APPENDIX H

RAINFALL AND WATER-LEVEL TELEMETERING SYSTEM STANDARD SPECIFICATIONS

RAINFALL AND WATER-LEVEL TELEMETERING SYSTEM

STANDARD SPECIFICATIONS

CONTENTS

CHAPTER 1 GENERAL

1-1 Scope

These specifications cover the rainfall and water-level telemetering system (called "this system" hereinafter) for river, dam and road management. Special operations and additional functions not covered by these specifications shall conform with the Specifications For Special Items (called "SSI" hereinafter).

1-2 Special Range

The basic system stipulated in these specifications shall not be modified by the previously mentioned SSI.

[COMMENT 1]

1. In principle, the functions that may be added according to SSI shall be within the range given in these Specifications.

1-3 Ambient Conditions

This system shall satisfy the ratings given in these Specifications under the following conditions:

Classification \ Equipment		Master station eq. and monitoring station eq.	Repeater station eq.	Gauging station eq.
Electrical section	Temp.	-5°C - +40°C	-10°C - +40°C	-10°C - +40°C
	Relative humidity	90% or less	90% or less	95% or less
Mechanical section	Temp.	+5°C - +40°C		
	Relative humidity	40% - 90%		

[COMMENT 2]

1. To operate the master station equipment and monitoring station equipment stably for an extended period of time, air conditioning and dustproofing measures should be considered.

2. "Mechanical section" indicates the typewriter.

3. When the relative humidity, one of the ambient conditions of the repeater station equipment, exceeds 90%, the cabinet shall employ a moistureproof construction in accordance with the specification of SSI. However, in this case, the additional functions shall be housed in a separate cabinet.

1-4 Power Requirement

The power supply operating range and ratings-guaranteed range of this system shall be as follows.

		Operating range	Ratings-guaranteed range
Master station eq. and Monitoring station eq.	Telemetering eq. and monitoring eq.	(1) DC 21.6V - DC 26.4V (+ ground) Ripple 3% or less Noise voltage 5mV or less (2) Single-phase AC 100V ± 10% 50Hz or 60Hz	(1) DC 21.6V - DC 26.4V (+ ground) Ripple 1% or less Noise voltage 5mV or less (2) Single-phase AC 100V ± 10% 50Hz or 60Hz
	Typewriter	Single-phase AC 100V ± 10% 50Hz or 60Hz	
Repeater station eq. and Gauging station eq.	Repeater eq. and Telemetering eq.	DC 10.5V - DC 16.5V (- ground) Ripple 3% or less Noise voltage 5mV or less	DC 10.8V - DC 14.5V (- ground) Ripple 1% or less Noise voltage 5mV or less

[COMMENT 3]

1. Whether the power supplied to the master station equipment and monitoring station equipment is DC24V or AC100V must be specified in the SSI. However, even when this power is DC24V, the power supplied to the typewriter shall be AC100V.

2. The power supply unit installed shall be for AC or DC operation depending on whether the power supplied to the master station equipment and monitoring station equipment is AC or DC.

3. Because of the supply voltage of the newest circuit elements, DC power supply grounding is normally negative (-), but is made positive (+) when power is shared by multiplex radio equipment, telephone exchange or other similar equipment.

4. DC24V can be supplied to the repeater equipment and telemetering equipment by adding a DC-DC converter to each equipment.

1-5 Electrical and Mechanical Strength

No electrical or mechanical abnormalities shall occur after this system has been left standing for 4 hours under the following conditions.

(1) Ambient temperature -20°C and +50°C

(2) Relative humidity 95% (ambient temperature +35°C)

[COMMENT 4]

1. "Electrical and mechanical strength" indicates that the equipment provides normal operation when restored to the ambient conditions of par. 1-3 after standing under the above ambient conditions with the power supply to each equipment turned off.

1-6 Construction

Printed circuit boards shall employ a plug-in system for easy mounting and dismounting, as standard. Inspection, adjustment and other operations shall be performed from the front of each unit.

1-6-1 Telemetering equipment for master station and monitoring station

Bay dimensions shall be 2,350 mm high, 520 mm wide and 250 mm deep or less. The front door shall be constructed to open outward to both sides from the center.
Connections to external devices shall be made at the top or bottom of the bay.

1-6-2 Repeater equipment

Bay dimensions shall be 2,000 mm high, 520 mm wide, and 250 mm deep or less. The front door shall be constructed to open outward to both sides from the center.
Connections to external devices shall be made at the top or bottom of the bay.
However, in the case of moistureproof construction, such construction shall be specified by SSI, and in this case the above bay dimensions shall not apply.

1-6-3 Telemetering equipment for gauging station

The cabinet shall be of wall-mount type having dimensions of 600 mm high, 600 mm wide, and 300 mm deep or less, and shall use packing considering moistureproofing.

[COMMENT 5]

1. A mounting base shall be necessary when the telemetering equipment for gauging station is not used as wall-mount type.

1-7 Coating

1-7-1 The bay and cabinet coating shall be baked coating after rust-resisting processing.

1-7-2 The color of the bay and cabinet shall be Munsell 2.5B6/3.

1-7-3 The color of operating console, etc. shall be specified separately with color sample, etc.

1-8 Nameplates

1-8-1 Equipment nameplate

The equipment name, model, serial No., date of manufacture and manufacturer's name shall be designated on the equipment nameplate.

1-8-2 Equipment main sections and main electrical parts indication

The main sections of the equipments shall be indicated by nameplates, engraving or stamping. Symbols or numbers of main electrical parts that can be collated with the circuit diagrams shall be indicated. Moreover, special handling precautions shall be indicated in red at the required points.

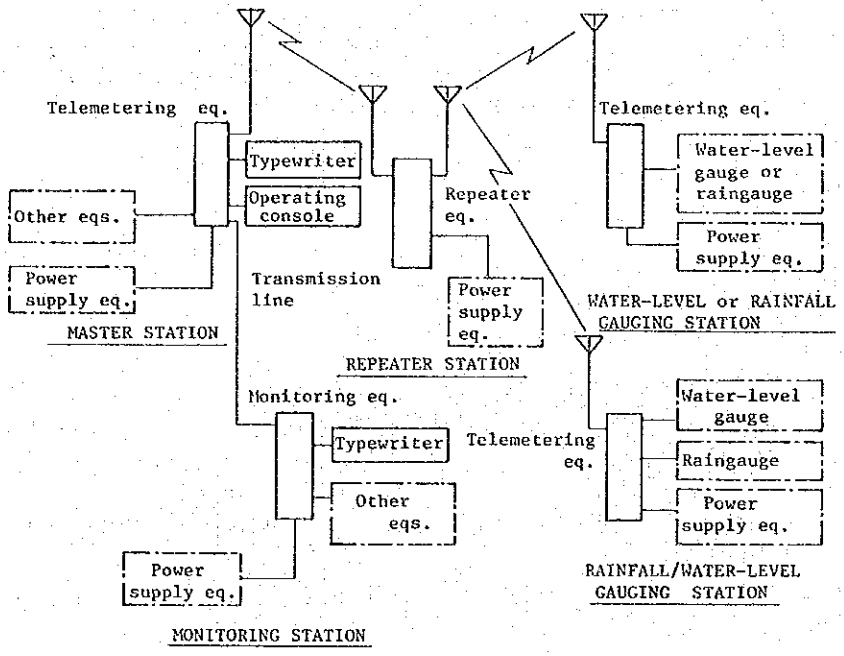
[COMMENT 6]

1. In case a radio equipment is installed, a radio equipment nameplate shall be fitted, together with the nameplate of the equipment on which it is installed.

CHAPTER 2 SYSTEM CONFIGURATION AND FUNCTIONS

2-1 System Configuration

This system shall consist of one master station and a maximum of 30 gauging stations (including repeater stations and monitoring stations as required), and shall have a system configuration as shown below.



TELTMETERING SYSTEM CONFIGURATION (Example)

Legend : 1. ▭ --- Standard configuration equipments.

2. ⬚ --- Equipments outside the scope of these specifications.

[COMMENT 7]

1. In the telemetering system configuration diagram, the master station and repeater station are connected by a simplex radio link, but may also be connected by a multiplex radio link.

2. The monitoring station equipment may also be connected via a repeater station, or directly to the master station by a simplex radio link or multiplex radio link or other similar link.

2-2 Description of Operation

2-2-1 The master station shall gather and print rainfall, water-level

and other data by calling the gauging stations.

2-2-2 The gauging stations shall automatically send the data from a raingauge, a water-level gauge, etc. on calling from the master station.

2-2-3 The monitoring station shall receive and print the rainfall and water-level data from the gauging stations via the master station, the repeater station or directly.

2-2-4 When repeater stations are provided in this telemetering system, the repeater stations shall be automatically started before calling of the gauging stations, and shall be stopped after the end of control of the gauging stations.

2-3 System Functions

2-3-1 Calling mode

1) Automatic calling

This calling shall be started automatically by a clock, and shall be directed to all the gauging stations, except the stations that are shutdown, in the predetermined order. The calling shall be made at the following 6 intervals: 10 minutes, 15 minutes, 30 minutes, 1 hour, 3 hours, and 12 hours.

Moreover, automatic calling shall have priority over other modes of calling.

2) Manual calling

This calling shall be started manually and be directed to all the gauging stations or the gauging stations arbitrarily selected, in the predetermined order.

3) External start calling

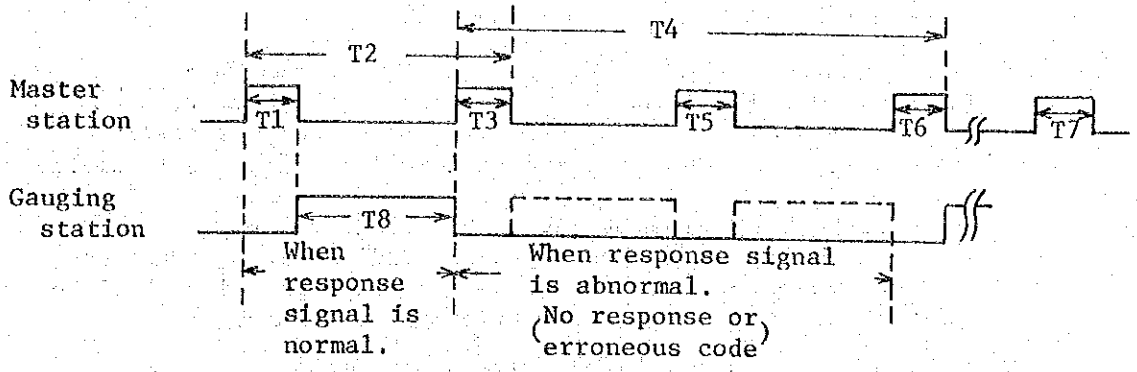
This calling mode shall permit gauging stations to be called by start signals from external devices.

4) Re-calling

If any error code has been detected in the data code from a gauging station, or if there is no response from a gauging station, that gauging station shall be automatically re-called once more. If there is an error code or a called gauging station failed to respond again, a visual and audible alarm shall be actuated and the system shall shift to the next operation.

[COMMENT 8]

1. The operation sequence of this system shall be as follows:



T1: Date and time printing and No.1 station calling (including reperater station starting when there is a repeater station)

T2: No.1 station processing

T3: No.1 station printing and No.2 station calling

T4: No.2 station processing

T5: No.2 station re-calling

T6: No.2 station printing and No.3 station calling

T7: Final station printing (including repeater station stopping when there is a repeater station)

T8: Response signal transmission

2-3-2 Response mode

The gauging station called from the master station shall convert the measured values into digital signals and then send the measurement code to the master station.

2-3-3 Data code check system

The master station shall perform the following code checks each time a data code is received:

1) Odd parity check at each digit

2) Check of total number of bits

2-3-4 Printing and display

The data code shall be received from the gauging stations, and the following printing and display operations shall be performed at the master station:

1) When the received data code is normal, the measured value and additional information shall be printed at the predetermined station position, and the data shall be digitally displayed.

2) When the received data code is faulty, printing and display of faulty code shall be performed. However, when total bits and station number bits are normal, processing for faulty code shall only be performed for the faulty digit.

3) Printing format shall be page tabulation by a typewriter. The date, time, measured values and additional informations for one measuring operation or monitoring operation shall be printed at the predetermined printing positions.

2-3-5 Number of connectable transmission lines

The telemetering equipment for master station and monitoring equipment shall be connectable to a maximum of 3 transmission lines by arbitrarily combining the following transmission lines. However, the data code from the transmission lines of 2 or more directions shall not be input simultaneously into the monitoring equipment.

1) Simplex radio links

2) Multiplex radio links

3) Wire line

2-3-6 Repeating system

1) The repeating system shall be of the following two kinds:

(1) Simplex radio link and simplex radio link repeating (Called "V-V repeating" hereinafter.)

(2) Multiplex radio link and simplex radio link repeating (Called "μ-V repeating" hereinafter.)

2) Transmitter and receiver

(1) The transmitters shall employ a No.1 unit/No.2 unit changeover system.

(2) The receivers shall employ a No.1 unit/No.2 unit parallel operation system.

3) Transmitter failure detection and changeover system

(1) When the output of a transmitter has dropped to 1/2 or more, failure display shall be actuated and operation shall be automatically switched to the other transmitter. However, switching shall not be performed if the other transmitter is already faulty.

(2) Forced switching between the No.1 transmitter and No.2 transmitter by the local test buttons shall be possible.

4) Receiver failure detection

Receiver failure datection shall be performed by comparison and detection of the presence or absence of squelch voltage at the two receivers.
However, disconnection of the receiver judged to have failed shall be unnecessary. Moreover, the failure display shall be reset automatically when the failed receiver is judged to be normal.

2-3-7 Voice communication

Voice communication between the master station and gauging stations shall be possible in this system. Moreover, automatic calling shall have priority over voice communication.

2-4 Transmission System

2-4-1 General

(1) Communication system	Semi-duplex communication
(2) Calling signal system	2-frequency series signal
(3) Data code system	Long-short pulse system (RZ code system) Long mark (1) 60 ±12mSec Short mark (0) 20 ±4mSec Space 20 ±4mSec
(4) Transmission speed	50 bauds
(5) Data code check system	Parity check at each digit and total number of bits check
(6) Modulation system (measurement code)	Subcarrier frequency shift system
(7) Subcarrier frequency (fo)	Specified from the following frequencies by SSI. a. 2635 Hz b. 2465 Hz c. 2295 Hz d. 2125 Hz e. 1955 Hz

(8) Frequency shift width (Δf)	Specified subcarrier frequency (fo) ± 35 Hz
(9) Frequency shift direction	Mark (fo + Δf) Space (fo - Δf)
(10) Subcarrier shift frequency accuracy	± 6 Hz or less
(11) V-V repeater remote control signal system	2-frequency series signal system
(12) μ-V repeater control system	Ringer signal system (sent at control)

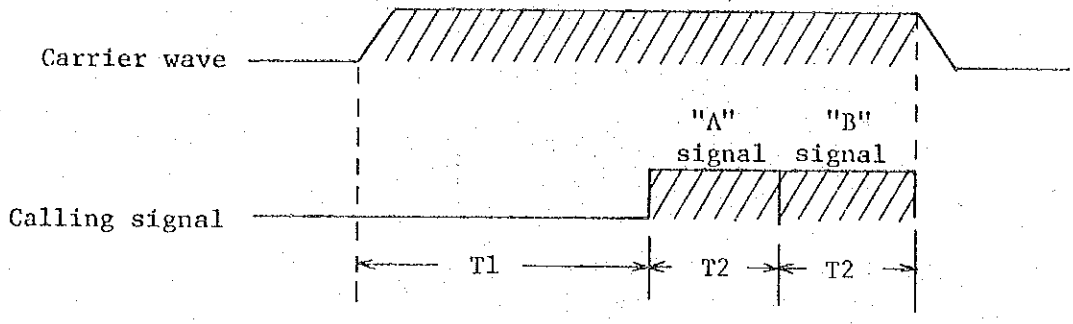
[COMMENT 9]

In the case of μ-V repeating, a ringer shall be sent for control to prevent abnormal operation of the transmitter by a trouble or momentary interruption of ringer circuit.

2-4-2 Calling signal system

1) Calling signal

The calling signal shall be a 2-frequency series signal system using frequencies in the voice band. The calling signals shall be sent in "A" signal, "B" signal order.
The calling signals shall be sent in accordance with the following time chart.



T1: Unmodulated radio frequency send time: 1000 ±100mSec

T2: "A" signal, "B" signal send time: 600 ±60mSec
Moreover, sending of the remote control signal for V-V repeater shall conform to the above.

[COMMENT 10]

1. The unmodulated radio frequency send time shall be as indicated below, considering control of one repeater station. Total required time is 900mSec, but shall be 1000 ±100mSec, considering the setting accuracy.

	Master station		Repeater station			Gauging station		Total
	Calling control	Tx	Rx	Repeat control	Tx	Rx	Signal detect	
Required time	50 mSec	100 mSec	200 mSec	100 mSec	100 mSec	200 mSec	150 mSec	900 mSec

2) Signal frequencies

The "A" signal and "B" signal used to call the gauging stations shall be specified from the following frequencies according to SSI.

(1) "A" signal

"A" Signal	Frequency
A 1	487.5 Hz
A 2	502.5
A 3	517.5
A 4	532.5
A 5	547.5
A 6	562.5
A 7	577.5
A 8	592.5
A 9	607.5
A 10	622.5
A 11	637.5
A 12	652.5
A 13	667.5
A 14	682.5
A 15	697.5

(2) "B" signal

"B" signal	Frequency	Remarks
B 1	412.5 Hz	
B 2	427.5	
B 3	442.5	
B 4	457.5	
B 5	472.5	
B 6	382.5	Repeating-start signal
B 7	397.5	Repeating-stop signal
B 8	352.5	No.1 → No.2 transmitter changeover signal (Repeater station)
B 9	367.5	No.2 → No.1 transmitter changeover signal (Repeater station)

[COMMENT 11]

The calling signals should be allocated as follows:

Gauging station		Calling signal
No. 1	:	Am . B1
No. 2	:	Am . B2
No. 3	:	Am . B3
No. 4	:	Am . B4
No. 5	:	Am . B5
No. 6	:	An . B1
No. 7	:	An . B2

3) Repeater station control

In case there is a V-V repeater station in the transmission links, a repeating-start signal shall be antomatically sent before calling of gauging stations, and a repeating-stop signal shall be sent after the end of measurement operation. B6, B7, B8 and B9 of the "B" signals added to the "A" signal shall be used as the repeater control signals.

4) Re-calling control

The time interval in which re-calling is performed shall be between 10Sec to 11Sec.

[COMMENT 12]

1. If the accuarcy of calling time and the gauging station protective circuit are considered, the re-calling time interval is basically 9,420 mSec, but shall be 10,000mSec (10 Sec) — 11,000mSec (11 Sec), considering the setting accuracy.

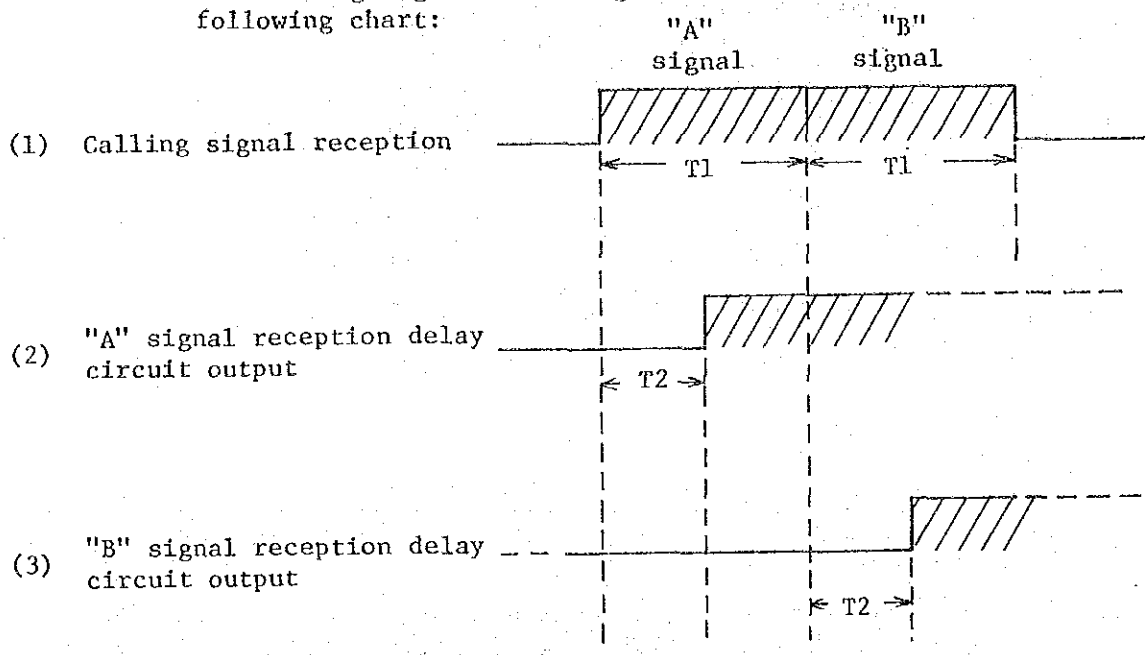
(Maximum calling time) + (maximum gauging station protective circuit time) = 2,420mSec + 7,000mSec = 9,420mSec

2-4-3 Gauging station receiving and responding system

Each gauging station shall send a response aignal to the master station only when it has received its calling signal allocated.

1) Calling signal receiving time chart

The calling signal receiving time shall conform to the following chart:



T1: "A" signal/"B" signal send time: 600 ±60mSec

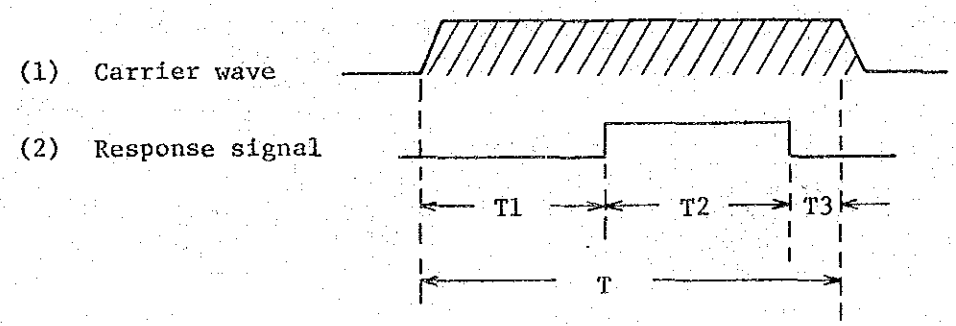
T2: Delay time for prevention of voice erroneous operation: 450mSec or more (including circuit delay time)

[COMMENT 13]

1. Voice noise is generally considered to be 250mSec or less. The delay time for prevention of voice erroneous operation shall be 450mSec by adding the 150mSec delay time of the signal detection elements to the 250mSec voice noise, plus a small margin.

2) Response signal transmission time chart

The response signal transmission time shall conform to the following chart:



T: Response signal

T1: Head space : 1,500 ±300mSec

T2: Data code : 1,344mSec (shortest code configuration) - 2,688mSec (longest code configuration)

T3: End space : 80 ±16mSec

[COMMENT 14]

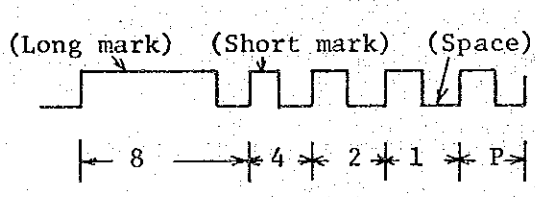
1. "Head space" is a signal used before the code to detect the beginning of the response signal from the gauging station at the receiving equipment (master station and monitoring station).

2. "End space" is a signal used after the code to detect the end of the response signal from the gauging station at the receiving equipment (master station and monitoring station).

3. The head space is 1,200mSec as shown below when control of one repeater is considered, but shall be 1,500 ±300mSec, considering the setting accuracy and other factors.

Gauging station		Repeater station			Master station		Total
Response control	Tx	Rx	Repeat control	Tx	Rx	Space detect	
50 mSec	100 mSec	200 mSec	100 mSec	100 mSec	200 mSec	450 mSec	1200 mSec

4. "Shortest code configuration" is a code configuration including one bit of long mark in each digit.
The code configuration is shown below:



(The code configuration of the decimal number "8" is shown at the left.)

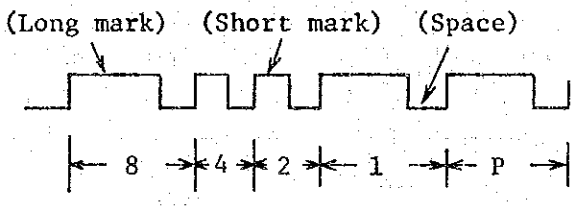
Therefore, the shortest time length per digit is as follows:

Shortest time length per digit = (long mark length - 20%) × 1 + (short mark length - 20%) × 4 + (space length - 20%) × 5 = (60mSec - 12mSec) × 1 + (20mSec - 4mSec) × 4 + (20mSec - 4mSec) × 5 = 48mSec × 1 + 16mSec × 4 + 16mSec × 5 = 192mSec

Consequently, the code length for the shortest code configuration is given by the following equation.

Shortest code length = (shortest code length per digit) × 7
= 192mSec × 7 = 1,344mSec

5. "Longest code configuration" is a code configuration including three bits of long mark in each digit.
The code configuration is shown below:



(the code configuration of the decimal number "9" is shown at the left.)

