REPORT
ON
NATIONAL POWER STUDY
IN
REPUBLIC OF INDONESIA

VOLUME II
DESCRIPTION

November 1969

OVERSEAS TECHNICAL COOPERATION AGENCY

GOVERNMENT OF JAPAN

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1. ORGANIZATION AND MANAGEMENT OF ELECTRIC POWER INDUSTRY OF INDONESIA

1. ORGANIZATION AND MANAGEMENT OF ELECTRIC POWER INDUSTRY OF INDONESIA

1-1 INTRODUCTION

(1) This section makes special mention of the essential elements of the overall organization and management for electric power industry of Indonesia.

(2) The following backgrounds were taken into consideration.

a. Geographical backgrounds

(a) Indonesia consists of many islands, each presenting a different status in many aspects.

(b) A large difference in electric power supply condition exists between Java island which is the centre of politics, economy and culture, and other islands.

(c) Even among the exploitasis in Java island, there are some difference in the actual status of electric power supply and management.

(d) The present condition of transportation and communication systems makes hard the centralization of management. It is presumed that it will take a considerable time to construct satisfactory transportation and communication systems.

b. Economic backgrounds

(a) The Five Year Development Plan whose execution is most important for the development of Indonesia and the electric power industry, the basic industry that sustains it are inseparable from each other.

(b) However, the electric power industry of Indonesia is still in the initial stage of development. Therefore, its rapid and stable development should be considered as one of the most important subjects of national policy.

c. International backgrounds

(a) Many countries in the world are paying attention to the economic, social and cultural development of Indonesia.

(b) The electric power industry, which is one of incentive industries for the development of economy, society and culture, should be well managed and operated to obtain an international credit.

(3) Careful study and frequent discussions on the aforementioned matters in the item (2) led to the following recommendations.

a. By making clear distinction between the administrative organ for supervision and control and the executive organ for management, the independence and responsibility of the enterprise should be established.

b. The Directorate General for Power and Electricity should function as the administrative organ after making necessary reorganization.

c. The national enterprise of PLN should function as the executive organ after reinforcing the organization and management of its head office and adjusting the authority of exploitasis in accordance with the actual conditions of communication.

(4) We recognize that the Government of Indonesia will find it difficult to immediately apply our recommendations to the electric power industry alone. However, since these recommendations are the basis for the desired development of electric power industry, we hope that they would be implemented step by step. For this purpose, it will be necessary to get appropriate advices of consultant or adviser in view of the present status of Indonesia.

(5) The quality of organization, which is the backbone of management, is not justified by its structure, but rather by the number of persons in the organization who directly contribute to its activities. Whether a good organization can be established or not is determined by the success of human development, that is how its members grow active and dilligent and serve for efficient management.

We hope that our recommendations will contribute to the organizational readjustment, and promote the development of electric power industry which should be a basic industry of Indonesia.

1-2 PROBLEMS ON ORGANIZATION AND MANAGEMENT OF ELECTRIC POWER INDUSTRY OF INDONESIA

We highly evaluate the fact that the Directorate General for Power and Electricity and PLN are making efforts to cooperate with each other in the management of the electric power industry in spite of the presence of several adverse conditions, such as the existence of many islands, weak communication system, old facilities, necessity of importing major materials due to deficient industrial development, shortage of highly educated personnel, and so on.

At present, however, the electric power industry of Indonesia is facing many difficul-

ties such as the increase of waiting consumers, increase of privately owned generators, deficient power supply against the population increase, low percentage of electrification, unstable operating condition due to lack of spare parts, and poor quality of electric power due to deterioration of facilities.

For solving such many problems as early as possible, the Directorate General for Power and Electricity and PLN should establish a clear target and clarify their intentions in developing the electric power industry of Indonesia, and they should make further efforts to attain the target.

The ultimate purpose of the electric power enterprise is to contribute to the improvement of people's livelihood and to materialize the efficient management through which to promote industrial development. The management system should naturally be based on the self-supporting system and should provide benefit to the public. In other words, the target of management should aim at supplying abundant, cheap and good quality electric energy.

Beside that, we must take due account of the support of foreign investments in future which is the necessity for the development of electric power industry of Indonesia. The electric power industry of Indonesia should have the intention and responsibility to prove the fact that the investment is used most rationally and effectively to the supporting countries and also to the Indonesian people who must directly or indirectly bear the aid. To do so, the electric power industry should carry out its duty to meet the expectation of the supporting countries and obtain the confidence of the Indonesian people.

From the viewpoint of the above-mentioned target and intention, we have made studies on the organization and the management which are the basic element affecting the activity of electric power industry of Indonesia, and as a result, the following items were selected as the important points needful of improvement.

1-2-1 Basic Problems Pertaining to Management Responsibility

(1) Problems of expansion of facilities

a. While the planning of large scale projects which play an important role in the electric power industry of Indonesia at present and in future is undertaken by the Directorate General for Power and Electricity, their construction work is executed by PLN.

b. If the independency of planning a project for the electric power industry, which is a so-called facility industry, is not given to PLN, it means that no independency of managing activity is given to it. Therefore, PLN cannot assume the responsibility for the process of "Plan-Do-and See".

c. On the other hand, the Directorate General for Power and Electricity, which formulates the plan of project, cannot assume full responsibility for the project, because the actual responsibilities for the execution and maintenance are taken by PLN.

d. Consequently, the responsibility for the project which is most important for the management cannot be located under the present system, which will not only result in the poor sense of responsibility for management on the part of PLN, but will also make indistinct the government supervisory function over the national enterprise. This could finally lead to discredit with the supporting countries, and loss of public confidence. The present system is causing the following financial problems, preventing PLN from succeeding in the self-supporting system.

(2) Problems of finance

a. Accounting and financing division is provided in PLN to execute the ordinary accounting business. On the other hand, the internal control system is provided for keep the balance between each division for budget control and auditing.

b. Even though PLN has such a system it is hard to prevent the occurrence of following matters.

(a) Because the government directly controls the foreign investment which is quite important for the management of electric power enterprise, PLN cannot manage the whole money flow in the electric power industry, and the government is unable to perform the auditing function for the entire system of PLN.

(b) The responsible managing system, which should aim at the self-supporting system covering the whole necessary funds for the enterprise including foreign investments, cannot be established.

(c) Even though the internal control system is provided, it is hard to maintain strict control because the controller is the member of the accounting and financial division which operates the routine works.

(3) Target and responsibility of management

The target of business for electric power industry is as previously mentioned. Comparison of actual conditions of the exploitasis which should have a same regional target discloses some difference existing among each other as mentioned below, and many of them still find it difficult to attain their target.

a. Exploitasis largely differ from each other in the actual conditions of demand

as well as the balance of demand and supply.

b. They are also quite different in geographic conditions, which necessitates different sorts of power source.

c. As the result, they have quite different management conditions.

The above condition is unavoidable at present. However, from the viewpoint of management, we can say that the difference in the regional management conditions or the difference in obligation and idea among exploitasis does not justify the negligence of responsibility to achieve the common target of enterprise.

(4) Distribution of responsibility and authority

What we have explained about the responsibility for management also applies to the authority which is necessary to accomplish the management responsibility. In this connection, we have noticed the following situation which is peculiar to the electric power industry of Indonesia.

a. Insufficiency of capable staff

b. Indistinct relationship between the Directorate General for Power and Electricity which controls the foreign investment and the PLN head office which bears the overall management responsibility for the enterprise.

c. Big difference in financial conditions between the exploitasis noticeable from the viewpoint of self-supporting accounting ability.

d. Deficiency of the management system

On account of the above-mentioned conditions, the electric power industry of Indonesia has the trend towards centralization under the split control of the Directorate General and PLN, but the exploitasis have the trend for decentralization because they need flexibility in management suited for their individual regional conditions. Because the distribution of responsibility and authority is not yet established, the responsibility and authority of exploitasis tend to be decided by the ability of the manager and the financial condition of each exploitasi.

1-2-2 Problems of Management Operation

(1) Internal reporting system

The specified forms for the reports are defined by the purpose. There are several problems as mentioned in the following.

a. Comparison between the plan and actual result is not clarified in many cases, namely, the problem in planning cannot be revealed by the actual results, and the form is not able to reflect such problems.

b. Collected data are neither utilized for the analysis to be conducted from the viewpoint of management, nor are their contents sufficient for the analysis.

c. Reports are forwarded to the head office only, and no suggestions usable for self-criticism through comparison with other exploitasis are sent from the head office.

d. Data are not satisfactorily used for the preparation of statistics.

The reporting system is inadequate to attain its purpose and function, and the purpose of data which should be used for the activity is not clear. The insufficiency of guiding principle noted with the head office is also witnessed in the exploitasis. They have no data sufficient to make numerical expressions of the management condition.

Such condition greatly influenced our survey, and is greatly affecting the management operation of enterprise.

(2) Personnel management, training and education

It should be remembered that the personnel management is realized by personal contact in which one person supervises the other.

Therefore, better personnel management is obtained by better human relations and better personnel management is attainable by upgrading personnel through training and education.

It is reasonable that the OJT system is being adopted by PLN at present. However, there actually are some problems as follows.

a. Persons with the teaching ability play an important role in the progress of routine works, and have no time to spare for training and education.

b. It is not easy to execute the group training because of difficulty of transportation.

c. No training and education facilities are provided for group training.

d. No training system except the OJT system is established.

PLN realizes the necessity for a wide extent of training and education, but it is forced to adopt the OJT system only, and will inevitably reach to the limit of effect of training and education.

In making up the defficiency of morality due to the limited effect of training and education, the personnel management is liable to fall into poor management as seen in the TKK method which disregards the personality of individuals by placing them under restraint.

As a result, persons who manage and who are managed both tend to criticize the management system, impeding the realization of a good personnel management.

Under such a management system, the manager himself cannot realize what is most important and what should be done first.

And the transfer of persons, even if its necessity is recognized, is sometimes given up with resignation because of the difficult living condition and different environments in the new post. This makes the management system even harder for the managers to agree and cooperate.

In case of personnel management, the standard number of personnel is decided mainly by the number of consumers and sort and capacity of facility, but it should be rationally decided considering the difference of education level, constitutions of experienced years, age, regional conditions as well as the management system.

1-3 HOW THE ELECTRIC POWER INDUSTRY OF INDONESIA SHOULD BE

We desire that the electric power industry of Indonesia will take off as soon as possible from the present delayed condition. It should be developed into a basic industry serving for public benefit which promotes the development of industries, economy, society and culture as well as the improvement of national life.

Consideration of the essential character of electric power enterprise and the present status of Indonesia leads to the following conclusions on how the organization should contribute to the development of the electric power industry of Indonesia.

1-3-1 Electric Power Industry of Indonesia should be managed by a National Enterprise under the Supervision of the Directorate General for Power and Electricity

(1) Even if the electric facilities were fully installed, the electric power would be utilized only by some portion of the population who are able to use it, and not by everybody. In addition, the purpose and extent of utilization can differ by the inten-

tions of users and their sense of economic value. Essentially, the electric power is a commercial property which the users should purchase at a cost borne by themselves.

The industry which supplies electric power is completely different from other industries that provide such properties as roads, bridges and flood prevention facilities which are offered free for the benefit of everybody. In consequence, it is not fair that the electric power industry is managed directly by the government since this will imply that the necessary expenses must be borne by the taxes. It should be managed by an enterprise, whether national or private.

(2) Electric energy is indispensable to the developments of industries, economy, and national life, and the electric power industry is one of the most important industries having a direct influence on the national development.

Particularly in Indonesia, the development of electric power industry which stands under the following condition is connected closely to the national development. The electric power industry of Indonesia has many elements which justify its national enterprise. In fact, the electric power development is given top priority as an infrastructured element together with transportation and communication in the Five Year Development Plan.

a. For the economic development of Indonesia which is supported mainly by the foreign aids, the nation itself should assume the leadership and obligations. In order to attain the desired progress of the Five Year Development Plan which is the most important government obligation, the development of electric power industry, one of the basic industries, should be based on the national policy.

b. The electric power supply which is indispensable to the development of industries and economy is considerably insufficient in comparison with other countries. It is an important subject for the national policy to reinforce the electric power supply.

c. The correction of unbalanced conditions in the electric power supply which is indispensable to the improvement of living environments in each territory and island is the most important measure to be taken by the government which is bound to improve the national life and carry out a fair national policy.

