

JICA team recommends that identification of such kinds of equipment shall be established clearly.

(3) Spare parts

When NAPOCOR intends to purchase some spare parts or materials

* Technical section should be allowed to order from particular manufacturer.

* Some kinds of consumables such as signal lamp of circuit breaker shall be specified in the specification to be able to apply locally available standard products (e.g., some circuit breakers have no indicating lights because of shortage of available spare lamps).

(4) Line men crew are assigned for each T/P and S/S at this stage, but they shall be concentrated by appropriate area, and, application of fault locator equipment for long T/Ls (e.g., Kalayaan-Malaya T/L) should be considered step by step.

2-3.4. RECOMMENDATIONS

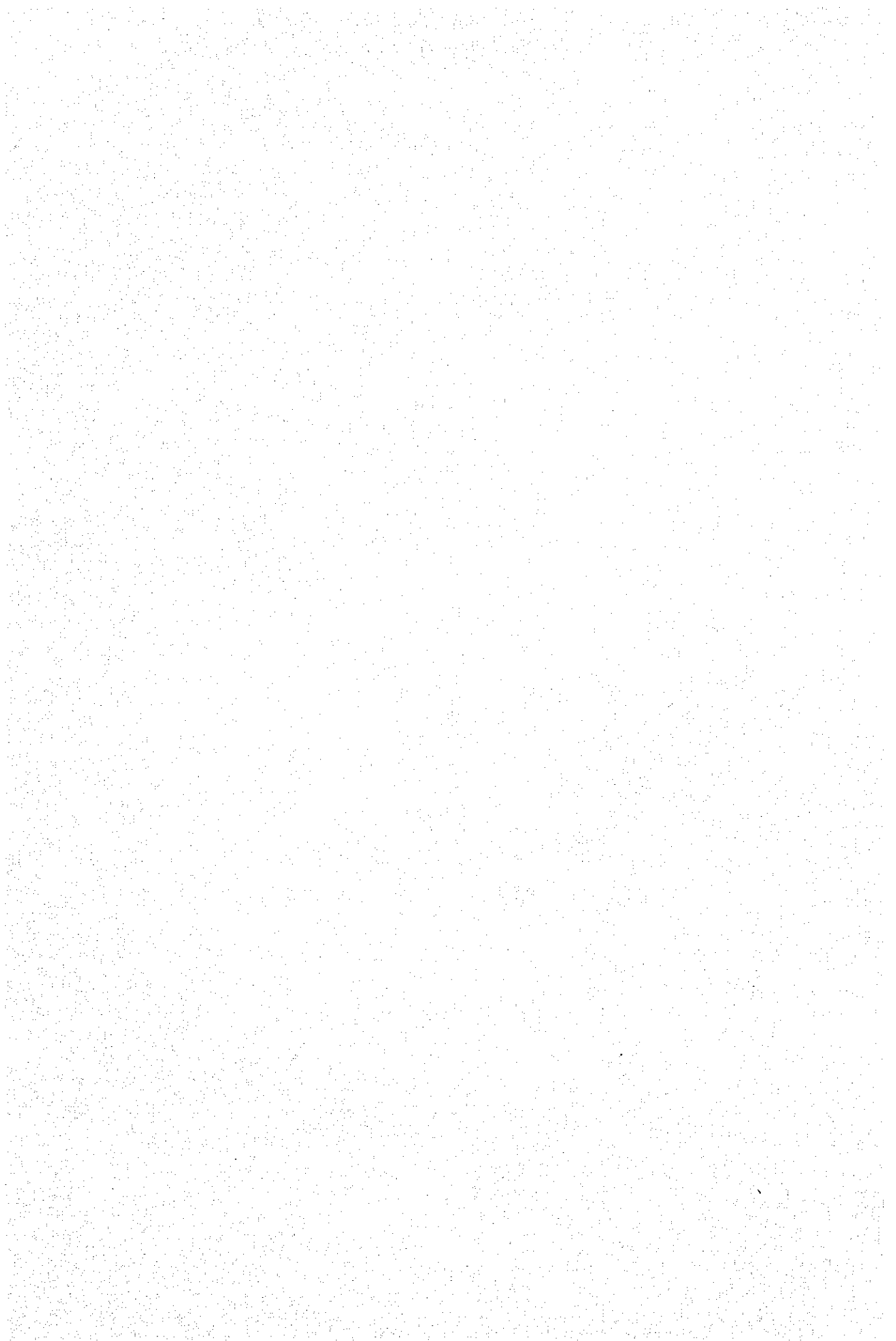
Considering the improvement for supplying table electrical power to Metro Manila area, JICA team carried out checking the fault records (outage of T/Ps) and survey of each T/P and S/S, and discussions with personnel concerned. then JICA team could pick up some problems and countermeasures against the problem. Summary of recommendations are as follows:

Short term program

- (1) Overall relay tests should be done when generator/transmission line is shutdown.
- (2) Lead wire checking should be done when generator/transmission line is shutdown.
- (3) Cleaning of surface of lightning arrester should be done when transformer is shutdown.

Long term program

- (1) Operation procedures should be prepared so as to have better coordination between NAPOCOR and MECO.



- (2) Computerized recording format which includes inspection, maintenance and fault should be prepared for better and adequate inspection, maintenance and operation work.
- (3) Some existing equipment should be repaired/reconstructed and some of equipment/apparatus/instruments should be added.
- (4) Technical level of NAPOCOR employees should be improved, and efficient utilization of NAPOCOR's manpower and identification of each personnel's responsibility shall be established.

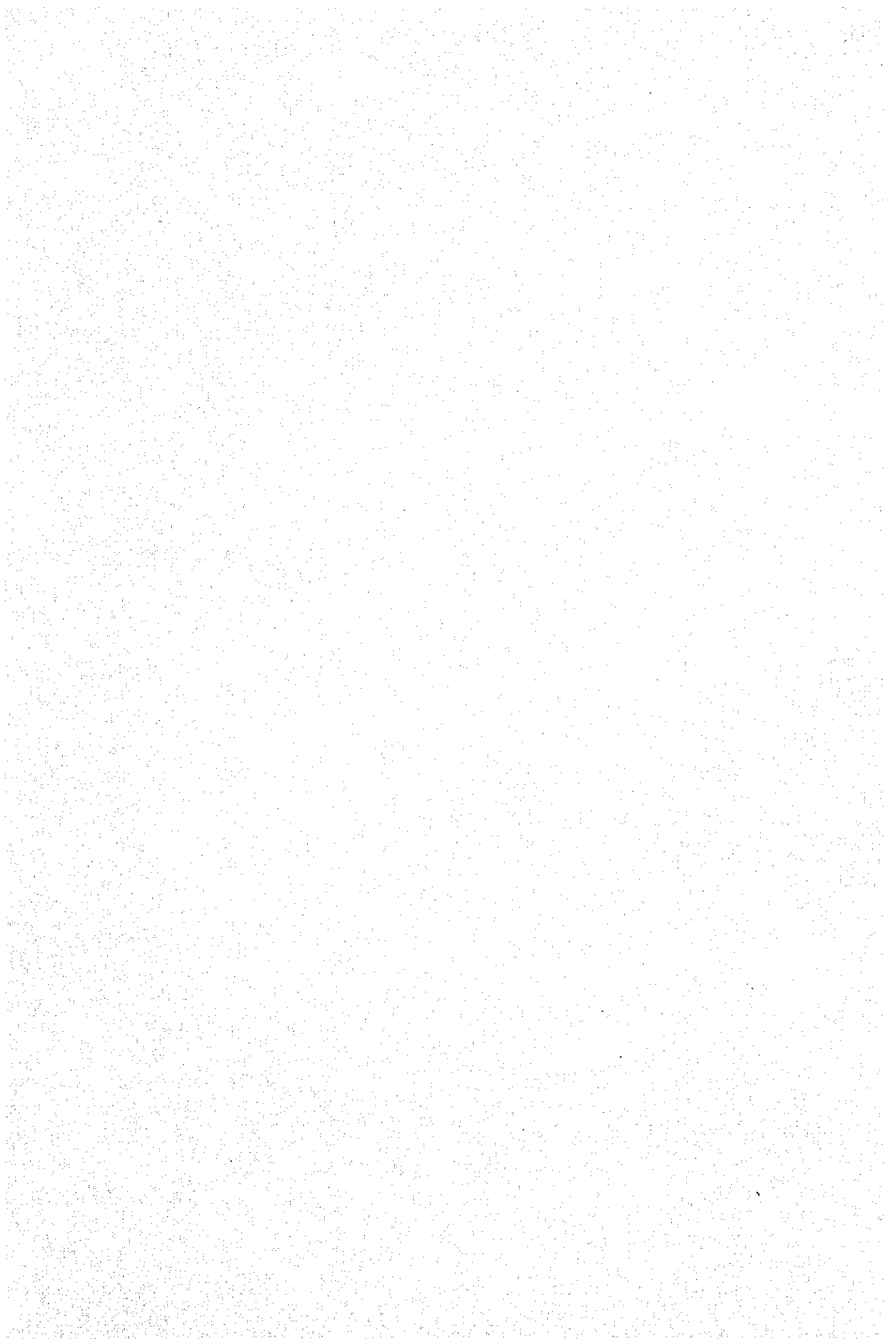
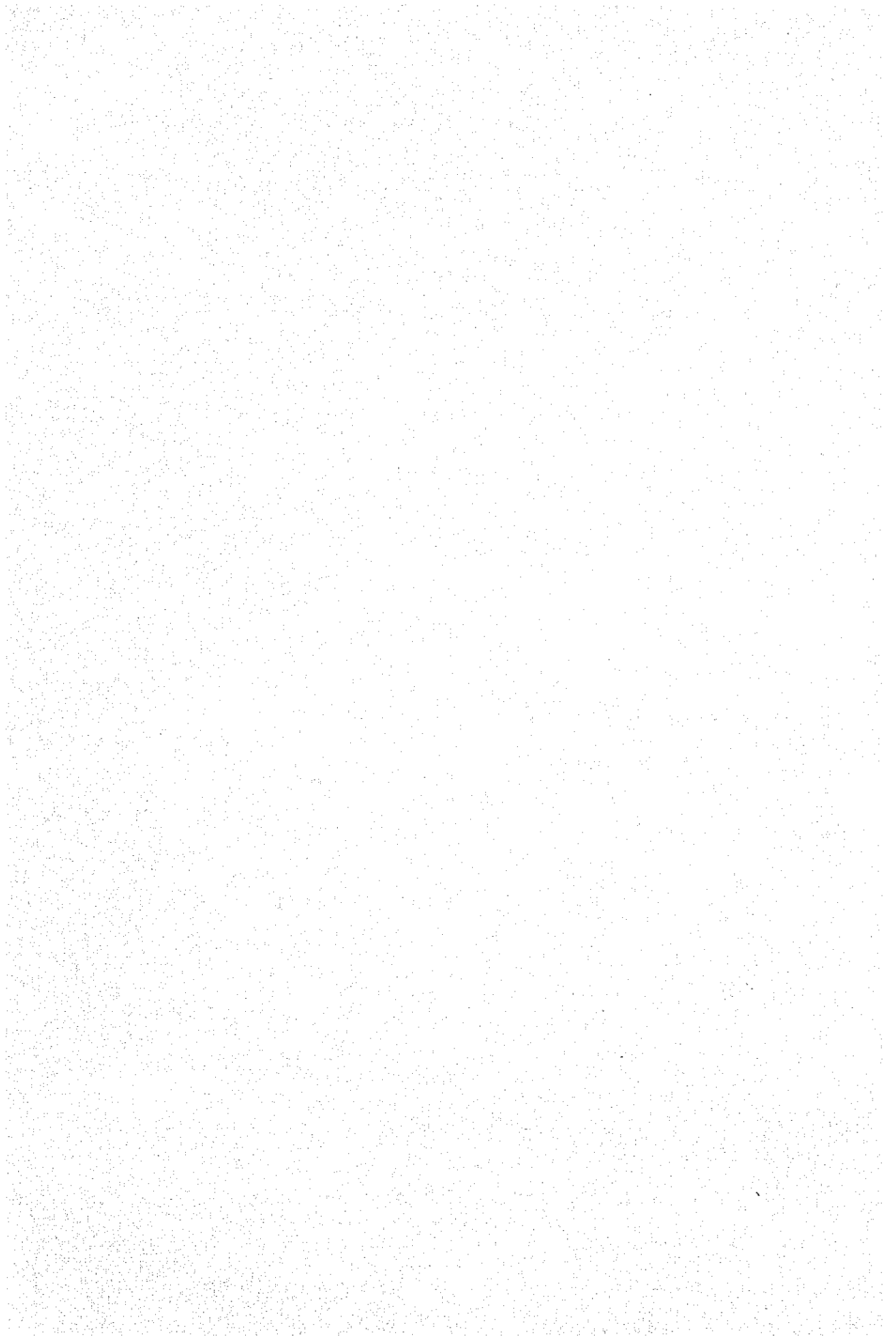


TABLE 2-6 OUTAGE OF UNIT

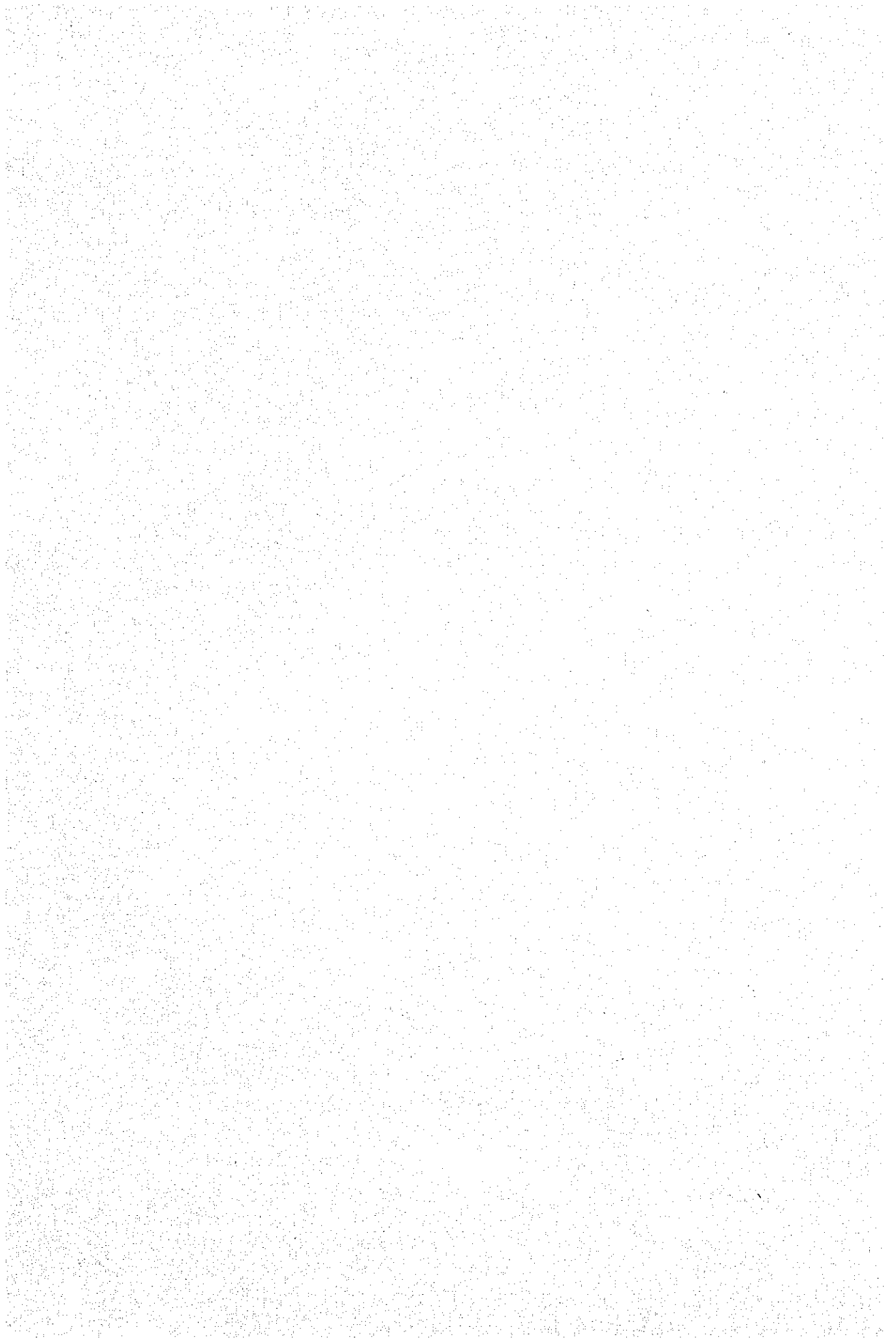
1979 Jan. - 1982 April

Name of Unit	Unit taken out of Service		Unit was placed back in line		Duration Hours	Reasons for Tripping/Shutdown
	Date	Time	Date	Time		
1 Gardner 1	Sept. 29, 1979	1:52AM	Sept. 29	3:00AM	1.15	Frequency system disturbance caused by the typhoon
2 - do -	Sept. 29, 1979	4:48AM	Sept. 29	6:21AM	1.55	- do -
3 - do -	May 12, 1980	7:20AM	May 12, 1980	11:48AM	4.47	Frequency disturbance caused by the down wire 115 kV Lalaria line
4 - do -	October 2, 1980	10:33PM	October 2, 1980	2:45PM	40.20	For replacement of detective main transformer jumper
5 Gardner 2	March 10, 1979	2:45AM	March 10, 1979	5:49AM	27.07	System frequency disturbance
6 - do -	July 27, 1979	5:09PM	July 27	8:10PM		Frequency disturbance
7 - do -	July 29, 1979	4:34PM	August 11	3:28AM	291.90	Frequency system disturbance and repair of G-2 and M-BFP
8 - do -	March 16, 1980	12:44AM	March 24	6:00PM	209.27	Tripping of M-BFP G2-B due to motor overload as a result of frequency system disturbance caused by tripping of TIWI Geothermal plant.
9 - do -	May 12, 1980	7:20PM	May 13	3:37PM	20.29	Frequency disturbance caused by the typhoon
10 - do -	Dec. 29, 1980	10:39AM	Dec. 30	3:37PM	17.02	Heating of jumper wire of main transformer phase A, Replacement of jumper wires of A, B & C
11 - do -	April 23, 1981	5:12AM	April 23	9:27PM	16.25	Outside trouble M-BFP G2-B breaker tripped automatically
12 Snyder 1	July 27, 1979	5:12PM	July 28	7:26AM	14.23	High system frequency
13 - do -	Nov. 7, 1979	8:05PM	Nov. 8	12:49	16.73	Bursting of main transformer lightning arrester phase C