Therefore, the longest code length per digit is as follows:

Longest code length per digit = (long mark length + 20%) × 3 + (short mark length + 20%) × 2 + (space length + 20%) × 5 = (60mSec + 12mSec) × 3 + (20mSec + 4mSec) × 2 + (20mSec + 4mSec) × 5 = 72mSec × 3 + 24mSec × 2 + 24mSec × 5 = 384mSec

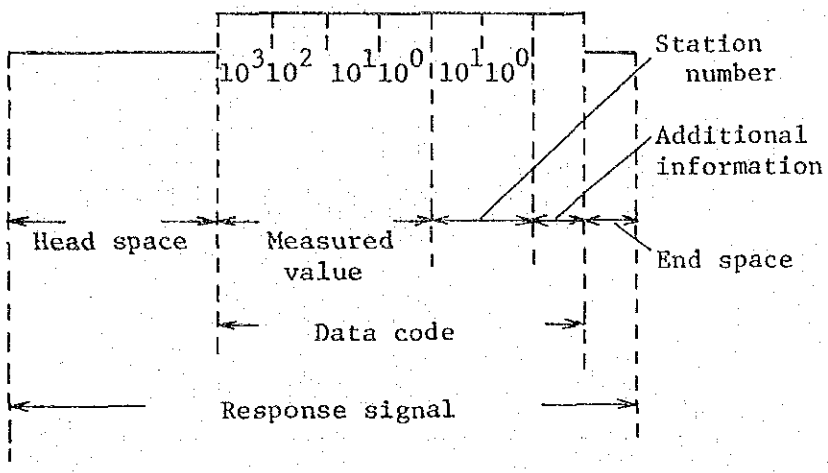
Consequently, the code length for the longest code configuration is given by the following equation.

Longest code length = (longest code length per digit) × 7
= 384mSec × 7 = 2,688mSec

6. The end space has a 4 space length that is impossible with the normal code configuration.

3) Response signal configuration

(1) The configuration of the response signal sent in response to calling shall conform to the following diagram:



(2) The data code items and number of digits shall be as follows:

Measured value: 4 digits

However, when the number of significant digits of the measured value is 3 digits, the 4th digit (thousands) shall be set to "0" as a dummy.

Station number: 2 digits

Additional information: 1 digit, 1 item

(3) The measured value, station number and additional information shall be binary-coded-decimal code to which a parity bit is added.

[COMMENT 15]

1. The correspondence between decimal value and binary-coded-decimal code is as follows:

1: long mark

0: short mark

		Decimal value									
		0	1	2	3	4	5	6	7	8	9
Binary-coded-decimal code	8	0	0	0	0	0	0	0	0	1	1
	4	0	0	0	0	1	1	1	1	0	0
	2	0	0	1	1	0	0	1	1	0	0
	1	0	1	0	1	0	1	0	1	0	1
	P	1	0	0	1	0	1	1	0	0	1

2. The raingauge uses 3 digits, but the water-level gauge uses 3 digits or 4 digits depending on the measurement site. When the number of measured digits is 3 ditits, the number of digits to be sent out is uniformly 4 digits by adding "0" as a dummy.

3. The station number of gauging station should coincide with the calling order, considering coinstallation of a monitoring system.

4. The item of additional information handled by one gauging station shall be one of the following:

   (1) Power supply voltage drop

   (2) Power supply abnormal

   (3) Water level abnormal

   (4) Housing door open/close

   (5) Other specified items

5. The bit configuration of the additional information is as follows:

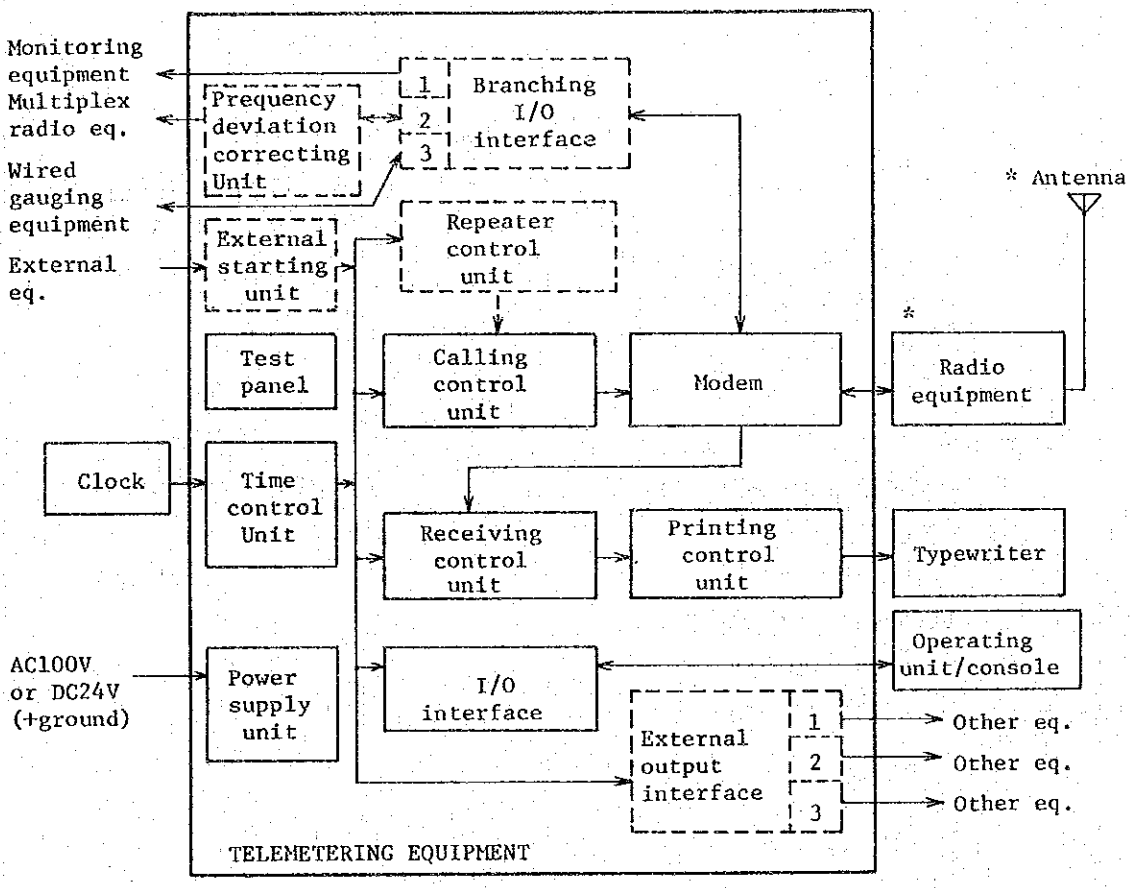
Item	Additional information bit format					Printing format
	8	4	2	1	P	
Normal	0	1	0	1	1	+
Abnormal	0	1	1	0	1	-

CHAPTER 3 EQUIPMENT COMPOSITION AND SPECIFICATIONS

3-1 Master station Equipment

3-1-1 Equipment composition

1) The equipment composition of the master station, including standard composition and optional functions, shall be as follows:



Legend : 1. * ; Not used when connected to μ-V repeater.

2. ; Standard composition

3. ; Optional functions

2) Components shall be as follows:

	Name	Qnt'y	Remarks
1	Telemetering equipment	1	
- 1	Modem	1	
- 2	Calling control unit	1	
- 3	Receiving control unit	1	
- 4	Printing control unit	1	
- 5	I/O interface 1	1	
- 6	Time control unit	1	
- 7	Test panel	1	
- 8	Power supply unit	1	
- 9	Bay	1	
-10	I/O interface 2	1	Optional function. Conforms with SSI.
-11	Frequency deviation correcting unit	1	"
-12	External output interface	1	"
-13	Repeater control unit	1	"
-14	External starting unit	1	"
2	Operating unit/console	1	Conforms with SSI.
3	Typewriter	1	
4	Radio equipment	1	Conforms with SSI.
5	Antenna equipment	1	"
- 1	Antenna	1	
- 2	Coaxial arrester	1	
6	Clock		Conforms with SSI.
7	Accessories	1 set	
- 1	Test cord	1	
- 2	Adjustment tools	1 set	
- 3	Handset	1	
- 4	Instruction manual	3 copies	Including those for each station equipment.
- 5	Test data	3 copies	
- 6	Technical service card	1 copy	In card case.
- 7	Accessory box	1	

[COMMENT 16]

The "Technical service card" for the master station consists of a block diagram, components diagram, transmitting and receiving radio frequencies table, send level table for each control signal and subcarrier signal frequency table, and has the following contents:

1. Block diagram

   (1) Diagram of each functional block. The operating system and each signal system are clearly indicated.

   (2) Symbols which can be collated with the components diagram of item 2 below are indicated at test points.

   (3) The standard level of each transmitting and receiving signal is entered in the system diagram.

2. Components diagram

   (1) The printed circuit boards and other units mounted in the telemetering equipment are clearly indicated in this diagram. Symbols that can be collated with the block diagram are indicated at the U-links and other test points.

   (2) The standard level, allowable range and measured value are stated at the transmitting and receiving signal test points.

3. Transmitting and receiving radio frequencies table

   When the telemetering equipment is equipped with radio equipment, the frequencies and transmitting output of the radio equipment are entered in this table.

4. Send level table for each calling signal

   The measured send level of each calling signal is entered in this table.

5. Subcarrier frequency table

   The subcarrier frequency of the response signal used in this system is entered in this table.

The technical service card for the gauging stations, repeater stations, and monitoring stations shall also conform with the above.

3-1-2 Functions and ratings

1) Telemetering equipment

Of the following units, the modem, receiving control unit,

printing control unit, time control unit, and power supply unit shall also be applicable when these units are used at a monitoring station.

(1) Modem

This unit shall send the calling signals and convert the frequency modulated signals into pulse codes.

(2) Calling control unit

This unit controls calling of the gauging stations.
A maximum calling capacity of this unit shall be 30.

(3) Receiving control unit

This unit shall convert the demodulated series code into parallel code, and perform code checks.

(4) Printing control unit

This unit shall output the following items in the parallel codes converted by the receiving control unit.

(a) Numbers and symbols: 1,2,3,4,5,6,7,8,9.0, +, -, & *

(b) Functions: Space, tabulation, carriage return, and power control

(5) I/O interface

This unit shall exchange signals between the calling control unit, receiving control unit, printing control unit and test panel, and shall exchange signals with external devices as operating units.

(6) Time control unit

This unit shall be driven by 1 minute pulses from the clock, and shall output the date and time data to the other units.
The date shall be changed automatically, and number of days of the month shall be set manually.

[COMMENT 17]

1. Measuring capacity of 30 stations has been selected, considering the data gathering time, but up to about 40 stations is possible, if necessary.

2. The time control unit may also be incorporated in the clock.

(7) Test panel

Telemetering equipment shall have the following functions for system monitoring and maintenance at the test panel, etc.

	Function	Operation	Display	Remarks
1	Test calling	o	-	Individual
2	Reset	o	-	For operation reset
3	Buzzer off	o	-	
4	Voice communication	o	-	
5	I/O level measurement	o	-	At U-links, etc. (By external measuring instruments)
6	Lamp test	o	-	
7	Calling frequency transmission	o	-	
8	Power ON/OFF	o	-	
9	Squelch adjustment	o	-	When equipped with radio equipment.
10	Typewriter printing ON/OFF	o	-	
11	Repeating start, stop control	o	-	When repeater station installed.
12	Data bit display	-	o	
13	Manual lock	-	o	
14	Receiving failure	-	o	
15	Transmitting	-	o	
16	Measuring	-	o	
17	Power	-	o	
18	Monitoring by voltmeter	-	o	Power supply voltage measurement use

(8) Power supply unit

This unit shall supply the necessary power to each unit. Its input shall be AC100V or DC24V (+ grounded).

[COMMENT 18]

1. Of the operating functions of the telemetering equipment, test calling and repeating start/stop control can be performed by setting the calling signal by a rotary switch or other switch, considering space and economy.

2. Of the operating functions of the telemetering equipment, the I/O level measurement is provided for measurement of the S/N ratios of the telecommunication links.

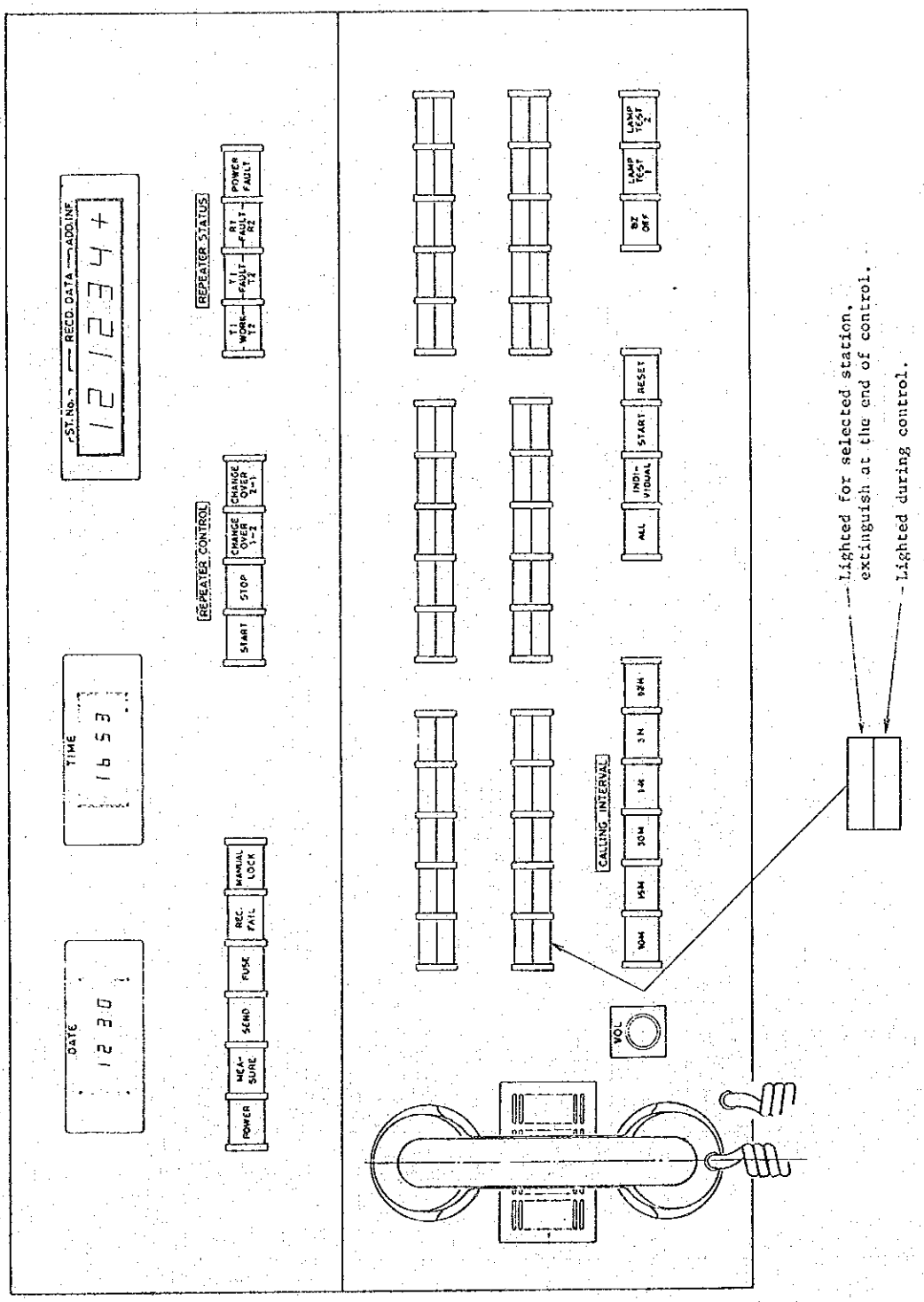
2) Operating unit/console

(1) The operating unit shall be connected to the telemetering equipment and shall perform the following operations and display. It shall be of table-top type.
However, it shall be of stand-alone type when an operating console is used.

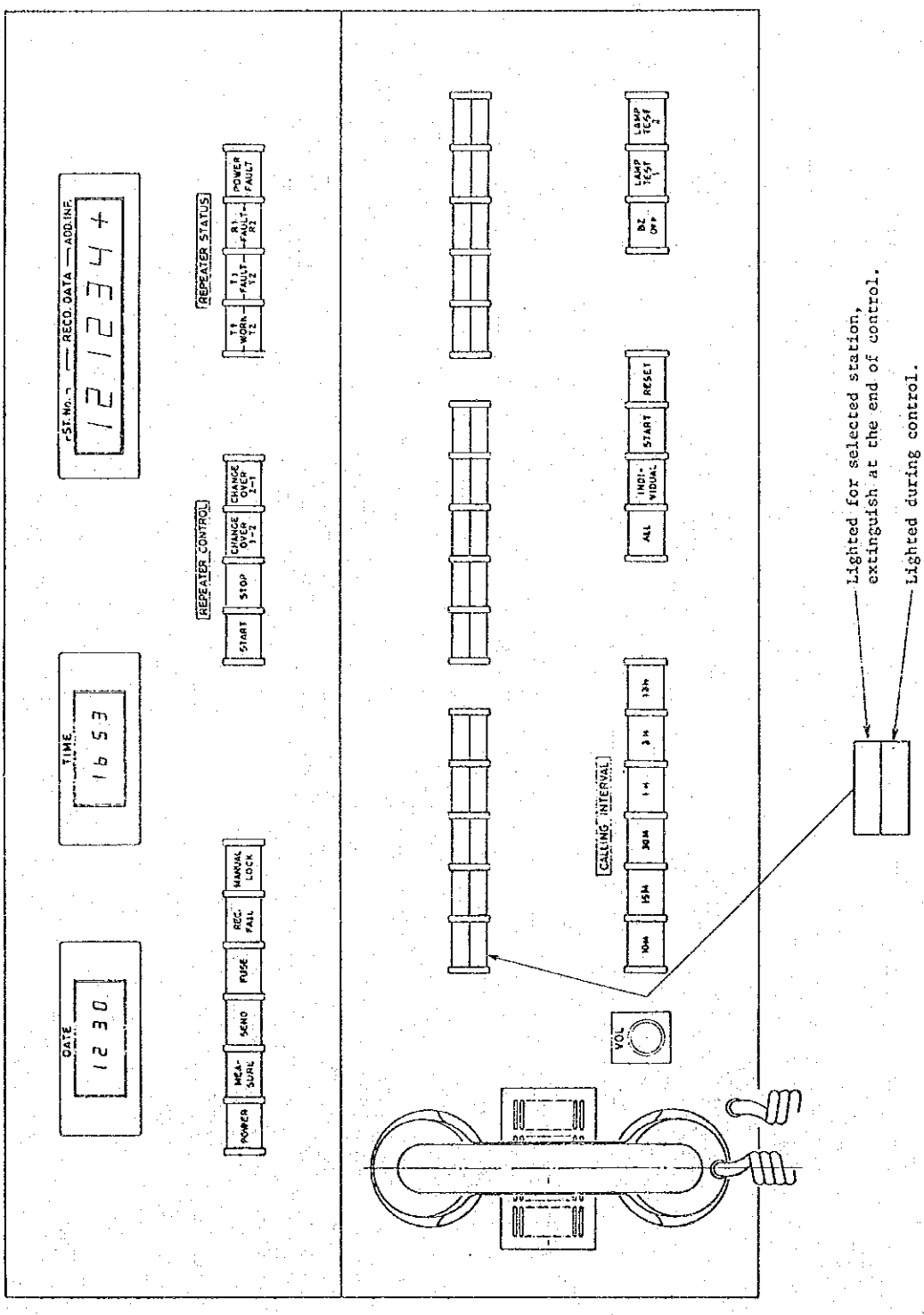
	Function	Operation	Display	Remarks
1	Station selection	o	-	Maximum 30 stations
2	Calling interval setting	o	-	10min, 15min, 30min, 1hr, 3hr, and 12hr
3	Measuring mode selection (All stations or individual stations)	o	-	
4	Manual starting, resetting	o	-	
5	Buzzer off	o	-	
6	Voice communication		-	
7	Transmitting	-	o	
8	Measuring	-	o	
9	Received data display	-	o	
10	Responding station	-	o	
11	Manual lock	-	o	
12	Receiving failure	-	o	
13	Time display, correction	o	o	Digital display
14	Power	-	o	
15	Burnt out fuse	-	o	
16	Lamp test	o	-	
17	Repeater control and display	o	o	Optional function

(2) The panel layout of the operating unit console shall be as follows.

a. For 30 stations capacity



b. For 15 stations capacity



c. Others

(a) Dimensions shall be specified in SSI.

(b) If there is an unnecessary switch, that shall be provided as a spare one, but wiring shall not be performed.

(c) A time correction function must also be provided at the operating unit/console, in addition to those given above.

d. When a stand-alone type operating console is required, it shall be specified in SSI.

[COMMENT 19]

1. A stand-alone type operating console conforms with the SSI but operation and display shall be within the range of functions of the operating unit, as a rule.

2. When the output of the A/D converter in dam water-level gauge or other similar sensor equipment is connected in parallel, a function that constantly displays the dam water level, etc. can be added according to SSI.

3) Typewriter

(1) Ratings

(a) Carriage width	13, 18, 24 or 27 inches, specified in SSI.
(b) Line feed	1/6, 1/4, 1/3 and 1/2 inch (Selectable in 4 steps)
(c) Character size	12 chars/inch
(d) Printing speed	4 chars/sec or greater (alphabet only)
(e) Control keys	Power, carriage return, tabulation, spacing and ribbon selection
(f) Printing keys	Numbers and alphabet
(g) Maximum printing width	(Carriage width - 1 inch)

(2) The following functions shall be remotely controllable.

(a) Numbers	1,2,3,4,5,6,7,8,9 and 0

	(b) Symbols	*, +, -,
	(c) Others	Carriage return, tabulation, spacing and power control

[COMMENT 20]

1. One typewriter shall be connectable to one telemetering equipment.

2. The number of gauging stations printable at the typewriter is found as follows:

$$\text{Number of printable gauging stations} = \frac{[(\text{carriage width} - 1\ \text{inch}) \times \text{number of printing characters/inch} - (\text{number of date, time printing characters})]}{\text{Number of printing characters/station}}$$

(NOTE) Number of printing characters/inch: 12 chars/inch
Number of printing characters/station: 8 chars/station
Number of date printing characters: 8 chars
Number of time printing characters: 8 chars

3. Zero suppression not performed.

4. Tabulation example

DATE	TIME	No. 1 station	No. 2 station	Remarks
u02u18uu	u12u00uu	u1234u+u	u2345u+u	Example of all stations calling.
u02u18uu	u12u08uu		u3456u-u	Example of individual station calling.

Example of power normal

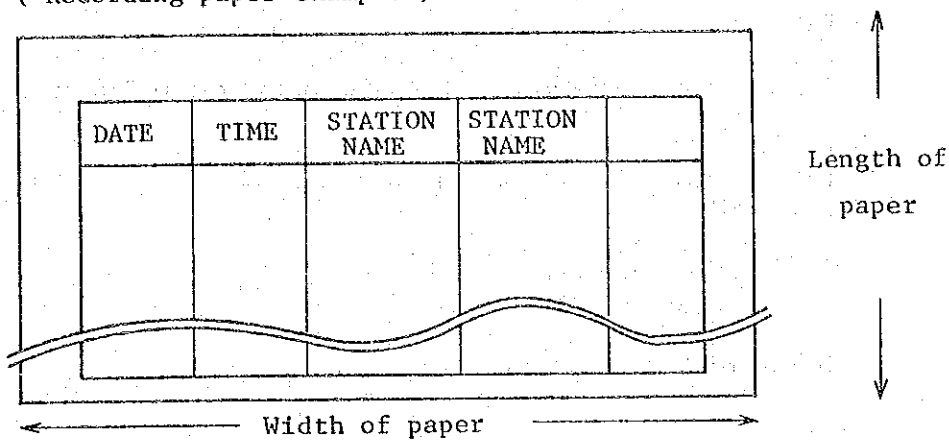
Example of power abnormal

(NOTE) u indicates a space.

5. Deciding the recording paper

The width of the recording paper is decided from the number of gauging stations, and the length of the recording paper is decided from the number of lines printed on one sheet.

(Recording paper example)



(Legend)

The case when JIS standards A size and B size paper is used is shown below.
(Conditions are 1/6 inch line feed and 1 inch = 25.4 mm margin at both ends of the paper.)

Paper size			Number of gauging stations	Number of printing lines	Typewriter
Standard	Width (mm)	Length (mm)			
A1	594	841	30 or less	186 or less	24 inches or 27 inches
A2	420	594	19 or less	128 or less	18 inches
A3	297	420	12 or less	87 or less	13 inches
B2	515	728	25 or less	159 or less	24 inches or 27 inches
B3	364	515	16 or less	109 or less	18 inches
B4	257	364	10 or less	73 or less	13 inches

4) Radio equipment

This equipment shall be installed at the telemetering equipment, and shall satisfy the following functions and ratings. Moreover, these specifications shall also be applicable when this equipment is used at the gauging stations, repeater

stations and monitoring stations.