(3) It is generally reasonable that the electric power industry is managed by regional enterprises in rationalizing the management by the thorough process from production to sales.

However, if such regional electric power enterprises are established in Indonesia at present, almost all of them would fail to maintain an independent management

because of the large gap existing between regions in many aspects.

(4) In view of items (1), (2) and (3), it is most desirable that the electric power industry of Indonesia be managed by the national enterprise which covers the whole country.

(5) A national enterprise is apt to fall into poor and uneconomical management. This is particularly so in case of a national electric power enterprise which covers the entire country without competition and supplies indispensable power for national life. If such a national enterprise falls into poor management, it would incur a serious loss to national economy. To prevent such a condition, competitive factors or a supervision system which takes the place of competitive factors should be introduced.

(6) The electric power industry of Indonesia needs foreign investments, and the electric power enterprise needs the government cooperation in introducing foreign investments. It is therefore evident that the government has the responsibility to supervise the effective use of investment.

(7) Considering the conditions given in items (5) and (6), the electric power enterprise of Indonesia should be a national enterprise under the supervision of the Directorate General for Power and Electricity.

1-3-2 How the National Enterprise of Electric Power Industry should be

(1) An enterprise of any kind, whether it is a national enterprise or a private company, should bear all the obligations due to its activities. The management of basic industries serving for public benefit, such as the electric power industry, greatly influences the national economy and life. In this way, the electric power enterprise is bound by the heavy responsibility of upholding proper management.

(2) The electric power enterprise should be established on the basis of the self-supporting system making concordance with its characteristic, as shown in Appendix 1-3, of giving public benefit.

(3) The management policy of the national electric power enterprise aims at performing functions required of the basic industries for public utility. Such functions include the rationalization and modernization to be effected in advance of other industries as well as supplying abundant and cheap electric power of good quality to the satisfaction of the nation's interest and expectation.

(4) The basic policy for the organization and administration of the electric power industry of Indonesia should be set up for the above-mentioned activities based upon the formation as mentioned in Section 1-3-1.

1-4 RECOMMENDATIONS

The function of the organization and management of the electric power industry is accomplished not only by the structure and method of management, but also by the activities of all the members who realize the purpose of structure and method of management.

We recommend the concept of organization and management under which the electric power industry should be achieved. We are aware of the fact that the actual administration condition of national enterprises involving the electric power enterprise of Indonesia does not allow the Government of Indonesia to apply our recommendation immediately and only for the electric power industry.

However, we believe that our recommendation is the fundamental element for the development of the electric power industry and it is important for Indonesia to make progress in pace with developed countries. Therefore, we hope that the Government of Indonesia will make up its mind to introduce our recommendation as early as possible.

Our recommendation does not touch on matters like the number of PLN exploitasis, delincation of districts for management, or actual number of personnel. Such items should be decided by the Government of Indonesia after the organization for the national enterprise of electric power industry has been established based upon our recommendation. The Government should perfectly realize the status of electric power industry of Indonesia, as mentioned and pointed out previously, concerning the problems on the organization and management, and how the electric industry should be. Then, persons concerned with the electric power industry of Indonesia should make a new structure and good arrangement for management.

The organization and management of national enterprises is one of important matters for the national administration, and is also the basis of the enterprise activity. Consequently, for the realization of good organization and arrangement, we recommend you to get advices from an appropriate consultant or adviser.

In accordance with the above concept, we recommend as follows.

(1) The electric power industry should be managed by the national enterprise which assumes full responsibility. Existing PLN should be assigned to this duty.

(2) From the viewpoint of administration, the Government should supervise the management of PLN (and PGN), and should also accomplish the function of supporting the development of PLN (and PGN). Existing Directorate General for Power and Electricity should perform this duty. In addition, as the administration of electric power industry is quite important and closely related administrative functions of the Governments, it is desirable to appoint an authoritative commission which coordinates the administration of electric power industry and all other relevant administrations, and

also makes recommendations for major items of works of the Directorate General for Power and Electricity.

Note: The word PGN is abbreviated hereafter.

PLN should be responsible for all the management of electric power industry, relieving the Government of direct responsibility for it. However, the business activity of PLN, which must serve for public benefit and has the importance of the basic industry, will greatly influence the administration. Therefore, the Government is responsible for the supervision of the management of PLN to prevent it from falling into inefficient management, and to check the condition of foreign investments. Accordingly, the Directorate General for Power and Electricity should accomplish the following duties.

a. Fundamental duties

(a) Supervising the electric power enterprise of PLN for its reasonable and effective management

(b) Supporting the activity of PLN for its smooth and prompt development as well as for the construction of electric facilities; and supervising the management system to secure the supply of abundant and cheap power of good quality

(c) Ruling uniformly all the electric power facilities not belonging to PLN, including the privately owned generating facilities

b. Main works

(a) Items of works which should be authorized by the Minister of Public Works

(i) Appointment of the President and the Vice Presidents of PLN

(ii) Authorization of the electricity tariff

(b) Supervision of the management of PLN

(i) Approval of the Directors of PLN

(ii) Grasp of the financial condition and auditing of account of PLN

(iii) Supervision of the actual power supply condition, especially grasp of service condition of PLN to the consumers

(iv) Supervision of the yearly and long range projects of PLN

(c) Supporting works for PLN

(i) Adjustment between the national economic developing plan and PLN management plan

(ii) Supporting the introduction of foreign and national funds, and the import of materials for the PLN project

(d) Others

(i) Affairs concerning an authoritative electric power commission, if necessary

(ii) Inspection of PLN electric facilities

(iii) Supervision and investigation of the electric facilities not belonging to PLN, involving privately owned generators, and adjustment between PLN and others

(iv) Making statistics for electric power and other energy sources and making investigation of actual conditions of foreign countries

(v) Establishment of security standards of electric power facilities (including the utilizing facilities) and the maintenance of standards for the electric metering and approval of electric meters

(3) The Directorate General for Power and Electricity should execute its new duties with a minimum number of qualified persons corresponding its new organization.

If the authoritative electric power commission is established, it is desirable that the commission consists of the Minister of Public Works, Chairman of BAPPENAS, several Ministers who are related to electric administration and the President of PLN.

The Chief of the Secretariat will be the Director General for Power and Electricity.

To realize the desired organization of the Directorate General for Power and Electricity based upon our recommendation, the following items should be considered.

a. Decision of definite contents of works to be performed by the Directorate General for Power and Electricity and PLN

b. Possibility of the arrangement of personnel based on the assumptive reinforcement of PLN

Appendix 1-1 shows, for reference, our idea which seems desirable for the structure of the Directorate General for Power and Electricity.

Our idea is based on the following conditions.

a. PGN as well as PLN should be reorganized.

b. PN INDRA-KARTA and PN WIDJAJA-KARTA should be reorganized into private companies as soon as possible.

(4) In case of a project for electric power development, PLN should conduct all the process from planning to execution. The planning and execution of the project should be carried out by different organizations in accordance with the scale as follows; large scale project by head office, middle scale project by exploitasis, and small scale project by branch offices. Except in the case of planning, each project needs an approval of the direct controlling office, and the head office needs a check of the Government.

(5) The following new systems should be established in PLN head office, and the reviewal on the overall organization to reinforce the internal structure should also be made.

a. New posts for two Vice presidents having the following duties should be established.

(a) Acting as the President's staff

(b) Control and management of the Committee of Directors

(c) One of them should manage all the power supply territory excluding Java island, especially on Sumatra island

(d) The other should manage the large size project throughout the process of planning to execution.

b. The following management committees should be established and placed under the direct control of the President.

(a) Committee of Directors

The purpose of this committee is to decide the highest object and policy of management as well as the long term basic plan, and to make the comprehensive adjustment and control for reviewing the actual results of management.

(b) Committee of Facility Plan

The purpose of this committee is to decide the highest object and

policy of facility plans as well as the long term project plans.

(c) Advisory Committee for Rewards, Punishments, Proposal for Business and Technical Improvement

One of the purposes of this committee is to improve the morality by making judgement on rewards and punishments, and the other is to establish the employee's proposal system and to make judgement on the proposal for business technical improvement.

c. General Planning Department should be established by absorbing the financial business.

(a) Giving assistance to the management committee (Drafting of management policy and compilation of budget)

(b) Comprehensive adjustment of long term planning

(c) Comprehensive control of the overall facilities and business

(d) Business concerning organization, structure, and authority

(e) Load estimation for overall electric power enterprises and each exploitasi, and for privately owned generators

(f) Management of budget and finance including raising of funds

(g) Grasp of achievements

(6) General Planning Division should be established at each exploitasi office by absorbing the financial business, and perform the following duties.

a. Making the drafts of highest management policy for exploitasis and direction for compilation of budget

b. Load estimation

c. Comprehensive adjustment of long term plan

d. Comprehensive adjustment for the project plan and overall business

e. Business concerning the authorization

f. Managements of budget and finance

g. Grasp of achievement

Appendix 1-2 shows the tentative plan of new structure and allocation of businesses for PLN head office and exploitasi office based on item Nos. 5 and 6. In addition to the realization of above-mentioned improvements of organization, efforts should be made to realize the following systems to improve the management of the entire PLN.

(7) Reinforcement of budget control system

a. The electric power enterprise has the following conditions by which importance is attached to budget control.

(a) The allocation of budget should be carried out to make it possible that the stable and balanced growth of enterprise may be achieved under the self-supporting accounting system and that the social requirements may be fully satisfied.

(b) Due to the large investment amount of necessary facilities, they occupy a large portion in the total capital cost, and this condition greatly influences the constitution of enterprise. In consequence, the investment in plant and equipment should be rationalized in order that the electric power enterprise will make a sound progress.

(c) Mutual adjustment should be made among various kinds and several aspects of management activities to attain an integrated and controlled activities.

b. Furthermore, the electric power industry of Indonesia, which must make a careful and accurate management of the foreign fund and national fund, needs the firm and unified financial system, involving the constitution of budget, term of budget, management of budget, compilation of budget (which clarifies the relationship of policy and plan of management with the purpose and method of compilation of budget), implementation and control of budget, etc.

c. As the result, it is necessary that the financial system which is the basis of management for the electric power industry of Indonesia should be made firm in future by making the following items clear.

(a) Clarification of the object and policy of management

(b) Clarification of important measures to be taken in each region

(c) Establishment of the fundamental policy for electric power facilities in Indonesia from the long term viewpoint as proposed by Section 2 of the

"Plan for Development of Electric Power Facilities".

(d) Reviewal on the tariff system which is recommended by Section 4 of the "Provisional Revision of Present Tariffs".

(e) Making a clear distinction between the expenditure and the installation cost

(f) Unification of materials for electric power facilities which are different by territories or even in a same territory at present

(g) Establishment of a unified fuel plan and other necessary plans based on the balanced of electric demand and supply

(8) Improvement of the internal reporting system into rational and instructive system

a. From the viewpoint of present condition, what is most required of the internal reporting system for electric power enterprise of Indonesia is to improve it to fit its purpose and function.

For improving the reporting system, the following purpose and meaning of the system should be understood. Especially, the reviewal on the reports related to item (b) below is important.

(a) Reports concerning the decision and planning

(b) Reports for checking and controlling the execution of an instructed plan which has been given in the form of order

(c) General reports concerning the trend and circumstances of the administration which reflect upon the general management

(d) Reports submitted independently about the problems which influence the management by the changes in circumstance and condition

b. The contents and the form of reports should be revised as follows to make them more functional in meeting the purpose, and the items which can be applied to analysis should be selected.

(a) The comments on the activity can be made by the manager and chief of each division.

(b) Indication is made as to what is the point, and what should be done from what viewpoint.

c. In addition, the following items should be taken into consideration to accomplish the function at the level of head office, exploitasis and branch offices.