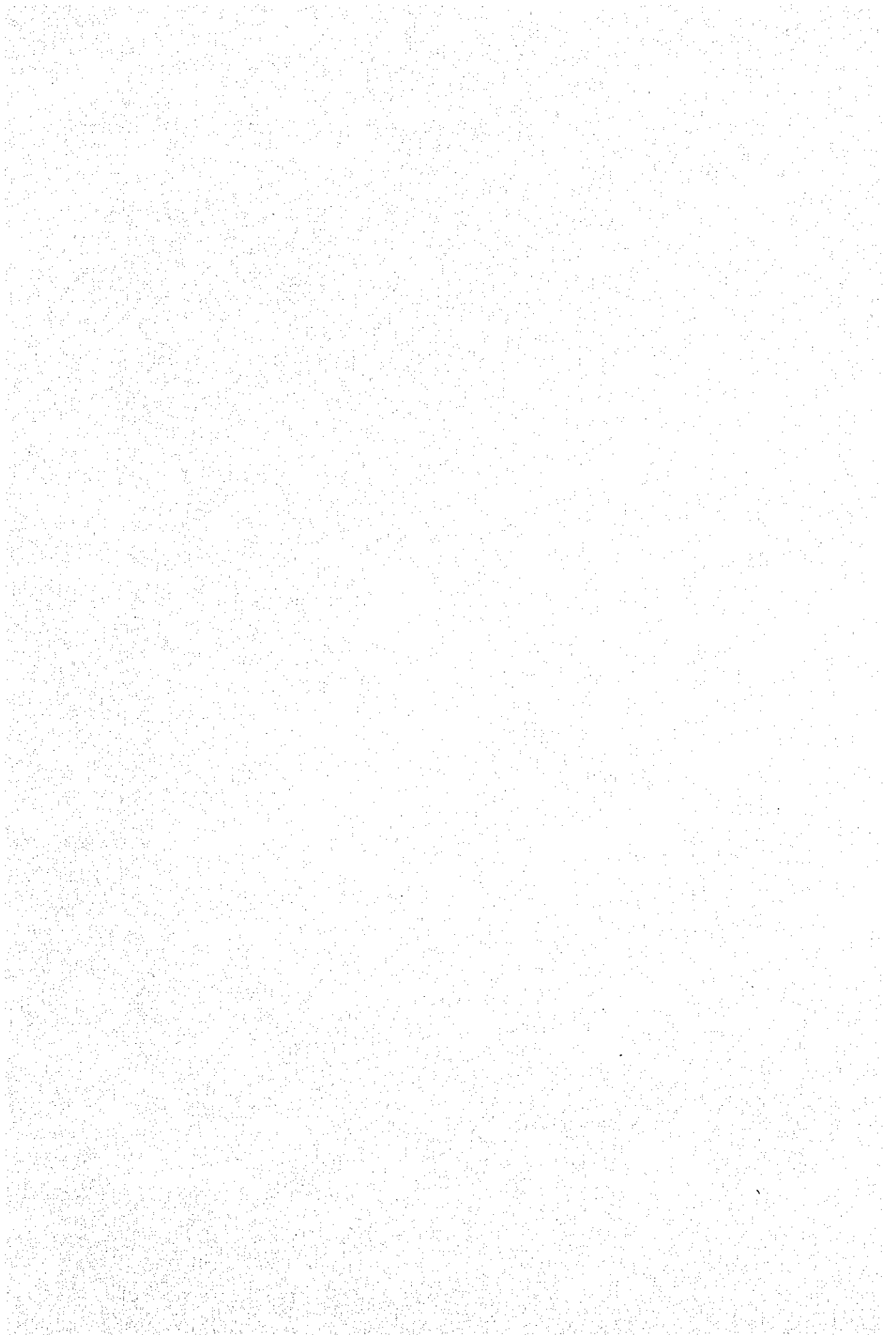
1979 Jan. - 1982 April

	Name of Unit	Unit taken out of Service		Unit was placed back in line		Duration Hours	Reasons for Tripping/Shutdown
		Date	Time	Date	Time		
14	Snyder 1	May 4, 1980	6:20AM	May 4	9:31AM	3.18	To facilitate the repair of jumper A of the main transformer that get red or beyond 110 MW
15	- do -	May 12, 1980	7:20PM	May 13	3:35AM	11.25	Due to frequency disturbance caused by typhoon
16	- do -	May 31, 1981	5:54PM	May 31	9:35PM	3.68	High frequency caused by tripping of MECO major 115 kV lines caused by the typhoon
17	Snyder 2	May 12, 1980	7:20PM	May 13	11:47PM	28.45	Unit tripped due to frequency disturbance caused by typhoon
18	- do -	August 19, 1981	1:15AM	August 19	1:42AM	0.43	Tripped by Gen. Bhr. Reverse power relay
19	Malaya 1	Feb. 9, 1979	9:45AM	Feb. 9	11:23AM	1.63	Accident tripping of Malaya Dolores S/S
20	- do -	March 4, 1979	8:39PM	March 5	12:20AM	15.68	Over frequency due to tripping of Dolores S/S
21	- do -	October 7, 1979	6:26PM	October 22	1:58AM	343.54	System disturbance which resulted to turbo-generator damaged on #2 and 8 bearing
22	- do -	July 16, 1980	12:13PM	July 16	8:25PM	8.20	Tripped thru main transformer over excitation and differential lockout.
23	- do -	July 30, 1980	5:39PM	August 2	12:24AM	54.75	Tripping of Dolores line which was hit by lightning
24	- do -	October 9, 1980	3:48PM	October 10	8:16PM	28.50	Tripping of Dolores 1 & 2
25	- do -	October 24, 1980	9:21AM	October 29	10:30AM	121.15	Tripped by gen. back up relay due to trouble on Dolores - Malaya 115 kV line and repair of boiler
26	- do -	Feb. 28, 1981	6:45AM	Feb. 28	8:20PM	13.58	Tripped due to explosion of lightning arrester of main transformer phase B of 230 kV



1979 Jan. - 1982 April

Name of Unit	Unit taken out of Service		Unit was placed back in line		Duration Hours	Reasons for Tripping/Shutdown
	Date	Time	Date	Time		
27 - do -	Sept. 15, 1981	8:00PM	Sept. 15	11:37PM	3.62	Tripped due to main transformer differential lockout relay
28 - do -	January 8, 1981	8:51AM	January 8	3:10PM	6.33	Tripped due to loss of excitation
29 - do -	Feb. 10, 1982	4:56AM	Feb. 10	11:07AM	6.18	Failures of 230 kV line San Jose TIWI
30 Malaya 2	May 14, 1979	1:14PM	May 25	6:11PM	268.95	Due to 480 volt bus trouble
31 - do -	March 27, 1979	4:27PM	March 28	9:07AM	16.67	Transformer differential lockout
32 - do -	April 2, 1979	2:11PM	April 2	6:55PM	4.73	Negative sequence over current relay
33 - do -	April 25, 1979	2:20PM	April 26	1:06AM	10.77	Bursting of the main transformer relief diaphragm
34 - do -	April 26, 1979	11:20PM	April 27	6:45AM	7.58	Oil pressure drop from the main transformer relief diaphragm
35 - do -	May 14, 1979	2:24PM	May 14	6:27PM	4.05	Due to outside trouble
36 - do -	August 17, 1979	10:48AM	August 18	12:19AM	25.52	Due to differential lockout at 330 MW load back on line with initial load of 300 MW
37 - do -	October 5, 1979	8:47AM	October 5	7:14PM	10.45	Accident remote tripped by operator
38 Malaya 2	October 5, 1979	9:09PM	October 6	6:15AM	9.10	Loss of excitation service, Emergency Feed fails to cut in
39 - do -	October 7, 1979	6:26PM	October 7	8:25PM	3.43	System disturbance
40 - do -	July 30, 1980	5:30PM	July 31	2:52PM	21.22	Tripping of Dolores Line No. 1 & 2 (hit by lightning)



1979 Jan. - 1982 April

Name of Unit	Unit taken out of Service		Unit was placed back in line		Duration Hours	Reasons for Tripping/Shutdown
	Date	Time	Date	Time		
41 - do -	October 9, 1980	3:48PM	October 21	12:00MN	296.23	Tripping of Dolores line No. 1 & 2, Turbine generator bearing was damaged
42 - do -	Nov. 2, 1981	9:25PM	Nov. 3	3:27AM	6.03	Failure of DC power supply and failure of BA cc emergency feed
43 - do -	Dec. 6, 1981	10:07AM	Dec. 7	5:31PM	31.40	Reverse power caused by malfunction of 88R2 relay on auto volt regulator
44 - do -	Dec. 26, 1981	9:19AM	Dec. 27	7:55AM	22.60	Explosion of main transformer lightning arrester for 230 kV line phase B

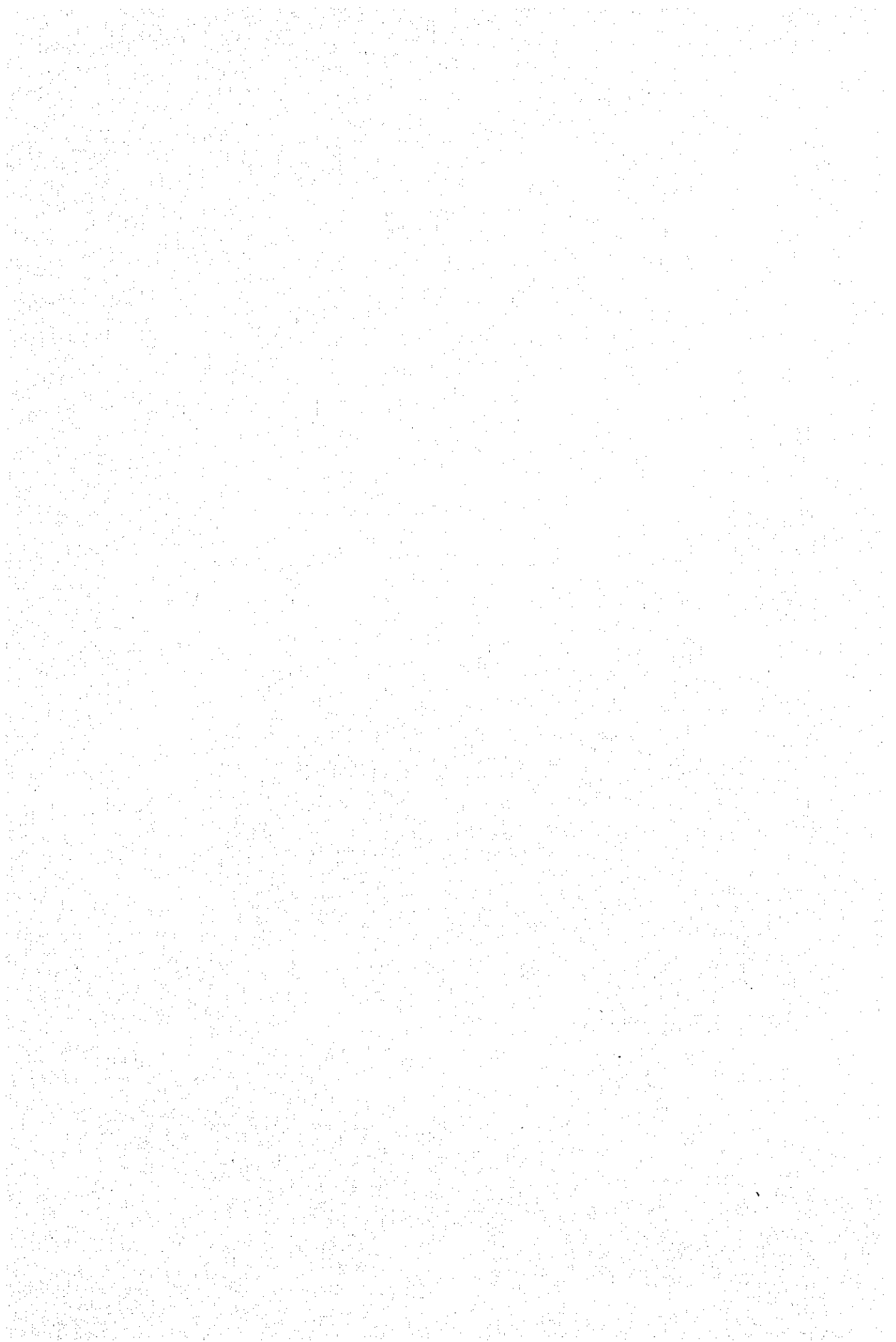
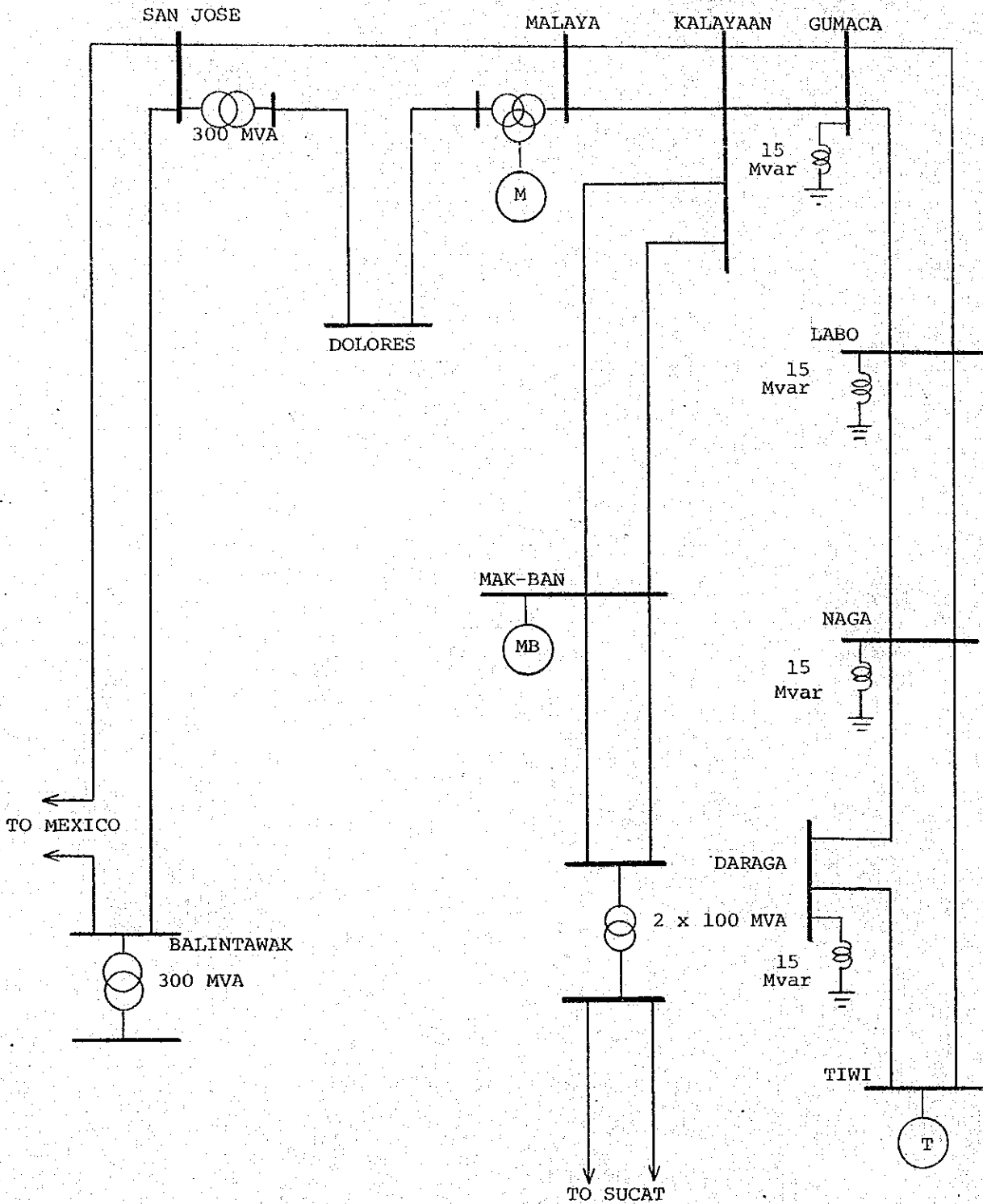
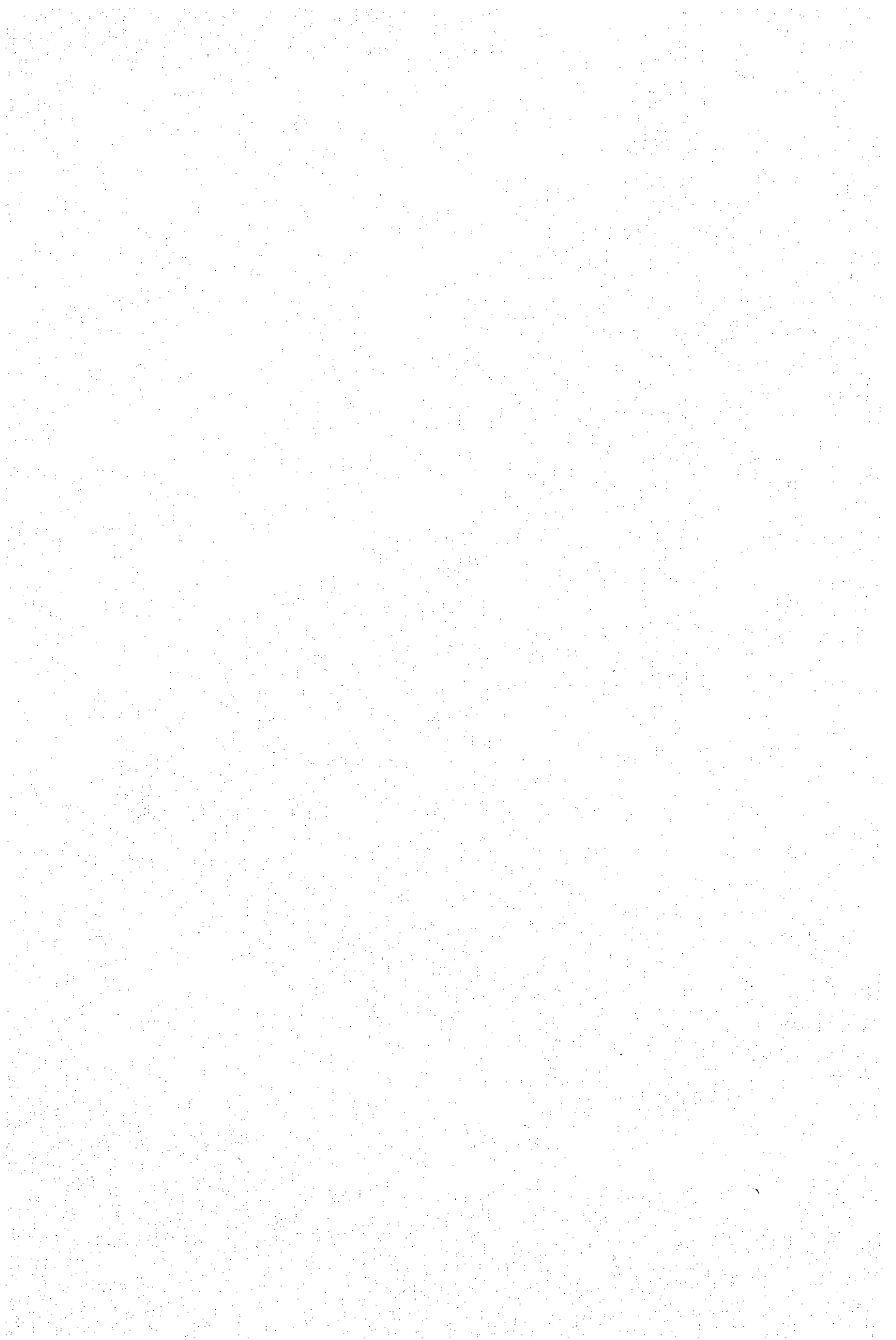


