5. PERILOUS SEA AREA WITH MINES

In special areas shown in ANNEX IV, four still exists the peril of mines that were laid during World War II. Because of the lapse of time, they are no longer considered to be a regular dangerous matter to navigation in these areas. But according to the degree of corrosion in triggering devices, it is very likely that the possibility of danger becomes a reality against fishing and anchoring, or all other activities undersea or on the seabed. Therefore, when a route is selected that includes sea areas not yet swept for mines, it is necessary to detect mines by a magnetic survey and confirm their locations, and shift the cable route for a safe distance or adopt other construction method than to lay them under the seabed to that the danger can be avoided.

6. ATMOSPHERIC PHENOMENA AND MARINE PHENOMENA

6.1 Atmospheric Phenomena (Wind Weather)

The wind at the Jawa Sea off the south coast of Kalimantan blows during April through November from east-southeast in the western part, from east in the central part, and between east-southeast and southeast in the eastern part. The northwesterly seasonal wind blows between west and west-northwest. The force of the wind is greater than the southeasterly seasonal wind mentioned above and it continues during December through March. There are thunders and squalls during the period when seasonal winds alternate.

Both the seasonal winds at the east coast of Borneo in the Makassar Straits are much weaker than at the Jawa Sea of the south coast of Borneo. Near the coasts of Borneo and Sulawesi sea wind and land wind blow throughout the year. Therefore, the characteristics of local topography and the direction of the coastline affect the force and direction of the wind that blows at the Straits. The land wind blows at 1900 to 0700 local time, and the sea wind at 1000 to 1700 local time. Sometimes the land wind does not blow at the coasts located on the leeward of a strong seasonal wind.

At the south part of the Straits and along the west coast of Sulawesi, the southeasterly seasonal wind starts blowing in April between northeast and southeast. It sometimes becomes calm or changes into a northwest. This unstable weather continues until June, and around this time it starts blowing somewhat regularly from southeast, and sometimes it changes to blow from southwest. During the nighttime in June it blows almost between east and southeast, and sometimes it blows between south and southwest. These seasonal winds create swell and blow in the reverse direction of the stronger south flow, and that causes chopping waves or rough waves.

In September and October winds and waves grow weak, in November the wind direction changes between east and south to west, and in December between southwest and northwest at the south part of the Straits and along the west coast of Sulawesi. But these winds are not sure to blow.

The northwesterly seasonal wind in this area blows most strong in January, and it blows from northwest. Strong squalls, much rain and violent heavy seas occur, but they being calming down in February. In March it becomes a gentle breeze with wind force of about 2, blowing between northwest and northeast, and east. Squalls and thunders occur in December.

December through March seem rainy months, but there are no showers in other months. July through September may be the dry season.

In the north of the Straits the force of the wind is weaker. Seasonal winds from the north and south-southwest are unstable and affected widely by a wind that circulates over the Sulawesi Sea and the Jawa Sea. A change of season is not clear, and it rains much.

In May south-southwest winds start blowing. These winds sometimes change to blow between west and northwest; somewhat easy to change and unstable.

This seasonal wind wanes in October, grows weakest in November, and the direction changes to between north and northeast.

In December winds blow generally from northwest, in January from north, in February winds blow a little stably from north-northeast, and in April the force of the winds wanes and it calms down or blows weakly and changeably.

In the north of the Straits cloudy weather is less than in the south, but rainfall is much more and raining continues long. Rainfall is more on the Borneo side of the Straits than on the Sulawesi side. The rainy season is from November through March, and the dry season is from July through September. Squalls and thunders are rare, but haze is generated.

6.2 Marine Phenomena (Ocean Currents Tides)

The marine flows that run along the south coast of Borneo are mixtures of tides and seasonal wind-caused currents. At high tides the current flows toward the west, and at about low tides it flows toward the east. It is thought that in the period of northwest seasonal wind the east flow becomes superior, and in the period of the southeast seasonal wind the west flow grows superior. The velocity of seasonal wind-caused currents seldom exceed 1 kts.

Ebb and flow at the south coast of Borneo is of diurnal tide, but sometimes a second ebb and flow with very small tidal range occur. In November, December and January a maximum tidal height and in July and August a minimum tidal height are observed.

Ebb and flow at the Makassar Straits is a mixed tide with a superior semidiurnal tide and a diurnal tide except at the southeast part of the Straits. Along the coast of Borneo, this phenomenon is most conspicuous at the south part of the Straits, and along the Sulawesi coast, at the north part of the Straits.

At the south of the Straits flood current flows toward north, and ebb current runs southward. The ocean current at the wide part of the Makassar Straits generally flows southward or southwestward throughout the year. Rarely, not always, at the east of the Straits it flows strongly toward the coast of Sulawesi. The average drift of the current is about 0.8 kts throughout the year, but it differs a little from month to month. The greatest drift of the current registered ever is 2 kts. During the period of the southeast seasonal wind (April through October) the current flows northward to the south of Tg.

Mangkalihat along the entire east coast of Borneo, then changes its direction southeastward and southward to join the regular southward current.

When or after the southeast seasonal wind blows strongly, the drift of the northward current off the mouth of the Balikpapan Bay reaches 1.5 to 2 kts, and the southward current off Pu. Balabalangan Island situated outward to Little Paternoster Island is observed to reach a drift of 2 kts.

At the south of the Straits the drifting direction of the southward current is affected by strong seasonal winds.

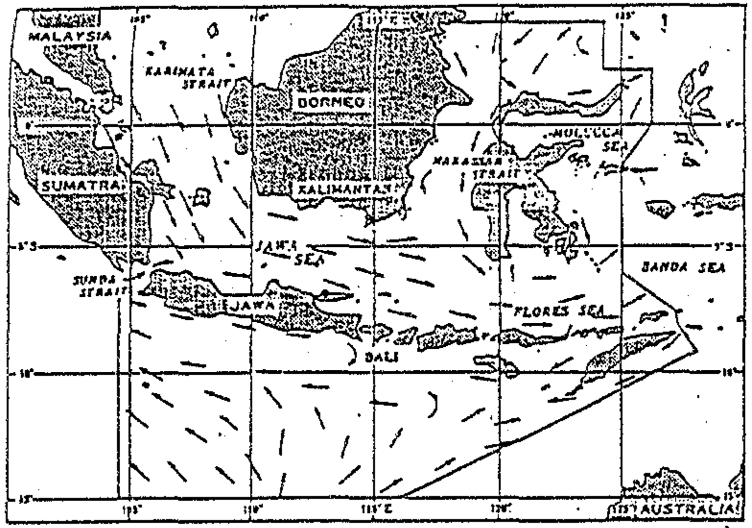
After it continues blowing for a long time, the surface current grows pretty strong, and sometimes the direction becomes against that of a major current. But when the wind calms down, regular current resumes flowing with its speed a little increased, and the drift of this current either increases or decreases with tidal current. Figure 4-4 shows the relationship between seasonal winds and tidal currents.

The temperature of sea water does not differ among times and places, and is in the range of 26 to 28 degrees centigrade. Individual observations in rare cases register more than 30 degrees centigrade or less than 25 degrees centigrade.

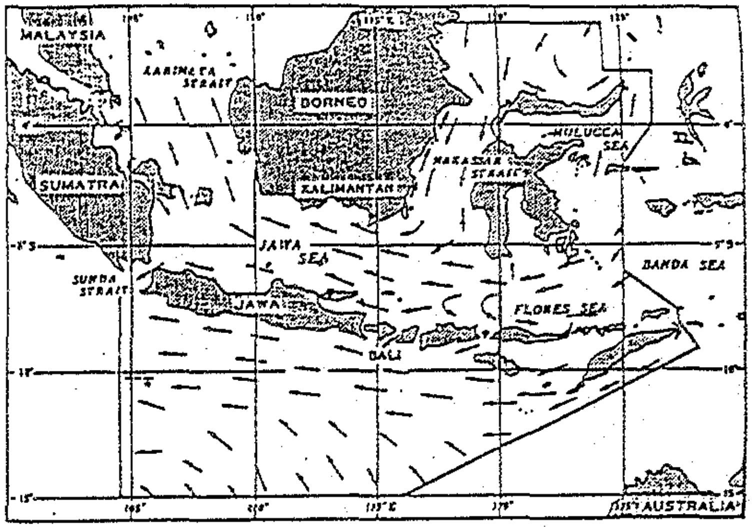
Sea water reaches its maximum temperature in April and May, and its minimum in September.

Between the sea water and the air above the sea surface, the average temperature is usually a little higher for the sea water, but the difference rarely exceeds one degree centigrade. This means that no fog grows in this sea area.

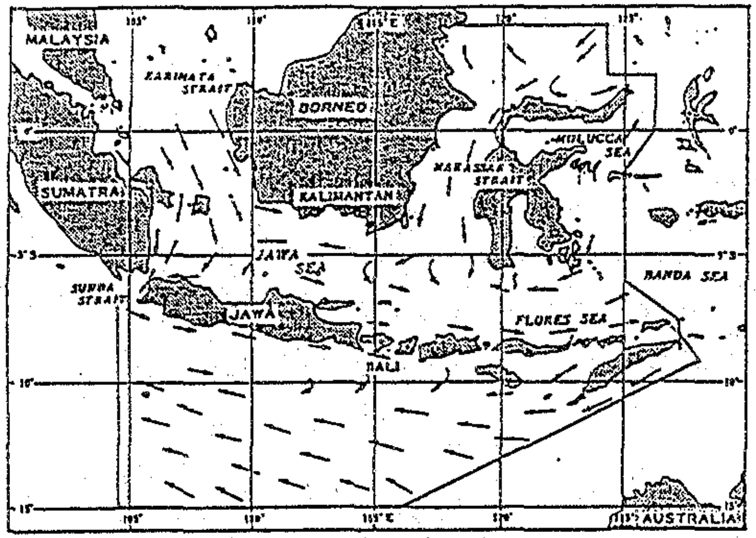
Figure 4-5 shows an outline of the average water surface temperature.



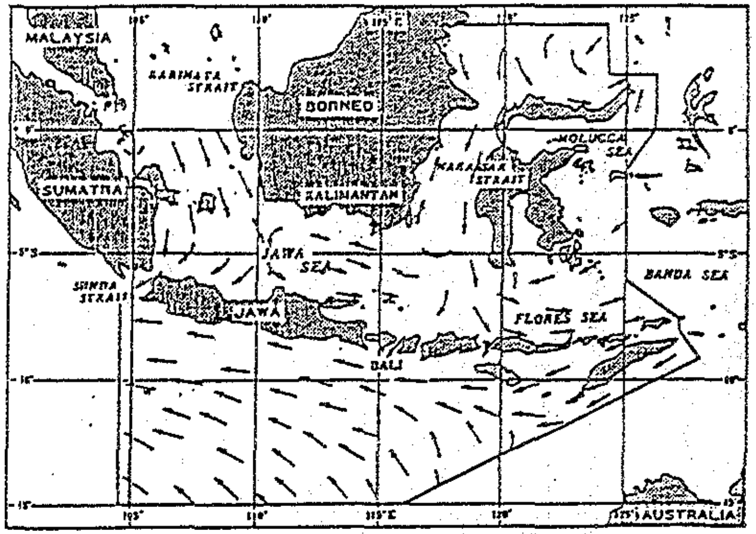
NW Monsoon (February)



SE Monsoon (August)



Monsoon in Transition(April)



Monsoon in Transition(October)

Figure 4-4 General Surface Current Circulation in the Jawa Sea

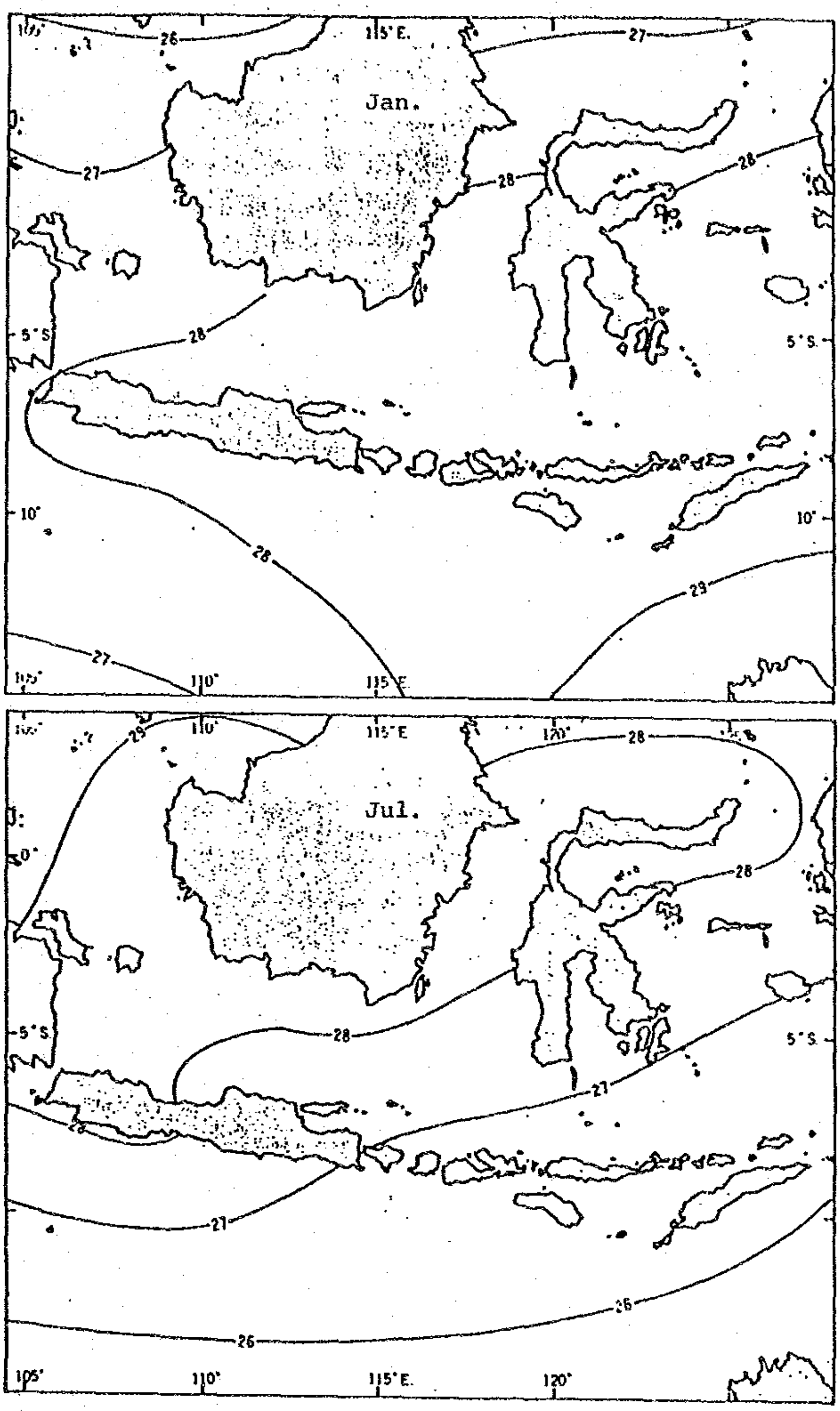


Figure 4-5 Outline of the Average Water Source Temperature

CHAPTER 5 SYSTEM BASIC DESIGN

CHAPTER 5 SYSTEM BASIC DESIGN

1. SUBMARINE CABLE SUBSYSTEM OUTLINE

1.1 Optical Fiber Submarine Cable Development Status-quo

The first generation of optical fiber submarine systems using a 1.3 μm wavelength has been tested for commercial application on a short distance system in several countries from 1985 to 1986. Now this is planned to be applied to long distance systems such as TAT-8 (Trans-Atlantic Cable), or TPC-3 (Trans-Pacific Cable), as an international circuit. The system development of the second generation using a 1.55 μm is also being tested in several developed countries. Compared with the system using a 1.3 μm wavelength, the second generation is expected to have an economical advantage because, here, the repeater spacing is almost doubled. Adopting a 1.55 μm wavelength will cause higher power in semi-conductor laser devices, higher sensitivity in receive devices or lower loss in optical fiber. And, eventually, it will extend the repeating distance. In these countries the second generation is aimed to be developed for practical application after the year 1990.

1.2 Optical Fiber Submarine Cable Features

The optical fiber submarine cable system features:

(1) Very low transmission loss in optical fiber.

(2) Digital signal transmittable at high speed over a long distance.

(3) Large transmission capacity.

(4) Lower installation cost per channel than by traditional coaxial cable system, because the channel capacity per cable is larger, although the installation cost per cable is higher.

(5) More economical even with higher installation cost, because the system lifetime is 25 years.

(6) Future channel expansion feasible because of new technology. The Digital Circuit Multiplexing Equipment (DCME) is now being developed in several countries to facilitate use of telephone channels efficiently, in optical fiber systems for international communication networks.

1.3 Selection in Optical Fiber Submarine Cable Systems

(1) Comparison between (280 Mbps x 1) and (280 Mbps x 2)

Using the demand forecast in Chapter 3, the number of channels needed for this submarine cable system is projected as 3621 telephone channels by the year 2004 and 6516 by 2019. Considering the channel grouping loss, the effective channels of a 280 Mbps optical fiber submarine cable system with a maximum capacity of 3840 channels are estimated at 3400. If a single system is introduced in this submarine cable system, it would be fully occupied by the year 2003. Therefore it would require two systems to accommodate all the channels at the end of its lifetime. The following comparison can be made between two cases when either a single or double 280 Mbps system is introduced at the initial stage.

1) Economical considerations

280 Mbps x 1: Chapter 8 proves that an effeiciency higher than 18% is possible in both F-IRR and E-IRR.

280 Mbps x 2: The initial cost will be 25% higher than that of 280 Mbps x 1. However, the F-IRR (18.21%) and the E-IRR would be higher like 280 Mbps x 1, because the revenue from telephone services will increase after the year 2004. Apparently, there will be excessive channels by the year 2019.

By the result of Economic/Financial Analysis mentioned in Chapter 8, the benefit of (280 Mbps x 1) system and (280 Mbps x 2) system are expected in 1977 and 2001, respectively. And the investment returns of both systems in the end of year 2000 will be:

(280 Mbps x 1): 6100 Million Rp.
(280 Mbps x 2): 5600 Million Rp.

Therefore, (280 Mbps x 1) is regarded as more economical than (280 Mbps x 2) according to the result of the above study.

2) Consideration from the aspect of technology development

At the moment the line speed of the international standard submarine cable system is 280 Mbps. But, the technology of submarine cable is progressing so rapidly that lower-priced cable system with higher speed could be developed in the near future. In these situations, it is not advisable to install a cable system with many surplus circuits to satisfy the demand in the very far future, 25 years later.

3) Consideration on network construction

280 Mbps x 1: In case that this system is applied the overflow traffic is to be divided to another submarine cable system on another route or microwave radio system, since this cable system is full with traffic. With this arrangement, the possibility of complete circuit cut-off on both paths become very small. (Duplex network configuration)

280 Mbps x 2: This system may accommodate more than 6000 channels by the year 2019. Should a cable be cut in this situation, WITEL-X, XI and XII will inevitably be isolated except for the satellite circuits.

With considerations of above items, therefore, (280 Mbps x 1 system) is introduced in the Study. Traffic after the year 2005 is assumed to be split with another submarine cable system, or with a new microwave radio system or other transmission media. Even when the other path is not considered, the available capacity of a preinstalled 280 Mbps x 1/3840-channels system may increase by 4 to 5 times, by applying the Digital Circuit Multiplexing Equipment (DCME) in the future.

(2) Comparison in wavelength between 1.55 μm and 1.3 μm

From the standpoint of repeater spacing, a 1.55 μm wavelength optical fiber submarine cable system would be more economical than with a 1.3 μm wavelength system. However, it is difficult to introduce the 1.55 μm wavelength submarine cable system because it is not a field-proven system, and besides, its cost is still uncertain. Therefore, a 280 Mbps optical fiber submarine cable system with a 1.3 μm wavelength should be applied in the system study. It is also necessary to study the possibility of practical use of the second generation when the System is designed in detail.

2. SUBMARINE CABLE SYSTEM LIFETIME AND RELIABILITY

The long distance system with a maximum of 8000 km, now being developed, is designed to have a lifetime of 25 years. For reliability of the submarine facility which is the main transmission path, the system has also been designed to make repair due to parts failure at less than 3 times within 25 years of lifetime.

Because all the four planned submarine cable routes between Kalimantan and Sulawesi are shorter than 1000 km, the lifetime and reliability of the System would be as follows in comparison with the aforementioned long distance system:

(1) System Lifetime: 25 years

(2) Reliability: Repair due to failure of components, and parts of the system will be less than once in the lifetime.

3. SUBMARINE CABLE SYSTEM CHARACTERISTICS

(1)	Line-bit-rate:	296.6 Mbps
(2)	Channel capacity:	3840/3780* (* denotes non-CEPT/Hybrid hierarchy)
(3)	Wavelength:	1.3 μm
(4)	Repeater spacing:	59.5 km
(5)	Type of fiber:	Single mode
(6)	Light source:	Laser diode
(7)	Light detector:	APD (Avalanche Photo Diode)
(8)	Repeater Supervisory:	Loop back supervisory system
(9)	Power Feeding Current:	1.6 A
(10)	Electrical Signal Interface:	139.264 Mbps (CCITT Rec. G703)
(11)	Average Bit-Error-Rate:	better than 1×10^{-8} < CCITT Rec. G82

4. SAMPLE OF CABLE LANDING STATION

The terminal of the 280 Mbps system mainly consists of a cable terminating, power feeder, multiplexing and supervisory equipment. The equipment required at the optical fiber submarine cable landing station is as shown below.

