Coastline and effects of Waves in Nearshore Zone

Changes of coastlines are caused by the following two factors combined in an algebraical sum: a world wide change of the level of the sea caused by change of volume of the sea water, which comes after deformation of the submarine earth's crust such as earthquakes and volcanic activities or after the formation or diminition of glaciers on a large scale on the one hand, and a change of the level caused by the rise and fall of land on the other hand, which might be the main cause for the coast line changes. Figure 2 shows the vertical deformation of the level of Japanese lands these 25 years. Judging from the figure the change is little at the Boso Peninsula, but at Sagami Bay and at Suruga Bay bottoms have sunk about 10 centimeters, that is, the coastline retreats in these area. As seen in Figure 3 at Sagami Bay and in the vicinity of the Boso Peninsula bottoms rose about one meter because of the catastrophic earthquake in Kanto district in 1923. The areas, therefore, are now being restored to the condition before the earthquake 1923. Any way the deformation of the land mass in these areas needs no consideration. The change of the coastline is likely to be effected rather by the circulation of sand and mud of those rivers which pour into the sea as well as by waves. For instance the coastline of Kamakura in Sagami Bay has retreated maximum 100 meters these 30 years, while the coastline west of Enoshima has been advanced, because of the circulating sand and mud poured out by the Sagami River into the bay. It is difficult to speculate how the coastline will change in the future because Sagami Dam was built resently at the upper stream of the Sagami River. With an investigation of various causes for the change of the coastline being made, and with precautionary measures being taken for protection, the coast will remain unchanged in the future. Japan Public Corporation for High Way Construction is now constructing a toll high way along with this shore, with intention to complete the work by 1962.

As for Kamogawa Bay there is no worry because the bay has no big rivers, while, for Suruga Bay and Gulf of Enshu with the Tenryu River, a possible change of the coast line might be considered because of the two big rivers pouring into the bays. In case of Kamogawa Bay, the change of the coastline will be lessned because of the embayment, though the bay faces on the Ocean.

The Gulf of Enshu faces directly the Ocean and the sand-dunes formed from the sand and gravels carried by waves may make incessant changes, effecting a big change of the coast line.

5. Study of Cable Laying Route

In studying cable laying route, it is also important to study its landing point. When we consider the laying route between Honshu and Guam Island by way of Io Sima, it must be taken into consideration that there lies Fuji Volcanic Chain to the south, and Nampo Shoto, Kazan Retto and other islands form the very complicated submarine topography and distribution of bottom materials. As we must avoid laying the cable across this volcanic chain, the landing point is considered to be either westside or eastside of Izu Peninsula according to whether the cable will be laid westside or eastside of this chain.

In the former case, if the route is too westward, the length of the cable will become much longer and connecting line between the landing point and Tokyo will also become longer. In the latter case, there lies the Japan Trench at the eastside of Japan Islands, and the bottom materials near the shore are not preferable except a part of Boso Peninsula, and, moreover, high waves constantly wash the shore. By these reasons, it is considered that this part is not suitable for the landing of a submarine cable except a part of Boso Peninsula.

Izu Peninsula itself belongs to Fuji Volcanic Chain, and the shore line is composed of igneous rock, so it is not preferable to land a submarine cable on this peninsula.

Under these considerations, we studied the cable route, dividing it to deep sea portion and the landing point on Honshu and adjoining shallow water portion, as follows:

5.1 Deep Sea Route

Items to be considered in establishing a route between Honshu - Io Sima - Guam Island may be classified as the following three major ones.

(1) Ocean current

Here, we take only Kuroshio (the Black Current) into consideration, taking aside surface waves caused by tidal current, typhoons, monsoons and tidal waves, and travelling of sea water which affects shallow water portion only.

(2) Crustal deformation

Submarine volcano, earthquake, land sliding and turbidity current.

(3) Submarine topography and distribution of bottom materials

When cliffs, rises and falls, inclinations etc. of the sea bottom exceed a certain limit, there may be a danger that the laid cable not only receives destructive residual tension, but also receives external trouble till it settles to the last position.

The effect of the Kuroshio in that area is considered to reach the depth as deep as 800 meters, so the cable must be laid in the sea bottom deeper than 1, 000 meters. Avoiding the volcanic islands including Nampo Shoto, Bayonnaise Rocks, Tori Sima and Io Islands, two routes are considered, namely, the eastside and westside of the islands. As shown in the attached chart, the westside route is quite preferable for choosing 4, 000 meter line, having relatively plain sea bottom except several sea mountains, the bottom materials are preferable, and having very rare shallow earthquake and deep focus earthquake which would give crustal deformation.

At the eastside of the volcanic islands, as mentioned before, the Japan Trench, the outer arc including shallow earthquake area and Bonin Islands, relatively plain area, and inner arc (arc of volcanic islands) extend, from east to west, southward in a parallel. The bottom of area between the two arcs (relatively plain area) has depth of about 2, 000 meters, and composed of mud and sand, and is far from the epicenter of earthquake and volcanic zone. Therefore, the east side of the volcanic islands may be taken into consideration as the shortest deep sea route.

The old telegraph cable connecting Kamakura - Titi Sima - Guam was laid, as shown in the attached chart, on the area a little inner (west) side between the above-mentioned inner and outer arcs, and the total troupbles during 20 years after laying between Kamakura & Titi Sima was only three including a trouble caused by the Great Earthquake of 1923, and one each occurred between Titi Sima & Guam near the landing point of Titi Sima and Guam respectively. Taking the landing point aside, it is presumed that a trouble free route can be obtained in this area considering the difference between the conventional armored cable and the new armorless cable as far as the deep sea portion is concerned.