FIGURE 2 - 21 PRESENT TRANSMISSION SYSTEM (1982)
(SOUTHERN LUZON GRID)





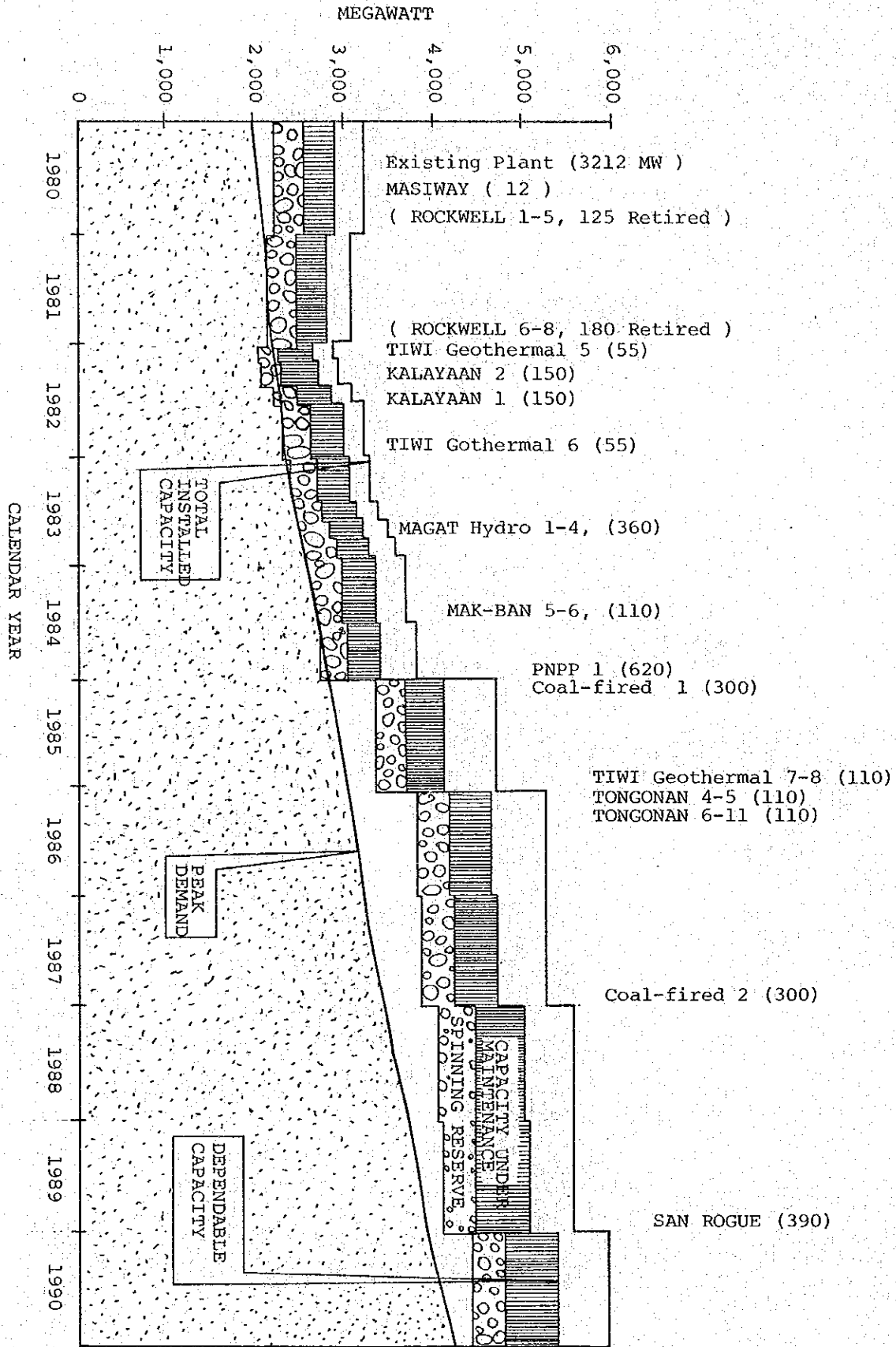


FIGURE 2-221000Z GRID SYSTEM PEAK DEMAND & CAPABILITY CURVE

COMMUNICATION SYSTEM IN LUZON GRID AS OF 1982

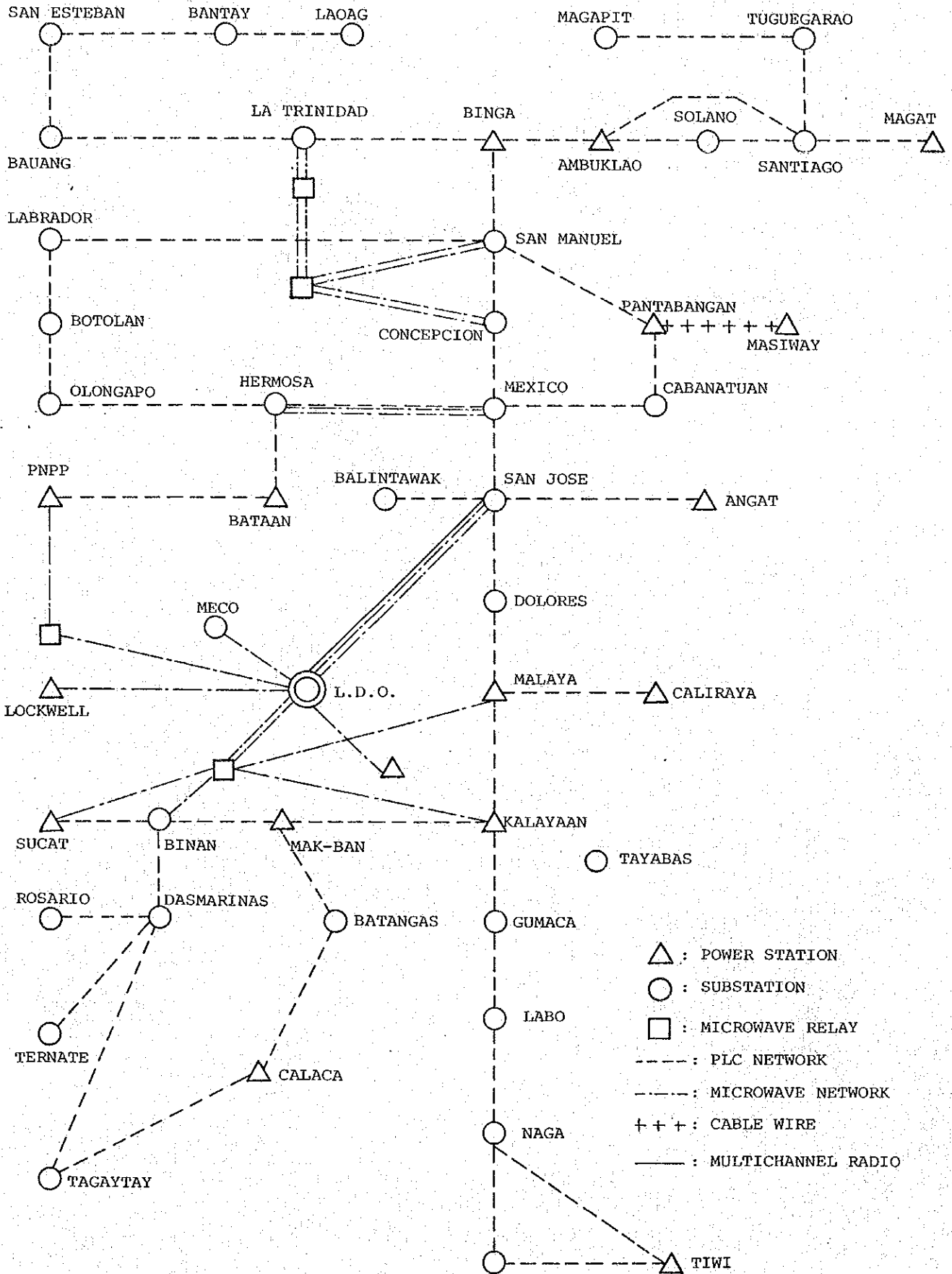


TABLE 2-7 AUTOMATIC OSCILLOGRAPH PLAN

<u>Name of Station</u>		<u>No. of Set</u>	<u>Note</u>
Kalayaan	P/S	1	
Gumaca	S/S	1	230 kV side
Mak-Ban	P/S	1	
Malaya	P/S	1	
Dolores	S/S	1	230 kV side
San Jose	S/S	1	230 kV & 115 kV side
Sucac	P/S	1	230 kV side
Bataan	P/S	1	
Balintawak	S/S	1	230 kV side
Mexico	S/S	1	230 kV side

Note: Installation plan ----- 5 oscillographs/year
Inkless recording system is composed of thermal sensitive
paper and heat pen (IC)
30 AC and 60 DC elements are available.

TABLE 2- 8 NUMBER OF CIRCUIT BREAKERS TO BE
REMODELED FOR HIGH SPEED RECLOSING

<u>Name of Station</u>	<u>Number of Circuit Breakers</u>	<u>Note</u>
Daraga	3	
Tiwi	3	Only T/L to Daraga & Naga
Naga	5	
Labo	5	
Gumaca	2	3 already scheduled
Kalayaan	1	10 already scheduled
Malaya	2	4 already scheduled
Mak-Ban	7	2 already scheduled
Binan	3	
San Jose	7	
Mexico	8	except Concepcion T/L
Hermosa	6	except Olongapo T/L
Bataan	3	except EPZA T/L
Total -----	65	

This plan shows only preliminary, some tank type OCB's (3Ø gang operation) used for the T/L interruption should be replaced for transformer primary circuit.

CHAPTER 3. GENERAL FINDINGS AND RECOMMENDATIONS

Through intimate discussions with NAPOCOR task force team and actual site survey, it comes to the conclusion that the existing situations and problems which cause brownout and unstable power generation, power transmission and power distribution are classified into the following three (3) categories.

1. General Management system
2. Thermal power plant overall engineering/design and standardized design philosophies
3. Actual physical and functional deterioration of existing thermal power plants

and in the other words

1. Long term rehabilitation items
2. Intermediate term rehabilitation items
3. Short term rehabilitation items

JICA team's recommendations and advices are given hereunder, however, NAPOCOR is liable for the final decision on the method of improvement and further advices and/or assistance will be given by JICA team in conformity with NAPOCOR's request. Common and general matters will be referred to in this chapter and individual items to be rehabilitated (short term items) e.g. actual defective items where replacement or repair is required will be mentioned in later chapter.

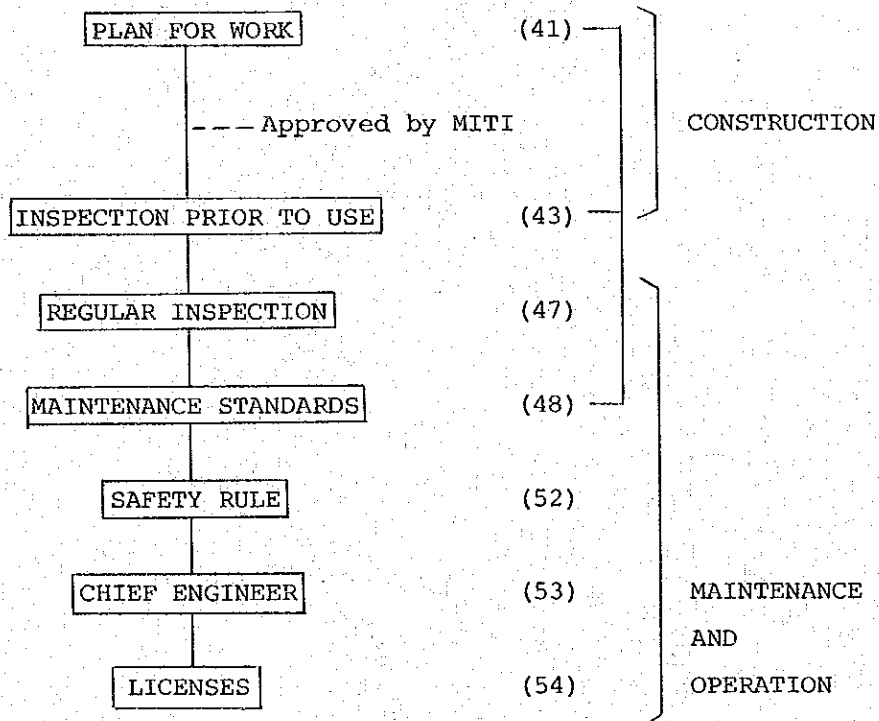
3-1. ORGANIZATION, MANAGEMENT AND HUMAN RESOURCES

It has come to the conclusion that NAPOCOR's organization is considerably complete to operate and maintain the whole power generation system and each power station, however, there still exist some imperfections in the present system, i.e.