Table 5-1 Equipment Required

Equipment	Number Required
Optical Fiber Transmission Terminal Equipment	1
Order Wire Equipment	1
Power Feeding Equipment	5
Power Regulator Rack	(1)
Power Monitor Rack	(1)
Load Transfer Rack	(1)
Test Load Rack	(1)
AC/DC Power Unit Rack	(1)
Terminating Equipment	1
Cable Fault Location Test Equipment	1
Supervisory Equipment	1
Supervisory Console	1
Total	11

5. POWER SUPPLY FACILITY

The power supply equipment at each submarine cable landing station will power the submarine repeaters, transmission terminal equipment and other facilities such as air conditioning and lighting. Takisung, selected as a submarine cable landing at the Kalimantan side has also been selected as a landing station for the Surabaya - Banjarmasin Submarine Cable System of which the construction plan is in progress. The power supply facility will have a three-engine generator system of 75 kVA each. This can also cover the consumption of the System. Therefore, only the Rectifier and Storage Battery should be added at Takisung in this project. Other submarine cable landing stations in this project will each have a three-engine generator system of 50 kVA each, a Rectifier and a Storage Battery.

6. EARTHING SYSTEM FOR POWER FEEDER

An optical fiber submarine cable system needs 1.6 A of constant current to operate its repeaters. Also, the power supply equipment needs a stable earthing system around the cable landing station. An earthing resistance of less than 1 ohm is generally required for this. And an automatic switchover equipment is also required for switching over to the station earth should the earthing system fail.

7. SUBMARINE CABLE DESIGN

The System comprises a submarine cable subsystem and two backhaul subsystems.

The submarine cable subsystem is designed as below, using the parameters of the 280 Mbps system. For the subsystem configuration (includes land cable, optical submarine cable, submarine repeaters and cable slack), see Figure 5-1. This configuration considers the following.

(1) The total cable length includes about 1.5% of cable slack and 500 m of land cable between the submarine cable landing station and the cable landing point at each end.

(2) The spacing between two repeaters is set at 59.5 km and the submarine cable landing station to the first repeater at 44.93 km (maximum) including increase in cable loss, due possibly to future repairs. (Refer to Table 5-2.)

(3) For cable protection, the following will be used:

- Double Armored Cable (DA) for up to 20 m depth
- Single Armored Medium Gauge (SA-M) Cable for up to 500 m, and
- Single Armored Light Gauge (SA-L) Cable for up to 1000 m.

Fish-Bite Protected (FBP) Cable, developed for protection against shark's bite will be used for depths of more than 1000 m.

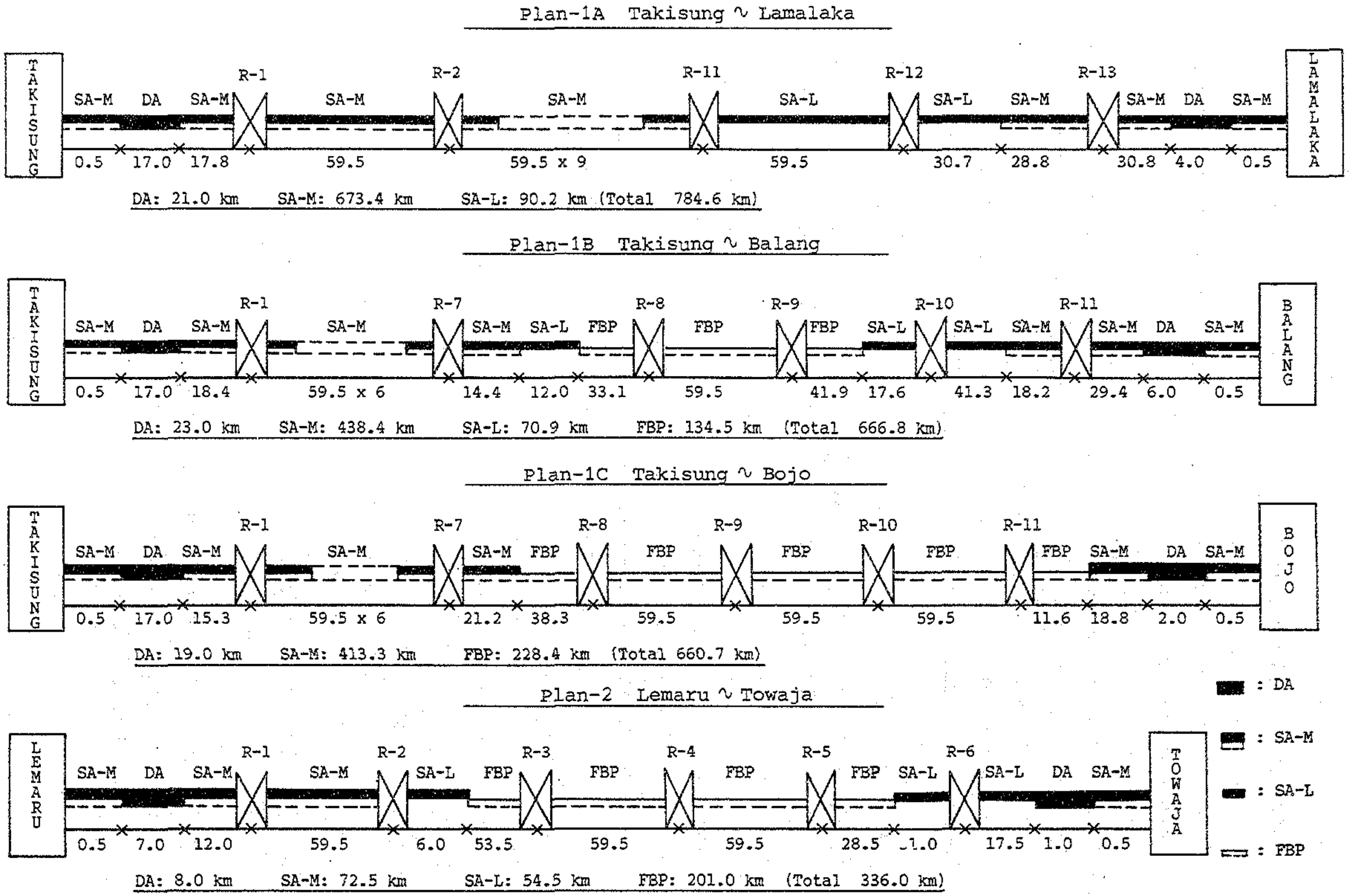


Figure 5-1 Submarine Cable System Configuration

Note: FBP cable coated with aluminum tape to protect optical fiber from shark's bite, will be used for depths of 1000 m to 3000 m.

(4) The loss distribution in the repeater spacing appears in Table 5-2.

Table 5-2 Loss Distribution

<table>
<tr><th colspan="2">Item</th><th>Repeater - Repeater</th><th>Cable Terminal - Repeater</th></tr>
<tr><td colspan="2">Repeater Output Level</td><td>-1.82 dBm</td><td>-1.82 dBm</td></tr>
<tr><td colspan="2">Cable Loss</td><td>23.78 dB</td><td>17.97 dB</td></tr>
<tr><td colspan="2">Fiber Connection Loss</td><td>0.30 dB</td><td>0.30 dB</td></tr>
<tr><td colspan="2">Repeater Input Level</td><td>-36.80 dBm</td><td>-36.60 dBm</td></tr>
<tr><td colspan="2">System Margin</td><td>8.0 dB</td><td>7.2 dB</td></tr>
<tr><td rowspan="5">Contents of System Margin</td><td>Design Error</td><td>1.5 dB</td><td>1.5 dB</td></tr>
<tr><td>Laying Effect</td><td>0.7 dB</td><td>0.5 dB</td></tr>
<tr><td>Cable Loss Deterioration with Time</td><td>2.6 dB</td><td>2.0 dB</td></tr>
<tr><td>Light Source Deterioration with Time (Laser Diode)</td><td>1.5 dB</td><td>1.5 dB</td></tr>
<tr><td>Light Detector Deterioration with Time (Photodiode)</td><td>1.7 dB</td><td>1.7 dB</td></tr>
<tr><td colspan="2">Repair Margin</td><td>2.9 dB</td><td>2.6 dB</td></tr>
<tr><td colspan="2">Loss between Cable Terminal and Repeater</td><td>0 dB</td><td>6.71 dB</td></tr>
<tr><td colspan="2">Cable Section Length</td><td>59.5 km</td><td>49.93 km</td></tr>
</table>

8. SUBMARINE CABLE LAYING

(1) Cable Landing Section (Cable Terminal Equipment to Landing Point)

Single armored cable with protection from external force or human damage will be laid more than 1 m underground. And if the cable is to cross a road, it will be laid through a cable protection conduit.

(2) Very Shallow Sea Section (Landing Point up to 20 m deep)

Double armored cable with protection from human damage or wave force must be used. And the cable at the coast must be laid underground to protect it from position drift or damage. Also, it may be laid with a cast-iron conduit, if required.

(3) Shallow Sea Section (20 to 1000 m deep)

Here, cables laid up to 200 m in depth should be at least 70 cm deep and as deep as possible in the seabed to prevent damage caused by fishing or anchoring. For the cable selection description, refer to Paragraph 3, Section 5.

(4) Deep Sea Section (1000 m or deeper)

In the deep sea section, damage by fishing or anchoring is not expected. The cable for this section is of FBP type with shark's bite protection. However, a lightly armored cable may also be used depending on the condition of the seabed (with rock or other obstacles which might come up later in the ocean survey).

Specific problems of submarine cable laying on each planned route are:

a) In the Takisung area, the seabed is soft with mud or muddy sand, and thus, any cable to be laid up to 200 m deep might need to be buried in the seabed.

b) The sea area 22 km off the shore of the Balang cable landing station about 30 km south from Ujung Pandang has not been swept for mines. Thereore, a magnetic survey should be made around the cable route before the cable laying. Also, a part of the route should be changed to use double armored cable without burying it in the seabed, or to take other precautions if mines are found.

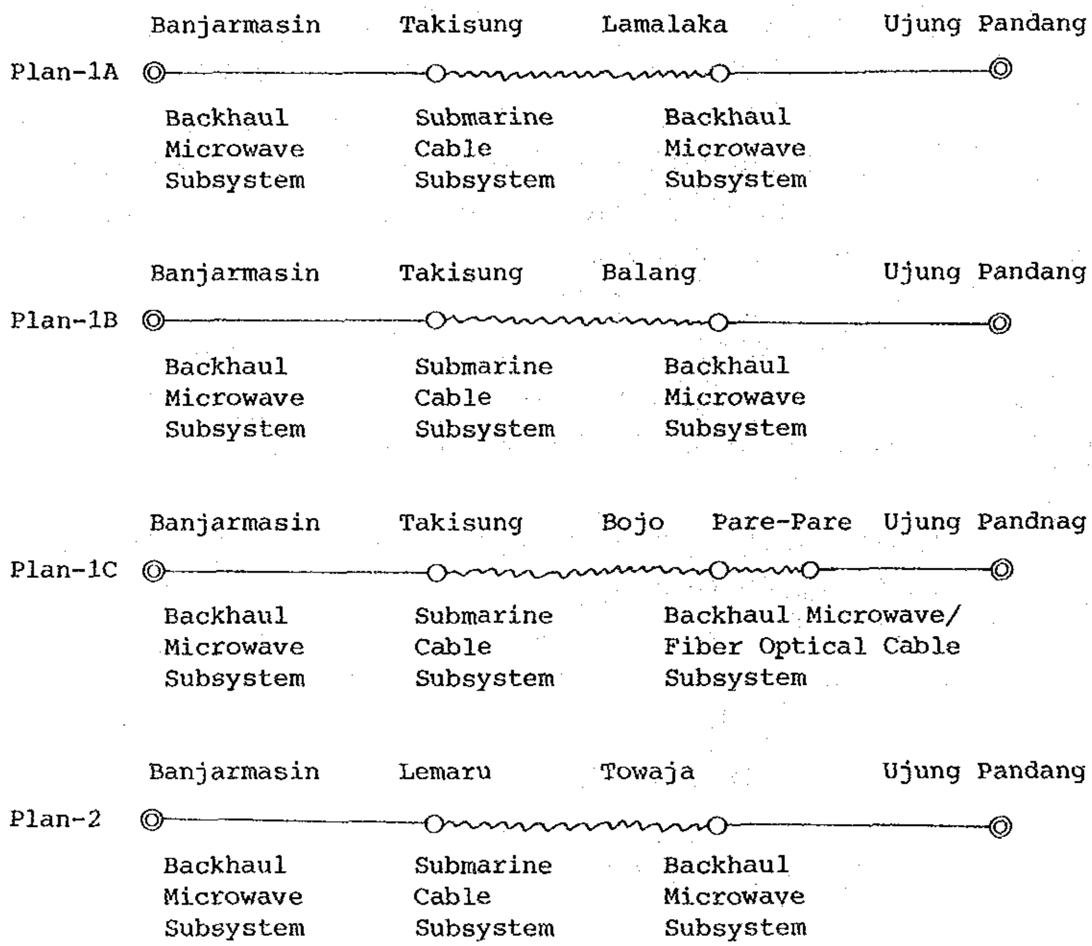
   There is a coral reef area in the front side of the landing station. The cable route selected for it, should have the cable buried in this reef.

c) The seabed on the Lemaru-Towaja submarine cable route in Plan-2 is very steep, with the deepest seabed reaching 2300 m. Therefore, prevention of cable hanging on the rising slope or adequate cable slack adjustment on the falling slope should be considered.

9. SYSTEM OUTLINE FOR EACH ROUTE

9.1 Submarine Cable Route Plan

The System consists of a microwave radio backhaul sub-system on the ground and an optical fiber submarine cable subsystem. Four possible routes planned for this Study are:



An ideal route should be selected from these four routes by studying and comparing the features of each route regarding the economic feasibility, reliability, maintainability, future technical trends and construction safety.

9.2 Cable Length and Submarine Facility for Each Route

(1) Cable Length

The lengths of the submarine cables on each route appear in Table 5-3.

Table 5-3 Cable Length

Plan #	Route	Route Length	Total Length, including Slack (15%)	Distance of Landing Station-Landing Point	Total Length Cables Laid
Plan-1A	Takisung to Lamalaka	772 km	783.6 km	2 x 0.5 km	784.6 km
Plan-1B	Takisung to Balang	656 km	665.8 km	2 x 0.5 km	666.8 km
Plan-1C	Takisung to Bojo	650 km	659.7 km	2 x 0.5 km	660.7 km
Plan-2	Lemaru to Towaja	330 km	335.0 km	2 x 0.5 km	336.0 km

(2) Submarine Facility

The following facilities and materials are required.

The spare materials should be calculated, using the Surabaya - Banjarmasin Submarine Cable Project as reference.

A. Takisung - Lamalaka (Plan-1A)

Table 5-4 (1/4) Submarine Facilities

Item	Main	Spare	Total
Double Armored Cable (DA)	21.0 km	5.0 km	26.0 km
Single Armored Medium Gauge Cable (SA-M)	674.3 km	10.0 km	684.3 km
Single Armored Light Gauge Cable (SA-L)	90.2 km	10.0 km	100.2 km
Fishbite-protected Cable (PBP)	0	0	0
Cable Termination	26	5	31
Joint Box	0	10	10
Transition	0	20	20
Submarine Repeater	13	1	14

B. Takisung - Balang (Plan-1B)

Table 5-4 (2/4) Submarine Facilities

Item	Main	Spare	Total
Double Armored Cable (DA)	23.0 km	5.0 km	28.0 km
Single Armored Medium Gauge Cable (SA-M)	438.4 km	10.0 km	448.4 km
Single Armored Light Gauge Cable (SA-L)	70.9 km	10.0 km	80.9 km
Fishbite-protected Cable (PBP)	134.5 km	10.0 km	144.5 km
Cable Termination	22	5	27
Joint Box	0	10	10
Transition	0	20	20
Submarine Repeater	11	1	12

C. Takisung - Bojo (Plan-1C)

Table 5-4 (3/4) Submarine Facilities

Item	Main	Spare	Total
Double Armored Cable (DA)	19.0 km	5.0 km	24.0 km
Single Armored Medium Gauge Cable (SA-M)	413.3 km	10.0 km	423.3 km
Single Armored Light Gauge Cable (SA-L)	0 km	0 km	0 km
Fishbite-protected Cable (PBP)	228.4 km	10.0 km	238.4 km
Cable Termination	22	5	27
Joint Box	0	10	10
Transition	0	20	20
Submarine Repeater	11	1	12

D. Takisung - Towaja (Plan-2)

Table 5-4 (4/4) Submarine Facilities

Item	Main	Spare	Total
Double Armored Cable (DA)	8.0 km	1.0 km	9.0 km
Single Armored Medium Gauge Cable (SA-M)	72.5 km	10.0 km	82.5 km
Single Armored Light Gauge Cable (SA-L)	54.5 km	10.0 km	64.5 km
Fishbite-protected Cable (PBP)	201.0 km	10.0 km	211.0 km
Cable Termination	12	5	17
Joint Box	0	10	10
Transition	0	20	20
Submarine Repeater	6	1	7

10. BACKHAUL SUBSYSTEM BASIC DESIGN

10.1 Subsystem Concept

A backhaul subsystem with a large capacity is usually constructed with either:

(1) A Digital Microwave Radio System, or

(2) An Optical Fiber Cable System.

The system must be selected with the following conditions considered for each route:

A. Economical Aspect

The "Strategic Development Plan, Indonesia" in Chapter 3 indicates that an optical fiber cable system is more economical than a digital microwave radio system, in distances of up to 50 km. In the Study, however, the two systems were compared with reference to the price of the optical fiber cable system (140 Mbps, GI Multimode, High Grade) now being built in Jakarta City, the result was:

The cheaper the system, the better.

B. Technical Aspect

Two different transmission media, Microwave Radio System and Optical Fiber Cable System, in one backhaul section apparently needs two different types of spares and two different maintenance systems or staff training. Therefore, one transmission media should be selected to minimize on cost.

Following is the outline of both systems:

(1) Digital Microwave Radio System

A. System Configuration

This system consists of a transmitter-receiver equipment, switchover equipment, remote supervisory and control equipment, multiplex terminal equipment, power supply equipment, and antenna and tower. A backhaul subsystem by microwave radio (Plan-1B) is shown in Figure 5-2. Two items of radio equipment with a capacity of 140 Mbps each will be installed initially to cope with the number of circuits required by the year 2019 (see Chapter 3). For the multiplex terminal, 1920 circuits will be initially installed to cope with the required number of channels by the year 1999 (end of the VI-th Five-year Plan). The channels should then be expanded as the demand increases.

B. Radio System Standby Equipment

Two types of standby or protection system are the set-standby and the system-standby. To enhance the reliability, the system standby is introduced. This should protect the circuit from interruption by fading, by equipment failure, during repair or during periodic maintenance. With the system standby, a frequency diversity effect is also expected. For radiowave propagation in the radio relay section where fading is likely to occur, quality degradation can be minimized by adopting compensation techniques such as space diversity or automatic adaptive qualizing.

C. Frequency Plan

Before planning the frequency allocation in the radio system design, the frequency band must first be selected according to:

- . required transmission bandwidth,
- . propagation characteritics,
- . equipment production feasibility, and
- . compatibility with the existing FDM system.

For this project the upper side of 6 GHz will be used. The radio frequency channel allocation (CCIR Rec. 384) appears in Figure 5-3.

When deciding the frequency allocation for each radio relay section, during detailed design, compatibility with the existing eastern microwave radio system, the planned Surabaya-Banjarmasin submarine cable, and the trans-Sulawesi microwave radio systems must be considered.

D. Quality Objectives

CCIR Rec. 594 describes the Bit-Error-Rate in the following operating conditions:

i. The Bit-Error-Rate (BER) of 10^{-3} should not exceed 0.054% of the time in any month. The measurement duration of the BER is 1 second.

ii. The BER of 10^{-6} should not exceed 0.4% of the time in any month. The integration time of the BER is 1 minute.

iii. The Error Second (ES) should not exceed 0.32% of the time in any month.

These are the design objectives of the link. Since the first objective is the most severe, the link should be designed to satisfy the one being studied.

E. Antenna Height

Selecting the propagation path clearance greatly influences the system performance tower height or number of relay paths. Therefore, for clearance, the conditions are:

i. The first fresnel zone radius should not be obstructed for K = 4/3.

ii. The obstructed first fresnel zone radius should be less than 0.3 for K = 2/3.

K: Equivalent Earth Radius Coefficient.

F. Radio Equipment Main Features and Facilities

1) Radio Equipment

a. Frequency Band
6430 to 7110 MHz (CCIR Rec. 384)

b. Transmission Capacity
140 Mbps (equivalent to 1920 telephone channels)

c. Number of Radio Channels
2 + 1 (Regular 2, Protection 1)

d. Modulation System
16QAM

e. Baseband Interface
139.264 Mbps CMI (CCITT Rec. 703)

2) Remote Supervisory and Control

The radio repeater and the submarine cable terminal stations (except Banjarmasin TC and Ujung Pandang TC stations), are basically unattended. It, therefore, requires a remote supervisory and control system that monitors and controls the radio equipment, multiplex terminal equipment and power supply equipment.

3) Multiplex Terminal Equipment

The interface conditions between radio equipment and multiplex terminal station, and between different hierarchy orders of the multiplex equipment are:

a. 4th-Order Digital Multiplexer

Higher Order Bit Rate:	139.264 Mbps (CCITT Rec. G751)
Lower Order Bit Rate:	34.368 Mbps
Multiplication:	4

b. 3rd-Order Digital Multiplexer

Higher Order Bit Rate:	34.368 Mbps (CCITT Rec. G751)
Lower Order Bit Rate:	8.448 Mbps
Multiplication:	4

c. 2nd-Order Digital Multiplexer

Higher Order Bit Rate:	8.448 Mbps (CCITT Rec. G751)
Lower Order Bit Rate:	2.048 Mbps
Multiplication:	4

(2) Optical Fiber Cable System

A. System Configuration

The backhaul subsystem by an optical fiber cable is shown in Figure 5-4. Application of optical fiber cable is classified as:

a. Land Cable (ordinary optical fiber cable)
b. Submarine Cable.

The submarine cable is usually laid at the deep seabottom where it cannot be replaced and it is firmly constructed. Since the initial investment cost of a submarine cable is consequently 2.7 times higher than that of land cable, land cable was decided for use in this study. The cable will be laid in an underground conduit from the submarine cable landing station to the TC exchange or to the repeater station along the road.

The conditions of introducing this cable system is that (1) the foundation of the road is solid, (2) the width of the road is clear, (3) no width expansion in the future, and (4) the road does not have a steep slope or bend.