(cf: "Report on Troubles of the existing submarine cables in the western Pacific area" already reported)

5. 2 Landing point on Honshu and adjoining shallow water portion

We consider the following places as the landing point of the cable.

Kamogawa Bay (Southeast part of Boso Peninsula)

Tokyo Bay

Sagami Bay

Suruga Bay

Enshu Nada

The former three are the points when the cable runs the eastside of the volcanic islands, while the latter two the westside.

5.2.1 Tokyo Bay

There is a remarkable canyon toward the ocean, and many small pieces of rock are found at the bottom. This is a proof that there was a land sliding at the innermost part of the bay or at both sides. Therefore, this is not appropriate for the cable route. But 50 - 100 meter depth lines along Miura and Boso Peninsulas were formed by the erosion of the old coastal line and is comparatively plain. The fact that there are few sediments in these area is a proof that there are very few bottom deformation. Therefore, if the cable must be laid along these lines, however, the longer the shallow water portion is, the more the danger of troubles by fishing activities is considered. Therefore, it is considered that this route is not preferable for the cable route.

It is considered to be the effect of the quake and land sliding that the old Guam cable was cut to pieces at the time of the Great Earthquake in Kanto District in 1923. When the cable was landed at Tokyo, the cable also suffered many troubles caused by fishing and anchor of ships and we were compelled to change the landing point to Kamakura in Sagami Bay. Such being the case, we consider that Tokyo Bay is not appropriate as a cable route.

5.2.2 Sagami Bay

The bottom is covered by sand in the area from the coast to the depth of 200 meters. The base under sand is clayey aqueous. Even in the area where the base is exposed, there may be no fear that the cable is damaged. However, there are several canyons in this bay, but the sea is calm and the coast is scarcely affected by tidal waves. So if an appropriate route is chosen by avoiding these canyons, a preferable landing point can be established in the bay. The old Guam cable has never been in trouble since the landing point was changed from Tokyo Bay to Sagami Bay.

However, there is one thing to draw our attention. According to the statistical study based on the record of old great earthquakes, the maximum accerelation of the earthquakes which are presumed to occur across Sagami Bay and Suruga Bay within the next 100 years would be 600 gal in peak value (M = 7.3).

Therefore, if we consider the defects of this bay for cable laying, they may be to avoid those canyons carefully in order to avoid troubles caused by turbidity current as a result of earthquake, and to pass between Boso Peninsula and O Sima where the bottom profile is very complex.

5.2.3 Kamogawa Bay in Boso Peninsula

This bay is located far from the epicenter of shallow earthquakes and above-mentioned estimated maximum accerelation peak value, and it is possible to establish a route to avoid the vicinity of O Sima. So the conditions are favorable. But the connecting land line will be longer by 40 n.m. than the case of Sagami Bay. On the contrary, cable length is shorter by 30 n.m. Therefore, there would be very little difference between the total construction cost in case of Sagami Bay, and Kamogawa Bay. The bottom is covered with sand, same as Sagami Bay, and the base rock is aqueous rock. In some seasons, Kuroshio changes its path to the north, so it is safe to choose the route in the area where the bottom is covered with sand. There is also a canyon but an appropriate landing point can be established by avoiding it in spite of a little larger shore waves.

5.2.4 Suruga Bay

A trench of the depth of 2,000 meters comes deeply in the bay. Its side near Izu Peninsula has the bottom inclination of 17° which is not measured even in the Japan Trench. The fact that there are pieces of rock and pebble means that there are collapse of cliffs and land slidings, same as the case of Tokyo Bay, and so this part may be dangerous for the cable route. The effect of tidal waves is very great in this bay.

5.2.5 Enshu Nada

Enshu Nada faces the Pacific directly and constant shore waves are high. The bottom is covered by sand and there are no remarkable canyons, and, the sea gradually deepens. Therefore, there is no problem for the landing point. However, the connecting line to Tokyo will be longer by 60 n.m. than the case of Suruga Bay. But in this case, just the same as the case of Kamogawa Bay, the cable length will be shortened by 30 n.m. Therefore, the total construction cost would be about the same.

It is common to all those bays mentioned above that the vertical crustal deformation near the shore is very small.

5.3 General route

Taking the above-mentioned studies into consideration, the general route between Honshu - Io Sima - Guam Island is considered to be the following two routes as shown in the attached chart.

(1)	Tokyo (130 n.m.)	Enshu Nada	655 n.m.	Io Sima	760 n.m.	Guam
(2)	Tokyo (70 n.m.)	Kamogawa Bay	640 n.m.	Io Sima	745 n.m.	Guam
	Tokyo (30 n.m.)	Sagami Bay	670 n.m.	Io Sima		

Numbers show the length of the span (Slack is not included).
Numbers in parenthesis show the length of connecting land line.

The former passes the westside of the volcanic islands, while the latter the eastside.

5.4 Matters for further study

We studied and made a tentative plan of the general route without surveying those areas. However, there are very few bibliographies concerning ocean survey of the waters in question and there are many unknown waters in the Pacific along the Japan Islands, so a preliminary survey of the following areas would be necessary.

(a) Eastside route

We anticipated a sea ridge which is composed of aqueous rock and rock and which is connected to Bonin Islands at the eastside of the volcanic islands and there would be a plain area between the ridge and the volcanic islands. We must make sure if it is true and also if there is any canyon which falls into the Japan Trench across the ridge.

(b) Westside route

We anticipated that there are plain areas of about 4,000 meters in depth at the westside of the volcanic islands. We must make sure if it is true.

(c) Shore

There are comparatively many data on shores, but few data are available for the shores of Enshu Nada, Kamogawa Bay and the northeastern part of O Sima. How are the bottom topography and bottom materials of those areas?