(a) Proper timing of reporting

(b) Collecting data for comparing regional characters

d. From the viewpoint of the above-mentioned revision, the PLN head office should decide the contents and form of reports so that the head office can statistically grasp the actual status of each exploitasi, and also each exploitasi office should similarly decide the contents and form to grasp the status of its branch offices.

(9) Establishment of target for control system

It is not desirable that the head office evaluates the actual results of each exploitasi only by the simplified target of management because of great and different conditions between each exploitasi. The target for control system should be established in such a way that the manager and staffs of every exploitasi can materialize the effective and economical management keeping their mind on the cost account, and the PLN head office can incorporate the individual conditions of every exploitasi in the overall management activities of PLN.

(10) For the effective management, improvement of business management should be attained by introduction of machinery and other methods.

In order to make progress in the business management, the conditions in economic and other aspects should be taken in consideration from the long term viewpoint. For this purpose, it is desirable to establish a committee for modernization of business management as an assistant organ for the President of PLN.

(11) The following items should be considered in reviewing the responsibility and authority of the whole PLN organization.

a. Reinforcement of the management of PLN head office

b. Clarification of relationship among orders, instructions and guidance which will be given on the basis of the line and staff system

c. Reinforcement to cope with the new organization

d. Clarification of the authority of the head office, exploitasis and branch offices, e.g. for procuring fuel

(12) Achievement of active progress of training and education, and stabilization of personnel management

a. Considering the present situation of electric power industry of Indonesia such as the geographical conditions, educational facilities and the conditions of personnel, it is desirable to make a model of systematic personnel structure, and then to gradually establish the actual system based on the model, in order to enhance the training and education and stabilize the personnel management. The model should provide a personnel system involving staffs and employees graduated from senior high schools and colleges who may be assigned to managerial posts in the future.

b. From the viewpoint of actual condition of electric power industry of Indonesia, the OJT system is most appropriate for the time being. To improve OJT, the basic training and divisional training should be established for the managerial staffs, positively introducing the method of guidance and training for junior managerial staffs and employees. To encourage interest in training and education, the following training methods are quite effective: the examination system which does not need a space required for the group training and the correspondence course which is executed by the head office and by each exploitasi. Thus, the training and education system should be reinforced by commencing the staff training.

c. To improve the ability of personnel for the efficient personnel management, it is necessary that the importance of personnel management is realized by the staffs and employees. Not the personnel management which is forced by the staff in upper posts, but the one which stands to the viewpoint of humanity and is agreeable to everybody should be established. The management should make it a practice to transfer members who will be staffs in future, transfer them to appropriate places for creating the method of work analysis or work evaluation, and make them study how to check the aptitude of personnel, etc.

For establishing the above-mentioned policy, the team work of staffs and the introduction of new members under the unified policy is necessary. For making active transfer of personnel, houses for personnel should be provided by the enterprise at an appropriate rent.

d. With respect to the labor conditions including salary and wages in future, the personnel in electric power enterprise should not be considered as the public officials who are working at government offices. Their labor conditions should be separately established by considering the character of the enterprise, conditions of their activity in the new organization and the improvement of efficiency of enterprise.

2. PLAN FOR DEVELOPMENT OF ELECTRIC POWER FACILITIES

2. PLAN FOR DEVELOPMENT OF ELECTRIC POWER FACILITIES

2-1 YEARLY INVESTMENT PLAN

2-1-1 Introduction

(1) In this report we present our recommendations concerning the minimum investment program which should be implemented in the fiscal years 1969-1970 and 1970-1971. As about 80% of electric power facilities in Indonesia are located in Java island, the recommendation of this section is limited to Java island, where has the majority in the electric power systems of Indonesia. In regard of other islands in Indonesia, we hope that the Government of Indonesia establishes the investment plan in accordance as our recommendation for Java island.

(2) The Five Year Development Plan of the Republic of Indonesia is about to be implemented beginning with the fiscal year 1969-1970. The plan for the electric power industry constitutes a basis for the economic and social development of Indonesia, and the efficient use of the investment fund for electric power development is a fundamental necessity for the successful implementation of the Five Year Development Plan. The most important part of the administration of electric power development is the sound planning and execution of capital investment programs.

(3) The fiscal year 1969-1970 has a special significance in directing the execution of the Development Plan.

In order to prepare recommendations concerning the investment programs of electric power development in Java for this important year, we carried out field surveys, and have come to entertain the following feelings:

a. The investment programs formulated by the exploitasis are based on an estimated growth of load of about 14 percent per annum. The attainment of this rate of growth is presently considered too high as a feasible estimate.

b. It is an urgent task to establish a philosophy concerning the most effective strategy for the power supply facilities which is suitable for individual conditions in Indonesia. Especially, considering the unbalance among the existing facilities, it is essential to examine positively the whole system of the supply of electricity from generation to distribution, from the stand-point of consistent system planning.

c. There are some areas where there is an acute shortage of power supply. The strengthening of power plants must be started immediately in these areas.

d. As a whole, the distribution facilities are the weakest among the electric power supply facilities, and the distribution voltage is exceedingly low in many areas. Thus, it is necessary to attach importance to the investments in the rehabilitation of distribution facilities.

(4) Based on the above-mentioned impressions, we proceed to the detailed analyses of the investment programs 1969-1970 and 1970-1971 in Java. Our fundamental approach is to investigate the following:

a. How to break through the bottlenecks most effectively with the minimum investment.

b. How to match this program with the vision of the future development of the electric power industry of Indonesia.

(5) As the investment plans for 1969-1970 and 1970-1971 in the Five Year Development Plan are slightly different in their implications, a special attention is given to the imminent rehabilitations in 1969-1970 fiscal year, and to the introduction of a long-range viewpoint in 1970-1971 fiscal year, in the specific studies for the facilities planning.

2-1-2 Load Estimation

(1) Basic philosophy

a. In studying the investment plans of 1969-1970 and 1970-1971 fiscal years, we estimated the loads up to 1975 by seven years as a minimum period necessary for the purpose of establishing early and proper measures to ensure the required supply capabilities, including the development of power sources for meeting the increasing demand.

b. In estimation of the load for the next five years up to 1973, minimum required rate of load increase was estimated, taking into account present status of power supplying capability, necessity of priority rehabilitation of existing facilities and other circumstances.

c. In regard to the load estimations for 1974 and 1975, it is expected that the economic development of Indonesia will be more accelerated from the latter half of 1970's through 1980's than the period of the first Five Year Development Plan. Correspondingly, the demand for electric power will be increased substantially.

The fiscal years 1974-1975 and 1975-1976 are considered to be the transitional years when the rate of load increase is expected to be gradually accelerated.

(2) Results of load estimation

Upon studies which are explained below, the load up to 1975 (corrected by the power supply capability) is estimated as follows, under the classifications of areas and years. (See Appendix 2-3)

Table 2-1-1 Estimated Loads by Areas and by Years

(Maximum Load at the Generating End)

Units: MW & %

Area \ Year		1968 (Actual)	1969 (Estimate)	1970 (Estimate)	1973 (Estimate)	1975 (Estimate)	Average Annual Increase		
							1968 – 1973		1973 - 1975
							This time	Exploitasi	
West	XII	84.0	(10.5) 92.7	(10.5) 102.5	(13.0) 145.9	14.2 189.7	11.7	13.3	14.0
	XI	53.3	(8.5) 57.8	(8.5) 62.7	(11.9) 85.8	(13.2) 109.6	10.0	13.3	13.0
	Sub-total	137.3	(9.7) 150.5	(9.7) 165.2	(126) 231.7	(13.8) 299.3	11.0	13.3	13.6
Central	X	39.3	(7.9) 42.4	(7.8) 45.7	(11.8) 62.6	(13.2) 79.9	9.8	15.0	13.0
East	IX	59.3	(4.4) 61.9	(5.7) 65.4	(25.8) 95.0	(13.2) 121.4	9.9	15.0	13.0
Total		235.9	(8.0) 254.8	(8.4) 276.3	(15.4) 389.3	(13.6) 500.6	10.5	—	13.4

Note: Figures in parentheses indicate the percentage of increase over the previous year.

a. The load for the five year period up to 1973

a-1. The estimation of the minimum required rate of load increase (tentative estimation) is estimated as follows, on the above-mentioned basic philosophy, and considering that the load increases caused by the economic growth, voltage improvement, and electrification.

Table 2-1-2 Load Estimation (Annual average rate of load increase) up to 1973

Unit: %

Contributing Factors \ Area / Period		Djakarta		All Java excepting Djakarta	
		1 - 2 Years	3 - 5 Years	1 - 2 Years	3 - 5 Years
Load Increase by Economic Growth	Load Increase by Population Increase	3.5	3.0	2.5	2.5
	Load Increase by Increased Per Capita Income	1.5	3.0	1.5	3.0
Load Increase by Voltage Improvement		2.6	2.6	2.6	2.6
Load Increase by Electrification		3.0	4.0	2.0	3.0
Total		10.6	12.6	8.6	11.1

a-2. Checking of the results of load estimation (original)

(a) If we compare the actual rate of national economic growth with the actual rates of load increase in the past, the average rate of load increase has been almost twice as much as the average rate of economic growth, notwithstanding the remarkable fluctuations from year to year.

Table 2-1-3 Rate of Economic Growth and Rate of Load Increase

Unit: %

Period	Rate of Economic Growth (A)	Rate of Load Increase (B)	(B)/(A)
1950 – 1966	3.4	6.6	1.94
1958 – 1966	2.7	6.3	2.33

(Figures for economic growth are estimated by the World Bank and rate of load increase are by PLN.)

As the Island of Java produces more than 80 percent of the total energy production in Indonesia, the above relationship between the economic growth and the load increase in Indonesia is applied to the estimation at this time. The rate of economic growth in the next five years up to 1973 is calculated which turns out to be about 5 percent same as the Five Year Development Plan estimates, and our estimate, therefore, is believed to correspond with the estimate by the Government of Indonesia.

(b) Checking of our estimation by using the projection based on the tendency of the past

The results of our estimation* by using the projection based on the tendency of the past for each exploitasi are as follows.

*Note: * The least square method is applied in the calculation.*

Linear equation:

The estimation is made by using the same tendency of increase as that of the annual average in the past.

Quadratic equation:

The estimation is made by using the same tendency of increment (quadratic increase) as that of the projected ratios of increments year by year in the past.

Logarithmic equation:

The estimation is made by using the same tendency of increase as that of the average projected ratio of increase in the past.

Table 2-1-4 Rate of Increase of Over the Previous Year

Unit: %

Exploitasi	Equation for Calculation	1969	1970
XII + XI	Linear Equation	6.8	5.6
	Quadratic Equation	4.6	4.0
	Logarithmic Equation	7.4	7.4
X	Linear Equation	2.5	2.5
	Quadratic Equation	0.1	0.0
	Logarithmic Equation	2.8	2.8
IX	Linear Equation	5.8	5.5
	Quadratic Equation	8.2	8.2
	Logarithmic Equation	7.4	7.4
Java Total	Linear Equation	5.2	5.0
	Quadratic Equation	3.6	4.5
	Logarithmic Equation	6.6	6.6

As shown in the above table, the majority of the calculated rate of load increase in Indonesia are less than 6 or 7 percent, and the maximum is 8.2 percent. For the whole Island of Java, the maximum rate is lower than our estimates of 8.0 percent for 1969 and 8.4 percent for 1970. Our estimate of 10.5 percent for the average rate of load increase from 1968 to 1973 seems to be a little higher than the projected rate of increase based on the past tendency.

Therefore, it seems to us that in order to realize our estimate of 10.5 percent as the average rate of load increase for the next five years, more vigorous efforts will be required.

b. The load for 1974 and 1975

The results of our estimation of the annual rates in 1974 and 1975 of average load increases for various factors of load increase are shown in Table 2-1-5. The estimations are made for the Djakarta area and the rest of Java.

It should be noted that the factor of increased electric power use by a consumer, which has been excluded from our consideration for the minimum rate

of necessary load increase estimated up to 1973, is taken into consideration this time. We also expect an increase in the rate of increase of electrification and a decline in the rate of load increase caused by the improvement of distribution voltages.