B. Optical Fiber Cable Features

The optical fiber cable system uses a 140 Mbps system to accommodate the same channel capacity as that of the Backhaul System of the Microwave Radio System.

1) Electrical Interface Conditions

a.	Bit Rate:	139.264 Mbps ±15 ppm
b.	Code:	CMI
c.	Line Impedance:	75 ohm (unbalanced)
d.	Return Loss:	More than 15 dB at 7 to 210 MHz
e.	Pulse Width:	1.0 V(p-p) ±0.1 V at 15 ohm
f.	Pulse Rising Time: (at the output)	Less than 2 ns should be at 10 to 90%
g.	Max. Insertion Loss:	12 dB at 70 MHz

2) Optical Interface Conditions

a.	Bit Rate:	Depends on suppliers' specification
b.	Code:	5B6B
c.	Wavelength:	Short λ = 850 nm Long λ = 1310 nm
d.	Transmission Mode:	Multimode, Singlemode
e.	Light Source:	Multimode GaAlAs-LD Singlemode InGaAsP-LD
f.	Light Detector:	Multimode Si-APD Singlemode Ge-APD

3) Channel Capacity: 1920 CH

10.2 Plan Outline

The backhaul route plans for four (4) submarine cable routes are shown in Figures 5-5 to 5-9. Table 5-5 shows the result of study and comparison of each plan.

The following outlines the plans.

(1) Plan-1A

1) Microwave Radio System

At the Takisung, Karamaian and Banjarmasin stations in the Kalimantan area, the site, the station building, the power supply system, the antenna system and the tower will be provided in the Surabaya - Banjarmasin cable project. Therefore, the radio equipment, its associated switchover control equipment and the multiplex terminal equipment will be provided in this Project. The protection or standby system is for common use. For the power supply system, a rectifier and a storage battery should be added since the engine-generator for the Surabaya - Banjarmasin cable project has enough power consumption capacity for this Project.

In the Sulawesi area, all the routes will be newly installed with a 140 Mbps digital radio system. The access road and the station building at the Tino, Saretene repeater station and the Ujung Pandang terminal station of the Eastern Microwave System can be used.

The Lamalaka station to be installed at the submarine landing point is located about 3 km east of the Bantaeng telephone office, a station branched from the Eastern Microwave Radio Link. And to reduce the number of repeaters, the Lamalaka station will be directly connected to the Tino repeater station at a mountain top without relaying at the Bantaeng microwave station. The tower at the Lamalaka and Saretene stations will be newly installed and the existing tower can be used with reinforcement at the Ujung Pandang and Tino stations.

2) Optical Fiber Cable System

An optical fiber cable system will be introduced only between Lamalaka and Bantaeng, because there is no direct road for cable laying between Lamalaka and Tino. A microwave radio system will still be needed between Bantaeng and Tino. From the standpoint of economy, the microwave radio system will be more suitable if it is used for the whole system, since the existing tower can be used at Bantaeng even though a new tower does not need at Lamalaka.

If the optical fiber cable is used only between Lamalaka and Bantaeng, the cost of cable laying would be high even if the cost for a new tower at Lamalaka is saved.

Hence, the microwave radio system is extremely advantageous and better from the aspect of maintenance.

(2) Plan-1B

1) Microwave Radio System

A plan identical to Plan-1A should be applied to the Kalimantan area and a new repeating section should be built in the Sulawesi area. The Balang station to be installed at the submarine cable landing point is about 28 km south of Ujung Pandang. The propagation path has been selected in the lower layer and route is in parallel to the coast line. Space diversity should be introduced here to improve the circuit quality. (Refer to Figure 5-2.) This plan has the simplest circuit configuration as compared with other backhaul plans. And the system reliability is high because of the short repeating distance.

2) Optical Fiber Cable System

The cable laid along the road will be about 36 km long. The initial installation cost of the optical fiber cable system with the configuration shown in Figure 5-3 will be 60% higher than that of the microwave radio system.

In Plan-1B the microwave radio system is more suitable when the results are compared.

(3) Plan-1C

1) Microwave Radio System

The same plan as in Plan-1A is also applied in the Kalimantan area. In the Sulawesi area, the site, the station building, the tower, antenna system, the power supply system and the protection channel to be built under the Trans-Sulawesi digital microwave project are used in common. However, a new power supply system will be needed at some repeater stations due to lack of capacity in the existing system.

The Bojo submarine cable terminal station is about 9 km south of the Pare-Pare station (telephone office and coaxial cable station). The propagation path is obstructed by a small hill and thus another repeater station is needed between Bojo and Pare-Pare. The link is established from this repeater to the Maloci station of the Trans-Sulawesi microwave route.

2) Optical Fiber Cable Station

The cable laid between Bojo and Pare-Pare will be about 11 km long. This cable system is more economical in cost, as compared with the radio system, since no extra repeater is needed. The Pare-Pare station is also a branching point of the Trans-Sulawesi Microwave route. This microwave route should be used in common from Pare-Pare to Ujung Pandang. With this arrangement, one backhaul section, therefore, contains two different transmission media.

The results of comparison indicate that introduction of the optical fiber cable is advantageous in this section even though it is unfavorable to have two different media for maintenance purposes.

(4) Plan-2

1) Microwave Radio System

In the Kalimantan area, a 2-GHz 34 Mbps system with 480 channels has been installed between Banjarmasin and Balikpapan in another project. In this Study, it is assumed that a 140 Mbps system with 1920-channels in the upper band of 6 GHz will be built, and the existing site, access road and station building will be used to maximum extent. However, the repeater interval of the 2 GHz system is too long (see Figure 5-7), that the 6 GHz system cannot satisfy the required circuit quality and the tower height. A new repeater station should be built within the repeater interval of the 2 GHz system (see Figure 5-6). The Lemaru station to be installed at the submarine cable terminal site is 18 km east-northeast of the Balikpapan radio terminal station. A radio link will be newly established between the two stations.

The Binuang and Tanah Grogot stations under construction in the 2 GHz system each have a self-stand type tower and the other stations with a supported type.

This system features:

- A propagation path in a lower layer of less than 100 m in most of the repeating sections.
- Generally high towers.
- Parabolic antenna mostly of grid type which is light and thus, gets a low wind pressure.

From the study of the tower strength, reflector mounting capacity and mounting position, it is apparent that all the towers must be newly built for this project.

The submarine cable landing point in the Sulawesi area is at Towaja which is about 35 km north-northwest of the Palu telephone office. The nearest communication facility is the planned Tawaeli repeater station on the Palu route of the Trans-Sulawesi microwave radio system. But, to save one repeater, the submarine cable landing station will be directly connected to the Donggala station on the same route. The propagation path of this link will be completely above the sea. To be used in this project, are the radio equipment, the associated switchover control equipment, the multiplex terminal equipment and a part of the power supply system which should be installed or expanded on the Donggala - Ujung Pandang link in the Trans-Sulawesi microwave radio system.

2) Optical Fiber Cable System

The Lemaru - Balikpapan optical fiber cable will be about 23 km long. When the two systems are compared, there is no difference in the initial cost because the optical fiber cable system needs repeaters. However, the microwave radio is easier to maintain. At the Sulawesi side the situation is same as with the Kalimantan side even though an optical fiber cable system is introduced between Towaja and Tawaeri.

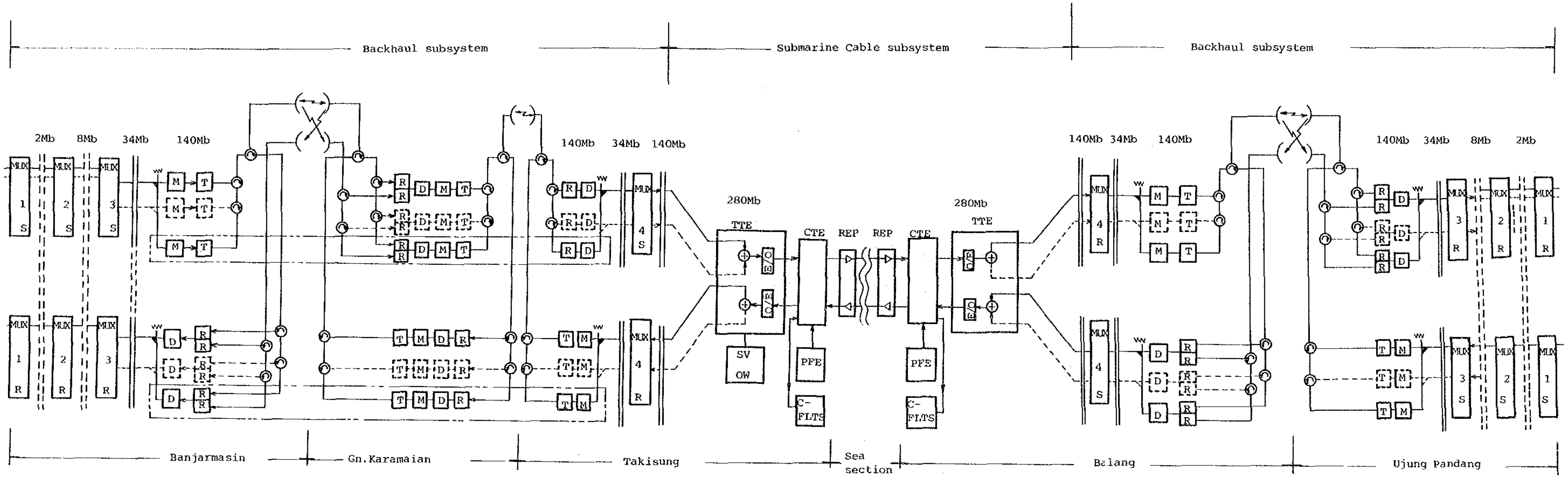
Therefore, a microwave radio backhaul system has been selected for Plan-2.

(5) Plan-2'

As an alternative, Plan-2' is described.

The circuit demand in the year 1999 that is; the final year of the VI-th Five-year Plan is 1969 channels. This period is also the initial investment stage of this project. The demand can be satisfied with only five systems of the existing 2-GHz band 34 Mbps transmission, equivalent to 2400 channels. The protection channel must be shared with the existing system. Although the antenna and power supply systems, may have to be expanded or added, the cost can be minimized at the Kalimantan side as compared with the 6 GHz 140 Mbps backhaul system to be built. However, two 6 GHz 140 Mbps systems must be newly installed in the year 2000 to cover the demand by the year 2019.

In this plan the initial investment can be minimized, but the additional investment cost would go up. Technically Plan-2' can be realized. Therefore, Plan-2 and Plan-2' are compared in Chapter 8 for economic advantages. Consequently, Plan-2 is more advantageous.



T: Transmitter
R: Receiver
M: Modulator
D: Demodulator

MUX: Multiplexing equipment
S: Send side
R: Receiving side

-(Parabolic antenna

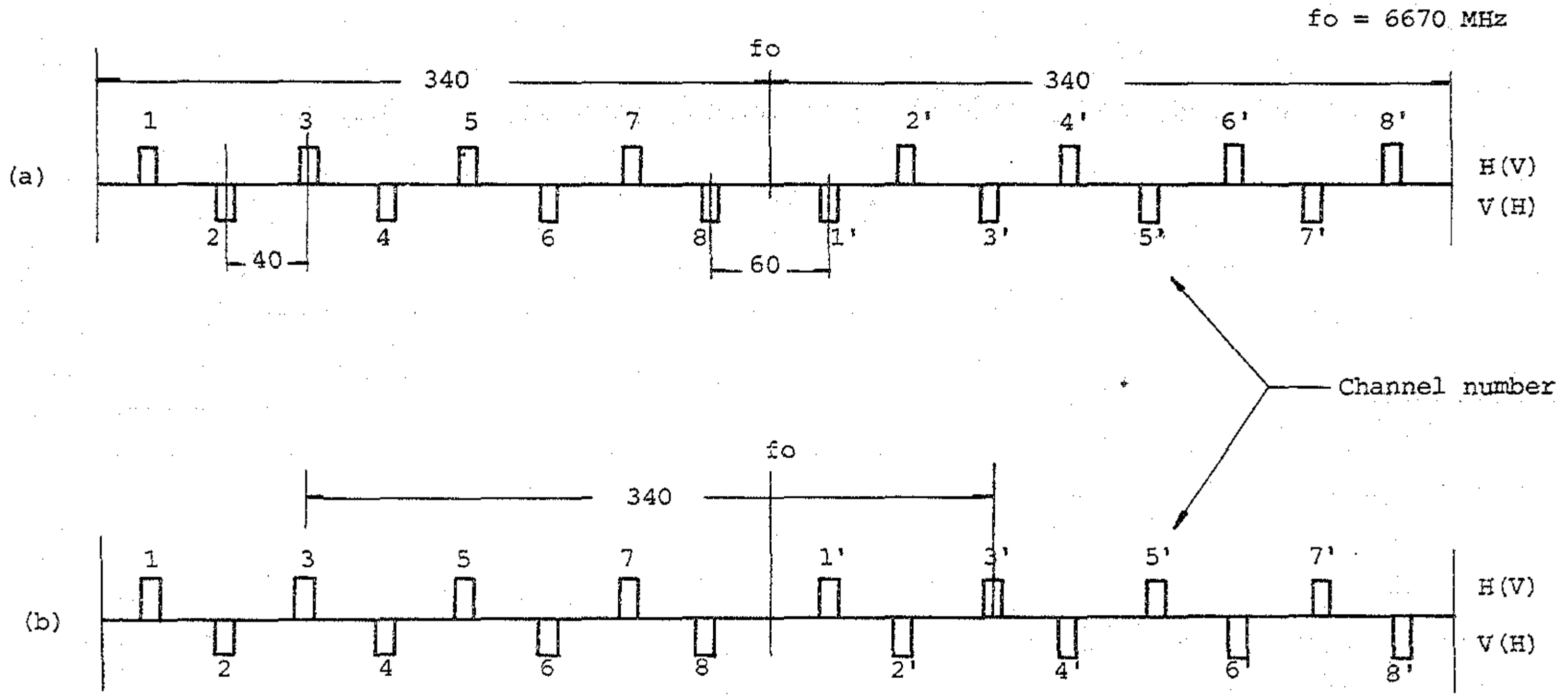
Circulator/branching filter

RF channel switching equipment

Note: Equipment surrounded by chain line show protection system provided by Surabaya-Banjarmasin Submarine Cable System.

TTE: Transmission Terminal Equipment
CTE: Cable Termination Equipment
SV: Supervisory
OW: Order Wire
PFE: Power Feed Equipment
C-FLTS: Cable Fault Localization Test Set
REP: Repeater

Figure 5-2 Plan-1B System Configuration for the Kalimantan-Sulawesi Submarine Cable System



(a) Channel arrangement for antennas with double polarization

(b) Channel arrangement for antennas with single polarization
(All frequencies are in MHz)

Figure 5-3 Frequency Plan for Backhaul System (CCIR Rec 384-4)