(1) Functions

(a) Antenna matchable range	Standing wave ratio 2.0 or less
(b) Transmitting output check	By external meter
(c) Modulation input check	"
(d) Demodulated output check	"
(e) Squelch adjustment	Continuously variable
(f) Demodulated output adjustment	Standard value ±3dB
(g) Monitor speaker volume adjustment	0 to 0.3W

(2) Transmitter ratings

(a) Type of emission	F2, F3
(b) Output	Specified out of 1W, 3W, and 10W according to SSI. Moreover, output rating shall be between +10% and -20% at 12.0V power supply voltage. (However, shall be within ±10% at 12.0V power supply voltage at normal temperature.)
(c) Frequency	70MHz band or 400MHz band. Frequency, specified separately.
(d) Antenna impedance	50 Ω
(e) Modulation method	Phase modulation
(f) Modulation input	1kHz, linear up to 70%. Input required for 70% modulation is within -4dBm ±3dB.
(g) Allowable frequency error	Within $\pm 10 \times 10^{-6}$
(h) Maximum frequency deviation	Within ±5kHz

(i) Modulation frequency response	Referred to 1kHz, 30% modulation 0.3kHz -10.5dB ±2dB 2.0kHz + 6.0dB ±2dB 2.7kHz + 8.5dB ±2dB 3.0kHz + 8.0dB ±2dB
(j) S/N ratio	45dB or greater at 1kHz, 70% modulation
(k) Distortion	10% or less at 1kHz, 70% modulation
(l) Spurious	
70 MHz --------	1mW or less. Moreover, must be 80dB in-band, 60dB or more out-of-band lower than average power of fundamental wave.
400 MHz --------	1mW or less. Moreover, must be 60dB or more lower than average power of fundamental wave.
(m) Occupied bandwidth	Shall be within 16kHz.
(3) Receiver ratings	
(a) Frequency	70MHz band or 400MHz band. Frequency, specified separately.
(b) Antenna impedance	50 Ω
(c) Receiving system	Superheterodyne
(d) Allowable local oscillator frequency error	Within $\pm 10 \times 10^{-6}$
(e) Bandwidth	12kHz or greater at 6dB down
(f) Selectivity	Within 25kHz at 70dB down
(g) Receiving frequency response	Referred to 1kHz, 30% modulation 0.3kHz ±10.5dB ±2dB 2.0kHz - 6.0dB ±2dB 2.7kHz - 8.5dB ±2dB 3.0kHz - 9.5dB ±2dB
(h) S/N ratio	30dB or greater at 15dBμV input at 1kHz, 70% modulation

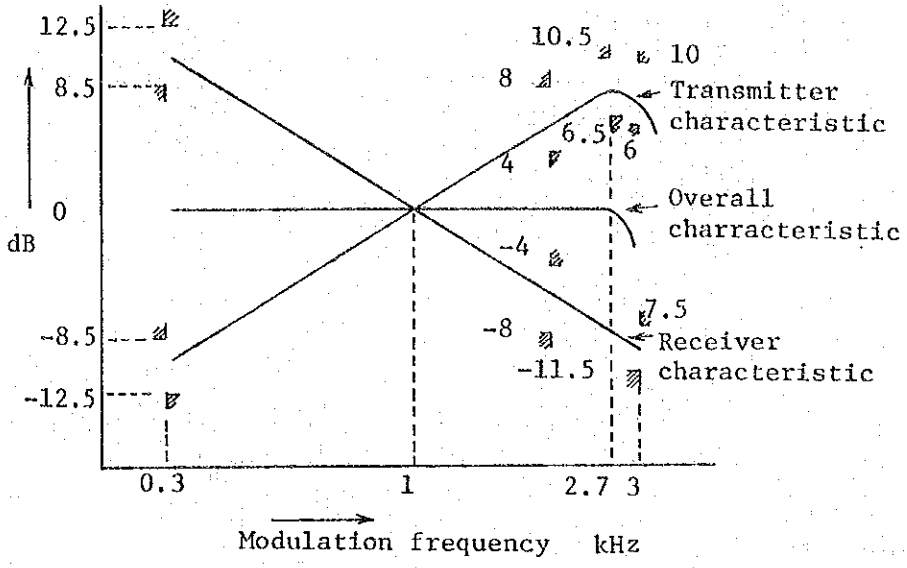
(i)	Squelch	Opened at 10dB or less noise suppression input voltage (or 0dBμV or less input field strength). Continuously variable to 20dB noise suppression voltage.
(j)	Receiving sensitivity	70MHz band: 3dBμV or less (2dBμV or less at normal temperature) 400MHz band: 4dBμV or less (3dBμV or less at normal temperature)
(k)	Spurious response	70MHz bnad: -80dB or less 400MHz band: -70dB or less
(l)	Blocking	With a wanted signal, 6dB higher than the necessary input voltage for 20dB noise quieting, the input voltage of an unwanted signal, 15kHz detuned in 70MHz band and 25kHz detuned in 400MHz band, shall be 70MHz band: 80dBμV or greater 400MHz band: 70dBμV or greater
(m)	Intermodulation characteristic	Noise quieting shall be 20dB or less when an unwanted signal causing an intermodulation is applied at 65dBμV input voltage without any desired wave.

(4) Others

This equipment shall be provided with functions which protect the transmitter and receiver against opening or shorting of the antenna system and excessive input. Moreover, external connections shall be made with N-type connectors.

[COMMENT 21]

1. Since this system uses audio band frequencies for the calling signals and response signals, the overall frequency response between the master station and gauging stations must be considered.
The installation of a repeater station in the radio links has an especially large affect. Therefore, the conventional specifications have been modified as the characteristics shown below.



Moreover, the overall characteristic is flat from 0.3kHz to 2.7kHz because it has been determined from the minimum and maximum frequencies of the signals to be transmitted.

2. The standing wave ratio of the matchable load for the transmitter and receiver has been made 2.0 by the following reason.
The standing wave ratio of the antenna is a maximum 1.5, but the standing wave ratio is generally assumed to be about 2.0 when the effects of insertion of a coaxial arrester and connectors, etc. are considered.

5) Antenna equipment

The antenna equipment shall fully satisfy the following specifications.
The specifications shall also be applicable when this equipment is used at gauging stations, repeater stations and monitoring stations.

(1) Antenna

(a) Frequency	70MHz band or 400MHz band. Specified in SSI.
(b) Type	Specified in SSI.
(c) Impedance	50 Ω
(e) Standing wave ratio	1.5 or less at the specified frequency
(f) Polarization	Vertical as standard

(2) Coaxial arrester

A coaxial arrester which grounds lightning shall be provided between the antenna and radio equipment. This arrester shall not hinder the functions of the radio equipment.

a. Ratings

(a)	Impedance	50 Ω
(b)	Insertion loss	0.5dB or less
(c)	Standing wave ratio	1.2 or less at the specified frequency

[COMMENT 22]

1. The kinds and typical ratings of applicable antenna elements are as follows:

Kind	Gain (GIS)	Front-rear ratio	Frequency width in SWR rating (1.5)
3-element folded Yagi antenna	8 dB or more	13 dB or more	Specified frequency only
4-element folded Yagi antenna	9.5 dB or more	13 dB or more	do
5-element folded Yagi antenna	11 dB or more	13 dB or more	do
Braun antenna	2 dB or more	-----	do
Sleeve antenna	2 dB or more	-----	do
Wideband 3-element folded Yagi antenna	6 dB or more	10 dB or more	5 MHz
Wideband 5-element folded Yagi antenna	9 dB or more	10 dB or more	5 MHz

2. Since the gain and directivity will deteriorate substantially relative to the other frequency when a general antenna is used in a radio link having different transmitting and recceiving frequencies and is set to only one of these frequencies, a wideband type antenna or separate transmitting and receiving antennas should be used when there is not so much margin in that radio link.

6) Clock

The clock shall fully satisfy the following specifications.

(1)	Accuracy	Daily error within ±3 seconds
(2)	Output signal	1 minute pulse signal
(3)	Power failure guarantee time	30 minutes or more by floating charge system

[COMMENT 23]

Operation by applying an external 1 minute pulse to the time control unit is also possible. In this case, the clock is unnecessary. Moreover, when several clocks must be installed at the same station, the time control unit of each clock should be driven by a 1 minute pulse from the main clock.

3-1-3 Additional functions

The following functions may be added to the telemetering equipment according to SSI.
Moreover, these specifications shall be applicable when the following units are used at the gauging stations and repeater stations.

1) I/O interface 2

This unit is used for connection to multiplex radio equipment and wire gauging equipment. It shall satisfy the following ratings.

(1)	I/O level	Settable within a range of 0 to -25dBm.
(2)	I/O impedance	600Ω ±20% balanced

[COMMENT 24]

1. When the data code is sent to another point, the received FS signal can be sent directly by branching circuit (hybrid transformer, etc.).

2. The number of I/O paths is a maximum of 3 paths.
The number of paths equipped must be specified in SSI.

2) Frequency deviation correction unit

This unit is inserted when the frequency deviation caused by the multiplex radio circuit exceeds 1Hz.
It shall satisfy the following ratings.

(1) Maximum correctable frequency deviation Within ±1.5Hz

(2) Correction accuracy ±0.5Hz

3) External output interface

This unit is used for connection to a display unit, etc. It shall satisfy the following conditions.

(1) Shall be no-voltage contacts.

(2) Shall close contacts by logic "1". Load conditions shall be 50V, 50mA or less.

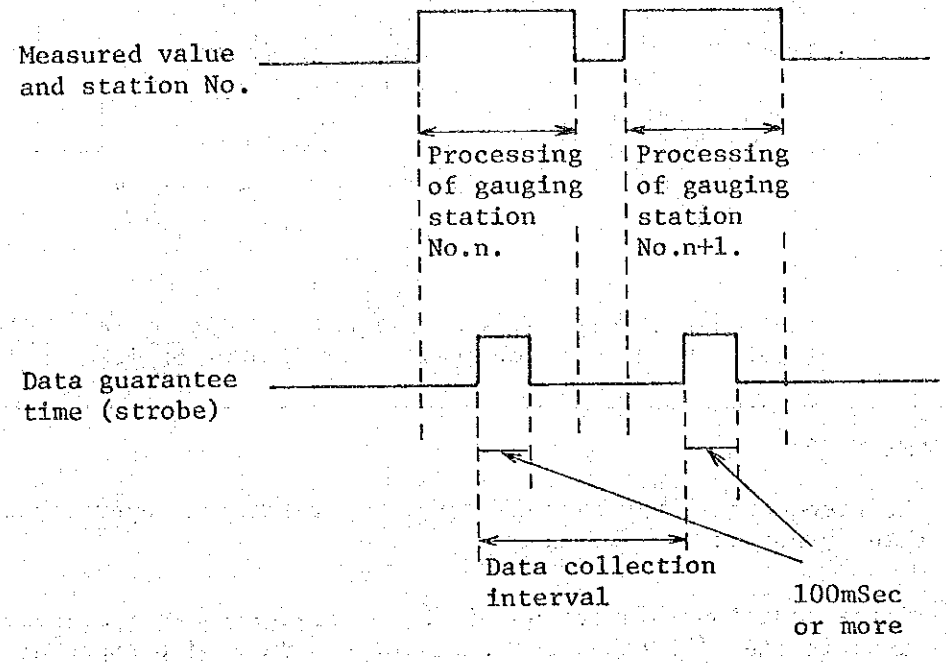
(3) Kinds of output signals

a. Output format

Output signal name	Output signal contents	Signal format	Remarks
Measured value	BCD 4 digits 20 bits	Momentary signal	With odd parity bit at each digit.
Station No.	BCD 2 digits 10 bits	do.	do.
Current time	BCD 4 digits 13 bits	Continuous signal	Without parity bit
1 minute pulse	1 bit	do.	
Calling time interval	6 bits	do.	
Periodic measurement	1 bit	do.	
Manual measurement	1 bit	do.	
Measuring	1 bit	do.	
Master station power abnormal	1 bit	do.	
Strobe		Momentary signal	

b. Data guarantee time

Output of data shall conform with the following time chart.



[COMMENT 25]

1. The maximum number of output paths shall be 3.
   The number of paths equipped must be specified in SSI.

2. The kinds of output signals must be selected and specified in SSI after an adequate study of the connected devices.

4) Repeater control unit

This unit shall have repeater station start/stop, transmitter switching, and receiving and processing function of repeater station status signal.

5) External starting

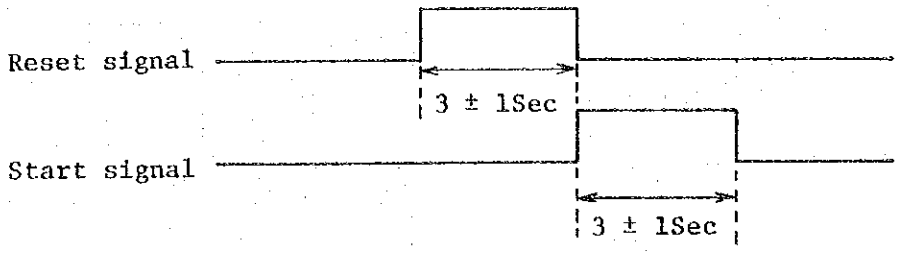
This unit shall have functions that permit starting of the telemetering equipment from the outside. Control by external starting shall be specified in SSI.

a. All gauging stations

b. Gauging stations set at the operating unit

c. Gauging stations specified beforehand

The time chart shall conform with the following:



The reset signal and start signal shall be relay contact input. Load capacity shall be 50V, 50mA or less.

[COMMENT 26]

1. The reset signal for external starting resets all operations other than by automatic calling.

2. Of the additional functions of the telemetering equipment, those given in item (1) below are wired or provided with space at the time of delivery and may be added at the site after installation. However, addition and modification for the additional functions given in item (2) below at the site after installation is uneconomical, and may be made by providing a separate bay from the standpoint of space, etc., depending on the contents.

   (1) Additional functions at the site after installation

      a. Connection to multiplex radio equipment

      b. Connection to wire gauging equipment

      c. Connection to monitoring equipment

      d. Connection to external interruption device

      e. Connection to operator's console

   (2) Additional functions which must be provided for at the time of delivery

      a. Connection to a display unit

      b. Connection to automatic gate control equipment

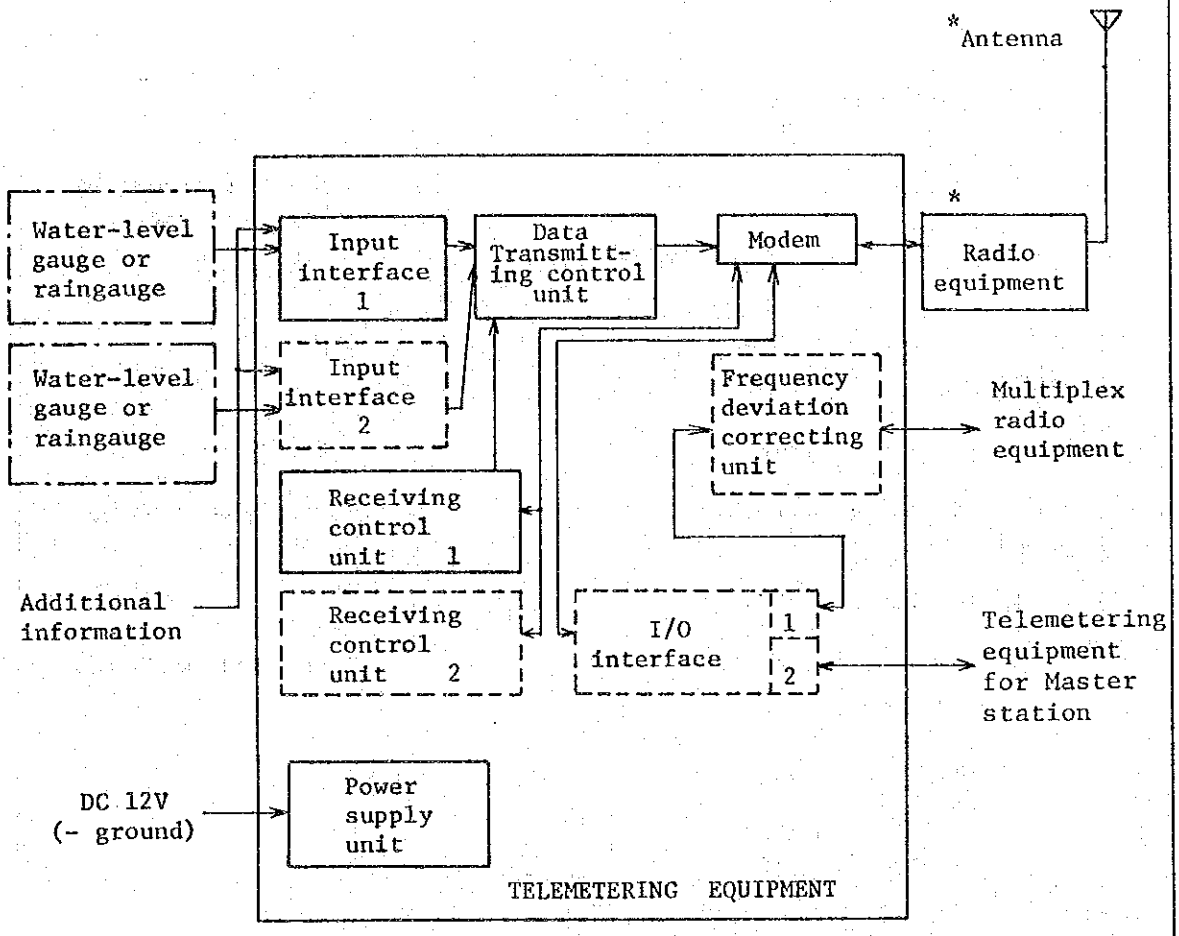
      c. Connection to other equipment

      d. Addition of repeater control function

3-2 Gauging Station Equipment

3-2-1 Equipment composition

1) The equipment composition of the gauging stations, including standard composition and optional functions, shall be as follows.



Legend : 1. * Not used when connected to multiplex radio equipment or directly to telemetering equipment for Master station.

2. ▭ Standard composition

3. ┄┄ Optional function

4. ┄·┄ Equipment outside the scope of these specification.

2) Components shall be as follows:

	Name	Q'ty	Remarks
1	Telemetering equipment	1	
- 1	Modem	1	
- 2	Data transmitting control unit	1	
- 3	Receiving control unit 1	1	
- 4	Input interface 1.	1	
- 5	Power supply unit	1	
- 6	Cabinet	1	
- 7	I/O interface	1	Optional function. Conforms with SSI.
- 8	Frequency deviation correcting unit	1	"
- 9	Receiving control unit 2	1	"
-10	Input interface 2	1	"
2	Radio equipment	1	Conforms with SSI.
3	Antenna equipment	1	Conforms with SSI.
- 1	Antenna	1	
- 2	Coaxial arrester	1	
4	Repeater control unit	1	Conforms with SSI.
5	Accessories		
- 1	Hand microphone	1	
- 2	Test cord	1	
- 3	Adjustment tools	1 set	
- 4	Instruction manual	1 copy	
- 5	Test data	1 copy	
- 6	Technical service card	1 copy	In card case
- 7	Accessory box	1	

3-2-2 Functions and ratings

1) Telemetering equipment

(1) Modem

This unit shall have a modulation function which converts pulse code into a frequency modulated signal, and a demodulation function which receives the gauging station calling signal.

(2) Transmitting control unit

This unit shall have a function which converts the input signals from the rain gauge and water-level gauge into a response signal.

(3) Receiving control unit 1

This unit shall perform frequency discrimination of the calling signal (2-frequency series signal) from the master station and provide an output to the transmitting control unit only when the unique frequency pair to its own station has been received.
The number of stations controllable at this unit shall be one, but addition of one more station shall be possible according to SSI.

(4) Input interface 1

This unit shall be connected to the raingauge, water-level gauge, etc. and shall have a function which interface these devices to the transmitting control unit. The number of gauges connectable to this unit shall be one, as standard, but shall be expandable by one according to SSI.

(5) Power supply unit

This unit shall supply the necessary power to each unit. Its input shall be DC12V (- ground).

(6) Others

a. The following operations shall be performed.

	Item	Remarks
1	Speech	Hand microphone, speaker, volume adjustment
2	Data code test transmission	
3	Transmitter input level	Measured by U-link
4	Receiver output level	"
5	Calling signal selection filter input level	Measured by U-link or check terminal
6	FS modulator input signal level	

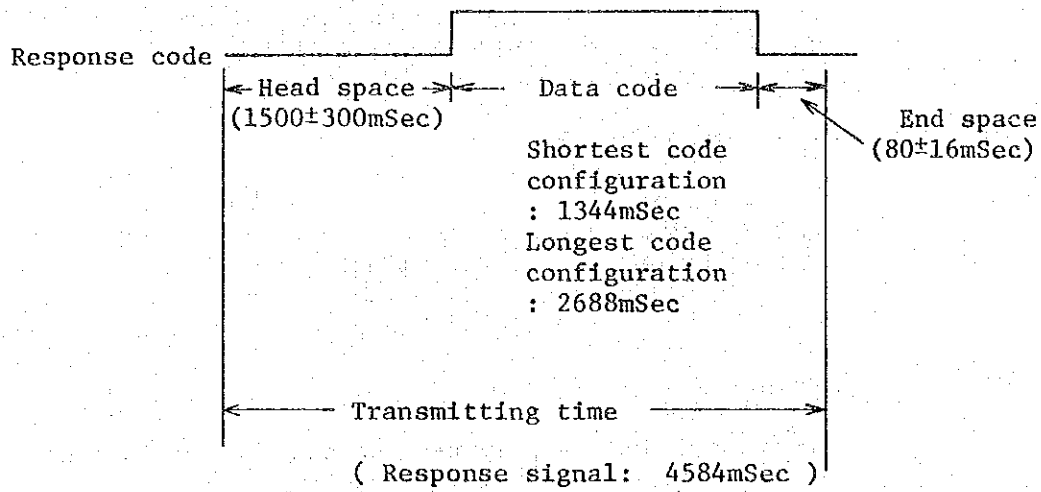
b. Protection circuit

A protection function that halts transmission after a fixed period of time to prevent the telemetering equipment from transmitting continuously because of

a failure in the transmitting control unit shall be provided.
This protection circuit shall be set for a time length of 6 ±1 seconds.

[COMMENT 27]

1. The setting time of the protection circuit is 4,584mSec as shown below, considering the maximum time of the response signal, but has been decided to be 6,000 ± 1,000mSec considering the setting accuracy.



2) Repeater control unit

This unit shall be installed at the telemetering equipment, and shall have a function which sends the repeating-start signal and repeating-stop signal.
It shall have a portable construction.
This unit is installed according to SSI.

[COMMENT 28]

The repeater control unit has a printed circuit board construction, and can be used by installing it at the telemetering equipment. Moreover, it may be easily carried by placing it in a special box.

3-2-3 Additional functions

The following functions may be added to the telemetering equipment according to SSI.

1) Receiving control unit 2

Reception of one more calling signal from master station shall be possible by adding this unit.

2) Input interface 2

Connection of one more sensor shall be possible by adding this unit. In this case, the station No. shall be given separately.

3-2-4 Gauging station equipment current consumption

The current consumption of the gauging station equipment shall satisfy the following ratings at 12.0V power supply voltage.

Item		Current consumption
Stand-by		15 mA or less
Receiving		150 mA or less
Transmitting	1 W	2.0 A or less
	3 W	2.5 A or less
	10 W	5.5 A or less

[COMMENT 29]

1. Note that the following current consumptions shall be added to the above values when a water-level gauge is connected to the telemetering equipment.

   (1) A water-level gauge current consumption of about 0.5A may be necessary when a water-level gauge is connected directly to the telemetering equipment.

   (2) When the voltage induced from the outside into the telemetering equipment is considered, elimination of the induced voltage by inserting a relay circuit between the telemetering equipment and water-level gauge is necessary. In this case, the current consumption of the relay circuit is about 1.0A.

3-2-5 Raingauge and water-level gauge connection conditions

Connection of the telemetering equipment to a rainguage, water-level gauge, etc. shall satisfy the following conditions. However, the minimum value of detection by the raingauge shall be 1mm, and the minimum value of detection by the water-level gauge shall be 1cm.

1) Electrically connected raingauge and water-level gauge

(1) Output format : No-voltage make contacts (Closed by logic 1)

(2) Code format

a. Water-level gauge	: BCD code with odd parity bit per digit (maximum 4 digits).
b. Raingauge	: BCD code with odd parity bit per digit (maximum 3 digits). Or contact signal of every 1mm (1 pulse/mm).

[COMMENT 30]

1. The following conditions are satisfied by gauging equipment requiring a gauging command.

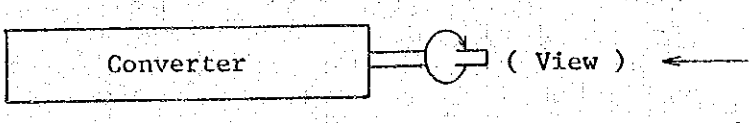
   (1) Response time : Within 1 sec (Time from issuing of gauging command to transfer of data to telemetering equipment)

   (2) Data : Continuous up to release of gauging command

2. Water-level gauging equipment connected mechanically

   When the telemetering equipment is connected to gauging equipment that does not output an electrical signal, a converter shall be added. Connection to this converter shall be mechanical.
   The converter shall satisfy the following conditions:

Revolution of shaft	: 1 revolution/m
Torque	: 500 g.cm or less
Direction of rotation	: Clockwise as viewed from the shaft



3. Since connection of water-level gauge and raingauge to telemetering equipment employs the following system, consideration must be given to their installation.

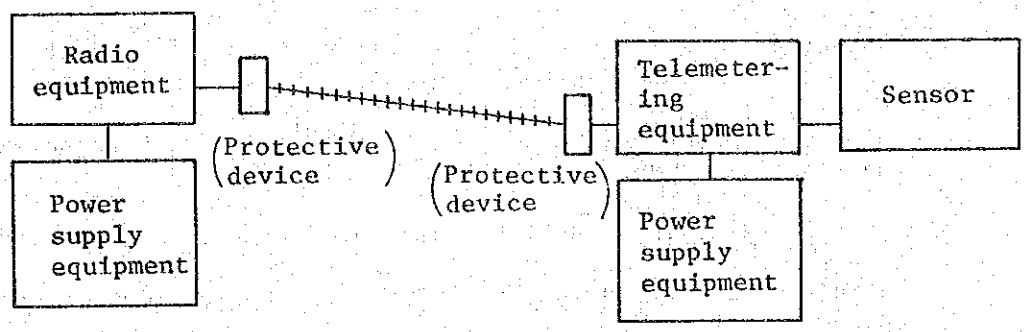
   (1) Water-level gauge

   Usually, an A/D converter shall be installed in the water-level gauge to output electrical signal, which is converted into response signal at the telemetering equipment.
   Since there are various kinds of format for output of the water-level gauge, consideration must be given to them.

(2) Raingauge

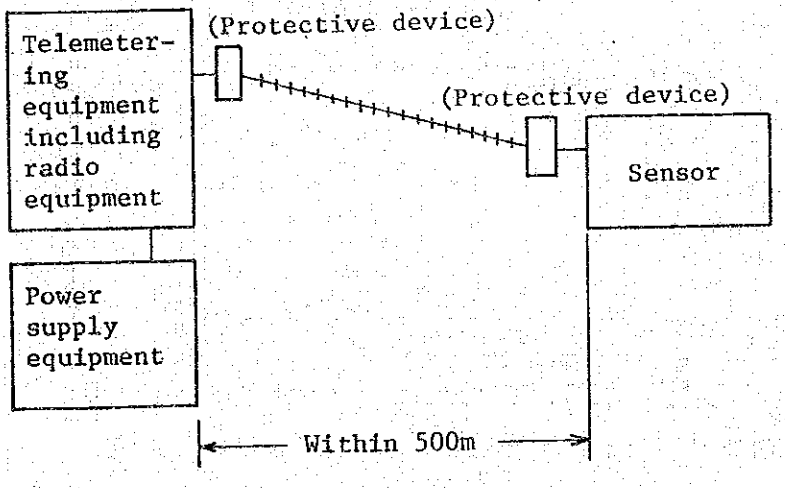
To obtain rainfall data, an A/D converter shall be installed in the raingauge, or a pulse counter which counts 1 mm pulses from raingauge shall be installed in the telemetering equipment.