Table 2-1-5 Estimation of Annual Rate of Average Load Increase for 1974 and 1975

Unit: %

Item \ Area		Djakarta	The Rest of Java	Remarks
Load Increase caused by Economic Growth	Population Increase	3.0	2.5	The estimation of the rate of population increase from 1969 to 1973 is applied.
	Per Capita Income Increase	3.0	3.0	The estimation of the rate of per capita income increase from 1971 to 1973 is applied.
Load Increase caused by the Voltage Improvement		1.5	1.5	As it is expected that there will be a substantial progress in the voltage improvement during five years of 1969 through 1973, there will be a decline in the rate of load increase to less than the annual rate of 2.6 percent up to 1973.
Load Increase caused by the Increase in the Rate of Electrification		4.0	4.0	It is assumed that the electrification will be promoted, more than before 1973, toward the goal of about 25 percent around the year 2000. For the industrial use, the elimination of waiting consumers is thought to correspond to this category.
Load Increase caused by the Increased Electric Power Use by a Consumer		2.5	2.0	We included this factor in our load estimation as we can expect the increased electric power use more than the increase in per capita income. For the industrial use, the transition from the dependence on the industrial self-generation to the PLN supply (the decrease in the proportion of the industrial self-generation units) is thought to correspond to this category.
Total		14.0	13.0	

As shown in the Appendix 2-18, we attempted a long-range estimation of load, and the upper-limit of the annual rate of the increase in peak load at about 14 percent in Java from 1970 to 1980 is estimated.

c. Revision of our tentative estimation with the consideration of power supply capabilities

Because the shortage of power supply is expected in the next three or four years, we studied the feasibility of our tentative estimation by comparison of the

power supply capabilities of the existing plants and the planned future additions of plants with the tentative estimation.

We come to the conclusion that in West Java, our tentative estimates are feasible, but in Central and East Java some negative revisions are necessary, considering the shortage of power generating capacity at present and in the near future. Therefore, the load increase for Java total is estimated as in Table 2-1-6.

Even with the final estimates, there exist some problems of reliability in Central Java, which will be explained on power plants.

Table 2-1-6 Estimated Load Increase (Java Total)

Unit: %

Year / Estimation	1969	1970	1971	1972	1973	Average 1968 - 1973
Tentative Estimation	9.1	9.2	10.7	11.7	12.3	10.6
Final Estimation	8.0	8.4	10.1	10.9	15.4	10.5

2-1-3 1969-1970 Investment Plan

(1) Scope of investment

a. Taking account of our finding on the above load estimation and the target mentioned in below, the necessary investment amount for 1969-1970 is shown in Table 2-1-7, and is increased by 1,290 million Rp. from the original budget amount.

Based upon the effective operation of the existing power facilities, the followings are aimed at as the basic targets.

(a) Concerning the balance between the demand and supply of power, to strive utmost for ensuring the power supply capability.

(b) Concerning the customer services, to improve excessive drops in consumer voltages, with an emphasis placed on central area of the cities.

Table 2-1-7 Revised Investment Program for 1969-1970 (Java)

Unit: Million Rp.

Fund / Facilities	*Original Program		Revised Program (Our Proposal)		Difference	
	Local Currency	Foreign Currency	Local Currency	Foreign Currency	Local Currency	Foreign Currency
Power Plants	363	945	363	595	0	△350
Transmission lines and Substation	475	945	553	677	+ 78	△268
Distribution	411	455	944	1,752	+ 533	+ 1,297
Diesel Plants	138	788	138	788	0	0
Sub-total	1,387	3,133	1,998	3,812	+ 611	+ 679
Total	4,520		5,810		+ 1,290	

Notes: *(1) Mark * shows the original program for 1969-1970 for Java Island formulated by the Government of Indonesia.*

(2) Diesel plants are not included in Power Plants.

(3) If we include the funds for electric power development outside of Java, survey and researches, and expansion of city gas, the total revised budget amounts to 12,175 million Rp. which is an increase by 1,290 million Rp. from the total budget of 10,885 million Rp.

b. The following is our revised program of investment for the fiscal year 1969-1970.

(a) Power plants

We examined the investment program by attaching importance to the analysis of the operation of the existing spare units and to the measures to improve the firm capacity of the existing power sources.

In West Java, by the more efficient operation of the main system and the improvement of the condition of operation and maintenance, it is possible to increase the present firm capacity.

Considering the balance of demand and supply in the Djakarta area, it is not necessary to install a new gas turbine station, which is proposed in the original 1969-1970 investment program. But, with a definite shortage of power supply in the near future in this area, it is urgently necessary to start the construction of the third unit of Priok steam power station as soon as possible.

In Central and East Java, the shortage of electric power is remarkable. Especially in Central Java, the construction of the proposed steam power station in Semarang should be started as soon as possible.

It is possible to eliminate the amount of 390 million Rp. for Djakarta gas turbines, but, there must be an additional fund of 40 million Rp. for the construction of the Semarang steam power station. The total revised budget for 1969 for the construction of power generating facilities will be 958 million Rp., which is less by 350 million Rp. than the original budget.

(b) Transmission line and substation

Emphasizing on the elimination of over-loaded facilities, the improvement of reliability by the interconnection of systems, and the strengthening of communication systems, the following items of our recommended investment program for transmission lines and substations are proposed.

(i) Interconnection between Tuntang and Ketenger systems

(ii) Supplementary works for double-circuit lines from the existing single-circuit lines

2 in Central and East Java

(iii) Construction of new substations

2 in West Java
1 in Central Java

(iv) Power line carrier communication systems

New construction	2 systems (Central Java)
Expansion	1 system (West Java)

Accordingly, the total budget for transmission lines, substations and communication facilities amounts to 1,230 Rp. which is less by 190 million Rp. than the original budget of 1,420 million Rp.

(c) Distribution facilities

In order to carry out the essential work for rehabilitation along with the more efficient use of existing facilities, the emphasis should be placed on the reinforcement of high tension lines, the elimination of the overloaded distribution facilities and the improvement of consumer voltage in urban areas.

We examined the budgets proposed by the head office of each exploitasi in Java from the above-mentioned viewpoint, and come to the following conclusion:

(i) 20 KV distribution line; slashed 551 million Rp.

(ii) High tension line; slashed 1,280 million Rp.

(iii) Low voltage distribution line; slashed 730 million Rp.

As a whole, even if the total budget for distribution requested by all the exploitasi offices in Java is decreased by 2,561 million Rp., the total budget necessary for the minimum investment in distribution is three times as large as the original government budget of 866 million Rp., allocated for distribution facilities. Thus, it is necessary to secure additional 1,830 million Rp. for distribution facilities.

(2) Power plants

a. Fundamental approach

We studied the 1969-1970 investment programs for electric power facilities, by putting our emphasis on the analysis of the actual condition of power plants in each exploitasi.

We formulated a program of investment for the fiscal year 1969-1970, with consideration to use the existing power plants more effectively and to decide on the most economical size and the most timely construction of power plants to meet the increasing demand.

b. Our finding

(a) In West Java, if PLN improves the operation of the existing system by using the existing stand-by units more effectively and doing the daily operational and maintenance works of power plants more carefully, it is possible to supply reliable power and to meet the increase of load for the time being. Thus, the gas turbine which is planned for the fiscal year 1969-1970 is not necessary, if the above conditions can be satisfied. But, it is important to implement the extension plan of Priok steam power station as soon as possible to carry the future increase of load.

(b) In Central and East Java, the power shortage is apparent in comparison with the situation in West Java. Thus, it is difficult to keep the stable power supply corresponding with the increase of load, even with the improvement of the operation of existing plants.

For the fundamental solution of this difficult problem, there is only one way, which is to promote the construction works of power plants under construction and to implement the plan for the construction of new plants as soon as possible.

(c) As a result of our study, we found that it is possible to delete the fund for the installation of gas turbines in Djakarta, which is included in the investment program for the fiscal year 1969-1970 (the cut of 3,900 million Rp.), but it is necessary to add the amount of 40 million Rp. to the total budget, for the promotion of the beginning of the construction works for the Semarang steam power station.

c. Explanation

c-1 West Java

(a) PLN has the policy of having some stand-by units at each station in calculating the firm capacity of both hydro power and thermal power stations. In the case of interconnected system, however, it is necessary to replace the existing policy with the policy of sharing the stand-by units among power stations in the whole system. Under the existing policy, PLN is bound to have the more excessive stand-by units as the load increases, which results in the uneconomical pattern of investments in power plants.

(b) For instance, the stand-by units are provided in both Djatiluhur hydro power station and Priok steam power station which are interconnected to the same system. Even though these two stations are operated under different enterprises, it seems enough to keep one stand-by unit at either station from the viewpoint of system operation. In order to determine the location of stand-by unit either at Djatiluhur or Priok, we must examine the measures to cope with accidents and study the economy and reliability of power supply. As to the daily operation of stations, the maintenance of the facilities with careful inspections is required. Thus, by the effective system operation as mentioned above, the firm capacity of power sources in West Java can be increased. The load increase can be adequately coped with by the existing facilities for the time being, and the excessive investments in the power generating facilities can be restrained.

(c) Owing to the troubles of high-pressure feedwater heaters at the Priok steam power station which is at present the major power source in West Java, the firm capacity of each unit is only 22 MW compared with the rated capacity of 25 MW. The high pressure feedwater heaters should be repaired as soon as possible, not only to increase the firm capacity, but also to recover the thermal efficiency.

In the following table, the relationship between the firm capacity of power sources and the load increase in West Java is shown.

Table 2-1-8 Firm Capacity and System Load in West Java

Unit: MW

	1968	1969	1970	1971	1972	1973
Annual Load Increase (%)		9.7	9.7	11.1	12.1	12.6
Load	137.3	150.5	165.2	183.6	205.8	231.7
Firm Capacity during Wet Season	174.5	174.5	177.5	202.5	*272.5	272.5

Note: * *2 units of 50 MW for Priok units 3 and 4 will be put into operation.*

In order to sustain the firm capacity indicated in the above table, it is necessary to carry out an effective program of the maintenance of existing facilities, and to manage the stand-by units more efficiently by thinking in terms of the total system which includes units both at Djatiluhur and Priok. In addition, it is required to recover the rated capacity of Priok steam power station by October, 1970 at the latest, by repairing the high pressure feed-water heaters, so that it is possible to have the continuous operation of two units.

If the above-mentioned conditions can be satisfied, the firm capacity will be enough to meet the load increase as shown in the above table. Consequently, it is possible to delete the fund for the new gas turbines in Djakarta, which is included in the 1969-1970 investment program proposed by the Government of Indonesia. However, it is quite clear that generating power will be insufficient by 1972. Thus, the construction of Priok unit 3 should be started as soon as possible, so that the operation of the new unit can be started at the beginning of 1972.

c-2 Central Java

(a) In Central Java, the shortage of power supply is serious, and at present it is impossible to supply stable power, considering the prospective load increase. The system is barely supported by the abnormal rainfalls in recent years. If rainfalls are insufficient, the gas turbines recently installed at Semarang which is intended to be used for the peak load, must be operated as the base. But there exist several remaining problems to be solved in order

to use the Semarang gas turbines as the base. Even if the gas turbines can be operated as the base, owing to the lack of stand-by units which can be operated in the case of emergency, long black-out cannot be avoided, when the gas turbines get into trouble.

(b) Under the circumstances, it is urgently required to begin the construction of Semarang steam power station as soon as possible, in order to ensure the stable power supply. Until the operation of Semarang steam power station can be started, all the existing power stations should be fully operated to meet the increasing demand for the time being. Otherwise, it is necessary to suppress the load.

(c) Considering the above-mentioned situation in Central Java, we feel that it cannot be helped to sacrifice a certain degree of reliability and attempt to meet the increasing demand for the time being, so that the electric power industry can be established as the basis of economic and social development in Central Java.

(d) The following table shows the relationship among the annual increase of load, the firm capacity of power sources, and the available peak load capacity in the Tuntang system which is the main interconnected system in Central Java.