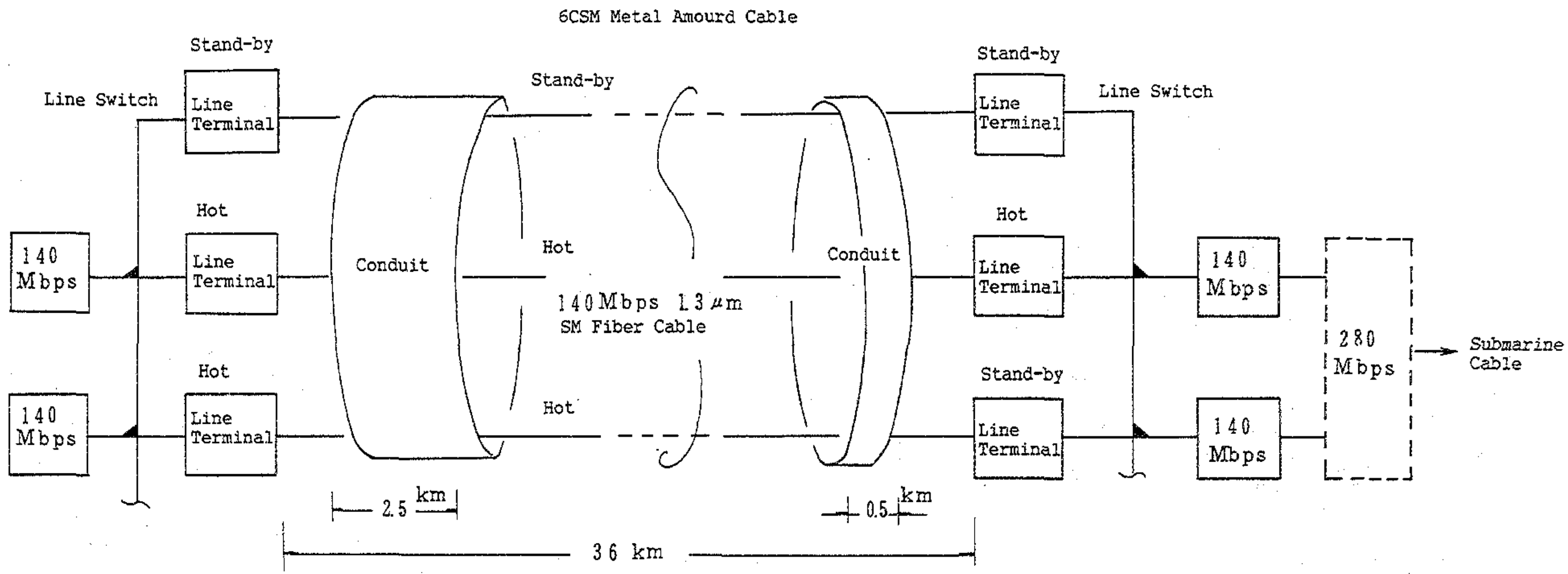


Figure 5-4 Backhaul System with Optical Fiber Cable System

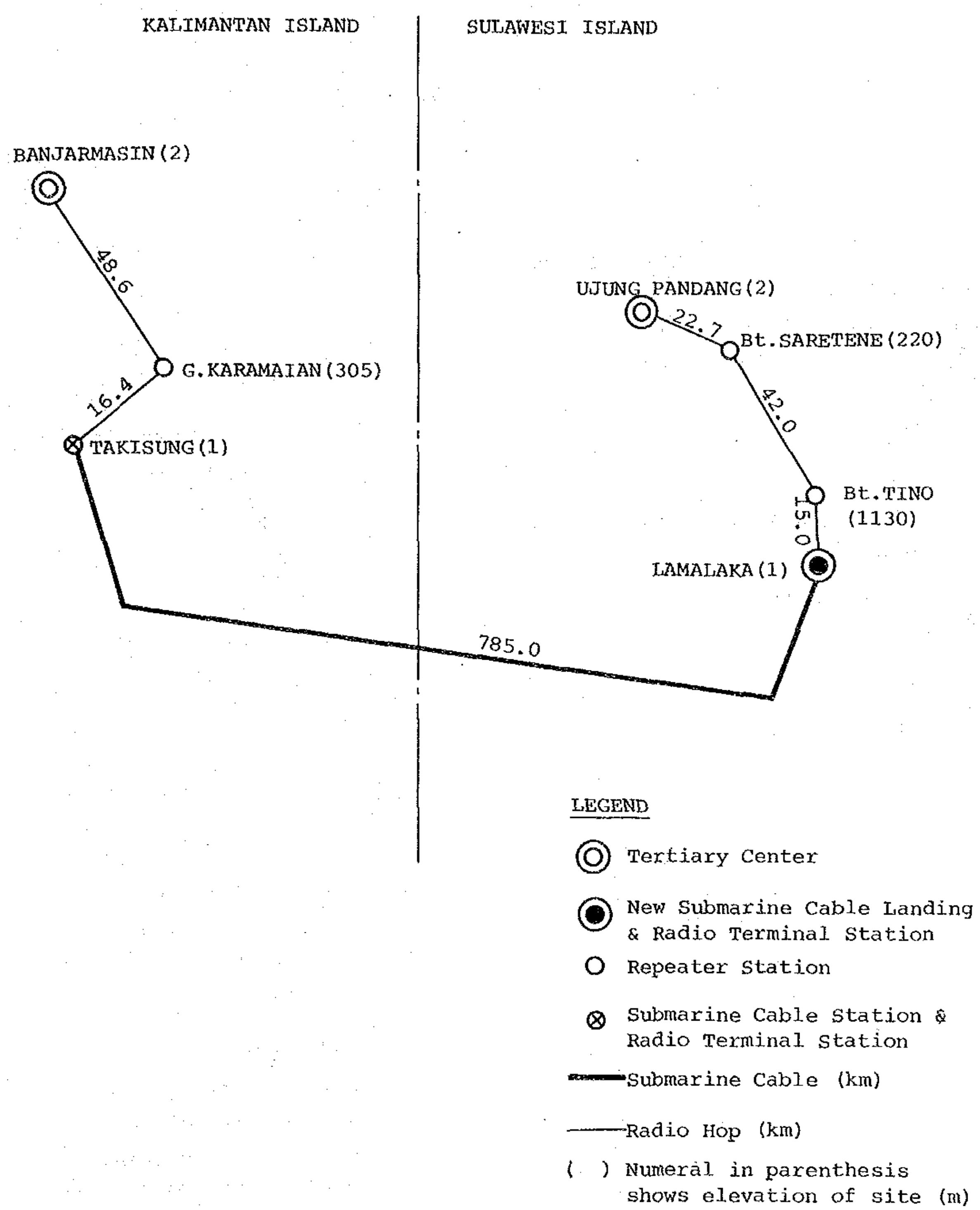


Figure 5-5 Route Map for Plan-1A

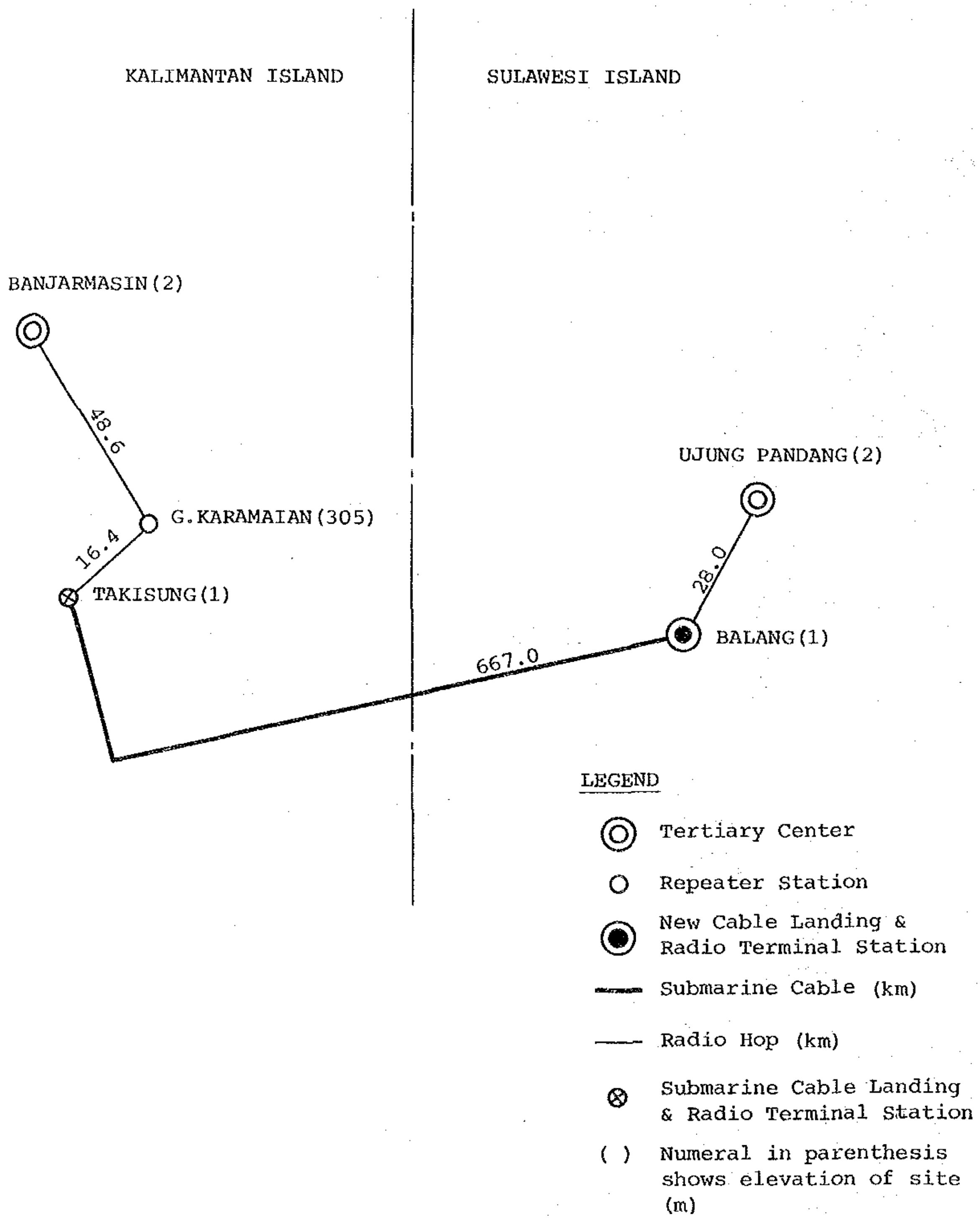


Figure 5-6 Route Map for Plan-1B

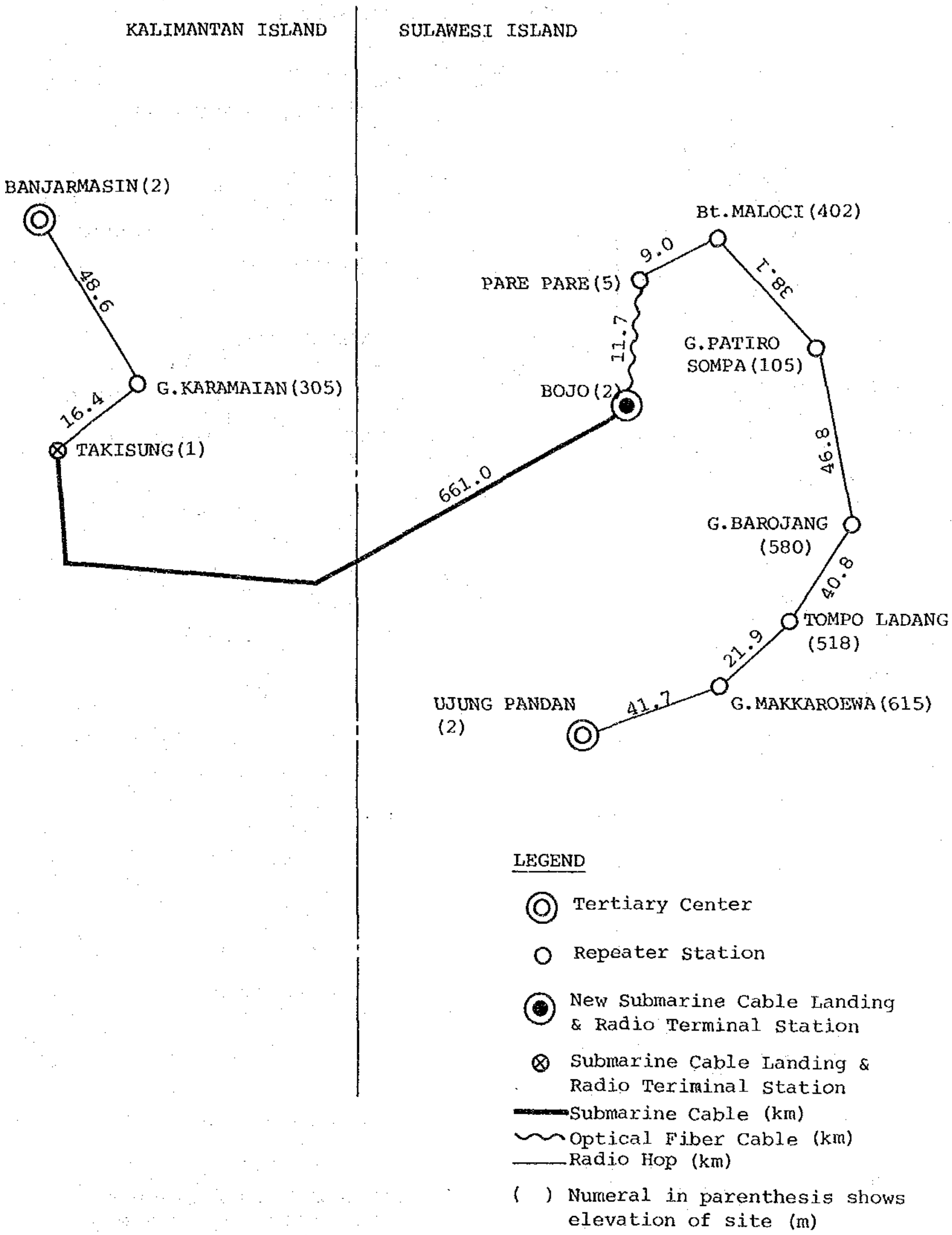


Figure 5-7 Route Map for Plan-1C

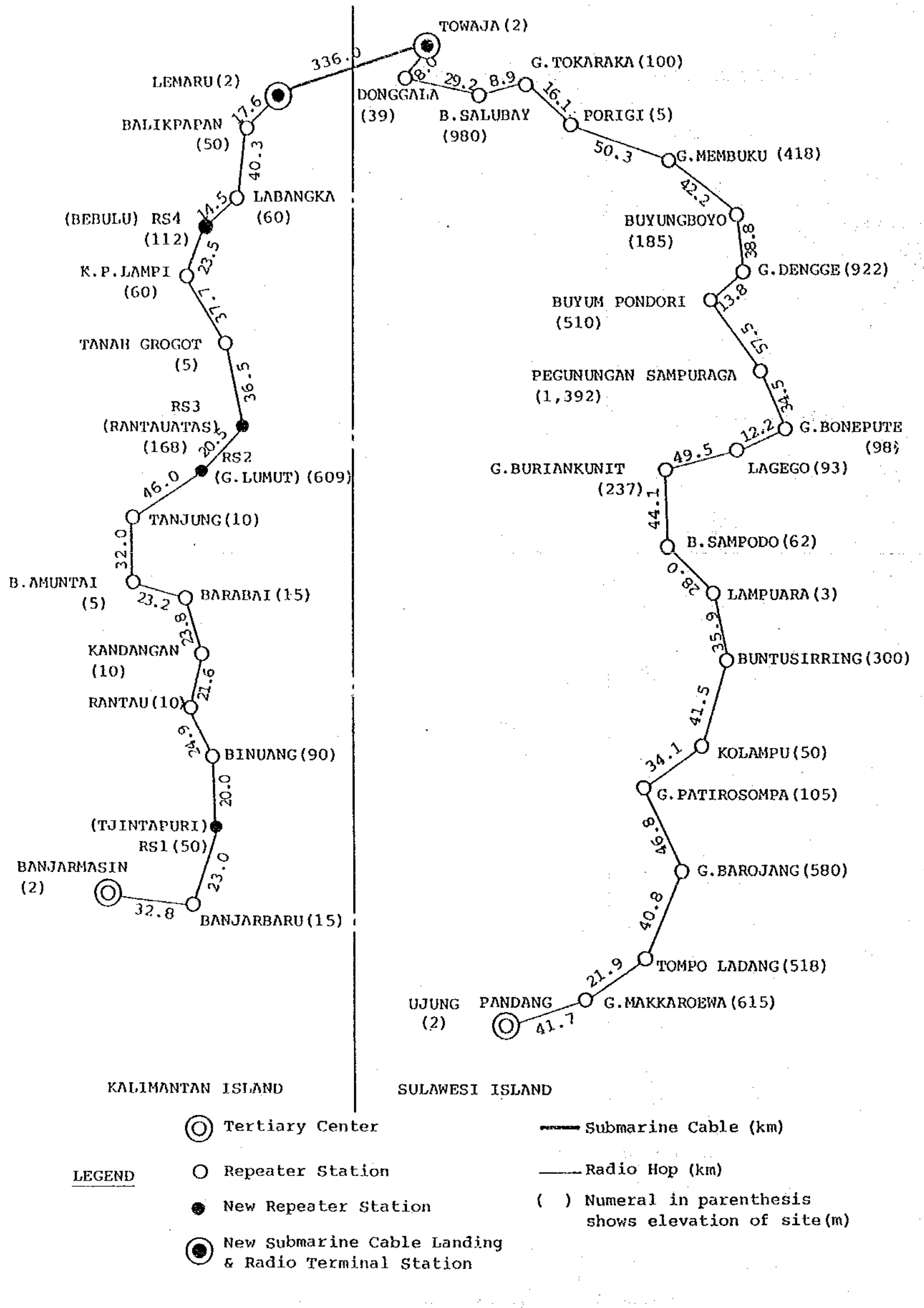


Figure 5-8 Route Map for Plan-2

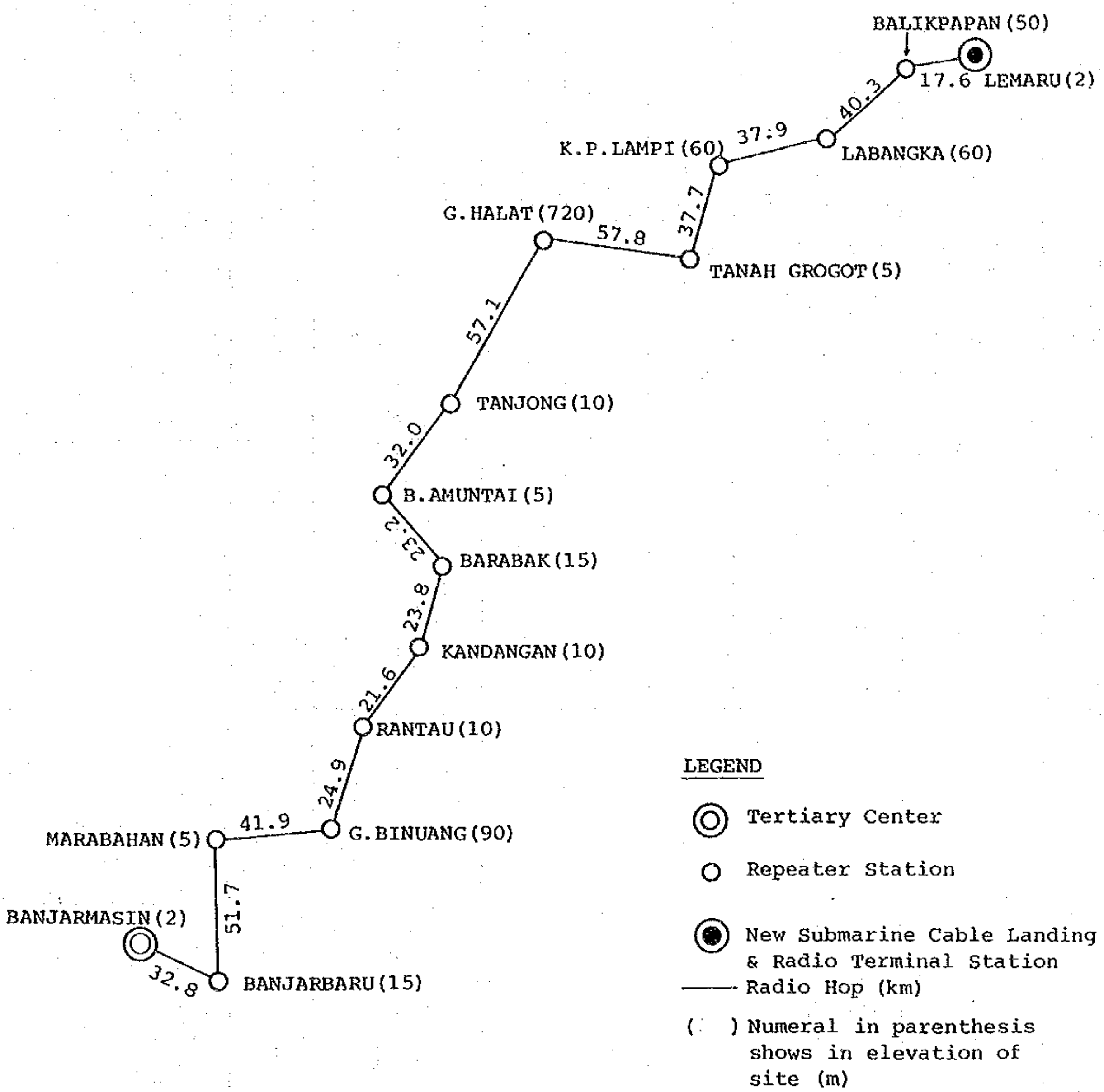


Figure 5-9 Route Map for 2 GHz/34 Mb System Between Banjarmasin - Balikpapan in Kalimantan (Other projects going on)

Table 5-5 Backhaul System Plan Comparison

Plan		No. of HOP	No. of Station	No. of New Station	No. of New Tower	Acess Road		Site Arrangement	Station Building	Route Distance	
						New Road	Repair			Each Route	Overall
1A	K	2	3	0	0	0	0	0	0	65	145
	S	3	4	1	2	0.2	0	2500	240	80	
1B	K	2	3	0	0	0	0	0	0	65	93
	S	1	2	1	1	0.5	3.0	2500	240	28	
1C	K	2	3	0	0	0	0	0	0	65	276
	S	7	8	1	0	0.2	0	2500	240	211	
2	K	16	17	5	16	8.2	1.0	4900	720	438	1134
	S	21	22	1	1	0.5	0	2500	240	696	

K: Kalimantan Side
S: Sulawesi Side

CHAPTER 6 OPTIMUM SUBMARINE CABLE ROUTE SELECTION

CHAPTER 6 OPTIMUM SUBMARINE CABLE ROUTE SELECTION

1. OPTIMUM ROUTE REQUIREMENTS

1.1 Proposed Routes

Following are the routes examined for the planned submarine cable system between Kalimantan and Sulawesi.

Plan-1A: Banjarmasin - Bantaeng Route

Plan-1B: Banjarmasin - Ujung Pandang Route

Plan-1C: Banjarmasin - Pare Pare Route

Plan-2: Balikpapan - Palu Route

Each location appears in the map of the beginning page of this report.

1.2 Requirements to be Examined

For ocean conditions nearby the planned submarine cable routes, the following requirements were compared and examined.

1.2.1 Selection of Suitable Landing Sites

Selecting suitable landing sitse for submarine cables must be conducted taking into consideration routing plans for toll transmission lines in the future and plans for local economic development, not to speak of the geographical conditions.

Requirements for submarine cable landing sites are usually as follows:

(1) Conditions of the seaside from standpoint of geography

1) The cable laying distance can be as short as possible. And short distance between the gateway station and the landing station is also preferable.

2) There are no rocky reefs, it is not shallow to an extreme distance, and the depth is not growing sharply.

3) Wind and wave are relatively calm throughout the year.

4) Long-shore currents are weak throughout the year.

5) There is a sandy beach where cable landing work is available.

6) There is not much shore drift sand, earthquakes, tidal waves and floods are hard to occur, and there is not much chemical substance like hydrogen sulfide that does harm to cables.

7) There are no other facilities or landing sites for seabed equipment (electric power cables, water pipes, oil pipes and so on) nearby.

8) No mouths of big rivers are nearby.

9) There is a lot available nearby to set up a building for landing cables on, or to build poles and land marks for them on. And the lot can be bought up or used.

10) No railway lines, roads, wharfs or piers cross a cable.

11) Construction of protective facilities (conduit lines) for cables is easy.

12) There is no fear of moving a cable and its facilities in the future by reason of plans for water control, embankments, harbor improvement, seabed dredging and so on.

13) There are roads available to carry in construction materials and equipment.

14) Maintenance workers' living is convenient.

15) Highly reliable transmission lines to connect from the landing station to transmission trunk lines are easily available or can be constructed.

(2) Conditions of fishing activities and shipping activities from the standpoint of artificially

1) Ships do not anchor nearby.

2) There is no problems in laying cables and their maintenance in respect to general fishing activities (fishing bases, fishing grounds, fishing seasons, number of fishing boats and so on).

3) There are no problems in respect to fishing techniques (fishing method, fishing gear, equipment of fishing boats and so on).

Preliminary map studies have been carried out on two areas (Banjarmasin and Balikpapan) on the Kalimantan side and four areas (Bantaeng, Balang, Pare Pare, and Palu) on the Sulawesi side as proposed landing sites for this submarine cable system. Data and information have been collected, and field investigations have been conducted in each area. And based on the requirements for the submarine cable landing site, the following proposed sites have been selected in each area.

Plan-1A:	Banjarmasin (Takisung)	-	Bantaeng (Lamalaka)
Plan-1B:	Banjarmasin (Takisung)	-	Ujung Pandang (Balang)
Plan-1C:	Banjarmasin (Takisung)	-	Pare Pare (Bojo)
Plan-2:	Balikpapan (Lemaru)	-	Palu (Towaja)

*( ) shows landing points.

1.2.2 Selection of Submarine Cable Routes

Requirements for a submarine cable route are generally as follows:

1) The cable laying distance should be as short as possible.

2) Unevenness on the seabed should not be much, and the depth should be great.

3) To keep away from coral reefs and roughness on rocky beds.

4) Seabed should be of sand and mud so that cables can be laid under it.

5) The slope of seabed should not be as steep as more than 30 degrees.

6) Tidal currents should not be fast.

7) To keep away from structures on the seabed.

8) To avoid perilous sea area (mines, active faults and so on).

Taking these requirements into consideration, the routes for this plan have been selected.

Figure 6-1 shows the planned routes. The detailed locations of these routes are shown in Volume II, Annex IV, Item 6.

1.2.3 Backhaul System Requirements

A. System Length

The same requirements as for submarine cables apply.

B. Existing Transmission Facilities

If part or all of the existing transmission facilities can be used, the construction cost can be minimized, and maintenance and operation expenses can be shared.

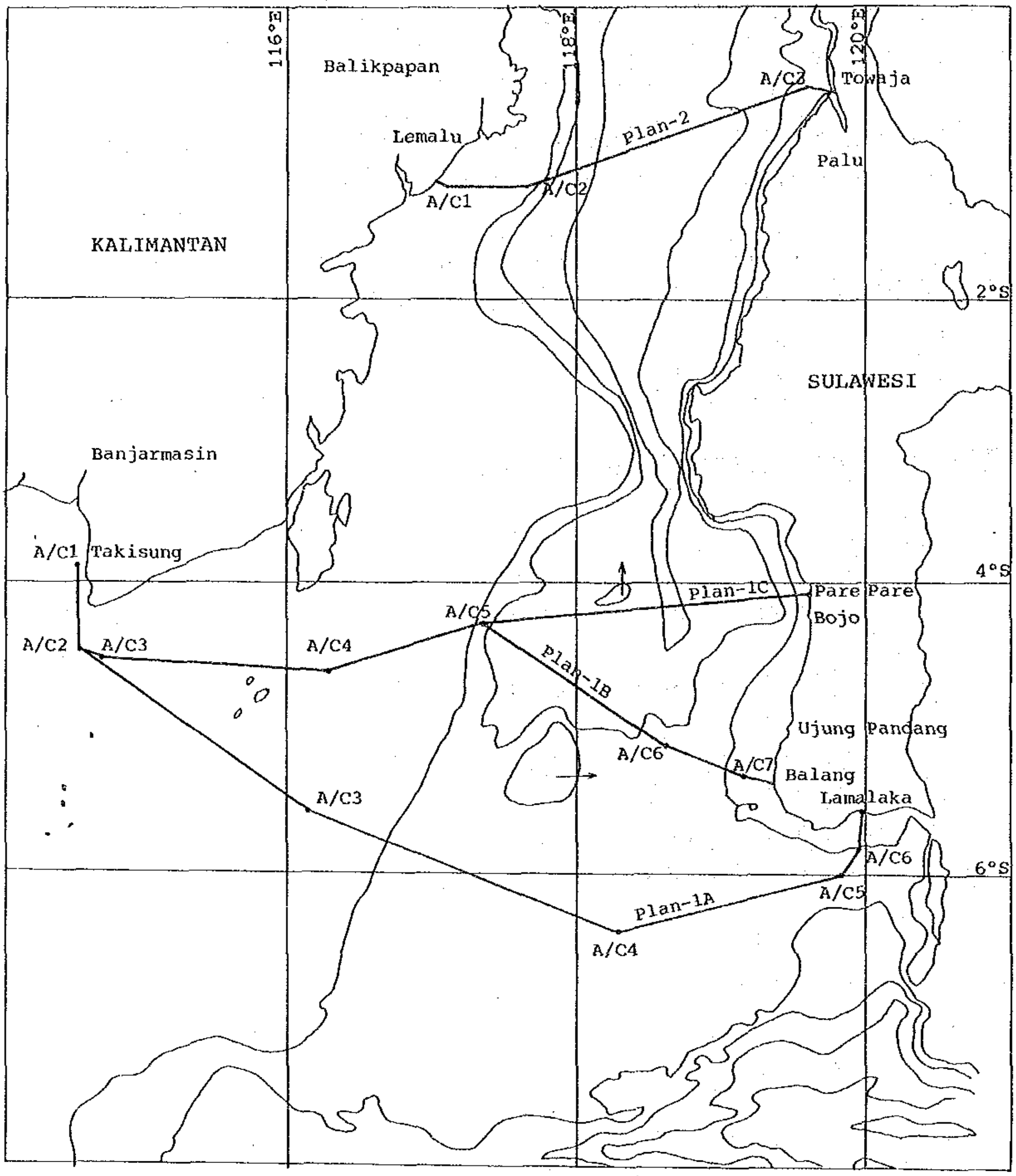


Figure 6-1 Route Plan

2. OCEAN CONDITIONS OF EACH ROUTE

(1) Plan-1A:

Banjarmasin (Takisung) - Bantaeng (Lamalaka)

The landing site on the Kalimantan side is Takisung located 60 km from Banjarmasin.

