REPORT

ON

THE SECOND SURVEY FOR THE ESTABLISHMENT
OF THE FLOOD FORECASTING AND WARNING SYSTEM
IN THE PAMPANGA RIVER BASIN
IN THE PHILIPPINES

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OVERSEAS TECHNICAL COOPERATION AGENCY

TOKYO, JAPAN

FOREWORD

The Overseas Technical Cooperation Agency (OTCA) has the pleasure to present herewith the Report on the Pilot System for Establishing a Flood Forecasting and Warning System in the Pampanga River Basin which was prepared by the second survey team dispatched to the Philippines by order of the Japanese Government.

During its stay in the Philippines from February 23 to March 23, 1972, the team had a series of discussions with and was offered valuable cooperation from the competent authorities and pertinent organizations, which enabled the team to successfully complete its field surveys including data collection.

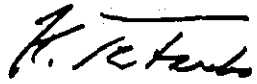
After its return to Japan, the team made further review and studies on the basis of data and information obtained by the survey. The present report is an outcome of such review and studies.

By the completion of the second survey, the prospect for establishing a flood forecasting and warning system in the Pampanga River Basin has been made even more visible than before.

The Agency hopes for early completion of the pilot system and wishes to add that it is ready to offer technical cooperation which will be required for the establishment of the proposed flood forecasting and warning system.

I take this opportunity to express my gratitude to the Philippine Government for the generous and valuable assistance extended to the team throughout the survey period.

September 1972



Keiichi TATSUKE
Director-General
Overseas Technical Cooperation Agency
Tokyo, Japan

H.E. Mr. David M. Consunji,
Secretary of Public Works and Communications,
Government of the Philippines

Your Excellency,

We have the honour to present herewith the Report on the Second Survey for Establishment of the Flood Forecasting and Warning System in the Pampanga River Basin of your country.

During its one-month stay in Manila, the survey team comprising the undersigned three telecommunications experts carried out surveys and investigations and discharged the duties assigned to it. The present report is an outcome of careful review and studies made in Japan on the basis of the survey data obtained during its stay in your country.

It is sincerely hoped that this report will prove useful for the establishment of the planned flood forecasting and warning system and at once serve to enhance the friendly relations now existing between the peoples of the Republic of the Philippines and Japan.

May we avail ourselves of this opportunity to express our deep gratitude for the valuable assistance offered by the competent officials of your government throughout the survey period.

Yours very truly,

S. Yoshioka

Head: Shigeki YOSHIOKA

K. Yamanaka

Kiyoshi YAMANAKA

K. Mugishima

Katsuo MUGISHIMA

The Japanese Government Second Survey Team
for
The Flood Forecasting and Warning System
under
The Colombo Plan

Tokyo, Sept, 29, 1972

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CHAPTER 1. INTRODUCTION

1-1 Background of the Survey

On the strength of the technical and economic cooperation agreements between the Governments of the Republic of the Philippines and Japan and taking note of the plan of ECAFE/WMO Typhoon Committee which was agreed upon by the two governments, the Japanese Government sent a survey team comprising nine experts to the Philippines during the period from November 19 to December 18, 1969 for the purpose of formulating a comprehensive plan for establishing a pilot flood forecasting and warning system in the Pampanga river basin. The results of the survey activities carried out by this team were compiled into the Basic Feasibility Survey Report and presented to the Philippine government in March 1970.

The second survey team composed of three telecommunications experts was sent to the Philippines in 1972 with the view to collecting engineering and design data required for implementing the plan proposed in the said basic feasibility survey report. The present report was prepared from the data and information collected by this second survey team.

1-2 Formation of the Survey Team

The survey team was composed of three telecommunications experts. The name, present post and assignment of each of the three experts are shown in the following Table 1-1.

Table 1-1 Formation of the Survey Team

Name	Present Post	Assignment
Shigeki YOSHIOKA	Deputy Head, Electricity and Telecommunications Section, Minister's Secretariat Ministry of Construction	Head, Overall Control
Kiyoshi YAMANAKA	Engineer, Technical Integrity Div., Tokyo Expressway Public Corporation	Radio Transmission Test, and Collection and Analysis of Data
Katsuo MUGISHIMA	Electricity and Telecommunications Section, Minister's Secretariat, Ministry of Construction	Radio Transmission Test, and Network Design

1-3 Survey Plan

The basic feasibility survey conducted in 1969 covered the on-the-map premilinary survey and reconnaissance survey at a number of proposed sites of gauging stations and repeater stations. This basic survey provided the basis for the telemetering system and network design of the flood forecasting and warning system proposed by the basic feasibility survey team.

In the present second survey, which was conducted along the lines of Case-II proposed in the report submitted by the basic feasibility survey team, the following activities were carried out for collection and analysis of data required for construction design.

1. Survey of the existing state of observation facilities.
2. Transmission tests between the Flood Forecasting Center, Bureau of Public Works, respective gauging stations and the repeater stations, as well as between respective repeater stations.
3. Noise level measurements at the Flood Forecasting Center, Bureau of Public Works and Cabanatuan repeater station.
4. Survey of the assigned frequency and the existence of interference therein.
5. Study on the layout of facilities and ground height of antennas at each proposed site.

1-4 Survey Itinerary

The survey team arrived at Manila on February 23, 1972 and returned to Japan on March 23 of the same year.

The team's itinerary during this period is shown in the following Table 1-2.

Table 1-2 Survey Itinerary

Date	Day	Description	Remarks
Feb. 23	Wed.	Departure from Tokyo at 11:30 a.m. by SK-984. Arrival to Manila at 3:20 p.m.	
24	Thu.	Courtesy visits paid to— *Bureau of Public Works* Weather Bureau ECAFE/WMO Typhoon Committee Japanese Embassy in the Philippines Donated equipment from Japan uncrated and checked for damage and number at the Bureau of Public Works.	

Date	Day	Description	Remarks
Feb. 25	Fri.	Checking and testing of the equipment at the Flood Forecasting Center, and provision of instructions and technical guidance for handling the equipment to the Philippine telecommunication engineer cooperating with Japanese experts.	
26 27	Sat. Sun.	) Holiday	
28	Mon.	Reconnaissance survey of the existing gauging stations and proposed sites of gauging and repeater stations for the flood forecasting and warning system in the Pampanga river basin. Central Luzon River Control District Office (Apalit; rainfall and radio telephone) Sulipan (water level) Candaba (rainfall and water level) Arayat (rainfall and water level) San Isidoro (rainfall and water level) Cabanatuan (repeater)	San Vincente site selected by the basic feasibility survey was changed to San Isidoro. Overnight stay at Cabanatuan.
29	Tue.	Reconnaissance survey of the following sites. Sapang Buho (rainfall, water level and floater dropping) Papaya (rainfall) Transmission test between the following sites. Sapang Buho – Cabanatuan Papaya – Cabanatuan	Overnight stay at Cabanatuan.
Mar. 1	Wed.	Reconnaissance survey at the following sites. San Rafael (rainfall and repeater) La Paz (rainfall and water level) Transmission test between the following sites. San Rafael – Cabanatuan	
2	Thu.	Consultations for design of flood forecasting and warning facilities and antenna poles at the Bureau of Public Works.	
3	Fri.	Maintenance and inspection of survey equipment, and charging of batteries.	

Date	Day	Description	Remarks
Mar. 4 5	Sat. Sun.	) Holiday	
6	Mon.	Noise level measurement at the following two places. Flood Forecasting Center (terminal telemetry) Bureau of Public Works (monitor) Transmission tests between the following places. Flood Forecasting Center – San Rafael Bureau of Public Works – San Rafael	
7	Tue.	Reconnaissance survey at the following site. Ipo (rainfall and water level) Transmission test between the following places. Ipo – San Rafael	
8	Wed.	Reconnaissance survey at the following site. Sibul Springs (rainfall) Transmission tests between the following sites. Sibul Springs – San Rafael San Isidoro – San Rafael	Biak na Bato site proposed by the basic feasibility survey was changed to Sibul Springs.
9	Thu.	Transmission tests between the following sites. Apalit – San Rafael Sulipan – San Rafael	
10	Fri.	Noise level measurement at the following site. Cabanatuan Second transmission test between the following sites. Cabanatuan – San Rafael Consultations and arrangements for transmission tests.	
11 12	Sat. Sun.	) Holiday	
13	Mon.	Arrangement of collected data and materials and the network design at the Flood Forecasting Center.	

Date	Day	Description	Remarks
Mar. 14	Tue.	The following activities were performed at the Flood Forecasting Center. Layout design and preparation of sketch drawings of the facilities to be installed at the Flood Forecasting Center. Discussions on the construction design.	
15	Wed.	The following activities were performed at the Bureau of Public Works. Second discussions on the design of flood forecasting equipment and antenna poles. Preparation of the draft of interim report.	
16	Thu.	Preparation of the draft of interim report at the Bureau of Public Works.	
17	Fri.	Preparation of the interim report at the Bureau of Public Works.	
18 19	Sat. Sun.	) Holiday	
20	Mon.	Arrangements with the Radio Control Office for frequency allocation. Translation of the interim report into English at the Flood Forecasting Center.	
21	Tue.	Typing up and checking of the English text of interim report at the Bureau of Public Works.	
22	Wed.	Submission of the interim report. Farewell greetings offered to – Bureau of Public Works Weather Bureau ECAFE/WMO Typhoon Committee Japanese Embassy in the Philippines Manila Office OTCA	
23	Thu.	Departure from Manila at 8:30 a.m. by CX-900.	

1-5 Acknowledgement

The team wishes to express its deep gratitude to all the parties who assisted in the survey, particularly to the officials and staffs of the Bureau of Public Works and Weather Bureau of the Philippine government and ECAFE/WMO Typhoon Committee who provided the team with helpful advices and data and also offered every convenience and cooperation for smooth progress of the survey.

The team's appreciation also goes to Mr. Onaka, First Secretary of the Japanese Embassy in Manila and his successor, Mr. Inayoshi, as well as to Mr. Yamamura, Resident Representative Manila Office, OTCA, who made kind arrangements and extended valuable help to the team throughout the survey period.

CHAPTER 2. SURVEY ACTIVITIES

2-1 General Condition of Proposed Sites

(1) Flood Forecasting Center (Quezon City)

The Philippine government accepted the proposal made in the basic feasibility survey report and established the Flood Forecasting Center in Quezon City as sub-organ of the Bureau of Public Works and Weather Bureau. At present, the Center is staffed by its chief and four officials deputed from these two bureaus who are engaged in the preparatory activities for the planned establishment of the flood forecasting and warning system.

The terminal telemetry and radio telephone equipment, which will be the center of data collection in the planned flood forecasting system, will be installed at this Center. The survey disclosed that the Center is spacious enough to accommodate the said equipment and is also provided with ample control functions required for their operation.

(2) Bureau of Public Works (Manila)

The Bureau of Public Works which assumes charge of improvement and flood protection of the Pampanga river is located in Manila about 10 km apart from the Flood Forecasting Center. In order that the Bureau may be constantly informed of accurate rainfall and flood condition within the Pampanga river basin, monitor and radio telephone equipment will be installed at the Bureau for receiving water level and rainfall data collected by the telemetry equipment at the Flood Forecasting Center. The survey revealed that the installation of the said equipment would entail no difficulties.

(3) Central Luzon River Control District Office (Apalit)

Telemetry and rainfall gauging equipment are planned to be installed at this District Office which is a branch of the Bureau of Public Works. The team discovered that both the building and site area of the District Office are satisfactory for the planned installation.

(4) Sulipan

The existing water level gauging station at this site is not performing its function because its headrace is covered with soil and its level gauge is in disorder.

Sulipan is located in the downstream section of the Pampanga river. The small water level fluctuation and the flat topography observed at this site make it justifiable to repair the existing station or to construct a new one. The team considers it appropriate to construct a new water level gauging station of the same float-type as the existing one.

The site is located close to the said District Office. A cable is therefore

recommended to be laid between the new gauging station and the District Office for connection with the telemetry equipment.

(5) Arayat

At this site, the existing water level gauging station which was constructed by making use of a bridge pier is not in service condition at present due to the damage incurred by a flood.

The damage can be repaired with ease, but the repair work should be so effected as will give sufficient rigidity to the station so that it will not be damaged again by flood water.

In addition to the repair of the water level gauging station, a station housing telemetry equipment and rainfall gauging equipment will be installed at an elevated place on the river bank, with a connecting cable laid between the two stations.

The water level gauging station to be installed on top of a tube well should be designed with countermeasures taken against vibration and dust intrusion in order to protect the water level gauging equipment.

The water level gauging station and the telemetry station will be separated from each other in the above layout, and this is expected to cause inconvenience to maintenance work. Further, there is fear that the cable connecting the two stations may break when the bridge pier is damaged by flood. For these reasons, it is preferable that the water level gauging station be installed in the telemetry station if budgetary arrangement can be made for this purpose.

(6) Candaba

Since the telemetry station is planned to be installed in the low-lying Candaba Swamp, it will have a steel structure. Concurrent installation of a headrace and a tube well for the float-type water level gauging equipment will not therefore entail any difficulties.

(7) La Paz

The telemetry station will have a steel structure since it is planned to be installed at a low-lying place as in the case of Candaba site. Concurrent installation of a headrace, tube well for the float-type water level gauging equipment, etc. will likewise entail no difficulties.

(8) San Isidoro

This site was selected by the Philippine government in place of San Vincente site for geographical and other reasons. The site allows a station to be constructed on the ground with high elevation, but will incur large cost for installing a headrace and

tube well for the float-type water level gauging equipment. Accordingly, use of a pole-type water level gauging equipment (TAKUWA) is recommended.

San Isidoro was proposed in the basic feasibility survey report as the installation site of a station for observing the discharge of the Pampanga mainstream as well as the inflow from San Antonio Swamp into Candaba Swamp through Cabiao-Candaba channel. The hydrologists who participated in the basic feasibility survey stated that for the said observation purpose, San Isidoro is on the upstream side to excess, and expressed the hope that a suitable new site would be selected on the downstream side.

(9) Sapang Buho

This site has a high ground elevation and therefore provides ample safety against flood damage. However, since the construction work of the tube well and headrace is considered to incur a large cost at this site, installation of pole-type water level gauging equipment (TAKUWA) is recommended.

Sapang Buho station should be provided with a rest room and a generator room because of the planned installation of discharge gauging facilities.

(10) Ipo

To offset the poor transmission characteristics between Ipo and San Rafael Repeater Station and also to provide against flood damage, the station at this site should be constructed at a place with as high an elevation as practicable.

Accordingly, installation of pole-type water level gauging equipment is recommendable as in the case of the above-mentioned two sites.

(11) Papaya and Sibul Springs

These two are the sites of rainfall gauging stations. The survey revealed that the geographical condition of the two sites is satisfactory.

(12) San Rafael

This is the site of a rainfall gauging and repeater station. Although its elevation is rather small, the site is suited for the maintenance of equipment.

(13) Cabanatuan

This site was selected for installation of repeater equipment within the building and compounds of the existing weather station. Located in the city area, the site has favourable geographical conditions.

2-2 Network Design

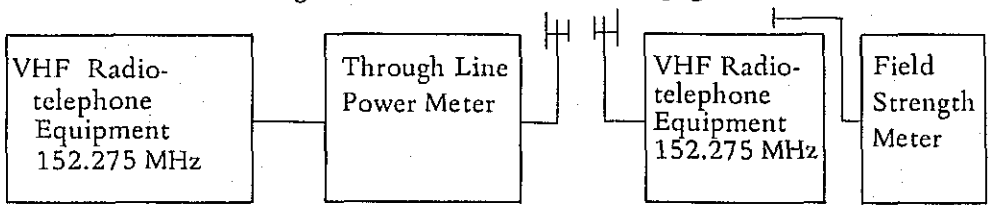
2-2-1 Method of Measurement

Measurements were conducted by means of the equipment donated by Japan such as the radiotelephone equipment, field-strength meter, high-sensitivity recording meter, quasi-peak meter, through line power meter, and portable antennas.

(1) Measurement of Propagation Loss

Propagation loss was measured by arranging the measuring instrument as shown below. The antenna position and antenna pole height were changed to measure the fluctuation of propagation loss and observe the quality of voice messages.

Fig. 2-1 Measurement of Propagation Loss



(2) Calculation of Propagation Loss

$$L_p = X + \gamma + L_{ft} + L_{fr} - G_{At} - G_{Ar} - P$$

L_p ... Propagation loss.

X ..... Conversion coefficient of receiving power and receiving open-circuit voltage ..... 113 dB

γ ..... Value measured by field strength meter (received input voltage) ..... dB μV

L_{ft} .... Transmitting feeder loss ..... dB

L_{fr} .... Receiving feeder loss ..... dB

G_{At} .... Gain of transmitting antenna ..... dB (G_{IS})

G_{Ar} .... Gain of receiving antenna ..... dB (G_{IS})

P ..... Value indicated by through line power meter ... dBm

(3) Calculation of Signal to Noise Ratio

The signal to noise ratio (S/N) was calculated by the application of the following equation. Under normal condition, S/N in each channel section should be better than 30 dB.

$$S/N = P_t - (L_p + L_f) + G_{At} + G_{Ar} - P_{rn} + I$$

S/N ..... Signal to noise ratio in the channel ..... dB

P_t ..... Transmitting power ..... dBm

L_p ..... Propagation loss ..... dB

L_f ..... Feeder loss ..... dB

G_{At} ..... Absolute gain of transmitting antenna ..... dB

G_{Ar} ..... Absolute gain of receiving antenna ..... dB

P_{rn} ..... Receiving noise power ..... dBm

The receiving noise power is the sum of the receiver internal noise power (P_{rni}) and external noise power (P_{rne}).

I ..... S/N improvement factor

The S/N improvement factor is the value obtained by the following equation.

$$I = 10 \log \left(\frac{3 \, fd^2 \cdot B}{fm^2} \right)$$

fd ..... Maximum frequency deviation

B ..... Equivalent noise frequency range of receiver

f_m ..... Maximum modulation frequency

The circuit reliability can be judged by whether the transmitting power (P_t) satisfies the following equation.

$$A + M \text{ (dB)} > P_t > A$$

$$A \text{ (dBm)} = (L_p + L_f + L_F) - G_{At} - G_{Ar} + P_{th}$$

where,

M ..... 10 dB under normal condition

L_F ..... Fading loss (dB) (0.1 dB per km)

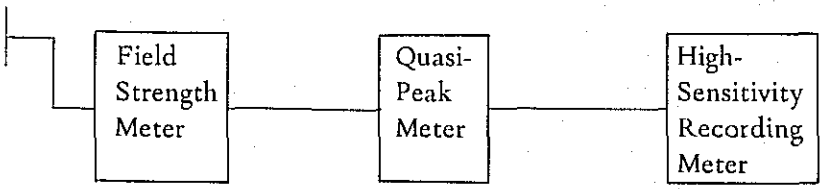
P_{th} ..... Threshold level (dBm)

The threshold level is the sum of P_{rn} and Cf = 9 dB.

(4) Existence of Jamming Frequencies in the Neighbourhood of Assigned Frequency

Existence and jamming effect of other frequencies in the neighbourhood of the assigned frequency were measured by arranging the field-strength meter as illustrated below.

Fig. 2-2 Measurement of Jamming Frequencies



2-2-2 Results of Measurements

(1) Table 2-1 shows the network design prepared on the basis of the results of transmission tests. The propagation loss includes the free space loss shown in this table. The values for Arayat, Candaba and La Paz were obtained by calculation.

(2) The level of city noise ranges from 10 to 20 dB, and is not considered to produce a large jamming effect at time of receiving.

(3) The spectrum and input voltage of jamming frequencies are shown in Table 2-2. From the values shown in this table, the team recommends that a new frequency which is in the neighbourhood of 140 MHz or 160 MHz be assigned for the flood forecasting and warning system.

Table 2-1 Network Design

			Sapang Buho →Cabanatuan	Papaya →Canabatuan	La Paz →Cabanatuan	Cabanatuan →San Rafael	Ipo →San Rafael	Sibul Springs →San Rafael	Apalit →San Rafael	Quezon City →San Rafael	San Isidoro →San Rafael	Candaba →San Rafael	Arayat →San Rafael	San Rafael →Manila
1	Transmitting Power	dBm	30	35	30	35	35	35	30	30	30	30	30	35
2	Free Space Loss	dB	−125.8	−131.8	−112.3	−122.8	−138.3	−136	−104.8	−113.8	−127.3	−109.3	−108.4	−110.8
3	Add Loss	dB												
4	Feeder Loss	dB	−2.2	−2.2	−2.2	−3.2	−2.2	−2.2	−3.2	−4	−2.2	−2.2	−2.2	−2.8
5	Gain of Transmitting Antenna	dB	8	8	8	8	8	8	8	8	8	8	8	6
6	Gain of Receiving Antenna	dB	6	6	6	6	6	6	6	6	6	6	6	8
7	Receiving Power	dBm	−84	−85	−70.5	−77	−91.5	−89.2	−63	−73.8	−85.5	−65.5	−66.6	−64.6
8	Receiving Noise Power	dBm	−117	−117	−117	−117	−117	−117	−117	−117	−117	−117	−117	−117
9	High Frequency S/N	dB	33	32	46.5	40	25.5	27.8	54	43.2	31.5	51.5	50.4	52.4
10	Improvement Factor of S/N	dB	20	20	20	20	20	20	20	20	20	20	20	20
11	Standard S/N	dB	30<	30<	30<	30<	30<	30<	30<	30<	30<	30<	30<	30<
12	Fading Loss	dB	−2	−1.8	−2.4	−5.7	−2	−2	−2.3	−3.8	−5	−2.2	−3.1	−4.3
13	S/N when Facing Takes Place	dB	30<	30<	30<	30<	30<	30<	30<	30<	30<	30<	30<	30<
14	Threshold Level	dBm	−108	−108	−108	−108	−108	−108	−108	−108	−108	−108	−108	−108
15	Fading Margin for Threshold Level	dB	24	23	37.5	31	16.5	18.8	45	34.2	22.5	42.5	41.4	43.4
16	Margin for Threshold Level when Fading Takes Place	dB	22	21.2	35.1	25.3	14.5	16.8	42.7	30.4	17.5	40.3	38.3	39.1

Table 2-2 Spectrum and Field Strength of Jamming Frequencies

Frequency	Input Voltage
102 MHz	50 dBμV
142.8 "	26 "
152.275 "	23 ~ 41.5 "
152.9 "	12.5 "
154 "	12.5 "
155 "	27 "
155.5 "	21 "
158.5 "	13.5 "
159 "	21 ~ 24.5 "

CHAPTER 3. FLOOD FORECASTING AND WARNING SYSTEM

3-1 Outline

From the results of the second survey, the team recommends that the flood forecasting and warning system be established with the originally proposed plan partially revised as shown in the attached Fig. 3-1 System Network.

One of the major revisions is to transmit the water level data by cable line from Sulipan to Apalit Central Luzon River Control District Office for connection to the telemetry equipment. This revision is recommended by reason of the short distance between the two places.

The other is to connect the Flood Forecasting Center, Bureau of Public Works and Apalit Station by a newly installed radiotelephone circuit and not by the telemetry radiotelephone circuit as originally proposed. This revision is recommended because the capacity of the solar cell power supply equipment at San Rafael Repeater Station is planned to be increased and also because the originally proposed plan is liable to hinder smooth operation of telemetering equipment.

These revisions will make it necessary to change the antenna tower at Apalit to a self-supporting triangular tower having a height of 30 m above ground level. As for San Isidoro site, the team considers it advisable that a suitable station site be selected on the downstream side as stated in Section 2-1-(8), Chapter 2.

3-2 Telemetering Equipment

The telemetering equipment which are to play the pivotal function in the flood forecasting and warning system should conform, as proposed in the basic feasibility survey report, to the Specifications for Standard Telemetry and Warning System of the Japanese Ministry of Construction.

For the purpose of smooth and efficient operation of the said equipment, the following instrumentation arrangements should be made at the Flood Forecasting Center, Bureau of Public Works and San Rafael Repeater Station.

At the Flood Forecasting Center, a graphic display panel should be installed in addition to the data writer for recording the observed water level and rainfall data so that the observation point, water level and cumulative daily rainfall values (cumulative rainfall data recorded each day from 00:00 hrs. or specified time or starting time of rainfall) will be indicated.

At the Bureau of Public Works, a wall-hung type display panel should be installed in addition to the data writer so that the water level fluctuation and cumulative rainfall values will be indicated.

At San Rafael Repeater Station, two sets of radiotelephone equipment, one for

constant use and the other for stand-by purpose, should be so installed that the former will be automatically changed over to the latter in case of its failure and thus maintain the station in perfect service condition at all times. This arrangement is necessitated by the fact that the data collected at each station are all transmitted through this unmanned station and therefore, its failure makes the entire system inoperative. Another reason for this arrangement is that the station is expected to become difficult of access in the wet season due to the poor road condition.

As for Cabanatuan Repeater Station, installation of an additional set of radiotelephone equipment besides the existing one set is not planned because 1) the distance between the station and Quezon City, though long, is covered by a trunk road, 2) the station's environmental condition will be good since it will be installed within the existing weather station, and 3) assignment of maintenance engineers is considered easy. However, since the existing equipment is of the cross-repeating type, 2 sets of telemetry repeater equipment, one for communication with San Rafael and the other with gauging stations, should be installed.

3-3 Hydrological Observation Equipment

3-3-1 Rainfall Gauging Equipment

For telemetering rain gauging, the tipping bucket type rain gauge is usually employed.

For each 1 mm of rainfall taken in the intake section having a diameter of 200 mm, this rain gauge makes one tipping, closing the contacts of the rainfall recorder and gauging the A/D converter (analog-digital converter) to make 1/10 turn when the said 1 mm is discharged into the receiver, whereby the rainfall data are sent to the telemetry system.

The rainfall gauge is available in two types, i.e., the integrate type which has its intake section and gauging section made into one piece and the separate type which has its gauging section connected through an intake pipe. At Apalit Station, the integrate type should be installed in its front yard. At other stations, the separate type should be installed with its intake set on the roof and gauging section indoors.

The outside view of the tipping bucket type rainfall gauge and the rainfall recorder is shown in the attached Figs. 3-2 ~ 4.

3-3-2 Water Level Gauging Equipment

The water level gauging equipment should be either newly installed or repaired since most of the existing water level gauging facilities are not in service condition.

The newly installed water level gauges will comprise two types, i.e., the float-type (SUIKEN Type 62) and the pole-type (TAKUWA Electronic Digital Water Level Gauge), which are known to exhibit high reliability when used in the telemetry system.

a. Float-type Water Level Gauge

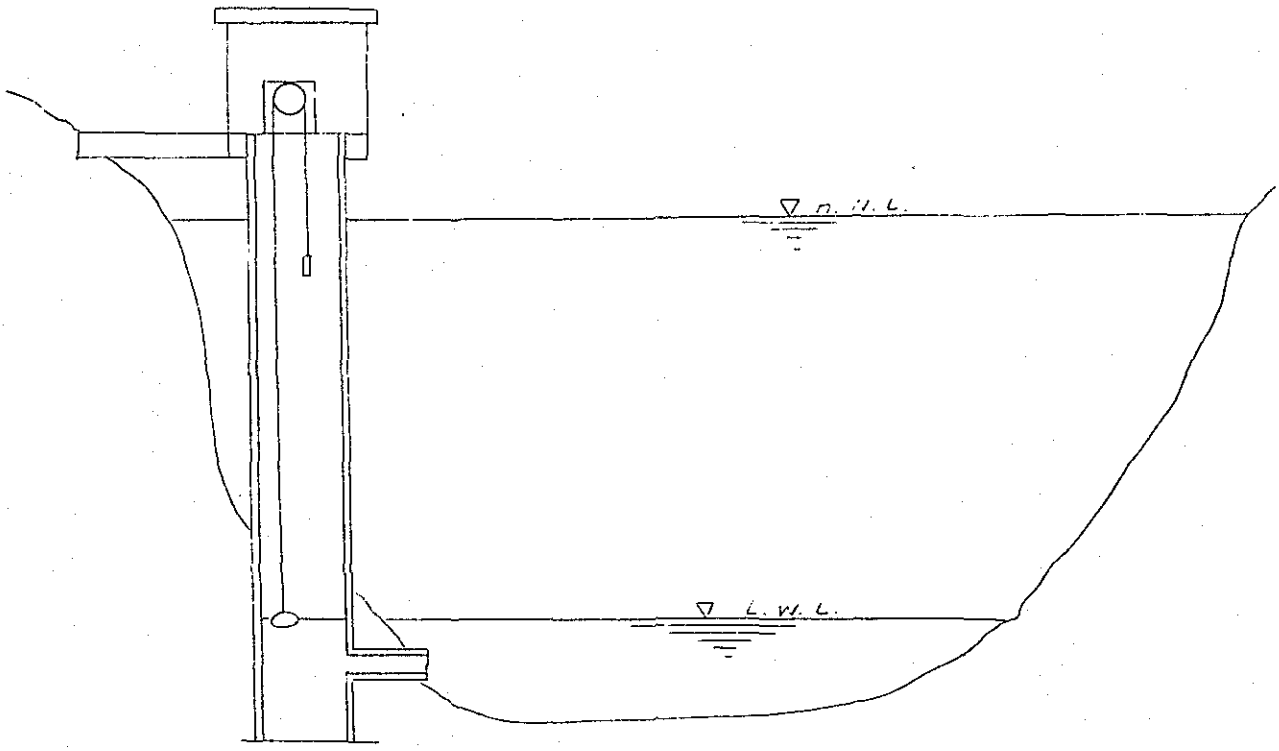


Fig. 3-1 Float-type Water Level Gauge

This gauge has long been use for the purpose of water level measurement. It records the water level data on the recording paper analogally by the up and down motion of the float, and is equipped with an A/D converter to send the converted output to the telemetry equipment.

This type of gauge is simple in structure, inexpensive and makes the maintenance work easy. Under certain geographical condition, however, it incurs a high cost for construction of the tube well and headrace.

As described in Section 2-1, this gauge will be installed at four stations, i.e., Sulipan, Arayat, Candaba and La Paz.

The outside view of the float-type water level gauge is shown in the attached Fig. 3-5.

b. Pole-type Water Level Gauge

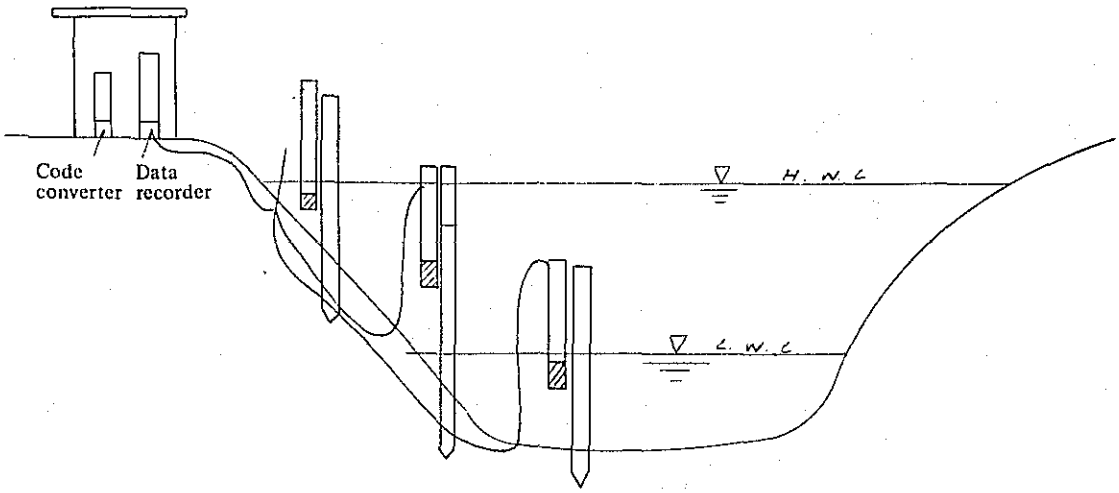


Fig. 3-2 Pole-type Water Level Gauge

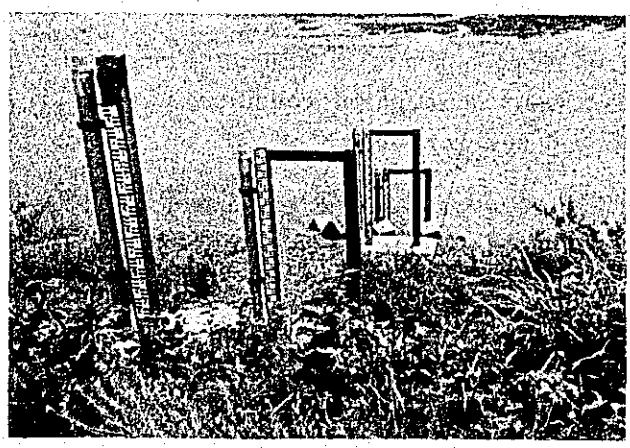
The pole-type level gauge records on the data recorder the digital water level signals electrically sent from the gauging poles which are affixed to the bearing piles driven in the river channel, and also converts such signals into input signals by the code converter and send them to the telemetry system.

The water level gauge of this type is advantageous in that it can be readily installed and can also cope with the change of river-bed configuration. Compared with the aforementioned float-type gauge, however, it is expensive and requires rather elaborate maintenance work due to its complex electric circuit.

The pole-type gauge will be installed at three sites, i.e., Sapang Buho, San Isidoro and Ipo, with the number and length of gauging poles determined by the gauging range and river cross-section.

Photo 3-1 shows the installation of gauging poles and the attached Figs. 3-6 ~ 8 show the outside view of the gauging poles, data recorder and code converter.

Photo 3-1 The Installation of Gauging Pole



3-4 Power Supply

Stabilized power supply immune from a failure in the commercial power service or any other accidents is indispensable for the smooth system operation. Accordingly, installation of power supply equipment is planned as follows.

See Materials 1 for the capacity calculation of solar cell power supply equipment.

(1) Flood Forecasting Center and Bureau of Public Works

Telemetering Equipment	Combination of commercial power supply (AC 220V 60Hz to be transformed to AC 100V 60Hz) and a diesel engine generator, designed for automatic switching of the latter's circuit into operation in the event of the former's interruption.
Radiotelephone Equipment	A DC power supply system incorporating automatic charger and alkaline batteries, designed to supply power for about 7 days of commercial power interruption.

(2) Apalit — A DC power supply system designed to supply power for about 7 days of power interruption.

(3) Other Gauging Stations — Combination of solar cell and alkaline batteries. A diesel engine generator will be installed at Sapang Buho for nighttime discharge measurement.

(4) San Rafael Repeater Station — Combination of solar cell and alkaline batteries. A diesel engine generator will also be installed to supply power to measuring and lighting equipment during the maintenance service.

(5) Cabanatuan Repeater Station — A DC power supply system, designed to supply power for about 7 days of power interruption.

3-5 Antenna Tower

A self-supporting triangular tower will be installed at Apalit Central Luzon River Control District Office, San Rafael Repeater Station and Cabanatuan Repeater Station.

Details of the design of the antenna tower are given in Materials 2.

3-6 Antenna Pole

(1)	Flood Forecasting Center	The existing wind direction pole of the Weather Bureau is to be utilized.
(2)	Bureau of Public Works	A steel pipe of 5 m or longer is to be fixed to the penthouse on the roof.
(3)	Arayat and Sapang Buho	10 m above ground level.
(4)	San Isidoro, Ipo, Sibul Springs and Papaya	15 m above ground level.
(5)	Candaba and La Paz	5 m or higher above the floor of station building.

3-7 Composition of Equipment

Budgetary allocation for the implementation of the present project has already been made by both the Philippine government and Japanese government, and agreement has also been reached that the Japanese government would supply the greater part of equipment to be installed. Specifications of the equipment are therefore given in this report, to which reference should be made for detailed composition of equipment.

3-8 Cost Calculation

The total cost required for the establishment of the flood forecasting and warning system is estimated to be about US$345,000, of which about US$80,000 is for housing facilities and about 265,000 is the cost of equipment and their installation, adjustment, etc.

The above total cost covers all the costs required for the design, execution, manufacture, transportation, installation, adjustment, etc. of all facilities, and is required to fully meet the specifications shown in this Report and Design Drawings.