4. In principle, the AC (FS signal) transmission system illustrated below shall be desirable when the telemetering equipment and radio equipment are separated.



Connection cable: 0.9 ϕ cable, as standard.

However, the DC transmission system illustrated below may be used when unavoidable, but the distance between the telemetering equipment and gauging equipment (sensor) is limited to approximately 500m. Since this system is easily struck by lightning, its use should be avoided in areas where lightning occurs frequently.



Connection cable: 0.9 ϕ cable, as standard.

5. Careful attention must be given to lightning damage when the telemetering equipment and gauging equipment (sensor) are separated. Lightning countermeasures including the facilities inside the station building, such as the following, must be taken when installed in areas where lightning frequently occurs.

   (1) In principle, installation of a lightning rod and surge absorb transformer and cable protector, etc.

   (2) Series connection of all groundings.

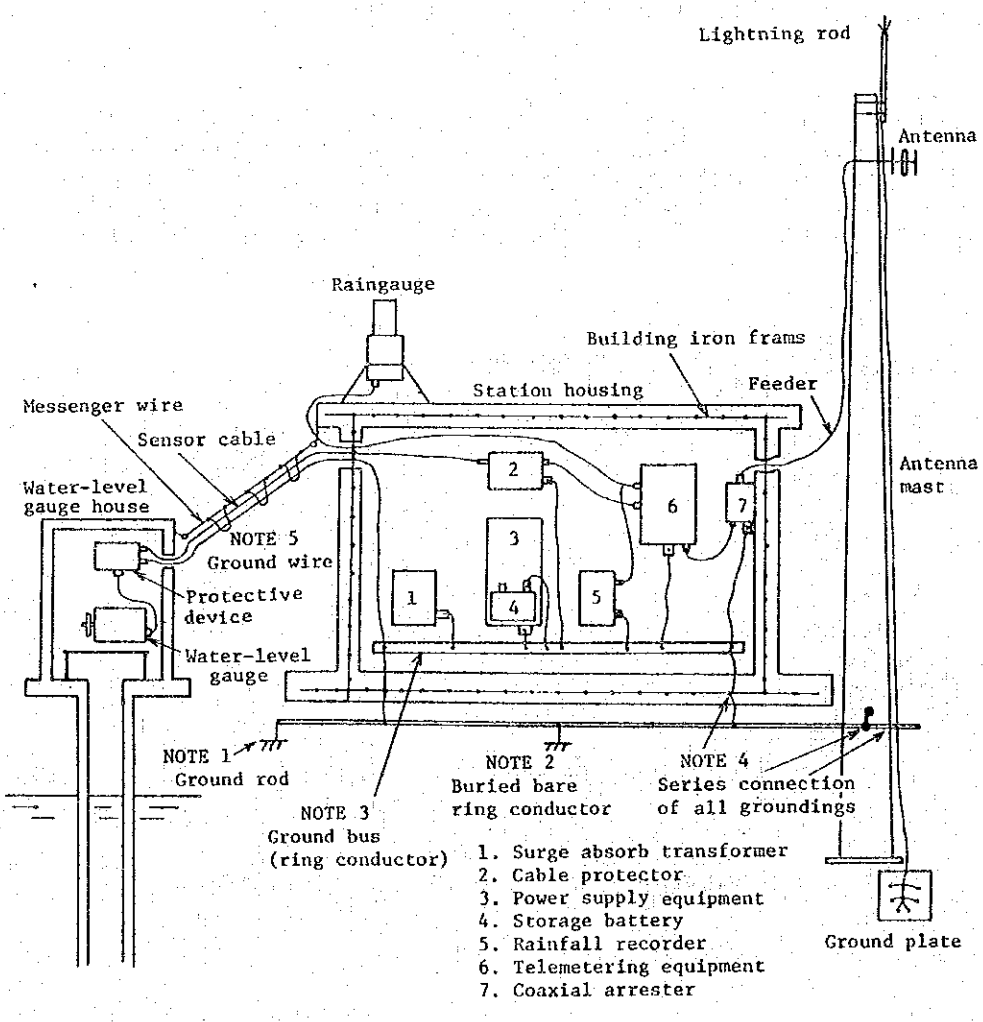
   (3) Installation of ring conductors inside and around the station housing.

   (4) Connection of structures inside the compound (iron tower, equipment, etc.) to the nearest ring conductor.

   (5) In principle, ground wire shall be 14mm^2 or larger copper wire, and connections shall be by telmit welding.

   (6) A target value of grounding resistance shall be 50Ω or less.

   (7) Example of grounding facilities of a gauging station is shown below.



NOTE 1 Ground rod

The number of rods is increased according to the grounding resistance by driving rods (1.5m) into the ground at intervals of 3m or more, or a grounding resistance reducing agent is used.

NOTE 2 Buried bare ring conductor

The various ground electrodes, etc. are connected.
The wire is bare conductor of about 22□, and grounding resistance reducing agent is used, as required.

NOTE 3 Ground bus (ring conductor)

The ground points of each facility inside the housing are connected in common.

NOTE 4 Series connection of all groundings

The various grounds and conductors and equipment installed in the same compound are connected in series by conductors of a necessary tickness.

NOTE 5 Ground wire

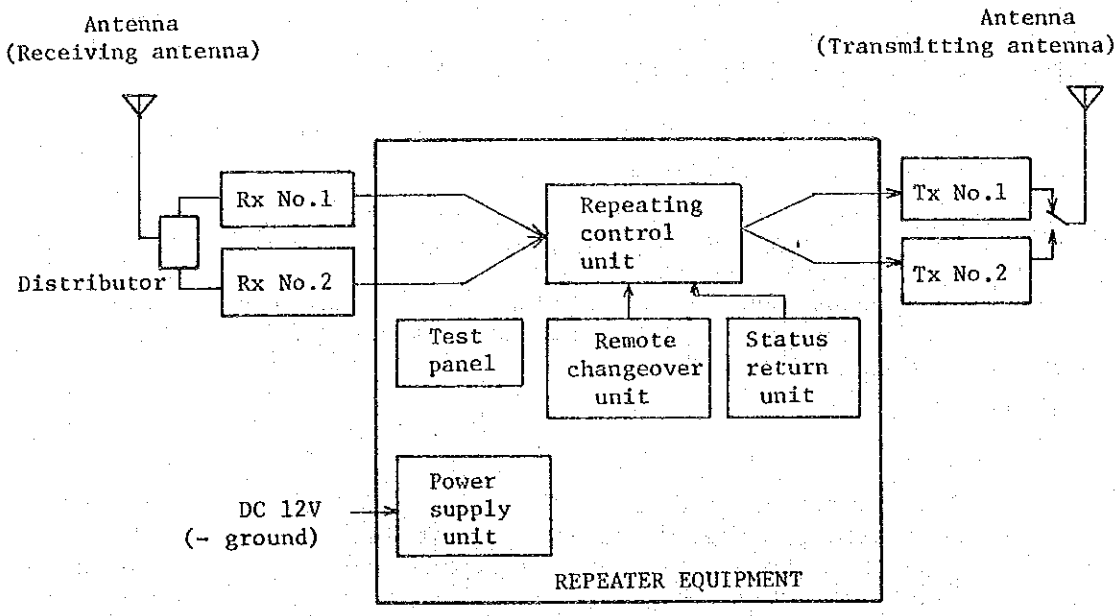
Ground wire is laid when necessary grounding resistance cannot be obtained at the water-level gauge installation site.
When the water-level gauge is separated from the station housing, a cable protector is installed and a separate ground cable of 14□ or greater is laid and connected to the other ground wire.

3-3 Repeater Station Equipment

3-3-1 Equipment composition

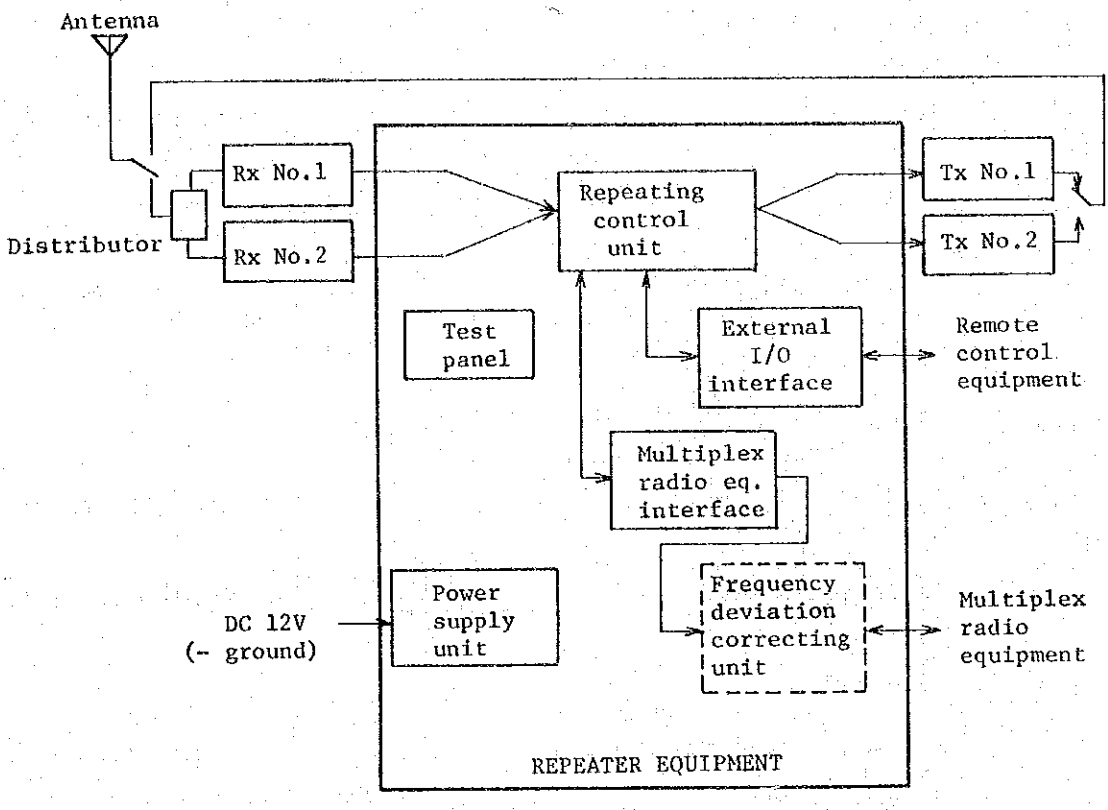
1) The repeater station equipment, including the standard composition and optional functions, shall be as follows.

(1) For V-V repeater



Legend : 1. ☐ Standard Composition

(2) For μ-V repeater



Legend : 1. ▭ Standard composition

2. ▭ Optional function

2) Components shall be as follows:

	Name	Q'ty	Remarks
1	Repeater equipment	1	
- 1	Repeating control unit	1	
- 2	Remote changeover unit	1	Installed for V-V repeating
- 3	Status return unit	1	"
- 4	Test panel	1	
- 5	External I/O interface	1	Installed for μ-V repeating
- 6	Multiplex radio eq. interface	1	"
- 7	Power supply unit	1	
- 8	Bay/Cabinet	1	
- 9	Frequency deviation correcting unit	1	Optional function
2	Radio equipment	1	Conforms with SSI.
- 1	Transmitter	2	
- 2	Receiver	2	
3	Antenna equipment	1	Conforms with SSI.
- 1	Antenna	1 set	
- 2	Distributor	1	Installed at repeater equipment
- 3	Filter	1	Conforms with SSI.
- 4	Coaxial arrester	1	
4	Accessories	1 set	
- 1	Test cord	1	
- 2	Adjustment tools	1 set	
- 3	Hand microphone	1	
- 4	Instruction manual	1 copy	
- 5	Test data	1 copy	
- 6	Technical service card	1 copy	In card case
- 7	Accessory box	1	

3-3-2 Functions and ratings

1) Repeater equipment

(1) Repeat control unit

This unit shall perform the receiver output repeating and receiver failure detection and automatic changeover by transmitter failure.

(2) Remote changeover unit

This unit shall be equipped for V-V repeating, and shall permit changeover of the transmitters by control signal from the master station.

(3) Status return unit

This unit shall be equipped for V-V repeating, and shall return the status of the repeater equipment to the master station. This unit shall use the telemetering equipment, and shall convert the repeater information into numerics and transmit them to the master station.
However, in this case, repeater information shall be handled per gauging station, and conversion into numerics shall be as follow.

Item	1,000 digit	100 digit	10 digit	1 digit
Transmitter No. 1 working	1			
Transmitter No. 2 working	2			
No transmitter failure		0		
Transmitter No. 1 failure		1		
Transmitter No. 2 failure		2		
No receiver failure			0	
Receiver No. 1 failure			1	
Receiver No. 2 failure			2	

Station No.; Station No. given to repeater station.

Additional information; Shall be 1 digit
(power supply information)

[COMMENT 31]

1. Since the repeater information which should be transmitted from the repeater station to the master station covers many items, the signal transmission system has been decided to be the same as that of the gauging station.

Moreover, if the same equipment as that of the gauging station equipment is installed as the repeater status return unit, this system is employed to simplify the processing method at the master station because the same maintenance as that of the telemetering equipment is possible and the signal format is the same.

2. Repeater information typeout example

DATE	TIME	Station A	Station B	Repeater station
02 18	12 00	1234 +	2345 +	1020 +

NOTES: (1) The above is an example when the repeater station is the 3rd station.

(2) Transmitter No.1 working, no transmitter failure, receiver No.2 failure and power normal are illustrated above.

(4) Test panel

The following functions shall be provided at the test panel for system monitoring and maintenance at the repater equipment.

	Function	Operation	Display	Remarks
1	Power ON/OFF	0	-	
2	Transmitting display	-	0	
3	Speech	0	-	
4	Repeating-start	0	-	V-V repeating only
5	Repeating-stop	0	-	
6	Transmitter No. 1 working	0	0	Including changeover operation
7	" 2 "	0	0	
8	" 1 failure	-	0	
9	" 2 "	-	0	
10	Receiver No. 1 failure	-	0	
11	" 2 "	-	0	
12	Display OFF	0	-	May be replaced by door switch.
13	Transmitter changeover lock	0	-	
14	Receiver No. 1 disconnect	0	-	
15	" 2 "	0	-	

(5) External I/O interface

This unit shall be installed for μ-V repeating, and shall satisfy the following conditions.

a. Input conditions

a) Shall be relay contact input.

b) Shall close the contact by logic 1. Load capacity shall be 50V, 50mA or greater.

c) Signal length shall be 200 ±100mSec.

d) Kinds of control items

(a) Transmitter changeover No. 1 → No. 2

(b) " No. 2 → No. 1

(c) Receiver No. 1 disconnect

(d) Receiver No. 2 disconnect

(e) Receiver parallel connection

b. Output conditions

a) Shall be relay contact output.

b) Shall close the contact by logic 1.
Load conditions shall be 50V, 50mA or less.

c) Kinds of output signals

(a) Transmitter No. 1 working

(b) Transmitter No. 2 working

(c) Receiver No. 1 failure

(d) Receiver No. 2 failure

(e) Transmitter No. 1 failure

(f) Transmitter No. 2 failure

(6) Multiplex radio equipment interface

This unit shall be equipped for μ-V repeater equipment and shall have a function that connects multiplex radio equipment and shall satisfy the following input/output conditions.

a. I/O level Settable within a range of 0 to -25dBm.

b. I/O inpedance 600Ω ±20% balanced

(7) Power supply unit

This unit shall supply the necessary power to the other units. Its input shall be DC 12V (- ground).

3-3-3 Repeater equipment current consumption

The current consumption of the repeater station equipment shall satisfy the following conditions at 12.0V power supply voltage.

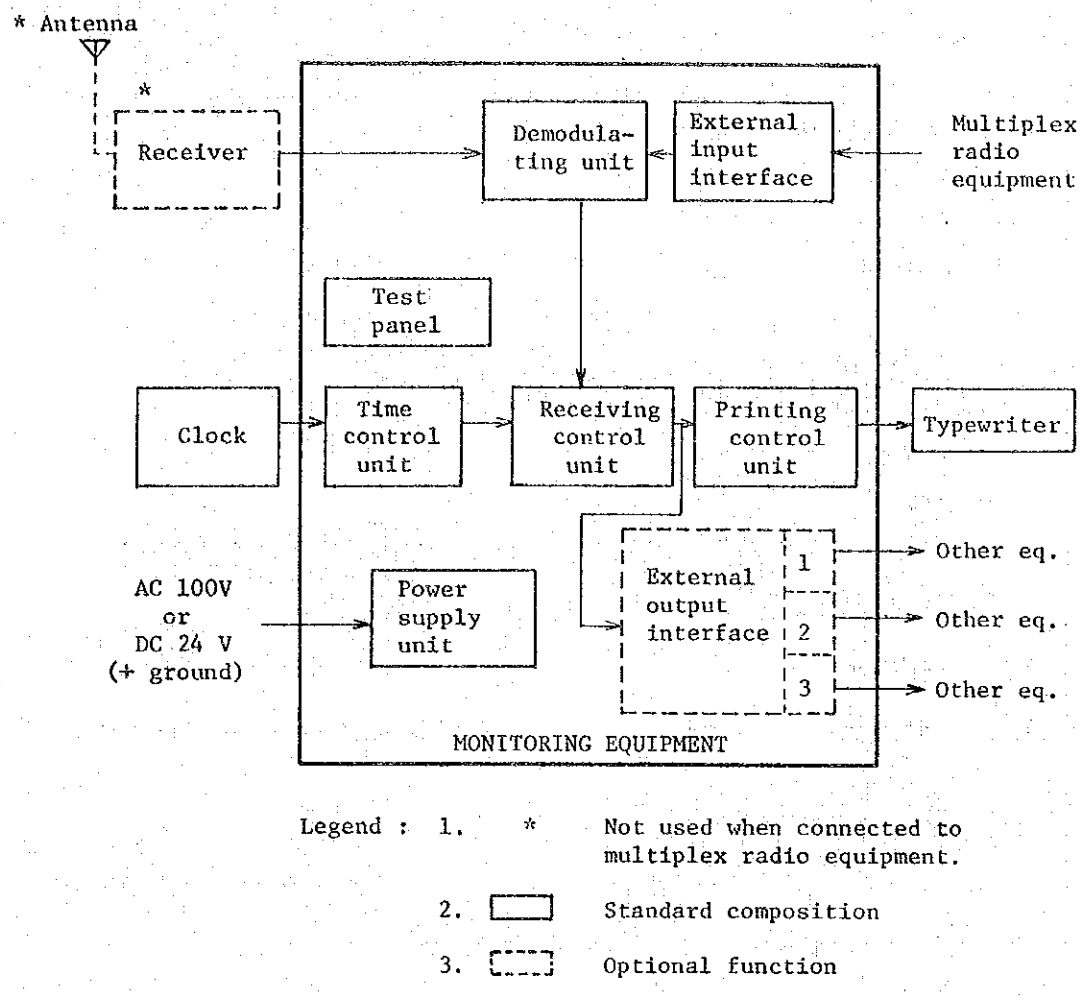
Item		Current consumption
Stand-by		50 mA or less
Receiving		1.3 A or less
Repeating	1 W	3.0 A or less
	3 W	3.5 A or less
	10 W	4.7 A or less

However, the current consumption in repeating shall increase 1.0A at status return unit operation (for V-V repeater).

3-4 Monitoring station Equipment

3-4-1 Equipment composition

1) The equipment composition of the monitoring station, including standard composition and optional functions, shall be as follows:



[COMMENT 32]

Monitoring performed by connection to multiplex radio equipment shall be the standard function, and antenna equipment and receiver shall be installed as optional components in the case of a simplex radio link.

2) Components shall be as follows:

	Name	Q'ty	Remarks
1	Monitoring equipment	1	
- 1	Demodulating unit	1	
- 2	Receiving control unit	1	
- 3	Printing control unit	1	
- 4	External input interface	1	
- 5	Test panel	1	
- 6	Time control unit	1	
- 7	Power supply unit	1	
- 8	Bay	1	
- 9	External output interface	1	Optional function
2	Typewriter	1	Same as par. 3-1-2 3)
3	Receiver	1	Conforms with SSI.
4	Antenna equipment	1	Conforms with SSI.
- 1	Antenna	1	
- 2	Coaxial arrester	1	
5	Clock	1	Conforms with SSI.
6	Accessories	1 set	
- 1	Test cord	1	
- 2	Adjustment tools	1 set	
- 3	Instruction manual	1 copy	
- 4	Test data	1 copy	
- 5	Technical service card	1 copy	In card case
- 6	Accessory case		

3-4-2 Functions and specifications

1) External input interface

This unit is used to connect to multiplex radio equipment. Its input conditions shall satisfy the following specifications.

(a) Input level — Settable within the range of 0 to -25dBm

(b) Input impedance — 600Ω ±20% balanced

2) Monitoring equipment

(1) Test panel

At the monitoring equipment, the following functions shall be provided at the test panel for system monitoring and maintenance.

	Function	Operation	Display	Remarks
1	Resetting	0	-	For operation resetting
2	Buzzer off	0	-	
3	Receiving tone monitor	-	0	
4	Input level measurement	0	-	U-link, etc. (By external measuring instrument)
5	Lamp test	0	-	
6	Typewriter printing ON/OFF	0	-	
7	Squelch adjustment	0	-	When receiver equipped
8	Data bit display	-	0	
9	Burn out fuse	-	0	
10	Power ON/OFF	0	-	
11	Power	-	0	
12	Monitoring by voltmeter	0	0	For power supply voltage measurement

3-4-3 Optional functions

The following functions shall be addable to the monitoring equipment according to SSI.

1) External output interface

This unit is used to connect to a display unit, etc. Its output shall satisfy the following conditions.

(1) Shall be no-voltage contact.

(2) Shall close the contact by logic 1.
Load conditions shall be 50V, 50mA or less.

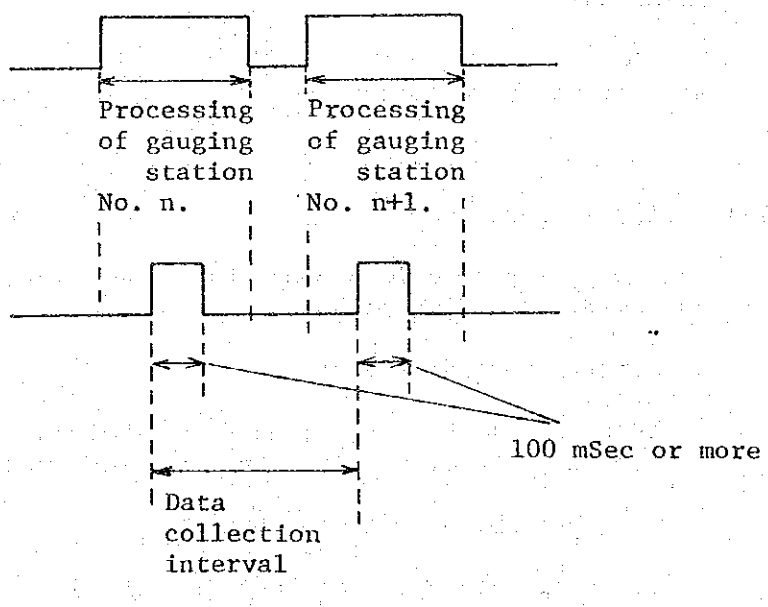
(3) Kinds of output signals

a. Output format

Output signal name	Output signal contents	Signal format	Remarks
Measured value	BCD 4 digits 20 bits	Momentary signal	With 1 bit odd parity at each digit
Station No.	BCD 2 digits 10 bits	do.	do.
Current time	BCD 4 digits 13 bits	Continuous signal	Without parity bit
1 minute pulse	1 bit	do.	
Monitoring	1 bit	do.	
Monitor station power abnormal	1 bit	do.	
Strobe		Momentary signal	

1. Data guarantee time

When data (momentary signal) are output to the outside, it shall conform with the following time chart.



[COMMENT 33]

1. The number of output paths shall be up to a maximum of 3 paths. The number of paths equipped must be specified in SSI.

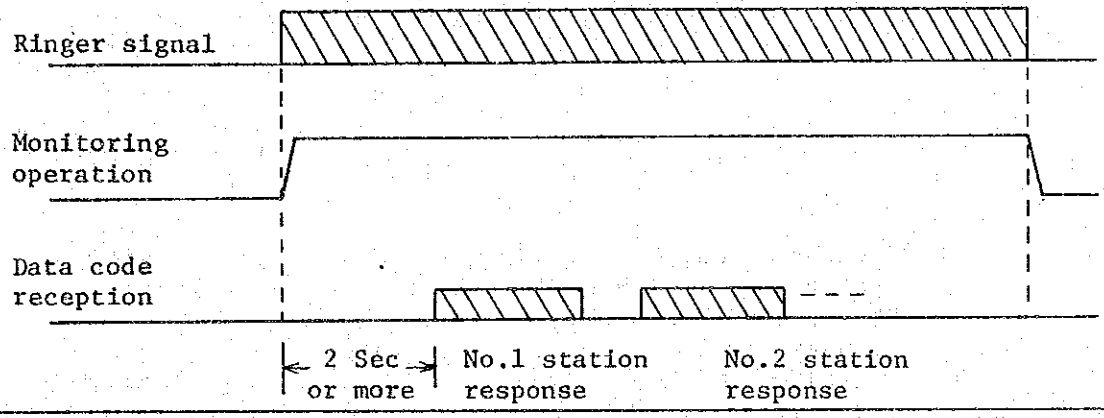
2. The kinds of output signals must be selected and specified in SSI after an adequate study of the connected devices.

3-4-4 The conditions of monitoring operation

The monitoring operation start and stop conditions shall conform with the following.

1) In case monitoring is performed by simplex radio links, the monitoring operation shall be started by detection of the subcarrier when the response signal has been directly input from the gauging station, and shall be ended by the timer after one series of operations is completed.

2) In case monitoring is performed by multiplex radio links, the monitoring operation signal (ringer signal) sent by the master station shall be received, and the monitoring operation shall be performed only while this signal is being received.
The operation time chart for this system shall conform with the following.