Table 2-1-9 Firm Capacity and Load for Tuntang System in Central Java

Unit: MW

	1968	1969	1970	1971	1972	1973
Annual Load Increase (%)		8.5	8.5	10.0	11.2	11.8
Load	27.3	29.6	32.2	35.4	39.4	43.9
Firm Capacity during Dry Season	12.2	24.7	24.7	24.7	24.7	*84.7
Load on Gas Turbines	–	4.9	7.5	10.7	14.7	–
Available Generating Capacity	27.3	29.6	32.2	35.4	39.4	–

Note: * *2 units of 30 MW for Semarang steam power station will be put into operation.*

In order to maintain the firm capacity and the available peak load capacity indicated in the above table, it is necessary not only to keep the

existing plants in good condition by giving much attention to inspections, but also to establish and adequate system of transportation and storage for the fuel used at the Semarang gas turbine station. It is also required to start the operation of the proposed diesel power station within the fiscal year 1969-1970. Though it is not shown in the above table, the completion of the construction of the new transmission line to interconnect the Ketenger system and the Tuntang system in 1971, is expected to increase the firm capacity by about 2.5 MW and upgrade the reliability of power supply.

In any case, it is clearly desirable to start the construction of the Semarang steam power station as soon as possible, to be able to operate the new station in the middle of 1972.

c-3 East Java

(a) In comparison with Central Java, East Java has some surplus of generating capacity having the Kalikonto system with the Perak steam power station (25MW x 2).

Thus, if the full operation of the Perak steam power station can be carried out, the load increase can be adequately met by the existing power generating facilities. But, in the case of the accident in the Perak steam power station, it may be impossible to avoid long black-out even during the wet season, owing to the lack of stand-by units.

(b) Under the circumstances, in order to operate the system with the high reliability of power supply, it is always required to keep one unit of the Perak steam power station as a stand-by unit for the whole system. In this way, we can minimize the black-out caused by the failures at power sources. Meantime, the suppression of load may be needed, considering the expected load increase.

(c) The following table shows the relationships among the load increase, the peak load, and the firm capacity in the dry season in the Kalikonto system, which is the main system of East Java.

Table 2-1-10 Firm Capacity and Load for Kalikonto System in East Java

Unit: MW

	1968	1969	1970	1971	1972	1973
Annual Load Increase (%)		4.5	4.5	6.9	6.9	29.1
Load	51.0	53.3	55.7	59.5	63.6	82.1
Firm Capacity during Dry Season	52.1	53.3	63.6	63.6	63.6	* 113.6

Note: * *2 units of 35 MW in Karangkates Hydro Power Station will be put into operation.*

To keep the above firm capacity, it should keep the conditions of the existing plants by giving attention to keep clean and good maintenance as well as other district.

In addition to it, it is quite important to put the Soloredjo Hydro Power Station of 4.5 MW into operation in 1970. On the other hand, it is desirable to operate earlier one unit of Karangkates Hydro Power Station (35 MW x 2) by the middle of 1972.

(3) Transmission lines, substations, and communication systems

a. Fundamental approach

In the review of the 1969-1970 plan for the transmission and substation facilities, we examine the following items from the stand-point of the whole system:

- Effective use of existing facilities
- Rational investments to meet the future demand
- Increase in the reliability for power supply

We emphasize on the execution of the following concrete measures:

- Eliminating the overload on the transmission and substation facilities by the extension of facilities
- Interconnecting the systems for the reinforcement of the systems and the accommodation of power supply
- Consolidating the communication systems for the system operation

b. Finding

(a) Having studied the investment program for the fiscal year 1969-1970, we recommend the following works to be carried out.

(i) Transmission lines

- New transmission lines connected with new substations (24 km in total length), two in West Java and one in Central Java
- New transmission line, interconnecting the main systems (80 km in length), one in Central Java
- Supplemental works for double circuit lines from the existing one circuit line (170 km in total length), one in Central Java and one other in East Java

- Replacement of transmission lines by large size wire (11 km in length), one in West Java

(ii) Substations

- Constructions of new substations (66 MVA in total capacity), two in West Java and one in Central Java
- Addition of new banks (27.5 MVA in total capacity), four in West Java

Note:

First, we thought that the construction work of the Mampang substation shall be delayed to the 1970-1971 investment plan. Thus, in this report, the budget is not included for that substation. However, since we discovered that the construction work in Mampang substation began, we now recommend that the construction work of Mampang substation shall be continued with the condition that the overhead distribution line shall be installed.

(iii) Communication facilities

Power line carrier communication system

- New construction
  2 systems in Central Java (16 places)
- Expansion
  1 system in West Java (7 places)

(b) Our proposed revision of the exploitasi's investment program is as follows:

(i) Advanced works

- For the reinforcement of the trunk line, the schedule of works for the interconnection between Tuntang and Ketenger systems in Central Java should be advanced from 1970-1971 to 1969-1970, one year earlier in 1969-1970
- For the smooth operation of the system in Central Java, the schedule of works for the communication system should be advanced from 1970-1971 to 1969-1970

(ii) Postponed works

- As the result of the review on the growth of load, the construction of North substation and Madjalaja substation in Exploitasi XI shall be postponed after 1970-1971

- The supplemental installation work for the quadrupled circuits at West substation of Exploitasi XI shall be postponed after 1970-1971.

c. Some discussions on transmission lines and substations

(a) The selection of proper transformer capacity

The transformer capacity of substations should be decided considering the most economical way to supply power from the stand-point of consistent system planning.

As the capacities of some transformers included in the investment programs of exploitasi offices seem to be too large, we must re-examine the programs. For instance, as the result of our economical calculation for Antjol substation, the adoption of 16 MVA is found to be more economical than the plan of 30 MVA. It is also possible to reduce the initial investment. Therefore, it is quite important to make a review of the other projects which is going to be implemented in the future.

(b) Appropriate regulation of distribution voltage at substations

We recommend to use immediately the voltage regulators installed in the existing substations to improve the low voltage.

The installation of voltage regulators in the existing substations or new substations where the voltage regulator are not installed, should be decided after the careful study on their necessity.

The installation of static condensers is a very economical method of voltage improvement in general. To improve the voltage of small substations, which are located at the far end of the system, we consider that static condensers should be adopted after the careful study of their necessity.

(c) Reinforcement of communication system

For the rational and smooth system operation, we recommend the establishment of communication system for the exclusive purpose of the system operation. Especially the exploitasi offices, power plants, and main substations should be provided with communication facilities.

Table 2-1-11 Planning for Power Transmission,Substation and Communication System in 1969-1970

Unit: Million Rp.

Area	Item	Investment			Outline of Works
		Foreign Currency	Local Currency	Total	
West Java	1. Extension of Transformer at Gambir Substation	0	4	4	$70/^{6}_{12}$ KV, 16MVA x 2 Units
	2. Extension of Transformer at Tjawang Substation	0	1	1	70/12 KV, 10MVA x 2 Units
	3. Extension of Transformer at Kedungbadak Substation	0	3	3	$70/^{7}_{12}$ KV, 10MVA x 1 Unit
	4. Extension of Transformer at Rangkasbetung Substation	0	1.5	1.5	70/30/6 KV, 1.5MVA x 1 Unit
	Sub-total	–	9.5	9.5	
	1. Construction of West Substation	87.5	40	127.5	70/20 KV, 10MVA x 2 Units
	2. Construction of Transmission Line for the above Item	28	60	88	70 KV, 2 cct, ACSR 210mm² 11 km
	3. Construction of 20/6 KV Substation (West)	42.7	20	62.7	20/6 KV, 20MVA x 2 Units
	4. Installation of Cable for the above Item	37.9	30	67.9	Cable 20KV, 4 circuit 150mm², 3km
	5. Replacement of Conductor of Transmission Line	63	101	164	11km of 70KV Double-circuit ACSR 187mm² will be newly installed and 8km of ACSR 31mm² will be replaced by 61mm².
	6. Reinforcement of Communication System	0	10	10	All the materials for communication system including 4 places in Exploitasi XI ordered from France
	Sub-total	259.1	261	520.1	
Central Java	1. Construction of Djebres Substation	43.4	29.8	80.2	30/6 KV, 6MVA x 1 Unit
	2. Installation of Transmission Lines for the above Item	7			70KV, 2cct 50mm², 10km (30 KV for the time being)
	3. Supplementary Works to provide Transmission Lines Double-circuit	108.2	115.5	223.7	30 KV, 137.5 km, Cu 50mm² Existing steel tower are of double-circuit
	4. Interconnection of Tuntang and Ketenger Systems	38.1	100	138.1	70 KV, Double-circuit, ACSR 210mm² (Semarang Utara – Pekalongon)

Unit: Million Rp.

Area	Item	Investment			Outline of Works
		Foreign Currency	Local Currency	Total	
					Schedule in each fiscal year Fiscal Year / Outline / Investment (Foreign Currency / Local Currency) 1969-1970 / Transmission Line 20Km / 38.2 / 100 1970-1971 / Transmission Line 40Km / 200 / 210 1971-1972 / Transmission Line 20Km Connection to Substation / 110 / 110 Sub-total 80Km / 348.2 / 420
	5. Reinforcement of Communication Systems	185.5	18	203.5	Tuntang System (9 Places) Ketenger System (7 Places)
	Sub-total	382.2	263.3	645.5	
East Java	1. Supplementary Works to provide Double-Circuit for Transmission Line	35.7	2.2	37.9	Waru – Bangil 70KV Cu. 50mm² 32km Existing steel tower are of double-circuit
	2. Reinforcement of Transmission Lines. Substation and Communication System	0	16.8	16.8	Waru II, Pasapen, Sawahan Substations and others
	Sub-total	35.7	19	54.7	
	Total	677	552.8	1,229.8	

(4) Distribution

a. Fundamental consideration

For the rehabilitation and extension of the distribution networks, the huge amount of investment is required in the future. Such being the case, it is extremely important to make urgent technical study for decreasing the investment. To cope with such situation, the minimum investment plan for the fiscal year 1969-

1970 should be carried into effect by the effective utilization of existing facilities, along with the study of concrete measures for decreasing the total investment of distribution network.
The priority should be given to the following:

- Elimination of overloaded facilities
- Reinforcement of high tension distribution system at the centre of Djakarta city
- Improvement of voltage drop in high tension distribution line, in which the voltage drop is too much
- Improvement of voltage drop in low tension distribution line in Djakarta and other principal cities

For the realization of the above items, the actual approaches to be taken are as follows:

- Introduction of small capacity substation of 20KV/6KV, 3000 KVA for the effective use of existing 20KV distribution facilities from the viewpoint of long run
- Preceded investment should be limited to the indispensable works.
- Construction of tie-lines should be limited to the indispensable tie-lines
- Improvement of loading factor by the rearrangement of transformers
- Improving the voltage of high and low tension lines by step-regulators and pole regulators

b. Finding of our study

As a result of our study on the draft program of each exploitasi and the actual condition of electric power facilities, the required investment of distribution network for whole Java is estimated at 2,696 million Rp.

It is 1,830 million Rp. more, as compared with the amount of 1969-1970 investment program of the Government, 866 million Rp., and is 2,563 million Rp. less, as compared with the amount of crash programs of exploitasis (5,259 million Rp.).

We have revised the crash program of each exploitasi as follows:

(a) 20 KV distribution network

At Bandung, to correspond with the growth of load, and to solve the overloaded condition of 6 Kv line, the small capacity substation of 20 Kv/ 6 Kv shall be provided in the centre of the city. And also by the elimination

for using 20 Kv cable in the wide extent, the investment will decrease by 551 million Rp.

At Surabaja, the voltage direct step-down method from 20 Kv to 127/220V customer-voltage shall be adopted for experiment. The ground earth resistance for neutral point shall be less than 5 ohm in this case. The pilot project for using the power supply voltage for customers from 127V/220V to 220V/380V which is still in planning should be abandoned.

Note: If the power supply is required for Gresik, 50 million Rp. of investment should be added.

(b) High tension distribution

New Mampang substation seems necessary in the future to cope with the city development plan.

For 1969 program, it is, however, more economical to supply the electric power from Djatinegara substation, in which the voltage step-up to 12 Kv is decided, instead of the construction of new Mampang substation.