1. Function and execution process of each division
2. Authority and assignment of each division
3. Human resources of each division especially operation/maintenance personnels of power stations
4. Authorized division which establish NAPOCOR's engineering,

- design and procurement philosophy (standards)
5. Authorized division which undertakes overall engineering/design, construction, testing/commissioning
 6. Institutional framework for regulating public utilities and industries.

Structure of the Electric Utility Industry Law of Japan for the regulation of the work of installing, constructing, maintaining and operating the electrical plants and facilities (figures in brackets show the law number of the Electric Utility Industry Law of Japan).



3-2. FUNCTION AND EXECUTION PROCESS, AUTHORITY AND ASSIGNMENT

From attached general organization and close discussion with NAPOCOR's task force team, it comes to JICA team's conclusion that there are imperfections in assignment and authority of organized divisions to achieve effective practice as;

1. To keep the plants in stable and good conditions

2. To proceed effective plant rehabilitation e.g. replacement equipment and/or parts procurement
3. To store necessary spare parts

3-2.1. PROCUREMENT

Following are actual present situations of procurement, management system

1. END USER - Prepare purchase requisition/order
(Thermal plant engineer)
2. CUSTODIAN - Certify for availability of spare parts/store on hand
3. FINANCE OFFICER - Certify for availability of funds
4. MANAGER - Approve purchase requisition if below ₱10,000.00. If more than ₱10,000.00, purchase requisition is sent to Regional Manager for approval
5. FINANCE DIVISION
 - Countercheck availability of funds or part of their control measures. They also check if parts being requisitioned are not available in other plants
6. PROCUREMENT DIVISION IN MANILA OFFICE
 - Receives a copy of purchase requisition for processing. If the amount is more than ₱500,000.00 it must obtain the approval of the Management Committee, and if over 1 Million, president approval is needed.
 - Procurement division invites possible supplier for bidding
 - In case of foreign orders, L/C must be opened by separate unit

TABLE 3-1 PROPOSED LEVEL OF AUTHORITY IN THE PROCUREMENT SYSTEM

<u>PROPOSED COMPUTERIZED SYSTEM</u>		<u>INTERIM SYSTEM</u>
<u>A. Authorization for Expenditure</u>		
Up to ₱500,000.00	- Regional Manager	- Plant/CMD Mgrs. and Provincial Super-intendents
Above ₱500,000.00 to ₱1,000,000.00	- Vice Pres. UO/Eng'g	- Manager of Plants
Above ₱1,000,000.00	- President	- Regional Managers
<u>B. Purchase Order</u>		
Up to ₱20,000.00	- Chief, Purchasing	- Vice Pres. UO/Eng'g
Above ₱20,000.00 to ₱100,000.00	- Manager, Administration	- President
Above ₱100,000.00 to ₱500,000.00	- Regional Manager	
Above ₱500,000.00 to ₱1,000,000.00	- Vice President UO/Eng'g	
Above ₱1,000,000.00	- President	
<u>C. Cash/General Voucher</u>		
<u>A. Purchase Requisition</u>		
Up to ₱10,000.00		
Above ₱10,000.00 to ₱20,000.00		
Above ₱20,000.00 to ₱100,000.00		
Above ₱100,000.00 to ₱1,000,000.00		
Above ₱1,000,000.00		
<u>B. Purchase Order</u>		
Up to ₱10,000.00		
Above ₱10,000.00 to ₱50,000.00		
Above ₱50,000.00 to ₱500,000.00		
Above ₱500,000.00 to ₱1,000,000.00		
Above ₱1,000,000.00 below ₱2,000,000.00		
₱2,000,000.00 and above		

7. PLANT MANAGER - Receives the quotation from Procurement Division for evaluation of bids. Then return it to Procurement (Div.) for the procedure.
8. REGIONAL OFFICE - In some cases, this office assists in the preparation of specifications and in the evaluation of the procedures.
9. CONTRACT COMMITTEE - is handling big account of the above amount
10. TASK FORCE - is created in some cases to study or recommend the projects and also for evaluation of bids.
11. COMMISSION ON AUDIT - monitors disbursement and inspect delivery of materials
12. QUALITY ASSURANCE GROUP - conducts receiving inspection to verify and ensure that the delivered materials, equipment and/or services conform to the specifications indicated in the purchase requisition.

Observing these present situations, JICA team understood that the most obstructive matters which adversely effects to the plant conditions are:

1. The plant managers/engineers have the authority to evaluate particularly on highly technical items coming from foreign suppliers, however, on local materials and/or equipment, the purchasing department has greater authority on the evaluation of materials.
2. It is felt that the most obstructive matters are the government restrictive policies on procurement of materials, e.g.
 - a. Policies of bidding
 - b. Specifying the particular manufacturer/supplier is not allowed
 - c. The long process of preparing and approving of purchase documents

On the other hand, improvement of discipline, knowledge and actual activity is indispensable.

RECOMMENDATION AND ADVICE

At this stage, degree of integrity of each plant looks not the same or not above the sufficient level in manpower, actual activity and discipline as far as this subject is concerned, the evaluation of parts and materials for spare, repair and replacement will be assigned to the support group such as the Technical Services Division and the Quality Assurance Group or the task force created for the rehabilitation program at this stage.

In Japanese case, around 3-4% of the plant capital cost is considered as annual maintenance expenses normally.

There now exist inadequacies in the preparation of specifications, design and technical problem evaluation and most important and indispensable improvement for the stage will be as follows:

1. Strengthening of the support group so that adequate engineering services could be rendered by those group.
2. Strong support of the Quality Assurance Group - assignment of authority to whole NAPOCOR personnel.
3. Replacement, repair of spare parts/materials should be genuine parts/materials from original manufacturer.
4. Simple and short term procurement system should be considered reflecting actual situations.

3-2.2. QUALITY ASSURANCE

"QUALITY ASSURANCE GROUP - Office of the President" has been established on 20th February, 1981.

The fundamental rationale for the Quality Assurance Group (QA) is the attainment of sufficiency in electric power generation through the improvement of the quality levels of maintenance, repair, overhaul and operation of this NAPOCOR's Thermal

Power Plants. The attainment of sufficient and reliable power supply became crucial because of the frequent brownouts causing numerous public complaints and considerable business losses. Because evidences pointed to poor quality of maintenance, repair, operation and overhauling as one of the contributory factors in the poor reliability of the Metro Manila Region thermal plants, the need for the creation of the Quality Assurance Group had emerged. Thus, on February 20, 1981 the Management Committee approved the organization of the Quality Assurance Group placing it under the Office of the President so that its operations and decisions will be devoid of any parochial institutional bias.

Quality assurance as commonly defined, shall comprise all those planned and systematic actions necessary to provide adequate confidence that a structure, system, equipment or component will perform satisfactorily in service. Therefore, the Quality Assurance Group's primary responsibility will be the establishment of and compliance with engineering, quality testing and control, and audit standards on procedures, dimensions, tolerances and specifications.

The nature of the Quality Assurance Group function may be broadly categorized into two (2), namely; (a) it pertains to the job of analyzing/evaluating how and how well a specific task with respect to quality are being carried out, and, (b) it entails reporting to Management quality the result of the evaluation or study in support of its planning and control functions; it may also furnish the particular thermal plant or division a result of the particular thermal plant or division a result of the study for the implementation or adoption of appropriate measures. This shows that the Quality Assurance Group will generally serve in dual capacity - as a central service facility for all thermal plants and as parallel control system in support of, and consistent with, the general executive concerns/responsibility of the Office of the President. Also, although the QA Group is principally a staff

organization, it has some built-in line function such as conducting tests and inspection (quality control function).

The QA Group has three (3) work groups, namely: Engineering/Administration, Inspection and Test, and Audit. The QA Engineering/Administration shall be responsible for the development of QA programs, standard manuals, and the maintenance of data banks for the use of the whole division. It shall also be charge in coordinating with the various plants and offices in the implementation of QA programs. Taking into account that one of its inherent functions is the scheduling of the different programs, it actually performs technical planning and servicing for the group.

Preventive and corrective type of inspection works are separately vested on the Inspection and Test group and the Audit group, respectively. Preventive inspection includes external and internal evaluation of quality, such as conformance by suppliers and contractors with quality requirements of specifications, quality workmanship of fabrication, installation, designs/drawings, and repairs to ensure acceptability. Preventive inspection connotes on-the-spot surveillance of activities, materials and machines. The audit Section similarly performs external and internal review albeit on a post performance basis. Since the nature of its work is substantially corrective or remedial, "independent judgement" has to be made to evaluate what is being done or what has been done (performance) as against what ought to be done (plan). Thus, it can be inferred that the "audit" work shall be on a more selective or a random basis, as differentiated from the works of QA Inspection and Testing which is usually done simultaneously with program/project execution.

The administrative component of the Engineering/Administration group services the whole QA division, and it may be further regarded as an ancillary part of the technical services

function of Quality Assurance.

The effectiveness of the review and audit process is a crucial element of the QA Group. Thus, the group should have the competence and expertise similar or perhaps even higher than its counterpart supervisors in the thermal plants; or at least comparable with plant consultants. In this regard, the initial core of the group were chosen by the plant managers of the MMRC thermal plant. Also, it was conceded that the QA Group will be co-linear with a thermal plant or a regular corporate division and therefore the positions were made comparable, if not higher than the largest thermal plants.

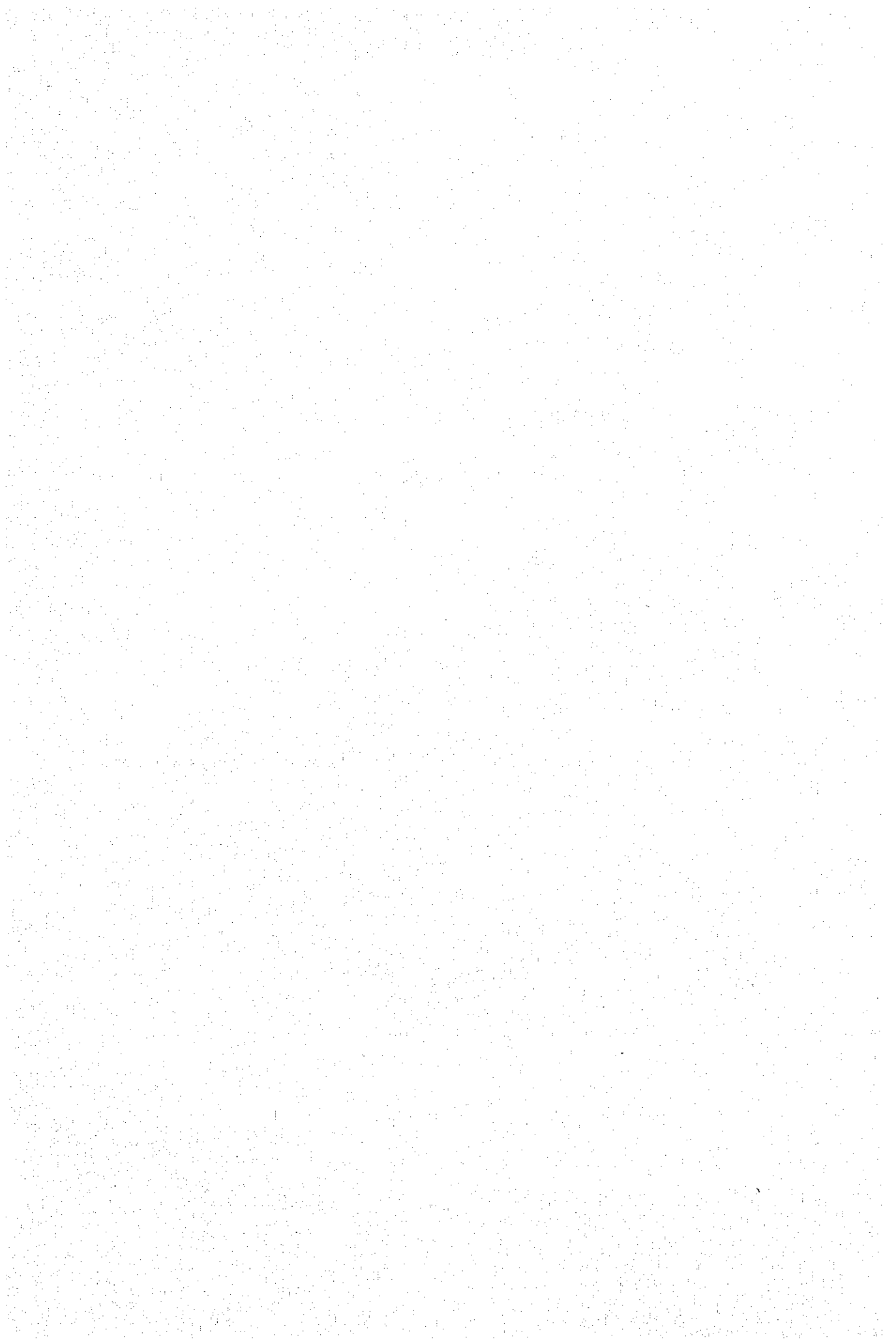
RECOMMENDATION AND ADVICE

JICA team understands that the QUALITY ASSURANCE GROUP is the promoter and key task force for overall rehabilitation in NAPOCOR.

This means that NAPOCOR has already launched the basical, primary improvement by themselves, and the assignment and contents (including degree, extent) of Report on S-2, G-1 Annual Overhauling - 1981, 1982 would be highly evaluated even if the overhauling records before the establishment of the Quality Assurance Group are not insufficient or no records can be found. However, the active work of the group is not completely understood by all NAPOCOR's personnel at this moment, and it would be one of prime management in NAPOCOR to fix the group, to standardize the work and to follow-up their recommendations actually and seriously.

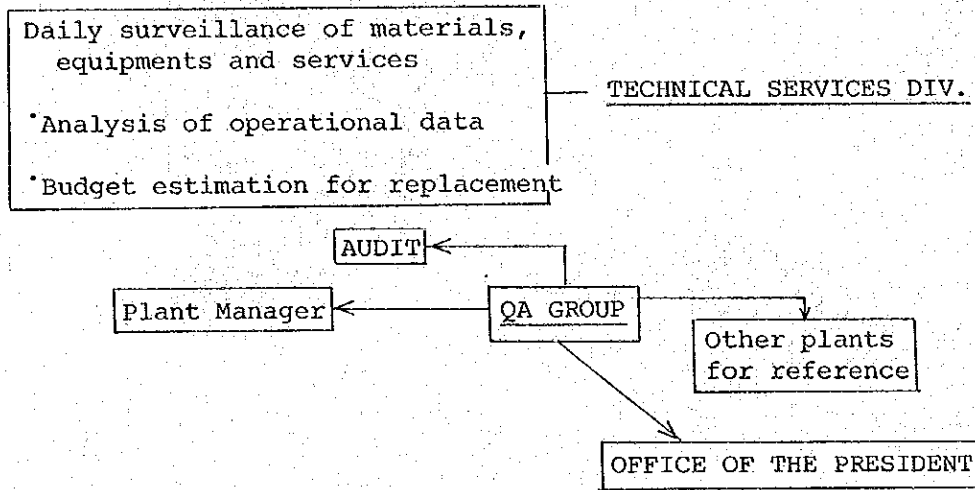
The actual situations/conditions of the plants (S-2 and G-1) are completely clarified in detail in the reports and general/common major items will be clarified in Section 2.3 Overall evaluation of power plants.

To perform the above-mentioned recommendations and advices, following system will be necessary:



1. Establishment of Information Management System through the improvement of Technical Services Division's activity in cooperation with QA Group as follows:

FIGURE 3-1 FLOW CHART OF MIS



2. Write up of Inspection Manual for autonomous maintenance policy.

3-2.3. POWER PLANT MANAGEMENT

There is basic, fundamental difference between Philippines and Japanese employment system and it would be understood that Japanese system is rather a particular case.

Actually, there are big differences in depth and width of layers in active positions -- skill, knowledge, performance, actual action, objective setting of improvement and discipline partly due to the above-mentioned difference of employment system. (Japanese system: life employment system)

At this stage, the depth and width of layers in each power plant looks not sufficient enough frankly speaking, due to the above-mentioned reasons.

Accordingly, the power plant manager must be most skillful and informed person even if he has many jobs to manage.

RECOMMENDATION AND ADVICE

As aforesaid difference in employment system, it will be meaningless to compare NAPOCOR's system with conventional Japanese system strictly.