[COMMENT 34]

1. Monitoring by simplex radio links conforms with the system that starts operation on detection of the subcarrier.

2. When a ringer signal can be used in a monitoring system by multiplex radio links, monitoring by means of this signal is desirable. However, when the ringer signal cannot be used, monitoring should conform with the above.

3-4-5 Data processing

1) When the monitoring operation is started by inputting the response signal directly by means of a simplex radio link, all the data shall be printed at both all-station calling and individual station calling.

2) When the monitoring operation is started by the ringer signal

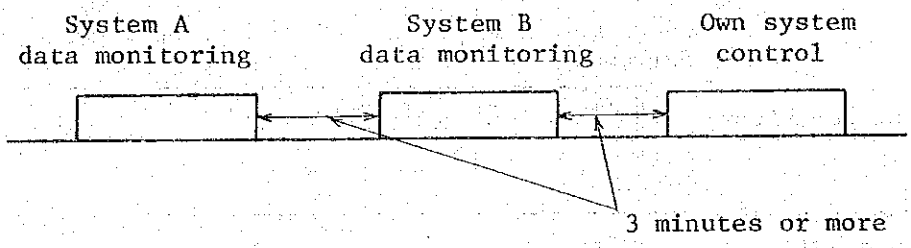
of multiplex radio link, only the data code of the gauging station received while the ringer signal is being received shall be printed.

3) The monitoring operation shall be performed from the lower gauging station number to the higher gauging station number, and printing shall not be performed when the station numbers are reversed during one monitoring operation.

3-4-6 System expansion function

1) The number of monitoring systems connectable to this equipment shall be a maximum of two systems.

2) The functions of master station shall be addable to this equipment as required.
In this case the operating time chart shall conform with the following, and the order of each system shall be specified in the SSI.

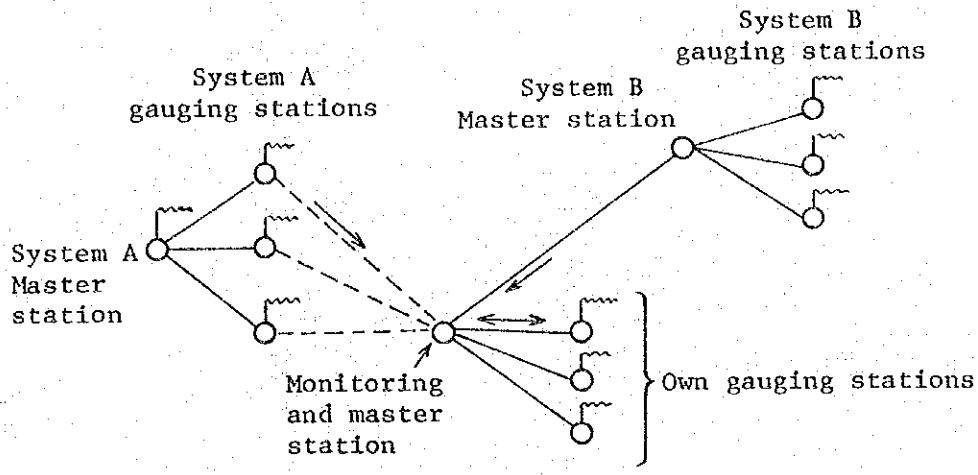


3) The total number of gauging stations of the monitoring system and own system shall be within 30 stations.
The station numbers in this case shall be one series of numbers for the entire system, and shall be assigned in calling order from low station number to high station number.

4) Printing shall be performed in one line for the entire system.

[COMMENT 35]

1. The transmission lines that can be connected to the monitoring/telemetering equipment according to these sepcifications shall be up to a maximum of 3 transmission lines by combining simplex radio links, multiplex radio links, and wire links.
A system example is given below. (A repeater station may also be installed in the links, but is omitted here.)



2. In the system example given above, time management is performed perfectly and all stations can be assumed to be controlled by a single master station.
   As an example of time management, if time management is performed by the clock of each station, the interval of each system (data interval) must be about 3 minutes, considered from the stand point of clock accuracy.

3. Since processing is performed by station number, there must not be stations having the same station number, including the station numbers of the own system gauging stations.

APPENDIX I

CALCULATION IN THE CIRCUIT DESIGN WORK

CALCULATIONS IN THE CIRCUIT DESIGN WORK

1. Formula

The free space loss is calculated by the following formula:

$$\text{Free space loss (dB)} = 20 \log f + 20 \log d + 32.4$$

f : Frequency (MHz)
d : Distance (km)

The additional loss is derived from the following:

$$\text{Additional loss (dB)} = \text{Diffraction loss (dB)} + \text{Topography coedficient (dB)}$$

Diffraction loss is found from Fig. 1 and Fig. 2. Topography coefficient in the range of 0 to 25 dB is estimated according to the conditions of the propagation path.

The receiving noise power (Prn) is the noise power at the input terminal of the receiver and consisted of the internal noise power of the receiver (Prni) and the esternal noise power (Prnc).

$$\text{Prni (dBw)} = 10 \log KTBF$$

K : Boltzman's constant 1.38×10^{-28} joule/°K
T : Absolute temperature (Normal temperature 290°K)
B : Receiver equivalent noise bandwith (Hz)
F : Noise figure

$$\text{Prni (dBm)} = 10 \lg B \text{ (KHz)} + F \text{ (dB)} - 144$$

$$\text{Prnc} = Nc$$

Nc: Deterioration by external noise (dB)

Therefore,

$$\text{Prn (dBm)} = 10 \log B \text{ (KHz)} + F \text{ (dB)} = 144 + Nc \text{ (dB)}$$

The following values were used in this report.

B = 12 KHz

F = 8 dB

Nc= 10 dB

Therefore,

Prn - 10 log 12 + 8 - 144 + 10 = - 115 dBm

The S/N (signal-to-noise ratio) improvement factor (I) is given by the following formula:

$$I\ (dB) = 10 \log \frac{3 \cdot fd^2 . B}{2 \cdot fm^3}$$

Fd : Maximum frequency deviation (KHz)

fm : Modulation frequency (KHz)

B : Receiver equivalent noise bandwith (KHz)

The following values were used in this report

fd : 5 KHz

fm : 3 KHz

B : 12 KHz

Therefore,

$$I = 10 \log \frac{3 \times 5^2 \times 12}{2 \times 3^3} = 12 \text{ dB}$$

The threshold level (Pth) is given by the following equoation:

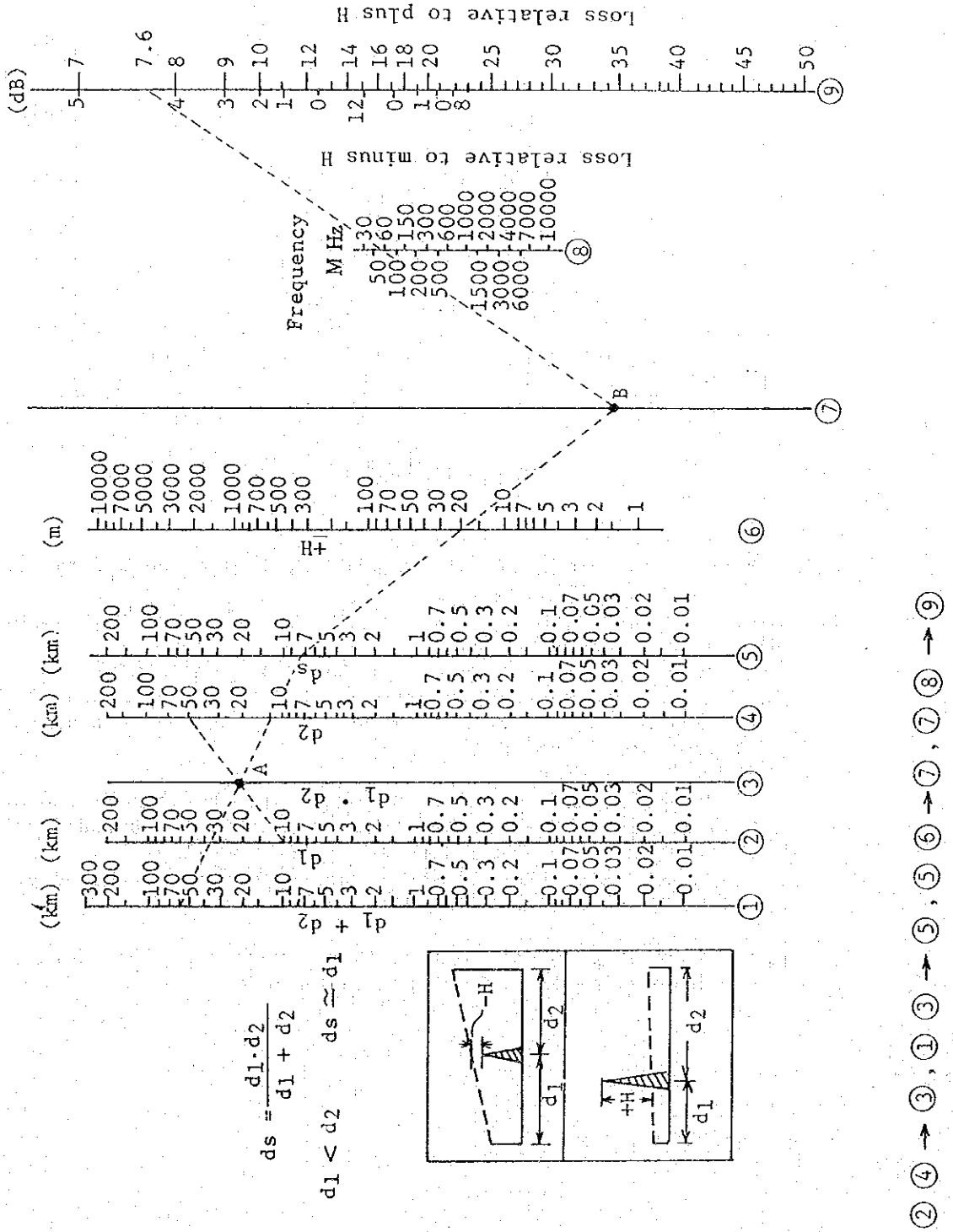
Pth (dBm) = Prn (dBm) + 9

Prn = 115 dBm

Therefore

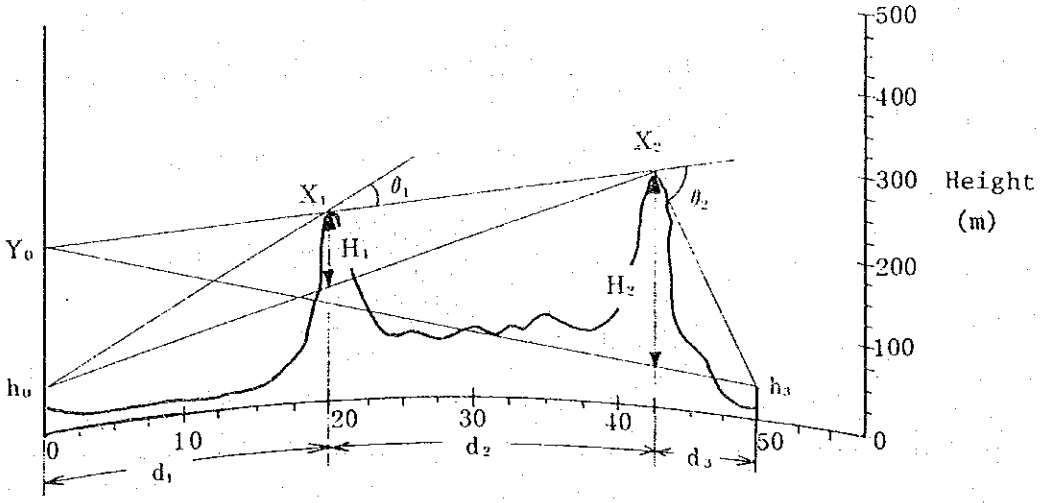
Pth = (-115) + 9 = - 106 dBm

Loss added to free space loss when there is diffraction by knife edge.



② ④ → ③ , ① ③ → ⑤ , ⑤ ⑥ → ⑦ , ⑦ ⑧ → ⑨

Loss added to free space loss when there is diffraction by knife edge.



Calculation is performed as follows when there are two diffractions:

1. Antenna heights of h_0 and h_3, and an overall zone distance of ($d_1 + d_2 + d_3$) is assumed.
   The antennas are considered to be located at points h_0 and X_2, and the diffraction loss Γ_1dB caused by X_1 is found by means of Figure 4-1. In this case, H_1 is considered to be the height of the edge. (Distances are d_1 and d_2).

2. Point Y_0 is assumed to be at h_0 on the line between X_1 and X_2, and the antenna is assumed to be at point Y_0, h_3, and the diffraction loss $\Gamma_2$db caused by X_2 is found from Figure 4-1.
   In this case, H_2 is considered to be the height of the edge.
   [Distances are ($d_1 + d_2$) and d_3].

3. This method applies to 3 diffractions, and is performed in the same manner also for 4 or more diffractions.

2. Example

Kinabatangan River Basin

The free space loss and the additional loss between Mt. Balat and Kuamut are calculated as follows:

f : 70 MHz

d : 15.3 km

Therefore,

Free space loss = 20 log 70 + 20 log 15.3 + 32.4

= 93 dB

Diffraction loss = 3 + 2 = 5 dB

d_1 = 4 km, d_2 = 11.3 km, H_1 = - 20 m, Γ_1 = 3 dB

d_3 = 10 km, d_4 = 5.3 km, H_2 = - 30 m, Γ_2 = 2 dB

(see Fig. 3 and Fig. 4)

Topography coefficient = 25 dB

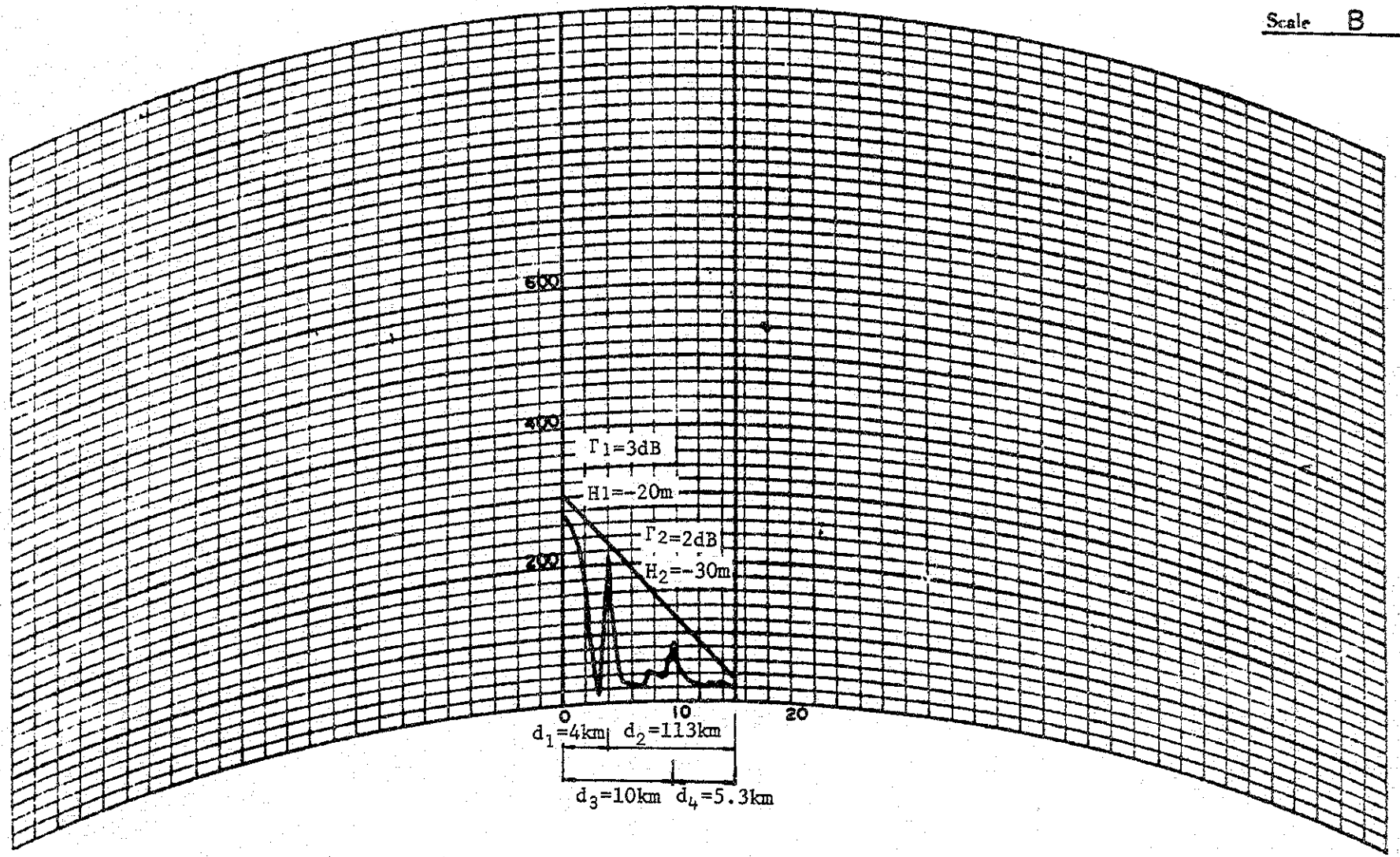
Therefore,

Additional loss = 5 + 25

= 30 dB

PROFILE (K=⅓)

Scale B



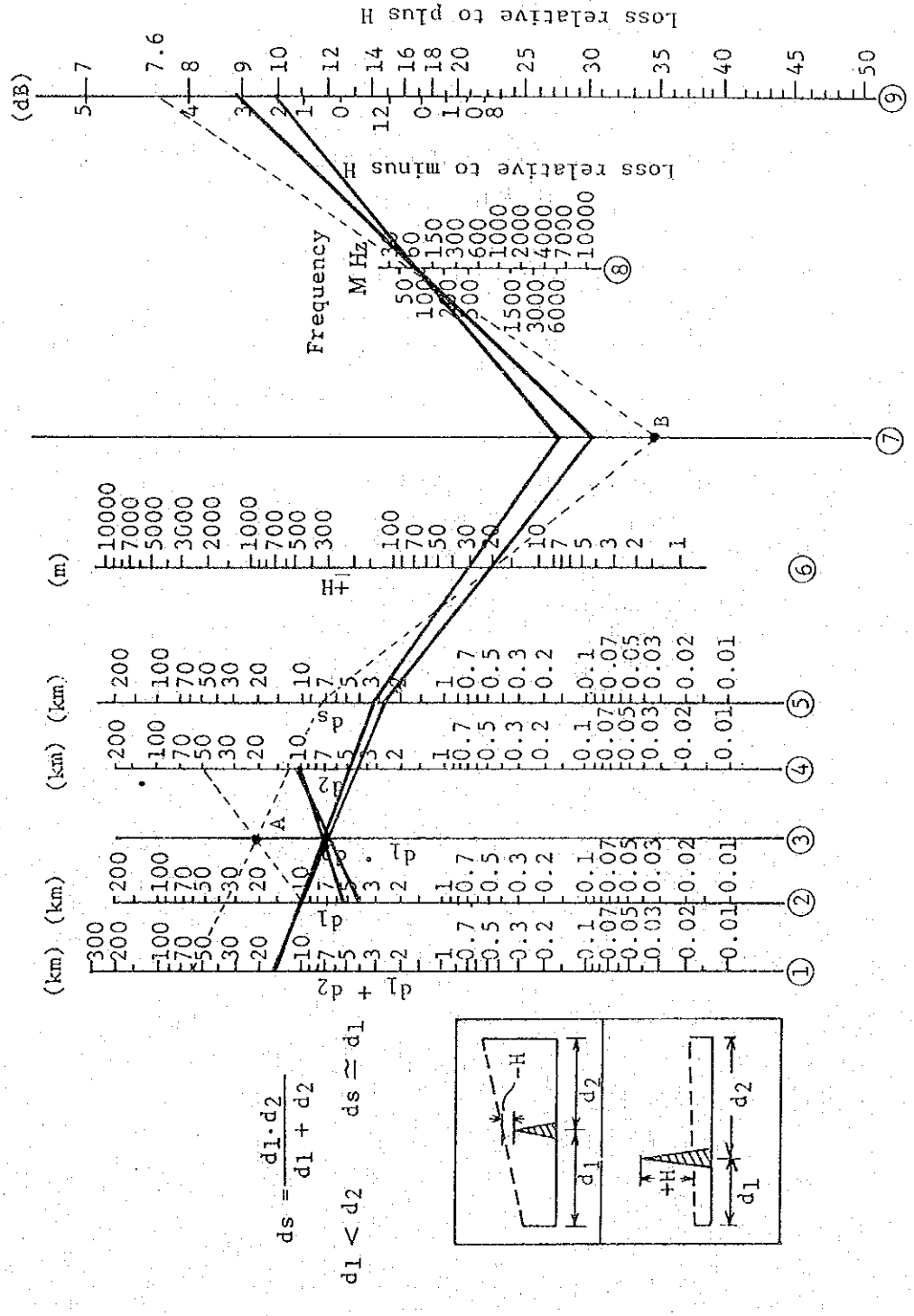
Full Scale
A=240km
B=120km
C= 60km

Mt. Balat		Kuamut
Altitude 275 m	15.3 km	Altitude 20 m
Antenna Height 30 m		Antenna Height 10 m

DATE	DESIGN	TRACED	CHECKED	APPR

DRAW NO. M.PE

Loss added to free space loss when there is diffraction by knife edge.



Sadong River Basin

The free space loss and the additional loss between Mt. Serapi and Serian are calculated as follows:

f : 70 MHz

d : 62.8 km

Therefore,

Free space loss = 20 log 70 + 20 log 62.8 + 32.4

= 105.3 dB

Diffraction loss = 23 dB

d_1 = 59 km, d_2 = 3.8 km, H_1 = 250 m, Γ_1 = 23 dB

(See Fig. and Fig. 6)

Topography coefficient = 0 dB

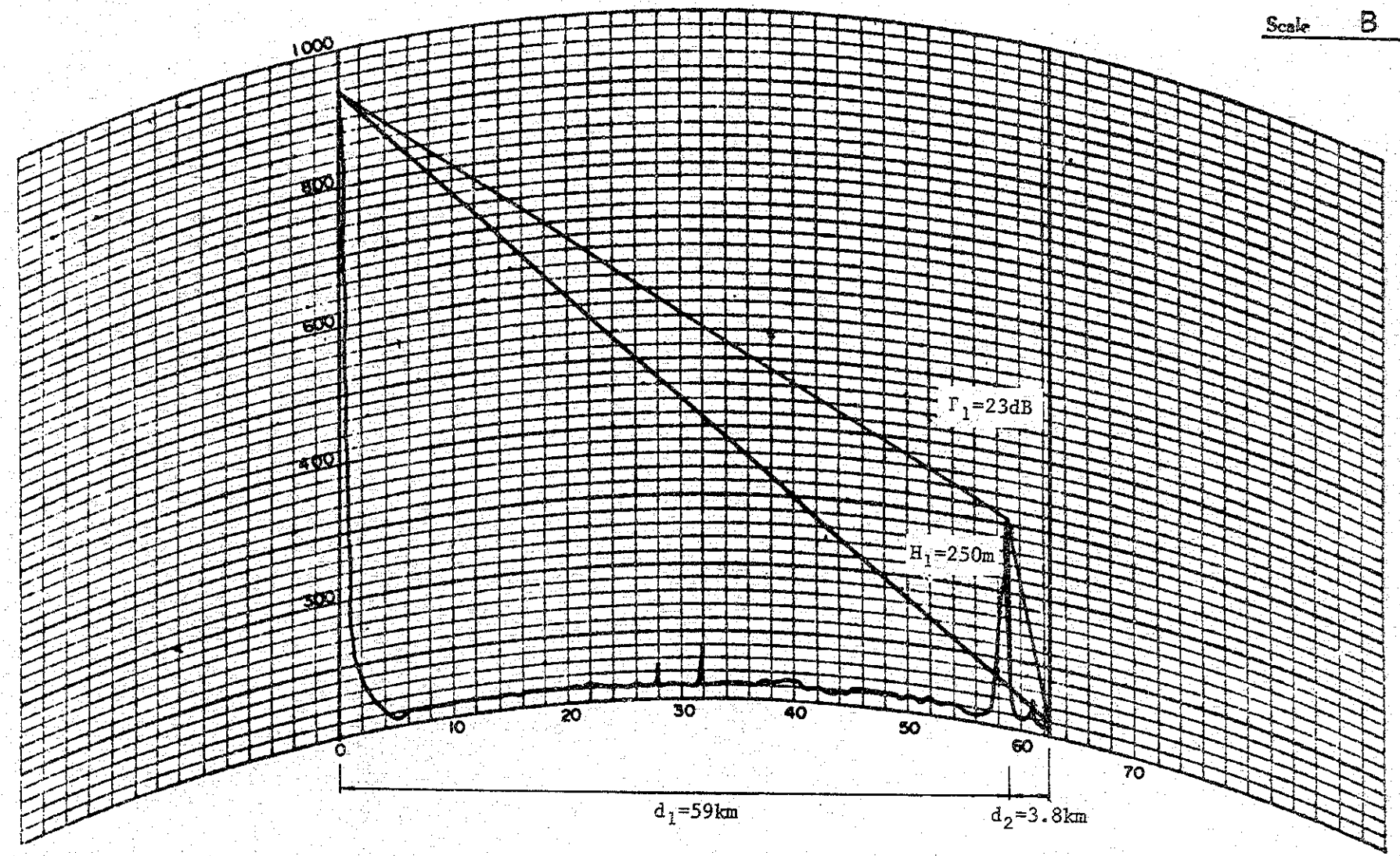
Therefore,

Additional loss = 23 + 0

= 23 dB

PROFILE (K=⅓)

Scale B



Full Scale
A = 1000m
B = 1000m
C = 250m

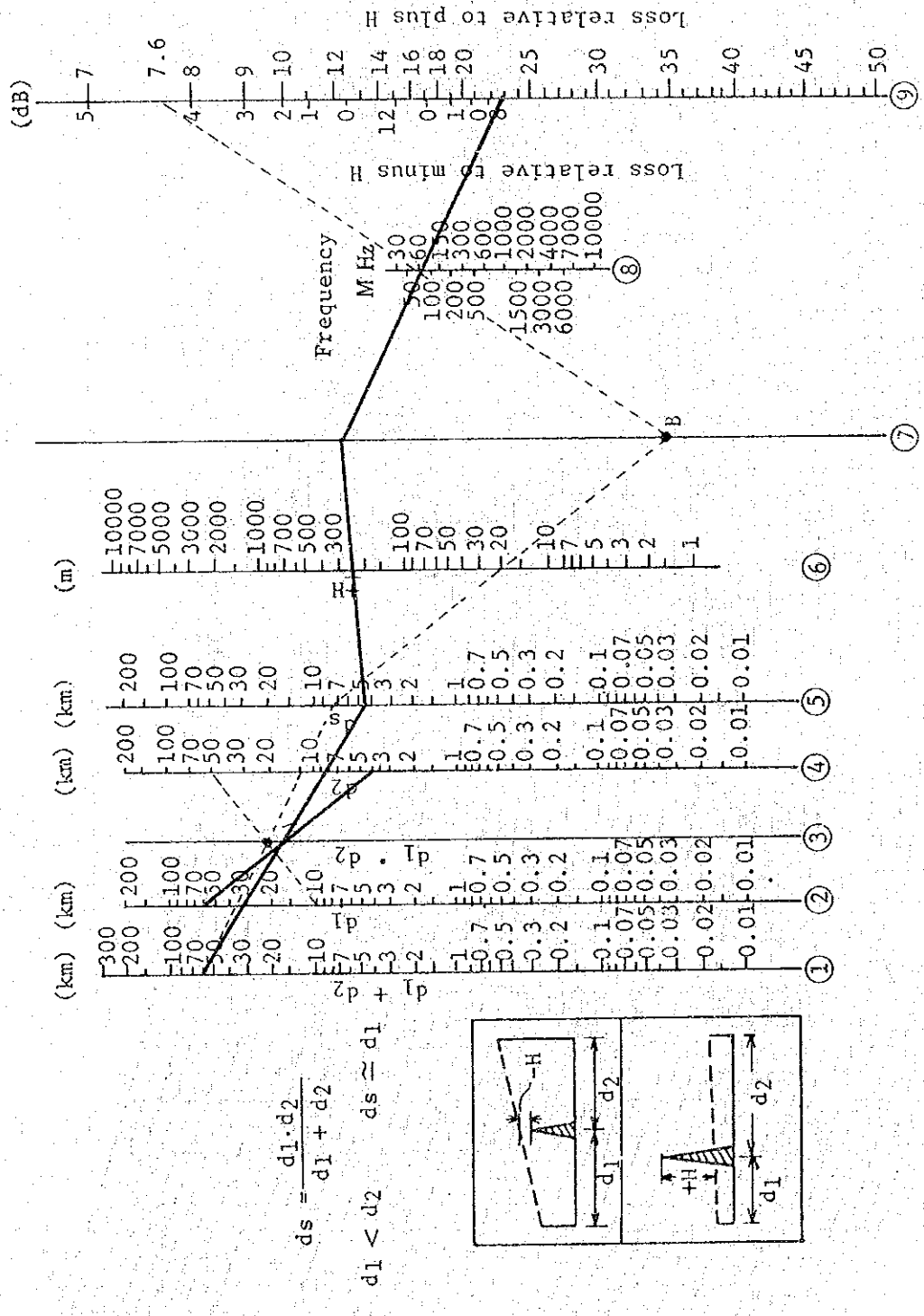
Full Scale
A=240km
B=120km
C = 60km

Mt. Serapi		Serian
Altitude 910 m	62.8 KM	Altitude 10 m
Antenna Height 30 m		Antenna Height 10 m

DATE	DESIGN	TRACED	CHECKED	APPR

DRAW NO. M.PE

Loss added to free space loss when there is diffraction by knife edge.