The breakdown of the said total cost is shown in Table 3-1. In calculating the cost of housing facilities, the data made available by the Philippine government were utilized, while the cost of equipment was obtained by making use of the past price record of the Japanese Ministry of Construction.

Table 3-1 Breakdown of Construction Cost

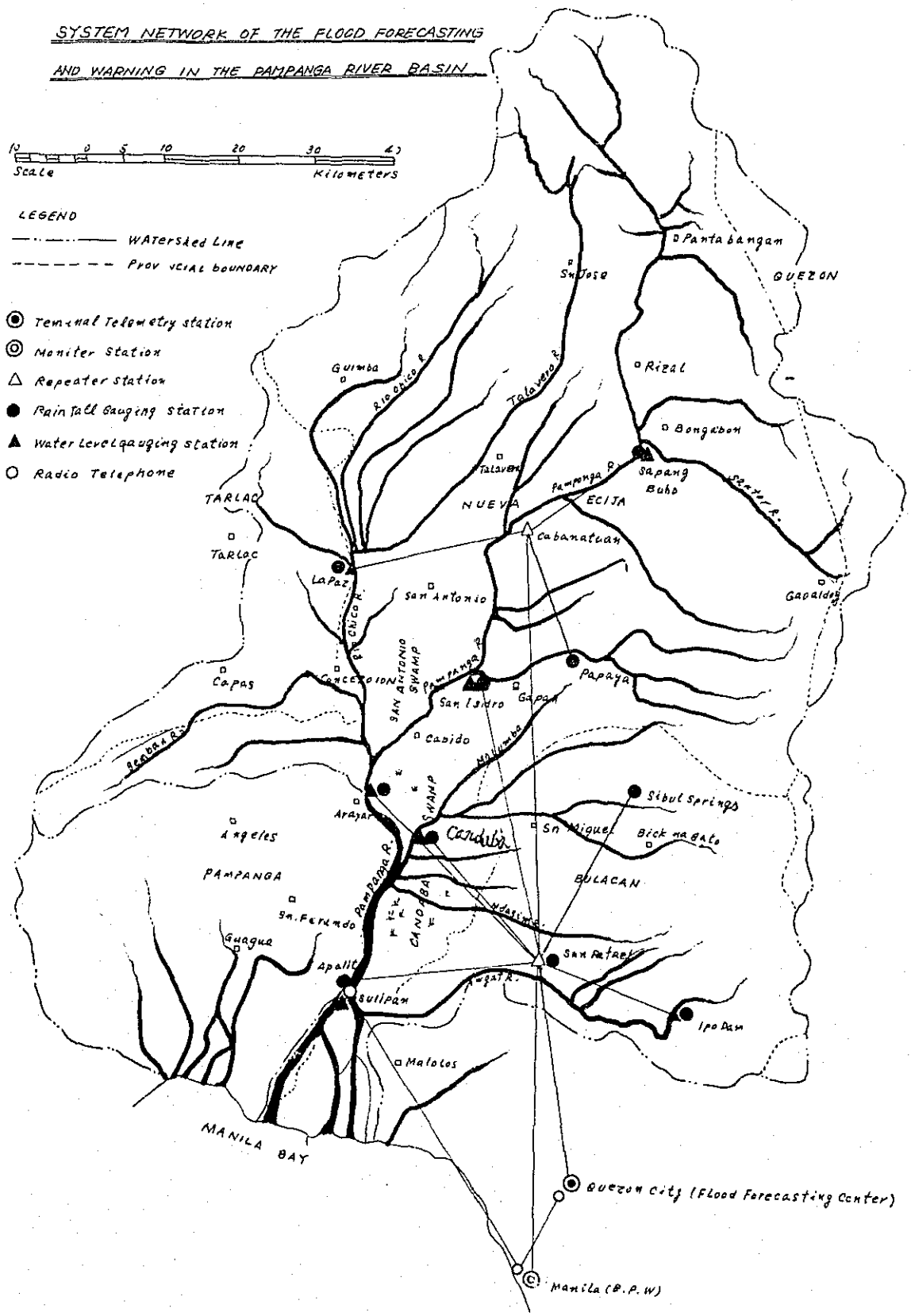
Item	Class	Q'ty	Unit Cost (US$)	Cost (US$)	Remarks
1. Housing Facilities, etc.					
Station Building	A	5	1,600	8,000	Papaya, Sibul Springs, San Isidoro, Arayat, Ipo
"	B	2	5,600	11,200	La Paz and Candaba
"	C	2	3,200	6,400	Sapang Buho and San Rafael
Water Level Gauging House		2	470	940	Sulipan and Arayat
Tube Well		4 places	2,400	9,600	Sulipan, Arayat, Candaba, and La Paz
Gauging Pole		3 "	1,900	5,700	Sapang Buho, San Isidoro, and Ipo
Floater Dropping Facilities		1 place		4,800	Sapang Buho
Antenna Pole	A	6	800	4,800	Papaya, Sapang Buho, San Isidoro, Arayat, Ipo and Sibul Springs
"	B	3	320	960	Candaba, La Paz and BPW
Antenna Tower	Foundation & erection	3	6,400	19,200	Apalit, San Rafael, and Cabanatuan
Transportation and Labour in the Philippines		1 set		8,400	
Total				80,000	
2. Cost of Equipment and Their Installation, Adjustment, etc.					
Equipment Cost		1 set		213,400	
	Terminal telemetry equipment	1 "		50,800	Flood Forecasting Center (Quezon City)
	Monitor equipment	1 "		34,100	Bureau of Public Works (Manila)
	Rainfall gauging and repeater equipment	1 "		19,800	San Rafael
	Repeater equipment	1 "		11,800	Cabanatuan
	Rainfall gauging equipment	2 sets	6,150	12,300	Papaya and Sibul Springs

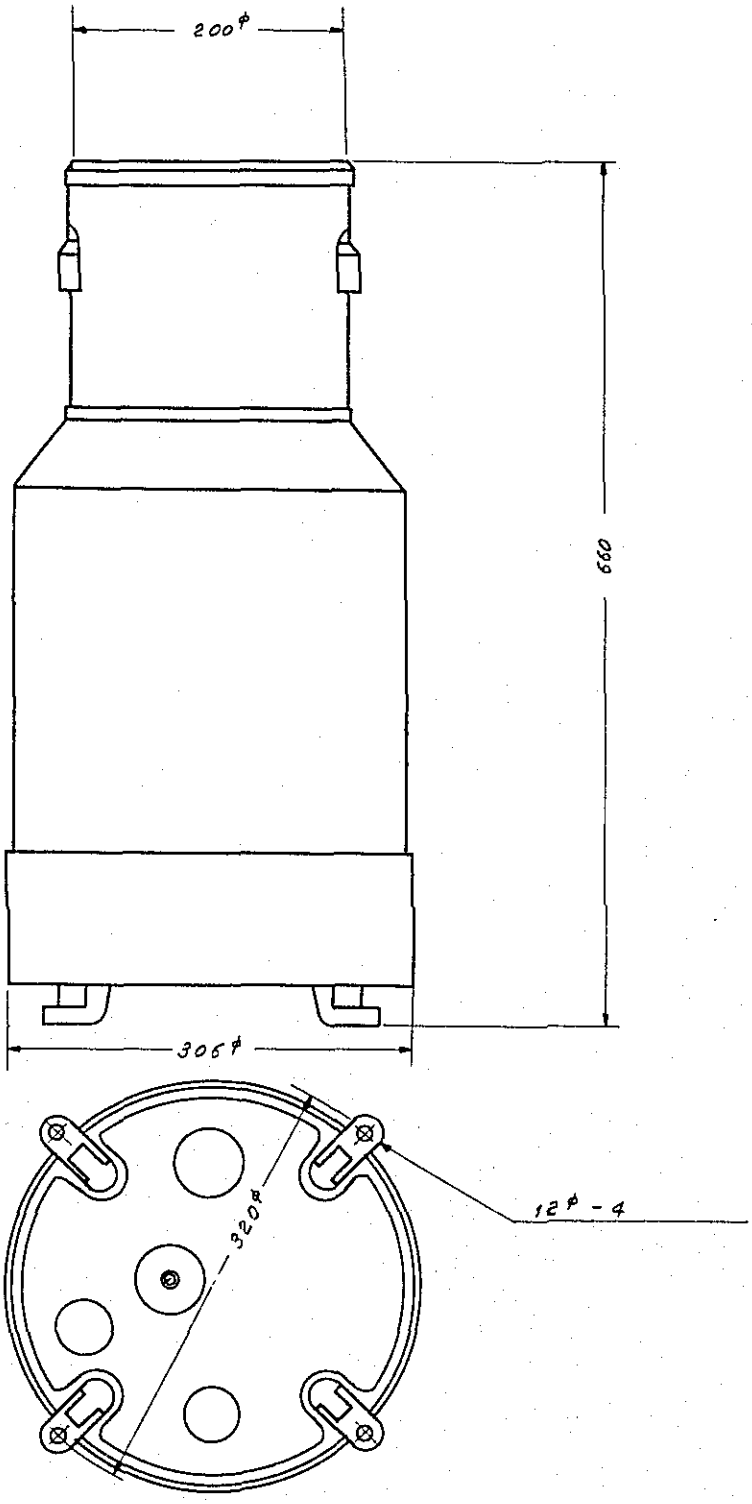
Item	Class	Q'ty	Unit Cost (US$)	Cost (US$)	Remarks
	Rainfall and float-type water level gauging equipment	2 sets	8,700	17,400	La Paz and Candaba
	Rainfall and pole-type water level gauging equipment	1 set		13,400	San Isidoro
	Rainfall and float-type water level gauging equipment	1 "		9,100	Arayat (partly composed of cable line)
	Rainfall and pole-type water level gauging equipment	1 "		13,500	Ipo
	"	1 "		15,900	Sapang Buho (discharge gauging facilities inclusive)
	Rainfall and float-type water level gauging equipment	1 "		15,300	Apalit (Sulipan inclusive)
Auxiliary Equipment and Spare Parts		1 "		19,400	
Installation and Adjustment				27,400	
Crating, transportation and insurance				4,800	Marine transportation cost to Manila port inclusive
Total				265,000	
Grand total				345,000	

Note: US$1.00 ≒ 6.3 pesos ≒ 301 yen

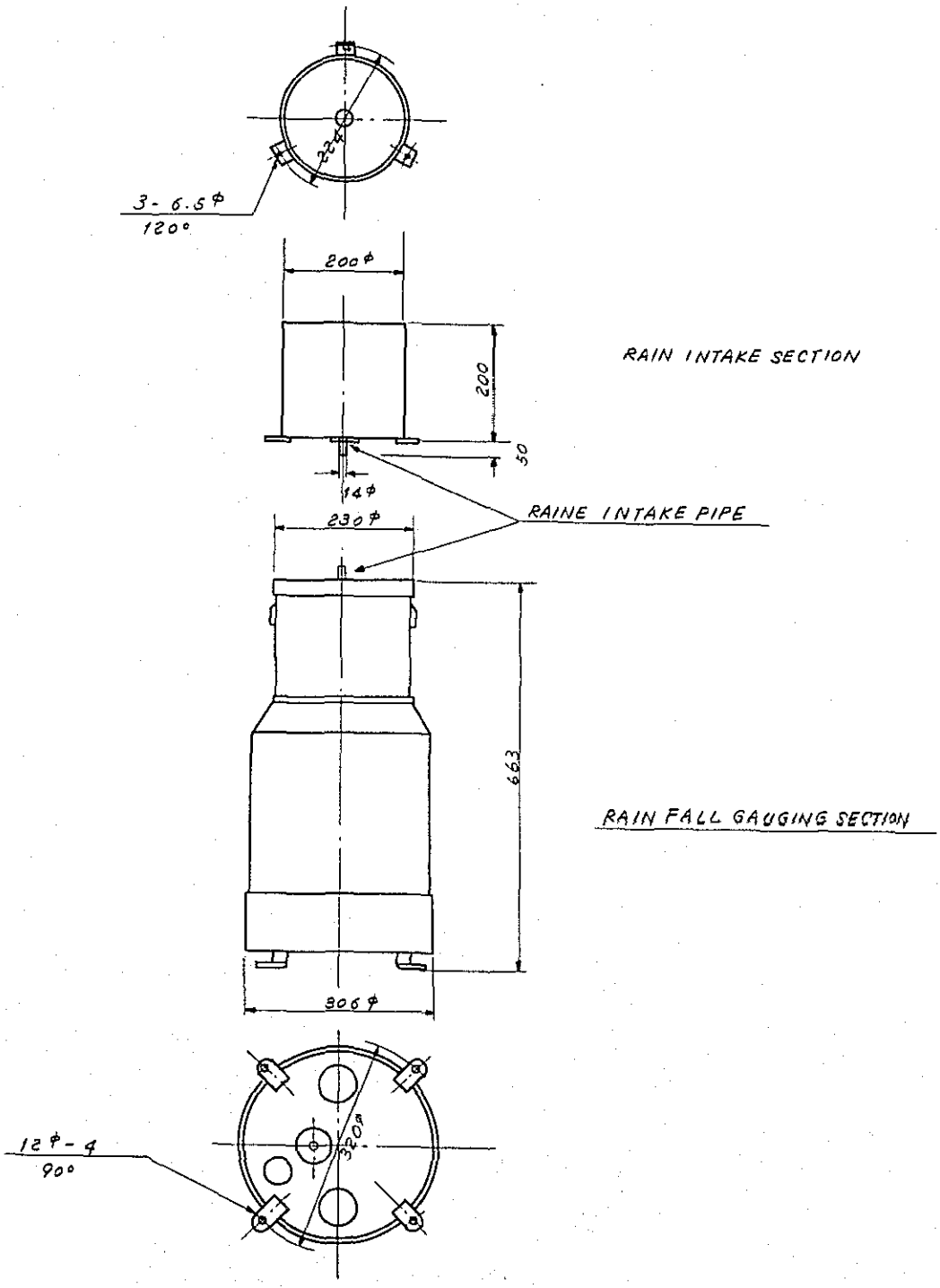
ANNEX Fig. 3-1

SYSTEM NETWORK OF THE FLOOD FORECASTING AND WARNING IN THE PAMPANGA RIVER BASIN

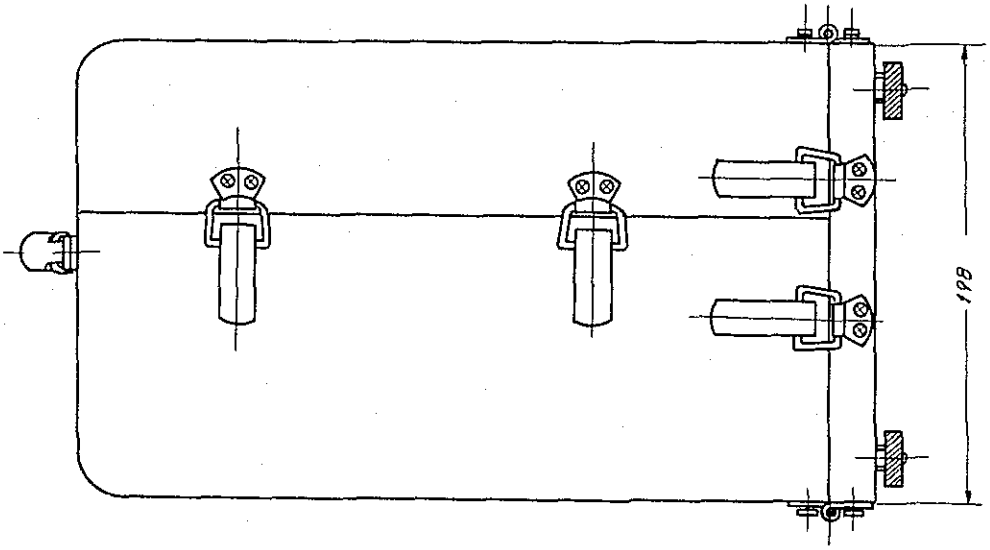




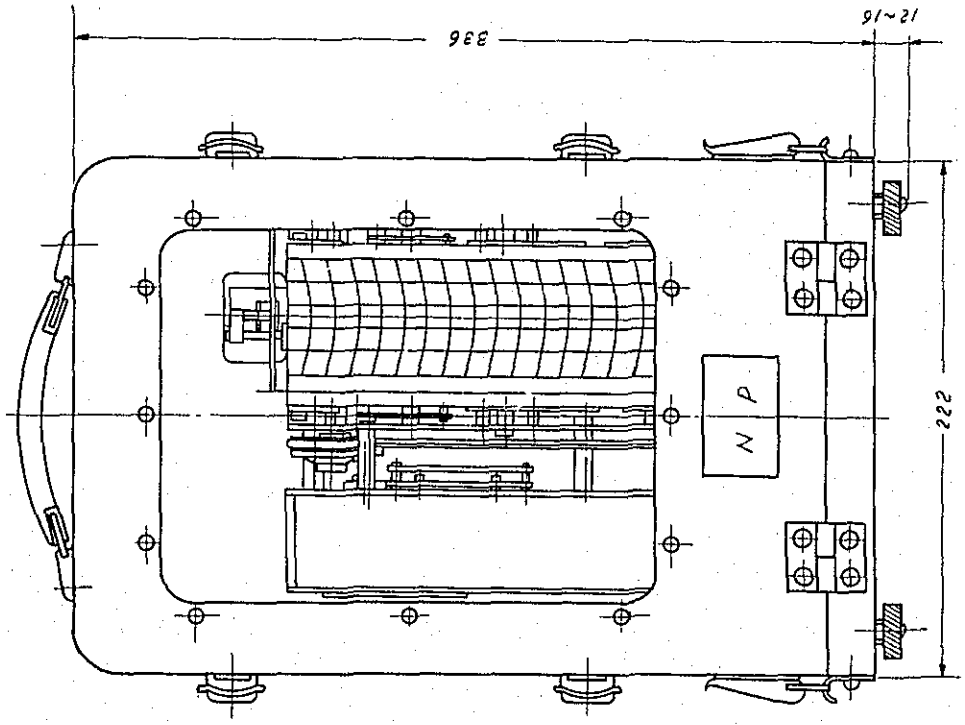
SCALE		UNITS	MM	3RD ANGLE PROJECTION
TITILE	TIPPING BUCKET RAIN FALL GAUGE (INTEGRATE TYPE)			
DRAWING No.	ANNEX 3-2			

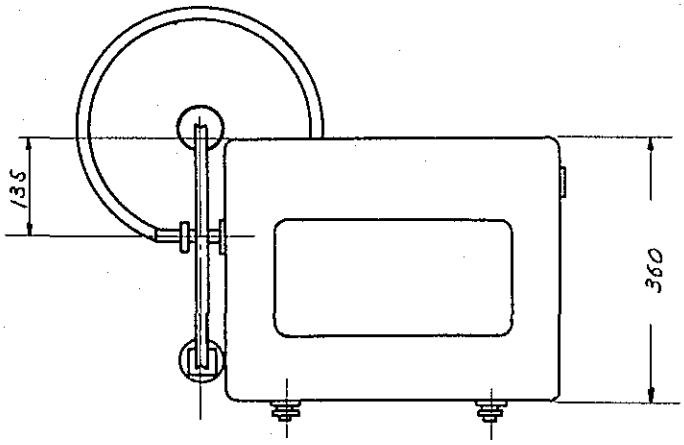


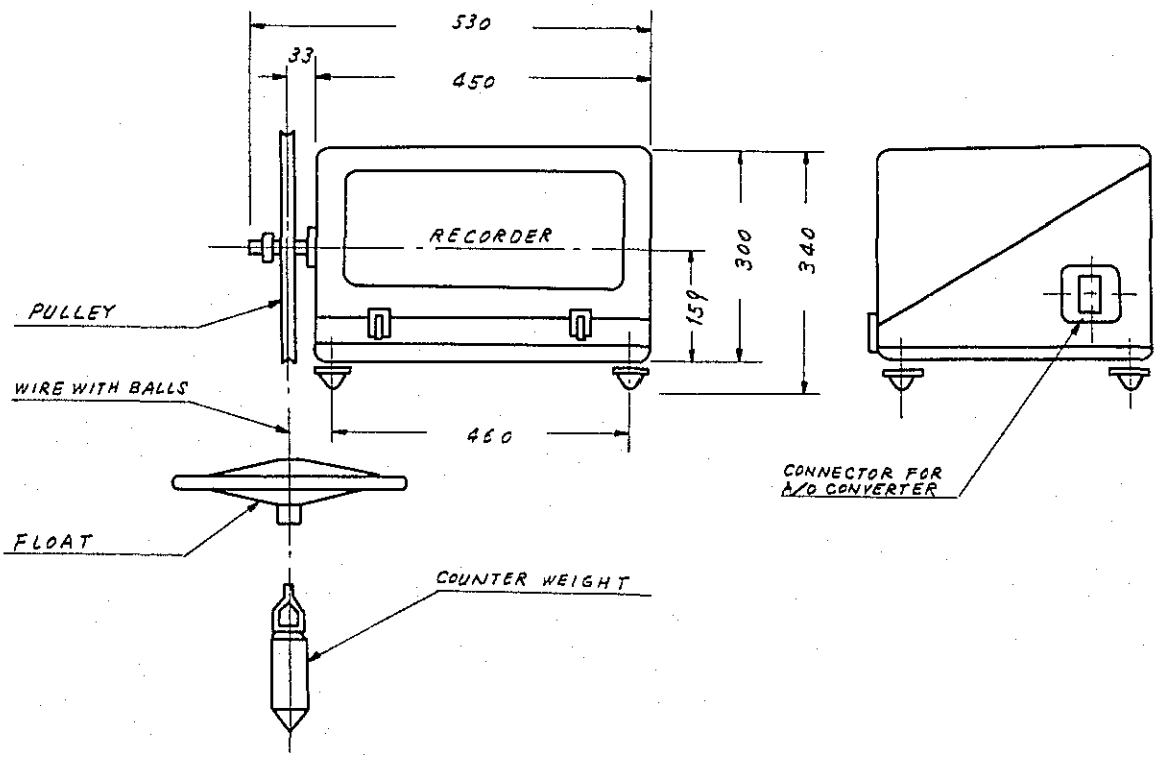
SCALE	1/10	UNIT	mm	3RD ANGLE PROJECTION
TITLE	TIPPING BUCKET RAINFALL GAUGE (SEPARATE TYPE)			
DRAWING NO.	ANNEX 3-3			



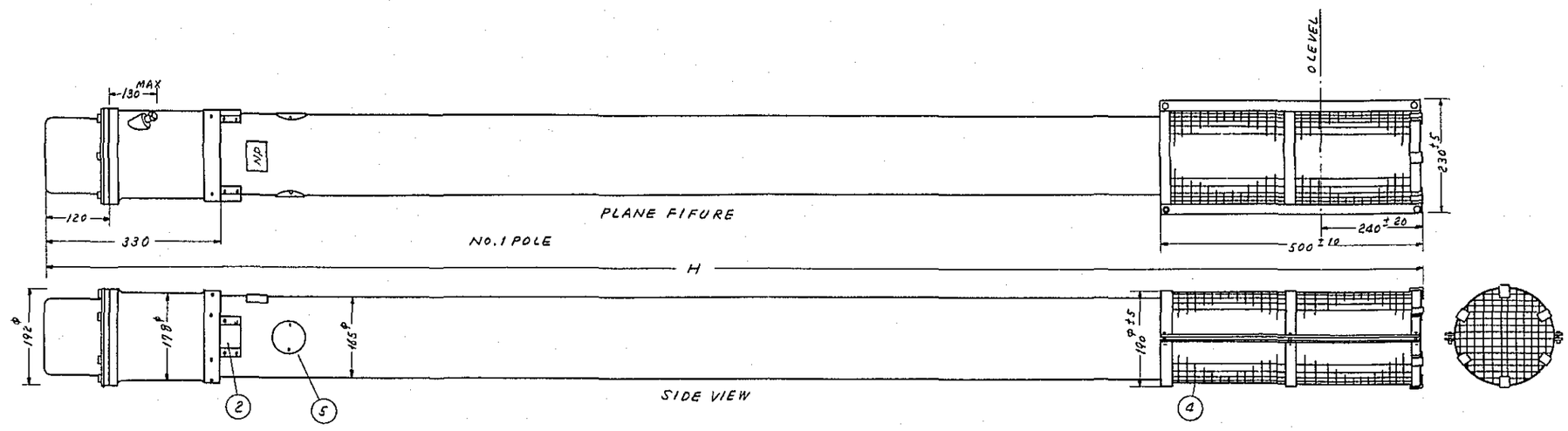
SCALE		3RD ANGLE PROJECTION
	UNITS	mm
TITLE	RAINFALL RECORDER	
DRAWING NO	ANNEX 3 - 4	







SCALE		UNITS	mm	3RD ANGL PROJECTION
TITIEL	FLOAT - TYPE WATER LEVEL GAUGE (SUIKEN 62)			
DRAWING NO.	ANNEX 3 - 5			

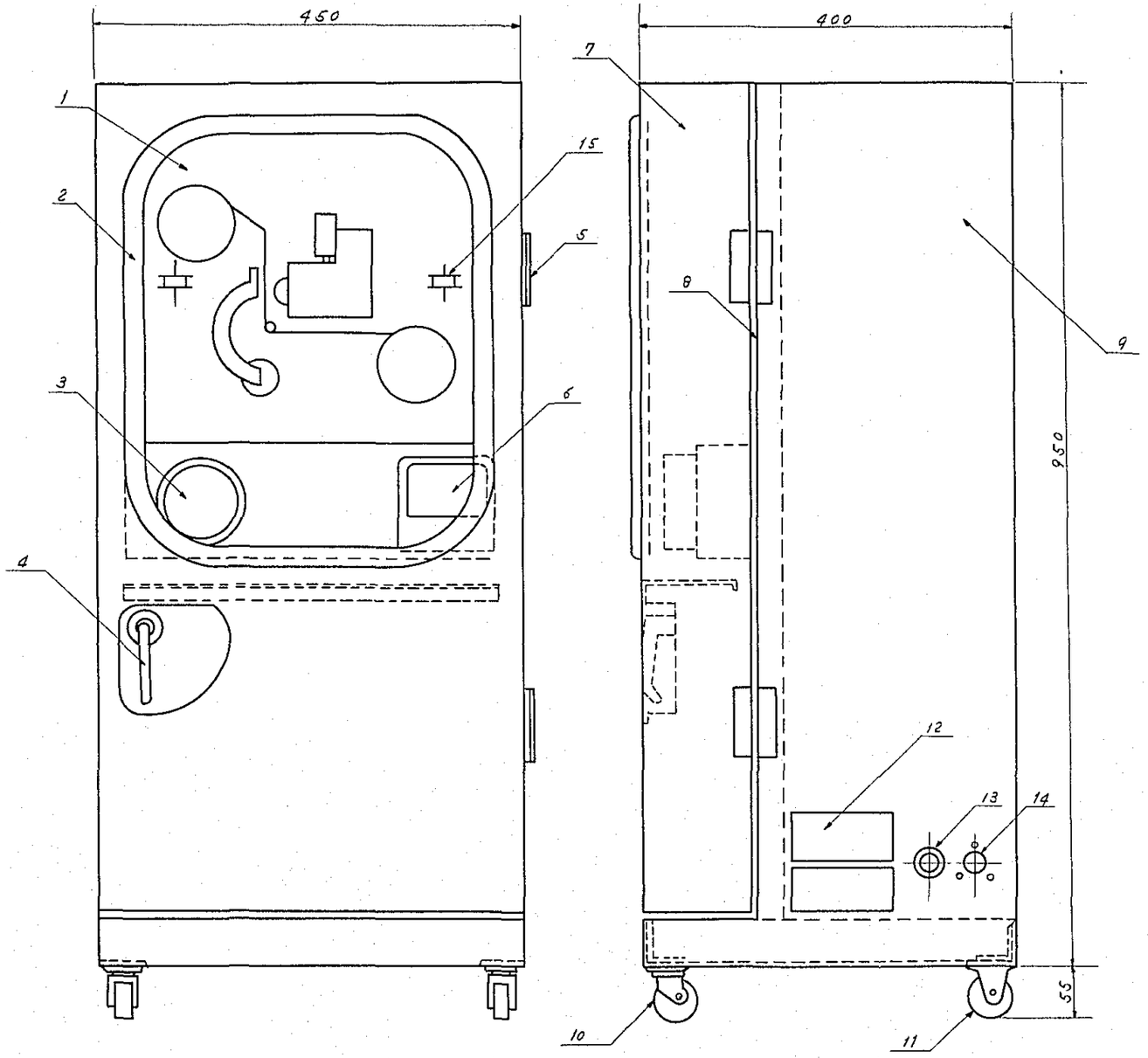


RANGE OF WATER LEVEL GAUGE(UNIT. cm)	LENGTH OF GAUGING POLE (H)
0 ~ 99	1650 ± 20
0 ~ 149	2150 ± 20
0 ~ 199	2650 ± 20

RANGE OF WATER LEVEL GAUGE(UNIT. cm)	LENGTH OF GAUGEING POLE (H)
0 ~ 249	3150 ± 20
0 ~ 299	3650 ± 20
0 ~ 349	4150 ± 20

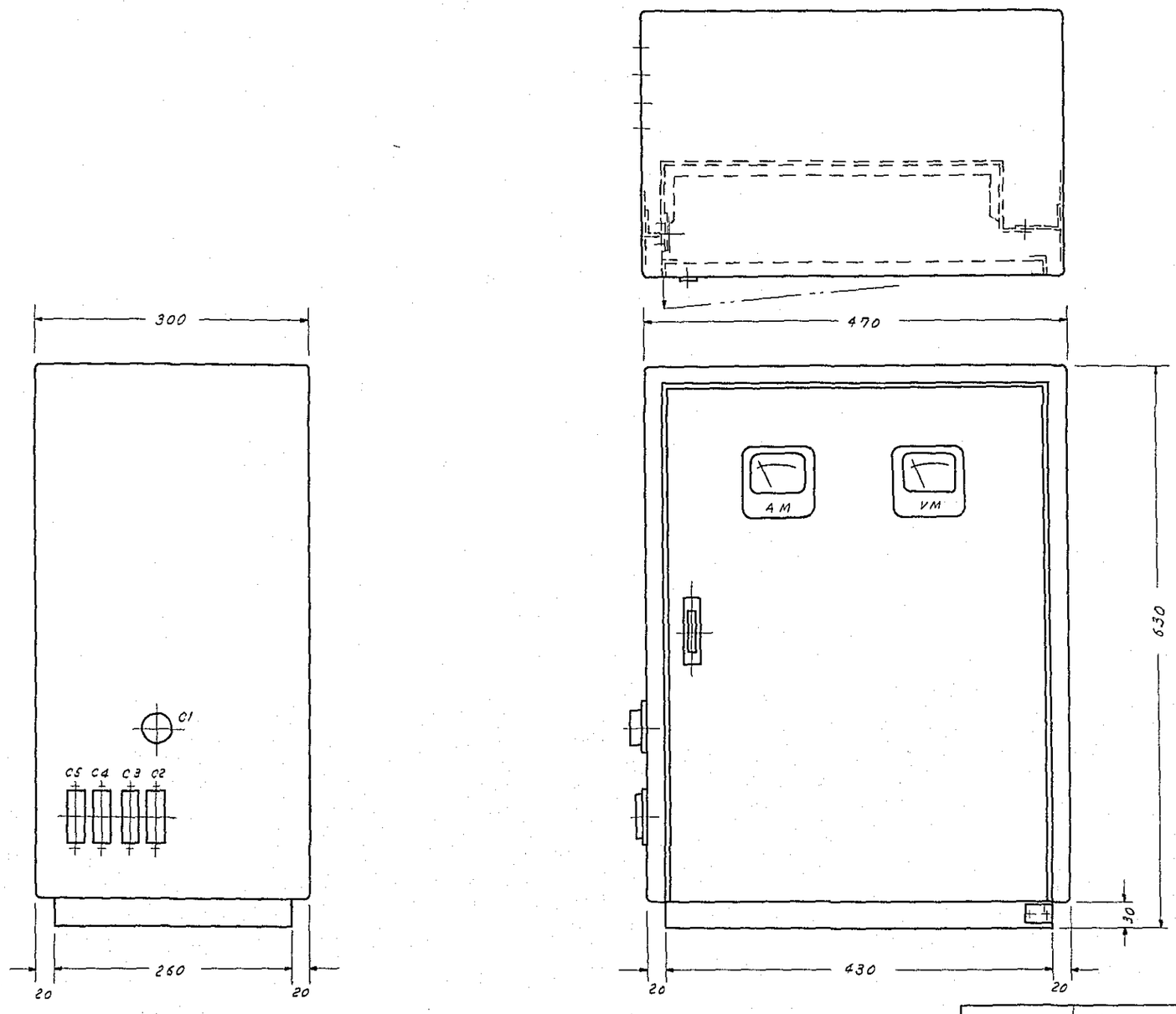
NO.	NAME
1	HEAD
2	AIR PORT
3	CYLINDER
4	STRAINER
5	INSPECTION HOLE
6	PLUG
7	TERMINAL
8	REED SWITCH
9	RAIL
10	FLOAT

3RD ANGLE PROJECTION	TITLE: POLE TYPE WATER LEVEL GAUGE (TAKUWA) GAUGEING POLES
SCALE	
UNITS: mm	DRAWING NO.: ANNEX 3 - 6



NO.	NAME
1	WINDOW GLASS
2	RUBBER SEAL
3	CLOCK
4	HANDLE
5	HINGE
6	VOLT METER
7	DOOR
8	GASKET
9	HOUSING
10	FREE WHEEL
11	WHELL
12	COVER
13	GROMMET
14	CONNECTOR
15	TYPEING RIBBON

3RD ANGLE PROJECTION	TITLE POLE TYPE WATER LEVEL GAUGE (TAKUWA) DATA RECRDER
SCALE	
UNIT m m	DRAWING NO. ANNEX 3 - 7



3RD ANGLE PROJECTION	TITLE POLE TYPE WATER LEVEL GAUGE (TAKUWA) CORD CONVERTER
SCALE 1/5	
UNITS mm	DRAWING NO. ANNEX 3 - 8

MATERIALS

CONTENTS

1. CAPACITY CALCULATION OF SOLAR CELL POWER SUPPLY EQUIPMENT

1. Operation Conditions of Telemetering Equipment

(1) Measuring Frequency

a.	Wet season (May ~ October)	Once/3 hrs.
b.	Dry season (November ~ April)	Once/12 hrs.
c.	During typhoons (typhoons lasting for two days assumed to occur once a month during the wet season)	Once/0.5 hrs.
d.	At time of periodical inspection (conducted twice a month during the wet season and once a month during the dry season)	3 times/inspection day
e.	Communication time at time of periodical inspection	5 min. of transmission and reception/inspection day

(2) Current Consumption

	Rainfall Observation	Water Level Observation		Repeat
		Pole Type	Float Type	
Transmission	2.6A	9.6A	5.0A	3.02A
Receiving	0.25	0.25	0.25	0.32
Waiting	0.025	0.025	0.025	0.03

(3) Observation Time (Based on the Specifications for Standard Telemetry and Warning System, Ministry of Construction, Japanese Government)

a.	Transmitting time (rainfall data in 3-digit decimals and water level data in 4-digit decimals)	Rainfall 2.26 sec./time Water level 3.02 sec./time
b.	Receiving time (call from the terminal telemetry station)	2.08 sec./time
c.	Rise time after reception of call (included in the receiving time)	1.00 sec./time

(4) Maximum Monthly Operation Hours for Typhoons

a. Rainfall gauging station

Total transmitting hours = 2.26 sec. x (24/3 times x 28 days + 24/0.5 times x 2 days + 3 times x 2 days) + 300 sec. x 2
= 2.26 x (8 x 28 + 48 x 2 + 6) + 600
= 2.26 x (224 + 96 + 6) + 600
= 2.26 x 326 + 600 = 1336.76 sec.
= 0.38 hrs.

Total receiving hours = 3.08 sec. x (24/3 times x 28 days + 24/0.5 times x 2 days + 3 x 2 days) + 300 sec. x 2
= 3.08 x (8 x 28 + 48 x 2 + 6) + 600
= 3.08 x (224 + 96 + 6) + 600
= 3.08 x 326 + 600 = 1604.08 sec.
= 0.45 hrs.