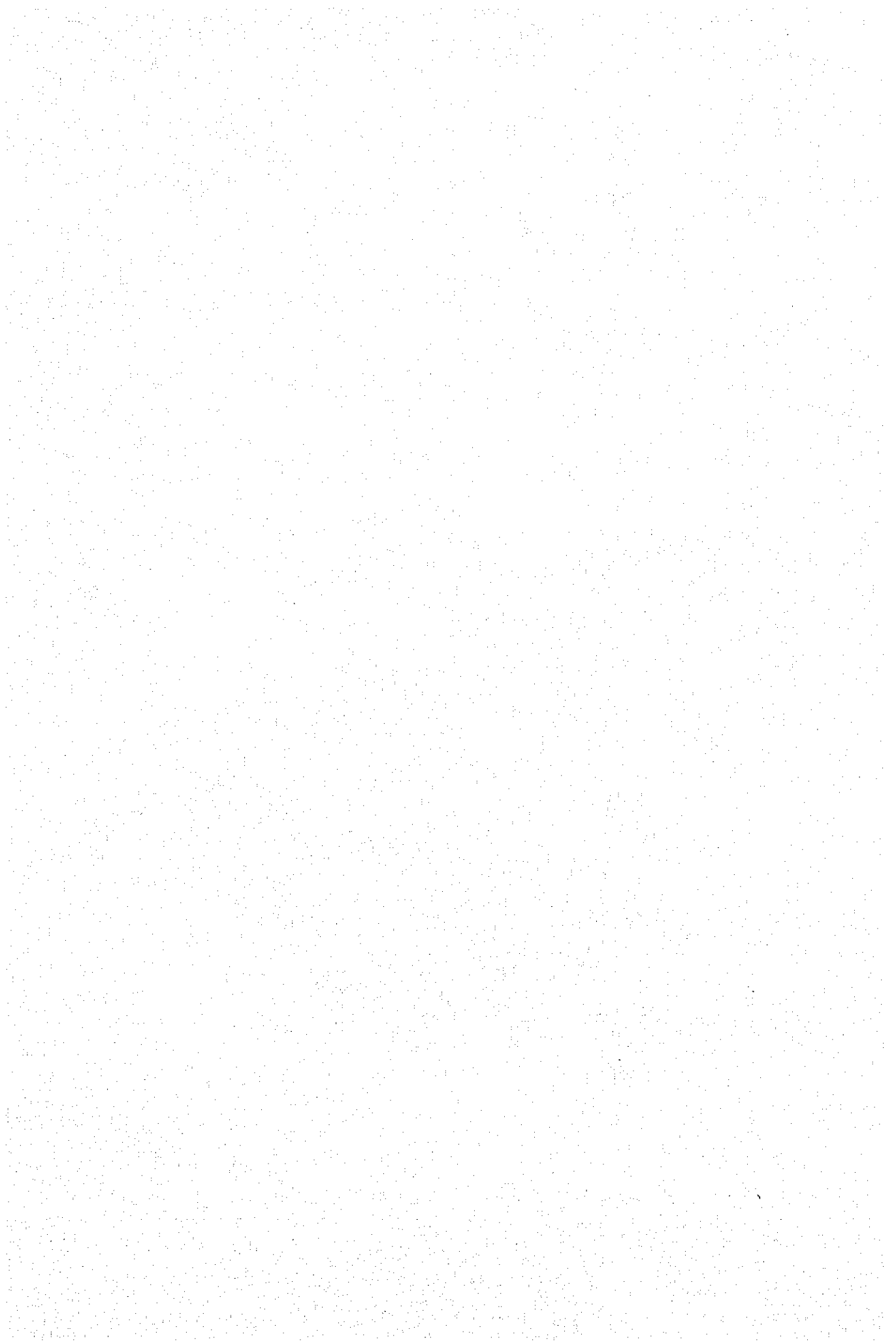
However, following basical and fundamental matters will be commonly applied to all systems:

1. The plant manager will further be required to concentrate his activities toward managing the operation and maintenance personnel to obtain better performance and discipline of plant personnel.
2. The common, general activity of administrative person is
 - 1) Show how to do it
 - 2) Make subordinates do it
 - 3) Evaluate the subordinates practice
3. Application of education program for administrative persons
4. Overlapping with the predecessor for certain duration especially for less experienced personnel in case of personnel change
5. In Japanese case, all firms are requested safety control in accordance with relevant laws and regulations. And each firm performs safety control with their own further safety control regulations, and those safety control system shall be considered effectively followed-up in NAPOCOR.

3-2.4. HUMAN RESOURCES AND TRAINING SYSTEM

The human resources is the most important and critical subject to consider whole NAPOCOR enterprise and long term rehabilitation for NAPOCOR's stable management, power generation and power supply.

In the power stations, organization to operate the plant appropriately and to maintain the plant in stable condition has been established, however, there is considerably large deficiency in numbers of personnel to meet necessary demand



especially in the backbone class operation/maintenance personnel whom are necessary for stable operation and stable maintenance, and this common problem to all power plants even if there exist small difference in each power plant. This human resources problem will bring about rather less technical accumulation not only for operation and maintenance, but also for NAPOCOR's basic engineering/design philosophy and important experiences.

In the attached power plant organization for example (this example shows Malaya Thermal Plant), there are much personnel resignation tendency before the control area in comparison with the control area and the other utility station in overseas.

There is fundamental counter situation particular in the Philippines, that is, skilled person release to overseas promotes advance of Philippine economy rehabilitation but this phenomenon gives disadvantage on domestic technical accumulation, development and stable power supply on the other hand.

Following are present ordinary process for human resources, actual education of operators and actual situations of training referring to attached sheet.

1) Hiring new operator

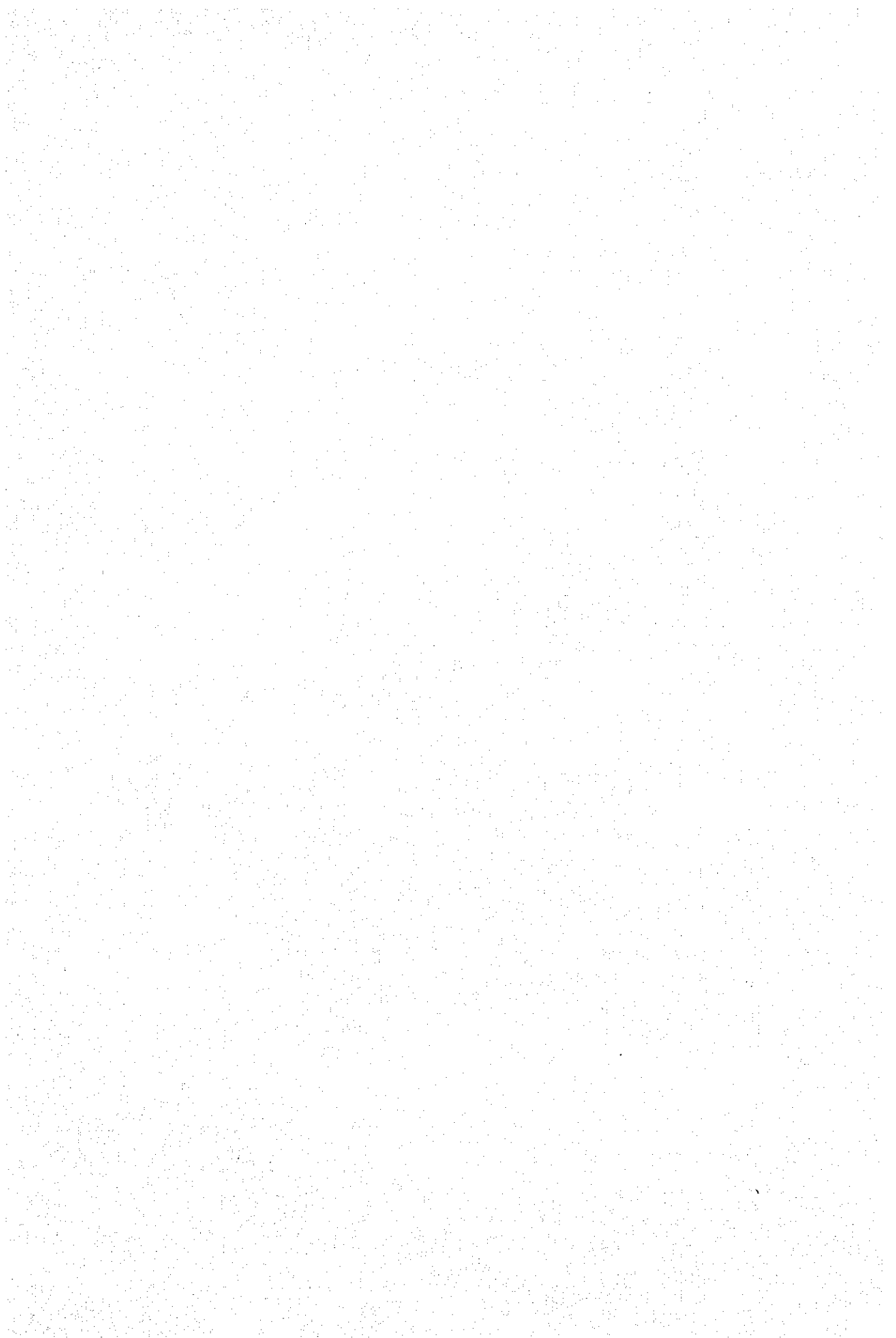
*Hiring executed by MMRC/NAPOCOR Main Office referring to original request prepared by each plant

*Qualification

- 1) Trade school graduate
- 2) Engineering graduate/undergraduate

*Investigation

- 1) Police clearance
- 2) Physical test
- 3) Psychological test



4) Intelligence quotient test

2) Start/Steps

- *Start the steps from "Operation trainee" for 4-6 months
- *After this, assign to "Equipment Operator C" (Attendant facility/equipment patrol, data collect) for approximately 1 year. *1
- *Then step up into "Sr. Equipment Operator B" (Basement area auxiliaries) and stay in the position for approximately 1 year. *1
- *Then step up into "Sr. Equipment Operator A or or B" (Boiler or turbine area) and stay in the position for approximately 2 years. *1
- *Then step into "Sr. Control Engineer/Operator A" and stay in the position for approximately 2 years. *1
- *Finally step up into "Sr. Control Engineer/Actual Chief Operator."

(*1: In case there is vacancy in the upper post. If there is no vacancy, they will stay in their post for an indeterminate period.)

And it takes minimum approximately 6.5 years (for approximately 85%) are necessary from the "Operator trainee" to "Sr. Control Engineer/Actual Chief Operator", however, personnel resignation tendency exists in these personnel up to 4-5 years, and remaining personnel rate is generally approximately 85% in comparison with initial number of employees.

It is concluded from those tendency that there are chronic deficiency of power plant personnel generally approximately by 15-20% of the most necessary and active personnel.

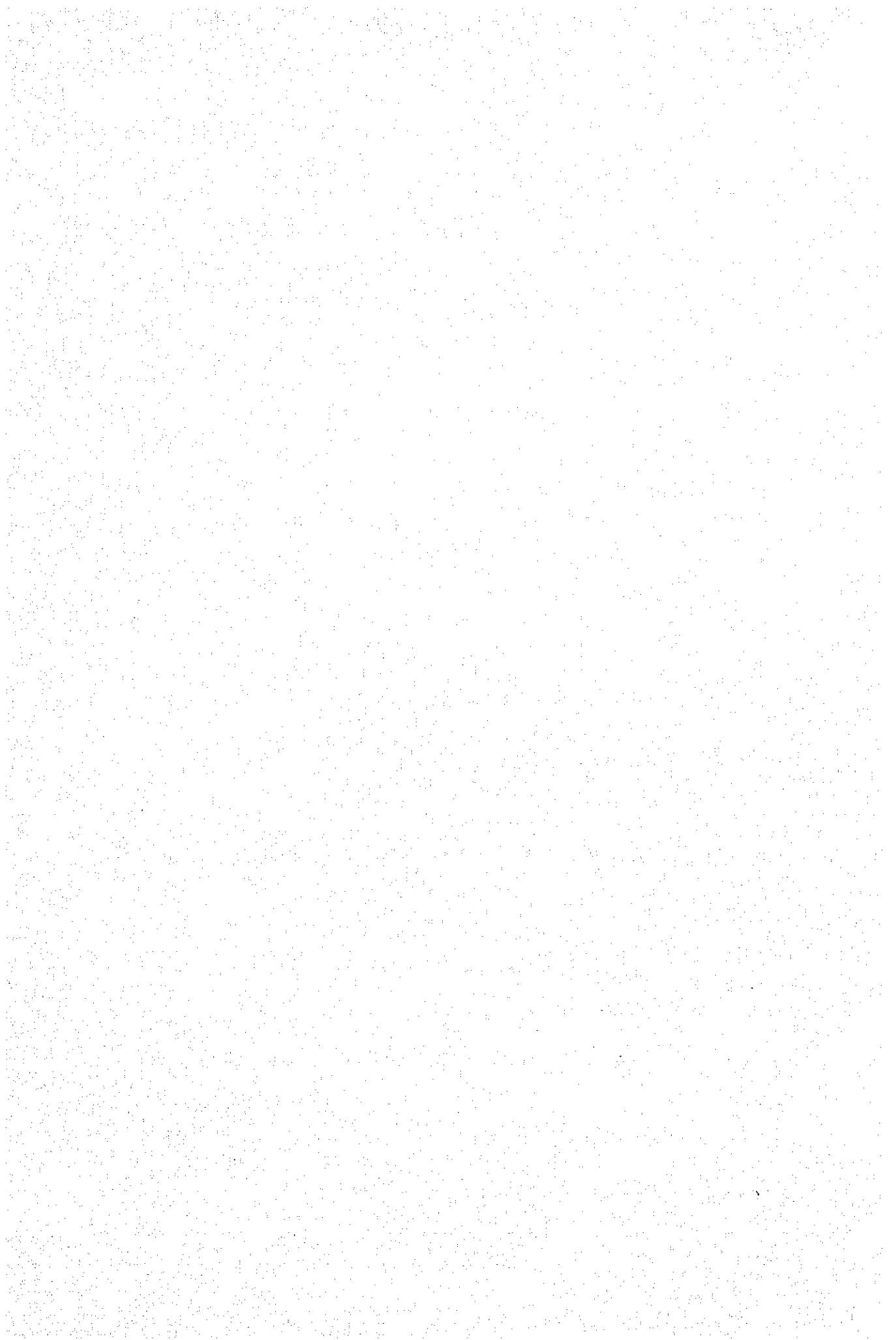
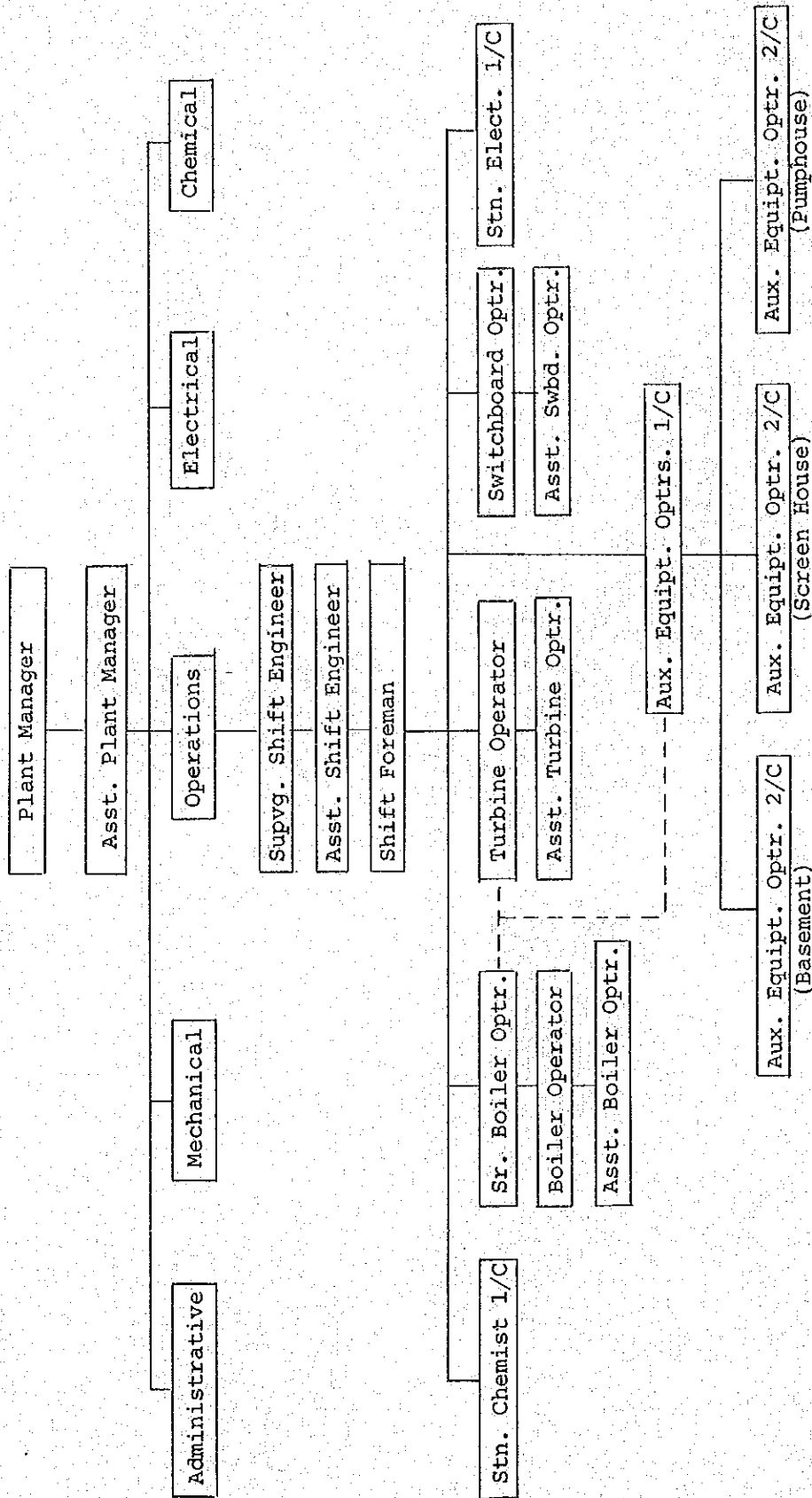