Mampang substation is, however, already progressing the construction. In the circumstances, if it is intended to complete the substation in 1969 program, it is strongly recommended to adopt the overhead distribution line for experiment, to construct more economical distribution line in the future.

It will be resulted to the decrease of investment by 650 million Rp. as compared with the proposal of exploitasi.

In Djakarta, the reinforcement of high tension line should be limited in central area of the city. Construction of presently uneconomical tie-line should be postponed. Consequently, the decrease of investment by 630 million Rp. will be obtained.

(c) Low tension distribution

In case of low tension line, the decrease of investment by 732 million Rp. will be obtained by limiting the works which are urgently necessary, the pertinent rearrangement of transformers and others.

c. Discussion on distribution facilities

It is clear that the reinforcement and extension of distribution facilities are most important problems for rehabilitation and construction of electricity net-

work. For the most effective way, the following items should be executed one by one from the feasible problem.

(a) Decreasing investment

As the result of our study on the construction cost per KW in next 5 years, it seems to be required about 200.000 Rp. to 110.000 Rp. per incremental KW demand (this figure achieves 6 to 7 times of the cost as compared with Japanese figure). For the future development, it is quite important to decrease the investment. So that, the adoption of overhead high tension line system should be promptly decided, and should be positively used. In that case, the adoption of common poles for high and low tension line may be more economical.

On the other hand, also the following items should be considered.

- Utilization of aluminum wire for overhead lines
- Adoption of smaller and more simple distribution transformer and switching stations
- Standardization of equipment and material

(b) Review on the project of 20KV distribution system

In view of the load density at Bandung and Surabaja, it is suitable to use 70KV/6KV distribution substation. However, the 70/20KV distribution substations are already completed. So that, we recommend to construct the small size substations of 20/6KV for their effective use. In accordance with the recommendation for substation, whole project of distribution concerned should be reviewed.

(c) Raising of customers voltage

The adoption of voltage step-up for low tension line should be decided by making further consideration on the economical condition of the nation, standardization of system voltage, compensation for consumer which needs 400.000 Rp. – 100.000 Rp. per consumer, safety, and feasibility.

(d) To do the most economical distribution system, the construction site shall be located near by the centre of load. Consequently, it is important to have a good cooperation of administration concerned to obtain the site for substations.

(e) Making the balance of investment for each year in the Five Year Development Plan

The investment of distribution should be gradually increased year by

year based upon the available numbers of workers and ability of PLN. Yearly allocation of investment for distribution in 5 year development plan may be reviewed.

Table 2-1-12 Our Proposal for 1969-1970 Investment Program

Unit: Million Rp.

EXPLOI-TASI	BAPPE-NAS (a)	Proposal of District Office				Revised Proposal				Difference	
		High Tension Line		Low Tension Line	Total (b)	High Tension Line		Low Tension Line	Total (c)	b - a	c - a
		20Kv	6Kv or 12Kv			20Kv	6Kv or 12Kv				
XI	351	843	28	65	936	292	28	39	359	4,447	2,100
XII			2,637	1,225	3,862		1,357	735	2,092		
X	280		12	82	94	12		32	44	- 186	- 236
IX	235	20	70	277	367	20	70	111	201	139	- 34
Total	866	863	2,747	1,649	5,259	324	1,455	917	2,696	4,393	1,830

Table 2-1-13 Plan for Power Distribution System in 1969-1970 (Java)

Unit: Million Rp.

EXPLOITASI	20 KV Distribution System				6 or 12 KV High Tension Distribution				Low Tension Distribution System			
	Original		Proposed		Original		Proposed		Original		Proposed	
	Outline of Work	Investment Cost	Investment Cost	Reason	Outline of Work	Investment Cost	Investment Cost	Reason	Outline of Work	Investment Cost	Investment Cost	Reason
XII	–	–	–	–	1. Installation of express feeder for 133^{076} km in total 2. Construction and betterment 17 switch station 3. Cable installation from new Mampang Substation for 33 km in total	2637	1357	1. Construction of new Mampang Substation will be postponed 2. Reinforcement of tie-line	1. Installation of 180 units of distribution transformers and low tension lines	1225	735	Decreasing unit cost for: 1. Supplying new consumers 2. Voltage improvement
XI	1. Installation of 20 Kv cables for 235^{5} km in total 2. Installation of 92 units 20Kv circuit breakers 3. Construction of 216 units of 20Kv disconnecting switches	843	292	Costs for installation of 20Kv cable and construction of station will be decrease as the result of the construction of small substations	Installation of express feeder cable for 20^{74} km in total	28	28	–	1. Installation of distribution transformers. 2. Installation of low tension cables for 30km 3. Installation of overhead lines for 24,900 kg	65	39	Decreasing unit cost for: 1. Supplying new consumers
X	–	–	–	–	1. Installation of cable between substation and switching station	12	12	–	Improvement and extension of low tension distribution network	82	32	Decreasing unit cost for: 1. Supplying new consumers 2. Voltage improvement
IX	1. Installation of 20 Kv cables for 13 km in total 2. Pilot project for 1 unit transformer of 20Kv/220/380V 3. Pilot project for 10 units of transformers of 20Kv/127/220V	20	20	–	1. Cable installations between substation and switch station 11.75 km in total 2. Extension of overhead lines for 9.4 km in total	70	70	–	1. Installation of 97 units of distribution transformers and low tension line	277	111	Decreasing unit cost for: 1. Supplying new consumers 2. Voltage improvement

2-1-4 1970-1971 Investment Plan

(1) Scope of investment

The results of our calculations for the required amounts of investments for the fiscal year 1970-1971 are shown in Table 2-1-14.

Basic targets are:

(a) To secure the necessary supply capabilities to meet the demand as soon as possible, and

(b) To upgrade, to a great extent, the existing levels of consumers' voltages and reliability by 1973 from the standpoint of the consistent system planning.

Table 2-1-14 Scope of Investment for the Fiscal Year 1970-1971

Item	Local Currency	Foreign Currency	Total
Power Plants	3,158	4,315	7,473
Transmission Lines and Substations	778	909	1,687
Distribution Facilities	813	4,695	5,508
Sub-total	4,749	9,919	14,668
Diesel Units	57	171	228
Total	4,806	10,090	14,896

Note: Power Plants exclude diesel units.

The implementation of the investment plan 1969-1970 seems to be lagging behind the schedule on account of the changes in circumstances, and the situation is still fluid.

Accordingly, we have excluded the consideration of such changes in circumstances in principle. We recommend the fiscal year 1970-1971 plan by assuming that the investment plan for the fiscal year 1969-1970 has been and will be implemented in accordance with our recommendations made for the fiscal year 1969-1970.

In establishing the investment plan for the fiscal year 1970-1971, the Government of Indonesia must add the consideration of the progress in the implementation of the investment plan for the fiscal year 1969-1970, while making our recommendations as the foundations of the plan.

Nevertheless, as the investment plan proposed in this section specifically expresses our philosophy and approach for the electric power development in Indonesia, it is earnestly hoped that in revising our proposed investment plan, the main points of our recommendations should not be missed or neglected.

(2) Power plants

a. In the 1969-1970 investment plan, based on our load estimation up to 1973, we recommended the promotion of the extension works for Priok units 3 and 4, the construction of Semarang units 1 and 2, and of the early commencement of the operation of the Karang Kates hydro power station in order to ensure the stable power supply capabilities in Java.

In studying the 1970 investment plan for power plants, we examined the required construction schedule for the development of new power sources, which must be started in the near future, based on our long-term load estimation, especially up to 1975.

As a result of our study, we came to the conclusion that by 1975 or 1976, there will be a shortage of power sources throughout Java, and that it is necessary to take various preparatory measures necessary for the development of new power sources so that the operation of new power plants may be started in 1975 or 1976.

The following is the summary of our conclusions for each area of Java.

b. In West Java, as we stated in 1969-1970 investment plan, it is possible to ensure the stable supply capabilities for the increasing load up to 1973 by the effective use of reserve capacities in the system, the efficient operation of existing facilities and the promotion of construction works for Priok units 3 and 4. If we calculate the balance of the system load and power supply based on our long-term estimation of load up to 1975, we come to the conclusion that in the beginning of 1975, there will definitely be a shortage of power sources, as shown in Table 2-1-15.

Therefore, we recommend that the necessary measures should be taken as soon as possible during the fiscal year 1970-1971 for the preparation of construction works, including various survey works for the development of new power sources, so that the operation of new power plants may be started at the end of 1974.

Table 2-1-15 Firm Capacity and System Load in West Java

Unit: MW

Item \ Year	1968	1973	1974	1975
Annual Load Increase (%)	—	11 (average for five years)	13.5	13.8
Load (a)	137.3	231.7	262.9	299.3
Firm Capacity During the Wet Season (b)	174.5	272.5	272.5	272.5
Margin of Firm Capacity During the Wet Season (b) - (a)	37.2	40.8	9.6	△ 26.8

Note: The firm capacity must be maintained so that, even in the case of the trip of the maximum unit in the system (such as Priok unit 3 or 4), no shortage of power supply may occur. (Refer to Appendix 2-4)

c. In Central Java, there is a very serious problem of the shortage of power sources. As a basic measure to solve this problem, we recommended the promotion of the early commencement of the construction work for Semarang Steam Power Station as recommended in 1969-1970 investment plan.

Nevertheless, we found in the draft of the 1970-1971 investment plan prepared by the Directorate General for Power and Electricity no specific program or budget. This poses a grave concern for the promotion of the welfare of the people in this area.

We recommend once again that specific measures should be taken immediately so that the operation of Semarang steam power station may be started in the middle of 1972.

On the other hand, a new investment in the diesel units in the isolated areas (about 3.3 MW including advanced construction works) is included in the draft of the 1970-1971 investment plan prepared by the Directorate General for Power and Electricity. Some investment in diesel units is thought to be too early and should be excluded from the 1970-1971 investment plan.

Table 2-1-16 shows the result of our study concerning the balance of the system load and power supply for the main system of Central Java.

It shows that even if the operation of Semarang steam power station can be started in 1972, there will be a shortage of power sources in the beginning of

1977. Therefore, we recommend that also in this area, various preparatory measures should be taken during the fiscal year 1970-1971 for the construction of new power plants whose operation can be started at the end of 1976.

Table 2-1-16 Firm Capacity and System Load in Central Java

Unit: MW

Item \ Year	1968	1973	1974	1975
Annual Load Increase (%)	–	10 (average for five years)	12.8	13.2
Load (a)	34.3	55.3	62.4	70 6.
Firm Capacity During the Dry Season (b)	19.3	66.7	84.2	84.2
Margin of Firm Capacity During the Dry Season (b) - (a)	–	11.4	21.8	13.6

Note:

1. *As the Tuntang and Ketenger systems will be interconnected into one system in 1972, we considered the total of the two systems.*

2. *The firm capacity must be maintained so that, even in the case of the trip of the maximum unit in the system (Semarang unit 1 or 2), no shortage of power supply may occur. (Refer to Appendix 2-4)*

d. In East Java, we recommended, in the Section 2-1-3 of 1969-1970 investment plan, the early commencement of the operation of the Karang Kates hydro power station in order to ensure the stable power supply. The load will have to be suppressed to a certain extent until the time of the commencement of the operation of the power plant which will be able to absorb the large increase of load.

As shown in Table 2-1-17, our study of the balance of the system load and power supply up to 1975 indicates that there will again be a shortage of power sources for the main system of Kalikonto system in 1976. Therefore, we recommend that also in this area surveys and other preparatory works should be started during the fiscal year 1970-1971 for the development of new power sources (Perak units 3 and 4, for example) which can be operated from 1975.

Table 2-1-17 Firm Capacity and System Load in East Java

Unit: MW

Item \ Year	1968	1973	1974	1975
Annual Load Increase (%)	–	10 (average for five years)	12.8	13.2
Load (a)	51.0	82.2	92.7	104.9
Firm Capacity During the Dry Season (b)	52.1	113.6	113.6	113.6
Margin of Firm Capacity During the Dry Season (b) - (a)	1.1	31.4	20.9	8.7

Note: The firm capacity must be maintained so that, even in the case of the trip of the maximum unit in the system (such as Perak unit 1 or 2), no shortage of power supply may occur. (Refer to Appendix 2-4)

c. The following Table 2-1-18 shows the summary of the proposed 1970-1971 investment plan for electric power sources in Java.