Total waiting time = 24 hrs. x 30 − (0.38 + 0.45)
= 720 − 0.83
= 719.17 hrs.

b. Rainfall and water level gauging station

Total transmitting hours = 2.26 sec. x 326 times + 3.02 sec. x 326 times + 300 sec. x 2
= 736.76 + 984.52 + 600 = 2321.28 sec.
= 0.65 hrs.

Total receiving hours = 3.08 sec. x 326 times x 2 + 300 sec. x 2
= 2608.16 sec.
= 0.73 hrs.

Total waiting time = 720 − (0.65 + 0.73) = 720 − 1.38
= 718.62 hrs.

c. Repeater station (5 stations assumed to be covered for rainfall, and 10 stations for rainfall and water level)

Total transmitting hours = 0.38 x 5 + 0.65 x 10 + 0.45 x 5 + 0.73 x 10
= 1.9 + 6.5 + 2.25 + 7.3
= 17.95 hrs.

Total receiving hours = 0.38 x 5 + 0.65 x 10 + 0.45 x 5 + 0.73 x 10
= 17.95 hrs.

Total waiting time = 24 x 30 x 2 − 17.95 x 2
= 1404.1 hrs.

(5) Monthly Power Consumption (Power consumption during the maximum monthly operation hours for typhoons)

a. Rainfall gauging station

Transmitting	2.6A x 0.38	=	0.99AH
Receiving	0.25A x 0.45	=	0.12AH
Waiting	0.025A x 719.17H	=	17.98AH
	Total	=	17.98AH

b. Rainfall and pole-type water level gauging station

Transmitting	2.6A x 0.21H + 7.6A x 0.45H	=	3.97AH
Receiving	0.25A x 0.73H	=	0.19AH
Waiting	0.025A x 718.62H	=	17.19AH
	Total		22.13AH

c. Rainfall and float-type water level gauging station

Transmitting1	2.6A x 0.21H + 5.0A x 0.45H	=	2.80AH
Receiving	0.25A x 0.73H	=	0.19AH
Waiting	0.025A x 718.62H	=	17.97AH
	Total		20.96AH

d. Repeater station

Transmitting	3.02A x 17.95H	=	54.21AH
Receiving	0.32A x 17.95H	=	5.75AH
Waiting	0.03A x 1404.1H	=	42.13AH
	Total		102.09AH

(6) Average Hourly Current Consumption (Q_L)

a.	Rainfall gauging station	19.09AH/24H x 30 days =	26.52mA
b.	Rainfall and pole-type water level gauging station	22.13AH/24H x 30 days =	30.74mA
c.	Rainfall and float-type water level gauging station	20.96AH/24H x 30 days =	29.12mA
d.	Repeater station	102.09AH/24H x 30 days =	146.80mA

2. Capacity Calculation of Solar Cells

(1) Average Hourly Charging Rate (Q_{in})

The table below shows the monthly charging rate based on the sunshine data recorded at San Miguel Tarlac (N 15°27', E 120°38') from October 1968 to September 1969. In this table, the number of parallel module of the solar cell is taken at 1.

Month	Sunshine Hours	Monthly Charging Rate
October	248.3H	11.25AH
November	246.9	11.24
December	259.6	11.37
January	245.3	11.12
February	226.7	11.24
March	284.6	11.12
April	279.3	12.50
May	279.3	12.42
June	123.5	7.50
July	133.2	7.50
August	187.6	9.74
September	106.1	6.25
1 year	2576.7	123.25

From the values shown in the table, the average hourly charging rate (Q_{in}) can be calculated as follows.

$$Q_{in} = \frac{123.25AH}{365 \text{ days} \times 24H} = 0.014A = 14mA$$

(2) Correction Factor

a. Correction factor of charging efficiency (η_c)

Since the daytime atmospheric temperature does not drop below 0°C in the Philippines if weather is fair, $\eta_c = 1.11$.

b. Correction factor of photo-energy reception loss (F_{c1})

If θ of latitude at the installation site is 15°, the value of F_{c1} can be obtained by the application of the following equation.

$$F_{c1} = 1.31 \times \cos (35° - \theta)$$

$$F_{c1} = 1.31 \times \cos (35° - 15°) = 1.17$$

c. Assuming that the transmittivity of inlet beam would drop to 95% of the original value due to the secular change of the acryl resin case, the correction factor for

this drop can be calculated as follows.

$$F_{c2} = 1/0.95 = 1.05$$

(3) Capacity of Solar Cells

a. Number of series modules (Ns)

The number of Ns is 4 since alkaline batteries will be used to supply power at a rated voltage of 12V.

b. Number of parallel modules (Np)

$$Np = \frac{Q_L}{Q_{in}} \times \eta_c \times F_{c1} \times F_{c2}$$

Rainfall gauging station

$$Np = \frac{26.52mA}{14mA} \times 1.11 \times 1.17 \times 1.05$$

$$= 1.895 \times 1.364 = 2.585 = 3$$

Rainfall and pole-type water level gauging station

$$Np = \frac{30.74mA}{14mA} \times 1.364 = 2.196 \times 1.364$$

$$= 2.996 = 3$$

Rainfall and float-type water level gauging station

$$Np = \frac{29.12mA}{14mA} \times 1.364 = 2.08 \times 1.364$$

$$= 2.838 = 3$$

Repeater station

$$Np = \frac{141.8mA}{14mA} \times 1.364 = 10.129 \times 1.364$$

$$= 13.816 = 14$$

c. Capacity of solar cells (P)

P = Ns x Np x 0.36w (0.36w is the capacity of 1 module)

Rainfall gauging station

P = 4 x 3 x 0.36w = 4.32w

Rainfall and pole-type water level gauging station

P = 4 x 3 x 0.36w = 4.32w

Repeater station

$P = 4 \times 14 \times 0.36W = 20.16W$

(4) Capacity Calculation of Alkaline Batteries

a. Monthly energy charged into alkaline batteries from solar cells (Q_{in}')

$$Q_{in}' = Q_{in} \times Np \times \frac{1}{\eta_c} \times \frac{1}{F_{c1}} \times \frac{1}{F_{c2}}$$

$$= Q_{in} \times Np \times \frac{1}{1.11} \times \frac{1}{1.17} \times \frac{1}{1.05}$$

$$= Q_{in} \times Np \times 0.73$$

By applying the values shown in the table shown in Section 2-(1) and the values shown in Section 2-(3)-b to the above equation, the monthly charged energy at respective types of stations can be obtained as tabulated below.

Month	Gauging Station			Repeater Station
	Rainfall Gauging Station	Rainfall & Pole-type Water Level Gauging Station	Rainfall & Float-type Water Level Gauging Station	
Oct.	24.63AH	24.63AH	24.63AH	114.97AH
Nov.	24.61	24.61	24.61	114.87
Dec.	24.90	24.90	24.90	116.20
Jan.	24.35	24.35	24.35	113.65
Feb.	24.61	24.61	24.61	114.87
Mar.	24.35	24.35	24.35	113.65
Apr.	27.37	27.37	27.37	127.75
May	27.19	27.19	27.19	126.93
June	16.42	16.42	16.42	76.65
July	16.42	16.42	16.42	76.65
Aug.	21.33	21.33	21.33	99.54
Sep.	13.68	13.68	13.68	63.87

b. Monthly replenished capacity (bc)

When the monthly charged energy falls short of the monthly power consumption values shown in Section 1-(5), the shortage will be covered by the energy supplied from Alkaline batteries. The energy to be thus replenished at respective types of stations is shown below.

Rainfall gauging station

June	19.09AH	– 16.42AH	= 2.67AH
July	19.09AH	– 16.42AH	= 2.67AH
September	19.09AH	– 13.68AH	= 5.41AH
		Total	10.75AH

Rainfall and pole-type water level gauging station

June	22.13AH	– 16.42AH	= 5.71AH
July	22.13AH	– 16.42AH	= 5.71AH
August	22.13AH	– 21.33AH	= 0.80AH
September	22.13AH	– 13.68AH	= 8.45AH
		Total	20.67AH

Rainfall and float-type water level gauging station

June	20.96AH	– 16.42AH	= 4.54AH
July	20.96AH	– 16.42AH	= 4.54AH
September	20.96AH	– 13.68AH	= 7.28AH
		Total	16.36AH

Repeater station

June	102.09AH	– 76.65AH	= 25.44AH
July	102.09AH	– 76.65AH	= 25.44AH
August	102.09AH	– 99.54AH	= 2.55AH
September	102.09AH	– 63.87AH	= 38.22AH
		Total	91.65AH

c. Calculation of Alkaline battery capacity (Bc)

$Bc = bc + 1/2bc + 20\ Q'_L$

$Q'_L = Q_L \times 24$ ..... Average daily power consumption

1/2bc ..... Replenished portion of residual battery capacity

Rainfall gauging station

$Bc = 10.75 + 1/2 \times 10.75 + 20 \times 0.027 \times 24$
$= 10.75 + 5.375 + 12.96 = 29.085$
$= 30AH$

Rainfall and pole-type water level gauging station

$Bc = 20.67 + 1/2 \times 20.67 + 20 \times 0.031 \times 24$
$= 20.67 + 10.34 + 14.88 = 45.89$
$= 50AH$

Rainfall and float-type water level gauging station

$$Bc = 16.36 + 1/2 \times 16.36 + 20 \times 0.03 \times 24$$
$$= 16.36 + 8.18 + 14.4 = 38.96$$
$$= 40AH$$

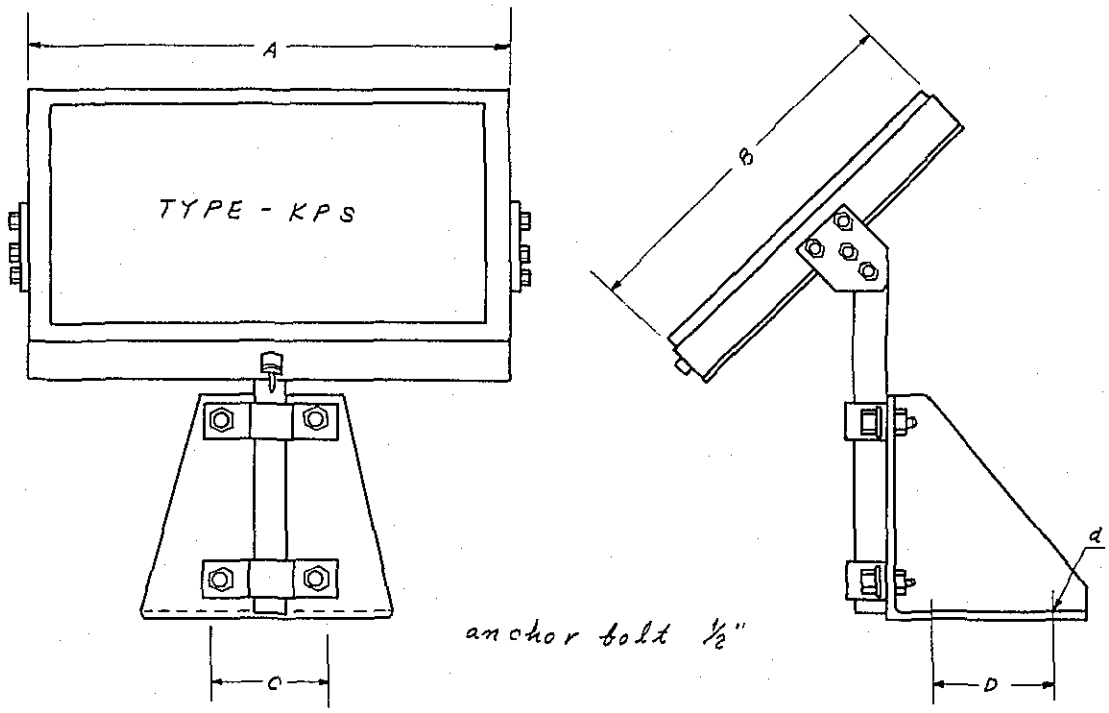
Repeater station

$$Bc = 91.65 + 1/2 \times 91.65 + 20 \times 0.142 \times 24$$
$$= 91.65 + 45.825 + 68.16 = 205.635$$
$$= 200AH$$

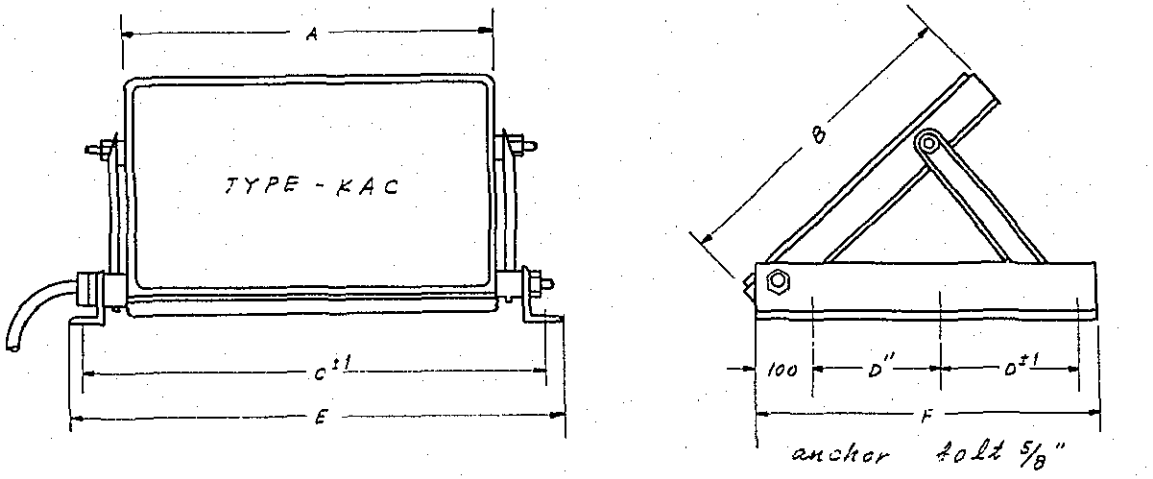
3. The capacity of solar cell power supply equipment at respective gauging stations and repeater stations will be as shown in the following table.

	Rainfall Gauging Station	Rainfall and Water Level Gauging Station		Repeater Station
		Equipped with Pole-type Water Level Gauge	Equipped with Float-type Water Level Gauge	
Solar Cells	4.32W	4.32W	4.32W	20.16W
Alkaline Batteries	30AH	50AH	40AH	200AH

Outside View of Solar Cell Rack



Capacity	model	Design wt (kg)	A (mm)	B (mm)	C (mm)	D (mm)
4.32W	KPS - 12	12	360	280	120	120



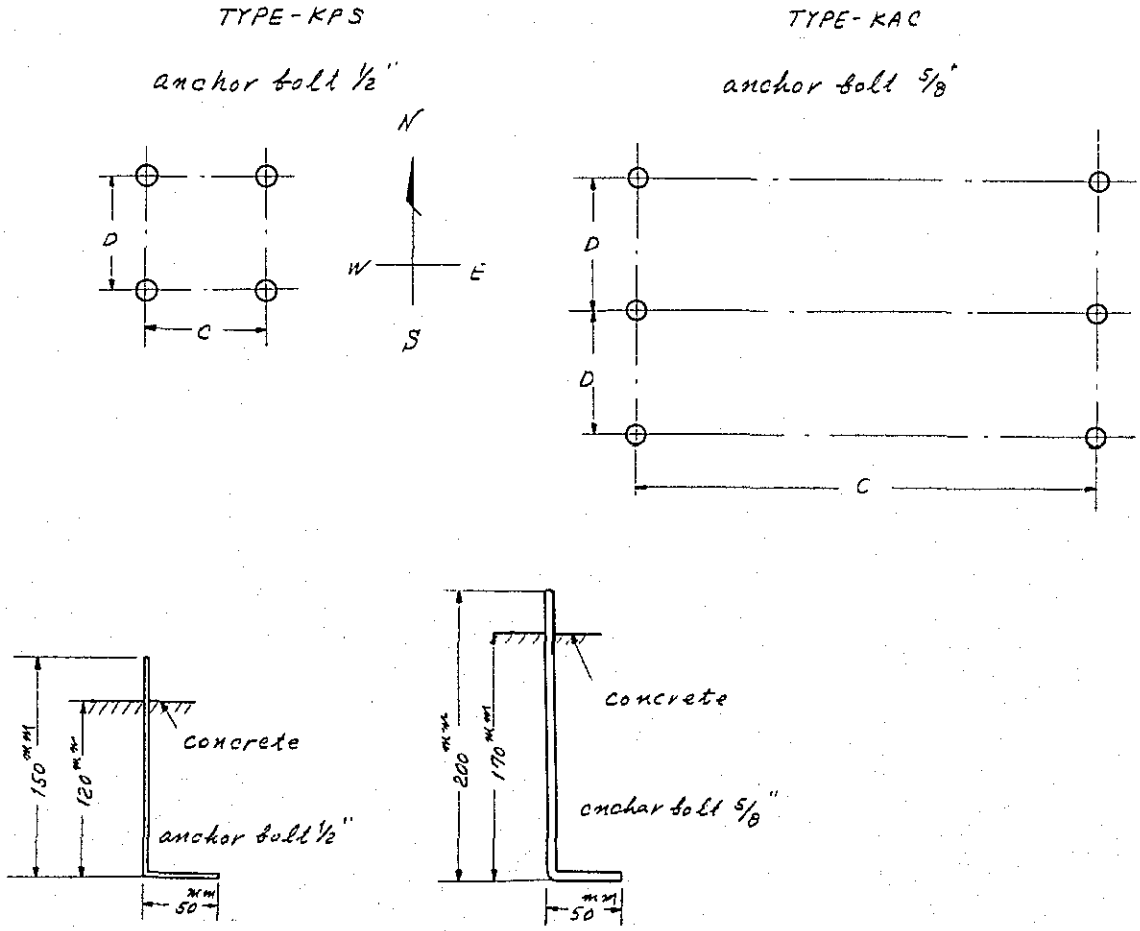
Capacity	medel	Design wt (kg)	A (mm)	B (mm)	C (mm)	D (mm)	E (mm)	F (mm)
20.16W	KAC - 60	28	840	520	970	195	1020	530

I. Type of Solar Cell Rack each Stations

a. Type KPS is 8 stations
Sapang Buho, Papaya, La Paz, Candaba, San Isidro, Arayat, Ipo, Sibul Springs

b. Type KAC is 1 station
San Rafael

II. Install the Solar Cell Rack by Fixing its Anchor Bolts in Position as Shown Below.



2. DESIGN SPECIFICATIONS OF SELF-SUPPORTING TRIANGULAR TOWER

1. Steel Tower

(1) Outline of Structure

As shown in Fig. M 2-1, the steel tower shall be composed of six 5-m long blocks, each manufactured by welding double latticed rod steel diagonals to three main members of rod steel, and shall have a total length of 30 m.

(2) Standard for Strength Calculation

The "Standard for Structural Calculation of Steel Towers" of the Architectural Institute of Japan shall apply to the strength calculation. The wind pressure shall be calculated by the following equation.

$$P = q \cdot c \cdot A$$

$$q = 120\ \sqrt[4]{h}$$

where, P : Wind pressure (kg)

q : Velocity pressure (kg/m^2)

c : Wind force coefficient

A : Outward area (m^2)

h : Height above ground level (m)

In case $q < 225\ kg/m^2$, the value of q shall be taken as $225\ kg/m^2$ (equivalent to a wind velocity of 60 m/sec.).

(3) Component Material

The rod steel for manufacture of blocks shall be SS41 specified in Japan Industrial Standard G 3101, and its allowable tensile and compressive stress for temporary loading shall be $2.4\ t/m^2$. The constants of respective blocks are shown in the table in Fig. M 2-2.

(4) Wind Pressure on Mounted Antenna

The wind pressure imposed on two 150 MHz 3-stage colinear antennas mounted on top of the tower shall be as follows when calculation is worked out by the equation shown in Section 1-(2), with the wind force coefficient (c) taken at 1.2.

$$P = q \cdot c \cdot A \qquad q = 120\ \sqrt[4]{30} = 280\ kg/m^2$$

	Outward Area (A)	Wind Force Coefficient (c)	Wind Pressure (P)
Antenna	0.36 m^2 x 2	1.2	252 kg
Metal Supporters	0.3 m^2	1.2	101 kg
			353 kg

The allowable load on the tower top is 785 kg, which is large enough to accommodate additional antennas.

2. Foundation

(1) Bearing Capacity

The long-term allowable bearing capacity specified in the "Standard for Structural Design and Calculation of Building Foundation" of the Architectural Institute of Japan is as tabulated below.

Ground Condition		Bearing Capacity (t/m^2)	N-value
Gravelly	Compact	60	
	Not compact	30	
Sandy	Compact	30	30 ~ 50
	Medium	20	20 ~ 30
		15	10 ~ 20
	Loose	5	5 ~ 10
	Very loose	*0	Less than 5
Clayey	Very stiff	20	15 ~ 30
	Stiff	10	8 ~ 15
	Medium	5	4 ~ 8
	Soft	2	2 ~ 4
	Very soft	0	0 ~ 2
Loam	Stiff	15	More than 5
	Somewhat stiff	10	3 ~ 5
	Soft	5	Less than 3

Note: The short-term bearing capacity twice the values shown in the above table shall be applied to steel towers whose stress is affected by wind load.

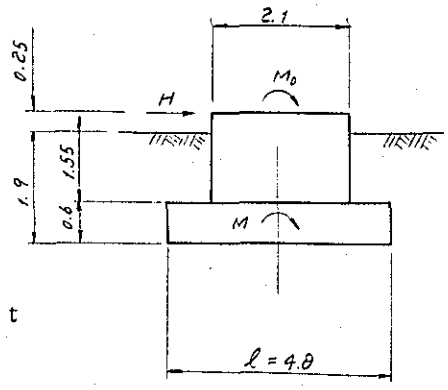
(2) Allowable Short-term Bearing Capacity ... Assumed to be 10 t/m^2

(3) Load on Foundation Top

Mo = 59.86 t-m

H = 3.65 t

(4) Load on Foundation Bottom



○ Volume and weight of foundation

$$V_f \begin{cases} 2.1^2 \times 1.55 = 6.84 \\ 4.8^2 \times 0.6 = 13.82 \end{cases}$$

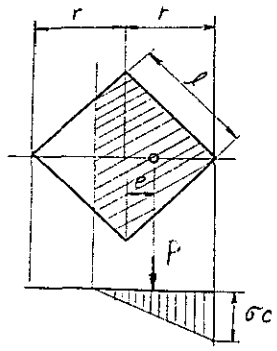
$$\Sigma V_f = 20.66 \text{ m}^3$$

$$W_f = V_f \times \rho = 20.66 \times 2.4 = 49.58 \text{ t}$$

○ Volume and weight of earth

$$V_e = 4.8^2 \times 1.9 - 19.53 = 24.25 \text{ m}^3$$

$$W_e = 24.25 \times 1.6 = 38.8 \text{ t}$$



○ Weight of tower and its accessories $W_t = 2.8$ t

○ $P = W_f + W_e + W_t = 49.58 + 38.8 + 2.8 = 91.18$ t

(5) Upsetting Moment on the Foundation Bottom

$$M = Mo + Mh = 59.86 + 3.65 \times 2.15 = 67.71 \text{ t-m}$$

(6) Contact Pressure on the Foundation Bottom Surface (wind direction: 45°)

Eccentricity

$$\epsilon = \frac{e}{r} = \frac{M}{Pr} = \frac{67.71}{91.18 \times 3.39} = 0.219$$

$$\sigma_c = \frac{P\alpha}{A} = \frac{91.18 \times 2.3}{48^2} = 9.10 \text{ t/m}^2 < 10 \text{ t/m}^2$$

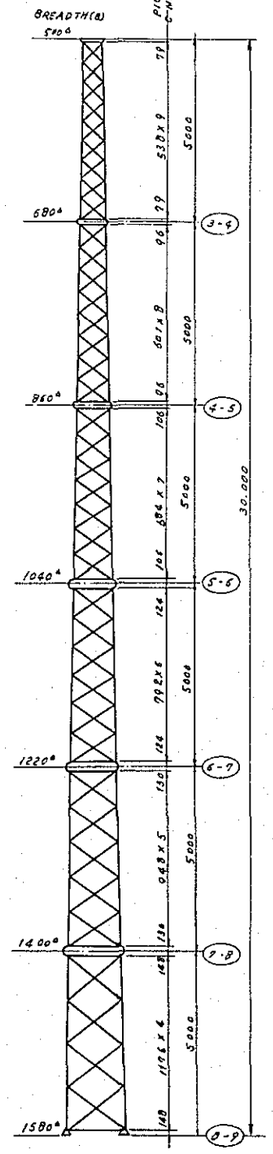
where, α : Factor of eccentric load

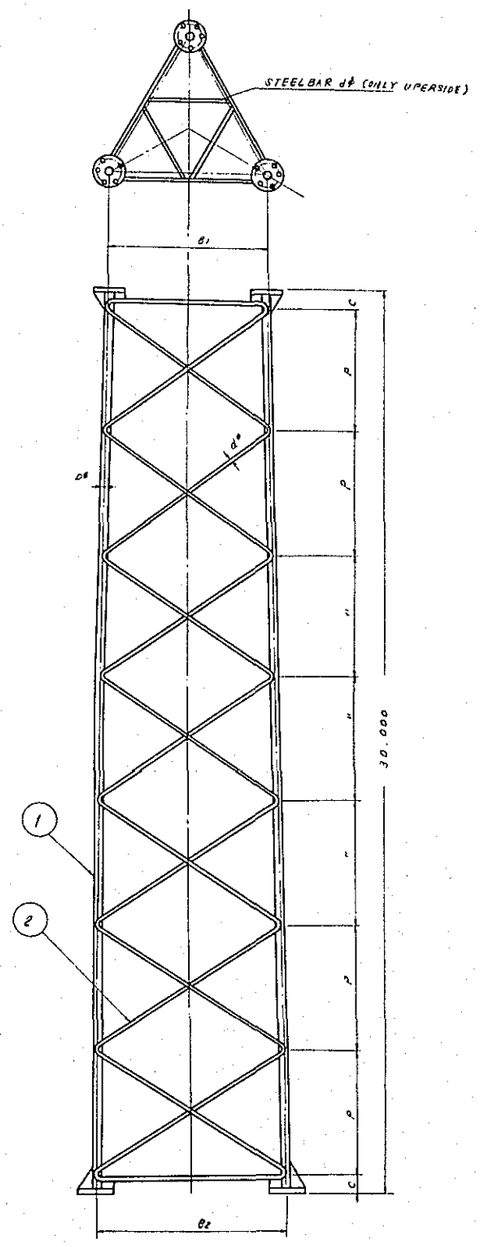
The above calculation is based on the graphs and tables shown in "Calculation of Foundation Reaction" by Naomitsu Shibata.

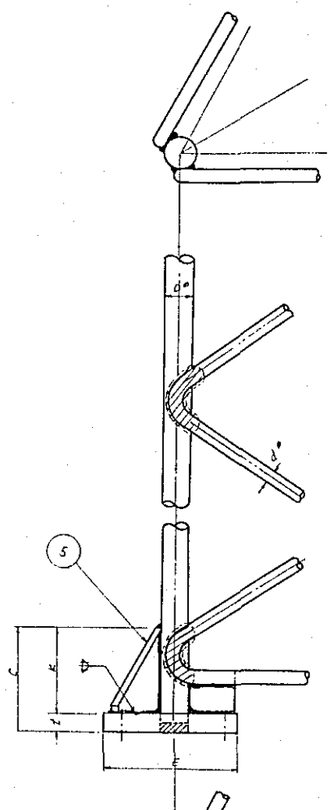
(7) Working Drawing

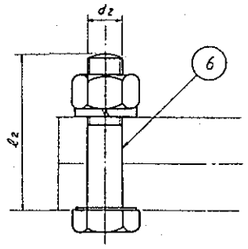
Erection work shall be carried out according to Figs. M 2-3 and M 2-4.

	NO. OF TYPE
TYPE J1	
	DIAMETER OF MAIN MEMBER
32φ	32φ
	DIAMETER OF DIAGONALS
2 × 13φ	2 × 13φ
TYPE G1	
38φ	38φ
2 × 16φ	2 × 16φ
TYPE S1	
44φ	44φ
2 × 19φ	2 × 19φ
TYPE G1	
50φ	50φ
2 × 22φ	2 × 22φ
TYPE S1	
55φ	55φ
2 × 22φ	2 × 22φ
TYPE B1	
60φ	60φ
2 × 25φ	2 × 25φ





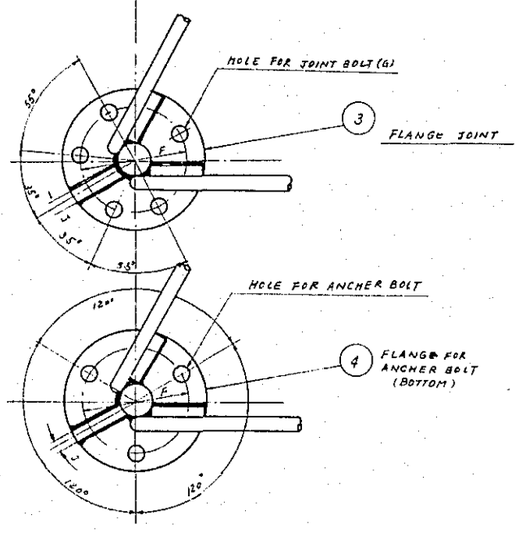




MEASUREMENT OF JOINT SECTION

NAME	MARK	3-4	4-5	5-6	6-7	7-8	8-9
⑥ FLANGE JOINT THICKNESS	t	19	19	25	25	28	28
⑥ FLANGE JOINT DIAMETER	E	150	170	195	205	230	240
⑥ FLANGE JOINT P. C. D	F	120	130	150	160	180	190
⑥ FLANGE JOINT HOLE FOR JOINT BOLT	G	18	18	21	21	21	24
⑤ RIB FLANGE FOR ANCHER BOLT THICKNESS	t	19	19	25	25	28	28
⑤ RIB FLANGE FOR ANCHER BOLT DIAMETER	E	170	200	220	250	260	290
⑤ RIB FLANGE FOR ANCHER BOLT P. C. D	F	120	140	160	180	190	210
⑤ RIB THICKNESS	T	12	12	16	16	19	19
⑤ RIB HIGHT	k	100	110	120	130	140	150
① JOINT BOLT	d_1	W 5/8"	W 5/8"	W 3/4"	W 3/4"	W 7/8"	W 7/8"
	ℓ_2	65	65	85	85	95	95
" ANCHER BOLT	d_3	W 3/4"	W 7/8"	W 1"	W 1 1/8"	W 1 1/8"	W 1 1/4"

SURFACE TREATMENT : GILDING WITH ZINC BUT NO. B1 BLOCK IS COAT WITH PAINT



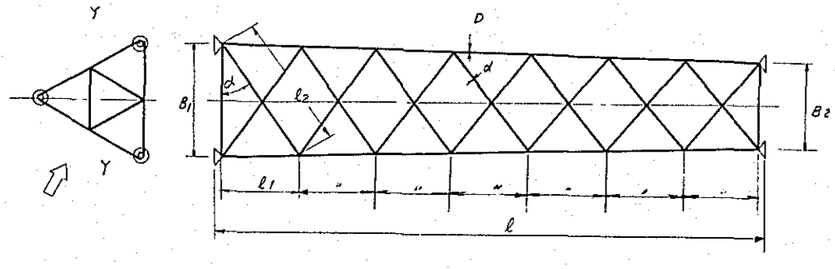
6	HIGH TENSION BOLT	F8T
5	RIB	SS41
4	FLANGE FOR ANCHER BOLT	
3	FLANGE JOINT	
2	DIAGONALS	
1	MAIN MEMBER	SS41B-D
NO	NAME	MATERIAL

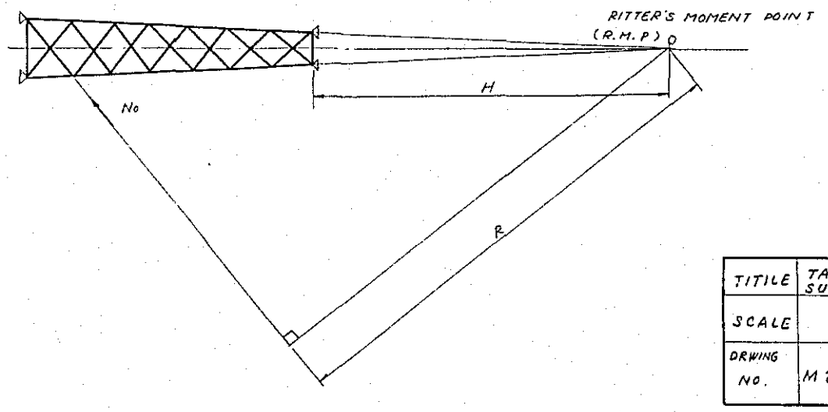
DRAWING NO.	M 2 - 1			
TITLE	SELF-SUPPORTING TRIANGULAR TOWER . BLOCK STRUCTURE (SUDA)			
SCALE	1/100, 1/20, 1/5	UNITS	m/m & INCH	3RD ANGLE PROJECTION

	NO. OF BLOCK	31	41	51	61	71	81
OUTLINE OF BLOCK	LENGTH OF BLOCK ℓ (m)	5.0	5.0	5.0	5.0	5.0	5.0
	UPPER-SIDE BREADTH " B_2 (m/m)	500	680	860	1040	1220	1400
	UNDER-SIDE BREADTH " B_1 (m/m)	680	860	1040	1220	1400	1580
	DIAMETER OF MAIN MEMENBER D (m/m)	32	38	44	50	55	60
	DIAMETER OF DIAGONALS d (m/m)	13×2	16×2	19×2	22×2	22×2	25×1
	WEIGHT OF BLOCK W(kg)	171	255	362	491	560	685
WIND PRESSURE ON BLOCK	OUTWARD AREA OF BLOCK A (m^2)	0.538	0.678	0.830	0.979	1.046	1.153
	COEFFICIENT OF WIND FORCE C	2.38	2.41	2.41	2.41	2.36	2.46
	P = CA	1.28	1.634	2.00	2.36	2.47	2.84
ALLOWABLE BENDING MOMENT OF BLOCK	PITCH OF DIAGONALS ℓ_1 (m/m)	538×9	601×8	684×7	792×6	948×5	1176×4
	SECTIONAL AREA OF MAIN MEMBER a_1 (cm^2)	8.042	11.34	15.21	19.63	23.76	28.27
	RADIUS OF GYRATIOS OF MAIN MEMBER r_1 (cm)	0.80	0.95	1.10	1.25	1.38	1.50
	SLENDERNESS RATIO OF MAIN MEMBER λ_1 (cm)	67	63	62	63	69	78
	BUCKLING COEFFICIENT OF MAIN MEMBER w_1	1.22	1.19	1.18	1.19	1.24	1.32
	MOMENT OF INERTIA OF BLOK I_Y (cm^4)	18634	41963	82189	146026	232815	352892
	SECTIONAL FACTOR OF BLOCK Z_Y (cm^3)	455.6	813.2	1321.4	2003.1	2784.9	3746.2
	RADIUS OF GYRATION OF BLOCK r_1 (cm)	27.8	35.1	42.4	49.8	57.2	64.5
	ALLOWABLE BENDING MOMENT OF BLOCK M_0 (tm)	8.57	15.6	25.5	38.4	51.7	64.8
ALLOWABLE MOMENT OF DIAGONALS	ANGLE OF DIAGONALS α	38°47′	35°29′	33°52′	33°33′	34°35′	37°14′
	LENGTH OF DIAGONALS ℓ_2 (cm)	86.0	104.2	123.7	144.6	167.9	195.7
	SECTIONAL AREA OF DIAGONALS (cm^2)	1.327	2.011	2.835	3.801	3.801	4.909
	RADIUS OF GYRATION OF DIAGONALS r_2 (cm)	0.33	0.40	0.48	0.55	0.55	0.63
	SLENDERNESS RATIO OF DIAGONALS λ_2	130	130	129	132	153	156
	BUCKLING COEFFICIENT OF DIAGONALS w_2	2.82	2.82	2.77	2.90	3.90	4.06
	ALLOWABLE COMPRESSIVE STRESS N_0	1.130	1.711	2.455	3.145	2.338	2.906
	R(m)	14.45	19.15	23.63	27.83	31.53	34.37
	H(m)	13.89	18.90	23.90	28.90	33.90	38.90
	ALLOWABLE MOMENT AT RMP M_d(tm)	16.32	32.77	58.03	87.53	73.74	99.74

ALLOWABLE LOAD OF TOP 785 kg

TOTAL WEIGHT 2.524 kg

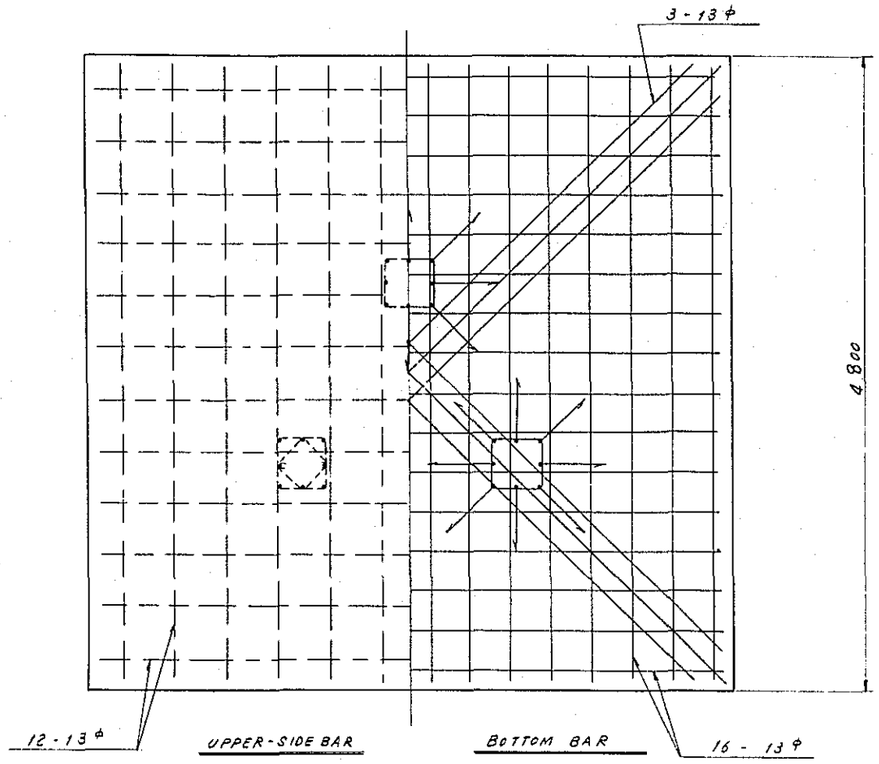


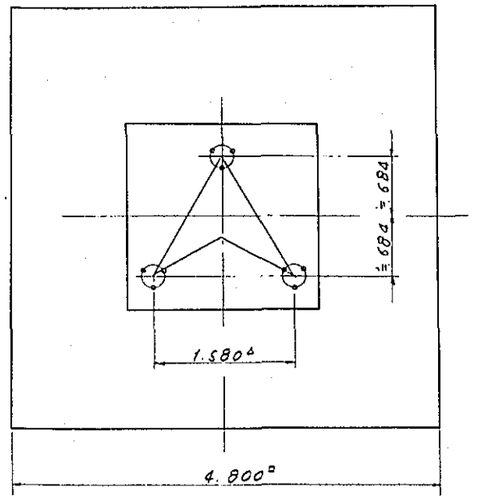


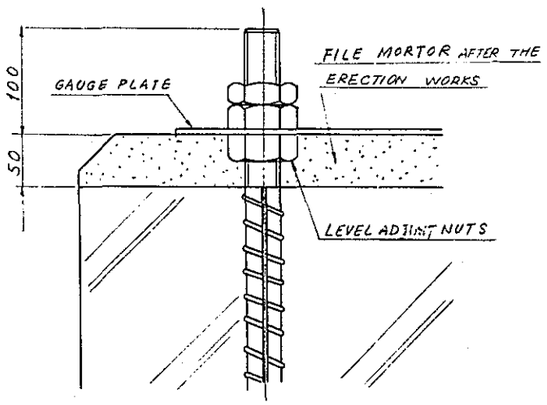
1. OUTWARD AREA OF BLOCK (A) IS A REAL PROJECTED AREA OF THE SIDE WHOSE LENGTH IS ℓ.
2. ALLOWABLE COMPRESSIVE STRESS (σ_0) OF THE MATERIAL IS 2.4 t/cm². HOWEVER, 2.3 t/cm² IS APPLIED TO ALLOWABLE BENDING MOMENT, TALKING SUCH ADDITIONAL COMPRESSIVE STRESS WEIGHT OF THE TOWER ITSELF INTO CONSIDERATION. (σ_1)
3. M_0, N_0 AND M_D ARE GIVEN AS FOLLOWS.