FIGURE 3-2 ORGANIZATION OF POWER PLANT



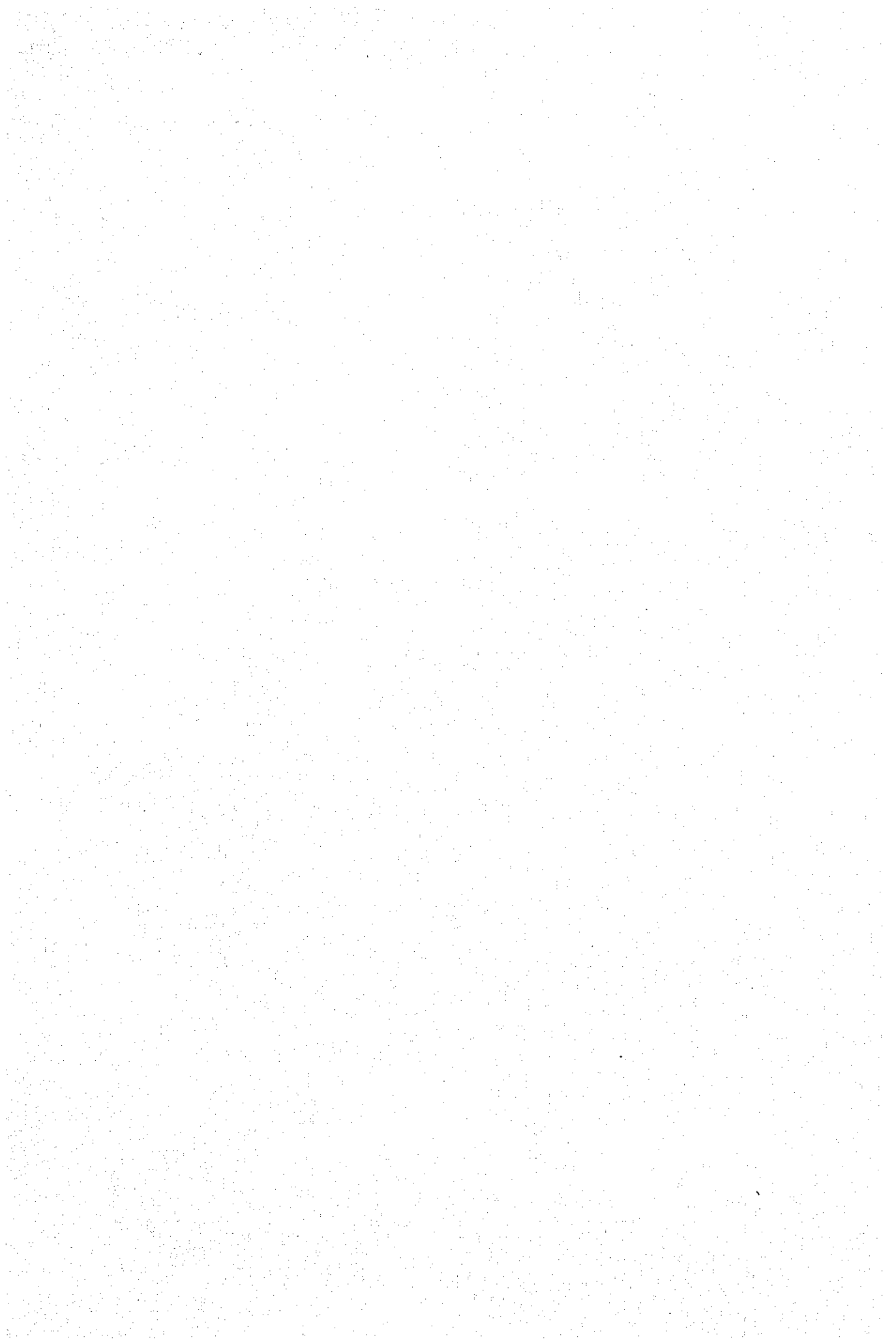
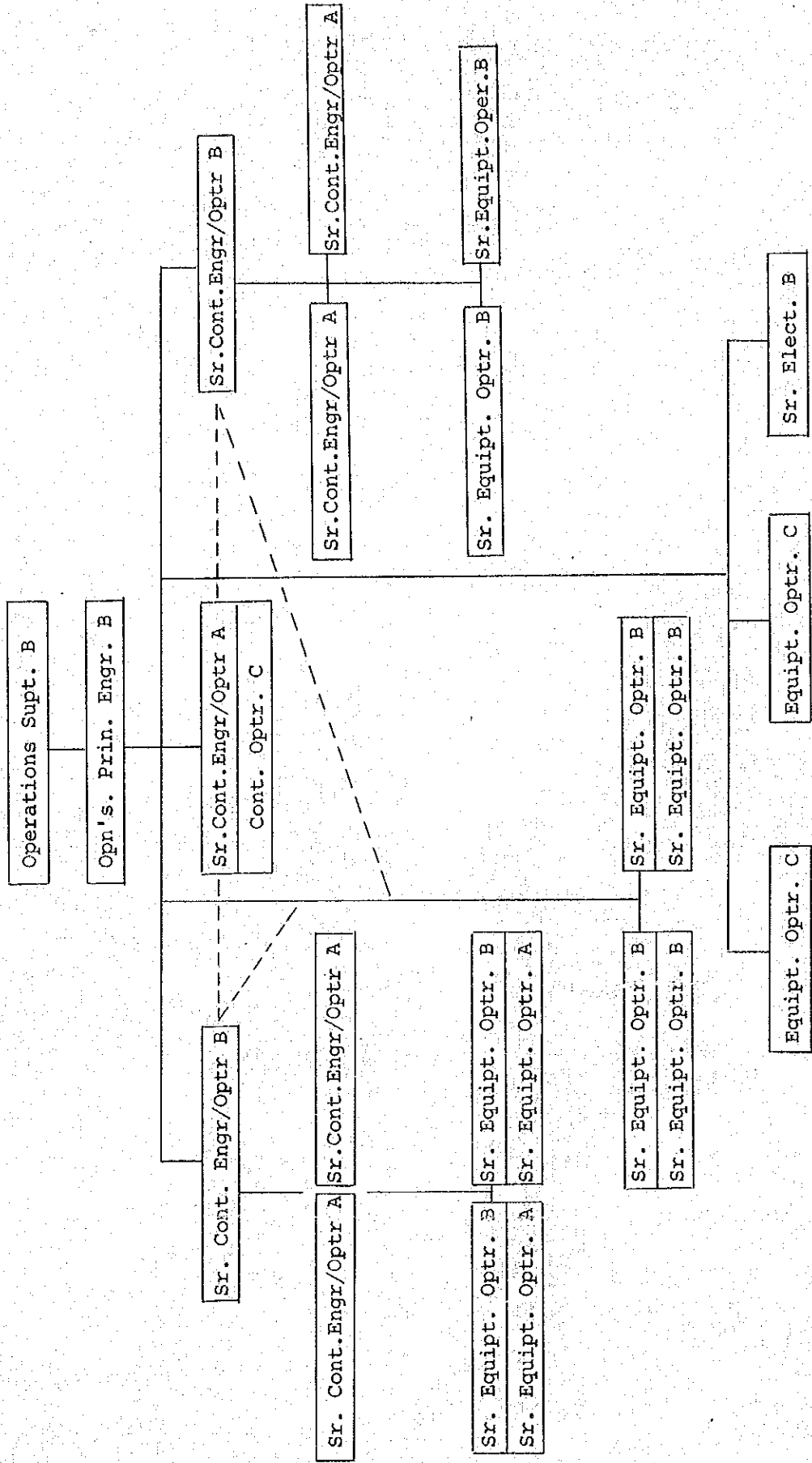


FIGURE 3-3 ORGANIZATION OF MALAYA POWER PLANT



3) Training

At this stage, NAPOCOR has already started improvement for training of NAPOCOR personnel as awarded by attached standard training schedule (example of Malaya) and particular training program executed for reinforcement of active operators.

From "TRAINING PROGRAM-UTILITY OPERATIONS NAPOCOR", we understand that NAPOCOR is executing much efforts for training of NAPOCOR personnel, and the "TRAINING PROGRAM" includes the fields of;

1. Maintenance of safe working environment
2. Switchboard - characteristics, system load/frequency/voltage regulations, control system, operation, etc.
3. Boiler operation - boiler proper (both once-through and drum), boiler accessories and auxiliaries, FW and fuel oil system, operation/start-up procedure/shutdown procedure/normal and emergency, by-pass system, hydrostatic test procedure, remote and direct manual operation, fundamentals of automatic controls, safety valves testing
4. Turbine operation - protective devices, lube and hydraulic oil system, main cycle diagram, cooling water system, hydrogen and CO₂ system, start-up procedure, shutdown procedure, testing of turbine protective devices, turbine wall stress evaluation (should not only be wall stress but also rotor especially around HP stage)
5. Auxiliary equipments - boiler and turbine auxiliaries, seal oil and dryer, screen house, fuel oil handling system.

And the references are:

1. Instruction manuals
2. Charts

3. Drawings
4. Technical literature, etc.

However, there are still some imperfections and unavoidable disadvantages, that is;

1. Imperfections -
 - * Coordination of B-T-G overall operation
 - * Coordination of power generating plant and S/S transmission line
 - * Fundamental properties of monitoring, instrumentation and control system
 - * Fundamental properties of water/steam quality
 - * Fundamental characteristics of water treatment system - water demineralizing equipment, condensate demineralizing equipment
 - * Basic plant design philosophies

2. Unavoidable disadvantage for actual execution at this stage

- (1) Trainer There is not enough trainer at this stage due to chronic shortage in NAPOCOR's active personnel

- (2) Basic and standard instruction, education textbook

There is not enough education materials which should be composed of qualified level/grade of education contents (minimum requirements) and commonly used by every trainer

At this stage each trainer shall prepare the education materials respectively by his own opinion.

- (3) Training term

Actually, the training term which NAPOCOR can cede for new operators is

approximately one (1) month covering basic theories, operation and maintenance and other than this time, the operators are educated by OJT (on-job-training) only.

The OJT is also, of course, very important, however, actual education - all fields in one (1) month - is not enough and too much items to understand, absorb and to use effectively.

But this short time education depends on the chronic shortage in NAPOCOR's active personnel partly and due to the not so enough education materials partly.

(4) OJT Trainer

At this stage Operations Superintendent Prin. Engineer rank is assigned for OJT trainer not actual work leader.

RECOMMENDATION AND ADVICE

There exists special matter particular to the Philippines (e.g. manpower outflow to Middle East) and this problem will be studied also by Philippine government base, and following will be some of our ideas to improve the situation.

1. For systematic training

To recruit highly educated personnel required in NAPOCOR, training center will be established and ordered management will effectively follow-up the program to perform the overall training and education. For further training and education e.g. plant actual utilization will be performed by OJT in each power plant.

2. For human resources

- 1) To educate much more new operator than actually required, if possible this education will be executed as national conduct.
- 2) To adopt national qualification certificate system

with national examination and give the qualified personnel advantage on step up system in power plants.

- 3) To adopt regulation system i.e. minimum staying period in NAPOCOR for each occupation post.
- 4) To adopt maximum staying period in one post (rank) and qualification system in NAPOCOR to promote into higher rank especially for assistant plant manager and plant manager, and also short pass system with the qualification examination.

3. For education materials

Standard education materials for power station engineer/operator and for S/S transmission line engineer/operator should be established at an early date to give same standardized grade/extent of education to all trainees, and this will be understood as minimum necessary education and information to the engineers and operators. The education materials will be composed of four (4) grades covering all relating fields, that is;

1. Elementary course -- basic theories, outline of power plant general etc.
2. Middle course ----- details of each facility, system and equipment etc.
3. Senior course ----- overall plant in detail, plant facility, human management
4. Case study course -- special education time to time for emergency case etc.

At this moment, "EMERGENCY SYSTEMS-STANDARD OPERATING PROCEDURES" provided by NAPOCOR task force team has just been completed. The text covers all of unexpected failures which NAPOCOR experienced up to now, and the emergency action to be taken instantaneously, recovering way are also covered in the text, and this could be used as one of the education materials for the above-mentioned "case study course". And the text will be revised/added some contents reflecting actual application to all power stations.

For the other education materials, it will be necessary for JICA team to assist, advise, and/or to prepare basic/general part of the education materials for NAPOCOR's reference, and refine work/finalizing work to suit the NAPOCOR's actual conditions/situations will be done by NAPOCOR's task force team.

4. For training program

As aforesaid present situations, the biggest problem to execute effective and actual education is: "how to achieve the scheduled program under the actual/present conditions" since there exist big human resources problem. However, to improve present situation, the precise education of personnel is indispensable for improvement from root and for maintaining stable and better technical level even if there is unavoidable disadvantage.

JICA team will be able to receive trainees of NAPOCOR personnel for first stage training improvement as part of this rehabilitation project. But the training by JICA team will be able to apply on key personnel only but not for all. And well-planned/uninterrupted education should be proceeded and maintained by NAPOCOR, such as the training center and effective management. The next page shows a reference example for NAPOCOR's uninterrupted education proposed by JICA team in this survey.

<u>Time</u>	<u>Purpose of Training</u>	<u>Items and Contents</u>	<u>Duration</u>	<u>Methods/Text</u>	<u>Trainer</u>	<u>Remarks</u>
At assignment	To instruct the outline of work in power station and to give knowledge on the new job	<ol style="list-style-type: none"> 1. Outline of the power station <ol style="list-style-type: none"> 1) Organization 2) Details of the job, part of the job 3) Situation in the electric network 4) Outline of facilities 2. Outline of the Boiler, Turbine, Generator <ol style="list-style-type: none"> 1) Main flow 2) Properties of steam/water 3) Kinds of fuel and its properties/combustion 4) Material selection, corrosion/erosion 3. Outline of automatic control <ol style="list-style-type: none"> 1) Basic instruction on elec. and instrumentation 2) Control system of B-T-G 3) How to read sequence 4) Concept of each interlock 4. Outline specification of B.T.G and attendant facility 	2-4 weeks	<ul style="list-style-type: none"> *Desk study *Training text books *Desk study & field explanation with schematic diagrams 	*Assistant chief/staff	*Actual field observation will be included.
1 month after assignment	To promote experience and interest based on own experience and leadership of seniors, and	<ol style="list-style-type: none"> 1. Main points of machinery/equipment operation 2. Main points of supervisory, record & its necessity 3. Proficiency of handling, operation, maintenance 4. Actual example of each kinds of control 	3 months	<ul style="list-style-type: none"> *Actual observation study (man to man) *Training text books & handling standards 	*Work leader	<ul style="list-style-type: none"> *Full time trainer will be available all the time. *Examination will be applied to check the effects of training.