APPENDIX J

EXAMPLE OF CAPACITY CALCULATION

EXAMPLE OF CAPACITY CALCULATION

1. Kinabatangan River Basin

Conditions for capacity calculation of solar cell and storage battery are as follows:

Trig Hill Relay Station

Number of gauging stations: 20 stations
Calling signal time from master station: 2.5 sec/station
Response signal time from gauging station: 4.6 sec/station
Relay equipment current drain

Standby	:	0.05A
Receiving	:	1.3A
Transmitting:		4.0A (transmitting power 1W)

Measurement interval : 30 min (48 times/day)
Speech (maintenance) : 10 min/month (of these, 5 min is transmitting)
Storage battery used : Pocket type alkaline storage battery
Maintenance factor : 0.8
Minimum storage battery temperature: 5°C
Allowable minimum voltage: 1.1 V/cell
Assumed power interruption time: 6 days

Mt. Balat Relay Station

Number of gauging stations: 20 stations
Calling signal time from master station: 2.5 sec/station
Response signal time from gauging station: 4.6 sec/station
Relay equipment current drain

Standby	:	0.05A
Receiving	:	0.13A
Transmitting	:	12A (Transmitting power 20W)

Measurement interval : 30 min (48 times/day)
Speech (maintenance) : 10 min/month (of these, 5 min is transmitting)

Storage battery used : Pocket type alkaline storage battery
Capacity correction coefficient : 0.7
Annual sunshine time : 2,000 hours
Maximum continuous non-sunshine time: 20 days

Gauging Station

Number of gauging stations: 20 stations
Calling signal time from master station: 2.5 sec/station
Response signal time from gauging station: 4.6 sec/station
Telemetry equipment current drain

Standby	:	0.015A
Receiving	:	0.15A
Transmitting	:	12A (Transmitting power 20W)
		2.5A(" " 3W)
		2.0A(" " 1W)

Measurement interval : 30 min(48 times/day)
Speech (maintenance) : 10 min/month (of these, 5 min is transmitting)
Storage battery used : Pocket type alkaline storage battery
Capacity correction coefficient : 0.7
Annual sunshine time : 2,000 hours
Maximum continuous non-sunshine time : 20 days

For example, capacities of Mt. Balat and the gauging station using a 20W transmitting power radio equipment are calculated as follows:

Mt.Balat Relay Station

T_1 = Standby time - T_2 - T_3
= 24 hours x 30 days - 60 hours - 60 hours
= 600 hours

T_2 = Receiving time
= (2.5 sec + 4.6 sec) x 20 stations x 48 times x 30 days
+ 10 min x 20 stations + 5 min
= 60 hours

T_3 = Transmitting time

= (2.5 sec + 4.6 sec) x 20 stations x 48 times x 30 days + 10 min x 20 stations + 5 min

= 60 hours

I = Average load current

$$= \frac{600 \text{ hours} \times 0.05A + 60 \text{ hours} \times 1.3A + 60 \text{ hours} \times 12A}{24 \text{ hours} \times 30 \text{ days}}$$

= 1.15A

P = Solar cell output

= 1.15A x 12V x 12

= 166 W 168W

C = Capacity of storage battery

$$= \frac{1.15A \times 24 \text{ hours} \times 20 \text{ days}}{0.7}$$

= 789 AH 800 AH

Gauging Station (transmitting power 20 W)

T_1 = Standby time $-T_2 - T_3$

= 24 hours x 30 days - 58 hours - 2 hours

= 660 hours

T_2 = Receiving time

= (2.5 sec x 20 stations x 4.6 sec x 19 stations) x 48 times x 30 days + 10 min x 19 stations + 5 min

= 58 hours

T_3 = Transmitting time

= 4.6 sec x 48 times x 30 days + 5 min

= 2 hours

I = Average load current

$$= \frac{660 \text{ hours} \times 0.015A + 58 \text{ hours} \times 0.15A + 2 \text{ hours} \times 12A}{24 \text{ hours} \times 30 \text{ days}}$$

= 0.06A

P = Solar cell output

= 0.06A x 12V x 12

= 9 W 14 W

C = Capacity of storage battery

$$= \frac{0.06\ A \times 24\ hours \times 20\ days}{0.7}$$

= 41 AH 80 AH

2. Sadong River Basin

Conditions for capacity calculation of solar cell and storage battery are as follows:

Mt. Serapi Relay Station

Number of gauging stations: 20 stations
Calling signal time from master station: 2.5 sec/station
Response signal time from gauging station: 4.6 sec/station
Relay equipment current drain

Standby	:	0.05A
Receiving	:	1.3A
Transmitting	:	5.7A (Transmitting power 10 W)

Measurement interval : 30 min (48 times/day)
Speech (maintenance) : 10 min/month (of these, 5 min is transmitting)
Storage battery used : Pocket type alkaline storage battery
Maintenance factor : 0.8
Minimum storage battery temperature: 5°C
Allowable minimum voltage : 1.1V/cell
Assumed power interruption time: 6 days

Gauging Station

Number of gauging stations : 20 stations
Calling signal time from master station : 2.5 sec/station
Response signal time from gauging station : 4.6 sec/station
Telemetry equipment current drain

Standby	:	0.015A
Receiving	:	0.15A
Transmitting	:	5.5A (Transmitting power 10W)
		2.5A (" " 3W)
		2.0A (" " 1W)

Measurement interval : 30 min (48 times/day)
Speech (maintenance) : 10 min/month (of these, 5 min is transmitting)

Storage battery used : Pocket type alkaline storage battery

Capacity correction coefficient : 0.7

Annual sunshine time : 2,000 hours

Maximum continuous non-sunshine time : 20 days

For example, capacities of Mt. Serapi and the gauging stations using a 10W transmitting power radio equipment are calculated as follows:

Mt. Serapi Relay Station

T_1 = Assumed power interruption time
= 24 hours x 6 days
= 144 hours

T_2 = Receiving time + T_3
= (2.5 sec + 4.6 sec) x 20 stations x 48 times x 6 days
+ 10 min x 20 stations + 5 min + 15 hours
= 30 hours

T_3 = Transmitting time
= (2.5 sec + 4.6 sec) x 20 stations x 48 times x 6 days
+ 10 min x 20 stations + 5 min
= 15 hours

K_1 = Capacity conversion time relative to T_2
= 6.5 hours = 5 hours + 144 hours
= 145.5 hours

K_2 = Capacity conversion time relative to T_2
= 6.5 hours - 5 hours + 30 yours
= 31.5 hours

K_3 = Capacity conversion time relative to T_3
= 6.5 hours - 5 hours + 15 hours
= 16.5 hours

C = Capacity of storage battery

$$\frac{1}{0.8}\left\{\begin{array}{l}145.5 \text{ hours} \times 0.05A \times 2 + 31.5 \text{ hours} \times (1.3A - 0.05A) \\ \times 2 + 16.5 \text{ hours} \times (5.7A - 1.3A)\end{array}\right\}$$

= 207 AH 250 AH

Gauging Station (Transmitting power 10W)

T_1 = Standby time $-T_2 - T_3$

= 24 hours x 30 days - 58 hours - 2 hours

= 660 hours

T_2 = Receiving time

= (2.5 sec x 20 stations + 4.6 sec x 19 stations) x 48 times x 30 days + 10 min x 19 stations + 5 min

= 58 hours

T_3 = Transmitting time

= 4.6 sec x 48 times x 30 days + 5 min

= 2 hours

I = Average load current

$$= \frac{660 \text{ hours} \times 0.015A + 58 \text{ hours} \times 0.15A + 2 \text{ hours} \times 5.5A}{24 \text{ hours} \times 30 \text{ days}}$$

= 0.04A

P = Solar cell output

= 0.04A x 12V x 12

= 4 W 7 W

C = Capacity of storage battery

$$= \frac{0.04A \times 24 \text{ hours} \times 20 \text{ days}}{0.7}$$

= 21 AH 40 AH

APPENDIX K

JOB SPECIFICATIONS FOR

ASSIGNMENT OF PERSONNEL

1. Assigned Tasks of Personnel

(1) Flood Forecasting Center

General description of tasks assigned for personnel at flood forecasting center are as follows:

Section	Designation	Assignment
Hydlorogy	Chief	General management of the center planning of operation program, formulation of budget scheme, final decision making in forecasting procedure.
	Supervisor	Management of the hydrology section, highly technical decision making (Planning of maintenance, regular inspection, development and formulation of improved forecasting method, training program)
	Engineer	Technical system planning, maintenance and inspection (Gauging Equipment, Improvement of facilities, routine inspection, adjustment and repair)
Telecom	Supervisor	Advisory work, highly technical judgement (Planning of maintenance, regular inspection, improvement and training program)
	Engineer	Technical system planning, maintenance work with technicians (Spares supply plan, instrument maintenance program, periodical inspection, adjustment and repair).
	Technician	Routine maintenance and inspection (Periodical inspection and repair, supply spare parts and consumables)

2. Assignment in Discharge Observation

(1) Discharge Observation by Float

Assignment by Designation

Group Leader: General management of observation procedure including safety measures, designation of observation time, report of measured values

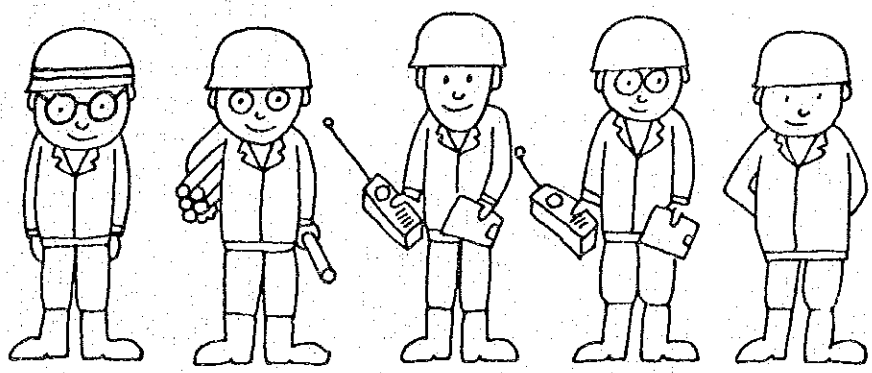
Float Keeper: Selection of specific float for water stage, operation of float dropper

1st Watchman: Report to Second Watchman the time when float passes first line of view

2nd Watchman: Measure the time float takes to travel the distance between first and second line of view

Stage Reader: Take the reading of staff gauges placed at first and second line of view as well as that of standard staff gauge on every hour and at time designated by Group Leader

Group Set-up



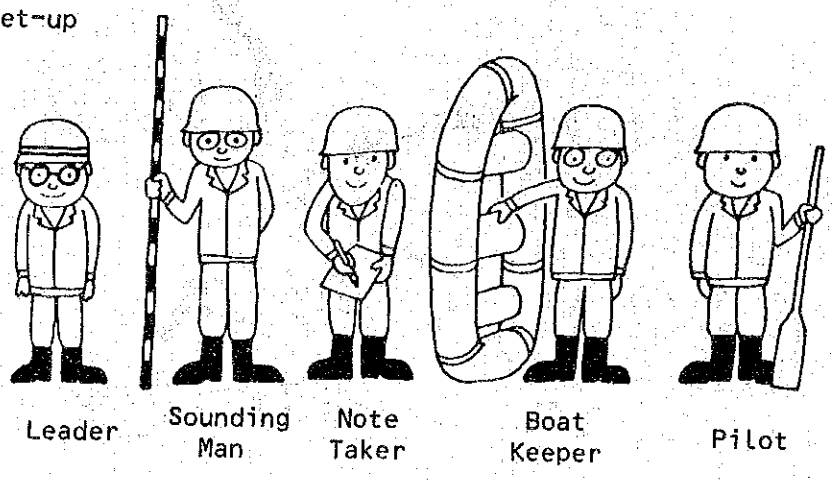
2) Discharge Observation by Current Meter

For discharge measurements to be taken during normal water stage period, procedure stated below could be followed.

Assignment by Designation

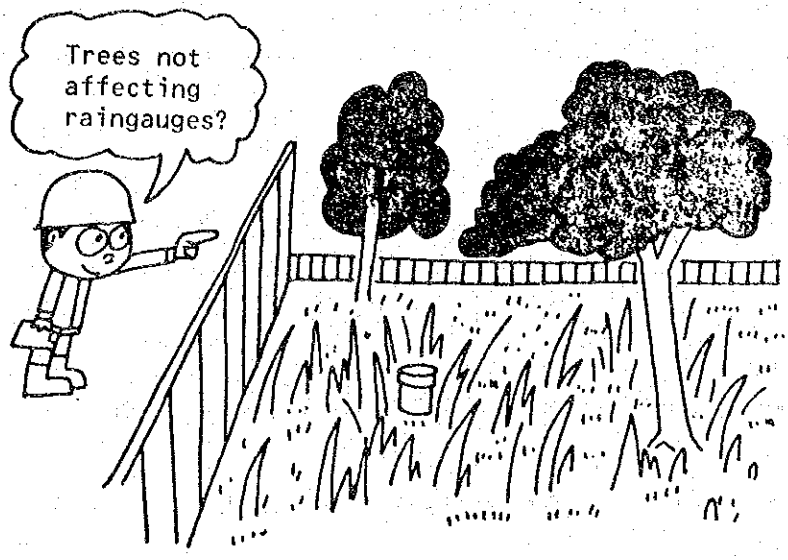
Group Leader:	General Management of observation procedure including safety measures, designation of reference line and observation location
Sounding Man:	Reads the depth of water from rods
Gauge Holder:	Keeps current meter in right position
Note Taker:	Records on field note position of current meter relative to river bank and river bed
Velocity Taker:	Records the velocity reading of current meter on field note
Boat Keeper:	Keeps boat in right position by wires extended from banks
Boat Pilot:	Drives boat to right position and controls it in water

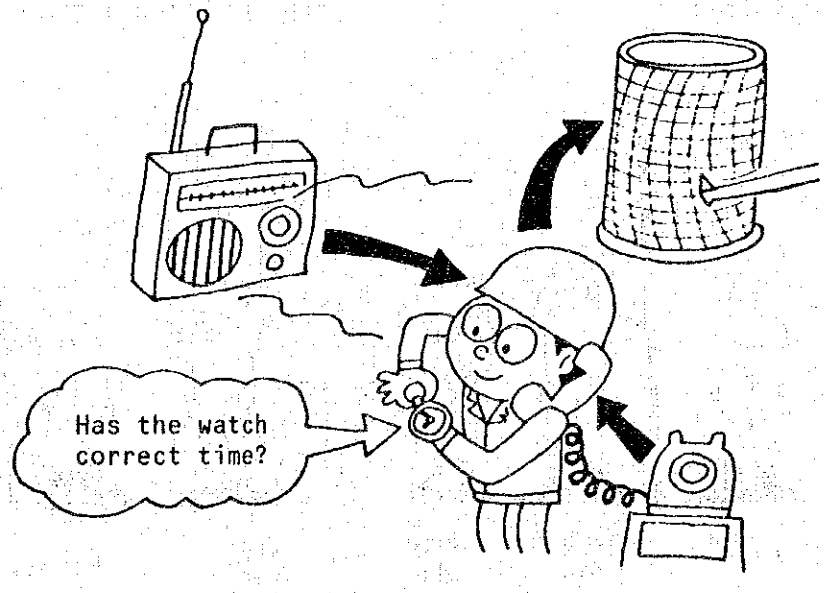
Group Set-up



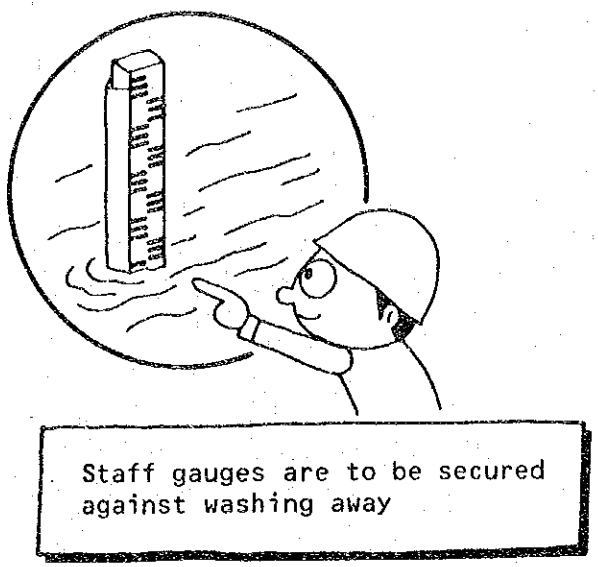
3. Assignment of Gauge Keeper

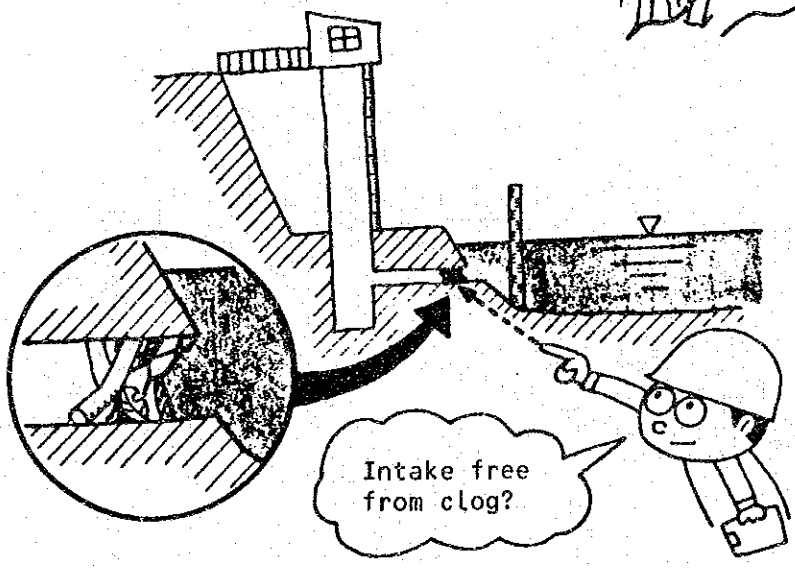
(1) Rainfall Gauging Station





(2) Water Level Gauging Station





APPENDIX L

CHECK LIST FOR GAUGING FACILITIES

1. Rainfall Gauging Facilities

Check lists for the inspection of rainfall gauges are described below.

(1) Is there any dense forest near a gauging station which may affect the rainfall?

(2) Is the distance between the nearest wall or house and the rainfall gauge at least four times the height of the rainfall gauge?

(3) Rain receiver

a) Is the mouth with a diameter of 20cm free from deformation?

b) Is the head horizontal?

c) Is it free from leaves and dust?

d) Are the legs stable?

(4) Is the paint hard to remove?

(5) Does the pen indicate 20 mm on the recording paper when water is poured into the rain gauge to 20 mm?

(6) After the pen indicated 20 mm, does it indicate 0 mm correctly?

(7) Does the water drain completely when the tippig bucket is inverted?

(8) Does the mercury switch operate without fail?

(9) Does the watch indicate correct time?

(10) Does the recording rain gauge require servicing?

(11) Is the recording paper attached properly?

(12) Are the date and time of setting and replacement of the recording paper entered?

(13) Does the pen absorb ink properly? Is the pen point free from dregs?

(14) Is the pen properly fitted into the insertion part?

(15) Is the recorded line in good condition? Does the penholder move up and down smoothly while recording?

(16) Is the glass tube filled with water?

(17) Are entries in the fieldbook correct?

2. Water-Level Gauging Facilities

Check lists for the inspection of water level gauges are described below.

(1) Suiken type water level gauge

a) Is the mouth of intake tube free from clog.

b) Is the mouth of intake tube not dry due to lowering of the river bed during dry season?

c) Does the tower, bridge, and the housing require repairing?

d) Does the recording water level gauge require servicing?

e) Has the clock worked properly? How is the correspondence between the recording time of the water level gauge, the standard clock, and the time of recording tables? Allowable time lag: (4 minutes day).

f) Does the observer or gauge keeper perform regular readings of the staff gauge? Is the clock correct? Are the entries in the field-book correct?

g) Do the recordings have continuity?
Is the paper attached horizontally?

h) Is the recording paper wound up correctly around the socket?

i) Is the paper winding belt tight?

j) Is the ink absorbed properly? Does the ink have the correct color?

k) Is the pen point not clogged? Is it free from dregs and bubbles?

l) Are not the float and weight in contact with the bottom?

m) Are the paper setting and replacement date, time and water levels entered?

n) Is it necessary to remove any surrounding suspended things and grass?

o) Has the water level gauge dried up under the influence of sedimentation?

p) Is the water level gauge in the housing not dusty?

q) Is there any need for oiling or servicing the water level gauge connection and for replenishing the ink?

r) Are there sufficient ink and recording paper?

s) Are the pulley nuts tight?

t) Is there any foreign matter in the well?

u) Are the gear linkage and fastening screws between the water level gauge and the telemeter A-D converter tight?

v) Is the gearing normal

(2) Digital water level gauge and sensing pole gauge

a) General check items are the same as those for the Suiken type water level gauges.

b) Abnormalities of the measuring pole

° Are there any cracks or evidences of impact on the PVC tube?

° Is the joint between the cable and the PVC tub l free from failures?

c) Is the recording paper properly wound?

d) Is the print out clear?

e) Is the typing ribbob not broken? Is it necessary to replace it?

f) Is not the cushion rubber at the tip of the printing hammer cracked?

g) Checks of remaining recording paper.

h) Checks of the autobalancing device and batteries for specified AC voltage and current settings, positive insertion, specific gravity of battery fluids, terminals, cleanliness, etc.

i) Are the seitches on?

Although digital water level gauges require specialized knowledge for handling, the above-mentioned checks can be performed by any observer.

3. Current Meter

(1) Is the current meter tested once a year?

(2) Is it put into a container while transferred?

(3) Check before and after use for:

a) Properccup rotation.

b) Proper buzzer sound.

c) Proper cord connection and no disconnection.

d) Broken suspended ropes.

e) Proper measuring tapes.

f) Water in the contact part.

g) Contact with naked wires.

h) Weight attachment.