Since Takisung has already been appointed as the landing site on the Kalimantan side on the submarine cable construction plan to connect Surabaya with Banjarmasin that was started in 1986, it has been selected again for the landing site on this submarine cable construction plan to connect Banjarmasin with Ujung Pandang.

As coconut trees that lie down with their roots washed by waves are often seen, the coast line in this neighborhood is eroded. It is necessary to take countermeasures such as laying cables along the seashore deep under the ground in order not to be washed out or move around. There is much accumulated sand on the shore, and the range of tide is 2.60 m.

This planned route proceeds more southward than the Surabaya - Banjarmasin route, and it reaches A/C1 at 17 km from the starting point. The depth of water is about 20 m at A/C1. The seabed is even and the slope between these points is about 1/1000. It is about 5 km from the Surabaya - Banjarmasin route at A/C1. The seabed is mainly sand on the seashore and the mixture of mud increases the further it goes into the offing.

At 57 km from A/C1, in the direction of 180 degrees, it reaches A/C2 at a water depth of 27 m. The running distance is 74 km. Muddy sand increases on the seabed. At about 6 km from A/C1 an oil development mining area begins. The distance of the Plan-1A route in the mining area is about 239 km.

At 218 km from A/C2, in the direction of 125 degrees, it reaches A/C3 at a depth of 60 m. The running distance is 292 km. The seabed between these points is growing sand. And the seabed topography is even with a slope of 1/3000.

At 242 km from A/C3, in the direction of 110 degrees, it reaches A/C4 at a depth of 400 m. The running distance is 534 km. Between these points is a low ground with a water depth of 656 m. The maximum slope in this low ground is 1/23. The seabed is muddy sand. And apparently, along the outer edge of the continental shelf are unconfirmed coral reefs. Thus, this needs to be inspected fully.

At 181 km from A/C4, in the direction of 77.5 degrees, it reaches A/C5 at a water depth of 469 m. The running distance is 715 km. Between these points is hollow with a maximum water depth of 934 m. This is the deepest spot of the route. The seabed slope is 1/54.

At 19 km from A/C5, in the direction of 35 degrees, it reaches A/C6 at a depth of 300 m. The running distance is 734 km. From A/C5 starts a rising slope with a maximum gradient of about 1/100.

At 38 km from A/C6, it reaches the landing site of Bantaeng. The running distance is 772 km. The seabed slope is 1/14. On the seabed, rocks seem exposed up to about 20 m of water depth from the shore line. The selected landing point is located at Lamalaka about 3 km to the east of the Perumtel Office. Houses stand roof-by-roof along the road. Conglomerates are exposed in places on the seashore around there, and not much sand is accumulated. The bank is protected on some shore line and the shore is eroding. The range of tide at 1.8 m, is smaller than on the Kalimantan side. And there is no perilous sea areas with mines and habor facilities around there.

Bantaeng is about 80km southeast of Ujung Pandang, and is relatively a large town. The microwave circuit that connects Ujung Pandang to the east of Indonesia branches out to Bantaeng, and a main trunk road leads into Bantaeng from Ujung Pandang.

(2) Plan-1B:

Banjarmasin (Takisung) - Ujung Pandang (Balang)

The landing site on the Kalimantan side is Takisung, the same place as in Plan-1A. The planned route branches from A/C2 of Plan-1A. At 20 km from A/C2, in the direction of 124 degrees, the route reaches A/C3 at a water depth of 29 m. The running distance is 94 km. The seabed topography is flat, and the seabed is of mud mixed with mud.

At 179 km from A/C3, in the direction of 91.5 degrees, it reaches A/C4 at a depth of 47 m. The running distance is 273 km. The seabed is flat, and is of sand mixed with mud.

The distance the planned route passes through an oil development mining area is 232 km.

At 179 km from A/C4, in the direction of 72.0 degrees, it reaches A/C5 at a depth of 200 m. The running distance is 396 km. Since new coral reefs are now between these points, there apparently will be other unconfirmed coral reefs. Therefore an investigation is required. The seabed is sandy.

At a distance of 168 km from A/C5, in the direction of 125.5 degrees, it reaches A/C6 at a depth of 650 m. The running distance is 634 km. Between these points is a low ground with a depth of 1911 m, the maximum sea depth on the route. The slope of the seabed is 1/12.

At a distance of 70 km from A/C6, in the direction of 112 degrees, it reaches A/C7 at a depth of 40 m. The running distance is 634 km. Between these points the seabed topography is a rising gradient of about 1/20.

At a distance of 22 km from A/C7, it reaches the landing site. This section is a mine-perilous sea area, and it is necessary to inspect it for mines to secure the cable burying work. And as there are coral reefs nearby, it also needs to be inspected carefully for coral reefs. The seabed seems dandy.

The seashore of the landing site is an extremely vast sandy beach. Coastal currents seem weak because scattered coral reefs exist. Apparently, there is not so much drift sand. The range of tide is 1.8 m.

Balang that is a proposed landing point is situated about 30 km to the south of Ujung Pandang. It can be reached through an unpaved road from a main trunk road. The distance is about 14 km. Automobiles can run on the road.

Balang is a fishing village with a little more than 50 houses, and there are no telephone lines and commercial power source. Also, there are no harbor facilities nearby.

(3) Plan-1C:

Banjarmasin (Takisung) - Pare Pare (Bojo)

The site on the Kalimantan side is Takisung, the same place as in Plan-1A and 1B. The planned route is branched from A/C5 of Plan-1B.

At a distance of 254 km from A/C5, the route reaches the landing site of Pare Pare. The running distance is 650 km. This section has a low ground at 136 km from A/C5 with a depth of 2333 m, the greatest of the route. The seabed slope is 1/12. From this hollow to the landing site is a rising gradient. The outside of Bojo Bay where the landing site is located is a steep gradient of 1/4. The seabed seems to be of sand mixed with mud.

Bojo, selected for the landing site, is located 5 km to the south of Pare Pare Harbor. The seabed around the landing site is of sand, but it seems that rocks are exposed in places and not much sand is accumulated. Coastal currents seem strong and drift sand seems to be much, because the water depth is greatly out of the bay. The range of tide is 1.8 m.

There is a main, paved trunk road in parallel with the shoreline, and between the seashore and road stand houses roof-by-roof. About 1 km southward from the landing site, a fishing activity is carried out, using a Bagan mode of bamboo. And near there, mangroves grow thick.

There is a salt field in the north side of the landing site and salt is being produced.

There are no mine-dangerous sea areas.

(4) Plan-2:

Balikpapan (Lemaru) - Palu (Towaja)

The proposed landing site Lemaru on the Kalimantan side is situated about 20 km to the north of Balikpapan. The vicinity of the landing site is about 1.3 km away from a main trunk road, and there are several private houses. But there are no commercial power source and telephone lines.

The seashore in this neighborhood is a shoaling beach. The coast line is, as the coconut trees fell because their roots were washed by the wave, being eroded. The range of tide is 2.8 m. On the north side of this vicinity, mangroves grow thick. There is the mouth of a relatively large river 3 km to the south, and outflowing clasitics is much. The north side of the mouth is a sea bathing place. The seabed nearby the landing site is of sand, and it accumulates thinly on coral limestone.

About 3 nm off the coast are Bagans, and fishing activities are thriving.

Oil developing is also brisk in the offing, and the distance of the planned route passing the developing oil mining area is about 85 km.

The planned route reaches A/C1 of 20 m water depth at 7 km away, in the direction of 112 degrees. The seabed of this section is flat, and sandy.

At a distance of 72 km from A/C1, in the direction of 90 degrees, the route reaches A/C2 of 200 meters water depth. The running distance is 79 km. The seabed topography of this section is a falling gradient of 1/1120. The seabed is of sand mixed with mud.

At a distance of 232 km from A/C2, in the direction of 70 degrees, it reaches A/C3 of 730 meters depth. The running distance is 311 km.

In this section the route crosses the Makassar Straits. The maximum depth of sea water is 2300 m, and the seabed slope is 1/16. The seabed seems to be of mud mised with sand.

It reaches the proposed landing site on the Sulawesi side, Towaja, at a distance of 19 km from A/C3. The running distance is 330 km. One kilometer from the coast line is a slope 1/2 that of the greatest seabed incline of the four planned routes. The seabed of coastline is of gravel mixed with sand, and the diameter of th gravel is 10 to 20 cm. The coast line is being eroded near the site and coconut trees lie down with their roots washed by waves. The range of tide is 2.40 m.

The proposed site for the station building is in a coconut palm field located 4.0 m above sea level, about 500 m toward the site from a main road.

The proposed landing site Towaja is at the mouth of Palu Bay 33 km northwest of Palu City.

Palu Bay was formed by a collapse during an earthquake. At the mouth of the bay, a topographical rise exists, the top of which has a water depth of 36 m. The difference in relative height is about 700 m. At the recess of the bay, there are many rivers and the supply of outflow clastics is large. Also, there are many harbor facilities and many ships at anchor.

3. ECONOMICAL AND FINANCIAL COMPARISON

Although the optimum submarine cable route is to be mainly selected by the aforementioned requirements, the economical effect and financial effect for each proposed route are also to be compared.

4. EVALUATION METHOD FOR EACH EXAMINATION ITEM

4.1 Criteria for Evaluation

The proposed submarine cbale routes were evaluated from:

A. System Reliability

In both the submarine subsystem and the backhaul system, the shorter the system distance, the better its reliability. Here the depth of the sea, the inclination of seabed, earthquakes, the fishing activity, and the harbor facilities are among the factors that influence the reliability.

B. Maintenance

In a submarine cable subsystem, most maintenance is on both terminal stations, regardless of its system distance. Thus, there is no difference between routes. But in a backhaul subsystem, the maintenance at intermediate repeater stations increases according to system distance. Therefore, the shorter the distance, the easier the maintenance. Also, because maintenance of power supply equipment takes a longer time as compard with other communications equipment, the existence of commercial power source influences the maintenance.

C. Construction Work Feasibility

Marine conditions that greatly influence the feasibility of construction work include:

. Mines, coral reefs, submarine oil excavating fields, sea depth and seabed inclination, and

- Requirements for landing sites, such as the existence of sandy beaches, sites for buildings, road access and connections, and commercial power source.

D. System Economy

For economy of the system, the initial investment cost, the extent of social influence of the project and the economic effect are evaluated as important factors.

E. Ways to Effectively Use Existing Facilities

To minimize the construction cost, existing facilities must be used, if possible. But, if the need for new facilities or equipment is likely to arise in the future, use of the existing facilities alone relative to the initial investment is not reasonable for evaluating the system economy.

4.2 Evaluation and Grading

In comparing each submarine cable route on the items listed in Item 1 above, the following criteria were adopted:

(1) Regarding marine conditions, landing site requirements, submarine cable requirements and backhaul system requirements, if there are shortcomings, these would be hard to consider as grave defects because:

- Concernign requirements, e.g. about earthquake, the probability of occurrence is a major point, and
- Consequent danger can be avoided by shifting the route slightly, as in mine-unswept sea areas, or by changing the construction method.

Therefore, for each item, 1 refers to "no problem", and 0 to "undesirable".

(2) For economic comparison, merits are clearly shown by numerical values. And the revenue from this submarine cable system is the same as with any of the proposed routes. Therefore, less establishing cost is better.

(3) In the evaluation method above, an ideal or best route gets a full mark of 24 points for technical requirements and 12 points for Financial/Economic comparison.

5. SUBMARINE CABLE ROUTE COMPARISON

A summary appraisal list of the proposed routes is shown in Table 6-1 (1/2), and the points each route got in the comparison made according to the evaluation criteria specified in Item 2 above is shown in Table 6-1 (2/2).

For details of each route relative to each requirement, refer to the chapters listed below.

Marine Conditions:	Chapter 4 (Marine Conditions of Each Route)
Requirements for Landing Sites:	Chapter 4 (Marine Conditions of Each Route)
Submarine Cables System:	Chapter 5 (System Basic Plan)
Backhaul System:	Chapter 5 (System Basic Plan)
Economic Comparison:	Chapter 8 (Financial, Economic Analysis)

Table 6-1 (1/3) Submarine Cable Routes
Summary Evaluation Table

	Plan-1A	Plan-1B	Plan-1C	Plan-2
Landing Site Requirements	9	11	8	7
Planned Route	4	4	5	5
BH System	1	1	2	1
Total Technical Points	14	16	15	13
(Technical Evaluation)	(3)	(1)	(2)	(4)
Financial, Economic Comparison	5	12	6	0
Evaluation	3	1	2	4

Table 6-1 (2/3) Route Evaluation from Economic/
Financial Aspect

	Plan-1A	Plan-1B	Plan-1C	Plan-2
FIRR/EIRR	1	3	2	0
Initial Investment	1	3	2	0
Additional Investment	2	3	1	0
Investment Return Period	1 (1999)	3 (1998)	1 (1999)	0 (2000)
(Total Evaluation)	5	12	6	0
Evaluation	3	1	2	4

Table 6-1 (3/3) Submarine Cable Route Evaluation

Proposed Landing Site Comparison

	Plan-1A				Plan-1B		Plan-1C		Plan-2			
	Takisung		Lamalaka		Balang		Bojo		Lemaru		Towaja	
Sandy Beach	1	Much sand accumulation	0	Thinly accumulated plumstone	1	Much sand accumulation	0	Exposed rock bed	0	Exposed rock bed	0	Pebbly beach, not much sand
Drift Sand	0	Much	0	Much	1	No drift sand	0	Much	0	Much	0	Much
Harbor Facility	1	Nil more than 50 km away	1	Nil more than 50 km away	1	Nil more than 20 km away	1	Nil about 5 km away	1	Nil more than 20 km away	1	Nil more than 20 km away
Site for Buildings	1	Yes	0	Narrow	1	Yes	0	Narrow	1	Yes	1	Yes
Roads Condition	1	Paved road	1		1	Unpaved road	1	Paved road	1	Unpaved roads	0	About 0.5 km to a road
Dwelling Environment	1	Not extremely bad	1	Not extremely bad	1	Not extremely bad	1	Not extremely bad	1	Not extremely bad	1	Not extremely bad
Commercial Power Source	0	Unstable	1	Yes	0	Nil	0	Yes, unstable	0	Nil	0	Nil
Total	(9)				(11)		(8)		(7)			

Planned Route Comparison

	Plan-1A		Plan-1B		Plan-1C		Plan-2	
Horizontal Distance	0	772.0 km	0	656.0 km	0	650.0 km	1	330.0 km
Mine-perilous Sea Area	1	---	0	22 km	1	---	1	---
Coral Reefs	0	Yes	0	Yes	0	Yes	1	Nil
Oil Development	0	239 km	0	232 km	0	232 km	0	85 km, in operation
Sea Depth	0	934.0 m	1	1911.0 M	1	2333.0 m	1	2300.0 m
Seabed Inclination	1	1/14	1	1/12	1	1/4	0	1/2
Fishing Activities	1	Small-scaled	1	Same as left	1	Same as left	1	Same as left
Earthquake	1	Not many	1	Same as left	1	Same as left	0	Many, Fault Zone
Total	(4)		(4)		(5)		(5)	

Backhaul System Comparison

	Plan-1A		Plan-1B		Plan-1C		Plan-2	
System Length	1	145 km	1	93 km	1	267 km	0	1134 km
Existing Facilities	0	JA-KAL System Nothing on Up Side	0	Same as left	1	JA-KAL System TR.Sulawesi M/W	1	BJM-BLK M/W TR. Sulawesi M/W
Total	(1)		(1)		(2)		(1)	

6. OPTIMUM ROUTE SELECTED

For the route of the Kalimantan - Sulawesi Submarine Cable System, Plan-1B (Takisung : Banjarmasin - Balang : Ujung Pandang) would be ideal.

The submarine conditions along this route were concluded from marine charts and statistical data and not from actual field observation.

In particular, regarding coral reefs, the route was decided to run along a route with minimum influence of coral reefs as shown on the charts.

Some change in the cable route however, might be made depending on results of an ocean survey in the future. And, as the Plan-1B route runs the mine-unswept area near Ujung Pandang, it is recommended that a magnetic survey be made to check for mines and to confirm their locations before laying the submarine cables.

CHAPTER 7 PROJECT IMPLEMENTATION PLAN

CHAPTER 7 PROJECT IMPLEMENTATION PLAN

1. PROJECT IMPLEMENTATION GUIDELINE

1.1 Contractor

This project comprises oceanic and land portions; neither of which has any existence value independently. Simultaneous completion of the two portions is indispensable and technical interface conditions must be guaranteed. Therefore, the whole system works should be on a turn-key basis to be done by one contractor.

1.2 Consultant

To expedite this project, it is recommended that an experienced consultant be hired. Such a consultant must be able to accept full responsibility and must be able to work harmoniously, with local consultants, by transfer of the required technology, as much as possible.

1.3 Construction Schedule

This project is positioned in the V-th Five-year Telecommunications Development Plan (REPELITA-V). Therefore, this project must be completed by the end of 1993.

1.4 Local Material Procurement

For this project, it is recommended that depending on the quality and quantity requirements, the products, materials, and raw materials be locally procured whenever feasible.

1.5 Operation and Maintenance Technical Assistance

It is recommended that the contractor of this project assign several competent engineers to PERUMTEL for one year to provide technical assistance in operation and maintenance.

2. PROJECT EXECUTION RESPONSIBILITY

2.1 Indonesian Side Executive Organization

PERUMTEL will be respnosible for the execution and administration of this project, under control of the POSTEL (Ministry of Tourism, Posts and Telecommunications).

2.2 Contractor's Responsibility

(1) Detailed design of entire system,

(2) Production and shipment of materials and equipment and works,

(3) Provision and presentation for approval of necessary documents, data, specifications, and drawings,

(4) Inspection of materials and equipment at the factory,

(5) Execution of works

(6) Training of PERUMTEL engineers and technicians, and

(7) Technical assistance on operation and maintenance.

2.3 Consultant and PERUMTEL Responsibilities

(1) Design of system and preparation of specifications for bidding,

(2) Review and screening of bidders and contract negotiations,

(3) Witnessing at inspection and testing in the factory,

(4) Review and approval of documents presented by the contractor,

(5) Control and administration of works execution, and

(6) Witnessing for receiving inspection at sites.

3. IMPLEMENTATION SCHEDULE

The proposed implementation schedule (see Table 7-1) is as summarized below:

- The feasibility study (includes Ocean Survey) will be completed in 1988,
- The loan agreement and the consultant will be determined in 1989,
- The contractor will be determined in 1990, and
- The materials and equipment will be produced, and the works will be implemented from 1991 to 1991.
- After 1993, service will start and in 1993 technical assistance will be provided for operation and maintenance.

Table 7-1 Implementation Time Schedule

Item / Year	1989				1990				1991				1992				1993				1994			
Quarterly	I	II	III	IV	I	II	III	IV	I	II	III	IV	I	II	III	IV	I	II	III	IV	I	II	III	IV
1. Conclusion of Loan Agreement			▼																					
2. Approval of Consultant Contract				▼																				
3. System Design, Survey and Preparation of Tender Document					━																			
4. Bidding and Evaluation						━	━																	
5. Approval of Suppliers Contract								━																
6. Equipment Manufacturing (Includes Detailed Design and Survey)								━	━	━	━	━	━											
7. Shipment and Installation									▽ 1st Shipping	━	━	━	━	━										
8. Approval of Test																━								
9. Service-in																	▼							
10. Assistant Service for Operation and Maintenance																	━	━	━	━				
11. Building Construction by PERUMTEL								━	━															

4. PROJECT COST ESTIMATE

4.1 Initial Investment

The initial investment for each proposed route of this submarine cable project (Chapter 4) is as shown in Table 7-2. Plan-2' in this Table refers to use of the existing facilities (executed by France), to the possible maximum extent for the Kalimantan-side backhaul system.

Exchange Rate: ¥1 = 14.4 Rp. was adopted according to the exchange rate US$1 = ¥145, US$1 = 1,650 Rp. This was the actual value in October 1987.

4.2 Additional Investment

This project comprises a submarine cable portion and a backhaul portion. The years of life for the backhaul portion are set at 15 years (years of life for the submarine cable - 25 years). Therefore, renewed investment for the backhaul portion is needed.

The initial capacity for the submarine cable is 280 Mbit/s, but 140 Mbit/s is for the backhaul, because the earlier investment had to be decreased. Accordingly, any increase in traffic would require an investment for expansion of the multiplexer in 1998. And because of this, an additional investment for each of the proposed routes was calculated as in Table 7-3, and the operational schedule of the backhaul system for each proposed route was set as in Figure 7-1.