<u>Time</u>	<u>Purpose of Training</u>	<u>Items and Contents</u>	<u>Duration</u>	<u>Methods/Text</u>	<u>Trainer</u>	<u>Remarks</u>
	to give self-awakening in the job	<ol style="list-style-type: none"> 5. Work standard and practice of ordinary work 6. Handling way of rotating machineries 7. Outline of anti-pollution facilities 				
4-6 months after assignment	To give further knowledge based on actual experience in actual plant and give enough practice for regular operator	<ol style="list-style-type: none"> 1. Details of B.T.G and attendant facilities 2. Details of Control, Protection & Monitoring System 3. Detailed handling methods based on each standard 4. Actual observation in periodical inspection plant 5. Actual join in start-up/trial run after periodical inspection 	6 months	Ditto	Work leader	Examination will be applied and re-training will be done on insufficient items
Occasional-ly 1 time/1-2 months for each items	Step up of operation technology for abnormal and/or emergency conditions	<ol style="list-style-type: none"> 1. Main points for equipments, machineries check/inspection 2. Main points on plant start up and shut down 3. Review on past records of troubles and failures 4. Review on improvement of handling and safety 5. Establish training program and actual training on assumed troubles and failures 	Occasionally 1-2 hours	Gathering education style	Assistant chief/work leader/staff	

<u>Time</u>	<u>Purpose of Training</u>	<u>Items and Contents</u>	<u>Duration</u>	<u>Methods/Text</u>	<u>Trainer</u>	<u>Remarks</u>
10-15 years after assignment	To give necessary knowledge required for leader of the place of work	<ol style="list-style-type: none"> 1. Leadership and its way for their subordinates 2. Improvement measures of job 3. Keeping measure of safety, sufficient circumstances 4. Review on example of troubles, failures 5. Management/countermeasure on abnormal/emergency stage 	3 days	<ul style="list-style-type: none"> * Gathering education * Discussion style * Publication style 	Chief/assistant chief	
		<ol style="list-style-type: none"> 6. Establish of knowledge on high pressure fluids and hazardous goods 7. Important point education on each unskillfulness points 8. Establish and modification of handling standard 				

Standard Training Schedule

General

1. Training of Personnel
 - a. Training program of operation technology
 - a. Operation supervisors
 - b. Emergency measures training
 - c. Training of maintenance technology

2. Standards of Rules
 - a. Operation Manual - Operation Supervisors
Instrument and Results
 - b. Maintenance Manual - Mechanical and Electrical
 - c. Unit Start-up/Shutdown Procedures
 - a. T S D
 - d. Water Quality Control
 - a. Chemical Section
 - e. Environmental Countermeasures Standards
 - f. Performance Administration
 - g. Administration Standards for spare parts
 - h. Boiler Chemical Cleaning Standards
 - a. T S D - Chemical

A. REINFORCEMENT OF SKILLS

1. February 2, 1982 - Planning for a Licensing Program
2. February 8, 1982 - Innovative Training

B. SETTING OF GUIDELINES AND SOP'S

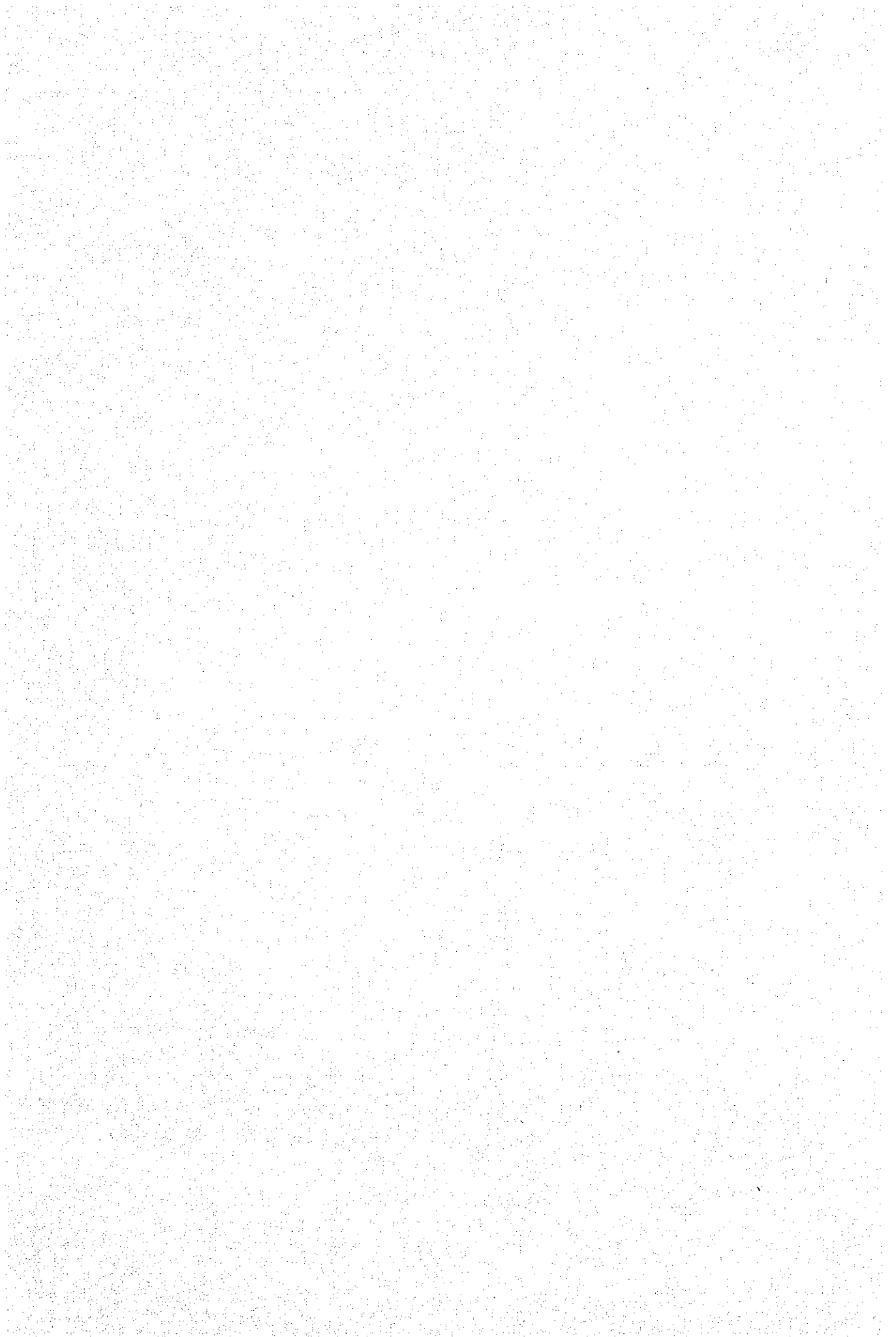
1. July 28, 1981 - Start-up SOP
2. November 9, 1981 - Shift Turnover
3. August 1981 - Daily Operating Logsheets
4. December 9-11 - Convocation on Emergency Systems
5. June 16, 17, 18, - Convocation on Operational SOP's
1982

C. UPGRADING OF CONTROL SYSTEMS, ETC.

1. September 1981 - Study for the Automation of Once-
Through Start-ups
2. December 1981 - Study for and Specification and
Procurement
Data logging

D. OTHERS

1. September 16, 1981- Launching of study teams
2. July 23, 1981 - Procurement of sequence of
events recording
3. November 13, 1981 - Design revision of Emergency
Systems
4. October 21, 1981 - Water Quality



MALAYA THERMAL PLANT

1. Standard Training Schedule

I. Orientation Courses for New Hirees (Trainees - A one-month

Course sponsored by the HRD to be attended by newly hired plant personnel.

II. Meralco Power Engineering Program (MPEP) - A one-year Course on Design, Operation and Maintenance of Power Plants sponsored by Meralco. About Three (3) Junior Engineers from each division are invited to participate.

III. Refresher Course on Thermal Power Plant Operation -

(a) Class room lecture - 10-day lecture series sponsored by HRD. The Scope is similar to Orientation Courses for newly hired personnel, only emphasis is given on start-up and shutdown procedures, tending of equipment and trouble shooting.

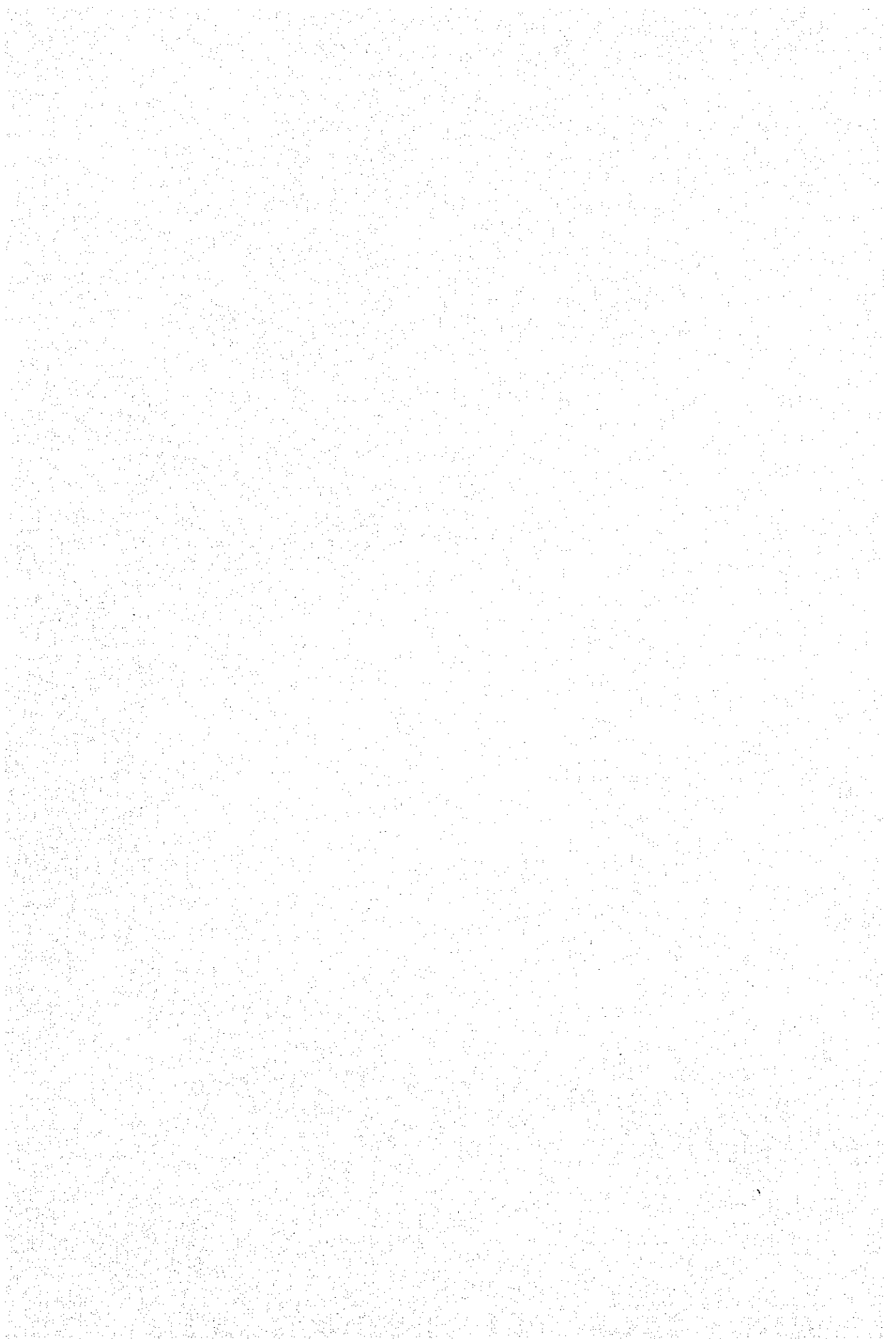
(b) On-the-job - Continuous series of lectures and discussion about normal plant operation. Chosen subject are especially related to current activities, recent problem, trouble or unit tripping. A 2 hour period is allocated during 1st and 3rd shifts to carry-out this refresher course.

2. Standard Training Text

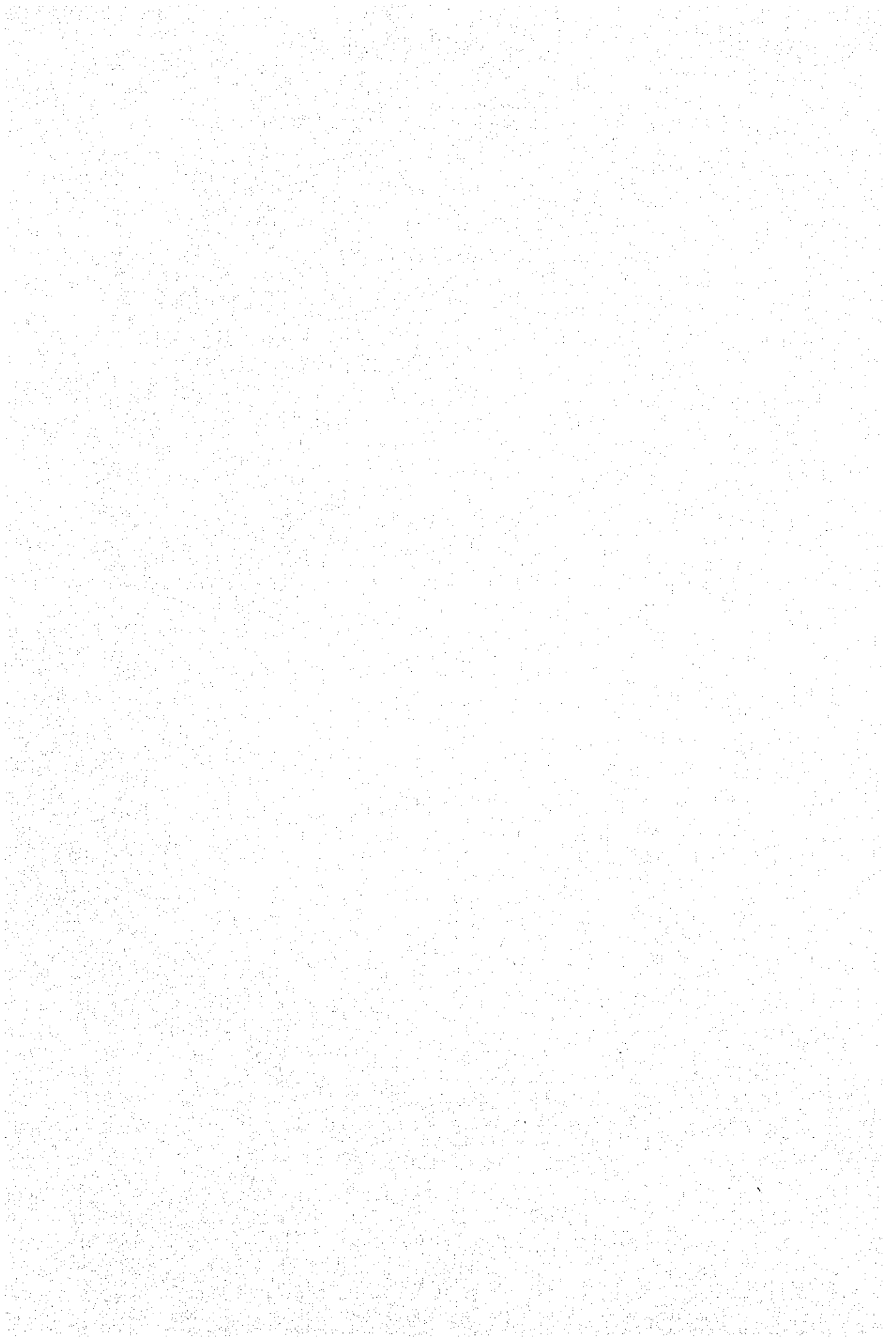
- a. Engineering Data
- b. Instruction Manuals for respective equipment, auxiliaries & accessories
- c. Commissioning Test results
- d. Exerpts from Power Magazine

3. Numbers of Personnel in one shift & total number of shift

There are five (5) shift groups with 23 men per shift.

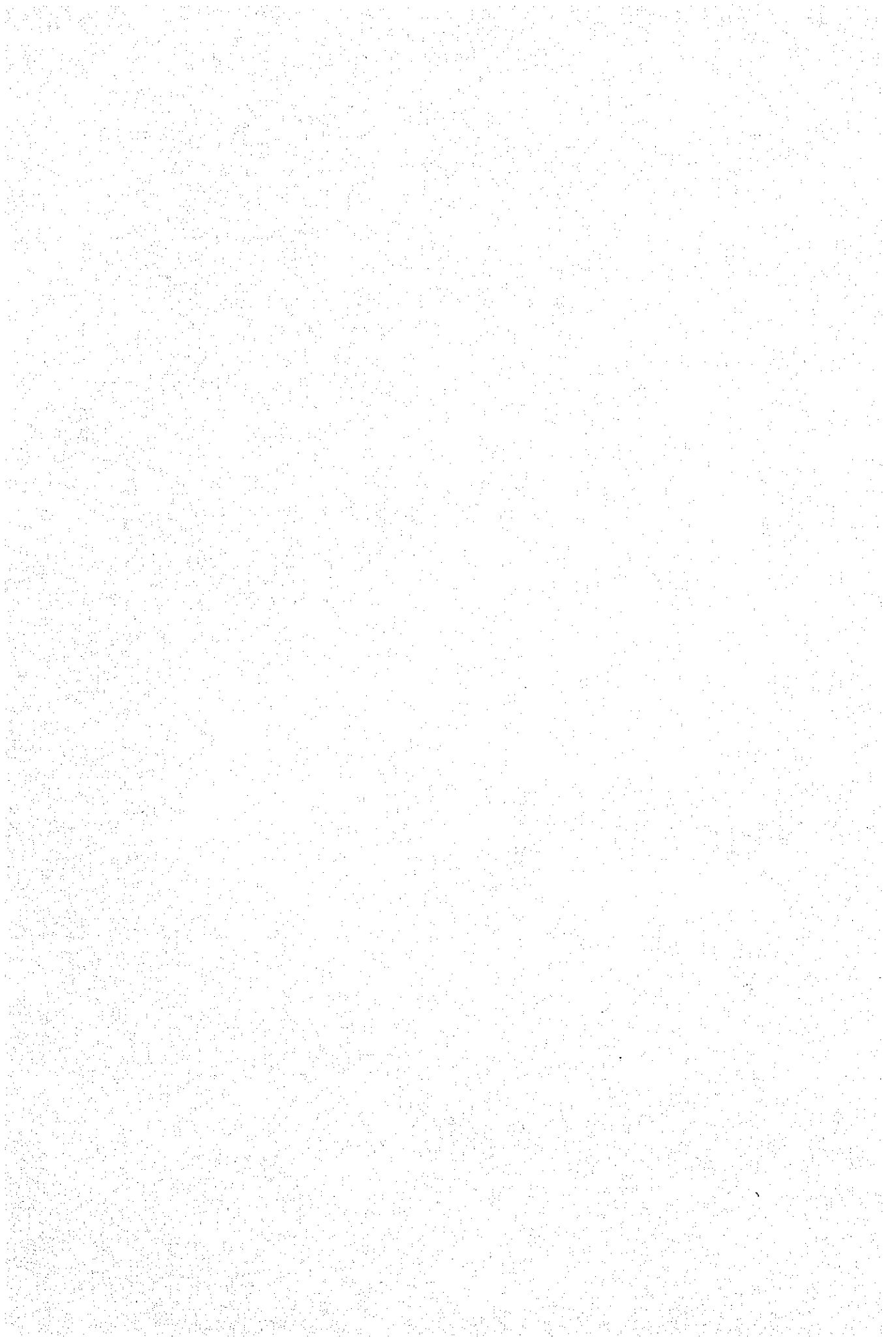


4. Numbers & Field of engineers other than Shift Operator
27 or 12.85% in the organization.
5. Time, Purpose, items and contents of Training
see attached.
6. Organization of Power Station
see attached.