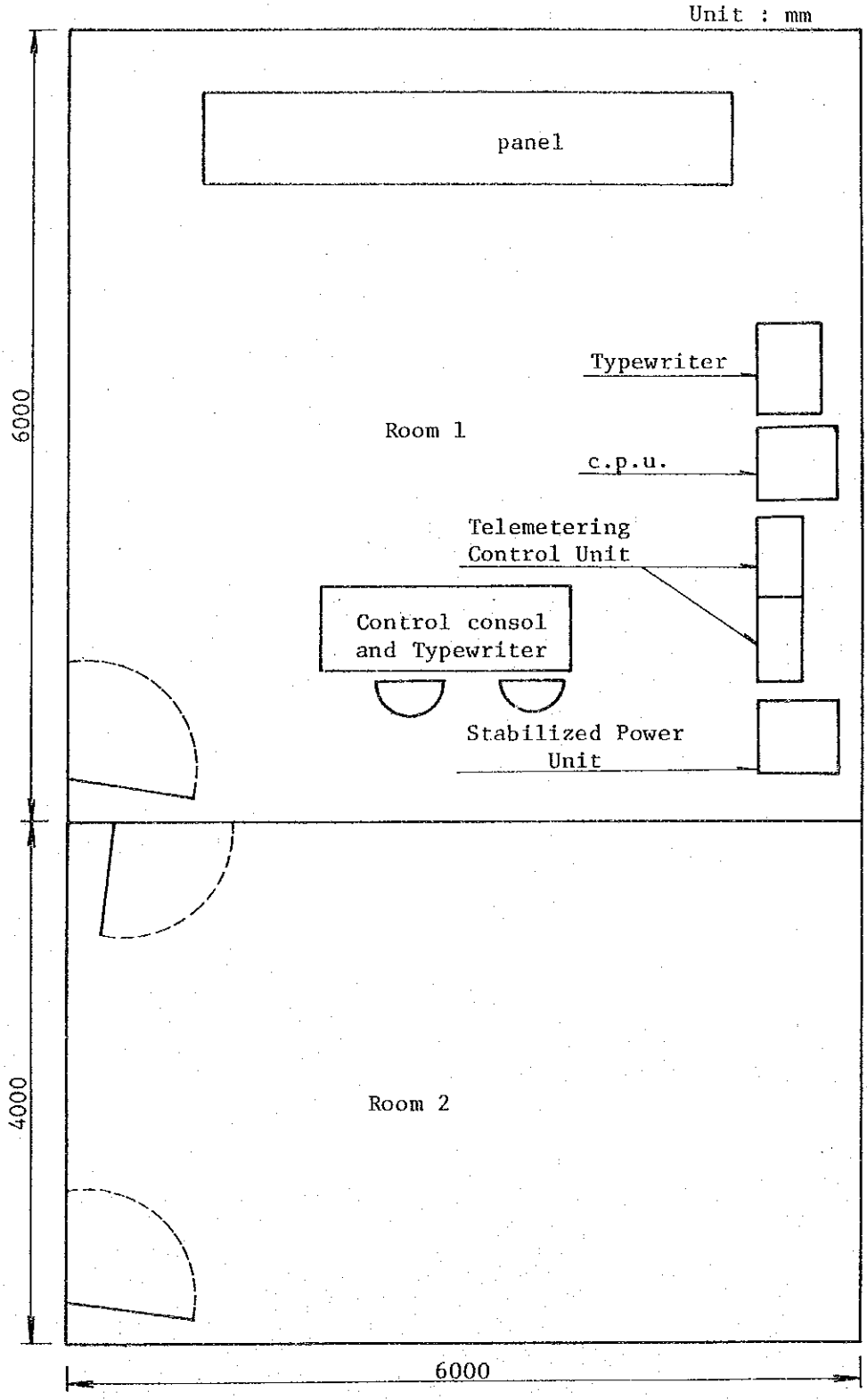
i) Voltage of the dry cells for buzzers.

j) Stained buzzer contact.

APPENDIX M

EXAMPLE OF FLOOD FORECASTING AND WARNING CENTER (LAYOUT)

Flood Forecasting Room of Master Control Station



APPENDIX N

UNIT PRICE OF HYDROLOGICAL OBSERVATION EQUIPMENT AND STATION HOUSING

Rainfall Gauge (New)

Feb. 1980

No.	Item	Price	Foreign		Local
			Yen (¥	U.S.($)	M$
I Equipment Cost	Rainfall Gauge (w-3.5kg)	Tipping buket raingauge monthly 1mm pulse	117,500	534	
	Modulater (w=0.5 kg)	DC 0~1V, 0~1mA output	275,000	1,250	
	Recorder (w-17.0 kg)	Monthly, moter watch	412,500	1,875	
	Spare parts	above-mentioned 10%	80,500	366	
II	Shipping	4.5$ (1000 Yen)/kg	21,000	95	
III	Sub total	(I + II)	906,500	(4,120) 4,100	
IV	Installation	(III x 0.15)		650	1,365
V	Indirect expenses	(III x 0.15) Tax. Delivery, Charge, etc.		650	1,365
VI	Sub total	(IV + V)		1,300	2,730
VII	Total	(III + VI)		5,400	2,730

(1$ = 2.1 M$ = 220 Yen)

Water Level Gauge (bubble type)

Feb. 1980

No.	Item	Price	Foreign		Local M$
			Yen (¥)	U.S. ($)	
I Equipment Cost	Bubble gauge unit (w=15 kg)	h = 0 10 m	1,125,000	5,114	
	DC control unit (w=5 kg)	DC 12V	137,500	625	
	Blower unit (w=13 kg)		162,500	739	
	Rack		37,500	170	
	AD converter		44,000	200	
	2" header		20,000	90	
	Recorder (w=23 kg)	Suiken 62 type	652,500	2,966	
	Gear-set		12,500	57	
	Gas cylinder		47,300	215	
	Spare parts	above-mentioned 10%	111,940		
I	Shipping	4.5$ (1000 yen)/kg	60,000	273	
III	Sub total	(I + II)	2,410,740	10,950	
VI	Installation	(III x 0.15)		1,525	3,205.5
V	Indirect expenses	(III x 0.15) Tax. Delivery charge, etc.		1,525	3,205.5
VI	Sub total	(IV + V)		3,050	6,405
VII	Total	(III + VI)		14,000	6,405

(1$ = 2.1M$ = 220 Yen)

Water Level Gauge (float, floatless type)

Feb. 1980

No.	Item / Price		Foreign		Local
			Yen (¥)	U.S. ($)	M $
I Equipment Cost	Suiken 62 type (w=23 kg)	AD converter	1,000,000	4,545	
	Gauge wire	ø1mm stainless	2,000	9	
	Spare parts	above-mentioned 10%	100,200	455	
II	Shipping	4.5$ (1000 Yen)/kg	23,000	104	
III	Sub total	(I + II)	1,125,200	5,100	
IV	Installation	(III x 0.15)	152,400	700	1,470
V	Indirect expenses	(III x 0.15) Tax, Delivery charge, etc.	152,400	700	1,470
VI	Sub total	(IV + V)	304,800	1,400	2,940
VII	Total	(III + VI)	1,430,000	6,500	2,940

(1$ - 2.1 M$ - 220 Yen)

Current Meter

Feb. 1980

No.	Item	Price	Foreign		Local
			Yen (¥)	U. S. ($)	M $
I Equipment Cost	Current Meter	0.3 2m/sec 4m/sec with select position	875,000	3,978	
	Measuring pole		9,500	43	
	Cable	20 m	50,000	227	
	Weight		18,750	85	
	Spare parts	above-mentioned 10%	95,250	443	
II	Shipping	4.5$ (1000 Yen)/kg	29,500	134	
III	Sub total	(I + II)	1,078,000	4,900	
IV	Installation	(III x 0.15)	-	-	-
V	Indirect expenses	(III x 0.15) Tax, Delivery charge etc.	154,000	700	1,470
VI	Sub total	(IV + V)	154,000	700	1,470
VII	Total	(III + VI)	1,232,000	5,600	1,470

Staff Gauge (Plastic type)

Feb. 1980

No.	Item / Price		Foreign		Local
			Yen (¥)	U.S. ($)	M $
I Equipment Cost	Plastic gauge (w = 14 kg)	1.00m/sheet 10m	75,000	341	
I	Spare parts	above-mentioned 10%	7,500	35	
II	Shipping	4.5$ (1000 Yen)/kg	14,000	64	
III	Sub total	(I + II)	96,500	440	
IV	Installation	(III x 0.15)	14,300	65	136.5
V	Indirect expenses	(III x 0.10) Tax. Delivery charge etc.	7,700	35	73.5
VI	Sub total	(IV + V)	22,000	100	210.0
VII	Total	(III + VI)	118,500	540	210

(1$ - 2.1 M$ - 220 Yen)

Breakdown of Station Housing Construction Cost
Type 2.5 M x 2.5 M Housing

Pay Item	Description	Material				Labor				Total (US$)
		Unit	Q'ty	Unit Cost	Amount	Unit	Q'ty	Unit Cost	Amount	
					US$				US$	
	Temporary work Clearing of site					LS			165.00	
	Earthwork Excavation					M^3	7	3.50	24.50	
	Backfill					M^3	7	1.75	12.25	
	Concrete (1:2:4) (Reinforced)	M^3	4	70.86	283.44	M^3	4	21.00	84.00	
	Concrete hollow blocks									
	6" x 8" x 16"	Pc.	50	0.70	35.00	Pc.	50	0.15	7.50	
	4" x 8" x 16"	Pc.	230	0.55	126.50	Pc.	230	0.15	34.50	
	Reinforcement	Kg	395	1.33	525.35	Kg.	395	0.05	19.75	
	Formwork	M^2	6	23.50	141.00	M^2	6	9.30	55.80	
	Plastering work	M^2	50	0.65	32.50	M^2	50	0.65	32.50	
	Door, Windows & Glass work	LS			1,450.00					
	Steel ladder	Kg	14	1.22	17.08	Kg	14	0.49	6.86	
	Fancing	LS			1,390.00					
				Sub total	4,000.87				442.66	4,443.53
								Indirect Expense (35%)		1,556.47
								Total		6,000.00

APPENDIX O

MANUAL FOR RIVER GAUGING BY HELICOPTER

River Gauging by Helicopter

The author proposes a method of flood-velocity observation by means of floats dropped from a helicopter and photographed, in cases where the natural conditions prevent the employment of normal methods

By M. CAPUCHO VIEIRA

FOR the past three years the author has been in charge of a party engaged in the hydrological survey of the Zambezi River and its tributaries in Portuguese East Africa. Hydrometric work in this region is not easy, particularly during flood seasons, when ground access to most of the places suitably located to provide adequate velocity observations is difficult or impossible, and when the rivers carry hundreds of trees, so that observations by boat become dangerous and the use of current meters practically out of the question. As a study of plans of development very often requires a reasonable knowledge of flood discharge, a method is proposed to observe water velocity under such adverse conditions by using

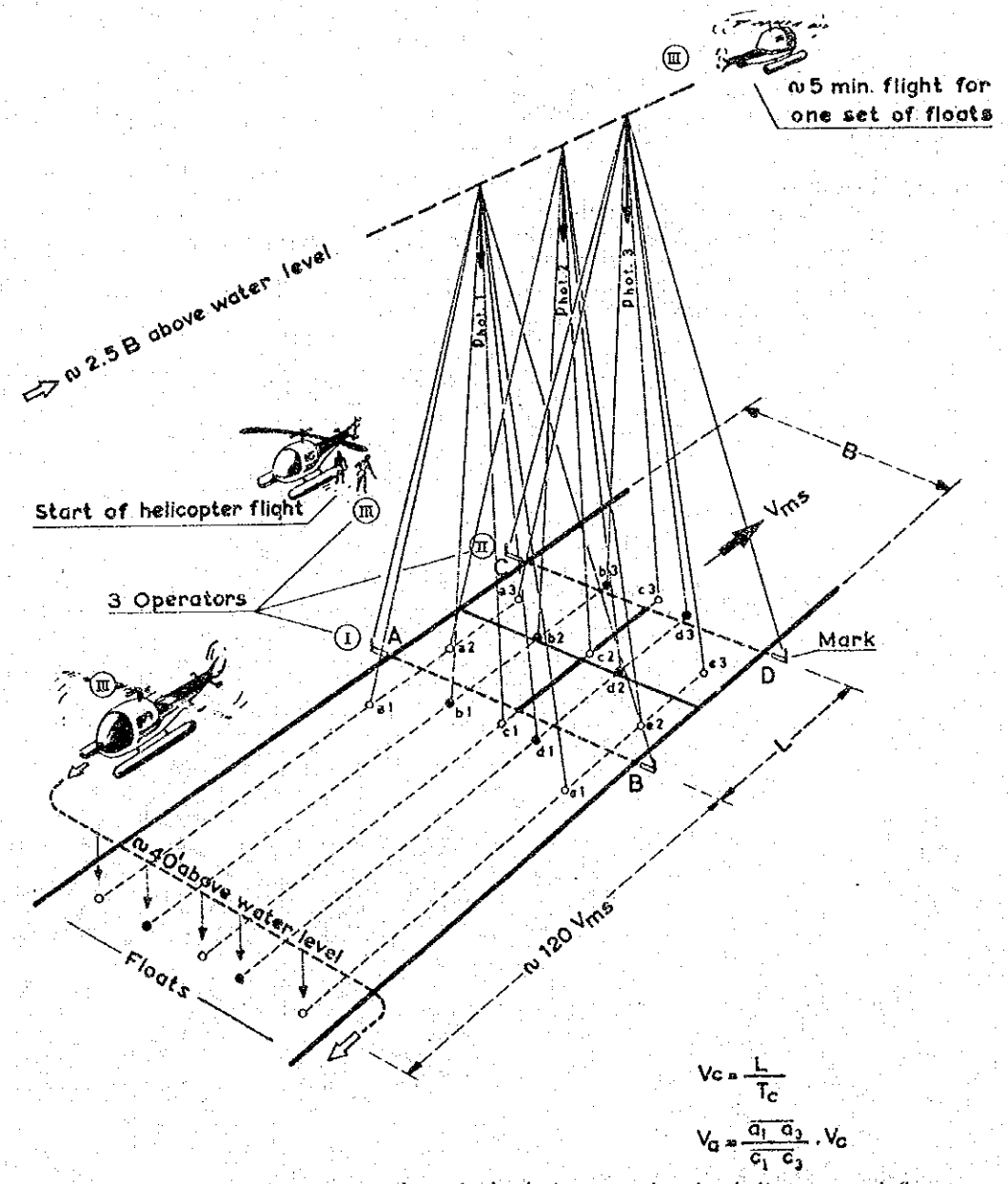


Fig. 1. A sketch of a suggested method of river gauging by helicopter and floats

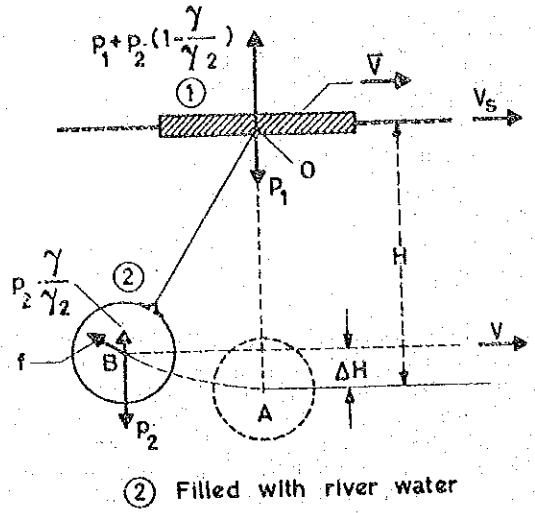


Fig. 2. Illustration of under-surface velocity observation

floats in conjunction with a helicopter. The mean velocity at the gauging section is computed by drawing curves of equal velocity.

Surface-Velocity Observations

The gauging station is prepared during the dry season. Two marks on each river bank define two sections *AB* and *CD* (Fig. 1) for velocity control, between which it is assumed that the mean velocity at any point represents the velocity at the same point of the gauging section. Levels of these four marks are taken with reference to the zero of the gauging scale of the station, and distances *AB*, *AC*, *CD* and *DB* are measured. The cross section of the gauging section is then determined.

The method proposed to observe surface velocity is indicated in Fig. 1 and summarised below:—

(i) A helicopter carries to the station three operators and an adequate quantity of floats.

(ii) Operators I and II, each one with a stopwatch, take up positions close to marks *A* and *C*.

(iii) Operator III, flying in the helicopter, throws down one float and roughly calculates the maximum surface velocity V_{ms}.

(iv) Operator III, flying at about 40 ft. above water level, puts down on the river a set of floats at a distance of about $120V_{ms}$ upstream of section *AB*, in order to provide the helicopter time enough to reach the proper level for taking photographs 1, 2, and 3;

(v) Operators I and II check the time T_c in which float *c* travels the distance *L* from *AB* to *CD*;

(vi) After this, a new set of floats can be operated in the same way.

Velocity of float *c* is given by $V_c = L/T_c$, and the velocity of another float, *a* for instance, is calculated by

$$V_a = \frac{\overline{a_1a_3}}{\overline{c_1c_3}} . V_c$$

$\overline{a_1a_3}$ and $\overline{c_1c_3}$ being taken from photographs 1 and 3.

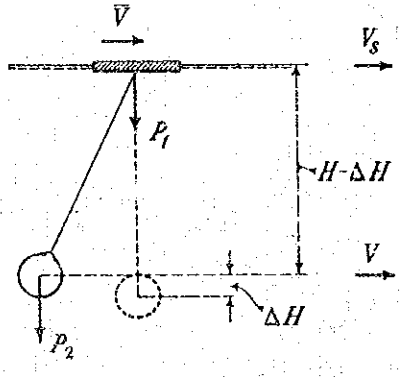
$\frac{P_1}{P_2} = 1$

$\gamma = 1{\cdot}1$

$\gamma_2 = 7{\cdot}2$

$\frac{v}{P_2} = 3{\cdot}47$ cm.^{3}/g.

$g = 980$ cm./sec.^{2}



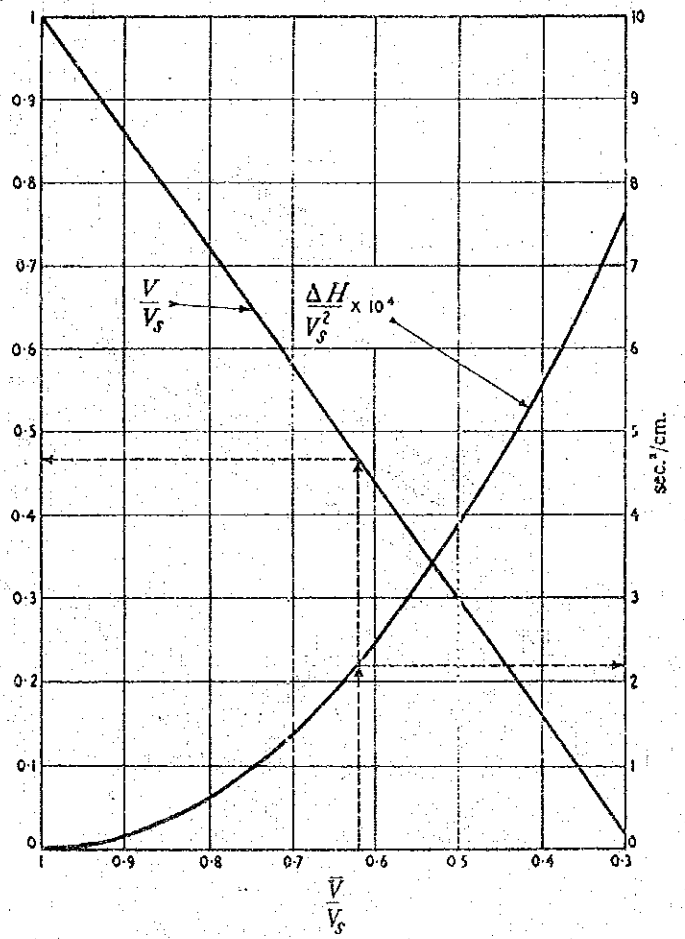


Fig. 3. Calculated graph of V/V_s and $\Delta H/V_s^2$ for a cork float 30 cm. diameter and 3 cm. thick

APPENDIX P

DESCRIPTION OF THE TRAINING COMPONENTS

1. Hydrology Course

This course consisted of lectures, exercises, operation practice and field study.

a) Hydrologic Cycle

- Lectures on basic concepts of hydrologic cycle and workings of its elements including precipitation, run-off, ground water, evaporation and infiltration.

- Concepts on uniform and non-uniform flow and Manning's equation for the primary understanding of hydraulics.

- Study tour to C.T.I. Engineering Kawagoe Hydraulics Laboratory.

b) Processing of Hydrologic Data

- Lectures on methods of rainfall and water level measurement

- Arrangement of data by Suiken format. Excercise on data reading and arrangement using recording sheet

- Lectures on data checking and compensation methods

- Lectures on calculation of mean rainfall in a basin

- Brief explanation on statistical and probability analysis of data

c) Discharge Measurement

- Lectures on methods of discharge measurement and use of measuring equipments and fieldbook for entering discharge measurement data

- Arrangement of collected data and preparation of H-Q rating curve

- Brief explanation of river surveying

d) Run-off Analysis

- Lectures on run-off phenomena and working mechanism from precipitation to run-off

- Run-off analysis after mathematical model by use of rational formula, unit hydrograph method, tank model and storage function model

- Fundamental formula for tank model and its application for run-off calculation of a basin

- Lecture and exercise on preparation of coaxial correlation diagram as possible solution to run-off forecasting problems

e) Flood Forecasting

- Lectures on run-off prediction in a flood forecasting system

- Brief explanation on rain prediction methods

- Flood forecasting methods using tank model and coaxial diagram with attention to forecast error and forecast time and their significance in flood forecasting

- Exercise for preparation of coaxial correlation diagram using data from Kiso River

- Exercise for tank model method by simulation with help of computer

f) Computer Programming

- Lectures on fundamental theories of computer programming
- " BASIC " language programming
- Lectures on FORTRAN language and exercises on tank model simulation and multiple regression analysis

g) Administration of Gauging Facilities

- Lectures on operation and maintenance of rain and water level gauges

h) General Description of Telecommunication

- Lectures on basics and general ideas of telecommunication

2. Telecommunication Course

The course consisted of lectrures, practice, exercises, for the following subject on the equipment, and field reconaissance.

a) Basic approach and knowledge about Hydrology

b) Outline of Telecommunication

- Description in details about frequency allocation
- Radio wave propagation (VHF, UHF and SHF band) and radio interference
- maintenance briefing of the radio set, outline of the system's composition

c) Telemetering System in General

- Description of Telemetry
- Operation of the system
- Signals used on calling outside station
- Pulses corresponding to calling signals
- Station details including description on master, gauging and monitor stations

d) VHF Radio Equipment

- Lecture on transmitter and receiver details on the standard level
- Practical training on signal tracing, test and adjustment of VHF radio used on telemetering system

e) Logic Circuit

- Brief description of logic, gates and its uses in the telemetering sy tem
- Boolean algebra, flip-flops and counter

f) Test Instruments

- Practice on use of level meter, calling tester, code checker, signal generator and synchroscope

g) Gauging Station

- Lecture on circuit composition functions of each circuit, pulse code, signalling and calling system, inspection points and pulse checking method for each module

- Frequency series transmission

- Practice on testing, adjustment, and signal and level tracing

h) Practice on Method of Troubleshooting on Gauging Station

- Trouble isolation and detection method using telemetry code checker, calling signal meter and synchroscope

- Actual application of pulse comparison method of maintenance and repair

i) Raingauge and Recorder

- Lecture and practice on operation, adjustment and maintenance

- Recording chart replacement method and principle of mercury swtich

j) Repeater Stations

- Lecture on circuit configuration types of repeater and block diagram illustrations

- Practice on operation and level and voltage measurements

- Location of test points and squelch adjustments

k) Master Station

- Lecture on composition, function and operation

- Explanation of calling sequences of the remote stations

- Practice on actual operation and observation of the unit

- Hardware of the Master Station, including unit by unit description of each module and block diagram explanations

- Software of Master Station including principle of programming, operational codes, octal, hexa and binary counting, basic programming and code meaning

1) Routine Maintenance

- Lecture on the installation, handling and maintenance of telemetering equipment

- Practical training on the wire wrapping method and coaxial cable connector for better workmanship

APPENDIX Q

MINUTES OF MEETINGS

LIST OF MINUTES

Meeting on "Technical Feasibility Study Report for Flood Forecasting and Warning System in Sabah" held at the Economic Planning Unit Conference Room on 1st November, 1979 at 10:30 a.m.

In Attendance: -

1.	Joseph Yeoh Hoh Hoh	(Chairman) Drainage & Irrigation
2.	Azizan bin Husain	State Economic Planning Unit
3.	Vincent Gadalon	State Economic Planning Unit
4.	Maznah Ghani	State Economic Planning Unit
5.	Leilie Chong	Telecommunications
6.	Liew Sak Lin	Telecommunications
7.	Paul Hii	Drainage & Irrigation
8.	V. Thiagarajah	Drainage & Irrigation
9.	Akira Yuasa	Japanese Survey Team
10.	Toyoharu Hiruma	Japanese Survey Team
11.	Yasuo Koiwai	Japanese Survey Team
12.	Tatsuo Hamaguchi	Japanese Survey Team
13.	Hiroomi Nakao	Japanese Survey Team
14.	Yoshiharu Nakagawa	Japanese Survey Team
15.	Takashi Ushijima	Japanese Survey Team
16.	Teiji Maeda	Japanese Survey Team

Minutes

The Director of Drainage and Irrigation Sabah (chairman)opened the meeting by welcoming all present. He further stated that the meeting is presently confined to only Technical Departments to discuss the Preliminary Report submitted by the Japan International Cooperation Agency. He then introduced the State Government officers and the Japanese Team.

For the benefit of all present the chairman gave a background of the project.

He also stated that the DID Headquarters in K.L. after prior consultation with the Federal E.P.U. had decided to extend a telemetric Flood Forecasting System to Sabah and Sarawak on the lines of the system run in Peninsula. The Japanese Government was approached to provide assistance to conduct the technical feasibility studies for the setting up of such a system.

In the case of Sabah, although several river basins suffer from annual floods, the Sg. Kinabatangan was chosen because it is the most seriously affected besides being the most suitable, by virtue of its catchment size and sheer isolation. The chairman added that there were three ways in which the State Government could obtain funds for subsequent implementation of the project. They are:

(1) Free Japanese aid to lesser developed countries.

(2) Japanese loan credit at soft rates.

(3) Aid from elsewhere.

Since Malaysia was not considered a lesser developed country, it did not qualify for the first type. Funds for the project would thus be sought under the Fourth Malaysia Plan.