Also, the renewal investment was estimated, subtracting the expenses for infrastructure such as steel towers, offices, and roads from the earlier investment.

Additionally, in Plan-2' the existing facilities considered for use in the renewal investment were inspected at both the Kalimantan and Sulawesi sides.

4.3 Operating Expenses

These expenses represent the ones involved in operation and maintenance with and without personnel services. Here, however, they are calculated with the formula - (equipment cost) x (operational expenses rate). Assuming two percent for operational expense rate of the submarine cable system, and six percent for the backhaul operational expenses rate, the operational expenses rate for each proposed route averaged from the equipment cost in both systems is as follows:

Plan-1A	2.3%
Plan-1B	2.3%
Plan-1C	2.5%
Plan-2	4.0%

The investment amount for expansion is smaller than that of the initial investment. Thus, this will not affect the equipment cost rate. And the rate is considered to be constant during the project period. Therefore, the operational expenses for each proposed route will be:

Plan-1A	2536 (million Rp/year)
Plan-1B	2142 (million Rp/year)
Plan-1C	2396 (million Rp/year)
Plan-2	4422 (million Rp/year)

In Plan-2', the operation and maintenance are considered to be same as those in Plan-2. Although the existing facilities are to be used, the operational expenses for Plan-2 were applied as they are.

Table 7-2 Cable Route Capital Costs Estimates

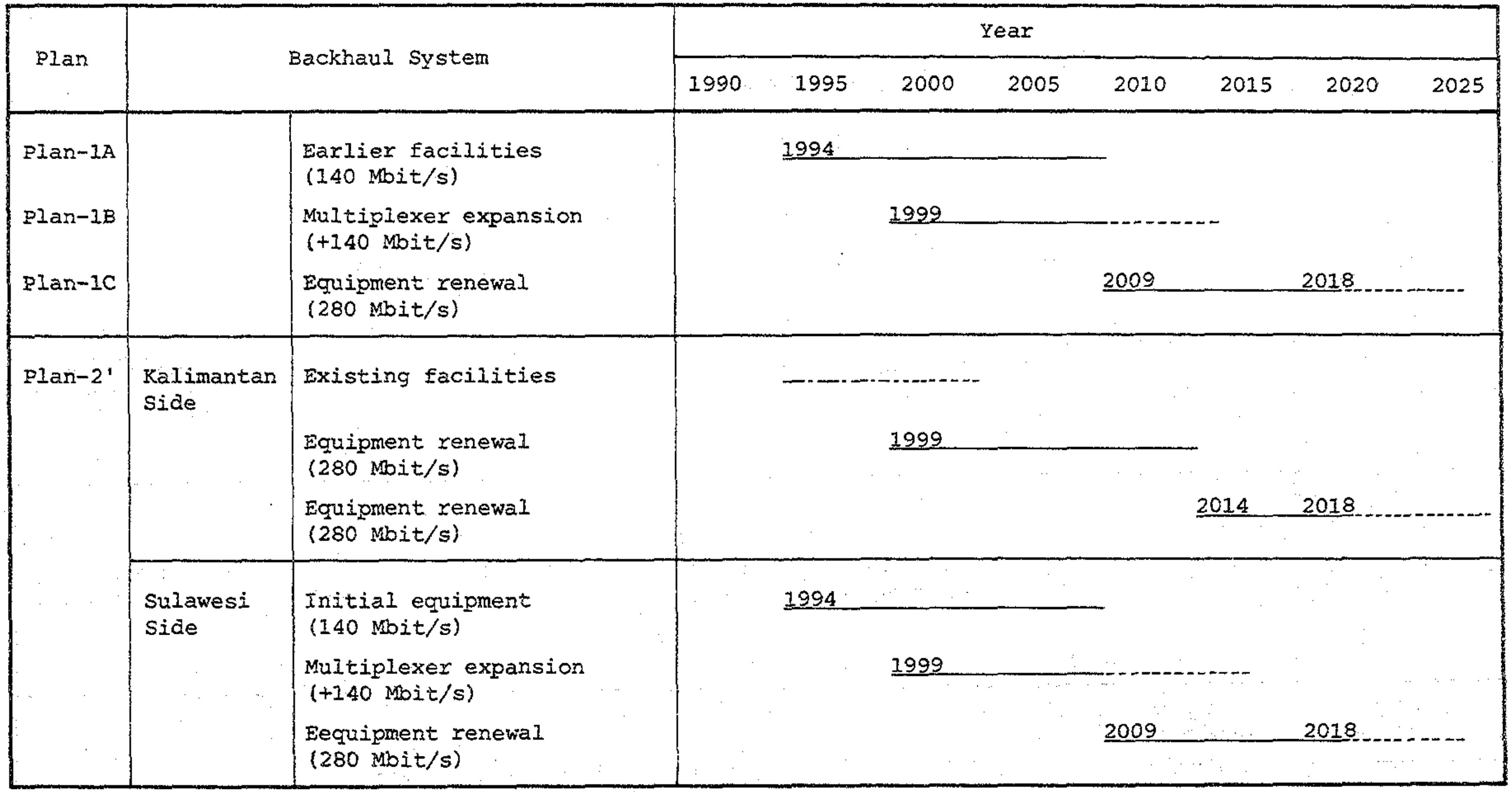
	Plan-1A		Plan-1B		Plan-1C		Plan-2	
	F/P Mill.¥	L/P Mill.Rp	F/P Mill.¥	L/P Mill.Rp	F/P Mill.¥	L/P Mill.Rp	F/P Mill.¥	L/P Mill.Rp
1. Equipment								
(1) Submarine Cable	5853	0	4997	0	4822	0	3112	0
(2) Microwave	513	0	361	0	666	0	3060	0
(3) Power Supply Equipment	160	0	160	0	160	0	160	0
(4) Training	65	348	65	348	65	348	65	348
(5) Assistant Service for Operation and Maintenance	62	206	62	206	62	206	62	206
(Subtotal - ①)	6653	554	5645	554	5775	554	6459	554
(6) Freight and Insurance	281	0	243	0	243	0	278	0
(Subtotal - ②)	6934	554	5888	554	6018	554	6737	554
2. Installation								
(1) Submarine Cable	1705	216	1408	179	1348	171	754	96
(2) Microwave	124	388	87	274	145	445	821	2554
(3) Site Preparation	0	376	0	536	0	1163	0	2861
(Subtotal - ③)	8763	1534	7383	1543	7511	2333	8315	6065
3. Consultant Fee	368	321	310	322	315	487	349	1267
4. Contingency	365	146	308	147	313	223	346	579
5. Total (③ + 3 + 4)	9496	2001	8001	2012	8139	3043	9010	7911

Exchange Rate 1$ = Rp.1650 = ¥145 (¥1 = Rp.11.4) at October, 1987

Table 7-3 Additional Investment for Each Route

(Million Rp)

	Plan-1A	Plan-1B	Plan-1C	Plan-2	Plan-2'	
					Kalimantan Side	Sulawesi Side
Expansion Investment	1998: 342	Same as at left	Same as at left	Same as at left	--	1998: 342
Renewal Investment	2008: 7036	2008: 5050	2008: 9327	2008: 38,760	1998: 19,746 2013: 19,404	2008: 19,699



———: Operational period, -------: Remaining period, —-—·—: Operational period of existing system

Figure 7-1 Backhaul System Operational Schedule

CHAPTER 8 FINANCIAL AND ECONOMIC EVALUATION

CHAPTER 8 FINANCIAL AND ECONOMIC EVALUATION

Financial and economic evaluations of this project are conducted in this chapter. This financial evaluation will assist in judging if this project is a good investment by calculating the internal rate of return (IRR) and preparing financial statements. An economic evaluation will assist in understanding the influence of this investment on the Indonesian macro-economy and industrial structure, and at the same time, investigate changes in employment conditions brought about by this infux of capital.

1. FINANCIAL EVALUATION

For the financial evluation of this project,

(1) Cost-benefit analysis

(2) Financial analysis

are conducted. The cost-benefit analysis is to appraise the relationship between the costs needed for the implementation of this project and the expected benefits of it by it using an index called IRR. A feature of this analysis is the latent social benefit gained (in this case, it corresponds to the consumer's surplus). Also, the financial analysis appraises relations between cost and benefit by using IRR. This differs from the cost-benefit analysis in that the financial analysis does not include the latent social benfits and evaluates a project purely as an investment opportunity. Furthermore, the financial analysis makes hypothetical statements about business entity that executes this project and provides financial statements (income statement, cash flow statement and balance sheet). Thus, an investigation of its financial condition is conducted. A comparison of the two analyses is shown in Table 8-1-1.

To carry out these analyses, it is necessary to determine the expenditures required for this project and the benefits brought about by it. Since the expenditures have already been calculated in Chapter 7, this chapter first describes details of the benefits, then explains the evaluation method for both analyses, and finally, an overall assessment is provided using the results of the calculation.

Table 8-1-1 Comparison of Evaluation Concepts

	Cost - Benefit Analysis	Financial Analysis
Benefit	Direct Benefit and Consumer's Surplus	Direct Benefit
Project Cost	Capital Cost and Operation Costs	Same as at left
Financing	None	Paid in Share Capital and Long-term Debt
Evaluation	EIRR (Economic IRR)	FIRR (Financial IRR) Financial Statements Income Statement Cash Flow Statement Balance Sheet

(Note) IRR (Internal Rate of Return)

1.1 Benefits of the Project

1.1.1 Direct Benefit

This benefits of this project consist of direct benefit and consumer' surplus (latent social benefit). Direct benefit is composed of telephone income and other incomes. The contents of the incomes are detailed as follows.

① Telephone Income

- Installation fee
- Rental fee
- SLDD callcharge

② Other Incomes

- Telegram income
- Telex income
- Leased circuit fee

According to the financial statements of PERUMTEL, the ratio of its telephone income reaches 80 percent of its total income for the last five years. Therefore, telephone income will be examined in detail, but other revenues will be lumped together as other incomes.

(1) Telephone Income

Telephone income consists of installation fee, rental fee and SLDD call charges.

1) Installation fee

To calculate the income on the installation fee, the number of telephone sets to be installed each year should be determined first, based on the accumulative number of installed sets shown in Chapter 3, Telephone Set Supply Plan. This number should then be multiplied by the installation fee and the reverting/belonging earning ratio of this project. The calculation are detailed as follows:

① Since the benefit brought about by this project is concentrated in the areas east of Sulawesi, the calculation is made with the number of WITEL

X, XI and XII installed and to be installed. This is as follows: (Refer to Chapter 3.)

Year	Accumulative number of WITEL X, XI, XII	Number to be installed
1985	38,306 units	
	)	12,422 units/year
1994	150,107 units	
	)	24,946 units/year
1999	274,835 units	
	)	24,396 units/year
2004	396,815 units	
	)	25,680 units/year
2009	525,215 units	
	)	27,606 units/year
2014	663,245 units	
	)	30,282 units/year
2019	814,656 units	

② For the telephone installation fee, the average (275,000 Rp/unit) installation fee for Areas II and III shown in Table 8-1-2 is given.

③ The Imputting Earning Ratio is calculated in the following way.

Communication traffic east of Sulawesi is passed through an submarine cable, and also is transmitted to other cities of Indonesia via a communications satellite. Thus the imputing earning ratio of this project is calculated by fixing the Ratio of terrestrial System, and multiplying it by the Toll Transmission Equipment Ratio (15%) outlined in the Equipment Sector Investment Ratio investigated by the World Bank. However, the capacity of this project will reach its limit in the year 2004, so newly installed telephone sets will thereafter belong to another project, and consequently, installation fee on them are shown as zero.

Year	Ratio of Terrestrial System
1994	0.25
1999	0.48
2004	0.68

Note: The ratio of Terrestrial System is calculated based on the distribution between the terrestrial system and the satellite system shown in the figure in Chapter 3. In this connection, it is taken into consideration that an average traffic length passing through this submarine cable is about 2000 km, REPELITA IV is in 1994, the middle of REPELITA IV and REPELITA V is in 1999 and REPELITA V in 2004.

The income from the installation fee that has been calculated based on the above method is as shown in Table 8-1-4.

2) Rental Fee

The income from the rental fee is computed by the following expression:

Accumulative number of installed telephones x Rental fee x Imputing Earning Ratio

where,

① Accumulative number of installed telephone is shown in 1) Installation Fee.

② For rental fee, 2000 Rp/month as shown in Table 8-1-2 is used.

③ The Imputing Earning Ratio is shown in 1) Installation Fee, but after the year 2014, it will be a fixed fee for reason described in the Installation Fee section.

Calculation of rental income is based on the above assumptions and is shown in Table 8-1-4.

3) SLDD Call Charge

Income from the SLDD call is calculated in the following manner.

① First, calculate the required circuit number for every two-way call between secondary centers (SC). (Refer to Chapter 3.)

② Next, referring to the circuit number between the SCs of WITEL V, VI and VII and SCs of other WITELs (for example, Jakarta ↔ Ujung Pandang), and taking into consideration the busy hour outgoing traffic and the busy hour concentration ratio, compute the outgoing traffic volume per day.

$$T^D_{i,j,t} = C_{i,j,t} \times BT \times 3600(sec)/BCR$$

where,

$T^D_{i,j,t}$: outgoing traffic volume per day (sec) from SCi to SCj in year t.

$C_{i,j,t}$: required circuit number from SCi to SCj in year t.

BT: busy-hour traffic (0.65 erlang)

BCR: busy-hour concentration ratio (12.5%)

SCi: SC belonging to other than WITEL V, VI, VII.

SCj: SC belonging to WITEL V, VI, VII.

The average distance per passing circuit was found to be about 2000 km throughout the project period from

$$dt = (\sum_i \sum_j D_{i,j} \times C_{i,j,t}) / (\sum_i \sum_j C_{i,j,t})$$

Therefore, a rate system of 75 Rp per 2 (sec/pulse) was applied, and hence daily income from the telephone rates is computed by.

$$R_t^D = (\sum_i \sum_j T_{i,j,t}^D)/S \times 75 \text{ (Rp)}$$

where,

R_t^D: income on SLDD calls per day in year t

S: 2 (second/pulse)

Further, income from SLDD calls per year with for 302 days of operation yearly will be

$$R_t^Y = R_t^D \times 302$$

where,

R_t^Y: income on SLDD calls in year t

③ Finally, the benefit of this project is calculated. The input earning ratio is defined from:

- the length that this submarine cable holds in an average distance per passing circuit. For the length of this submarine cable, the linear distance from Banjarmasin to Ujung Pandang, and
- Toll Transmission Circuit Equipment Ratio (the investigation by the World Bank is referred to),

that is,

Imputing Earning Ratio = (BJM - UP Linear Distance/Average Distance per One Passing Circuit) x Transmission Circuit Equipment Ratio (0.15)

The income from SLDD call found by the above method above is as shown in Table 8-1-4.

Table 8-1-2 Telephone Tariff Table in Indonesia

October 1987

<table>
<tr><th colspan="2">Installation Fee</th><th colspan="2">Extra Additional Fee</th><th>Branch Tel. Inst. Fee</th><th colspan="3">Rental Fee/Month Rp.</th><th>3 Minutes Fee Rp.</th><th>SLDD</th></tr>
<tr><td>Classification of Area</td><td>Rp.</td><td>Rp. (Route)</td><td>Rp. (No route)</td><td>Rp.</td><td rowspan="4">Auto</td><td rowspan="2">JAKARTA
BANDUNG
SEMARAN
SURABAYA
MEDAN</td><td rowspan="2">3500</td><td rowspan="8">Only JAKARTA Subscribers

Rp.75: JAKARTA</td><td rowspan="8">See Table 3-3</td></tr>
<tr><td>I</td><td>50,000</td><td rowspan="2">50,000</td><td rowspan="2">100,000</td><td>63,000</td></tr>
<tr><td>II</td><td>350,000</td><td>32,000</td><td rowspan="2">Other</td><td rowspan="2">2000</td></tr>
<tr><td>III</td><td>200,000</td><td rowspan="2">40,000</td><td rowspan="2">80,000</td><td>19,000</td></tr>
<tr><td>IV</td><td>175,000</td><td>13,000</td><td rowspan="4">Manual</td><td rowspan="2">L.U<500</td><td rowspan="2">1000</td></tr>
<tr><td>V</td><td>125,000</td><td>30,000</td><td>60,000</td><td>10,000</td></tr>
<tr><td>VI</td><td>90,000</td><td rowspan="2">20,000</td><td rowspan="2">40,000</td><td>7000</td><td rowspan="2">L.U>500</td><td rowspan="2">2000</td></tr>
<tr><td>VII</td><td>75,000</td><td>3750</td></tr>
</table>

Note: Extra Additional Fee shows value per 100 m.
Rental Fee shows that fee of main Branch is half of it.

Table 8-1-3 Manual Toll Call and SLDD Call Tariff Table

October 1987

Area	Distance (km)	Manual Toll Call	SLDD Call			
		Fee for one Minute (Rp.)	Metering Pulse Interval (sec.)		Fee for One Minute (Rp.)	
		Day	Day	Night	Day	Night
		6:00-21:00	6:00-22:00	22:00-6:00	6:00-22:00	22:00-6:00
-	0 - 25	75	75	75	75	75
I	25 - 100	750	6	12	750	375
II	100 - 200	900	5	10	900	450
III	200 - 300	1125	4	8	1125	563
IV	300 - 1000	1500	3	6	1500	750
V	1000 -	2250	2	4	2250	1125

Table 8-1-4 Direct Benefit

(Million Rp)

Year	Installation Fee	Rental Fee	SLDD Call Charge
1994	128	135	10,763
⋮	⋮	⋮	⋮
1999	494	475	24,418
⋮	⋮	⋮	⋮
2004	684	971	44,442
⋮	⋮	⋮	⋮
2009	0	971	44,442
⋮	⋮	⋮	⋮
2014	0	971	44,442
⋮	⋮	⋮	⋮
2019	0	971	44,442

Note: Case for a GDP growth rate of 5%

(2) Other Incomes

The following table shows the ratios of other incomes to the income on telephone rates taken from the financial statements of PERUMTEL for the last five years.

(Billion Rp)

	1982	1983	1984	1985	1986
① Telephone income	286	355	380	463	529
② Other incomes	39	54	65	79	88
③ ②/①	0.136	0.152	0.171	0.171	0.166

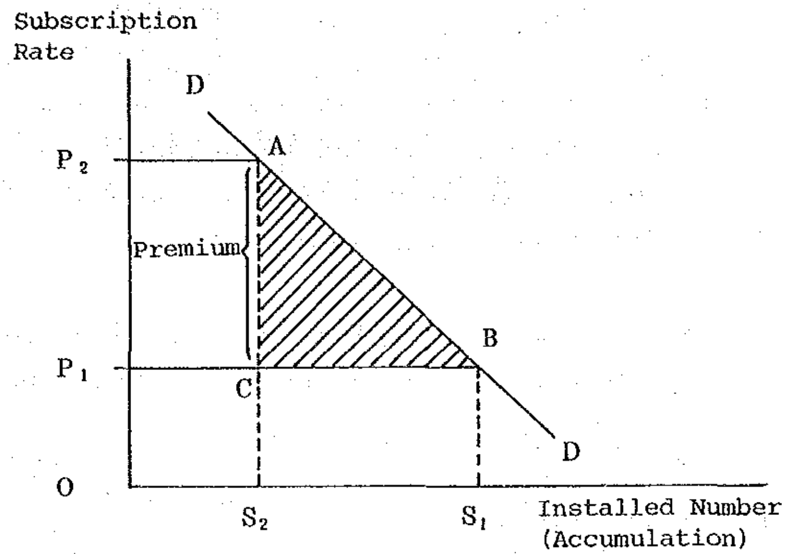
Therefore, the ratio of other incomes to the telephone income is:

(0.136 + 0.152 + 0.171 + 0.166)/5 = 0.1592 = 0.16

1.1.2 Consumer's Surplus

(1) Conception of consumer's surplus

The general conception of the consumer's surplus as shown below is applied to this project as well. However, it is necessary to fix a distribution rate for imputing earnings such as the direct benefit. Usually the size of the consumer's surplus is in inverse proportion to the expansion rate of the necessary facilities. Since this improvement project deals with a very small part of the total communication system, the same distribution rate that was used to calculate the direct benefit is applied to the imputing earnings. The consumer's surplus appears in the form of a premium to the subscription rate, and as for the telex rate, it depends on the user's degree of willingness to pay. In short, the estimation of total surplus on this project is made by presuming from the demand forecast the price that subscribers can pay and estimating the consumer's surplus per subscriber.



In the above figure, the number of telephones currently supplied is OS_2, and the number installed is OP_1. Demand is DD, and the accumulation BC. It the installed number of telephones is OS_2, the maximum subscription rate will be P_2.

Therefore, the difference, AC, is a premium on the subscription rate, and, from the social point of view of this project, the benefit becomes the area of the triangle ABC.

In addition, similar to the subscription and basic rates, the conception of the consumer's surplus on the telephone rates is closely related to a demand curve descending toward the right hand side.

For example, if a consumer (a subscriber) can only make one call per day, he is willing to pay a higher rate, despite the fact that he needs to make several calls. However, telephone rates are usually fixed, so consumers pay the same rate for every call. Therefore, those who make fewer calls are considered to be willing topay a higher rate for calls than actually charged. Likewise, the same thing can be said for the accumulative subscribers, but these consumer's surpluses are not estimated due to insufficient data.

The consumer's surplus is applied based on the "JAKAL Report" on telephone income, and is described as follows.

(2) Installation Fee

The consumer's surplus on installation fees is estimated as follows.

① First, referring to the difference in the number of telephone sets between demand and supply specified in Chapter 3, the consumer's surplus is to be calculated on the differences of increase.

(Units)

Year	Demand	Supply	Difference	Increase in Difference
1994	191,125	160,170	41,018	
			)	74
1999	316,224	274,835	41,389	
			)	8957
2004	482,987	396,815	86,172	
			)	5262
2009	637,699	525,215	112,484	
			)	5816
2014	804,810	663,245	141,565	
			)	6248
2019	987,460	814,656	172,304	

② Next, reffering to the "JICA Report", the premium is assumed to be 325,000 Rp/set.

③ Imputing Earning Ratio is assumed to be the same as the direct benefit.