Table 2-1-18 The Amounts of Investments for Power Sources for 1970-1971 Investment Plan

Unit: Million Rp.

Area	Facilities	MW	Local Currency	Foreign Currency	Total	Remarks
West Java	Priok Units 3 & 4	50 x 2	1,538	1,575	3,113	Operation of Unit 3 starts in the beginning of 1972
Central Java	Semarang Units 1 & 2 Garung	30 x 2 10 x 2	820 300	1,340 350	2,160 650	Operation of Semarang Unit 1 starts in the middle of 1972
East Java	Karang Kates Seloredjo	35 x 2 4.5 x 1	500	1,050	1,550	Operation of Seloredjo starts in 1970
Sub-total			3,158	4,315	7,473	
Whole Java	Diesel units		57	171	228	East Java 3,250 KW in 1970
Total			3,215	4,486	7,701	

(3) Transmission lines and substations

a. In our study of the 1970-1971 investment plan:

- We examined the investments in the main systems from the standpoint of the long-term system expansion based on our estimation of power flow.
- For the expansion of substations, we checked the overall loading conditions of transformers in major cities and other areas, and attempted as much as possible the examination of individual substations in major cities.

  In our judgment as to whether a new substation should be established or an existing substation should be expanded, special attention is paid to the comprehensive analysis of related electric power facilities including the distribution facilities.

b. The following is the summary of recommendations based on our findings.

(a) For the strengthening of system:

(i) In West Java, it is desirable to study further the proper way of the strengthening of transmission lines from Bandung to Tjirebon and then to start the construction works.

Some measures are thought to be necessary for the solution of the problem of overloading of some tie transformers (70/30 KV).

(ii) In Central Java, it is recommended to promote the construction works for the interconnection of Tuntang and Ketenger systems as stated in the 1969-1970 investment plan.

(iii) In East Java, it is desirable to start the construction works for the interconnection of Kalikonto and Madiun systems and the strengthening of transmission lines to Letjes.

The construction of the transmission lines from Karang Kates to Surabaja should be started in 1970, but the amount of investment for this item is included in the construction cost for Karang Kates hydro power plant.

(b) The construction of new distribution substations and the expansion of existing distribution substations are thought to be necessary in some areas other than large cities in West Java, some cities in Central Java, and Surabaja and some other areas in East Java.

In the implementation of the plan for the strengthening of distribution substations, it is necessary to study the load in the area and the condition

of existing facilities. It is more desirable to carry out the expansion of existing substations as much as possible rather than to construct new substations.

Our analysis of individual substations indicate that the construction of Antjol substation in Djakarta is reasonable considering the distribution condition in this area.

(c) The following Table 2-1-19 shows the summary of our proposed investment plan for 1970-1971.

Table 2-1-19 Plan for Transmission Lines, Substations and Communication Systems

Unit: Million Rp.

Area	Item	Construction Cost			Outline of Works
		Foreign Currency	Local Currency	Total	
West Java	1. Antjol Substation (70 KV)	95	50	145	Transformer: 70/12 KV 30 MVA x 1 Unit 70 KV transmission line: 1 KM, ACSR 187mm^2 & 2-cct
	2. Other Construction Works and Surveys	235	160	395	Construction works for substations (Ubrug, Madjalaja, Kratjak and others) and strengthening of transmission lines to Tjirebon
	3. Extension of Communication System	35	5	40	Power line carrier communication equipment (Ubrug, Kratjak, Kedungbadak, Depok, Tjikalong, Lamadjan and Plengan)
	Sub-total	365	215	580	
Central Java	1. Interconnection of Tuntang and Ketenger Systems	200	210	410	70 KV transmission line: 40 KM, ACSR 210mm^2 & 2-cct (Semarang Utara-Pekalongan)
	2. Other Construction Works and Surveys	125	75	200	Construction works for substations (Wirobradjan, Gasturbin and others)
	Sub-total	325	285	610	

Year	Outline of Works	Construction Cost	
		Foreign Currency	Local Currency
1969	Transmission Line: 20KM	38.2	100
1970	Transmission Line: 40KM	200	210
1971	Transmission Line: 20KM (including substations)	110	110
Total	80	348.2	420

Unit: Million Rp.

Area	Item	Construction Cost			Outline of Works
		Foreign Currency	Local Currency	Total	
East Java	1. Transmission Line from Karang Kates	Included in the construction cost for Karang Kates			150 KV transmission line (Karang Kates - Surabaja)
	2. Interconnection of Kalikonto and Madiun Systems	77	85	162	70 KV transmission line: 20 KM, ACSR 120mm^2 & 2-cct (30 KV for the time being)
	3. Strengthening of Transmission lines between Bangil and Probolinggo	56	62	118	70 KV transmission line: 15 KM, ACSR 120mm^2 & 2-cct
	4. Other Construction Works and Surveys	86	131	217	
	Sub-total	219	278	497	
	Total	909	778	1,687	

Year	Outline of Works	Construction Cost	
		Foreign Currency	Local Currency
1970	Transmission Line: 20KM	77	85
1971	Transmission Line: 30KM (including substations)	135	140
Total	50KM	212	225

Year	Outline of Works	Construction Cost	
		Foreign Currency	Local Currency
1970	Transmission Line: 15KM	56	62
1971	Transmission Line: 35KM (including substations)	152	160
Total	50KM	208	222

(4) Distribution

a. For the reinforcement and extention of distribution facilities in major cities (Djakarta, Bandung, Semarang and Surabaja) in 1970-1971 investment plan, the range of consumers' voltages should be from 107 V to 127 V, and the level of service should be substantially raised by decreasing the frequency of service interruption, and also by eliminating long-time service interruption. With these targets, we set the most suitable system patterns of high and low voltage distribution lines, drew a long-term facilities plan and calculated the required amount of investment.

As for the areas other than the above-mentioned major cities, we established the target of service level next to that for the major cities. We attempted the minimization of the unit construction cost for the incremental KW by the positive use of over-head high tension lines and others and the effective reinforcement of distribution facilities.

b. The following specific measures are considered essential for the reinforcement of distribution system.

(a) High tension system

- The replacement of existing cables by cables of larger size for main feeders, and the construction of interconnection lines
- The formation of open loop system for high tension lines in Djakarta
- Replacement of deteriorated cables

(b) Low tension system

- The extensive introduction of the distribution transformers of small capacities (from 75 KVA to 150 KVA)
- Replacement of deteriorated cables

(c) The efficient use of existing 20 KV distribution facilities

c. Table 2-1-20 shows the amounts of investments in 1970-1971 necessary for the strengthening and expansion of distribution facilities.

As the 1970-1971 investment plan for the reinforcement of high tension lines in the major cities is largely for the central areas of the cities, we assumed the use of underground cables in our calculation. But, hereafter, it is of vital importance to introduce over-head high tension lines as much as possible and to decrease the unit cost of construction.

Table 2-1-20 1970-1971 Investment for Distribution Facilities

Unit: Million Rp.

Exploitasi	Item		Local Currency	Foreign Currency	Total	Remarks
XII	City	High Tension Lines	88	890	978	Formation of open loop for high tension lines in Djakarta Construction of sub-switching stations Improvement of the voltage condition in low tension lines by increasing the number of transformers (with unit capacity of 150 KVA)
		Low Tension Lines	222	1,166	1,388	
		Sub-total	310	2,056	2,366	
	Other Areas		43	173	216	
	Total		353	2,229	2,582	
XI	City	20 KV Distribution	–	–	–	Replacement of high tension cables by cables of larger size and construction of interconnection lines Improvement of the voltage condition in low tension lines by increasing the number of transformers (with unit capacity of 100 KVA) Expansion of 20 KV distribution facilities is not necessary, judging from the loading and voltage conditions
		High Tension Lines	24	246	270	
		Low Tension Lines	74	387	461	
		Sub-total	98	633	731	
	Other Areas		66	265	331	
	Total		164	898	1,062	
X	City	High Tension Lines	10	105	115	Replacement of high tension cables by cables of larger size and construction of interconnection lines Improvement of the voltage condition in low tension lines by increasing the number of transformers (with unit capacity of 75 KVA)
		Low Tension Lines	47	211	258	
		Sub-total	57	316	373	
	Other Areas		43	173	216	
	Total		100	489	589	
IX	City	20 KV Distribution	6	60	66	Interconnection between Sawahan and Pesapen at 20 KV Replacement of existing 19 CB by cubicles and installation of new 4 cubicles at Gemblongan Replacement of high tension cables by cables of larger size and construction of interconnection lines Improvement of the voltage condition in low tension lines by increasing the number of transformers (with unit capacity of 100 KVA)
		High Tension Lines	34	348	382	
		Low Tension Lines	81	370	451	
		Sub-total	121	778	899	
	Other Areas		75	301	376	
	Total		196	1,079	1,275	
Grand Total			813	4,695	5,508	

2-2 METHOD AND APPROACH FOR LONG-TERM PLANNING

2-2-1 Introduction

(1) We present our recommendations concerning the method and approach for long-term planning in the electric power enterprise of Indonesia based on our study for Items J and K of the terms of reference.

Our recommendations are based on our analysis of the existing situation of the electric power industry of Indonesia, which have been made in cooperation with the members of the counterparts and other concerned persons and our experiences of long-term planning in Japan.

(2) The following points made in this report are thought to be very important.

a. From the viewpoint of managing an electric power enterprise, the systematization and coordination of all the facets involved in the planning must be sought.

b. For the systematization of the plan, necessary methods, couter-measures, systems, etc. should be devised.

c. Especially, responsible body for the formulation of the systematized plan should be clarified.

(3) Some specific examples are given from Appendix No. 2-12 through 18 for better and further understanding of the recommendations in this section.

2-2-2 Fundamental Approach

(1) Significance of long-term planning

a. The long-term plan of an enterprise provides the guide lines for the management. As indicated in our report on the organization, the comprehensive long-term planning is indispensable for the management of the electric power industry of Indonesia for the following reasons:

(a) The promotion of the development of electric power sources, the strengthening of systems, and the improvement of the existing facilities are urgently necessary in order to promote electrification and upgrade the level of service in correspondence to the economic development and the rise in the standard of living. Therefore, the electric power industry of Indonesia requires a large amount of investment in facilities.

(b) The electric power enterprise must suppress the level of electricity tariffs as much as possible and contribute to the economic and social development of the country.

(c) The self-supporting system for the efficient management of electric power enterprise must be established.

(d) Without the systematic coordination of the efforts to achieve the above-mentioned objectives, the mission of the electric power enterprise of Indonesia cannot be accomplished.

b. Especially the facility plan is the most important as a core of the long-term management plan. At present, the long-term plan of the electric power enterprise of Indonesia is merely the compilation of projects, and lacks the integration and relatedness mentioned above.

c. The facility plan is closely related to the management of enterprise, and must be a systematized plan for all the electric power facilities. It must also show the roles of individual projects in the whole facility plan as well as the priority of projects.

d. In order to formulate a long-term facility plan efficiently, the examination of individual projects should be limited to the power stations of large capacities and the main systems. Other small projects are treated as a coherent set of projects.

The works of plan formulation must be done systematically with an emphasis place on the synthetic whole.

e. The long-term facility plan consists of the following elements.

(a) The whole period of plan is ten years consisting of the first half period of five years and the second half period of five years.

(b) It must be consistent with the Five Year National Development Plan of Indonesia.

(c) The management targets must be established for more than the next ten years.

(d) The plan includes estimated load, examined system requirements, projects formulated after economic comparisons, the amount of investment in facilities after final coordination and adjustment from the viewpoint of financing, and the allocated amount of investment in each sector.

(2) The application of long-term facility plan to foreign loans

The clear assignment of the roles of individual projects in the whole facility plan will bring about favourable conditions for foreign loans to finance the projects for the following reasons.