I. ORIENTATION COURSES FOR NEW HIRES (TRAINEES)

<u>ITEMS & CONTENTS OF TRAINING</u>	<u>TIME (hrs)</u>	<u>OBJECTIVE</u>
I. FUNDAMENTALS		
16 To give the participants the opportunity to fully understand the basic principles involved in combustion, heat transfer, steam generation, conversion of energy from one form to another, generation and transmission of energy, friction and lubrication, etc.	16	
II. CONSTRUCTION FEATURES, PURPOSE, PRINCIPLES OF OPERATION OF EQUIPMENT/INSTRUMENT & CONTROL		
- Drum Type Boiler	8	To give the participants the opportunity to see with the aid of cross-section diagrams, drawings, prints, schematic diagrams, flow diagrams, etc., the construction and design of equipment and sub-systems. To enhance their know-how and gain more insight on the operating principles involved in the establishment of System set-ups.
- Once-Through Boiler	8	
- By-Pass System	8	
- Steam Turbine	24	
*Governing System		
*Turbine Protection		
*Control Oil System		
*Tube Oil System		
*Turning Gear		
- Generator	8	
- Plant Systems	24	
- Instrumentation and Control	16	
III. START-UP AND SHUTDOWN PROCEDURES		
- Drum-Type Boiler	16	To give the participants the opportunity to fully understand "why" and "how" of doing the established operating procedures. To know the operating units and precaution to be observe when starting, loading, unloading and shutting down all equipment or a system.
- Once-Through Boiler & its By-Pass System	16	
- Steam Turbine	16	
- Generator and Excitation System	8	
- Emergency & Normal Station Power	8	
- Other Plant Systems	16	

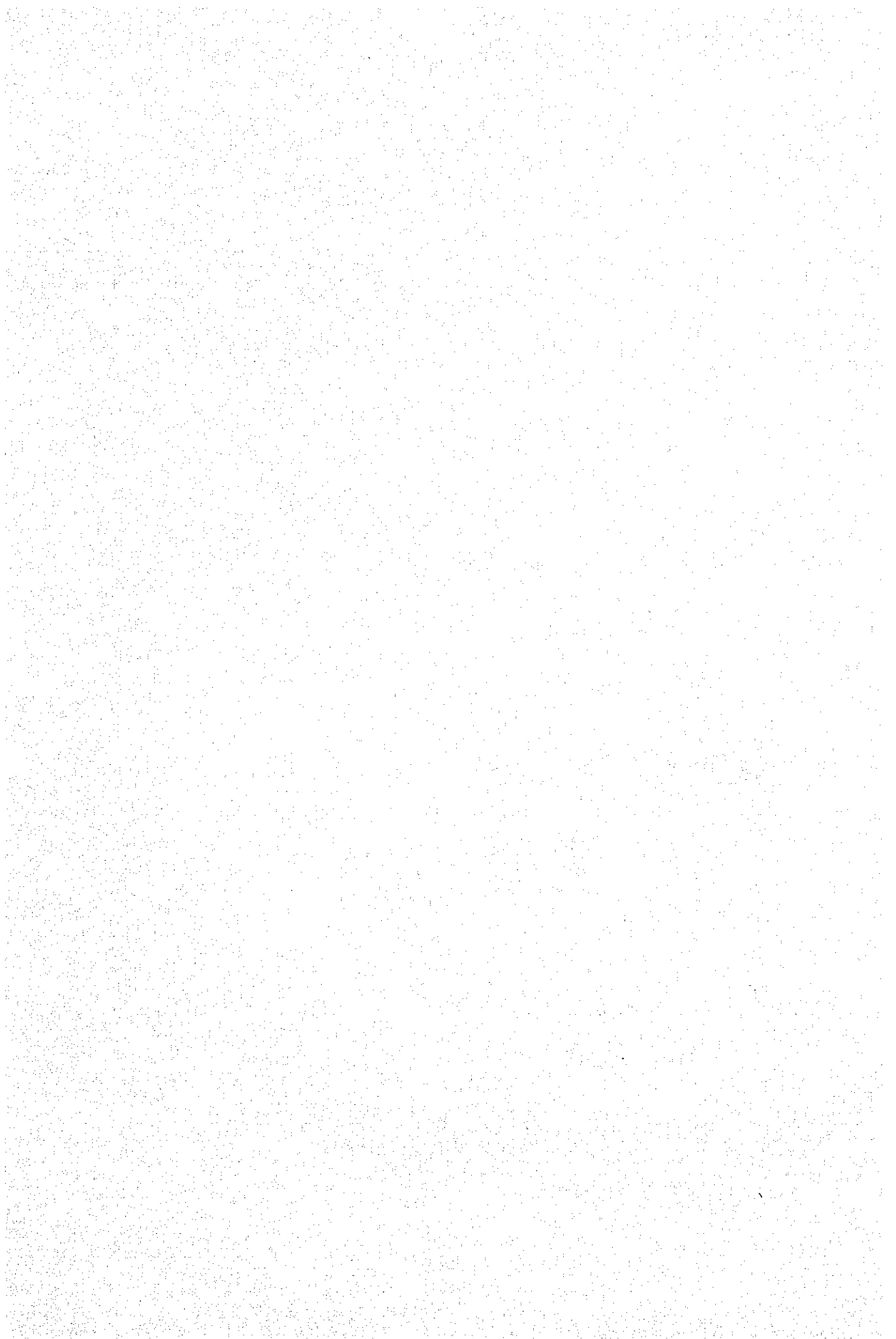


ITEMS & CONTENTS OF TRAINING

TIME
(hrs)

OBJECTIVE

- IV. TENDING OF EQUIPMENT
- Operating Parameter and its limit
 - Inspection of Equipment
 - Routine and Preventive Maintenance
 - Lubrication
 - Logging
- V. PLANT TROUBLES
- 16 To give the participants the opportunity to know "why" operating Parameters are recorded and "how" they are interpreted. To point out the importance of on-line and preventive maintenance.
- 16 To give the participants the opportunity to gain more insight into the causes of operational trouble, problem and the consequences ones not corrected. To discuss remedial & corrective measure appropriate for each kind of trouble.
- 8 Feedback on trainee's capability to accept more responsibility. To determine the effectivity of the program.
- VI. WRITTEN AND ORAL EXAMINATION

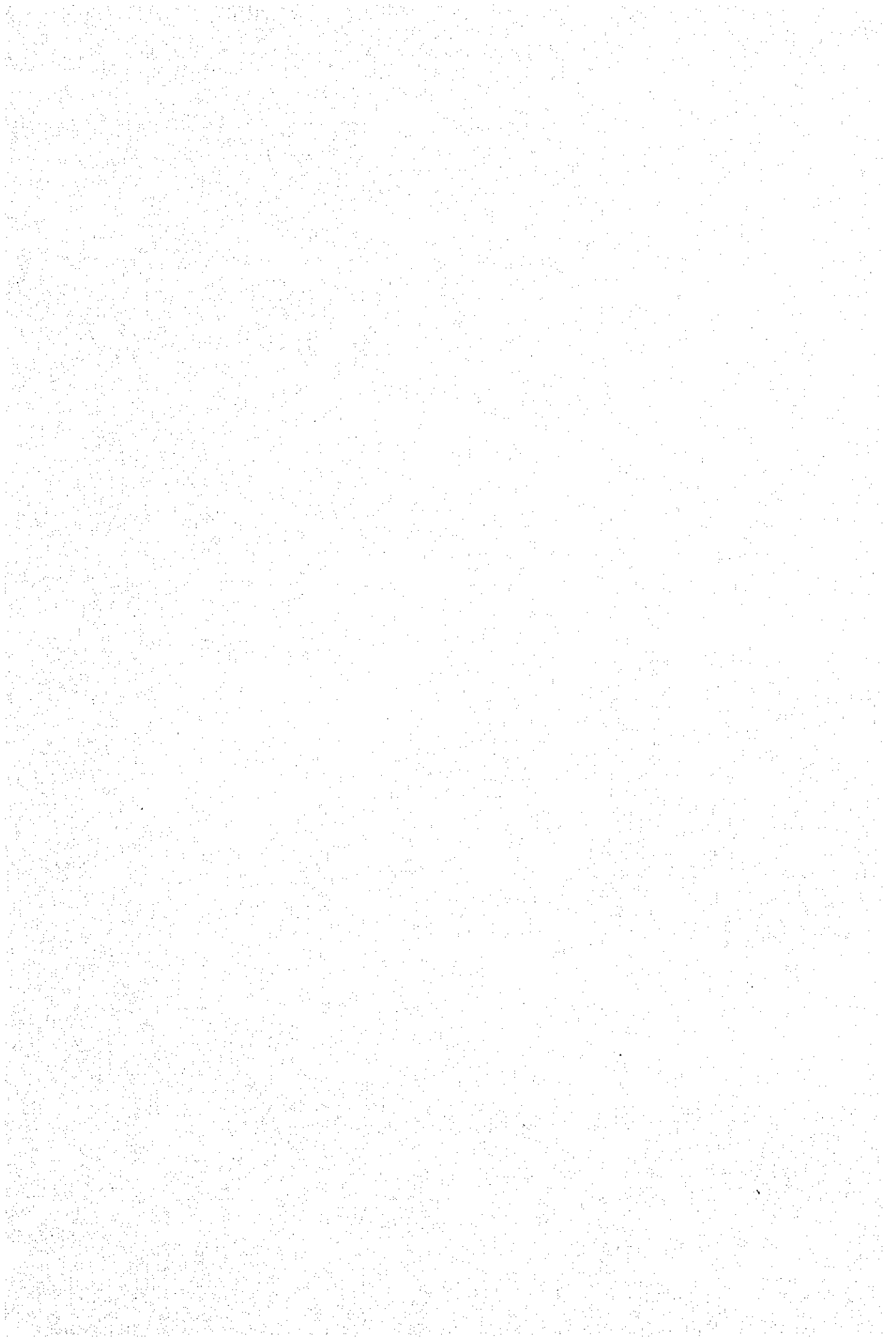


H I S T O R Y

- 1) Baseload Plants turned over to NPC ----- Nov. 1, 1978
- 2) Turnover M2 + T1 + T2 + Rockwell ----- Jan. 1, 1979
- 3) Number of people turned over ----- 976
- 4) Number of resignations up to the present ----- 178
- 5) Present complement ----- 1,105
- 6) Resignations (Jan. 1981 up to present):
 - Gardner-Snyder ----- 23
 - Malaya ----- 14

TRAINING PROGRAMS CONDUCTED BY HRD FOR MMRC

<u>Year</u>	<u>No. of People</u>
1979	975
1980	309
1981	276



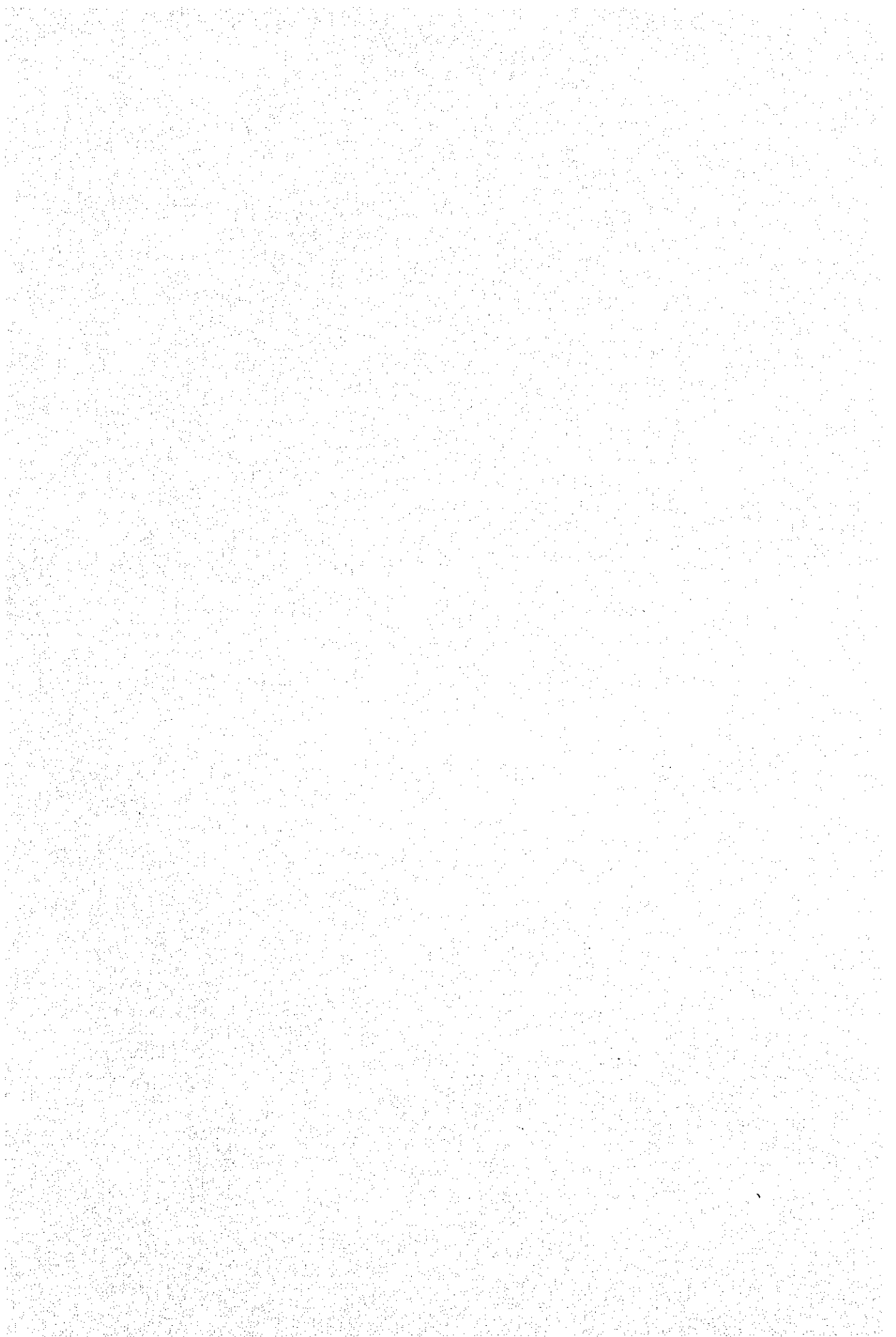
3-2.5. SKILL AND DISCIPLINE OF PERSONNEL

From actual feeling and experiences of JICA team through this survey including plant visiting and actual troubles occurred in team's staying in Metro Manila, it would appear that power plant personnel is manipulating the plant with their possible efforts and they are not so low skill level, so to speak, they are rather higher skill level than the other utility personnel to manipulate the imperfect plant e.g. less monitoring/instrument/control system faulty equipments. However, there are still imperfections to be improved basically, that is, to say,

"Well experienced personnel deficiency do exist especially senior operators as mentioned in section 2.1.2, however, recruitment and more vigorous training programs had been launched as mentioned in section 2.1.2. However, it has come to our attention that there are deficiencies in personnel discipline and moral to improve those existing problems from the root. It appears that there are certain differences in discipline and attitude of each personnel, generally operation-maintenance fields to brush up their performance. And there is certain unbalance in operation-maintenance fields. These properties can be aware from the actual action in emergency case, actual plant manipulation of fundamental/important points, ordinary cleaning/putting in order of inside power house, control room and interest in minor matters, e.g., valves, piping identification arrangement."

RECOMMENDATION AND ADVICE

As for this matter concerned, it is very difficult for JICA team to give recommendations and advices since this depends on basic and mean human properties which is sometimes particular to each country including different kinds of circumstances, native customs and original culture.



However, improvement of discipline is understood as fundamental and indispensable matter to resolve/improve the present situation/problem, and repeated/patient education up to plant manager must be practiced by NAPOCOR to improve their knowledge on actual case effectively.

And this education shall be included in aforesaid NAPOCOR's uninterrupted education.