④ Therefore, the consumer's surplus on installation fee is calculated by the following expression.

Increase in the gap between demand and supply x Premium x Imputing Earning Ratio

The result of the calculation is shown in Table 8-1-5.

(3) Rental Fee

Consumer's surplus on the rental fee is computed by multiplying the difference in the number of telephone sets between demand and supply as shown in (2) Installation Fee by the premium on the rental fee (3250 Rp/month) and the Imputing Earning Ratio. The premium on the rental fee is based on the "JICA Report", and the Imputing Earning Ratio is the same as for direct benefit. The result of this calculation is shown in Table 8-1-5.

(4) SLDD Call Charge

SLDD call charge is assumed to be 15 percent of the direct benefit based on the "JICA Report". The result of this calculation is shown in Table 8-1-5.

(5) Other Incomes

For other incomes, consumer's surplus could be applied to Telex, for example. However, their shares of the total income is so small that their influence on EIRR is negligible. Therefore, consumer's surplus on other incomes is not considered.

Table 8-1-5 Consumer's Surplus

(Million Rp)

Year	Installation Fee	Rental Fee	SLDD Call Charge
1994	56	60	1614
⋮	⋮	⋮	⋮
1999	2	116	4113
⋮	⋮	⋮	⋮
2004	297	343	6666
⋮	⋮	⋮	⋮
2009	0	343	6666
⋮	⋮	⋮	⋮
2014	0	343	6666
⋮	⋮	⋮	⋮
2019	0	343	6666

Note: Case for a GDP growth rate of 5%

1.2 Cost-Benefit Analysis and Financial Analysis

1.2.1 IRR

(1) Analysis model

The DCF method is used to assess large-scale, long-term projects, there is. By referring to the cash flow arising during a project term, the DCF system determines a discount rate by which the total cash flow in the period after being converted to the present value, becomes zero.

For example, when

CIFi: cash in-flow in the year i

COFi: cash out-flow in the year i,

then,

$$\sum_{i} CIFi/(1+r)^{i-ib} = \sum_{i} COFi/(Hr)^{i-ib}$$

The parameter, r, is the discount ratio and is also called IRR (Internal Rate of Return). The greater the rate, the higher the investment efficiency becomes.

This project calculates two IRRs, which are:

FIRR (Financial Internal Rate of Return), and
EIRR (Economic Internal Rate of Return).

The only difference between FIRR and EIRR is the addition of consumer's surplus to the cash in-flow of EIRR. Eventually, in the case of EIRR, the latent social benefit is also considered for cash in-flow, which means the IRR can be used for cost-benefit analysis. The components of the cash flow to be used for computing both IRRs are as follows.

. FIRR

Cash In-flow = Direct Benefit
= SLDD Call Income + Other Income
= Installation Fee Income + Rental Fee Income + SLDD Call Income + Other Income

Cash Out-flow = Initial Investment Cost + Additional Investment Cost + Operating Expenses + Income Tax

. EIRR

Cash In-flow = Direct Benefit + Consumer's Surplus

Cash Out-flow = Initial Investment Cost + Additional Investment Cost + Operating Expenses + Income Tax

(2) Case Study

First, FIRR and EIRR are calculated for each proposed route of this project examined in Chapter 6. General preconditions of each route are as shown in Table 8-1-6. The result of this computation is as follows.

	FIRR	EIRR
Plan-1A	16.72%	18.39%
Plan-1B	18.14%	20.08%
Plan-1C	17.85%	19.67%
Plan-2	15.87%	17.59%
Plan-2'	16.46%	18.30%

As far as IRR is concerned, it is understood that any route is feasible. However, considering that Plan-1B has the highest IRR and the lowest additional and locally-procured investment costs (about two billion Rupiah, indicating a minimal burden on the Indonesian side), this is the most economical plan. Plan-2' is equivalent to Plan 2, but also utilizes the existing backhaul system to be constructed on the Kalimantan side.

Next, as sensitivity analysis is conducted for Plan-1B selected above, based on the income and project cost, as follows.

	FIRR	EIRR
Plan-1B (income + 10%)	19.18%	21.14%
Plan-1B (income - 10%)	17.01%	18.81%
Plan-1B (cost + 10%)	17.09%	18.93%
Plan-1B (cost - 10%)	19.30%	21.30%

When income decreases uniformly by 10 percent, and cost increases uniformly by 10 percent, FIRR becomes more than 17 percent. Thus, sensitivity analysis has proved this project to be resistant to fluctuations in income and costs.

The above case study was made on the assumption of a middle Indonesian GDP growth rate of 5 percent, and calculation of the IRR for a low GDP growth rate of 3 percent has also been conducted. The result of the calculation for Plan-1B is as follows.

	FIRR	EIRR
Plan-1B (3% GDP)	15.80%	17.48%

Although IRR decreases by about two percent, the feasibility of this project is guaranteed.

Lastly, IRR calculations for Plan-1B were performed under the assumption that the capacity of the submarine cable is 280 Mbit/s x 2 from the beginning. However, due to technical reason, this plan was excluded from the proposal. The result of the calculation is as follows.

	FIRR	EIRR
Plan-1B (280 Mbit/s x 2)	18.21%	20.03%

This result compares with that of the original Plan-1B, because the increase in the initial investment cost (up about 12%) and the increase in income (no limit to income because of large growth capacity) are about equal in terms of the present value.

Table 8-1-6 Preconditions for Each Route

			Plan-1A	Plan-1B	Plan-1C	Plan-2	Plan-2'
Project Cost	Construction Cost	Initial Investment Amount	Total Amount 110,256 mil.Rp. (about 9.7 bil.Yen) Submarine Cable 100,557 mil.Rp. Backhaul 9,699 mil.Rp.	Total Amount 93,156 mil.Rp. (about 8.2 bil.Yen) Submarine Cable 85,965 mil.Rp. Backhaul 7,191 mil.Rp.	Total Amount 95,829 mil.Rp. (about 8.4 bil.Yen) Submarine Cable 82,845 mil.Rp. Backhaul 12,984 mil.Rp.	Total Amount 110,557 mil.Rp. (about 9.7 bil.Yen) Submarine Cable 51,576 mil.Rp. Backhaul 58,981 mil.Rp.	Total Amount 97,654 mil.Rp. (about 8.6 bil.Yen) Submarine Cable 51,712 mil.Rp. Backhaul 45,942 mil.Rp.
Exchange Rate 1$ = 145 Yen 1$ = 1,650 Rp. 1 Yen = 11.4 Rp.		Additional Investment Amount	Backhaul 1998: 342 mil.Rp. 2008: 7,036 mil.Rp. Total: 7,378 mil.Rp. (about 650 mil.Yen)	Backhaul 1988: 342 mil.Rp. 2008: 5,050 mil.Rp. Total: 5,392 mil.Rp. (about 470 mil.Yen)	Bakchaul 1998: 342 mil.Rp. 2008: 9,327 mil.Rp. Total: 9,669 mil.Rp. (about 850 mil.Yen)	Backhaul 1988: 342 mil.Rp. 2008: 38,760 mil.Rp. Total: 39,102 mil.Rp. (about 3.43 bil.Yen)	Backhaul 1988: 19,746 mil.Rp. 2008: 19,699 mil.Rp. 2013: 19,404 mil.Rp. Total: 58,849 mil.Rp. (about 5.16 bil.Yen)
	Operation Expenses		Initial Investment x 2.3% = 2,536 mil.Rp./year	Initial Investment x 2.3% = 2,142 mil.Rp./year	Initial Investment x 2.5% = 2,396 mil.Rp./year	Initial Investment x 4.0% = 4,422 mil.Rp./year	Same as left
Direct Benefit (Price in 1987)	Telephone Income & Other Income		Installation Fee 1994 128 1999 494 2004 684 | 0 2018 0	Rental Fee 135 475 971 | 971	SLDD Call Charge 10,763 27,418 44,442 | 44,442	Telephone Income:	Installation Fee + Rental Fee + SLDD Call Charge
Depreciation			Submarine Cable: 25-year fixed installment	Backhaul: 15-year fixed installment	IDC: 5-year fixed installment		(Remaining Book Value: 0)
Corporation Tax Rate			Amount for taxation x 35%	Losses before tax can be carried foreward for 5 years			
Terms of Loan Repayment			Long-term debt: graced for 5 years, 10-year repayment, 12.0% per annum interest rate		Short-term debt: year end borrowing/year end replayment, 12.0% per annum interest rate		
Fund Procurement			Paid-in share capital 2,001 mil.Rp. Long-term debt 135,347 mil.Rp. (Interest 27,092 mil.Rp.)	Paid-in chare capital 2,012 mil.Rp. Long-term debt 113,955 mil.Rp. (Interest 22,811 mil.Rp.)	Paid-in share capital 3,043 mil.Rp. Long-term debt 116,049 mil.Rp. (Interest 23,263 mil.Rp.)	Paid-in share capital 7,911 mil.Rp. Long-term debt 128,484 mil.Rp. (Interest 25,838 mil.Rp.)	Paid-in chare capital 4,014 mil.Rp. Long-term debt 117,354 mil.Rp. (Interest 23,714 mil.Rp.)

1.2.2 Financial Statements

In the previous section, Plan-1B was selected as the submarine cable route for this project on the based of its greater investment effectiveness and other superior factor (low additional investment and locally procured costs). This section will examine the following financial statements:

① Income statement

② Cash flow statement

③ Balance sheet

④ Cash flow list for IRR calculation

(1) Preconditions

Preparing financial statements presupposes the following conditions.

1) Schedule for initial investment

First, the initial investment amount for Plan-1B as specified in Chapter 7 is allotted to each phase of construction (1990 to 1993). Then, combining the distributed amount together with the investment amount for the submarine cable and the backhaul system, an appropriate yearly schedule for the initial investment cost is prepared. In allotting the initial investment cost, the relative importance of each construction period and other factors are taken into consideration. Expenses such as consultant fees, which do not belong to either the submarine cable or the backhaul system, are divided proportionally to each investment amount. The schedule for initial investment calculated in the above manner is as follows.

(Million Rp)

	1990	1991	1992	1993
Submarine Cable	20,113	41,104	23,827	921
Backhaul	1627	3321	2050	193

2) Financing

Initial investment outlay is financed by paid-in capital and long-term debt. As for the paid-in capital, it is the only part that will be procured locally, and the rest (foreign currency) of the outlay is financed by long-term debt. Interest during construction will now be considered as well. Thus, the financing for Plan-1B will be as follows.

(Million Rp)

	1990	1991	1992	1993
Paid-in Capital	296	740	751	225
Long-term Debt	21,444	46,258	33,250	13,003
Total	21,740	46,998	34,001	13,228
Submarine Cable	20,113	41,104	23,827	921
Backhaul	1027	3321	2050	193
Interest	0	2573	8124	12,114
Total	21,740	46,998	34,001	13,228

However, additional investment outlay is to be financed with retained earning or short-term loans.

3) Terms of debts

① Long-term debt

Terms of the debt are as follows:

- Grace period: 5 years
- Repayment term: Repayment of principal is evenly distributed over 10 years.

  Principal redemption will finish 15 years after borrowing.
- Interest rate: 12 percent per year
  This equals the fund procurement cost when PERUMTEL borrows funds from the Indonesian government.
- Year-end borrowing/year-end repayment (redemption by yearly installment system)

A listing for principal redemption and interest expenses that is drawn according to the above terms is as shown in Table 8-1-7.

② Short-term debt

When a fund shortage occurs during the project term, the shortage is financed by short-term debt. Terms of short-term debt are:

- Borrowing at the end of the year that the shortage occurred/one-time redemption at the next year-end
- Interest rate: 12% per year

Table 8-1-7 Long-term Debt and Interest Repayment Plan for Plan-1B

(Million Rp)

Year	Debt Outstanding at B.O.Y	Repayment Amount	Interest Payment
1994	113,955		13,675
1995	113,955		13,675
1996	113,955		13,675
1997	113,955		13,675
1998	113,955		13,675
1999	113,955	11,395	13,675
2000	102,560	11,395	12,307
2001	91,165	11,395	10,940
2002	79,770	11,395	9572
2003	68,375	11,395	8205
2004	56,980	11,395	6838
2005	45,585	11,395	5470
2006	34,190	11,395	4103
2007	22,795	11,395	2735
2008	11,400	11,400	1368

Note: B.O.Y represents Beginning of Year.

4) Terms of depreciation

The capital costs of this project are large, and are classified into the following three categories.

① Cost for submarine cable system

② Backhaul sysem

③ Interest Rates

Terms of depreciation for each category are:

- Submarine cable system: 25 years fixed-installment method, remaining book value 0
- Backhaul system: 15 years fixed-installment method, remaining book value 0
- Interest rates: 5 years fixed-installment method starting from 1994, remaining book value 0

Additional investment is considered for the backhaul system, but if replacement is necessary before the total value is depreciated, the remaining value is 0, because it cannot be used otherwise. Depreciation expense on Plan-1B are shown in Table 8-1-8.

5) Carry-over of losses before tax

When a loss before tax occurs, it can be carried forward up to five years; e.g., when a loss of 100 occurs in the year t, if the profits before tax during the year t + 1 to the year t + 5 are 100, the corporate taxes for those years are exempted.

6) Corporate Tax

The 35 percent corporate tax that was imposed after December 1984 applies.

Table 8-1-8 Depreciation for Plan-1B

(Million Rp)

Year	Submarine Cable	Backhaul	I.D.C.
1994	3439	479	4562
1995	3439	479	4562
1996	3439	479	4562
1997	3439	479	4562
1998	3439	479	4562
1999	3439	502	4563
2000	3439	502	
2001	3439	502	
2002	3439	502	
2003	3439	502	
2004	3439	502	
2005	3439	502	
2006	3439	502	
2007	3439	502	
2008	3439	506	
2009	3439	337	
2010	3439	337	
2011	3439	337	
2012	3439	337	
2013	3439	337	
2014	3439	337	
2015	3439	337	
2016	3439	337	
2017	3439	337	
2018	3439	337	

(2) Financial statements prepared

Based on the preconditions stated in (1), financial statements for Plan-1B have been prepared, as follows:

Income Statement	Table 8-1-9
Cash flow Statement	Table 8-1-10
Balance Sheet	Table 8-1-11
Cash Flow List for IRR Calculation	Table 8-1-12

The following is an analysis of these financial statements.

① The income statement indicates it is known that the single-year profit-and-loss account will show a profit three years after (1997) the opening of the new line and that cumulative profit-and-loss will show a profit seven years after (2000) opening, which will be followed by steady earning.

② The cash flow statement indicates that cash flow will worsen for 2 years (1994 and 1995) after opening due to the interest payment burden, but that after this period no short-term debt will occur. Furthermore, it is revealed that all additional investment for the backhaul system can be financed with retained earnings.

③ As a result, outstanding financial transits are shown below, and cash assets of 511 billion Rp will attained by the year 2018.

(Billion Rp.)

	1993	2003	2018
Assets			
Liquid assets	0	71	509
Fixed assets	116	55	2
Total	116	126	511
Liabilities			
Liquid liabilities	0	11	0
Fixed liabilities	114	46	0
Total	114	57	0
Equity			
Paid-in capital	2	2	2
Retained earning	0	67	509
Total	2	69	511
Liabilities, Equity	116	126	511

④ As a result, it is indicated that Plan-1B is financially feasible.

Table 8-1-9 Income Statement (Plan-1B)

********** INCOME STATEMENT **********

(Year)	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
1. REVENUE																		
2. TELEPHONE																		
3. INSTALLATION	0	0	0	0	128	309	350	401	442	494	523	564	604	644	684	0	0	0
4. RENTAL	0	0	0	0	135	189	245	316	387	475	560	652	752	858	971	971	971	971
5. SLDD CALL	0	0	0	0	10,763	14,094	17,425	20,756	24,087	27,418	30,823	34,228	37,632	41,037	44,442	44,442	44,442	44,442
6. (SUB TOTAL)	0	0	0	0	11,026	14,592	18,020	21,473	24,916	28,387	31,906	35,444	38,988	42,539	46,097	45,413	45,413	45,413
7. OTHERS	0	0	0	0	1,764	2,334	2,883	3,435	3,986	4,541	5,104	5,671	6,238	6,806	7,375	7,266	7,266	7,266
8. TOTAL REVENUE	0	0	0	0	12,790	16,926	20,903	24,908	28,902	32,928	37,010	41,115	45,226	49,345	53,472	52,679	52,679	52,679
9. OPERATION COSTS	0	0	0	0	2,142	2,142	2,142	2,142	2,142	2,142	2,142	2,142	2,142	2,142	2,142	2,142	2,142	2,142
10. DEPRECIATION																		
11. SUBMARINE	0	0	0	0	3,439	3,439	3,439	3,439	3,439	3,439	3,439	3,439	3,439	3,439	3,439	3,439	3,439	3,439
12. MICROWAVE	0	0	0	0	479	479	479	479	479	502	502	502	502	502	502	502	502	502
13. I.D.C.	0	0	0	0	4,562	4,562	4,562	4,562	4,563	0	0	0	0	0	0	0	0	0
14. (TOTAL DEPRECIATION)	0	0	0	0	8,480	8,480	8,480	8,480	8,481	3,941	3,941	3,941	3,941	3,941	3,941	3,941	3,941	3,941
15. GROSS PROFIT	0	0	0	0	2,168	6,304	10,281	14,286	18,279	26,845	30,927	35,032	39,143	43,262	47,389	46,596	46,596	46,596
16. INTEREST																		
17. LONG-TERM	0	0	0	0	13,675	13,675	13,675	13,675	13,675	13,675	12,307	10,940	9,572	8,205	6,838	5,470	4,103	2,735
18. SHORT-TERM	0	0	0	0	0	363	273	0	0	0	0	0	0	0	0	0	0	0
19. (TOTAL INTEREST PAID)	0	0	0	0	13,675	14,038	13,948	13,675	13,675	13,675	12,037	10,940	9,572	8,205	6,838	5,470	4,103	2,735
20. NET PROFIT B/TAX	0	0	0	0	-11,507	-7,734	-3,667	611	4,604	13,170	18,620	24,092	29,571	35,057	40,551	41,126	42,493	43,861
21. LOSS CARRYOVER	0	0	0	0	-11,507	-7,734	-3,667	0	0	0	0	0	0	0	0	0	0	0
22. INCOME TAX	0	0	0	0	0	0	0	0	0	0	4,933	8,432	10,349	12,269	14,192	14,394	14,872	15,351
23. NET PROFIT A/TAX	0	0	0	0	-11,507	-7,734	-3,667	611	4,604	13,170	13,687	15,660	19,222	22,788	26,359	26,732	27,621	28,510
24. ACCUMULATE NET PROFIT A/TAX	0	0	0	0	-11,507	-19,241	-22,908	-22,297	-17,693	-4,523	9,164	24,824	44,046	66,834	93,193	119,925	147,546	176,056

(Year)	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	TOTAL
1. REVENUE												
2. TELEPHONE												
3. INSTALLATION	0	0	0	0	0	0	0	0	0	0	0	5,143
4. RENTAL	971	971	971	971	971	971	971	971	971	971	971	19,134
5. SLDD CALL	44,442	44,442	44,442	44,442	44,442	44,442	44,442	44,442	44,442	44,442	44,442	924,893
6. (SUB TOTAL)	45,413	45,413	45,413	45,413	45,413	45,413	45,413	45,413	45,413	45,413	45,413	949,170
7. OTHERS	7,266	7,266	7,266	7,266	7,266	7,266	7,266	7,266	7,266	7,266	7,266	151,861
8. TOTAL REVENUE	52,679	52,679	52,689	52,679	52,679	52,679	52,679	52,679	52,679	52,679	52,679	1,101,031
9. OPERATION COSTS	2,142	2,142	2,142	2,142	2,142	2,142	2,142	2,142	2,142	2,142	2,142	53,550
10. DEPRECIATION												
11. SUBMARINE	3,439	3,439	3,439	3,439	3,439	3,439	3,439	3,439	3,439	3,439	3,429	85,965
12. MICROWAVE	506	337	337	337	337	337	337	337	337	337	337	10,789
13. I.D.C	0	0	0	0	0	0	0	0	0	0	0	22,811
14. (TOTAL DEPRECIATION)	3,945	3,776	3,776	3,776	3,776	3,776	3,776	3,776	3,776	3,776	3,766	119,565
15. GROSS PROFIT	46,592	46,761	46,761	46,761	46,761	46,761	46,761	46,761	46,761	46,761	46,771	927,916
16. INTEREST												
17. LONG-TERM	1,368	0	0	0	0	0	0	0	0	0	0	143,588
18. SHORT-TERM	0	0	0	0	0	0	0	0	0	0	0	636
19. (TOTAL INTEREST PAID)	1,368	0	0	0	0	0	0	0	0	0	0	144,224
20. NET PROFIT B/TAX	45,224	46,761	46,761	46,761	46,761	46,761	46,761	46,761	46,761	46,761	46,771	783,692
21. LOSS CARRYOVER	0	0	0	0	0	0	0	0	0	0	0	-22,908
22. INCOME TAX	15,828	16,366	16,366	16,366	16,366	16,366	16,366	16,366	16,366	16,366	16,369	274,283
23. NET PROFIT A/TAX	29,396	30,395	30,395	30,395	30,395	30,395	30,395	30,395	30,395	30,402	30,402	509,409
24. ACCUMULATE NET PROFIT A/TAX	205,452	235,847	266,242	296,637	327,032	357,427	387,822	418,217	448,612	479,007	509,409	4,515,123

Table 8-1-10 Cash Flow Statement (Plan-1B)