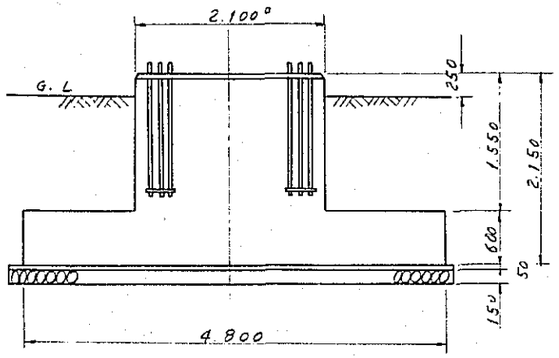
$$M_0 = \frac{Z r a_0}{W_1} \qquad N_0 = \frac{a_1 a_0}{W_2} \qquad M_D = R N_0$$

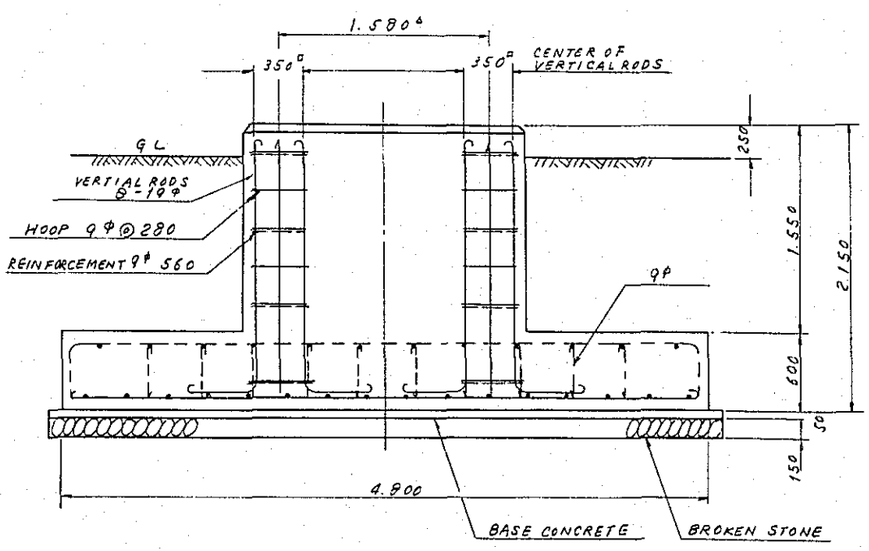
TITILE	TABLE OF A CONSTANT FOR BLOCK, SELF SUPPORTING TRIANGULAR TOWER
SCALE	UNITS
DRWING NO.	M 2 - 2









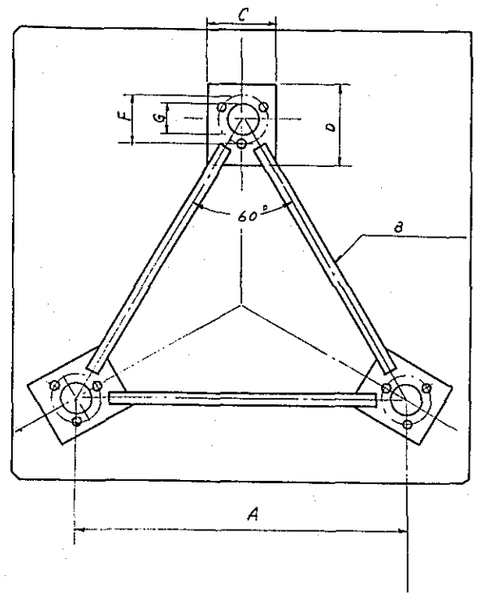


COMPRESSIVE STRENGTH OF CONCRETE

P_c = 180 kg/cm³ MORE THAN

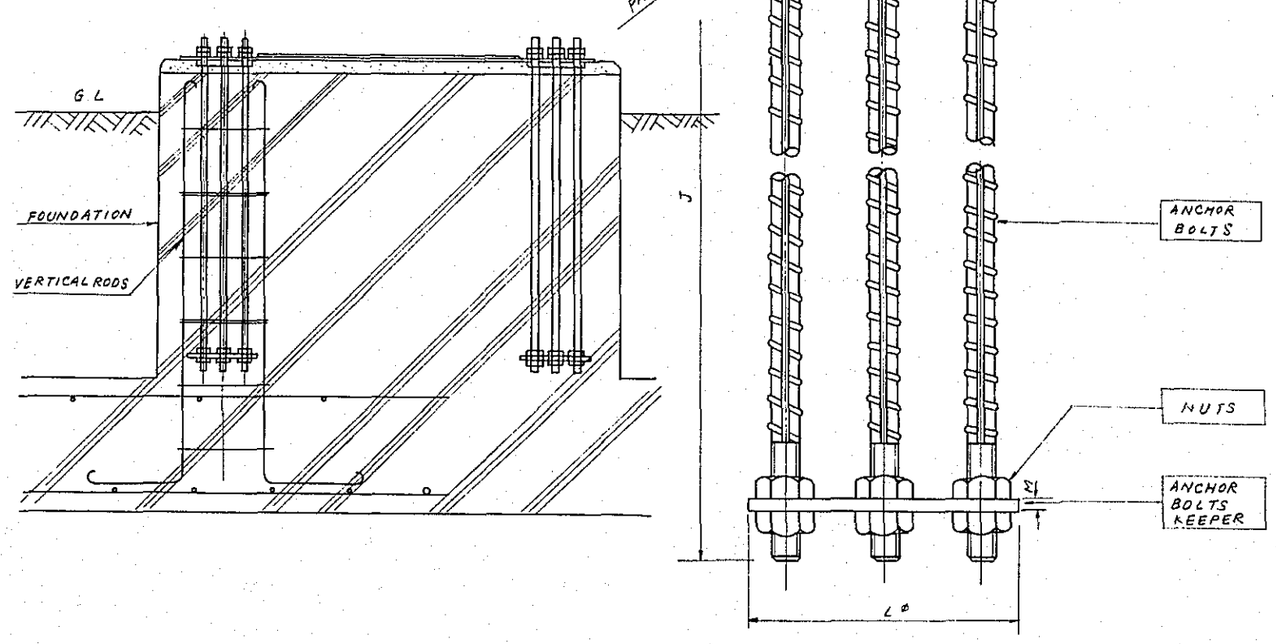
DRAWING NO.	M 2 - 3			
TITLE	FOUNDATION OF SELF - SUPPORING TRIANGULAR TOWER			
SCALE	1/40 1/60	UNITS	mm	3RD ANGLE PROJECTION

PLANE FIG. OF THE GAUGE PLATE



MEASUREMENT

		MARK	TYPE 81
GAUGE PLATE	WIDTH	A	150
	ANGLE	B	L50X4
	PLATE SIZE	C	300
	PLATE SIZE	D	350
	THICKNESS OF PLATE	E	4.5
	P.C.D	F	210
	DIAMETER OF HOLE	G	140
ANCHOR BOLTS	DIAMETER OF BOLTS	H	W 1¼"
	TOTAL LENGTH	J	1450
	LENGTH OF BOLTS HEAD	K	100
ANCHOR BOLTS KEEPER	DIAMETER	L	280
	THICKNESS OF PLATE	M	9



NOTE OF THE ANCHOR BOLTS SETING

MAKE THE HEADS UNIFORMLY LEVELLED OFF.

PAY ATTENSION TO THE LEVEL BEFORE INSTALLATION. REMOVE THE GAUGE PLATE BEFORE ERECTING THE TOWEA.

FILL MORTAR AFTER ERECTING THE TOWER

TO BE USED FOR LEVEL ADJUSTMENT OF THE GAUGE PLATE AND PERPENDICULARILY ADJUSTMENT OF THE POLE. FASTEN THE UPPER NUTS AFTER ELECTING THE TOWER

3	ANCHOR BOLTS KEEPER		3	
2	ANCHOR BOLTS	SD 30	3	
1	GAUGE PLATE	SS41	1	
NO.				

DRAWING NO.	M2 - 4
TITILE	SELF SUPPORTING TRIANGULAR TOWER ANCHOR BOLT & ITS SETTING
SCALE	UNTS m m

SPECIFICATIONS

THE SPECIFICATIONS
FOR
THE FLOOD FORECASTING AND WARNING SYSTEM
IN
THE PAMPANGA RIVER BASIN

CONTENTS

Page

ATTACHED MATERIALS:

1. Specifications for Standard Telemetry and Warning System, adopted by the Ministry of Construction, Government of Japan.
2. Specifications for CRI-15 VHF Radiotelephone Equipment, adopted by the Ministry of Construction, Government of Japan.

CHAPTER 1. GENERAL

1.1 Purpose

The present specifications specify the requirements for the equipments necessary for forecasting and warning the flood of Pampanga River, such as terminal telemetry, monitor, rain-fall gauging, water-level gauging and repeater. Flood Forecasting Center having terminal telemetry equipment gathers the data observed in the Pampanga River Basin for rain-fall and water-level promptly and accurately by means of telemetering equipment in order to comply with the early forecasting and warning of flood.

1.2 Location of System Equipment

Location of Equipment shall be as described in the attached table.

1.3 Date of Delivery

The equipment shall be delivered within nine (9) months after the signing of the contract. However, the radiofrequencies shall be decided and notified to the contractor not later than one hundred (100) days before the date of shipment from the contractor's factory.

1.4 Scope of Contract

The contract shall cover design, manufacturing, packing, transportation from Japan to Port in the Republic of the Philippines, installation at site and adjustment of the proposed equipment, and training, except for the followings:

(1) New establishment or improvement works of buildings and such structures as wells, and aquisition of land required.

(2) Construction works of rain-fall gauge footing and laying works of rain-fall gauging cable at Apalit Rainfall Gauging Station.

(3) Construction works of supporting columns for water-level gauging poles and installation works of water-level gauging poles. Also laying works of water-level gauging cable including Sulipan and Arayat Water-level Gauging Station.

(4) Power supply facilities for commercial use.

(5) Antenna pole and its construction.

(6) Foundation and errection works of antenna tower (self-supporting triangular tower).

(7) Installation works of diesel engine generator (San Rafael and Sapang Buho).

(8) A set of data on the float dropping facilities at Sapang Buho Gauging Station, except float-dropper, wire-rope and hand winch, and construction works of said facilities.

(9) Unloading, customs procedure and storage of the equipments described in this specification at a port of discharge in the Philippines, and local transportation and guarding to the field where those equipments are to be installed.

(10) Items concerning the application procedure of radio stations.

(11) Items in relation to the investigation and counter-measures for the problems of radio interference with the existing radio stations.

1.5 Inspection

Inspection shall be made after the equipment installation has been accomplished. Personnel and other expenditures necessary to make inspection shall be borne by Supplier.

1.6 Warranty

In case the equipment has developed those defects within one year after delivery which are due to inferior design, bad materials or imperfect manufacturing, such equipment shall be repaired or replaced with new one free of charge.

1.7 Technical Guidance

Technical guidance necessary for operation and maintenance of the equipment shall be held for about one month at the Flood Forecasting Center, Gauging Station or Repeating Station during and after installation.

1.8 Change of Specifications

Even after the contract has been signed, specifications may be changed after consultation with Supplier, when this Specification is found necessary to be improved.

1.9 Environmental Conditions

Every equipment shall operate stably under the environmental conditions as follows:

(1) Ambient Temperature: 0°C ~ +50°C
(32°F ~ 122°F)

(2) Humidity: Relative humidity: 90%

(3) Commercial Power Supply: AC220V +25V −45V, 60Hz ±5Hz

(4) Equipment to be installed outdoors shall be bearable against the maximum instant wind velocity of 60 m/sec.

1.10 System Network

The composition of communication system in relation to the equipment shall conform to System Network annexed Fig. 1 and Repeating System annexed Fig. 2.

1.11 Drawings and Literatures

Upon delivery of the equipment, five folds of Instruction manual, three folds of Test Data and five folds of Installation Drawings shall be submitted.

CHAPTER 2. COMPOSITION OF SYSTEM EQUIPMENT

System diagram of the proposed equipment shall be in conformity to the annexed Fig. 3. The equipment diagram of each station is described in the annexed Figs. 4 thru 14. The composition of each equipment shall be as shown in the following tables.

2.1 Terminal Telemetry and Radiotelephone Equipment in the Flood Forecasting Center

No.	Description	Specification	Q'ty	Remarks
1.	Terminal Telemetry Equipment		1 set	
1.1	Telemetry Equipment	Rear-support type, Capacity 25	1 set	
(1)	Signal Section		1 set	
(2)	Transmitting-Receiving Section	150 MHz, 1W	1 set	
(3)	Operation Section	w/Coverage on operation-panel	1 set	
(4)	Power Supply Section		1 set	
(5)	Connecting Section	Graphic display-panel connecting section	1 set	
(6)	Bay		1 set	within 2350(H) x 520(W) x 250(D) (mm)
1.2	Control Console	with Desk	1 set	
(1)	Operation Section		1 set	
(2)	Telemetry Clock		1 set	
(3)	Telemetry Clock Power Supply Section		1 set	
a.	Charger	AC 100V	1 set	
b.	Alkaline Battery	Closed Type	1 set	
(4)	Outer Casing		1 set	within 1100(H) x 1624(W) x 680(D) (mm)

No.	Description	Specification	Q'ty	Remarks
1.3	Data Writer	Remington 26, 21", w/case & desk	1 set	within 1000(H) x 1400(W) x 850(D) (mm)
1.4	Graphic Display Panel	Self-standing w/chart panel	1 set	within 2500(H) x 3000(W) x 800(D) (mm)
1.5	Antenna	Three Element Yagi, Vertical	1 set	
2.	VHF Radiotelephone Equipment			
2.1	Radiotelephone	CRI-15, 10W	1 set	Encased in Control Console
2.2	Antenna	Three Element Yagi, Vertical	1 set	
3.	Voltage Stabilizer & Power Switch	Input AC 220V Output AC 100V 1.5 kVA	1 set	
4.	DC Power Supply	Input AC 220V Output DC 12V Alkaline Battery 60 AH built-in	1 set	
5.	Diesel Engine Generator	Portable Type YANMAR F5C or Equivalent AC 100V, 60 Hz, 2 kVA	1 set	
6.	Illuminator	Tripod Standing AC 100V, 100W	3 sets	
7.	Cord Reel	AC 115V, 15A, 30m	3 pcs.	
8.	Voltage Stabilizer	Portable type, Input AC 220V, Output AC 100V, 500 VA	2 sets	For power supply of Gauging Stations

No.	Description	Specification	Q'ty	Remarks
9.	Measuring Instrument			
9.1	Telemetry Checker		1 set	
9.2	Tester	YEW 3201 or equivalent	2 sets	
10.	Clock	Electronic, Wall-clock SEIKO Vivron or equivalent	1 set	

2.2 Monitor and Radiotelephone Equipment in the Bureau of Public Works

No.	Description	Specification	Q'ty	Remarks
1.	Telemetry Monitor Equipment		1 set	
1.1	Telemetry Equipment	Rear Support type, Capacity 25	1 set	
(1)	Signal Section		1 set	
(2)	Receiving Section	150 MHz	1 set	
(3)	Operation Section	w/coverage on operation-panel	1 set	
(4)	Power Supply Section		1 set	
(5)	Connecting Section	Display-panel connecting section	1 set	
(6)	Outer-housing		1 set	within 2350(H) x 520(W) x 250(D) (mm)
1.2	Telemetry Clock Power Supply	Encased in typewriter desk	1 set	
(1)	Charger	AC 100V	1 set	
(2)	Alkaline Battery	Closed Type	1 set	
1.3	Data Writer	Remington 26, 21", w/case & typing desk	1 set	within 1000(H) x 1400(W) x 850(D) (mm)

No.	Description	Specification	Q'ty	Remarks
1.4	Display Panel	Wall-hung type, 25 display capacity and 18 display equipped	1 set	1200 x 1200 x 400
1.5	Antenna	Yagi 3 element Vertical	1 set	
2.	VHF Radiotelephone Equipment		1 set	
2.1	Radiotelephone	CRI-15, 10W	1 set	
2.2	Antenna	Yagi 5 element Vertical	1 set	
3.	Portable Radiotelephone Transceiver	150 MHz, 1W	2 sets	
4.	Voltage Stabilizer and Power Switch	Input AC 220V Output AC 100V	1 set	
5.	DC Power Supply	Input AC 220V Output DC 12V Alkaline Battery 60 AH built-in	1 set	
6.	Diesel Engine Generator	Movable Type YANMAR F5C or equivalent, AC 100V, 60 Hz, 2 kVA	1 set	
7.	Illuminator	Tripod Standing AC 100V, 100W	2 sets	
8.	Cord Reel	AC 100V, 15A, 30m	2 sets	
9.	Clock	Electronic, wall-clock SEIKO Vivron or Equivalent	1 set	

2.3 Rainfall Gauging and Radiotelephone Equipment at Apalit and Water-level Gauging Equipment at Sulipan

No.	Description	Specifications	Q'ty	Remarks
1.	Telemetering Gauging Equipment		1 set	1-6 Apalit Office
1.1	Telemetry Equipment		1 set	
(1)	Signal Section	Double Data	1 set	
(2)	Transmitting and Receiving Section	150 MHz, 1W	1 set	
(3)	Cabinet		1 set	within 552(H) x 528(W) x 252(D) (mm)
1.2	Antenna	Yagi 3 element Vertical	1 set	
2.	Rainfall Gauging Equipment		1 set	
2.1	Tipping Bucket Rain-Gauge	Integrate Type w/A-D converter	1 set	
2.2	Rainfall Recorder	80 daily recording type	1 set	
3.	VHF Radiotelephone Equipment		1 set	
3.1	Radiotelephone	CRI-15, 10W	1 set	
3.2	Antenna	Yagi 5 element Vertical	1 set	
4.	Portable Radiotelephone Transceiver	150 MHz, 1W	2 sets	
5.	DC Power Supply	Input AC 220V Output DC 12V Alkaline Battery 60 AH built-in	1 set	
6.	Antenna Tower	Self-supporting Triangular Tower 30M., SUDA Type 30ST 3181	1 set	

No.	Description	Specification	Q'ty	Remarks
7.	Water-level Gauging Equipment	Float Type	1 set	Sulipan
7.1	Water-level Gauge	SUIKEN 62 with Auto-recorder A/D Converter		
8.	Cable Protector	Wall-hanging, Moisture proof type	2 sets	Apalit 1 Sulipan 1

2.4 **Reinfall and Water-level Gauging Equipments at Arayat, Candaba and La Paz**

No.	Description	Specification	Q'ty	Remarks
1.	Telemetering Gauging Equipment		3 sets	
1.1	Telemetry Equipment		3 sets	
(1)	Signal Section	Double Data	3 sets	
(2)	Transmitting and Receiving Section	150 MHz, 1W	3 sets	
(3)	Cabinet		3 sets	within 552(H) x 528(W) x 252(D) (mm)
1.2	Antenna	Yagi 3 element Vertical	3 sets	
2.	Rainfall Gauging Equipment		3 sets	
2.1	Rain Intake Section	Separate Type	3 sets	
2.2	Rainfall Gauging Section	Tipping Bucket Type w/ A/D Converter	3 sets	
2.3	Rainfall Recorder	80 daily recording type	3 sets	
3.	Water-level Gauging Equipment		3 sets	
3.1	Water-level Gauge	SUIKEN 62 with Auto-recorder A/D Converter	3 sets	

No.	Description	Specification	Q'ty	Remarks
4.	Solar Cell Power Supply Equipment		3 sets	
4.1	Solar Cell Rack	SHARP or Equivalent 12V, 4.3W	3 sets	
4.2	Power Distributor	w/over-charge protector	3 sets	
4.3	Alkaline Battery	12V, 40 AH	3 sets	
5.	Cable Protector	Wall-hanging, moisture proof type,	2 sets	Arayat

2.5 Rainfall and Water-level Gauging Equipments at San Isidro and Ipo

No.	Description	Specification	Q'ty	Remarks
1.	Telemetering Gauging Equipment		2 sets	
1.1	Telemetry Equipment		2 sets	
(1)	Signal Section	Double Data	2 sets	
(2)	Transmitting and Receiving Section	150 MHz, 1W	1 set	San Isidro
(3)	Transmitting and Receiving Section	150 MHz, 3W	1 set	Ipo
(4)	Cabinet		2 sets	within 552(H) x 528(W) 252(D) (mm)
1.2	Antenna	Yagi 3 element, Vertical	2 sets	
2.	Rainfall Gauging Equipment		2 sets	
2.1	Rain Intake Section	Separate Type	2 sets	
2.2	Rainfall Gauging Section	Tipping Bucket type, w/A/D Converter	2 sets	
2.3	Rainfall Recorder	80 daily recording type	2 sets	
3.	Water-level Gauging Equipment	TAKUWA Pole type	2 sets	

No.	Description	Specifications	Q'ty	Remarks
3.1	Water-level Gauging Pole		2 sets	
3.2	Water-level Gauging Pole		2 sets	
3.3	Water-level Gauging Pole		2 sets	
3.4	Code Converter		2 sets	
3.5	Data Recorder		2 sets	
4.	Solar Cell Power Supply Equipment		2 sets	
4.1	Solar Cell Rack	SHARP or equivalent 12V, 4.3W	2 sets	
4.2	Power Distributor	w/over-charge protector	2 sets	
4.3	Alkaline Battery	12V, 50 AH	2 sets	

2.6 Rainfall, Water-level and Discharge Gauging Equipments at Sapang Buho

No.	Description	Specifications	Q'ty	Remarks
1.	Telemetering Gauging Equipment		1 set	
1.1	Telemetry Equipment		1 set	
(1)	Signal Section	Double Data	1 set	
(2)	Transmitting and Receiving Section	150 MHz, 1W	1 set	
(3)	Cabinet		1 set	within 552(H) x 528(W) x 252(D) (mm)
1.2	Antenna	Yagi 3 element, Vertical	1 set	
2.	Rainfall Gauging Equipment		1 set	
2.1	Rain Intake Section	Separate type	1 set	
2.2	Rainfall Gauging Section	Tipping Bucket type, w/A/D Converter	1 set	
2.3	Rainfall Recorder	80 daily recording type	1 set	
3.	Water-level Gauging Equipment	TAKUWA Pole type	1 set	

No.	Description	Specifications	Q'ty	Remarks
3.1	Water-level Gauging Pole		1 set	
3.2	Water-level Gauging Pole		1 set	
3.3	Water-level Gauging Pole		1 set	
3.4	Code Converter		1 set	
3.5	Data Recorder		1 set	
4.	Solar Cell Power Supply Equipment		1 set	
4.1	Solar Cell Rack	SHARP or equivalent 12V, 4.3W	1 set	
4.2	Power Distributor	w/over-charge protector	1 set	
4.3	Alkaline Battery	12V, 50 AH	1 set	
5.	Diesel Engine Generator	Fixed type, YANMAR F 5C or Equivalent AC 100V, 60Hz, 2 kVA	1 set	
6.	Illuminator	Tripod Standing AC 100V, 100W	4 sets	
8.	Float Dropping Facilities		1 set	
8.1	Float Dropper		1 set	
8.2	Winch	Hand Winding	1 set	
8.3	Wire Rope	6ϕ	200m	Includes clips and turn buckles
8.4	Wire Rope	9ϕ 6 x 24	400m	Includes clips and turn buckles
8.5	Wire Rope	14ϕ 6 x 37	200m	Includes clips and turn buckles
8.6	Pulley		1 set	Includes 9ϕ pulley axis

2.7 *Rainfall Gauging Equipments at Sibul Springs and Papaya*

No.	Description	Specifications	Q'ty	Remarks
1.	Telemetering Gauging Equipment		2 sets	
1.1	Telemetry Equipment		2 sets	
(1)	Signal Section	Double Data	2 sets	
(2)	Transmitting and Receiving Section	150 MHz, 3W	2 sets	
(3)	Cabinet		2 sets	within 552(H) x 528(W) x 252(D) (mm)
1.2	Antenna	Yagi 3 element Vertical	2 sets	
2.	Rainfall Gauging Equipment		2 sets	
2.1	Rain Intake Section	Separate type	2 sets	
2.2	Rainfall Gauging Section	Tipping Bucket type w/A/D Converter	2 sets	
2.3	Rainfall Recorder	80 daily recording type	2 sets	
3.	Solar Cell Power Supply Equipment		2 sets	
3.1	Solar Cell Rack	SHARP or Equivalent 12V, 4.3W	2 sets	
3.2	Power Distributor	w/Over-charge Protector	2 sets	
3.3	Alkaline Battery	12V, 30 AH	2 sets	

2.8 Rainfall Gauging and Repeater Equipment at San Rafael

No.	Description	Specifications	Q'ty	Remarks
1.	Telemetering Gauging & Repeater Equipment		1 set	
1.1	Telemetry Equipment		1 set	
(1)	Signal Section	Single Data	1 set	
(2)	Cabinet		1 set	within 552(H) x 528(W) x 252(D) (mm)
1.2	Telemetry Repeater Equipment		1 set	
(1)	Repeater Section	Squelch Repeating System	1 set	
(2)	Operation Section		1 set	
(3)	Transmitting and Receiving Section	150 MHz, 3W, No. 1	1 set	
(4)	Transmitting and Receiving Section	150 MHz, 3W, No. 2	1 set	
(5)	Connecting Section	For connecting to telemetry equipment	1 set	
(6)	Cabinet		1 set	within 1449(H) x 528(W) x 252(D) (mm)
1.3	Antenna	3-stage Colinear	2 sets	
2.	Rainfall Gauging Equipment		1 set	
2.1	Rain Intake Section	Separate type	1 set	
2.2	Rainfall Gauging Section	Tipping Bucket type w/A/D Converter	1 set	
2.3	Rainfall Recorder	80 daily recording type	1 set	
3.	Solar Cell Power Supply Equipment		1 set	
3.1	Solar Cell Rack	SHARP or equivalent 12V, 20.16W	1 set	

No.	Description	Specifications	Q'ty	Remarks
3.2	Power Distributor	w/over-charge protector	1 set	
3.3	Alkaline Battery	12V, 200 AH	1 set	
4.	Diesel Engine Generator	Fixed type, YANMAR F 5C or Equivalent AC 100V, 60Hz, 2 kVA	1 set	
5.	Antenna Tower	Self-supporting Triangular Tower 30m, SUDA type 30ST 3181	1 set	

2.9 Repeater Equipment at Cabanatuan

No.	Description	Specifications	Q'ty	Remarks
1.	Telemetering Repeater Equipment		1 set	
1.1	Telemetry Repeater Equipment		1 set	
(1)	Repeater Section	Cross-repeating System	1 set	
(2)	Operation Section		1 set	
(3)	Transmitting and Receiving Section	150 MHz, 3W, for Communication San Rafael	1 set	
(4)	Transmitting and Receiving Section	150 MHz, 3W, for Communication with Gauging Stations	1 set	
(5)	Cabinet		1 set	1204(H) x 508(W) x 350(D) (mm)
1.2	Antenna	Yagi 3 element Vertical	1 set	
1.3	Antenna	3 stage colinear	1 set	
2.	DC Power Supply	Input AC 220V, Output DC 12V Alkaline Battery 60 AH, built-in	1 set	
3.	Antenna Tower	Self-supporting triangular tower 30m, SUDA Type 30ST 3181	1 set	

CHAPTER 3. TELEMETRY EQUIPMENT

3.1 Specifications Applied

This equipment shall conform to Specifications for Standard Telemetry and Warning System, Ministry of Construction, Government of Japan. (Telecommunication Spec. No.11 Ministry of Construction) See attached material 1.

3.2 Common Requirements

3.2.1 Wiring

Wiring shall in principle meet the following norms:

(1) For Printed Circuit Board;

Heat-resistant vinyl wire for wrapping 0.32ϕ shall be used.

(2) For others;

Generally vinyl wire shall be used.

3.2.2 Soldering

Soldering should be applied after wire has been mechanically jointed firmly, except that it is applied within printed circuit boards.

3.2.3 Identification

(1) The outer housing of every major equipment shall carry a main identification plate in which the model and type of the equipment, its name, manufacturing date, manufacturing number and the name of manufacturers shall be clearly indicated. Each panel comprising such equipment shall carry a plate in which the model and type, the set frequency and the manufacturing number shall be clearly indicated.

(2) Portions to be adjusted or connected and main component parts shall carry those marks or numbers etched or stamped which facilitate to make reference to the drawings.

3.2.4 Parts and Materials Applied

(1) For all the active components, semiconductor elements such as I.C. or silicon transistor shall be used.

(2) For all the semiconductors, resistors and capacitors, goods standardized for communications equipment shall be used.

(3) Relays shall not be used in general, except high voltage, large current or alternating current circuits.

3.2.5 Housing

(1) Housing shall be sufficiently strong steel of good appearance, to which semi-mutting baking finish shall be applied after the rust-proof treatment.

(2) Housing of the telemetry equipment in the terminal telemetry station and monitor station shall be of rear-supporting type dust-proofing construction. (See the annexed Fig. 12-E.)

(3) Housing of the telemetry equipment in the gauging and repeater facilities shall be of small-sized, light-weighing and stationary type, easy to mount and dismantle, and of moisture proofing construction, so designed that equipments encased can be protected properly. (See the annexed Fig. 12-F, 12-G and 12-H.)

3.2.6 Signal Section

Each item comprising signal section shall be of plug-in system for the convenience of check for maintenance and shall have interchangeability between the similar equipments. Printed circuit boards can be checked at the front. Cabling and signal input section in the signal section of gauging stations shall be manufactured as double data processing type.

3.2.7 Transmitting and Receiving Section

(1) Construction

Conforming to 3.2.6 Signal Section.

(2) Transmitting Section

a.	Frequency Range:	142 MHz to 162 MHz
b.	Type of Service:	F2 and F3 (Telemetry Signal and Telephone)
c.	Transmitting Power:	1W and 3W (For 3W, power amplifier unit is added to 1W)
d.	Frequency Tolerance:	$\pm 10 \times 10^{-6}$
e.	Maximum Frequency Deviation:	±5 kHz
f.	Multiplication:	12
g.	Output Impedance:	50Ω
h.	Input Impedance:	600Ω, unbalanced
i.	Distortion Factor:	Not more than 10%
j.	Incorrect Radiation:	Within the band – less than 80dB Out-of the band – less than 60dB

However, in case of 1W, both within and out of the band, the value should be less than 60dB.

(3) Receiving Section

a.	Frequency Range:	142 MHz to 162 MHz
b.	Frequency Tolerance:	5×10^{-6}
c.	Bandwidth:	Within ±6 kHz (less than 6dB)
d.	Selectivity:	Less than −70dB (±12.5 kHz)
e.	Non-pressure Sensitivity:	Less than −80dB
f.	Signal to Noise Ratio:	Over 15dB at input of 0dBμV Over 30dB at input of 10dBμV Over 40dB at input of 30dBμV
g.	Output Impedance:	600Ω
h.	Distortion Factor:	Less than 10%
i.	Intermediate Frequency:	10.7 MHz
j.	Output Level:	−20dBm

3.2.8 Power Supply

(1) Terminal Telemetry and Monitor Equipment: AC 100V ±10% 60Hz

(2) Gauging and Repeater Equipment: DC 12V $^{+20\%}_{-10\%}$

3.2.9 Accessories

(1)	Maintenance Tools:	3 sets, one each for Flood Forecasting Center, San Rafael and Cabanatuan.
(2)	Data Recording Paper:	2000 sheets per each data writer.
(3)	Repeater Control Unit:	2 sets
(4)	Indicating Panel:	Acryl resin plate, curved seal indication of group and particular signal as well as radio frequency. 1 plate per each gauging station and repeater station.