The Japanese Team leader, Mr. Akira Yuasa, then thanked the State Government officials for the cooperation extended to his team. He said the purpose of the project was important as not only flood causes damage but also hampers development.

Then various members of the Japanese Team presented the Technical Feasibility Study Inception Report.

Encik Azisan of SEPU then asked whether the present study would lead to another report or could the project be implemented after this study. The Japanese Team after a lengthy discussion stated that after their present study, their report would form a basis for implementation of the project. The suppliers of the equipment would provide the working plans of the project for direct implementation.

The Telecoms representative wanted to know the extent of their involvement. The chairman replied that Telecoms would have to provide only maintenance service for the telemetric equipment and a new relay station to be set up at Balat, which would feed the information into the Telecoms Station at Trig Hill (Sandakan) for onward transmission via the existing communication service between Sandakan and K.K.

Telecoms stated that they would prefer unattended stations with 2/3 months periodical visits. To another question, the Japanese Team replied that they would recommend standby equipment and that power supply will be through solar batteries.

It was also recommended that this Team should make firm proposals regarding training of staff, both from the DID and the Telecoms.

Telecoms confirmed that the 70.38 MHZ frequency can be used for the current tests but to legalise future operation, another application would have to be made by DID. However the actual operating frequency could only be finally decided after tests. Replying to a question from the chairman the Telecom's representative quoted a figure of approx. $175/- per mile/year rental and operating costs would be in the order of 5% of Equipment cost. However he added that adequate spares should be stocked.

The chairman then requested the Team to present a comprehensive working paper, including design and estimated costs so that the Government could take a dicision on the matter.

Since there was no other business the meeting adjourned at 11:55 a.m.

Meeting on Survey Memorandum of Flood Forecasting
and Warning System in Sabah held at
D.I.D. Office, Nov.27,1979

Attendance:

1. Paul Hii	Drainage and Irrigation
2. Akira Yuasa	Japanese Survey Team
3. Yasuo Koiwai	
4. Tatsuo Hamaguchi	
5. Teiji Maeda	
6. Toyoharu Hiruma	
7. Takashi Ushijima	
8. Hidetomi Oi	UN Typhoon Commitee Secretariat

Subject:

1. Submission of Survey memorandum on Flood Forecasting and Warning System in Sabah.
2. Enquiries made by Survey Team.
3. Enquiries made by D.I.D.
4. Others

1. Findings of field survey conducted between 5 and 20 November were reported in a memorandum and was submitted to D.I.D. D.I.D. shall make comments and inquiries on the contents after studying the memorandum. Japanese Team requested D.I.D. for another meeting in Kuching, since the director and other concerned officials of the D.I.D. were not available then.

2. Enquiries made by Survey Team are:

1) Master Flood Forecasting Center (MFFC) and Flood Forecasting Center (FFC).

The Survey Team is planning to propose MFFC to be located in Kota Kinabalu and FFC in Sandakan, i.e. FFC serving solely as flood forecasting and warning office for Kinabatangan River, and MFFC as the main flood forecasting office for Sabah, should the operation be extended to other rivers. The Team is interested in the availability of personnel and facilities and this would-be location of the

offices. The Team would like to propose a new organization provided the above are available.

2) Method of Warning

The Team has the following plans as to warning method:

a. Warning apparatus installed along the river

This plan would cost very much and its effect is reduced in severe rains.

b. Warning by patrol vehicles and boats with the aid of warning radio installed at D.I.D. Kuamut Office

This plan, however, will not operate at night and poses problems to personnels attending the vehicles. The effect of warning is limited to areas along the river.

c. Warning by radio receivers lent to kampung chiefs

The warning sent by the radio will spread from the chiefs throughout the kampungs. This system can be operated at fairly low cost. Some problem may arise from jurisdiction of districts since D.I.D. will be sending the warnings directly to kampungs. If there can be changes in the jurisdiction so that warning can be sent simultaneously from the D.I.D. and the Police, this plan will work satisfactory. The equipments lent to the chiefs are to be collected at the end of rainy season for maintenance.

As to warning system at large, the Team shall further study the one in operation in West Malaysia.

3. Enquiries and requests made by D.I.D.

1) Approximate cost of the project is needed to be informed as the project will be proposed for the Fourth Malaysian Plan.

2) Organization of personnel at MFFC is requested to be proposed.

3) Training program is requested to be proposed.

As to the above, the Team was not able to answer immediately due to their reporting schedule. The Team, however, is willing to cooperate as much as possible. The reporting schedule is as follows:

Submission of draft final report ... March, 1980
Malaysian Government is requested to give comments on the above.

Submission of final report ... June, 1980

4. Others

The Team is planning to propose a FFC in the existing D.I.D. office in Sandakan. The office space, however, is rather small. Mounting of antenna pole (5m long) is needed. The team is interested to know if there is any regulation for such installation. Although rather small in space, the Team considers it appropirate to place FFC at the exiting D.I.D. office. Some problems remain unsolved for such matters as the installation of emergency power generator, antenna pole mounting and other difficulties arising from the structures of the Sandakan City Board Building. If it is ever possible to construct a new facility for FFC, the Team has in mind of proposing one at Trig Hill. The Team recommends, however, to have the FFC placed in the existing office with the addition of space (rooms), if possible.

The questions and requests made above are to be further discussed and decisions made in another meeting to be held in Kuching during the Team's stay there. It is imperative that the Director of the D.I.D. attend the meeting in Kuching for the survey team views it necessary that these matters be settled before the draft final report can be worked on.

MINUTES FROM THE MEETING

1. Date: 27hb. November, 1979

2. Place: Telecoms Office, Kota Kinabalu

3. Attendance:

Mr. Harold Read	Telecoms
Mr. Leslie Chong	
Mr. Liew Sak Lim	
Mr. H. Oi	Typhoon Com/U.N.
Mr. A. Yuasa	Survey Team
Mr. H. Nakao	
Mr. T. Maeda	
Mr. Y. Nakagawa	
Mr. Y. Koiwai	
Mr. T. Ushijima	

4. Summary

1) Rentals

M$ 175.00 mile/yr

2) Nature of Lease

Exclusive, full year basis

3) Organization of the Telecoms

a. Telecoms, a Government Department is responsible for looking after the use of frequencies in Sabah.

b. 1,000 members in Sabah, of which up to 800 are technical staff. Five technicians are now in Sandakan who are able to look after telemetry.

ORGANIZATION

DIR. GEN. in K.L.

	DIRECTOR		SABAH
(LIAISON OFFICE)	REGIONAL	H.Q.	K.K.
DISTRICTS			
West Coast/ Interior	Sandakan		Tawau

4) Circuit configuration of microwave link from Sandakan to K.K.

a. Necessary adjustments can be made

To suit the nature of data being sent, signal level and other circuit conditioning in accordance with CCITT.

b. Data signalling bit rate

Up to 9,600 bit/sec.
(This flood forecasting net work will send only up to 50 bit/sec of data).

c. Reliability

Transmittion well secured against rain/fading losses. Some lightning problems experienced.

d. Maintenance

Telemeter lines should be taken care of by the customer. As for the repair, equipments should be supplied with replacement circuit cards for on the spot remedy.

e. Frequency Allocation

Controlled by jointly committee of Telecoms and Army Telecoms of Brunei, Singapore and Malaysia.

3rd Meeting with D.I.D. Sabah

Place: Sabah D.I.D. Office Director's Room

Date : November 29, 1979, from 11:30 to 12:30

Attendance:		
	Daniel Wong	D.I.D. Deputy Director
	Paul Hii	Hydrology Engineer
	Akira Yuasa	Japanese Survey Team
	Toyoharu Hiruma	"
	Tatsuo Hamaguchi	"
	Yasuo Koiwai	"
	Hiroomi Nakao	"
	Yoshiharu Nakagawa	"
	Hidetomi Oi	UN Typhoon Committee Secretariat

Subject: 1. Enquiries made by Survey Team
2. Brief Explanation of Survey Memorandum

1. Location of MFFC and FFC

D.I.D. understood the meaning of the Team proposing FFC in Sandakan. However, as the Flood Disaster Committee will be organized in Kota Kinabalu, a Senior Engineer shall be assigned for his task in Kota Kinabalu. Therefore D.I.D. Sabah thinks it more appropriate to place Master Control Center in Kota Kinabalu and the decisions made in Kota Kinabalu with warning if necessary. The Team has agreed to that opinion and has decided to place FFC in Kota Kinabalu and a Monitoring Center in Sandakan. We finally decided that use of telephone line between Sandakan and Kota Kinabalu is more economical than the dispatchment of an engineer to Sandakan.

2. Method of Warning

Of three proposed plans the one in which warning is sent to kampung chiefs by radio was decided most appropriate due to reliability and economical advantage over other plans. D.I.D. has agreed to further investigate the extent of warning equipment needed.

3. Explanation on Survey Memorandum

Subjects related to hydrology was explained by Mr. Hamaguchi and telecommunication by Mr. Nakao.

1st Meeting with D.I.D. Sarawak

Place: Sarawak D.I.D. Headquarters, Conference Room

Date: November 30, 1979, from 9:30 to 10:30

Attednace:		
	Foong Ka Nim	Director, D.I.D. Sarawak
	Joseph Ting	Deputy Director, D.I.D. Sarawak
	Tserng Goong Farn	Hydrologist, D.I.D.
	Then Thiat Khiong	Acting W.S. (Hydrology) D.I.D.
	Akira Yuasa	Leader, Japanese Survey Team
	Noboru Sakuma	Hydrologist
	Toyoharu Hiruma	River Planning Engineer
	Yasuo Koiwai	Telecommunications Engineer
	Hiroomi Nakao	Telecommunications Engineer
	Teiji Maeda	Telecommunications Engineer
	Yoshiharu Nakagawa	Telecommunications Engineer
	Takashi Ushijima	Liaison Officer

Minutes:

The Director of Drainage and Irrigation, Sarawak opened the meeting by welcoming all present. The team leader of the Survey Team then introduced the members of the mission. For the benefit of all present, copies of inception report was submitted by the Survey Team. The report together with the field survey itinerary was studied carefully, and brief explanations were made by the Survey Team on some topics.

The Survey Team stated that instead of unit price of materials, construction cost of housing per square feet is required. They also stated that information on machinery procurement may not be necessary because large scale construction is not expected. On the use of testing frequency for radio, 70. 525 MHZ was confirmed as permitted. Use of Mt. Serapi facilities was to be further discussed that afternoon with the Telecoms (Refer to minutes from the meeting with Telecoms).

Concerning the placement of flood forecasting center, it was acknowledged that there is no need to place it in the Headquarters including a monitoring facility. The Flood Forecasting Center shall be located in D.I.D. Depot in Bintawa where the Hydrology Division is.

Upon request made by the Survey Team for detailed cross section surveying of the river at observation stations, D.I.D. has agreed to conduct the work on several locations and send the results by the end of January, 1980. The Survey Team was also informed that cross section surveying has already been conducted at Serian Water Level Station.

Meeting with Telecom Department, Sarawak

Place: Telecom Department Conference Room

Date: November 30, 1979, from 11:00 to 12:00

Attendance:		
	Chan Hick Ping	Telecoms Department
	Ronny Ong Tiang Lam	" "
	Tserng Goong Farn	D.I.D. Sarawak
	Then Thiat Khiong	" "
	Akira Yuasa	Japanese Survey Team
	Noboru Sakura	"
	Toyoharu Hiruma	"
	Yasuo Koiwai	"
	Hiroomi Nakao	"
	Teiji Maeda	"
	Yoshiharu Nakagawa	"
	Takashi Ushijima	"

Subject: Use of Mount Serapi Station (Telecoms) for Radio Propagation Test.

Minutes:

Upon opening the meeting, the members of the Survey Team were introduced by the Team Leader to the Telecoms engineer. Telecommunication Engineers of the Survey Team then went on with the enquiries concerning the use of Mt. Srapi facilities. The following are the answers given by the Telecoms.

1) Test outside the building atop Mt. Serapi is impossible due to limited space.

   Use of building rooftop and second floor will be made available for test purposes. However, a cable of 20m long will be necessary to connect the rooftop and second floor rooms.

2) No other facilities or equipment shall be provided.

3) Station building is three stories-high, each having 15 feet height.

4) To reach the station, trip to troposcatter station below the summit station can be made by vehicles. To climb further up to the building on summit, it is required to use 600 steps which can be covered by walking twenty minutes.

5) Equipment for the testing can be kept inside the building during the test period.

6) The use of Mt. Serapi station as relay station for flood forecasting and warning system in Sadong River basin shall be further discussed before implementation between the Telecoms Department and the D.I.D., based on the proposal made by this Survey Team.

MINUTES OF MEETING ON FLOOD FORECASTING AND WARNING SYSTEM IN SARAWAK HELD ON 15TH DECEMBER, 1979 AT D.I.D. HQ.

PRESENT

Director	- Mr. Foong Ka Nim	- Chairman
Deputy Director	- Joseph Ting	- Vice Chairman
Stenographer	- Jennifer Goh	- Secretary
S.E.E. (DP)	- Ngo Tok Pin	- Member
Hydrologist	- Tserng Goong Farn	- "
E.A. (Hydrological)	- Then Thiat Khiong	- "
Team Leader	- Akira Yuasa	- "
Hydrologist	- Noboru Sakuma	- "
River Planning Engineer	- Toyoharu Hiruma	- "
Telecommunication Engineer	- Yasuo Koiwai	- "
Telecommunication Engineer	- Hiroomi Nakao	- "
Telecommunication Engineer	- Teiji Maeda	- "
Telecommunication Engineer	- Yoshiharu Nakagawa	- "
Liaison Officer	- Takashi Ushijima	- "

Chairman's Speech

The Chairman took the opportunity to welcome all those present, especially the JICA Mission Team to the meeting. The main aim was to discuss the flood forecasting and warning system in the Sadong River Basin.

Confirmation of Technical Feasibility Study Memorandum

The Technical Feasibility Study memorandum was read and confirmed with the following amendments: -

In Page 4 under (1) 1-1 Target Area:
"Target Area shall cover majority floodplain area of the Sadong River Basin which was affected by the highest flood occurred in January 1976. Locations such as Tebakang, Serian, Tanah Puteh, Sebamban and Gedong will be included."

Under 1-2 Warning Point:
"According to the target area above, warning point selected are to be at Tebakang, Serian, Tanah Puteh , Sebamban and Gedong."

MATTERS ARISING

In Page 9 under 2-3 Discharge Measurement:
Locations under Para. 2 - Cableway is to be installed in Meringgu mainly due to the high flood flow.

Technical Report

The Report would be submitted to the State Government for final consideration as to which method, out of the three enlisted in the report they would adopt.

There being no other business, the meeting adjourned with Chairman thanking each and every one of the mission team for their good work they had carried out in D.I.D. Sarawak. On behalf of the JICA Mission team, the Team Leader, Mr. Akira Yuasa also thanked the Department staff for their kind cooperation.

(JOSEPH TING)
for Chairman,
Flood Forecasting & Warning System
in Sarawak.

Dated 15th December, 1979.

MEETING ON
TECHNICAL FEASIBILITY STUDY FLOOD FORECASTING
AND WARNING SYSTEM IN SABAH AND SARAWAK

Date:	20th December, 1979	
Time:	9.30 a.m.	
Venue:	D.I.D. Conference Room	
Chairman:	Mr. Sieh Kok Chi	- D.I.D.
Secretary:	Mr. Teh Siew Keat	- D.I.D.
Present:	Mr. Mohd. Aminuddin Hashim	- E.P.U.
	Mr. Rusli Bin Habib	- Telecom
	Mr. Xavier Goh Khen Wah	- Telecom
	Mr. Ong Hai Seng	- Telecom
	Mr. Tan King Seng	- D.I.D.
	Mr. Akira Yuasa (Leader)	- Japanese Survey Team
	Mr. Noboru Sakuma	- " " "
	Mr. Yasuo Koiwai	- " " "
	Mr. Hiroomi Nakao	- " " "
	Mr. Toyoharu Hiruma	- " " "
	Mr. Teiji Maeda	- " " "
	Mr. Yoshiharu Nakagawa	- " " "
	Mr. Takashi Ushijima	- " " "
	Mr. Ozawa	- Embassy of Japan
	Mr. Tanimoto	- Colombo Plan Expert
	Mr. Yatsuda	- JICA

1. Opening Remark by Chairman

The Chairman welcomed all those present. He apologised on behalf the Deputy Director General of D.I.D., who, as a result of the postponement of the meeting from 18th December to 20th December, 1979, was unable to chair the meeting due to other commitment. The Chairman also informed that D.I.D. and Telecom Officers from Sabah and Sarawak were unable to attend the meeting due to non availability of air-line seats to Kuala Lumpur.

2. Introduction of Members of the Meeting

Mr. Yuasa leader of the Japanese Survey Team introduced his team members. Others present were introduced by the Chairman or self introduced.

3. Opening Remark by Japanese Survey Team Leader

Mr. Yuasa informed the meeting that the Survey Team has successfully completed the technical freasibility study, having spent 1 month in Sabah and 3 weeks in Sarawak. He expressed his gratitude to Sabah and Sarawak Officers for their cooperation in the study and also thanked Federal D.I.D. for their kind advice.

4. Time Schedule for Preparation of Final Report

Draft Final Report is to be ready by beginning of March 1980 while the Final Report, after comments by Malaysia, is to be ready by beginning of June, 1980.

5. Report on the Study

The Survey Team pointed out that the feasibility study was carried out only from technical point of view. No consideration was given to social economic aspects. The Team then reported according to a 'Memorandum of Works' distributed during the meeting. Comments or discussion on the report are as follows: -

5.1 Kinabatangan River Basin

(i) Flood Forecasting Method

Forecasting by stage correlation method is recommended. Forecast at Kuamut is to be based on water level observation at Tangkulap and Ulu Kuamut. The lag time is in the order of 2 - 3 hours pending further analysis. D.I.D. expressed that use of Tongod will improve available warning time.

(ii) Radio Interference

Telecom expressed concern that there might be interference with their radio/TV transmission. Discussion with Regional Director and check by Telecom is therefore necessary.

(iii) Warning System

Three cases or methods were proposed namely (a) by Siren fixed at site, (b) by patrol car and boat along river and (c) by radio reciver to Kampong Chief. Sabah indicated preference over case (c). However, frequency for such radio

link is yet to be determined. Survey Team will provide more information on warning system in Final Report.

(iv) Durability of Instruments

The Survey Team was requested to include information on durability of telemetric equipment in Final Report.

(v) Relay Station

Encik Rusli questioned whether Bt. Garam could be a better choice than Balat for locating the relay station, considering the possibility of the access to Mt. Balat being cut off during monsoon. Another advantage is the availability of electricity supply at Bt. Garam. The Survey Team replied that judging from topography of the area, Bt. Garam appears not as suitable as Mt. Balat.

5.2 Sadong River Basin

(i) Forecasting Method

Due to insufficient data, stage correlation method is proposed for the time being. D.I.D. expressed the need to also consider the contribution of Batang Krang in the forecast at Gedong. Survey Team will supply reasons in Final Report for its exclusion.

(ii) Radio Inteference

As in 5.1(ii).

(iii) Warning System

The same three cases as for Kinabatangan River Basin were proposed. However, Sarawak has yet to indicate prefereence. Sarawak shall be asked to comment on this matter on receipt of the Draft Final Report.

(iv) Relay Station at Mt. Serapi

Encik Rusli informed that the space at Mt. Serapi Telecom Station is rather limited. The Regional Director Telecoms

will have to be further consulted on this matter.

(v) Radio Link between Mt. Serapi and Kayan River

The Survey Team indicated that the proposed water level site for future expansion on the Kayan River was at the road bridge from Tebedu to Serian.

The Final Report will confirm the exact location of the link at Kayan River.

5.3 General

(i) Plan for Future Improvement

Due to insufficient hydrological data, the Survey Team will develop forecasting methods or methodology based on stage correlation (with rainfall in some cases) only. However, the Survey Team will include in the Final Report a proposals to improve the forecasting methods and hence the necessary hydrological network and telecommunication systems.

(ii) Training for Maintenance of Telecommunication System

Encik Rusli emphasised the need to include in the Final Report a training programme for the Telecom staff to maintain the telecommunication system, and also the coordination between D.I.D. and Telecom in the overall maintenance of the system.

(iii) Rainfall Network

While telemetric stations are required to give real time data, D.I.D. viewed that non-telemetric gauges which require little maintenance, could be considred in the network design, especially in Kinabatangan River Basin, for future develcpment of forecasting models.

(iv) Radio Frequency

Final Report will include recommendation of radio-frequency band to be used in actual operation of the flood

forecasting and warning systems.

(v) Scope of Work

The Chairman drew the attention of the Survey Team to the Scope of Work outlined in the Inception Report, especially on the Analytical work to be carried out in Japan. He singled out the following as important for inclusion in the Final Report.

a) Hydrological Analysis
b) Telemetric Radio Circuit Design to facilitate calling of tenders.
c) Cost Estimates

The meeting ended at 11.30 a.m.

Meeting on Draft Final Report 'Feasibility Study on Flood Forecasting and Warning System in Sabah and Sarawak'

Date:	7th March, 1980	
Time:	2.30 p.m.	
Venue:	D.I.D. Conference Room	
Chairman:	Mr. Cheong Chup Lim	D.I.D. HQ.
Present:	Mr. Akira Yuasa	Japanese Mission
	Mr. Kazuhiko Takayama	Japanese Mission
	Mr. Noboru Sakuma	Japanese Mission
	Mr. Yomio Ishii	Japanese Mission
	Mr. Mohd. Aminuddin Hashim	E.P.U.
	Mr. Chong Beng Tiat	Telecoms
	Mr. Ong Hai Seng	Telecoms
	Mr. H. Abe	J.I.C.A.
	Mr. S. H. Thavaraj	D.I.D. HQ.
	Mr. Joseph Yeoh	D.I.D. Sabah
	Mr. Joseph Ting	D.I.D. Sarawak
	Mr. Seih Kok Chi	D.I.D. HQ.
	Mr. Teh Siew Keat	D.I.D. HQ.
	Mr. Ahmad Fuad b. Embi	D.I.D. HQ.
	Mr. Tadashi Tanimoto	Colombo Plan Expert

Action

1. Welcome and Introduction

The Chairman extended a warm welcome to the Survey Team and all others present. Mr. Yuasa introduced members of the Mission while the rest of the members of the meeting were either introduced by the Chairman or self-introduced.

2. Confirmation of Minutes of Meeting held on 20th December, 1979.

The meeting accepted the minutes without amendments.

Action

3. Matters Arising

3.1 Time Schedule for Preparation of Final Report

Discussion on this item was defered until after the presentation and discussion of the Draft Final Report.

4. Presentation and briefing of Draft Final Report by Japanese Mission

After introductory remarks by Mr. Yuasa, the Mission went on to present the Report. The Chairman then invited for comments and discussion from members of the meeting. The comments and discussion are recorded in the following paragraphs.

5. Comments and Discussion

5.1 Telecoms

(i) On staff requirement for the Flood Forecasting Centre recommended by Japanese Mission, Telecoms will ask their Regional Offices to comment. — Telecoms

(ii) The Telecoms expressed concern over the use of Mt. Balat for a Repeater Station. The Japanese Mission informed that technically, it is essential to use Mt. Balat instead of other hill sites. Moreover, an access road to Mt. Balat is available.

(iii) The Telecoms also expressed concern over some of the radio paths, which have been accepted as good by the Japanese Mission. The Chairman requested Telecoms to include this in their written comments. — Telecoms

	Action
5.2 D.I.D.	
Warning System	
(i) In answer to D.I.D. Sarawak, the Japanese Mission said it is possible to have a combination of different Cases of Warning Systems in one forecasting System. D.I.D. Sarawak will indicate their preference or provide suggestion for each warning point so that the Japanese Mission could include recommendations and cost estimates in the Appendix of the Final Report.	Sarawak
(ii) Similarly, D.I.D. Sabah will indicate their needs or provide suggestion for each warning point so that the Final Report could ensure completeness in presenting a flood forecasting and warning system.	Sabah
Cost Estimates	
(iii) Estimated costs are US$1,359,000 for Kinabatangan and US$737,000 for Sadong. D.I.D. felt that the estimates are high. The Japanese Mission will comment on the possibility of replacing some of the imported equipment with locally manufactured equipment, with a view to reduce the cost estimates.	Japanese Mission
(iv) In response to question on maintenance cost estimate and life span of the telemetric equipment, the Japanese Mission said in Japan the annual maintenance cost (on spares alone) is about 5% of the capital cost and the life span is about 10 years.	
Personnel Requirement of Flood Forecasting Centre	
(v) The Japanese Mission was requested to include the Final Report outline of duties for the	

	Action
4 hydrology engineers and 4 telecommunication engineers recommended for the Flood Forecasting Centre	Japanese Mission
Flood Forecaeint Methods	
(vi) On the alternative forecasting system for Kinabatangan, the D.I.D. made the following comments: -	
(a) Kuamut could be more significant than Balat as a telemetric water level station in view of the higher population and the need for real-time feedback of the flood station.	
(b) Tongod could be more suitable than Tungkulap in view of a longer warning time.	
The Mission took note of the above comments	Japanese Mission
(vii) The flood forecasting model for Kuamut (K-1) has not considered backwater effect from Milan River. The Japanese Mission took note of the above.	Japanese Mission
Damages from Flood	
(viii) The losses in the Kinabatangan River Basin was corrected from M$200,000,000 to M$200,000 in 1967 and M$100,000,000 to M$100,000 in 1971.	Japanese Mission
6. Deletion	
Section paragraph of item (ii) Pg II-112 is to be deleted.	
7. Draft Final Report	
Telecoms was given 3 copies, EPU 2 copies, D.I.D. Sabah 2 copies, D.I.D. Sarawak 2 copies and D.I.D. HQ. 1 copy of the Report.	

Action

8. Time Schedule for Comments and Final Report

(i) Written comments on the Draft Final Report from the various Department are to be collated by D.I.D. and forwarded to E.P.U. by 7.4.80. E.P.U. will transmit the comments to the Japanese Mission through the J.I.C.A. Office bedore 10.4.80. — Telecoms, E.P.U. D.I.D.

(ii) The Final Report is to be ready by early July, 1980. — Japanese Mission

9. The Chairman thanked all members for their participation. The meeting ended at 6.00 p.m.

Minutes recorded by
Ir. Teh Siew Keat