********** CASH FLOW STATEMENT **********

(Year)	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
1. SOURCE OF FUND																		
2. PAID-IN SHARE CAPITAL	296	740	751	225	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3. LONG-TERM DEBT	21,444	46,258	33,250	13,003	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4. SHORT-TERM DEBT	0	0	0	0	3,027	2,281	0	0	0	0	0	0	0	0	0	0	0	0
5. NET PROFIT A/TAX	0	0	0	0	-11,507	-7,734	-3,667	611	4,604	13,170	13,687	15,660	19,222	22,788	26,359	26,732	27,621	28,510
6. DEPRECIATION	0	0	0	0	8,480	8,480	8,480	8,480	8,481	3,941	3,941	3,941	3,941	3,941	3,941	3,941	3,941	3,941
7. (TOTAL SOURCE OF FUND)	21,740	46,998	34,001	13,228	0	3,027	4,813	9,091	13,085	17,111	17,628	19,601	23,163	26,729	30,300	30,673	31,562	32,451
8. APPLICATION OF FUND																		
9. CAPITAL COSTS																		
10. SUBMARINE	20,113	41,104	23,827	921	0	0	0	0	0	0	0	0	0	0	0	0	0	0
11. MICROWAVE	1,627	3,321	2,050	193	0	0	0	0	342	0	0	0	0	0	0	0	0	0
12. (TOTAL CAPITAL COSTS)	21,740	44,425	25,877	1,114	0	0	0	0	342	0	0	0	0	0	0	0	0	0
13. INTEREST DURING CONSTRUCTION																		
14. REPAYMENT																		
15. LONG-TERM	0	0	0	0	0	0	0	0	0	11,395	11,395	11,395	11,395	11,395	11,395	11,395	11,395	11,395
16. SHORT-TERM	0	0	0	0	0	3,027	2,281	0	0	0	0	0	0	0	0	0	0	0
17. (TOTAL REPAYMENT)	0	0	0	0	0	3,027	2,281	0	0	11,395	11,395	11,395	11,395	11,395	11,395	11,395	11,395	11,395
18. TOTAL APPLICATION FUND	21,740	46,998	34,001	13,228	0	3,027	2,281	0	342	11,395	11,395	11,395	11,395	11,395	11,395	11,395	11,395	11,395
19. SURPLUS CASH	0	0	0	0	0	0	2,532	9,091	12,743	5,716	6,233	8,206	11,768	15,334	18,905	19,278	20,167	21,056
20. ACCUMULATE SURPLUS CASH	0	0	0	0	0	0	2,532	11,623	24,366	30,082	36,315	44,521	56,289	71,623	90,528	109,806	129,973	151,029

(Year)	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	TOTAL
1. SOURCE OF FUND												
2. PAID-IN SHARE CAPITAL	0	0	0	0	0	0	0	0	0	0	0	2,012
3. LONG-TERM DEBT	0	0	0	0	0	0	0	0	0	0	0	113,955
4. SHORT-TERM DEBT	0	0	0	0	0	0	0	0	0	0	0	5,308
5. NET PROFIT A/TAX	29,396	30,395	30,395	30,395	30,395	30,395	30,395	30,395	30,395	30,395	30,402	509,409
6. DEPRECIATION	3,945	3,776	3,776	3,776	3,776	3,776	3,776	3,776	3,776	3,776	3,766	119,565
7. (TOTAL SOURCE OF FUND)	33,341	34,171	34,171	34,171	34,171	34,171	34,171	34,171	34,171	34,171	34,168	750,249
8. APPLICATION OF FUND												
9. CAPITAL COSTS												
10. SUBMARINE	0	0	0	0	0	0	0	0	0	0	0	85,965
11. MICROWAVE	5,050	0	0	0	0	0	0	0	0	0	0	12,583
12. (TOTAL CAPITAL COSTS)	5,050	0	0	0	0	0	0	0	0	0	0	98,548
13. INTEREST DURING CONSTRUCTION												22,811
14. REPAYMENT												
15. LONG-TERM	11,400	0	0	0	0	0	0	0	0	0	0	113,955
16. SHORT-TERM	0	0	0	0	0	0	0	0	0	0	0	5,308
17. (TOTAL REPAYMENT)	11,400	0	0	0	0	0	0	0	0	0	0	119,263
18. TOTAL APPLICATION OF FUND	16,450	0	0	0	0	0	0	0	0	0	0	240,622
19. SURPLUS CASH	16,891	34,171	34,171	34,171	34,171	34,171	34,171	34,171	34,171	34,171	34,168	509,627
20. ACCUMULATE SURPLUS CASH	167,920	202,091	236,262	270,433	304,604	338,775	372,946	407,117	441,288	475,459	509,627	4,485,209

Table 8-1-11 Balance Sheet (Plan-1B)

********** BALANCE SHEET **********

(Year)	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
1. ASSETS																		
2. CURRENT ASSETS	0	0	0	0	0	0	2,532	11,623	24,366	30,082	36,315	44,521	56,289	71,623	90,528	109,806	129,973	151,029
3. FIXED ASSETS																		
4. SUBMARINE	20,113	61,217	85,044	85,965	85,965	85,965	85,965	85,965	85,965	85,965	85,965	85,965	85,965	85,965	85,965	85,965	85,965	85,965
5. MICROWAVE	1,627	4,948	6,998	7,191	7,191	7,191	7,191	7,191	7,533	7,533	7,533	7,533	7,533	7,533	7,533	7,533	7,533	7,533
6. I.D.C	0	2,573	10,697	22,811	22,811	22,811	22,811	22,811	22,811	22,811	22,811	22,811	22,811	22,811	22,811	22,811	22,811	22,811
7. LESS DEPRECIATION	0	0	0	0	8,480	16,960	25,440	33,020	42,401	46,342	50,283	54,224	58,165	62,106	66,047	69,988	73,929	77,870
8. NET FIXED ASSETS	21,740	68,738	102,739	115,967	107,487	99,007	90,527	82,047	73,008	69,967	66,026	62,085	58,144	54,203	50,262	46,321	42,380	38,439
9. TOTAL ASSETS	21,740	68,738	102,739	115,967	107,487	99,007	93,059	93,670	98,274	100,049	102,341	106,606	114,433	125,826	140,790	156,127	172,353	189,468
10. LIABILITIES																		
11. CURRENT LIABILITIES																		
12. LONG-TERM DEBT TO BE REPAIED IN A YEAR	0	0	0	0	0	0	0	0	11,395	11,395	11,395	11,395	11,395	11,395	11,395	11,395	11,395	11,400
13. SHORT-TERM DEBT	0	0	0	0	3,027	2,281	0	0	0	0	0	0	0	0	0	0	0	0
14. TOTAL CURRENT LIABILITIES	0	0	0	0	3,027	2,281	0	0	11,395	11,395	11,395	11,395	11,395	11,395	11,395	11,395	11,395	11,400
15. FIXED LIABILITIES	21,444	67,702	100,952	113,955	113,955	113,955	113,955	113,955	102,560	91,165	79,770	68,375	56,980	45,585	34,190	22,795	11,400	0
16. TOTAL LIABILITIES	21,444	67,702	100,952	113,955	116,982	116,236	113,955	113,955	113,955	102,560	91,165	79,770	68,375	56,980	45,585	34,190	22,795	11,400
17. EQUITY																		
18. PAID-IN SHARE CAPITAL	296	1,036	1,787	2,012	2,012	2,012	2,012	2,012	2,012	2,012	2,012	2,012	2,012	2,012	2,012	2,012	2,012	2,012
19. RETAINED EARNING	0	0	0	0	-11,507	-19,241	-22,908	-22,297	-17,693	-4,523	9,164	24,824	44,046	66,834	93,193	119,925	147,546	176,056
20. TOTAL EQUITY	296	1,036	1,787	20,12	-9,495	-17,229	-20,896	-20,285	-15,681	-2,511	11,176	26,836	46,058	68,846	95,205	121,937	149,558	178,068
21. LIABILITIES & EQUITY	21,740	68,738	102,739	115,967	107,487	99,007	93,059	93,670	98,274	100,049	102,341	106,606	114,433	125,826	140,790	156,127	172,353	189,468

(Year)	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
1. ASSETS											
2. CURRENT ASSETS	167,920	202,091	236,262	270,433	304,604	338,775	372,946	407,117	441,288	475,459	509,627
3. FIXED ASSETS											
4. SUBMARINE	85,965	85,965	85,965	85,965	85,965	85,965	85,965	85,965	85,965	85,965	85,965
5. MICROWAVE	12,583	12,583	12,583	12,583	12,583	12,583	12,583	12,583	12,583	12,583	12,583
6. I.D.C	22,811	22,811	22,811	22,811	22,811	22,811	22,811	22,811	22,811	22,811	22,811
7. LESS DEPRECIATION	81,815	85,591	89,367	93,143	96,919	100,695	104,471	108,247	112,023	115,799	119,565
8. NET FIXED ASSETS	39,544	35,768	31,992	28,216	24,440	20,664	16,888	13,112	9,336	5,560	1,794
9. TOTAL ASSETS	207,464	237,859	268,254	298,649	329,044	359,439	389,834	410,229	450,624	481,019	511,421
10. LIABILITIES											
11. CURRENT LIABILITIES											
12. LONG-TERM DEBT TO BE REPAIED IN A YEAR	0	0	0	0	0	0	0	0	0	0	0
13. SHORT-TERM DEBT	0	0	0	0	0	0	0	0	0	0	0
14. TOTAL CURRENT LIABILITIES	0	0	0	0	0	0	0	0	0	0	0
15. FIXED LIABILITIES	0	0	0	0	0	0	0	0	0	0	0
16. TOTAL LIABILITIES	0	0	0	0	0	0	0	0	0	0	0
17. EQUITY											
18. PAID-IN SHARE CAPITAL	2,012	2,012	2,012	2,012	2,012	2,012	2,012	2,012	2,012	2,012	2,012
19. RETAINED EARNING	205,452	235,847	266,242	296,637	327,032	357,427	387,822	418,217	448,612	479,007	509,409
20. TOTAL EQUITY	207,464	237,850	268,254	298,649	329,044	359,439	389,834	420,229	450,624	481,019	511,421
21. LIABILITIES & EQUITY	207,464	237,859	268,254	298,649	329,044	359,439	389,834	410,229	450,624	481,019	511,421

Table 8-1-12 Cash Flow for IRR Calculation (Plan-1B)

********** INTERNAL RATE OF RETURN **********

EIRR = ... 0.2008065 = 100%

(Year)	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
1. CASH IN-FLOW															
2. TELEPHONE REVENUE	0	0	0	0	11,026	14,592	18,020	21,473	24,916	28,387	31,906	35,444	38,988	42,539	46,097
3. OTHER REVENUE	0	0	0	0	1,764	2,334	2,883	3,435	3,986	4,541	5,104	5,671	6,238	6,806	7,375
4. CONSUMER'S SURPLUS	0	0	0	0	1,730	2,187	2,697	3,208	3,719	4,231	5,003	5,573	6,147	6,723	7,306
5. TOTAL IN-FLOW	0	0	0	0	14,520	19,113	23,600	28,116	32,621	37,159	42,013	46,688	51,373	56,068	60,778
6. CASH OUT-FLOW															
7. CAPITAL COSTS	21,740	44,425	25,877	1,114	0	0	0	0	342	0	0	0	0	0	0
8. OPERATION COSTS	0	0	0	0	2,142	2,142	2,142	2,142	2,142	2,142	7,075	10,574	12,491	14,411	16,334
9. TOTAL OUT-FLOW	21,740	44,425	25,877	1,114	2,142	2,142	2,142	2,142	2,484	3,142	7,075	10,574	12,491	14,411	16,334
10. ANNUAL CASH FLOW	-21,740	-44,425	-25,877	-1,114	12,378	16,971	21,458	25,974	30,137	35,017	34,938	36,114	38,882	41,657	44,444
11. ACCUMULATE ANNUAL CASH FLOW	-21,740	-66,165	-92,042	-93,156	-80,778	-63,807	-42,349	-16,375	13,762	48,779	83,717	119,831	158,713	200,370	244,814
12. DISCOUNTED CASH FLOW	-21,740	-36,995	-17,946	-643	5,953	6,797	7,157	7,214	6,971	6,745	5,604	4,824	4,325	3,859	3,429
13. ACCUMULATE DISCOUNTED CASH FLOW	-21,740	-58,735	-76,681	-77,324	-71,371	-64,574	-57,417	-50,203	-43,232	-36,487	-30,883	-26,059	-21,734	-17,875	-14,446
14. DISCOUNT RATE	1	0.8327735	0.6935118	0.5775383	0.4809586	0.4005296	0.3335505	0.2777720	0.2313212	0.1926382	0.1604240	0.1335968	0.1112559	0.0926510	0.771573

FIRR = ... 0.1813648 %

(Year)	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
1. CASH IN-FLOW															
2. TELEPHONE REVENUE	0	0	0	0	11,026	14,592	18,020	21,473	24,916	28,387	31,906	35,444	38,988	42,539	46,097
3. OTHER REVENUE	0	0	0	0	1,764	2,334	2,883	3,435	3,986	4,541	5,104	5,671	6,238	6,806	7,375
4. TOTAL IN-FLOW	0	0	0	0	12,790	16,926	20,903	24,908	28,902	32,928	37,010	41,115	45,226	49,345	53,472
5. CASH OUT-FLOW															
6. CAPITAL COSTS	21,740	44,425	25,877	1,114	0	0	0	0	342	0	0	0	0	0	0
7. OPERATION COSTS	0	0	0	0	2,142	2,142	2,142	2,142	2,142	2,142	7,075	10,574	12,491	14,411	16,334
8. TOTAL OUT-FLOW	21,740	44,425	25,877	1,114	2,142	2,142	2,142	2,142	2,484	3,142	7,075	10,574	12,491	14,411	16,334
9. ANNUAL CASH FLOW	-21,740	-44,425	-25,877	-1,114	10,648	14,784	18,761	22,766	26,418	30,786	29,935	30,541	32,735	34,934	37,138
10. ACCUMULATE ANNUAL CASH FLOW	-21,740	-66,165	-92,042	-93,156	-82,508	-67,724	-48,963	-26,197	221	31,007	60,942	91,483	124,218	159,152	196,290
11. DISCOUNTED CASH FLOW	-21,740	-37,604	-18,541	-675	5,466	6,424	6,901	7,089	6,963	6,869	5,653	4,882	4,429	4,001	3,601
12. ACCUMULATE DISCOUNTED CASH FLOW	-21,740	-59,344	-77,885	-78,560	-73,094	-66,670	-59,769	-52,680	-45,717	-38,848	-33,195	-28,313	-23,884	-19,883	-16,282
13. DISCOUNT RATE	1	0.8464785	0.7165258	0.6065237	0.5134093	0.4345899	0.3678710	0.3113940	0.2635291	0.2231225	0.1888684	0.1598730	0.1353291	0.1145532	0.0969668

EIRR = ... 0.2008065 = 100%

(Year)	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	TOTAL
1. CASH IN-FLOW															
2. TELEPHONE REVENUE	45,413	45,413	45,413	45,413	45,413	45,413	45,413	45,413	45,413	45,413	45,413	45,413	45,413	45,413	949,170
3. OTHER REVENUE	7,266	7,266	7,266	7,266	7,266	7,266	7,266	7,266	7,266	7,266	7,266	7,266	7,266	7,266	151,861
4. CONSUMER'S SURPLUS	7,009	7,009	7,009	7,009	7,009	7,009	7,009	7,009	7,009	7,009	7,009	7,009	7,009	7,009	146,650
5. TOTAL IN-FLOW	59,688	59,688	59,688	59,688	59,688	59,688	59,688	59,688	59,688	59,688	59,688	59,688	59,688	59,688	1,247,681
6. CASH OUT-FLOW															
7. CAPITAL COSTS	0	0	0	5,050	0	0	0	0	0	0	0	0	0	0	98,548
8. OPERATION COSTS	16,536	17,014	17,493	17,970	18,508	18,508	18,508	18,508	18,508	18,508	18,508	18,508	18,508	18,511	327,833
9. TOTAL OUT-FLOW	16,536	17,014	17,493	23,020	18,508	18,508	18,508	18,508	18,508	18,508	18,508	18,508	18,508	18,511	426,381
10. ANNUAL CASH FLOW	43,152	42,674	42,195	36,668	41,180	41,180	41,180	41,180	41,180	41,180	41,180	41,180	41,177	821,300	
11. ACCUMULATE ANNUAL CASH FLOW	287,966	330,640	372,835	409,503	450,683	491,863	533,043	574,223	615,403	656,583	697,763	738,943	780,123	821,300	8,154,445
12. DISCOUNTED CASH FLOW	2,772	2,283	1,880	1,360	1,272	1,059	882	734	612	509	424	353	294	245	233
13. ACCUMULATE DISCOUNTED CASH FLOW	-11,674	-9,391	-7,511	-6,151	-4,879	-3,820	-2,938	-2,204	-1,592	-1,083	-659	-306	-12	233	-720,748
14. DISCOUNT RATE	0.0642545	0.0535095	0.0445613	0.0371094	0.0309038	0.0257358	0.0214321	0.0178481	0.0148634	0.0123778	0.0103079	0.0085842	0.0071487	0.0059532	5.9502698

FIRR = ... 0.1813648 %

(Year)	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	TOTAL
1. CASH IN-FLOW															
2. TELEPHONE REVENUE	45,413	45,413	45,413	45,413	45,413	45,413	45,413	45,413	45,413	45,413	45,413	45,413	45,413	45,413	949,170
3. OTHER REVENUE	7,266	7,266	7,266	7,266	7,266	7,266	7,266	7,266	7,266	7,266	7,266	7,266	7,266	7,266	151,861
4. TOTAL IN-FLOW	59,688	59,688	59,688	52,679	52,679	52,679	52,679	52,679	52,679	52,679	52,679	52,679	52,679	52,679	1,101,031
5. CASH OUT-FLOW															
6. CAPITAL COSTS	0	0	0	5,050	0	0	0	0	0	0	0	0	0	0	98,548
7. OPERATION COSTS	16,536	17,014	17,493	17,970	18,508	18,508	18,508	18,508	18,508	18,508	18,508	18,508	18,508	18,511	327,833
8. TOTAL OUT-FLOW	16,536	17,014	17,493	23,020	18,508	18,508	18,508	18,508	18,508	18,508	18,508	18,508	18,508	18,511	426,381
9. ANNUAL CASH FLOW	36,143	35,665	35,186	29,659	34,171	34,171	34,171	34,171	34,171	34,171	34,171	34,171	34,171	34,168	674,650
10. ACCUMULATE ANNUAL CASH FLOW	232,433	268,098	303,284	332,943	367,114	401,285	435,456	469,627	503,798	537,969	572,140	606,311	640,482	674,650	6,510,408
11. DISCOUNTED CASH FLOW	2,966	2,477	2,069	1,476	1,439	1,218	1,031	873	739	625	529	448	379	321	308
12. ACCUMULATE DISCOUNTED CASH FLOW	-13,316	-10,839	-8,770	-7,294	-5,855	-4,637	-3,606	-2,733	-1,994	-1,369	-840	-392	-13	308	-75,7214
13. DISCOUNT RATE	0.0820803	0.0694792	0.0588126	0.0497836	0.0421408	0.0356712	0.0301949	0.0255594	0.0216354	0.0183139	0.0155023	0.0131224	0.0111078	0.0094025	6.4619030

2. ECONOMIC EVALUATION

Regarding the costs incurred by this submarine cable project and paying attention to that part of the costs which will be expended within Indonesia, this chapter analyzes the influence of these costs on the Indonesian economy and industry using the following two models:

① Macro-economic model - income multiplier effect

② Input-output model - production inducement effect

The macro-economic model regards the expenditures incurred by this project within Indonesia as a public investment, and, by paying attention to the difference in real GDP between two cases, where the project either exists or does not exist, the influence the public investment will exert on Indonesia is to be analyzed in a macro-economy.

Alternatively, the input-output model allots the expenditures described above among industries and final demand items, and is then used to determine the production volume by industry which will be induced by the expenditure. This model is also used to examine changes in production volume due to this project and to analyze the increase in employment generated by the increase in production volume.

However, comparing the cost for this project and the scale of Indonesia's GDP reveals the following:

The project cost expended in Indonesia (1987 value)
.... about 7 to 11 billion Rp

Indonesia's GDP (1985 nominal)
.... about 96 trillion 66 billion Rp

It is clear that both the income multiplier effect and the product inducement effect are small. Therefore, this section focuses on the measurement of income and production increases attributable to this project, and will not refer the multiplier effect to the whole of Indonesia.

2.1 Project Cost to be Used for Economic Evaluation

Based on the list of project costs by routes shown in Chapter 7, the proportion that will be expended within Indonesia is estimated. The preconditions are as follows.

① Expenditure for equipment is excluded because it will all be paid to foreign countries.

② Since training is conducted in foreign countries before the service starts, pertinent expenditure is regarded as that paid to foreign countries.

③ The domestic currency portions of installation expenditures excluding training fee, consultant fees and contingency are all expended within the local country.

④ As it is difficult to believe that the foreign currency portion the expenditures is entirely expended within Indonesia, the following arrangement was decided upon based on discussions with specialists.

- Construction, operation and maintenance costs for the backhaul system and consultant fees are regarded as the costs of procuring raw materials and sending technical experts, 10 percent of the costs are regarded as domestic expenditure.
- For installation costs for the submarine cable system, 30 percent of them are regarded as domestic expenditures.

⑤ Contingencies are allotted proportionately.

The project costs estimated in the above manner for the macro-economic model are shown in Table 8-2-1.

Next, estimating the project costs for the input-output model is attained by allotting the aforementioned project costs for the macro-economic model by industry and final demand items. The procedure is as follows.

① Purchasing of sites and the construction of buildings are regarded as fixed capital formation in the construction sector.

② The domestic currency portion of the installation cost for the submarine cable is regarded as government consumption in the transportation sector.

③ Others costs are regarded as private consumption in the service sector, by considering them as expenditures of, for example, lodging charges for foreign experts.

Thus, the estimated project cost for the input-output model is shown in Table 8-2-1.

Table 8-2-1 Project Costs for Economic Evaluation

(Million Rp)

		Plan-1A	Plan-1B	Plan-1C	Plan-2
Project costs for macro-economic model	(A) Yen currency	6721	5552	5412	4152
	(B) Rupia currency	1626	1636	2667	7535
	(C) (A) + (B)	8347	7188	8079	11,687
	(D) Initial investment sum	110,255	93,223	95,554	110,625
	(E) (C)/(D)	7.6%	7.7%	8.5%	10.6%
Project cost for input-output model	Fixed capital formation of construction sector	405	578	1255	3087
	Government consumption in transportation sector	233	193	184	104
	Private consumption in service sector	7709	6417	6640	8496
	Total	8347	7188	8079	11,687