3.2.10 Spare Parts

(1) For Terminal Telemetry Equipment

a.	Relays:	1 set each

b.	Pilot Lamps and Fuses:	200% of working quantity
c.	Printed Sheet (including Transmitting and Receiving Section):	1 set
d.	Spare Parts Box:	1 set

(3) For facilities in San Rafael Network (to be delivered to Flood Forecasting Center)

a.	Mechanical Filters and Relays:	To each location, each type 1 set
b.	Pilot Lamps and Fuses:	To each location, 200% of working quantity
c.	Telemetry Equipment:	Double data, w/3W transmitting and receiving section 1 set
d.	Printed Sheet for Telemetry Repeater Equipment:	Including transmitting and receiving section 1 set
e.	Spare Part Box:	1 set

(4) For facilities in Cabanatuan Network (to be delivered to Flood Forecasting Center)

a.	Mechanical Filters and Relays:	1 pc. for each type
b.	Pilot Lamps and Fuses:	200% of working quantity
c.	Telemetry Equipment:	Double data, w/transmitting and receiving section of 3W 1 set
d.	Printed Sheet for Telemetry Repeater Equipment:	Including transmitting and receiving section 1 set
e.	Spare Parts Box:	1 set

3.3 Terminal Telemetry Equipment

3.3.1 General

This equipment, consisting of telemetry equipment, control console, data writer and graphic display panel to be located at Flood Forecasting Center, shall control each telemetry gauging equipment and shall meet the followings:

3.3.2 Capacity and Mounting

Calling and indicating capacity included in this equipment shall be 25, however, the present system shall be equipped with 17.

As for the future increase of mounting volume up to 8, the terminal telemetry equipment shall not require any additions nor modifications.

3.3.3 Control Console

(1) Construction

Control Console shall be of steel make, desk type and of good appearance, easy to handle. Push buttons and switchgears shall be covered so as not to be mistakenly operated. (See the annexed Fig. 12-A.)

(2) Functions

All the telemetry equipment shall be controlled on this control console and have functions as follows:

a. Switching of the main power supply.

b. Lamp indication of the operation and conditions of facilities.

c. Meter indication of voltage and level at each portion of facilities.

d. Watching of the conditions of repeater equipment and remote switching thereof.

e. Setting of the time intervals of telemetry auto-calling observation and control of auto-calling.

f. Calling of all or individual stations by means of manual observation.

g. Indication of the observation time of telemetry observed values.

h. Radiotelephone and volume adjustment between each gauging station and repeater station by handset and speaker.

i. Buzzer alarming and suspension of operation in an emergency.

j. Receiving of AM/FM radio broadcast.

k. Space for incorporating CRI-15 VHF transceiver, which shall be so constructed as to be capable of being mounted and dismantled.

3.3.4 Graphic Display Panel

(1) Panels shall be of steel plate and self-standing type of good appearance. The graphic display panel shall have the map plate at its center and indicator plates for the telemetry observed values.

And, on the map plate of the graphic display panel, main cities, towns, rivers,

major roads, institutes concerned and observation stations shall be described. External dimensions are approximately 2,500(H) x 3,000(W) x 800(D) mm, and shall be of separate type for the convenience of transportation. (See the annexed Fig. 13.)

(2) Contents indicated

a. Observation time

b. Name of gauging stations (Gauging Stations 18, Stations actually mounted 11, Indication Capacity 25, Indication actually mounted 17)

c. Values observed (Water-level 4 digits; Rainfall 3 digits, values calculated to the daily rainfall)

d. Special information

e. Stations being called shall be indicated by flickering.

3.4 Monitor Equipment

3.4.1 General

This equipment, consisting of telemetry equipment, power supply section for clocks, data writer and display panel, is always in a waiting condition, and in receiving signals (synchronized signal) for starting monitor equipment, will start monitor operation.

3.4.2 Functions

Functions of this equipment shall conform to Terminal Telemetry Equipment, except for the function of calling.

3.4.3 Display Panel

(1) Appearance and Construction

Display panels shall be of steel plate make and wall-hung type, indicating normally the telemetry observed values.

External dimensions are approximately 1,200 x 1,200 x 400 mm. (See the annexed Fig. 14.)

(2) Contents Indicated

The contents are the same as mentioned in 3.3.4 Graphic Display Panel, (2) Contents indicated, except e.

3.5 Gauging Equipment

3.5.1 General

This equipment is always in a waiting condition and only when the calling

signal particularly allotted to the station is received from the terminal telemetry equipment, it will start the operation of the transmitting unit and signal generating circuits, and the equipment will transmit the data observed.

3.5.2 Values Observed

(1) Information observed shall be digital. (Binary decimal, w/parity bit.)

(2) Values observed for rainfall shall be an integrating value ranging from 000 mm to 999 mm, and in excess of 1,000 mm the digit shall return to 000 mm.

(3) Water-level gauging values shall range from 0000 mm to 9999 mm.

3.6 Gauging and Repeater Equipment (San Rafael)

3.6.1 General

This equipment consists of gauging equipments and repeater equipments.

Gauging equipments shall conform to 3.5 Gauging Equipment, but the transmitting and receiving equipment shall not be mounted therein.

3.6.2 Repeating System

This system shall be a squelch repeating system, whose transmitting and receiving section shall be dual (No.1 and No.2). And, RF filters, inserted into receiving input circuit to eliminate interference frequency, will prevent the sensitivity from lowering by suppression.

3.6.3 Switching System

The transmitting and receiving section No.1 and No.2 have the same function and can be switched over to each other under the following conditions:

(1) Periodical Switching (Switching by Clock)

At an interval optionally set in a unit of five minutes, said two sections shall be switched alternately. And, during operation of repeater equipments, switching shall be suspended, while the periodical switching shall be also suspended after the automatic switching in case of trouble as mensioned below has been made.

(2) Automatic Switching

At an interval optionally set in a unit of five minutes, every part of the transmitting and receiving section shall be checked. When a trouble is found at the equipment in operation, switch over to the standby equipment shall be made automatically. And, when a damage is found at the standby equipment, switching shall be suspended. During operation of the repeater equipment, checking for damages shall be also suspended.

(3) *Remote Switching*

When a switching signal is received from the terminal telemetry equipment, switch over to the standby equipment is made, if both No.1 and No.2 are in a normal condition and switching operation is not locked.

3.6.4 Reporting

The terminal telemetry equipment shall be reported of the operating conditions of the repeater equipments when periodical, automatic and remote switching have been made.

3.7 Repeater Equipment (Cabanatuan)

A cross repeating system shall be adopted, whose transmitting and receiving sections shall be for two destinations, one for San Rafael Repeater Station and the other for Gauging Stations. And, the sensitivity drop shall be prevented by inserting into the receiving input circuit RF filter which will eliminate interference frequency.

CHAPTER 4. RAINFALL GAUGING EQUIPMENT

4.1 General

This equipment gauges rainfalls at the gauging station, makes a digital conversion of measured values, send the data to the telemetry system, and records them on the rainfall recorder.

4.2 Rain Gauge

The rain gauge shall be a tipping bucket type; the integrate type for Apalit Station and the separate type for other stations.

(1) Rain Intake Section

The rain intake section shall be provided with a function of taking in rainfalls and shall be of standard outdoor installation type having a diameter of 200 mm.

The integral type shall have its rainfall gauging mechanism made into one piece, while the separate type shall have its rainfall gauging section connected through a water intake pipe.

(2) Rainfall Gauging Section

The integrate type shall be installed outdoors with the rain intake section, while the separate type shall be mounted indoors. Each shall consist of the gauging mechanism and sender.

a. Gauging Mechanism

This is a tipping bucket which makes one tipping for a rainfall of 1 mm. The mechanism causes the A/D converter to be driven and the mercury switch causes the recorder to be actuated.

b. Sender

This part consists of an A/D converter which converts the measured values at the gauging mechanism into digital values (binary coded decimals with parity bit).

4.3 Rainfall Recorder

The rainfall recorder shall be a long-term type self-writing electric contact counter (with roll paper for 80-daily recording).

The electric contact counter permits data to be automatically recorded on the roll paper through operation of the electromagnetic lever caused when the contacts built in the tipping bucket rain gauge are ON and OFF.

The feed mechanism of this rainfall recorder shall be a micromotor.

4.4 Accessories and Spares

(1)	A/D Converter:	2 sets
(2)	Anchor Bolt:	1 set for each equipment
(3)	Vinyl Pipe:	1 set for each equipment
(4)	Recording Paper:	10 rolls for each equipment
(5)	Ink:	2 bottles for each equipment
(6)	Squirt:	2 for each equipment
(7)	Spare Pen:	2 sets for each equipment
(8)	Spare Parts Box:	1 set for each equipment

CHAPTER 5. WATER LEVEL GAUGING EQUIPMENT (FLOAT TYPE)

5.1 General

The water level gauging equipment shall convert the up and down motion of the float installed on the well into digital values, send the converted output as water level data to the telemetry equipment, and record the data analogally on an automatic recorder.

5.2 Water Level Gauge

The water level gauge shall be the SUIKEN type 62 and incorporate an automatic recorder and an A/D converter.

The recording shall be made with two pens; the red pen for recording data in meter and the green pen for recording data in centimeter.

The winding power of the automatic recorder shall be a spring clock with an effective operating time of 80 days.

The water-level range to be measured is 0 ~ 10 m. However, the A/D converter shall be 4 digit type.

5.3 Accessories and Spares

(1)	A/D Converter:	1 set
(2)	Shoes:	1 set for each equipment
(3)	Float:	1 set for each equipment
(4)	Counterweight:	1 set for each equipment
(5)	Auxiliary Weight:	1 set for each equipment
(6)	Stainless Steel Wire with Beads:	1 set for each equipment
(7)	Anchor Bolt:	1 set for each equipment
(8)	Recording Paper:	10 rolls for each equipment
(9)	Ink (Red and Green):	2 sets each for each equipment
(10)	Squirt:	4 sets for each equipment
(11)	Vinyl Pipe:	2 sets for each equipment
(12)	Spare Pen:	2 sets for each equipment
(13)	Spare Parts Box:	1 set for each equipment

CHAPTER 6. WATER LEVEL GAUGING EQUIPMENT (POLE TYPE)

6.1 General

The water level gauging equipment of pole type shall put water level signals sent from the level gauging poles installed at the site into the code converter at the gauging station, send the observed water level data to the telemetry system, and record them on a data recorder.

6.2 Water Level Gauging Pole

The water level gauging pole shall consist of the outer pipe, measuring pipe, head air-tight chamber, float, strainer, etc. It shall withstand such shocks as may be caused by wood running in the water, direct sunshine, and such other adverse circumstances, and operate stably for a long time.

The pole shall also be able to transmit signals to the data recorder when the measured water level exceeds the setting.

6.3 Code Converter

The code converter shall convert the 3 digits of decimal codes supplied from the water level gauging pole into 4 digits of binary-coded decimals. Provision shall be made for making possible the combined use of a data recorder.

6.4 Data Recorder

The data recorder shall store water level signals sent from the code converter at every time interval predetermined (10, 20, 30 or 60 minutes), while at the same time recording them digitally.

The recorder shall also permit the recording time intervals to be reduced by signals from the gauging pole, should the measured water level exceed the setting.

6.5 Performances

(1) Gauging range and type of poles
As specified in Chapter 2 Composition of Equipment.

(2) Unit of measurement: 1 cm

(3) Measuring accuracy: ±1 cm

(4) Power supply: DC 12V $^{+20\%}_{-10\%}$

6.6 Accessories and Spares

(1)	Repair parts:	1 set
(2)	Recording paper:	Equivalent to about 2-year's operation

CHAPTER 7. VHF RADIO TELEPHONE EQUIPMENT

7.1 General

This equipment shall be used for intercommunications among the Bureau of Public Works, Flood Forecasting Center, and Central Luzon River Control District Office (Apalit), as well as for maintenance of the telemetry system, etc.

7.2 Specifications Applied

This equipment shall conform to the Specification of VHF Radio Telephone Equipment, CRI-15, provided for by the Ministry of Construction, the Government of Japan. (Telecommunication Spec. No.16 Ministry of Construction) See attached material 2.

CHAPTER 8. PORTABLE RADIO TELEPHONE TRANSCEIVER

8.1 General

This equipment shall be used for localized intercommunications and shall allow communications between these portable equipments or between the portable equipment and the VHF radio telephone equipment referred to in Chapter 7 of this specification.

8.2 Construction

This equipment shall be of allweather type, small in size, light in weight, and easy in handling.

8.3 Performances

(1) General

a.	Frequency range:	142 ~ 162 MHz
b.	Communication system:	Simplex
c.	Type of service:	F3 (telephone)
d.	RF input impedance:	50Ω

(2) Transmitter

a.	Transmitting output:	1W
b.	Frequency tolerance:	Within $\pm 10 \times 10^{-6}$
c.	Oscillator circuit:	Crystal controlled
d.	Modulation system:	Phase modulation
e.	Maximum frequency shift:	±5 kHz
f.	Signal to noise ratio:	Better than 40dB

(3) Receiver

a.	Receiving system:	Superheterodyne
b.	Frequency tolerance:	Within $\pm 10 \times 10^{-6}$
c.	Sensitivity:	Less than 2μV (measured by 20dB noise quieting method)
d.	Rated receiving output:	100 mW
e.	Squelch sensitivity:	At 20dB noise suppressed sensitivity maximum, the squelch shall be opened and shall not suppress signals of 40dB or more.

(4) Power supply: DC 12V

Nickel-cadmium battery, UM-3 type x 10 or Dry cell UM-3 x 8

8.4 **Accessories and Spares (for one equipment)**

a.	Portable case:	1
b.	Earphone:	1
c.	Outside handset:	1
d.	Nickel-cadmium battery (with pack):	1
e.	Charger (AC 220V, 60Hz):	1
f.	Dry cell case:	1
g.	Dry cell (high efficiency, UM-3):	16
h.	Rod antenna:	1
i.	Flexible antenna:	1
j.	Connecting cable:	1
k.	Fuses and pilot lamps:	200% of working quantity

CHAPTER 9. VOLTAGE STABILIZER & POWER SWITCH

9.1 General

This equipment shall supply the telemetry terminal system and telemetry monitoring system with commercial power transformed and stabilized. In the event of a failure in the commercial power source, a diesel generator circuit shall be automatically switched into operation to supply the systems with necessary power.

9.2 Construction and Performance

(1) Construction

The equipment shall be stationary type, and all of its control functions shall be made on the front panel.

(2) Voltage Stabilizer

Input conditions:	Commercial power AC 220V $^{+25V}_{-45V}$ 60 Hz ±5 Hz
Output conditions:	AC 100V ±5V, 60 Hz ±5 Hz response time: 0.1 sec. max.
Capacity:	1.5 kVA

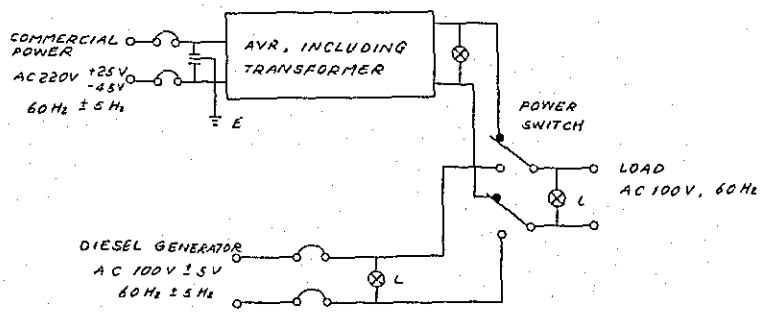
(3) Power Switch

In the event of interruption of the commercial power supply, the generator shall be automatically switched into operation. When the commercial power is restored and the generator is made OFF, the commercial power supply circuit shall also be automatically switched into running.

(4) Lightning Protective Circuit

There shall be provided a circuit which absorbs abnormal voltages in order to protect the equipment from lightning and such other surges.

(5) Circuit Diagram



CHAPTER 10. VOLTAGE STABILIZER

10.1 General

This equipment shall supply measuring instruments with stabilized power for maintenance at the gauging station to which commercial power can be led.

10.2 Construction and Performance

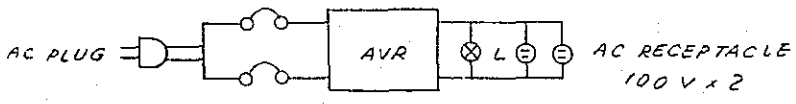
(1) Construction

The equipment shall be portable type, compact in size and light in weight.

(2) Performance

Input conditions:	Commercial power AC 220V $^{+25V}_{-45V}$ 60 Hz ±5 Hz
Output conditions:	AC 100V ±5V, 60 Hz ±5 Hz response time: 0.1 sec. max..
Capacity:	500 VA

(3) Circuit Diagram



CHAPTER 11. DC POWER SUPPLY

11.1 General

This equipment is a DC power supply system which incorporates constant voltage charging type alkaline batteries with automatic averaged charger. It shall permit supply of power to the telemetry gauging equipment or radio telephone equipment for intercommunication for about 7 days of power interruption.

11.2 Construction and Performance

(1) Charging Circuit

Input conditions:	Commercial power AC 220V $^{+25V}_{-45V}$ 60 Hz ±5 Hz with lightning protector
Output conditions	
At floating charge:	DC 14.5V ~ 15.5V (semi-fixed) 15A
At averaged charge:	DC 15 ~ 17V 15A
Voltage accuracy for floating charge:	Less than ±3%

(2) Alkaline Battery

a. Construction

The alkaline battery shall be contained in a transparent plastic cell for easy inside observation and maintenance. The cell shall be of such a type that a sufficient quantity of electrolyte may be filled inside and that the reduction in level may be insignificant if operated for a long time without checking.

b. Capacity:	12V 60AH or more

11.3 Accessories and Spares (for each equipment)

a. Maintenance tools:	1 set each
b. Lamps and fuses:	200% of working quantity

CHAPTER 12. SOLAR CELL POWER SUPPLY EQUIPMENT

12.1 General

This equipment shall use solar cells to convert the solar photo-energy directly into electric energy, charge it into the alkaline batteries, and supply it to the telemetry system and gauging equipment.

12.2 Construction and Performance

(1) Solar Cell Rack

a. Construction

The solar cell rack shall contain a necessary quantity of solar cell elements arranged in groups on a plane of a stainless steel frame. It shall be capable of being adjusted to the sun beam inlet angle. It shall also be equipped with a bird protection hardware.

b. Performance

Output voltage:	12V nominal
Rated output:	Specified in Chapter 2 Composition of System Equipment This rated output shall be for radiation of 100mW/cm^2 at 25°C temperature.

(2) Power Distributor

a. Cabinet

The cabinet shall be of 1 mm or more thick steel plate, drip-proof and wall mounted type. A connection diagram shall be provided on the inner wall of the front door.

b. Instruments and apparatus

Overcharge protector (operating voltage: $14.7\ ^{+0.26V}_{-0V}$):	1 set
Switch for the above:	1 set
DC voltammeter:	1 set
Reversing prevention diode:	1 set
Switch:	1 set

Connector: 1 set

(3) Alkaline Battery

The specifications given in 11.2 (2) of Chapter 11 DC Power Supply shall apply to the alkaline batteries mentioned here. However, their capacity shall be as per Chapter 2 Composition of System Equipment.

CHAPTER 13. DIESEL ENGINE GENERATOR

13.1 General

This equipment shall be a portable type diesel engine generator which supplies power for equipment and lighting when power supply is interrupted at the Bureau of Public Works and Flood Forecasting Center.

A fixed type generator shall also be provided for supply power of lighting, etc. for checking the equipment at San Rafael and Sapan Buho. This will be utilized at Sapan Buho at the time of discharge gauging.

It shall be so designed as to operate satisfactorily for a long time.

13.2 Construction and Performance

(1) Diesel Engine:	Horizontal type 4-cycle diesel, 5 PS, 2,000 revolutions per minute	
(2) AC Generator:	Single phase, 100V ±5%, 60 Hz, static excitation type	
(3) Power Distributor:	Accommodates instruments, circuit breakers pilot lamps, voltage regulator, terminals, double receptacle	
(4) Fuel Tank:	Portable type	mounted to the generator proper
	Fixed type	one mounted to the generator proper and the other mounted separately (about 100 liters)
(5) Others:	Silencer, vibration-proof common base and frame; auxiliary silencer air duct, etc. for fixed type	

13.3 Accessories and Spares

(1) Maintenance and Checking Tools:	1 set for each equipment
(2) Vinyl Cover:	1 for each equipment
(3) Pilot Lamp:	200% of working quantity
(4) Brush:	100% of working quantity
(5) Fan Belt:	1 for each equipment
(6) Portable Tank (10 liters):	2 sets for each equipment

(7) Portable Tank (5 liters): 2 sets for each equipment

(8) Portable Tank (3 liters): 2 sets for each equipment

(9) Anchor Bolt: 1 set each for fixed type

CHAPTER 14. ANTENNA TOWER

14.1 General

The antenna towers to be installed at Apalit, San Rafael and Cabanatuan shall be self-supporting triangular towers.

14.2 Construction

(1) Type 30ST-3181 (30m high) made by Suda Seisakusho Co.

(2) The tower shall be equipped with anchor bolts keeper, anchor bolts, gauge plates, grounding metals, and block jointing bolts.

(3) The tower to be installed at Apalit shall be equipped with a lightning rod.

CHAPTER 15. INSTALLATION AND ADJUSTMENT

15.1 General

(1) The Contractor shall have Purchaser's instructions prior to the installation of each equipment.

(2) During construction, the Contractor shall pay full attention to floods, winds, and such other disasters.

(3) Each equipment shall be installed rigidly with due considerations taken to the weather condition, vibration, and rusting.

15.2 Antenna and Feeder

(1) The antenna shall be installed in such a manner that its direction can be adjusted.

(2) The feeder shall be AF-50-4. Feeders shall be fixed with hardware on the sides of the tower and poles. Messenger wires shall be laid on the overhead part near the inlet of the building for suspension with hangers. Attention shall be paid not to allow rain water to enter the building through the feeder inlet.

(3) The antenna and feeders shall be connected to each other with considerations taken to protection against water and rusting. The connectors used shall be of water-proof type.

15.3 Wiring

(1) Each wiring shall be laid to avoid mutual interference and the wiring work shall be performed individually for each system.

(2) The cable shall be treated at the terminals using pressed ones, except for small diameter cables.

15.4 Rainfall Gauging Equipment

(1) The rainfall gauge at Apalit shall be an integrate type and fixed horizontally on the concrete foundation at the front court of the office. It shall be cabled to the telemetry unit and rainfall recorder within the office.

(2) The rainfall gauges at other stations than Apalit shall be a separate type. Its rain intake section shall be installed on rooftop of the gauging station and the gauging section and recorder within the station.

15.5 Water Level Gauging Equipment

(1) Instructions shall be given regarding the installation of the water level gauges on gauging poles and their cable laying.

(2) The cables between the water level gauging pole and code converter and between Sulipan and Apalit shall be 0.65 mm polyethylene insulated vinyl sheathed steel-corrugate city telephone cables with polyethylene protection against corrosion. These shall be directly embedded.

15.6 Solar Cell Power Supply Equipment

The solar cell rack shall be directed to the south for high efficiency.

15.7 Antenna Tower

Instructions regarding anchor bolt installation and tower erection shall be provided. Also, the grounding work for the tower shall be provided.

15.8 Adjustment

The following adjustment and testing shall be provided after the equipment has been installed at the site:

(1) Equipment operational tests

(2) Antenna direction adjustment

(3) Signal level adjustment

Attached Table

Location of Equipment for Flood Forecasting & Warning System
in the Panpanga River Basin

Location	District	Remarks
Flood Forecasting Center	Quezon City	
Bureau of Public Works	Manila	
Apalit		
Sulipan		
Arayat		
Candaba		
La Paz		
San Isidro		
Ipo		
Sapang Buho		
Sibul Springs		
Papaya		
San Rafael		
Cabanatuan		

Fig. 1 System Network

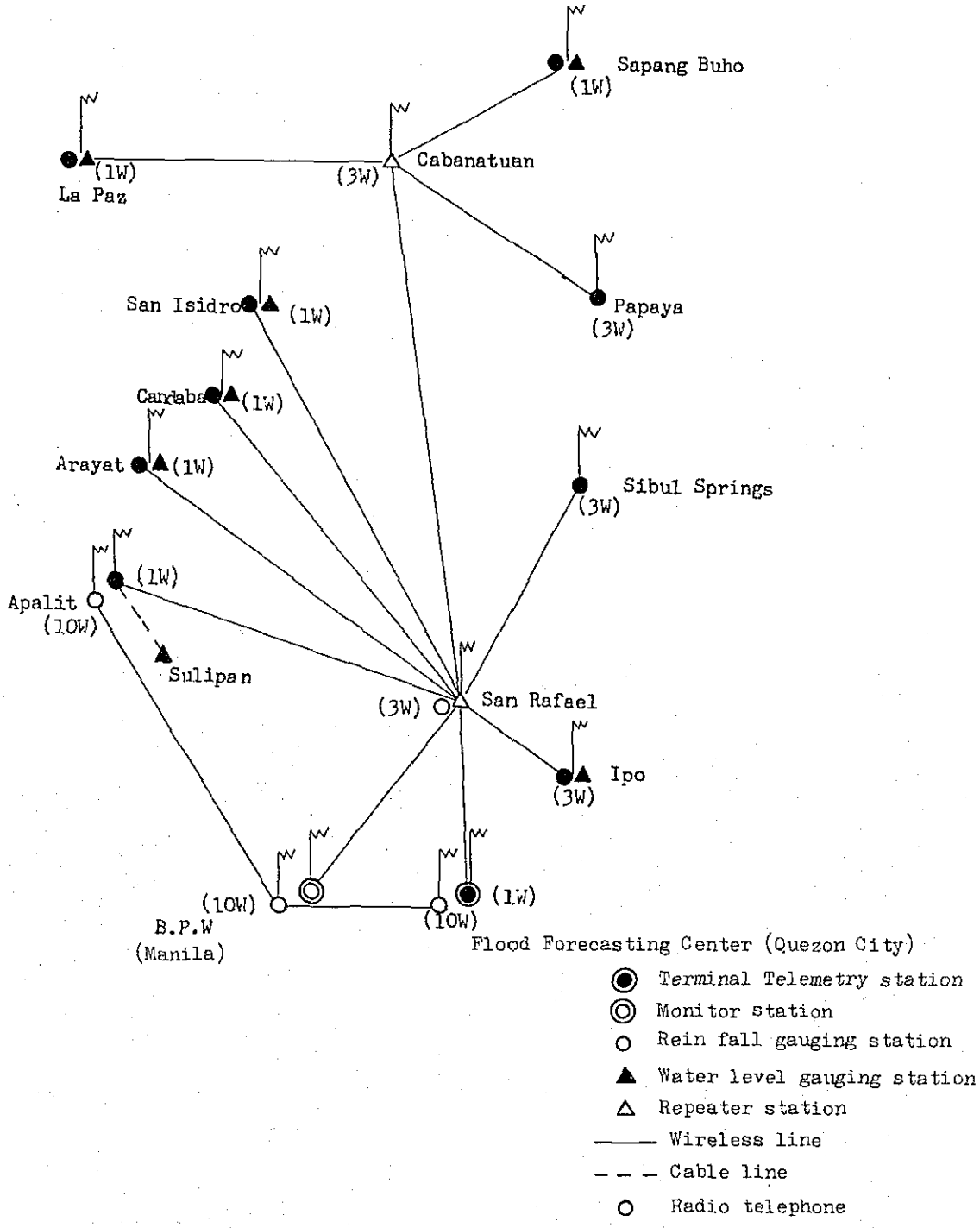
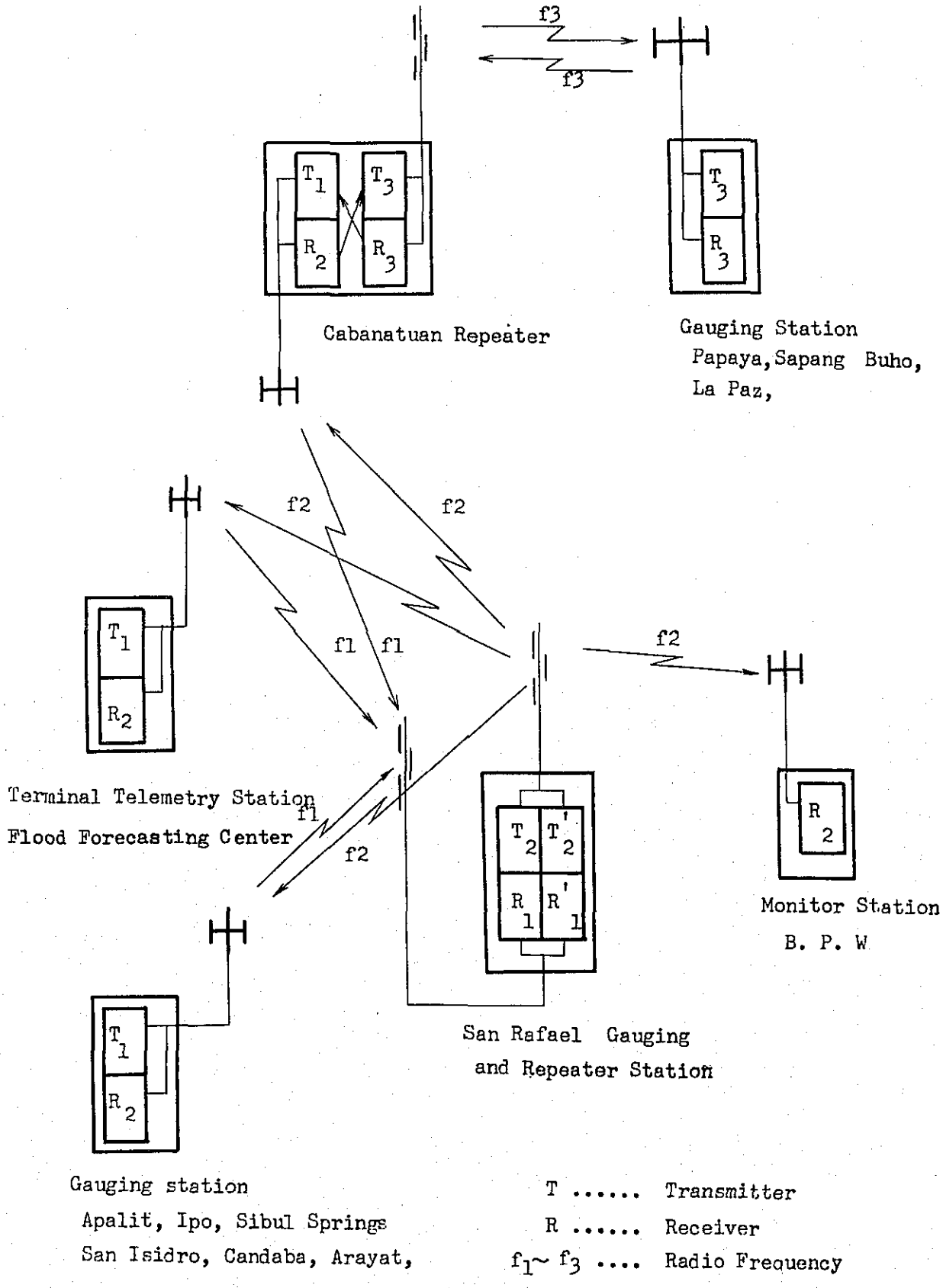
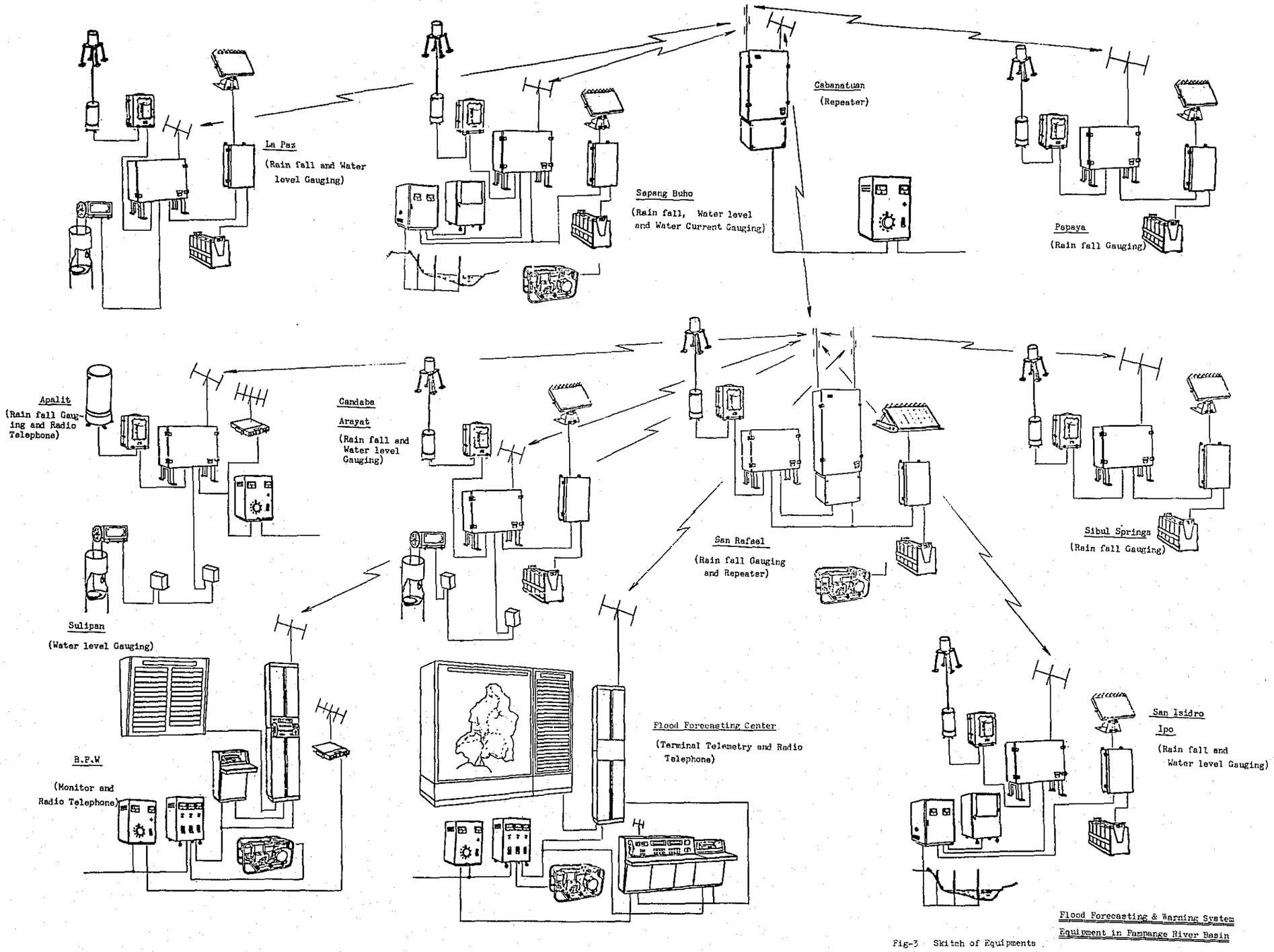


Fig. 2 Repeating System



T ..... Transmitter
R ..... Receiver
$f_1 \sim f_3$ .... Radio Frequency



Flood Forecasting & Warning System Equipment in Pampanga River Basin

Fig-3 Skitch of Equipments

Fig. 4-1 Terminal Telemetry and Radio Telephone Equipment for Flood Forecasting Center

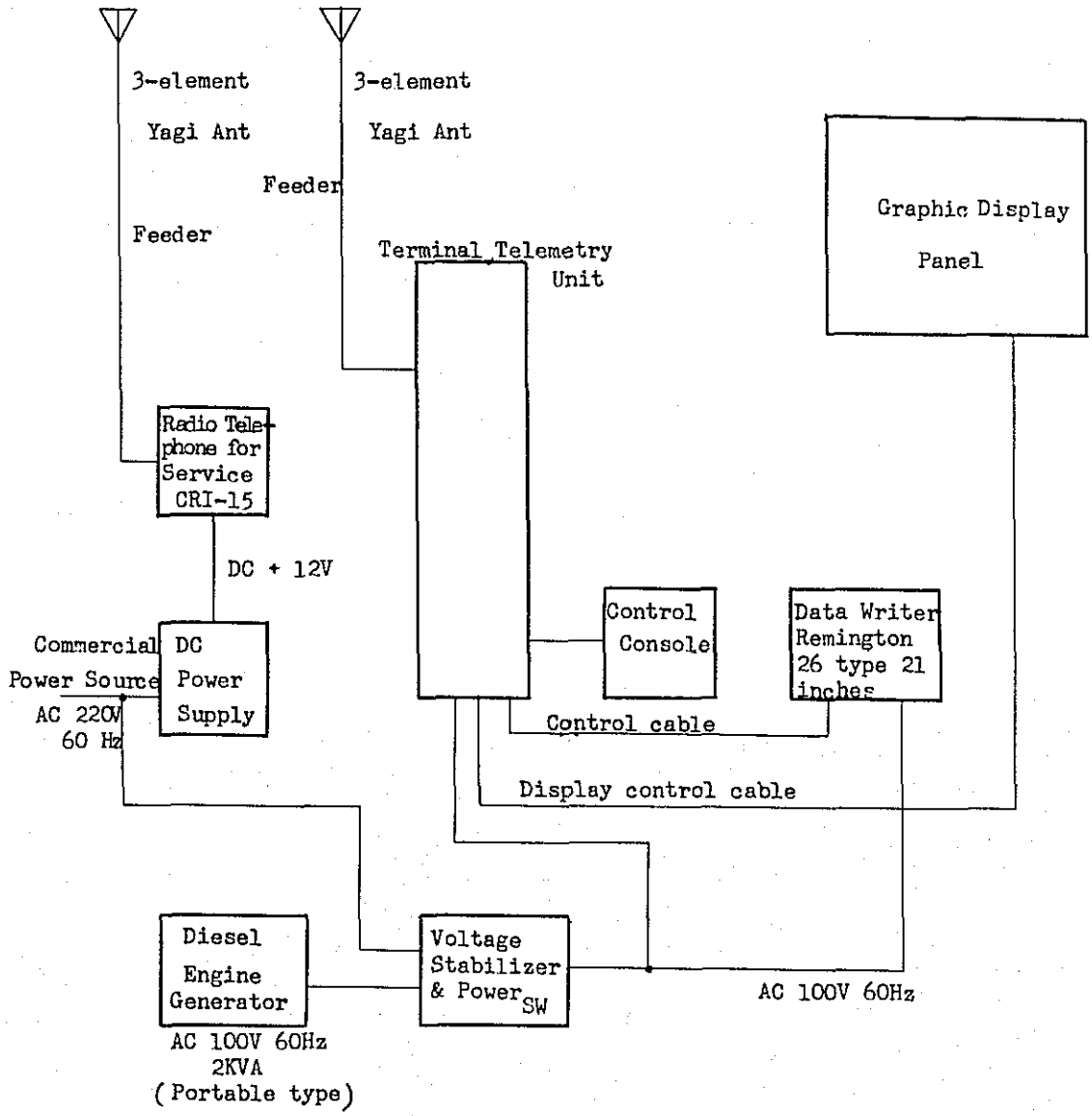


Fig. 4-2 Terminal Telemetry and Radio Telephone Equipment for Flood Forecasting Center

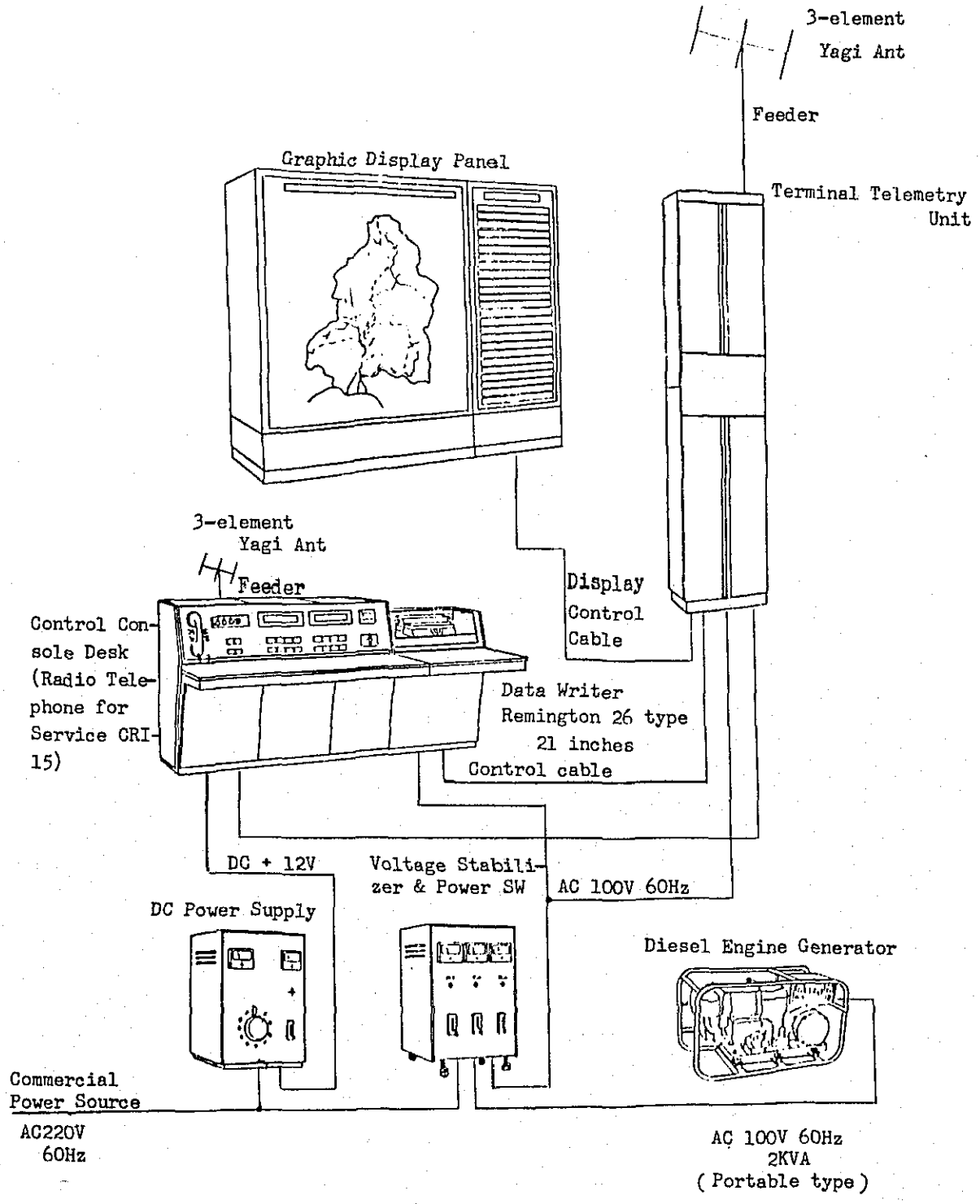


Fig. 5-1 Monitor and Radio Telephone Equipment for B.P.W.

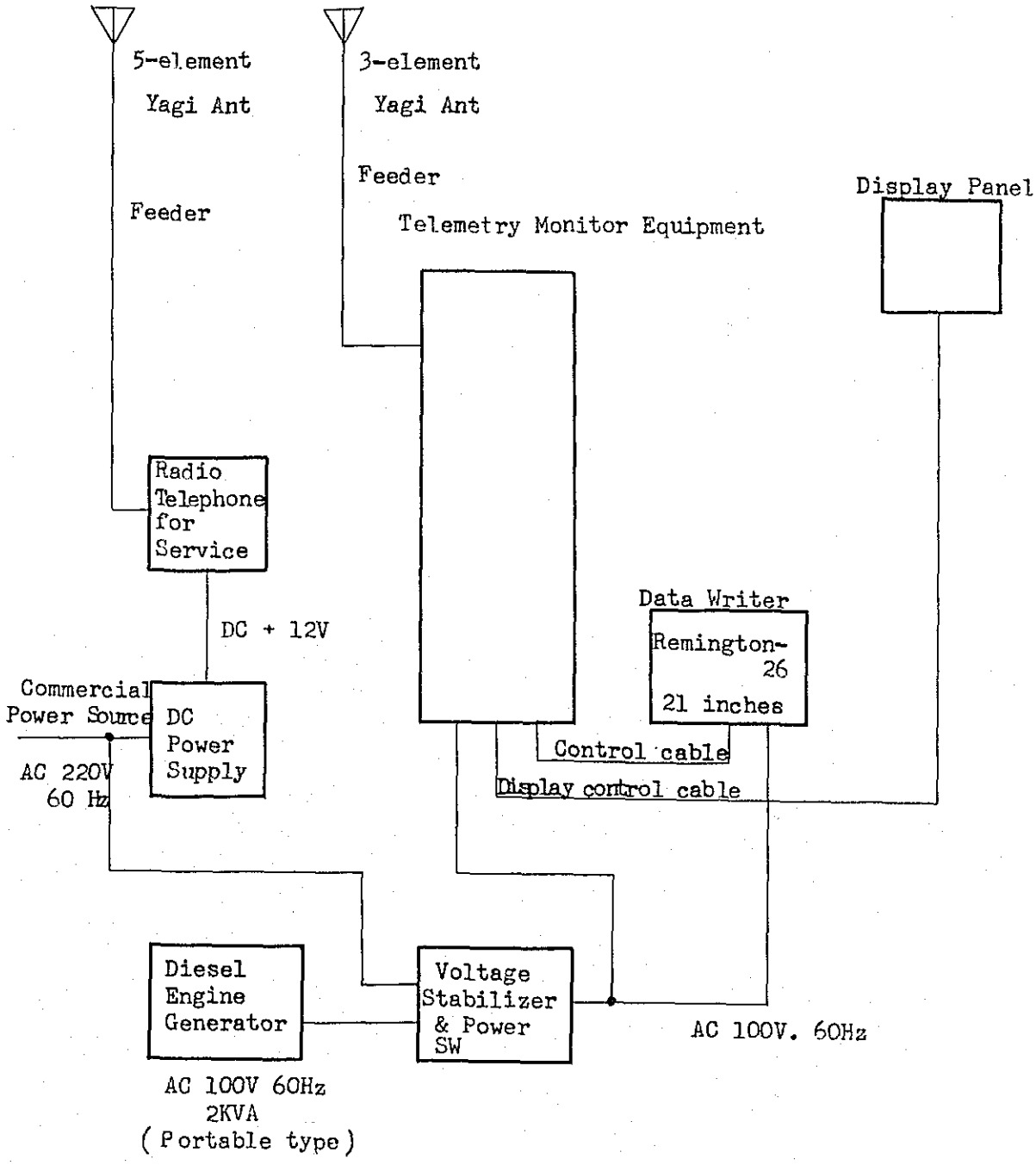


Fig. 5-2 Monitor and Radio Telephone Equipment for B.P.W.

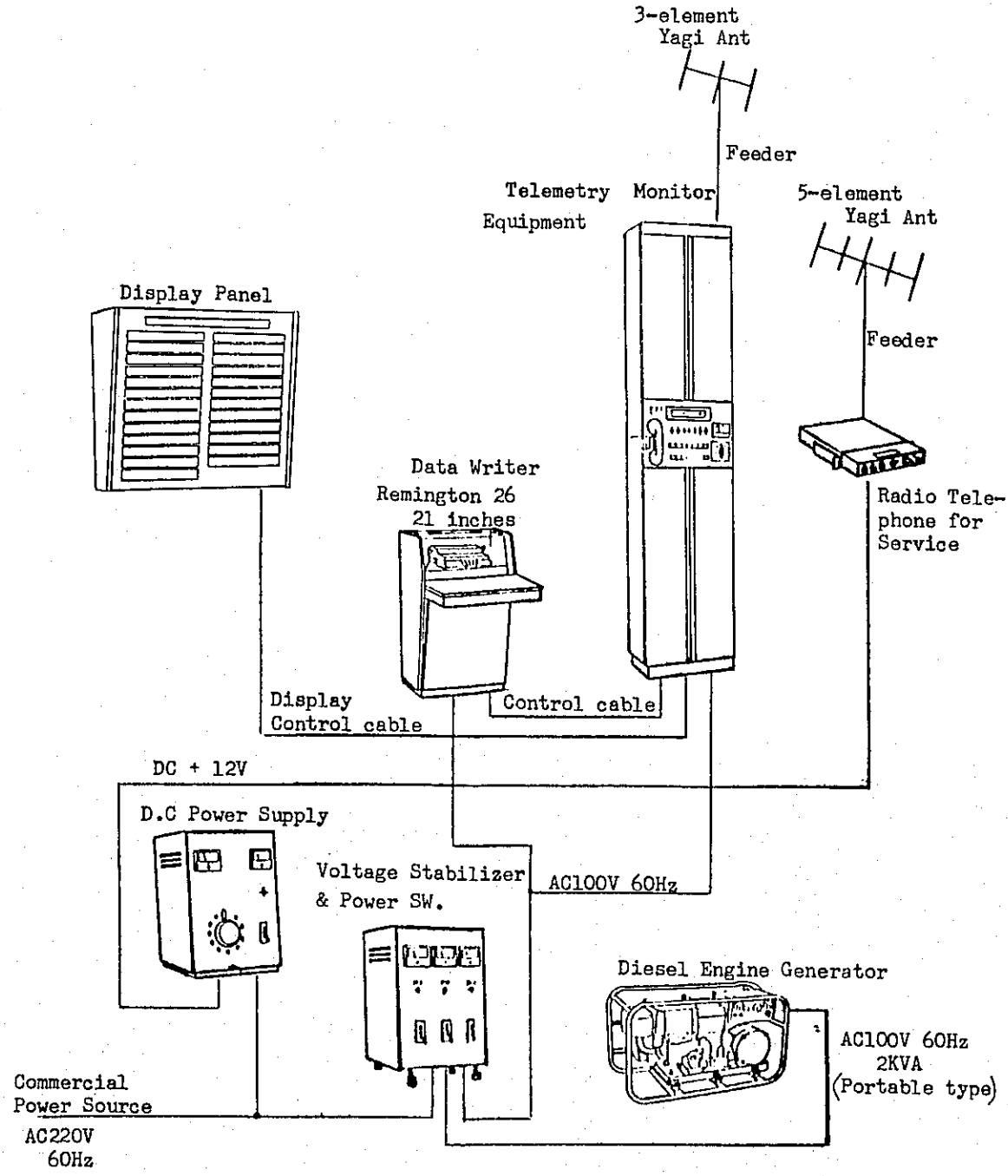


Fig. 6-1 Rainfall Gauging and Radio Telephone Equipment for Apalit and Water Level Gauging Equipment for Sulipan

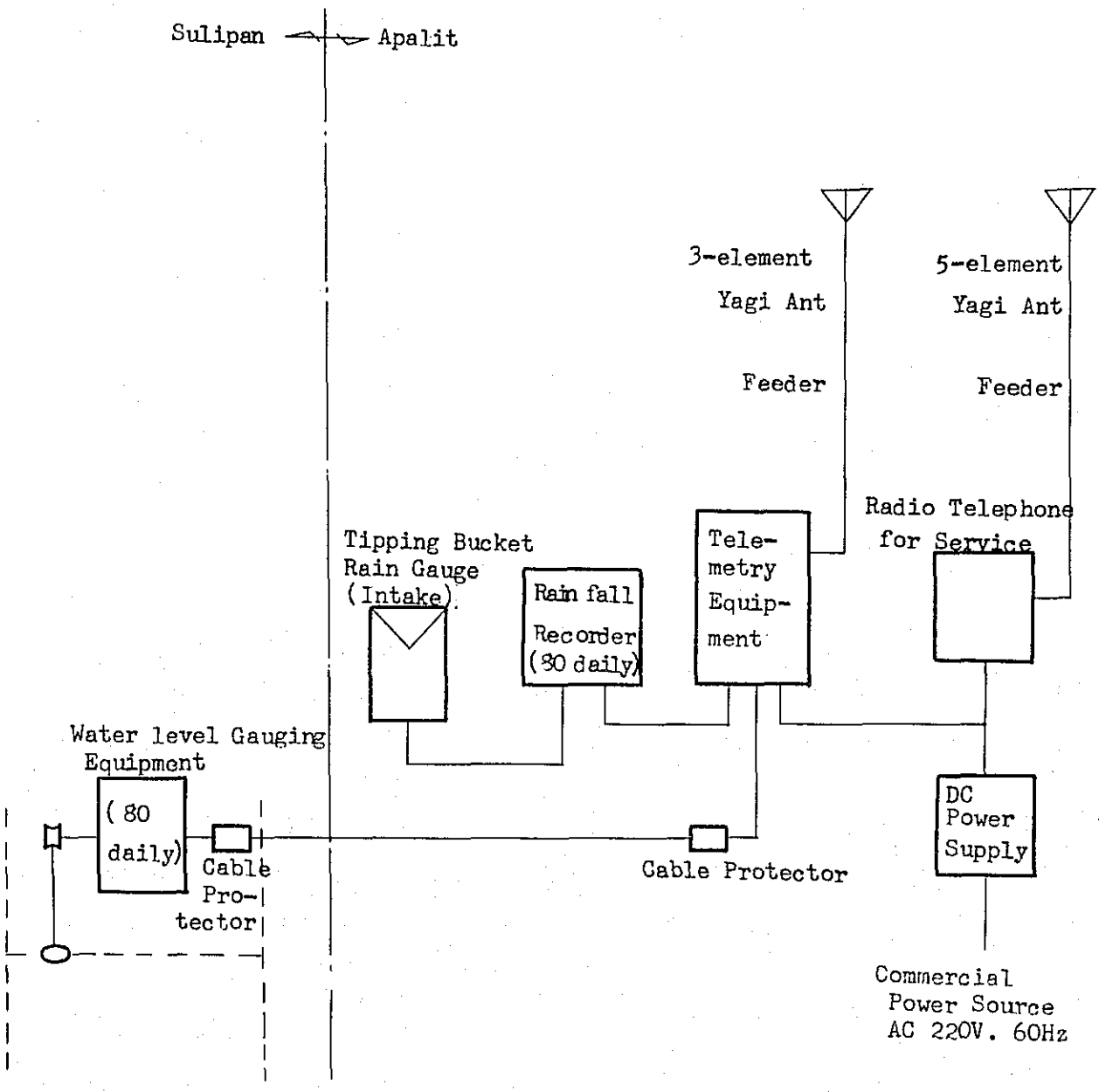


Fig. 6-2 Rainfall Gauging and Radio Telephone Equipment for Apalit and Water Level Gauging Equipment for Sulipan

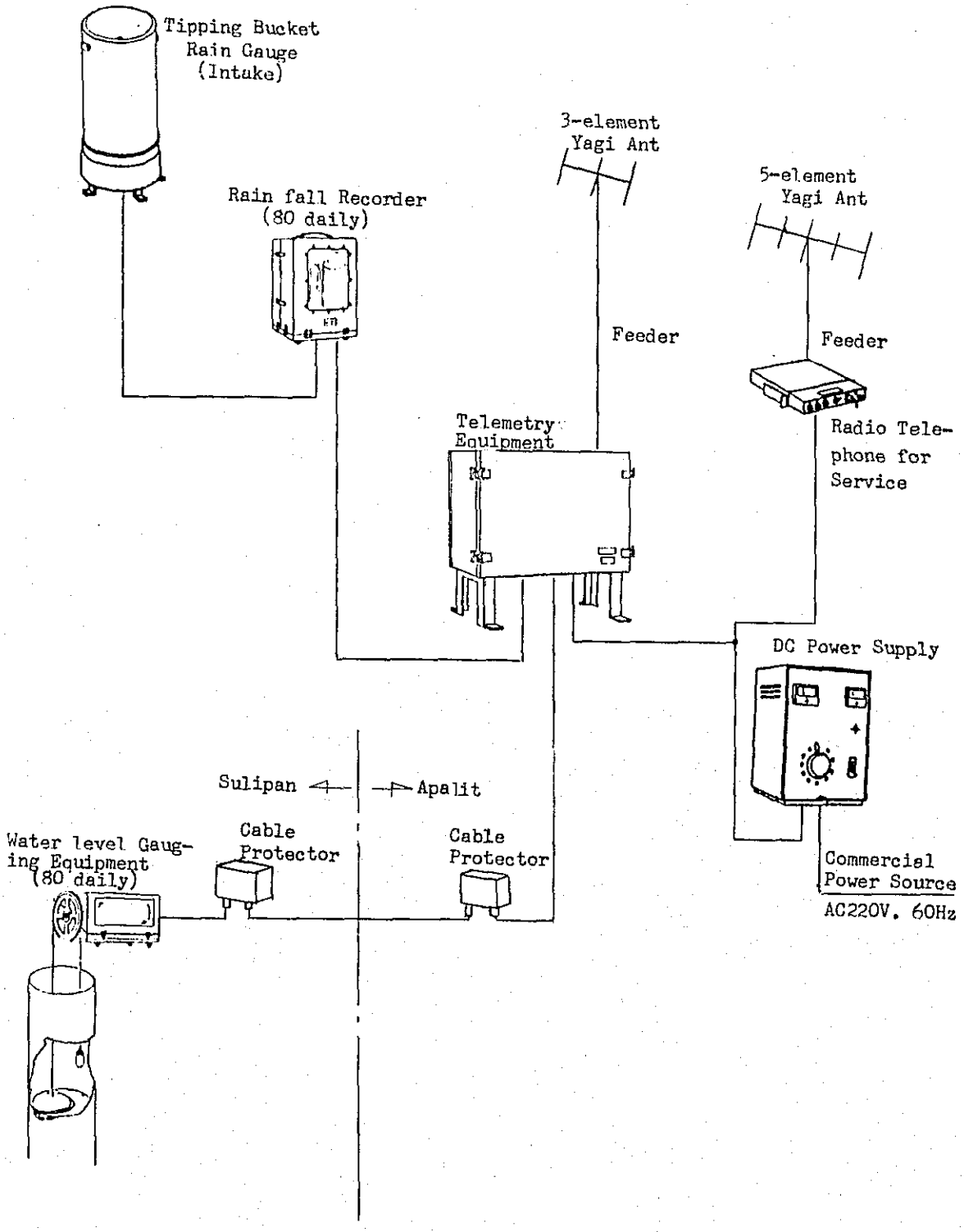


Fig. 7-1 Rainfall and Water Level Gauging Equipment for La Paz, Candaba and Arayat

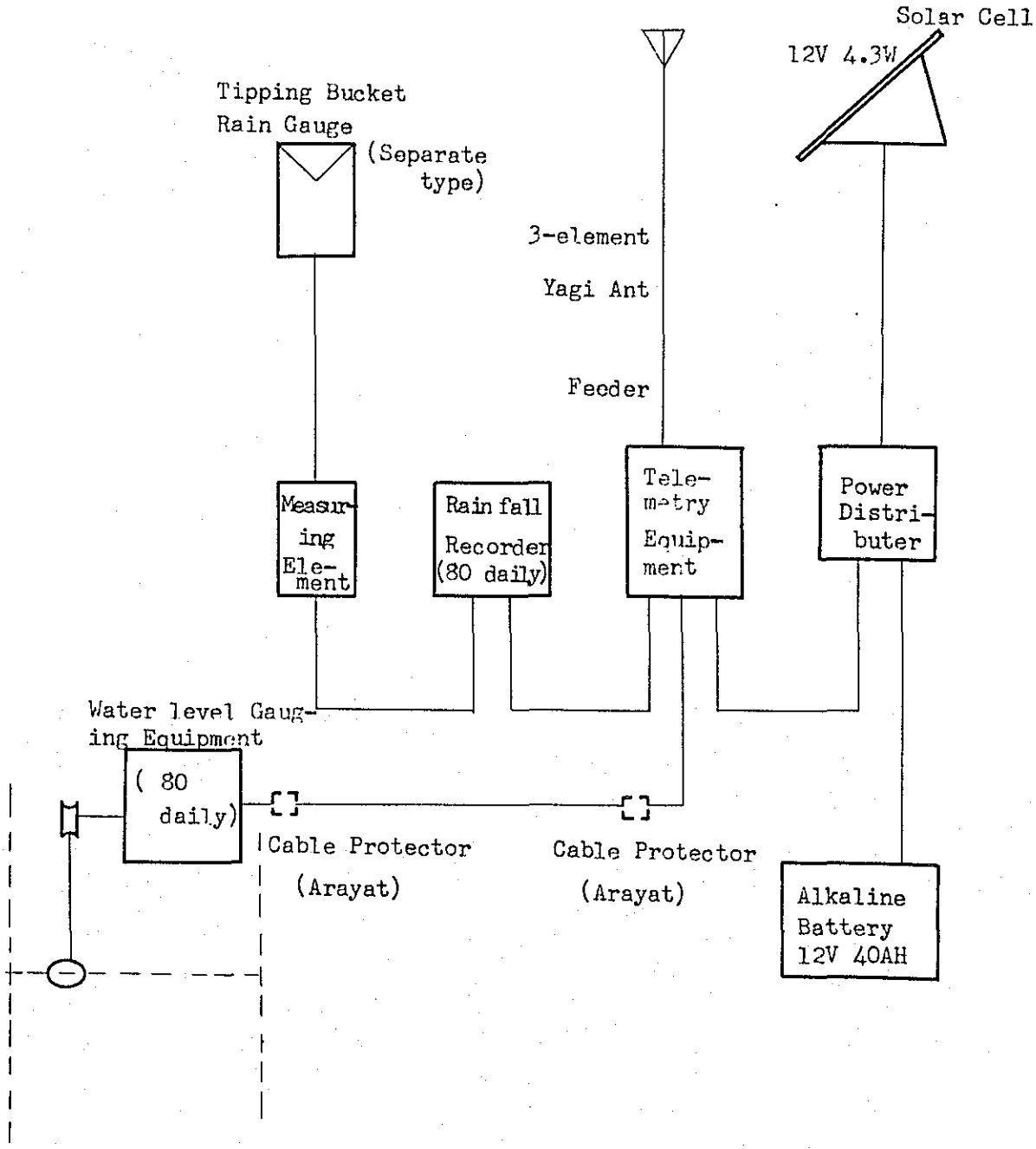


Fig. 7-2 Rainfall and Water Level Gauging Equipment
for La Paz, Candaba and Arayat

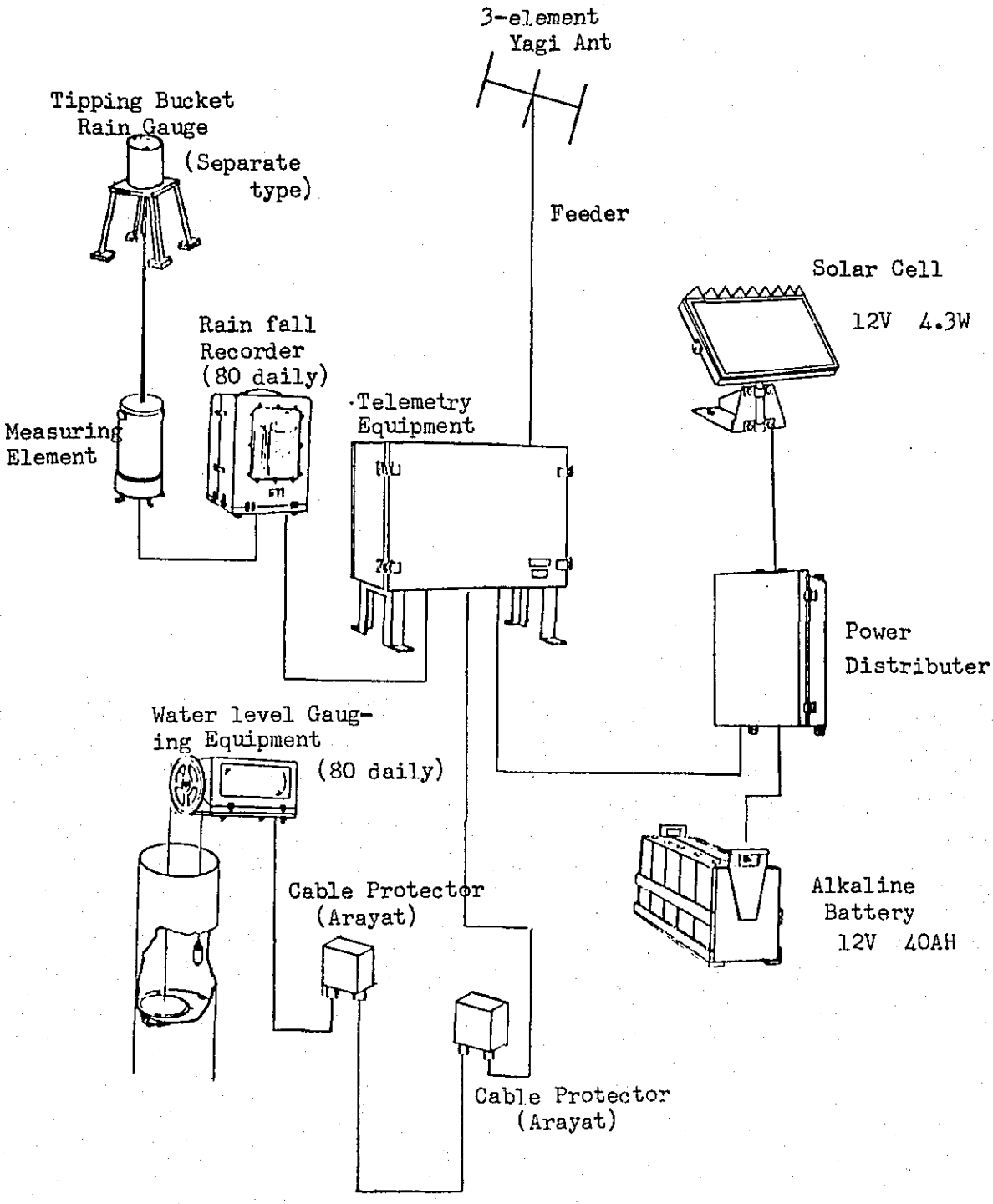


Fig. 8-1 Rainfall and Water Level Gauging Equipment for San Isidro and Ipo

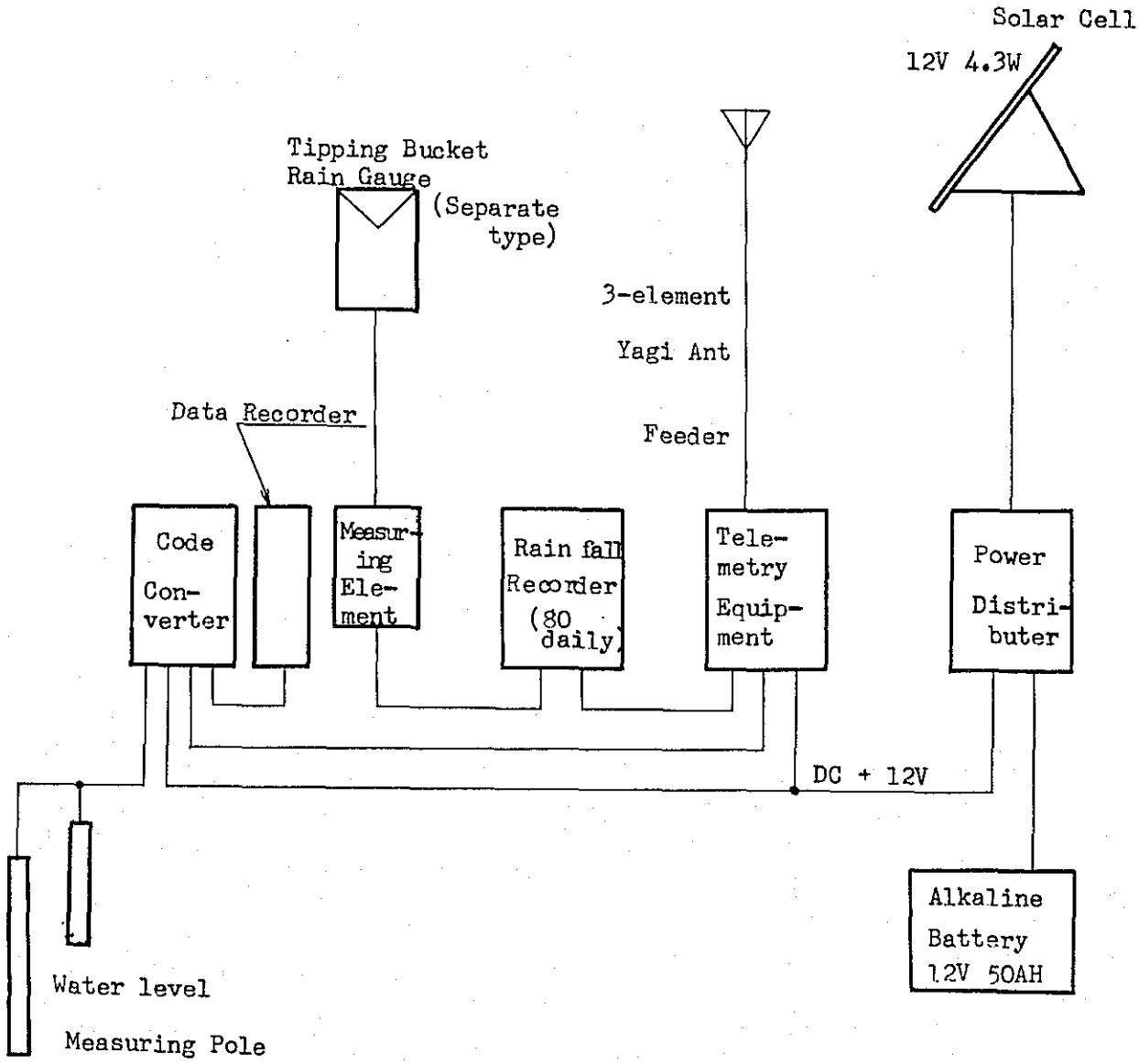


Fig. 8-2 Rainfall and Water Level Gauging Equipment for San Isidro and Ipo

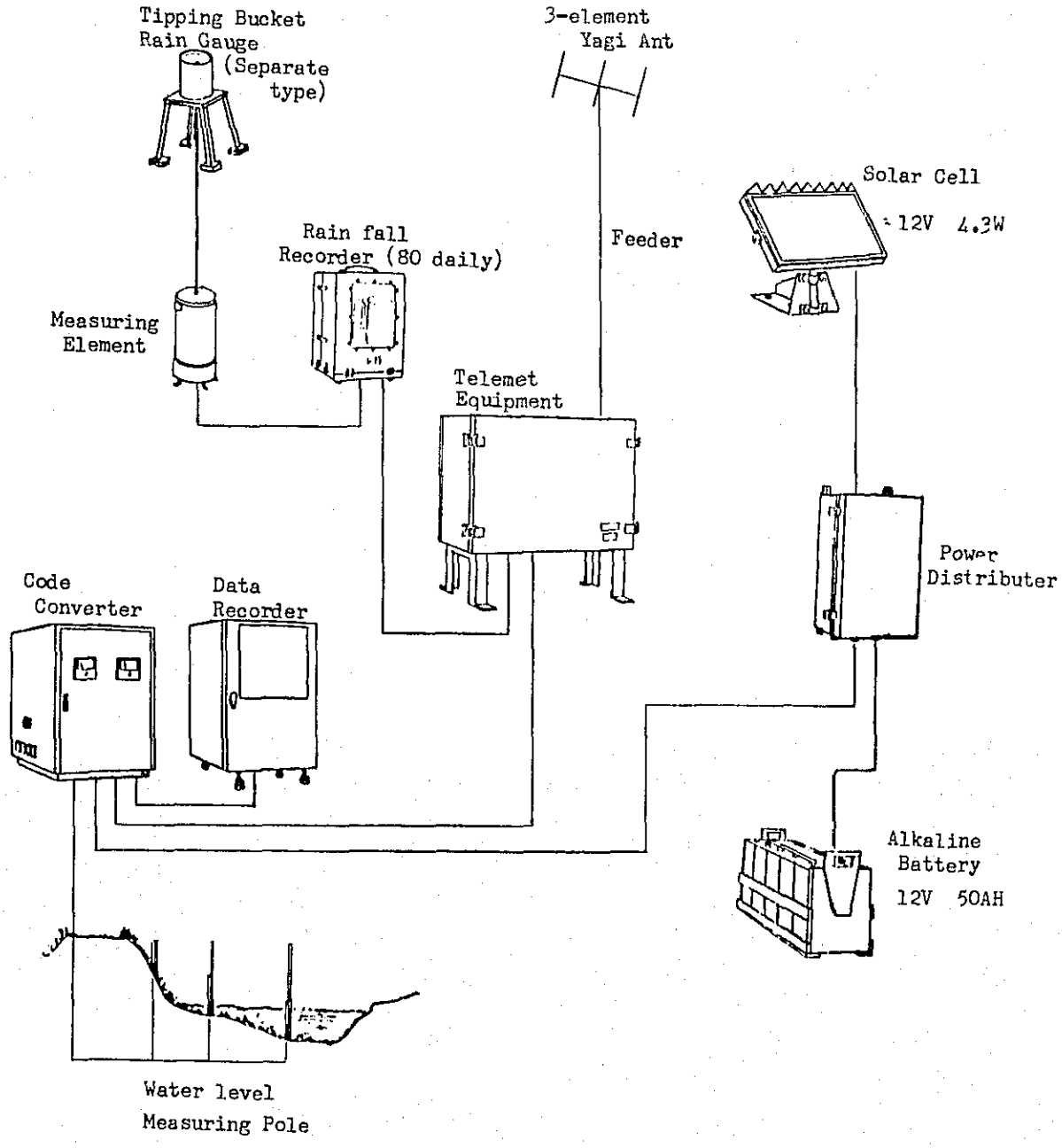


Fig. 9-1 Rainfall & Water Level Gauging and Discharge Gauging Equipment for Sapang Buho

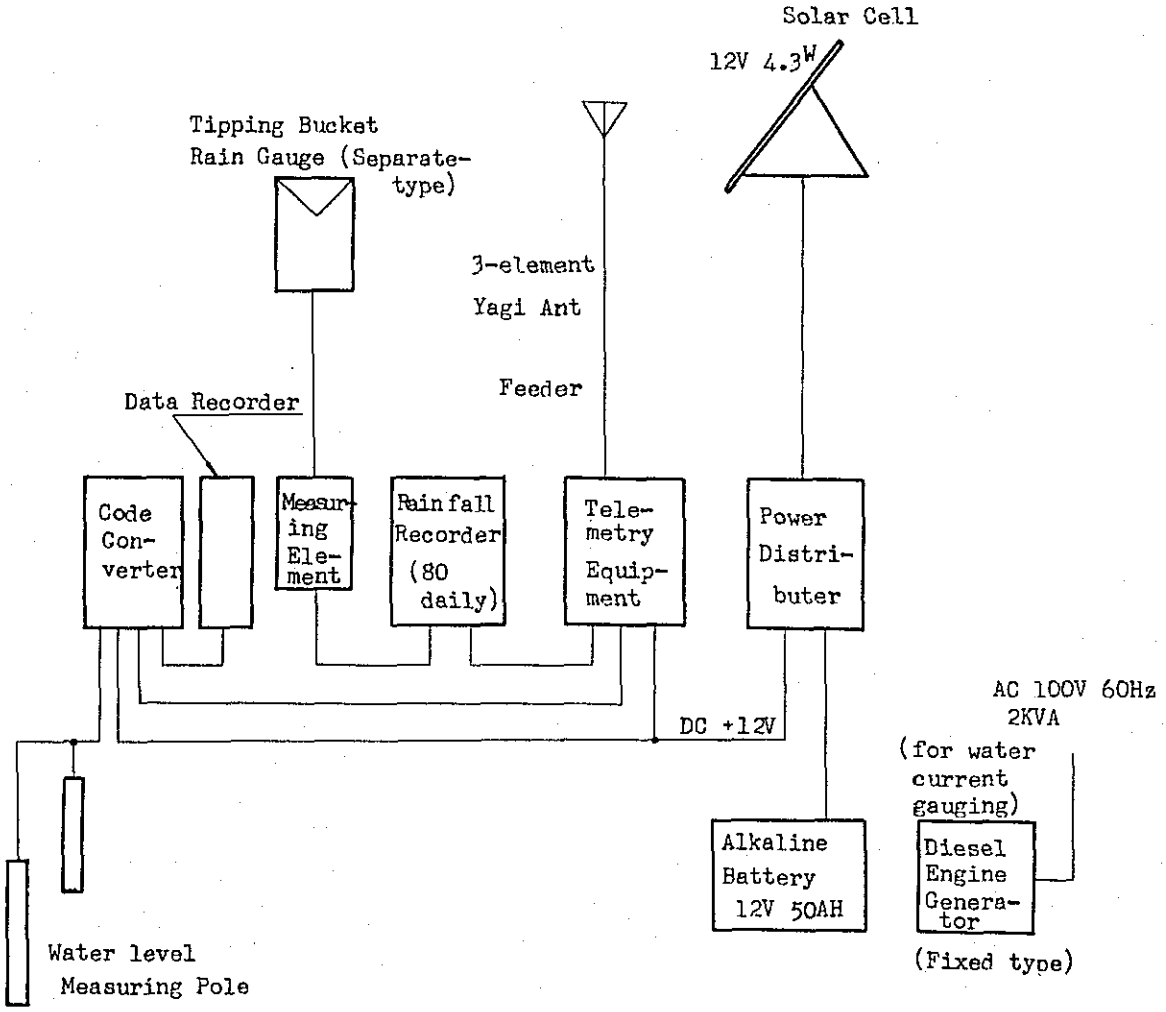


Fig. 9-2 Rainfall & Water Level Gauging and Discharge Gauging Equipment for Sapang Buho

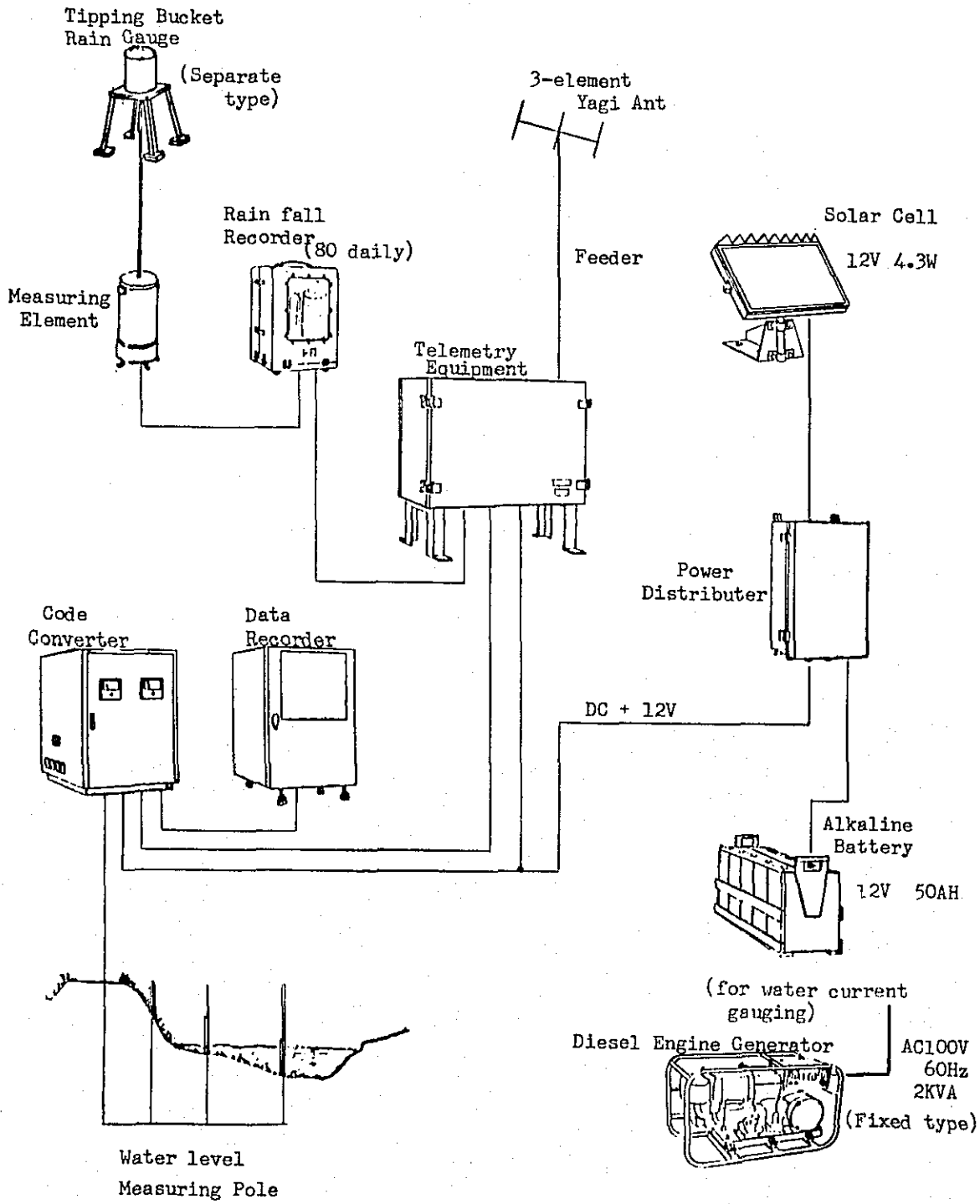


Fig. 10-1 Rainfall Gauging Equipment for Papaya and Sibul Springs

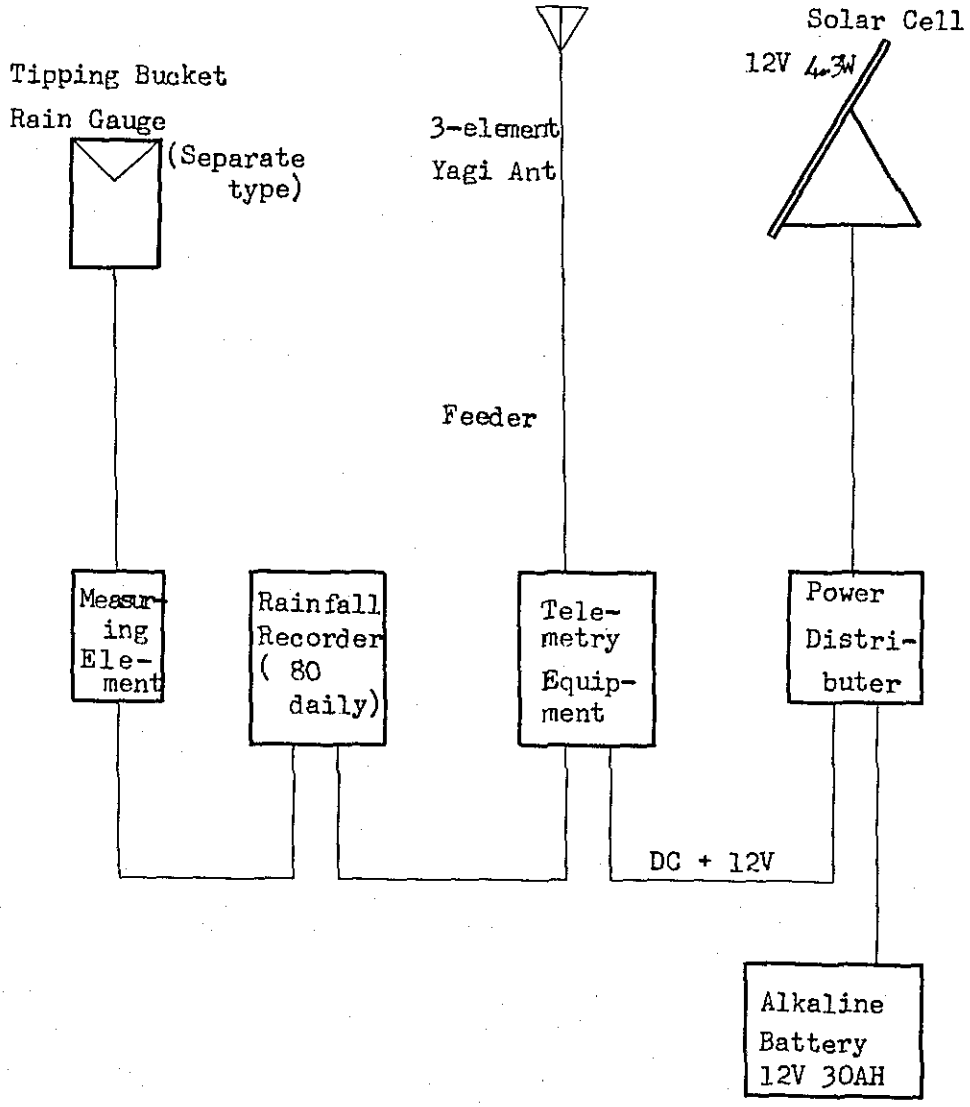


Fig. 10-2 Rainfall Gauging Equipment for Papaya and Sibul Springs

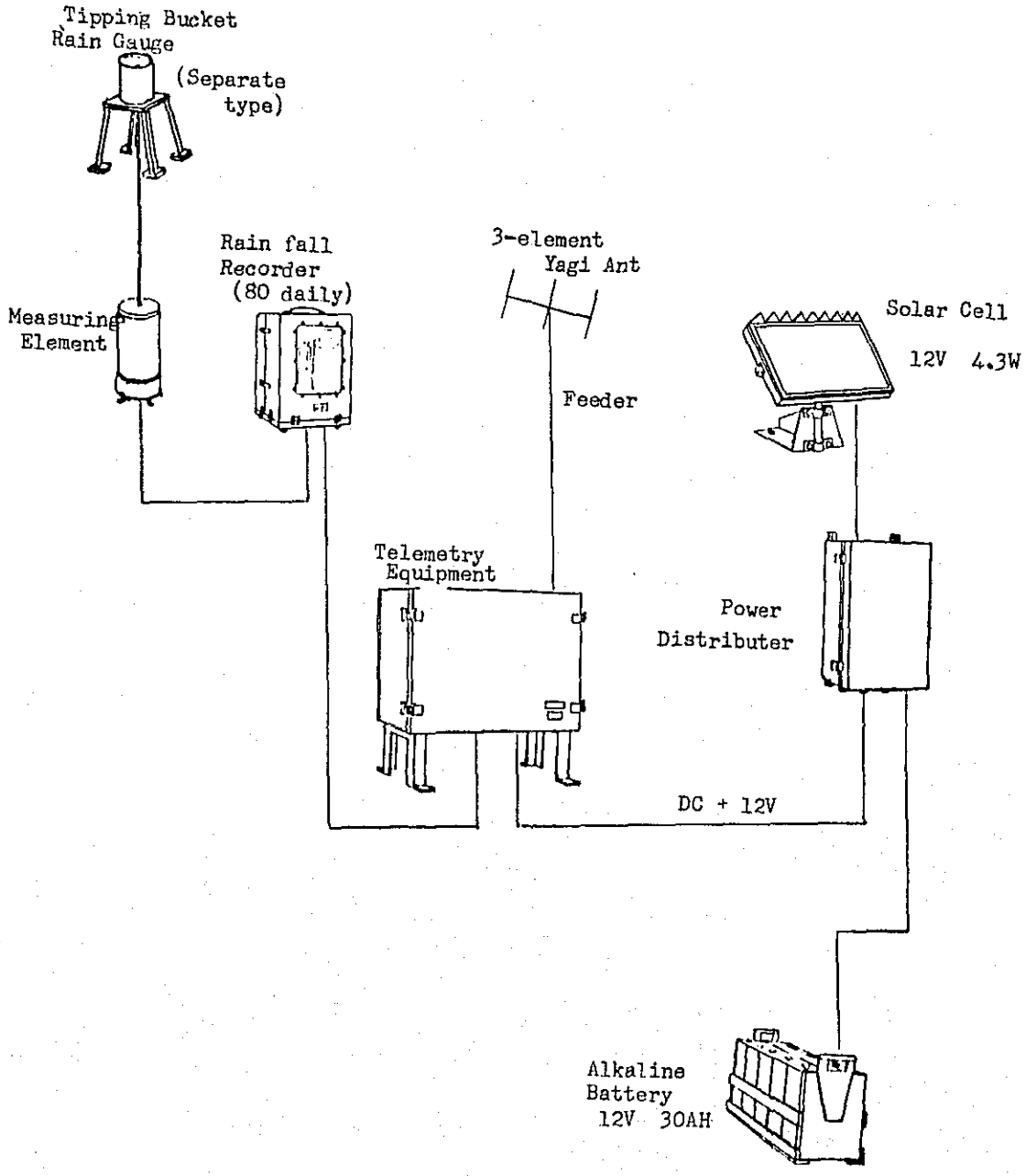


Fig. 11-1 Rainfall Gauging and Repeater Equipment for San Rafael

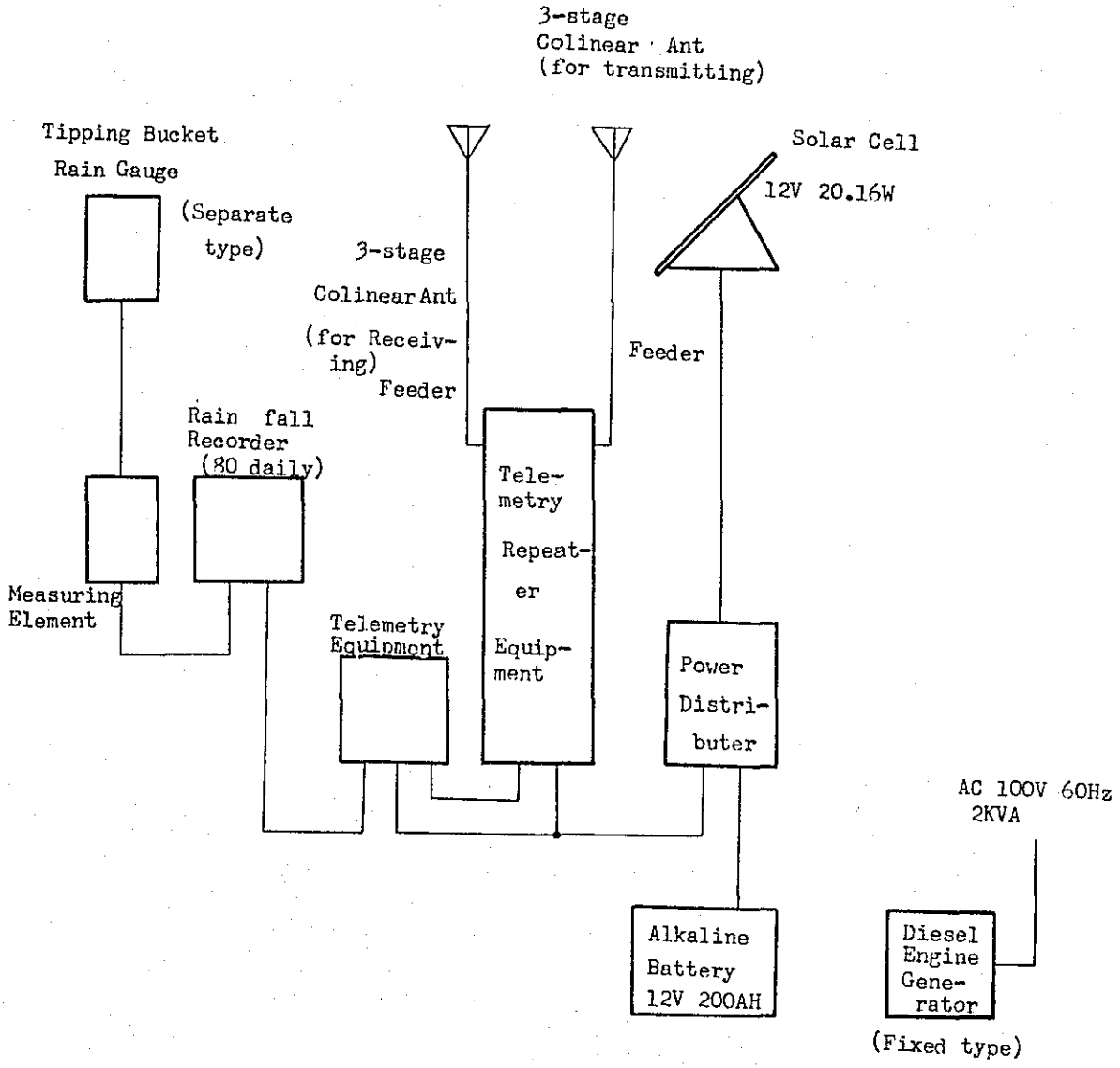


Fig. 11-2 Rainfall Gauging and Repeater Equipment for San Rafael

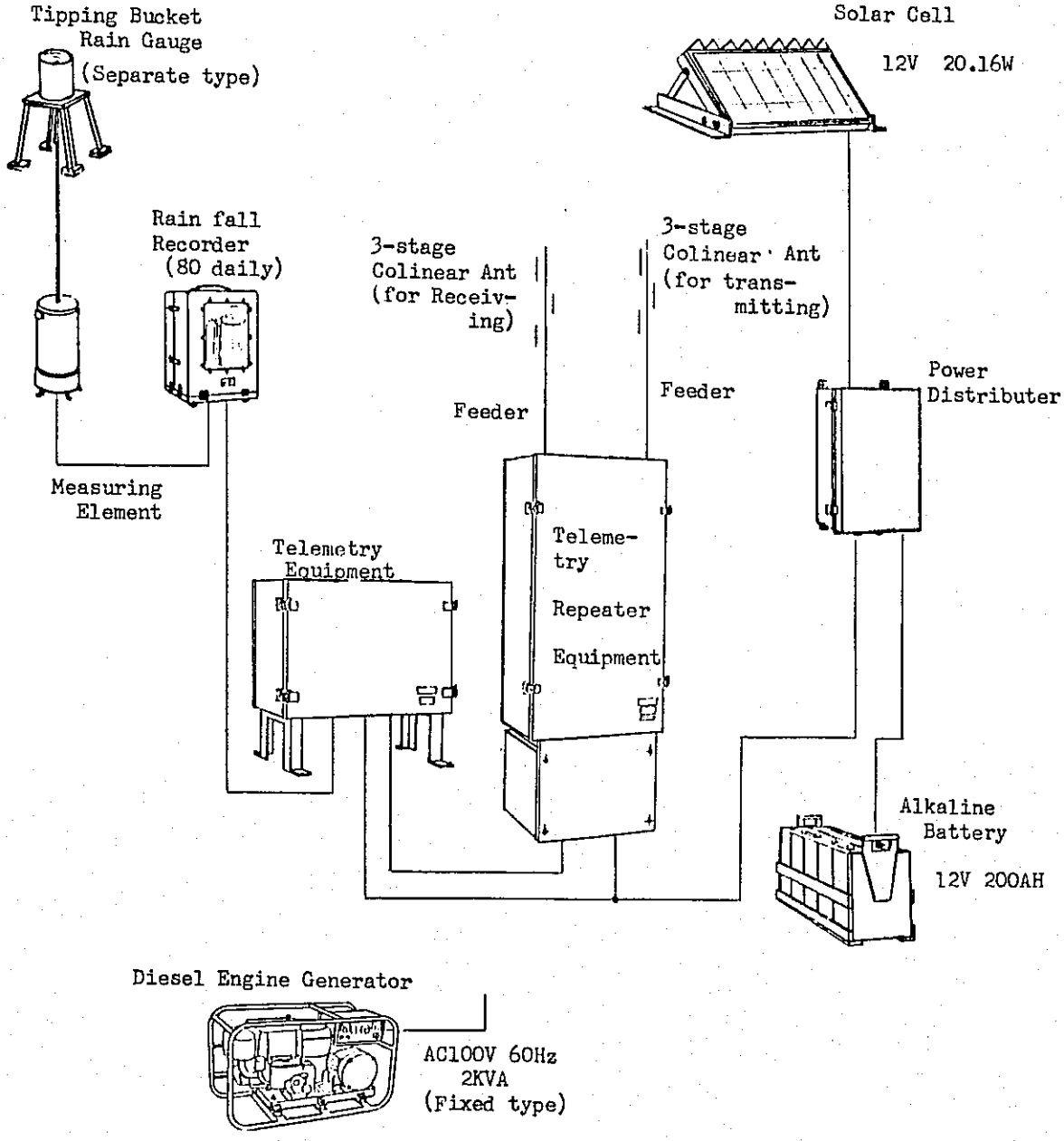


Fig. 12-1 Repeater Equipment for Cabanatuan

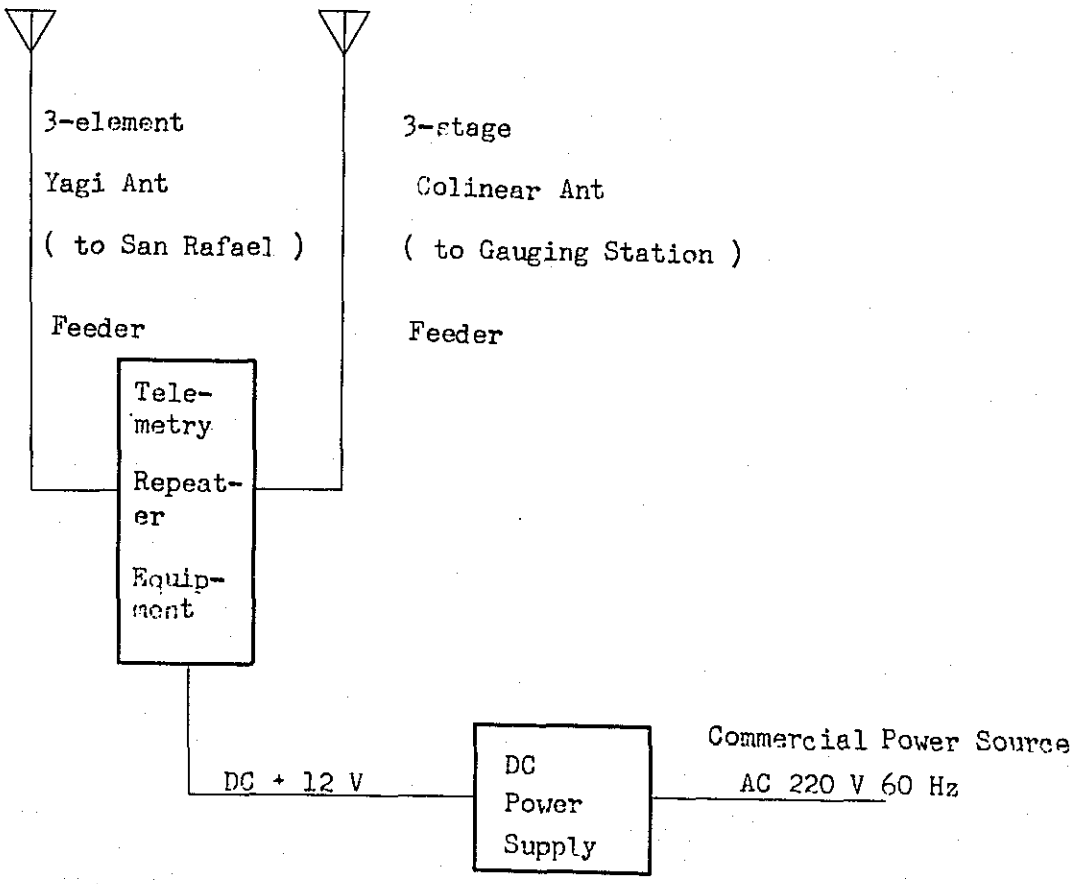


Fig. 12-2 Repeater Equipment for Cabanatuan

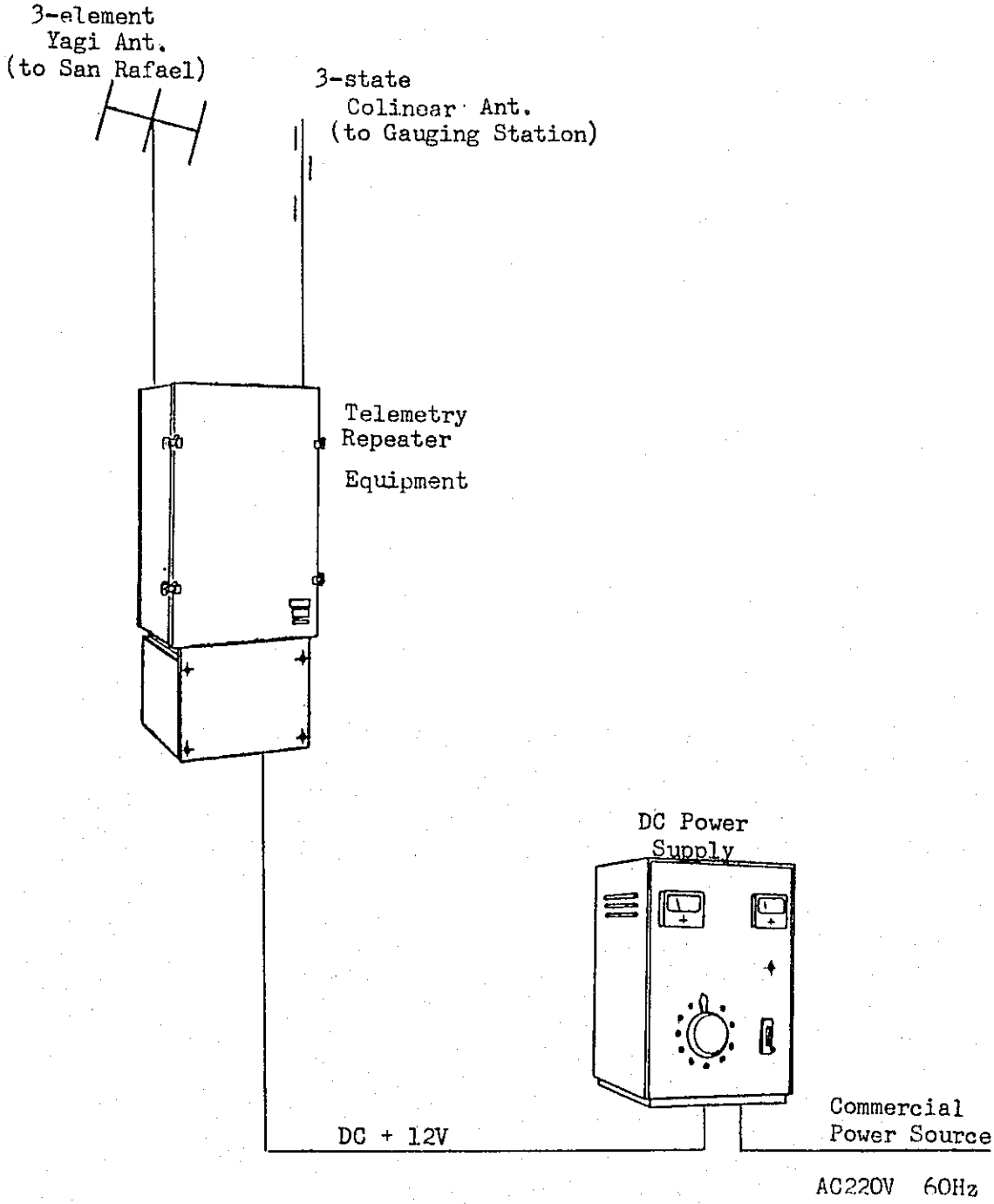


Fig. 13 Outside View of Equipments

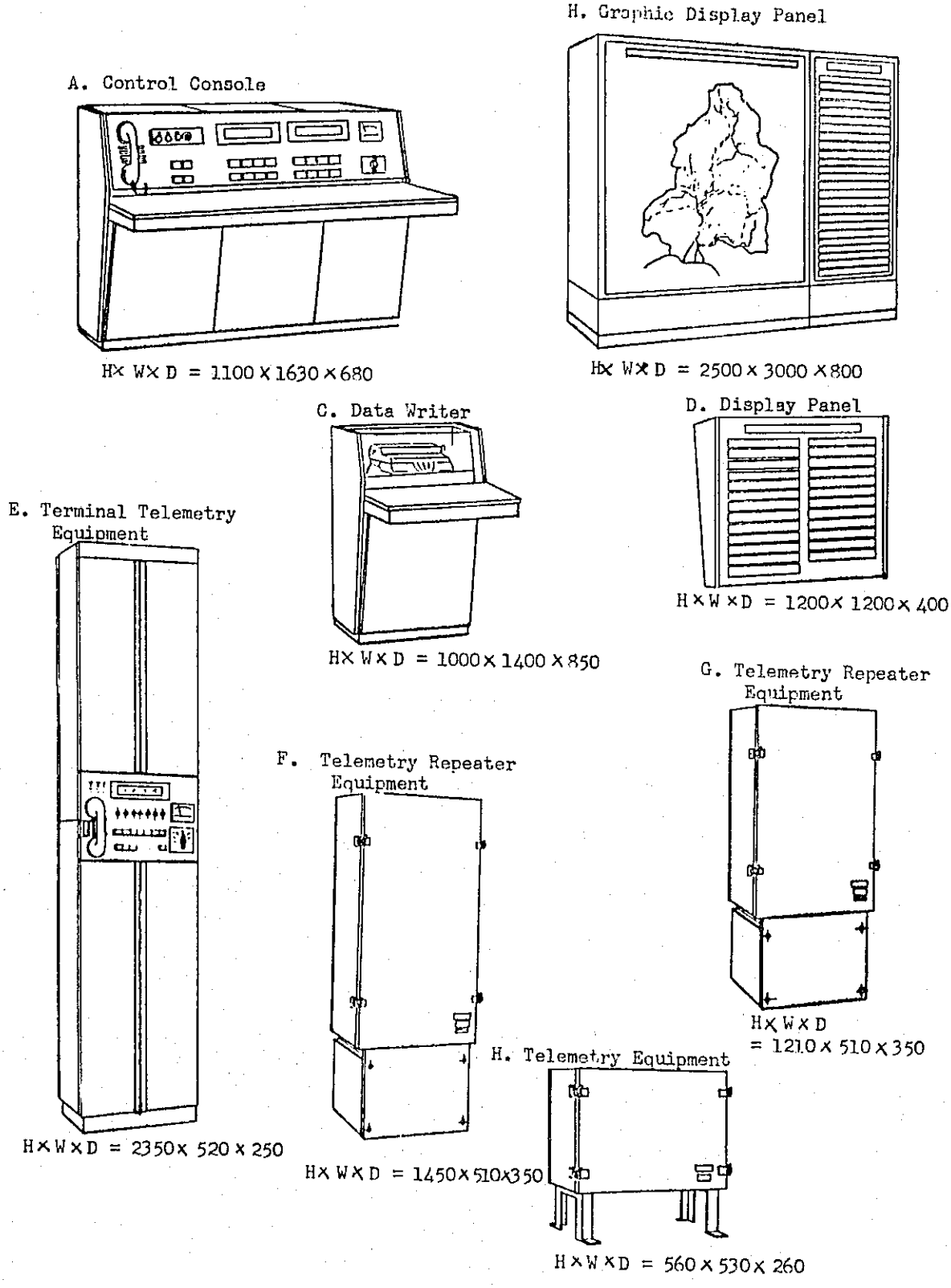
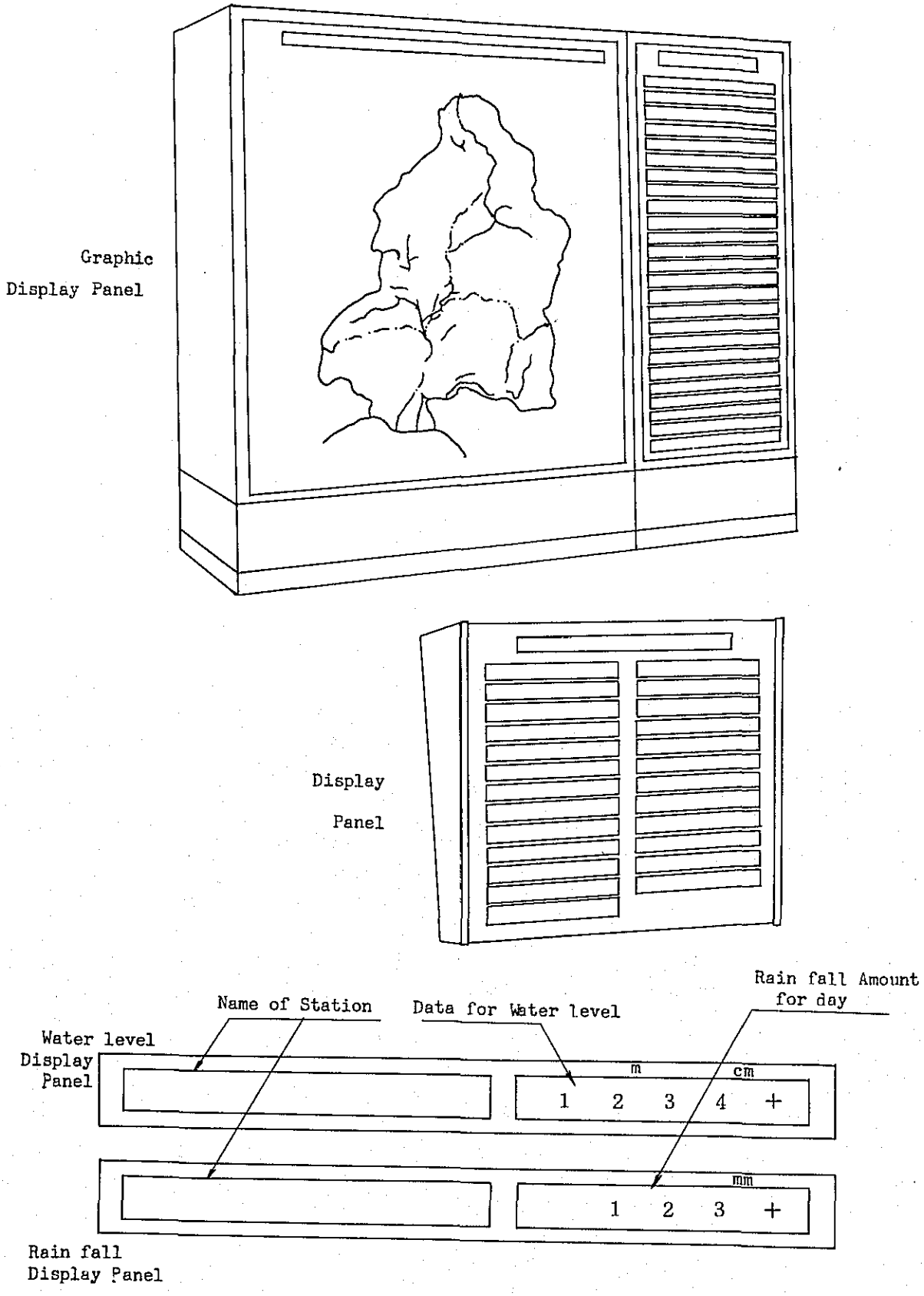


Fig. 14 Graphic Display Panel and Display Panel



ATTACHED MATERIAL 1

SPECIFICATIONS FOR STANDARD TELEMETRY AND WARNING SYSTEM

Scope:

This specification applies to the telemetry and discharge warning system, in connection with rainfalls, water levels, etc. for control of a dam to be installed by the Ministry of Construction. Special functions and special attachments that are not specified in this specification shall comply with special specifications separately provided for. However, these special specifications cannot govern or change the fundamental systems, etc. specified in the standard specification.

Telemetry System

The following three systems shall be used for calling a telemetry gauging station from the terminal telemetry station.

Classification of Calling Systems

a) Automatic all-station calling system

With automatic starting through use of a timer, all gauging stations are called consecutively in the order predetermined.

b) Manual all-station calling system

With manual starting, all gauging stations are called consecutively in the order predetermined.

c) Manual individual station calling system

With manual starting, only one station selected as desired is called.

As for the priority order of the three systems, the automatic all-station calling system shall precede the other tow, manual all-station calling and manual individual station calling. However, the priority control of the automatic all-station calling system can be released in an emergency.

Observation Time Interval Settings

In the case of the automatic all-station calling system, the time intervals consists of four stages, i.e., every 12 hours, every 3 hours, and every one hour (three stages), and one stage in which intervals consist of every 30 minutes, every 15 minutes, and every 10 minutes for free selection.

Frequency of Re-calls

Automatic re-calling shall be provided if no answer-back is from the called gauging station or the response involves error codes when an gauging station is called. Such re-calling shall be two times maximum; if no response comes back through warning of twice re-calling, or the response still involves error codes, audible and visual fault signals shall be emitted before proceeding with next operation.

Recording System

Recording shall be performed by an electric typewriter in the page-to-page tabulation system.

Data shall be recorded in such a manner that the time (hours and minutes) of observation shall be printed starting at the extreme left of the chart and observed data printed in the column specified in advance corresponding to each gauging station. (A typical example of records is shown in a separate sheet.)

The recording system to be taken at a monitor station shall not be limited.

Discharge Warning System

Only the manual individual station calling system shall be applied to the case where the terminal telemetry station calls a discharge warning station.

Calling System (Manual Individual Station Calling)

With manual starting, only one warning station selected as desired shall be called.

Operations of Warning Station

The following three operations shall be run under control of the terminal telemetry station.

(Warning)

Warning by siren predetermined shall be provided. If the siren function fails, a pseudo-siren sound shall be automatically generated to alert the terminal telemetry station that the siren function is defective.

(Checking)

The function of checking, without actuating the siren, whether or not the siren can be actuated.

(Addressing or Broadcasting)

The function of starting the loudspeaker system, broadcasting the voice from the

terminal telemetry station through it, and stopping the system after broadcasting.

Confimation of Warning Station Functions

The functions of a warning station shall be confirmed at the terminal telemetry station in the following manners:

(Warning)

If "warning" (siren sounding) is given under control of the terminal telemetry station, the warning station shall collect the siren sound and transfer it back to the control station, which in turn shall listen to the sound and make sure that warning is being made. The siren sound sendback time shall be about 10 seconds.

(Checking)

If "checking" is made under control of the terminal telemetry station, the warning station shall check and see whether or not a specified voltage is also applied to the final power switching terminal of the siren device and send the result back to the terminal telemetry station, which in turn shall confirm that condition.

Classification of Siren Sounding Systems

Siren shall be actuated in one system only, as a rule. In case this provision cannot be applied for an unavoidable reason from an operational point of view, three kinds of system at a maximum may be allowed. This shall apply to the case where pseudo-siren sound is generated through a loudspeaker system.

Display of Special Information

In case such special displays as the display of power supply and specified water level, in addition to normal records, special information of a single kind shall be transmitted during observation. Receiving such information, the terminal telemetry station shall display it in a predetermined system.

Control of Functions of Repeater Station

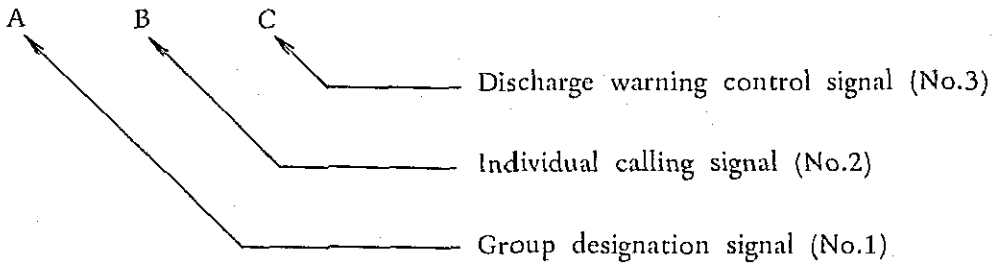
Where radio repeater equipment is involved in the transmission line system, starting and stopping of repeating operation shall be under control of the terminal telemetry station and warning station or gauging station. Such functions as may be necessary for that purpose shall be provided at the warning station and gauging station.

Signalling System

Transmission of Calling Signals

The gauging station or warning station call signals shall be transmitted in series using lead selector standard frequencies. Such frequencies shall be classified as follows

according to the purpose of application:



A- and B-frequencies in series shall be used for calling gauging station.

A-, B- and C-frequencies in series shall be used for calling warning station.

Group Designation Signals

Group designation signals shall consist of 15 groups, A1 to A15, as shown in the table below. The signals for telemetry system shall, as a rule, be higher than A1 and those for warning system lower than A15. Group signals may sometimes be used commonly where telemetry and discharge warning are set in one system. Allocation of group signals shall be decided by the Ministry of Construction as it associates with radio frequencies.

(Group Designation Signal Frequencies)

A1	487.5Hz	A6	562.5Hz	A11	637.5Hz
A2	502.5	A7	577.5	A12	652.5
A3	517.5	A8	592.5	A13	667.5
A4	532.5	A9	607.5	A14	682.5
A5	547.5	A10	622.5	A15	697.5

Individual Calling Signals

Gauging station and warning station individual calling signals shall consist of five frequencies, B1 to B5 as shown in the table below, and such frequencies shall be allocated to individual stations.

As B6 and B7 are used as control signals of the repeater station, they shall not be allocated as individual calling signal frequencies.

(Individual Calling Signal Frequencies)

B1	412.5Hz	B6	382.5Hz	Start of Repeater Working Stop.
B2	427.5			
B3	442.5	B7	397.5	
B4	457.5			
B5	472.5	B8	367.5	

Warning Control Signals

The warning station control signals shall consist of 10 items, C1 to C10 as shown in the table below and shall be allocated to individual operation items at the warning station.

(Warning Station Control Signal Frequencies)

C1	712.5Hz	Siren actuation (Type 1)	C7	802.5Hz	
C2	727.5	Siren actuation (Type 2)	C8	817.5	
C3	742.5	Siren actuation (Type 3)	C9	832.5	
C4	757.5	Siren checking	C10	847.5	
C5	772.5	Warning broadcast starting			
C6	787.5	Warning broadcast stopping			

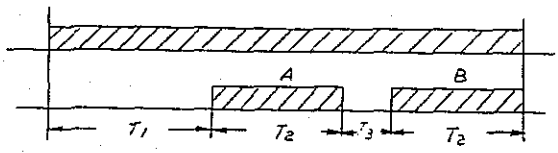
Transmission Time of Calling (Control) Signals

The ON-AIR time of calling signals shall be as follows:

(Configuration of gauging station and repeater station calling control signals)

Transmitting output

Calling signal

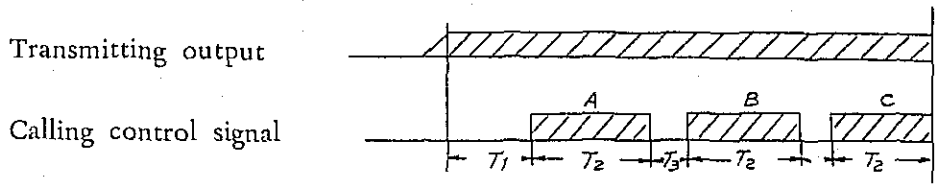


T1: transmission time of non-modulated radio frequency
600mS or more

T2: signal transmission time 600 ± 100mS

T3: signal spacing 50 ± 25mS

(Configuration of warning station calling control signals)



T1: transmission time of non-modulated radio frequency
600mS or more

T2: signal transmission time 600 ± 100mS

T3: signal spacing 50 ± 25mS

Transmission of Repeater Station Control Signals

If a radio repeater station exists in the transmission line system, a repeater station operation start signal shall be transmitted automatically prior to the starting of calling or control operation. After the operation, a repeater station operation stop signal shall be emitted.

Such repeater control signals shall use B6 and B7 of the individual display signal frequencies, and be sent with a group signal preceded.

Response System

Classification and Order of Information

The kind and order of information to be transmitted from an observation station shall be as follows. The station number is not needed for recording but shall not be omitted.

(1) Observation values

(2) Station number

(3) Special data or information

The observation values shall be given in decimals consisting of 4 digits (0000 ~ 9999) but may be in 3-digit decimals (000 ~ 999) if the 4 digit system is not required.
The station number shall be in 2-digit decimals (00 ~ 99) at a maximum.
Special data or information shall be transmitted where power supply display, water level warning, etc. are required, and shall be given in terms of a single kind of code. Such special data or information shall be omitted unless needed.

Coding of Data

Observed values and station numbers shall be coded by binary decimal display system, to which parity bits shall be added. Decimal digits corresponding to binary decimal codes are shown in the following table:

(Binary Decimal Code Correspondence Table)

Decimals	Binary decimals	Code
0	0	00001
1	1	00010
2	10	00100
3	11	00111
4	100	01000
5	101	01011
6	110	01101
7	111	01110
8	1000	10000
9	1001	10011

NOTE: A parity bit is added to the right end of each code, which turns the total of "1" into an odd number.

Transmission of Codes

Subcarriers (low frequency) FS system shall be used for transmission of codes, with "1" and "0" used corresponding to the long and short marks.

The subcarriers shall be carrier telephone channel frequencies at spacings of 170Hz, with a reference frequency of 2,635Hz. The following priority shall be given in case where other frequency allocation is considered to be necessary because of jamming or for any other reason.

(Subcarrier frequency order)

Priority order	Subcarrier
1	2,635Hz
2	2,465
3	2,295
4	2,125
5	1,955

The allowable frequency shift shall be ±35Hz for each channel, with an allowable deviation of ±6Hz.

The direction of shift shall be (+) for mark and (−) for space. The time length of mark and space shall be as follows:

Long mark (bit "1") 120mS ±20%
Short mark (bit "0") 40mS ±20%

Space between bits	40mS ±20%
Space between lines	40mS ±20%

Sending-back of codes shall be performed with as short a waiting time as possible after the call signal is in receipt.

(Attached Sheet)

Typical Example of Page Tabulation Record

Date	Time	Name of Gauging Station
—	—	—

ATTACHED MATERIAL 2

SPECIFICATIONS FOR CRI 15 (CRI 06) VHF RADIO TELEPHONE EQUIPMENT

1. General

1.1 This specification applies to the 150 MHz (60 MHz) band radio telephone equipment (for mobile and fixed) to be used by the Ministry of Construction.

1.2 The equipment shall conform to the Radio Law and such other governing rules and regulations.

1.3 Major specifications of the equipment are as follows:

Frequency range:	142 ~ 162.0375 MHz (54 ~ 68 MHz)
Channels accommodated:	4 channels (actual number of channels and frequencies shall be specified separately)
Modulation system:	Phase modulation
Type of service:	F3
Transmitting output:	10W
RF input impedance:	50Ω
Communication system:	Simplex
Receiving system:	Superheterodyne
Power supply:	12V nominal storage battery, with negative grounding

2. Ambient Conditions

2.1 Ambient temperature −10°C to +60°C

The system shall operate stably without adjustment and meeting the requirements given in this specification, in the power supply range of 11.6V ~ 15.6V (power cable input side terminal voltage) at the above-mentioned ambient temperature.

2.2 The equipment shall not be affected by anomality even in the ambient temperature range of −20°C to +60°C.

2.3 When exposed to an ambient temperature of +35°C and a relative humidity of 95%, for the duration of 4 hours, the equipment shall have no abnormaly.

2.4 The equipment shall have no anormaly when it is subjected to oscillations having an amplitude of 3mm and frequency of 0 ~ 500 cycles per minute and oscillations having

an amplitude of 1mm and frequency of 500 ~ 1800 cycles per minute that are applied laterally and longitudinally for 30 minutes, respectively.

2.5 The equipment shall not be affected when dropped three cycles from a height of 5cm to a hard wood floor.

3. Composition, Construction, Circuitry and Parts

3.1 Composition

The equipment shall be composed of the transmitter unit, receiver unit, control unit, and case.

3.2 Construction

3.2.1 This equipment shall be so designed as to be operated in a duplex system by slightly modifying the antenna, connections, etc. and adding a repeater unit and a remote control panel.

3.2.2 Normal checking and adjustment of the inner parts of the equipment shall be easily performed by merely removing the outer panels of the case.

3.2.3 The equipment shall be provided with a protective circuit against erratic connection of power supply polarities, with fuses plugged in both lines.

3.2.4 The coaxial jacks for antenna connection shall be of V-type.

3.2.5 The circuit block diagram and construction diagram of the equipment are given in the attached drawings (1) and (2), respectively.

3.2.6 Such major units as the transmitter and receiver shall be so designed as to be easily removed and connected.

3.2.7 All active elements used in the transmitter unit and receiver unit shall be semi-conductors.

3.2.8 The transmitter output shall be able to be changed to 5W by merely adjusting a part of circuit constants.

3.2.9 The operation of the power switch, squelch adjustment, volume control and frequency selection shall be performed on the front panel of the control unit. Jacks for handsets shall be provided. As standard, the handsets shall be speaker microphones. But handsets may also be used.

3.2.10 The control unit shall be so designed as to be used separately through use

of an adapter, and to be easily removed and reinstalled.

3.2.11 The case shall be provided no ventilation hole.

3.3 Circuits and Parts

3.3.1 Printed wirings shall be used, provided that the provision 3.3.2 is applied for an unavoidable reason.

3.3.2 The color coding of wirings shall conform with JIS C-6003 (nine colors) and all wirings shall as a rule be bundled. However, this provision does not apply to the wirings for commercial frequency power.

3.3.3 Each material shall conform to the JIS or higher specifications.

3.3.4 All parts used in this equipment shall be domestically produced ones.

3.3.5 The crystal oscillation elements in the 1st local oscillators for transmission and reception shall comply with JIS C-6701 J)-25 type, which is as follows:

	*60Hz	150 MHz
Resonance mode		
– Transmitting	Parallel	Series (tertiary overtone)
– Receiving	Series (tertiary overtone)	"
Frequency deviation	$\pm 10 \times 10^{-6}$	
Load capacitance	30 ± 0.5pF	–
Oscillation level		
– Transmitting	5 ± 1mW	2 ± 0.5mW
– Receiving	2 ± 0.5mW	2 ± 0.5mW
Resistance	40Ω min.	40Ω min.
Test oscillator		
– Transmitting	TS-330/TS	TS-683/TSM
– Receiving	I-483/TM	TS-683/TSM

3.4 Miscellaneous

3.4.1 The portion where parts requiring special attention when handled or the portion where cables are connected shall be provided with marking notifying such cautions.

3.4.2 Parts or printed wiring boards shall be provided with parts numbers that can be identified with the circuit diagram. This provision shall, however, be discarded for some

wirings if such marking is especially difficult.

3.4.3 The case shall be of aluminium alloy with anti-corrosion on the surface.

4. Performance of Each Unit

4.1 General Information

4.1.1 The equipment shall satisfy the requirements of this specifications without adjustment in the range of within ±500 kHz (200 kHz*) of the center frequency specified separately.

4.1.2 The power consumption of the equipment at a power supply voltage of 13.8V shall be as follows:

For waiting	0.035A maximum
For receiving	0.25A maximum
For transmitting	2.5A maximum

4.2 Performance of the Transmitter

4.2.1 The frequency multiplication shall be X6.

4.2.2 The allowable frequency deviation shall be less than $\pm 10 \times 10^{-6}$.

4.2.3 The transmitting output shall be at least 10W at a power supply voltage of 13.8V, provided that it shall be less than 12W for a voltage rise above the 13.8V rating. Also, the output shall be at least 5W at a power supply voltage of 11.6V.

4.2.4 The output circuit shall match a SWVR of 2 or a load connected to it through an unbalanced type 50 coaxial cable.

4.2.5 The input required for 70% modulation of 1 kHz shall be −30 ± 3dB when a speaker microphone is used, or −4 ± 3dB when a handset is used.

4.2.6 The maximum frequency deviation shall not exceed ±5 kHz. The equipment shall be furnished with an automatic frequency deviation control circuit to prevent the said maximum frequency deviation from being exceeded.

4.2.7 The modulation frequency response as referenced to 1 kHz and 30% modulation shall be as follows:

0.3 kHz	−10.5 ± 3dB
2 kHz	+4 ± 3dB
3 kHz	+6 ± 3dB

In addition, the equipment shall be provided with an automatic frequency shift control circuit and fixed lowband filter and the attenuation at 1 kHz shall be and that at 15 kHz or any frequency f kHz shall be 40 $\log_{10}$ f/3 dB at a minimum.

4.2.8 As for linearity of modulation, the frequency shall be linear at a modulation frequency of 1 kHz with a phase deviation of up to 3.5 radians, and the deviation shall be within ±2dB.

4.2.9 The distortion factor at 1 kHz and 70% modulation shall be less than −20dB.

4.2.10 The residual amplitude modulation content shall be less than 5% at 1 kHz and 70% modulation.

4.2.11 The transmitting S/N shall be more than 40dB at 1 kHz and 70% modulation.

4.2.12 The spurious radiation strength shall be 80dB lower than the mean power of carriers in the band and 40dB lower than the mean power outside the band.

4.2.13 The occupied frequency bandwidth shall be within 16 kHz.

4.3 Performance of the Receiver

4.3.1 The intermediate frequencies shall be as follows:

1st intermediate frequency	10.7 MHz
2nd intermediate frequency	455 kHz

4.3.2 The allowable frequency deviation of the local oscillator shall be within $\pm 10 \times 10^{-6}$. The local oscillation frequency shall, as a rule, be as follows:

1st local oscillation frequency
(line frequency − 10.7 MHz)/3 (*1)

4.3.3 The bandwidth as measured by the 20dB noise quieting method shall be more than 12 kHz at a 6dB down point.

4.3.4 The selectivity as measured by the 20dB noise quieting method shall be within 25 kHz in the width at a 70dB down point.

4.3.5 A protective circuit against excessive inputs from the antenna shall be provided.

4.3.6 The spurious gain shall be less than −80dB.

4.3.7 The receiver input voltage required for obtaining a noise quieting of 20dB shall be less than 3dB.

4.3.8 The interference input voltage shall be more than 80dB when the noise quieting is 20dB by applying a non-modulated frequency more than 20 kHz away from the receiving frequency in the condition that a desired input voltage 6dB higher than the receiver input voltage is applied to maintain 20dB noise quieting.

4.3.9 When an interference input voltage of 65dB with non-modulated frequency amplitude having such a relation as will cause cross-modulation if no desired signal is present is applied, the noise suppression shall be less than 20dB, provided that the frequencies having such a relation as will cause cross-modulation is more than ±20 kHz higher than the desired frequency.

4.3.10 When a 10dB receiving input voltage at 1 kHz having been modulated up to a maximum frequency deviation of 70% is applied, the total device output to the spurious component contained therein shall be more than 20dB.

4.3.11 The squelch circuit shall open at an input voltage of 10dB noise quieting. In addition, the squelch control resistor shall permit this voltage to be adjusted stably to the 20dB noise quieting input and also permit quieting of signals of more than 40dB.

4.3.12 The demodulated frequency response as referenced to 1 kHz and 30% modulation shall be as follows:

0.3 kHz	+6 ± 3dB
2 kHz	−4 ± 3dB
3 kHz	−8 ± 3dB

4.3.13 When an input signal of 40dB is applied to the antenna terminal at 1 kHz and 100% modulation, the output of the AF output amplifier shall be more than 0.5W.

5. Accessories

Speaker microphones	1 set
Test data	3 copies
Mounting hardware	1 set
Spares (lamps and fuses)	100% of working complements

APPENDIX

INTERIM REPORT

ON

The Second Survey for the Establishment of a Comprehensive Plan of the Flood Forecasting and Warning System in the Pampanga River Basin in the Philippines

THE JAPANESE GOVERNMENT SECOND SURVEY TEAM

For

The Flood Forecasting and Warning System

Under

The Colombo Plan

22 March 1972

The Japanese Government Second Survey Team consisting of three Telecommunications experts has implemented their second survey for the establishment of a comprehensive plan of the flood forecasting system in the Pampanga River Basin in the Philippines. The team arrived in Manila on the 23rd of February 1972 along the line of a plan of operation which was agreed upon by the Government of the Philippines and the Government of Japan. This is the interim report summarizing the results of the survey and study up to the end of their stay in the Philippines. It is understood that the final operation report will be submitted to the Government of the Philippines by the end of June 1972.

I. OUTLINE OF SURVEY

1. Field Survey and Existing State of Observation Facilities

On the basis of Case II proposed in the basic Feasibility Survey Report, the team conducted a field survey in the entire Pampanga river basin, i.e., the upper, middle and lower basins of the Pampanga and the Angat river basin, to investigate the condition of the existing gauging stations and of the sites proposed for installation of new stations.

The survey disclosed that the existing self-recording water level gauging stations are no longer in service condition due to the changes in river discharge and flood damages, and thus revealed that all the water level gauging stations required for the planned flood forecasting system should be newly installed.

The team discovered that Sulipan is thickly wooded and is therefore not suited for installation of a rainfall gauging station or solar cells.

San Vicente site and Biak na Bato site proposed in the Basic Feasibility Survey Report were changed to San Isidoro and Sibul Springs respectively at the request of the Philippine government.

2. Measurements for Telemetering System

2.1 Measurement Items

a) Transmission test between the Flood Forecasting Center, Bureau of Public Works, respective gauging stations and the repeater stations as well as between the repeater stations for measurement of field strength and checking of quality of voice messages.

Arayat, Candaba and La Paz sites were not covered by the transmission test because it could be dispensed with by reason of their topographic condition.

b) Noise level measurement at the Flood Forecasting Center, Bureau of Public Works and Cabanatuan Weather Station.

c) Study of frequencies in the neighbourhood of 152.275 MHz which was assigned to the flood forecasting network and their jamming effect, as well as the study of the frequency range from 100 MHz to 160 MHz. This study was made at the site of San Rafael Repeater Station.

2.2 Method and Results of Measurements

a) Transmission test between the Flood Forecasting Center, Bureau of Public Works, respective gauging stations and the repeater stations as well as between the repeater stations was conducted by means of VHF radio telephone equipment. In this test, the field strength was measured and the quality of voice messages was also checked.

The values obtained by the test and calculated values are shown in Table 1.

The test proved that the transmission of voice messages between the above-mentioned places is satisfactory.

b) The noise level in the neighbourhood of the assigned frequency was measured at the Flood Forecasting Center, Bureau of Public Works and Cabanatuan Weather Station by means of a field strength meter and a quasi-peak meter, and was recorded by a recording meter. Since the measured noise level ranged from 10 to 20 dB at all these places, it is believed that the reception of data will not present any problems.

c) The same noise level measurement as described above was conducted at the site of San Rafael Repeater Station to study the interference in the frequency band from 100 MHz to 160 MHz, particularly in the frequency previously assigned to the flood forecasting telemetering network.

The spectrum and field strength of received jamming frequencies are shown in Table 2.

2.3 Comment on Measurement Results

As a result of the above measurements, the transmitting power, kind of antenna and antenna height above ground level at respective station sites were made clear. These are shown in Table 3.

The system network of the planned flood forecasting and warning system is shown in Fig. 1.

II. RECOMMENDATIONS ON FLOOD FORECASTING AND WARNING FACILITIES

On the basis of its findings, the second survey team recommends that the following corrections be made to the flood forecasting and warning facilities including antennas.

1. San Rafael Repeater Station and Sapang Buho Station should be provided with a rest room for maintenance service and discharge observation. The rest room should also be built at other sites if necessary. If the construction of a rest room in or adjoining the station building is not feasible, a separate building should be constructed as a rest room.

2. The antenna height should be 10 m or more above ground level at all stations. The antenna tower should be a self-supporting triangular tower.

3. Since all the water level gauging stations should be newly constructed, studies should be made for use of TAKUWA's pole-type water level gauge which can be readily installed and can also meet the changes in the river-bed configuration.

4. The rainfall gauging station originally planned to be set up at Sulipan should be installed at Central Luzon River Control District Office.

III. PROPOSAL FOR ALLOCATING SUITABLE FREQUENCY

The survey disclosed that the frequency planned to be assigned to the flood forecasting and warning network (152.275 MHz) is already in use by a third party. The team therefore recommends the use of a frequency in the neighbourhood of 140 MHz or 160 MHz.

IV. OTHERS

1. It is hoped that the equipment supplied by Japan for the second survey will be put in effective use in the Philippines.

2. The design data of the floater-dropping facilities to be installed at Sapang Buho will be supplied by the Japanese government.

3. The flood forecasting and warning system consists of a great diversity of equipment. In order that these equipment are procured, installed and adjusted in a satisfactory manner well experienced contractors should be selected for their design and manufacture, with close supervision also exercised over their manufacture and installation work.

4. It is considered necessary that maintenance personnel be stationed at such important stations as San Rafael Repeater Station and Cabanatuan Repeater Station at time of typhoons.

5. It is understood that arrangements will be made at a later date to determine the share to be borne by the Philippines and Japan in the supply and installation of equipment and facilities of the flood forecasting and warning system.

V. CONCLUSION

As a result of the second survey, conclusion was reached that the planned establishment of the flood forecasting and warning system in the Pampanga river basin is feasible.

The system will comprise the following stations.

1.	Terminal telemetry and radio telephone station	
	Flood Forecasting Center (Quezon City)	1
2.	Monitor and radio telephone station	
	Bureau of Public Works (Manila)	2
3.	Rainfall gauging and radio telephone station	
	Central Luzon River Control District Office (Apalit)	1
4.	Rainfall and water level gauging station	
	Arayat, Candaba, San Isidoro, La Paz, and Ipo	5
5.	Rainfall, water level and discharge gauging station	
	Sapang Buho	1
6.	Rainfall gauging station	
	Papaya and Sibul Springs	2
7.	Rainfall gauging and repeater station	
	San Rafael	1
8.	Water level gauging station	
	Sulipan	1
9.	Repeater station	
	Cabanatuan	1

Table 1 Values Measured by Transmission Test and Calculated Values

Section	Pr	Prn	C/N	I	S/N	Pt
	dBm	dBm	dB	dB	dB	W
Terminal Station – San Rafael	–79	–117	38	20	30 <	1
Monitor Station – "	–86	–117	31	20	30 <	1
Sulipan – "	–59	–117	58	20	30 <	1
Apalit (Office) – "	–57	–117	60	20	30 <	1
Arayat – "	–59.9	–117	57.1	20	30 <	1
Candaba – "	–61.4	–117	55.6	20	30 <	1
San Isidoro – "	–79.5	–117	37.5	20	30 <	1
Sibul Springs – "	–88.5	–117	28.5	20	30 <	3
Ipo – "	–90.5	–117	26.5	20	30 <	3
La Paz – Cabanatuan	–63.7	–117	53.3	20	30 <	1
Sapang Buho – "	–88	–117	29	20	30 <	1
Papaya – "	–94	–117	23	20	30 <	3
San Rafael – "	–65	–117	52	20	30 <	3

Explanation of Symbols:

Pr : Receiving power
Prn : Receiving noise power
c/n : High frequency S/N
I : Improvement factor of S/N
S/N : Standard S/N
Pt : Transmitting power

Table 2 Spectrum and Field Strength of Jamming Frequencies

Frequency (MHz)	Field Strength (dBμV)
102,000	50
142,800	26
152,275	23 ~ 41.5
152,900	12.5
154,000	12.5
155,000	27
155,500	21
158,500	13.5
159,000	21 ~ 24.5

Notes: Date of measurement – March 9, 1972
Place of measurement – San Rafael, Bulacan

Table 3 Transmitting Power, Antenna Height above Ground Level and Kind of Antenna

1. Transmitting Power

   a. 3W at the following 5 stations

      San Rafael, Cabanatuan, Ipo, Sibul Springs and Papaya.

   b. 1W at the following 9 stations

      Flood Forecasting Center, Bureau of Public Works, Sapang Buho, La Paz, Candaba, San Isidoro, Apalit, Sulipan and Arayat.

2. Antenna Height above Ground Level

   a. 30 m at the following 2 stations

      San Rafael and Cabanatuan.

   b. 15 m at the following 4 stations.

      Ipo, Sibul Springs, Papaya and San Isidoro.

   c. 10 m at the following 4 stations

      Apalit, Sulipan, Arayat and Sapang Buho.

   d. 5 m above the roof at the following 2 stations

      Flood Forecasting Center and Bureau of Public Works.

   e. 5 m above the floor of station building at the following 2 stations

      Candaba and La Paz.

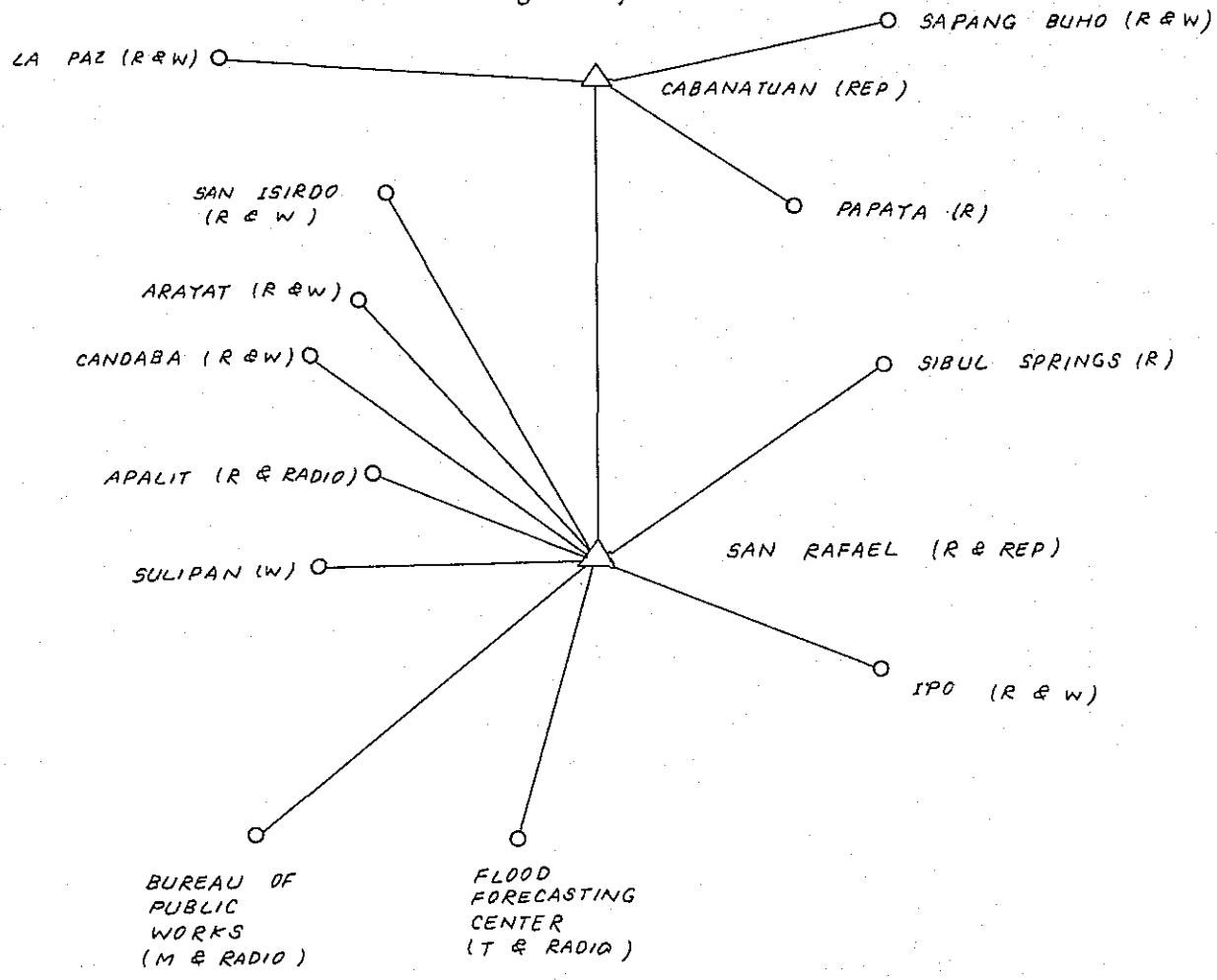
3. Kind of Antenna

   a. 3-element Yagi antenna and 3-stage colinear antenna at the following 2 stations

      San Rafael and Cabanatuan.

   b. 3-element Yagi antenna at all the other stations.

Attached Fig. 1 System Network



Legend:

T	–	Terminal telemetry station
Radio	–	Radio telephone station
M	–	Monitor station
Rep	–	Repeater station
R	–	Rainfall gauging station
W	–	Water level gauging station