The contents of individual projects and the backgrounds requiring the projects are clearly made known, and the preparation of the explanation material concerning the necessity of the projects is made easy. In this respect, systematic facility planning is a fundamental prerequisite to the development of the electric power industry of Indonesia.

In the case of the urgent necessity for foreign loans before systematic planning can be carried out, the compiled materials explaining the economic and technical comparison of the alternatives are to be prepared.

(3) Basic approach for the formulation of long-term plan and immediate measures required

a. Long-term facility planning is one of the most important tasks for the management of the electric power enterprise. The plan must be flexible enough to allow revisions resulting from the changes in the economic circumstances and the management conditions. In this respect, PLN must necessarily formulate a long-term facility plan by itself and must make necessary preparations now for the long-term planning.

b. In order to carry out the long-term planning, it is essential to have improvements in organization and management including the development of necessary human resources, as recommended in Section 1-4 of this report.

c. This report presents our recommendations concerning the method and approach for the long-term planning, and the immediate measures to be taken.

d. Considering that it will take some time for the electric power enterprise of Indonesia to complete the necessary preparations for the formulation of the first long-term plan in accordance with our report, it is wise to have the guidance and cooperation of advisors from developed nations in order to establish the first long-term plan as soon as possible.

2-2-3 System of Planning

(1) Principal steps in the plan formulation

In order to formulate a comprehensive investment plan for facilities, the following principal steps are necessary.

a. Load estimation

The estimation of electric energy consumption must be made by considering the economic development within the framework of the Five Year Development Plan and the characteristics of respective regions. In the estimation of load, the following factors must be considered.

(a) The target concerning the level of electrification

(b) Peak load, load curve and incremental KVA contracted for the study of system requirements

(c) Energy sales for the calculation of revenue

(d) Consistency among the above-mentioned factors

b. Study of system requirements

Calculations should be made for the required volumes of facilities for generation, transmission, substation and distribution, which correspond to the estimated load. In this case, the question of the determination of reserved capacities must be carefully examined.

c. Basic design of long-term system development

(a) As the electric power industry of Indonesia is still in the initial stage of development and the facility formation is apt to lack consistency because of the incoordinated foreign assistances from various nations, it is essential to draw a basic design of long-term system development for the next ten to twenty years.

(b) This basic design of long-term system development must be consistent with the stage of economic development and the growth of demand in each region, and must be approved by the persons concerned.

(c) The basic design of long-term system development should include the structure and location of power sources, voltage classifications, the formation of main systems, power distribution system and so on.

d. Study of alternatives

In the formulation of each project, the following considerations must be given.

(a) Each project should be most economically designed.

(b) Economic and technical comparisons should be made with other alternatives or with a standard model. For this purpose, the approach and method of economic analyses for facility plan must be acquired.

e. Comprehensive investment plan

The sum of the amounts of required investments for individual projects and coherent sets of small projects is checked with the constraints of fund raising and cost trend, and if necessary, some readjustments are made at each step of planning.

(2) Process of planning

In the process of plan formulation in accordance with the principal steps explained above, one of the most important tasks is to have frequent communications and effective coordinations so that a plan may be formulated systematically and efficiently.

The following is an example of the process of plan formulation.

a. At the early stage of the process, PLN head office collects basic information from each exploitasi offices.

b. PLN head office checks the estimates made by the exploitasi offices with its own data regularly collected and its own studies continuously made, and prepares the framework of the plan.

c. PLN head office presents the outline of plan as an information to the concerned agencies and asks exploitasi offices to check the regional targets within the framework of the plan.

d. PLN head office formulates a long-term plan by taking into consideration the results of the examinations done by exploitasi offices, and formally presents the plan to the competent authorities.

e. The competent authorities check the plan from an objective point of view and explain the plan to BAPPENAS, Ministry of Finance and other concerned agencies, while coordinations are made along the line of national policy.

f. After coordinations are made among the concerned agencies, PLN head office re-examines the whole plan, makes the final decision on the long-term plan, and informs the plan to Exploitasi offices.

The responsibility of formulating a long-term plan from a wide and objective point of view should be clearly borne by on a certain department of PLN

head office, and the necessary staffs must be provided.

It is essential to establish such a department as the "General Planning Department" explained in Section 1-4 of this report, increase the communication activities, and accomplish successful coordinations.

Table 2-2-1 Process of Planning

Planner	Elements of Plan	Process
Electric Power Commission	Comprehensive Planning	
Directorate General for Power and Electricity	Comprehensive Planning	
PLN head office	Load Estimation System Requirements	national, regional
	Alternatives	
	Comprehensive Planning	
Exploitasi office	Load Estimation System Requirements	regional, characteristics
	Alternatives	
	Comprehensive Planning	

Note: Solid lines indicate the process of works while dotted lines indicate the communication and coordination.

2-2-4 Method of Planning

The following is the general description of the specific process of planning in accordance with the principal steps explained.

(1) Load estimation

a. There should be some improvements in the method of load estimation employed at present from the following angle.

(a) Estimations should be made not only for the peak load as done at

present, but also for the KWH sales on which the calculation of revenue is based. There must be an existing consistency between the estimation of KWH and the estimation of peak load on which the calculation of required facilities is based.

The following items have to be estimated.

(i) For the calculation of required facilities

- Peak load
- Energy production
- Load curve
- Increase or decrease in the number of consumers
- Increase or decrease in contracted KVA

(ii) For the calculation of revenue

- Number of consumers
- Contracted KVA
- Energy sales

(b) The trend of demand should not be estimated by considering only one factor such as population, but should be estimated considering various factors from different angles. Several methods should be employed to check the validity of the estimates made. As the meaning of estimation includes the elements of not only forecast but also judgement, estimation should be based on as much available data as possible so that prudent judgement can be made.

Considering the fact that there is a lack of basic data collected in time series and systematically, there must be a supplementary data collection using cross section and other methods.

b. Practical method of load estimation

The following is a practical method of load estimation proposed by considering the existing circumstances in Indonesia.

(a) Estimation based on the analysis of the factors of load increase

These factors of load increase have their own characteristics depen-

ding on the stage of development of the electric power industry. In the case of Indonesia, the following principal factors are to be estimated.

(i) The load increase corresponding with the economic growth

(ii) The load increase caused by the increase in the rate of electrification

(iii) The load increase caused by the voltage improvement

(iv) The load increase caused by the decrease in the proportion of self-owned generation plants

(v) The condition of power supply

(b) Estimation based on the Five Year Development Plan

(i) Macro estimation by comparison

Estimation made by comparing the actual results of developing nations in the ECAFE region with the Five Year Development Plan of Indonesia

(ii) Estimation made by considering the relationship between the amount of investment in facilities in each industrial sector and the average contracted KVA

(c) Estimation based on the past trend

The minimum square method is used. This method is effective only if the past conditions will not be changed significantly.

(d) Estimation for each category of demand and each area

(i) In the estimation for each category of demand, estimates are made for the number of contracted consumers, contracted KVA, operating hours, and energy sales, which are the basic data for the calculation of revenue.

(ii) In the estimation for each area, estimates are made for each factor of load increase and each category of demand at every exploitasi or substation.

(e) The checking of load estimation considering the potential consumption

After the concept of potential consumption is clearly defined, the improvement of the method of load estimation employed by some exploi-

tasi offices (for example, Exploitasis XI and XII) should be made. The improved method would be useful not only for the estimation done by exploitasi offices, but also for the checking of exploitasi estimates and the establishment of regional targets by PLN head office.

(f) Estimation of load curve

Based on the estimates of electric energy consumption for each category of demand, daily energy consumption is estimated. By adding up all the daily load curves for each category of demand, a composite load curve is estimated.

c. The relationship between PLN head office and exploitasi offices in the estimation of load

PLN head office should place emphasis on the overall estimation of the demand for electric energy based on the analysis of the national economy, and should be able to check the estimates made by the exploitasi offices.

PLN head office gives suggestions to the exploitasi offices concerning the targets of electrification to be attained in the last year of the long-term plan. Each exploitasi office makes its own estimation considering the targets suggested by the PLN head office and the characteristics of the region. The estimates made by the exploitasi offices are fed back to the PLN head office.

In order to improve the reliability of estimates, frequent and intimate communications between PLN head office and exploitasi offices are necessary.

Note: The targets of electrification include the rate of electrification, the proportion of self-owned generation plants and the proportion of actual load to the potential load.

(2) Study of system requirements

a. Basic approach

(a) Required capabilities are determined based on the following considerations

(i) The supply capabilities should always be larger than the demand.

(ii) There must be a policy decision made concerning the quality of supply including the reliability of supply. According to this established policy, the reserved capacity is determined.

(b) Necessary facilities to ensure the required capabilities are determined mainly based on the following two conditions.

(i) The formation of facilities should be made in accordance with the standards, derived from the study of long range system development.

(ii) The formation of facilities should be economically justifiable. (See 2-2-4 (3))

(c) In the policy making concerning the level of service, the following considerations should be given.

(i) The improvement in the service level should be considered in relation to the costs involved.

(ii) The level of service should be consistent with the social and economic reality of each region.

(iii) Considering the effects of the characteristics of facilities on the service, differentiations should be made in the requirements of reserve in accordance with the kinds of facilities.

(iv) The limited investment funds should be used efficiently considering the harmonization of the promotion of electrification and the improvement of the service level.

b. Considerations necessary for the study of facility requirements

(a) Power sources

(i) Required capabilities are determined by the examination of the necessary reserve in a system. The reserve in the supply capability to be retained is determined by the policy concerning the reliability of supply. Considering the circumstances of Indonesia, the reserve in the supply capability which is equivalent to the capacity of the maximum thermal power unit in the system would be a proper target.

(ii) In the calculation of the KW balance between the demand and supply, the following considerations should be given.

- For the wet and dry seasons,respectively, the balance between the maximum load and the supply capability at the low water level should be calculated. (Ideally, the monthly balance between the demand and supply should be calculated.)

- The supply capability during peak hours is calculated assuming the full and effective utilization of hydro power sources based on the load curve study.

- The periodical overhaul of thermal power units should be scheduled when the supply capabilities of hydro power sources are large.

- Not only the KW balance but also the KWH balance should be considered.

(b) Power transmission and substation

(i) The requirement of facilities is determined with due consideration given to a contingency. For example, in the case of the fault of one of the transformers in a substation, it should be a general rule that the load on the faulted transformers in the substation is transferred to the rest of the transformers in the substation and to the adjacent substations.

(ii) In the calculation of required facilities, especially for substations, it is recommended to use a loading factor, which is calculated with due consideration given to a contingency. Concerning the definition and the use of the concept of a loading factor, see Appendix 2-14.

(c) Power distribution

(i) In the case of distribution, the calculation of required facilities must be made considering the voltage requirements as well as the necessary measures for failures.

Especially for low voltage distribution lines, the facility requirements are determined mainly based on the voltage requirements.

(ii) For the central planning department, it is considered appropriate to employ the following method in calculating the facility requirements.

- Distribution facilities are divided into such components as high tension lines, distribution transformers, low voltage lines, and meters.

- Requirements for the components are calculated, considering the contingency, voltage improvement, and new connection, separately.

- The results thus obtained are compiled to get the total requirements.

In this case, it is useful to employ the concept of "Average Loading Factor".

An example of the study of required facilities considering the voltage requirements is shown in Appendix 2-15.

(3) Study of alternatives

a. Importance of the Study of Alternatives in the Electric Power Enterprise

As the amount of investment in the facilities of the electric power enterprise is quite large and the life time of the facilities is long, the following considerations should be given to the systematic examination of a project.

(a) Efforts should be made in order to carry out the most economical facility formation after the careful comparison of various alternatives.

(b) Considerations should be given concerning the contribution of the project to the regional development and the effect of the project on the national economy including the allocation of resources.

It is prerequisite that more than two alternatives are prepared for one project.

The detailed explanation concerning the above item (b) is not presented in this report, for the criteria of judgement depend on the characteristics of each project. The following is the explanation concerning the formulation of alternatives and the method of economic evaluation.

b. Formulation of alternatives

(a) Basic Considerations

The following considerations must be given in the formulation of alternatives.

(i) All the related facilities must be taken into consideration.

For example, in the case of a substation project, not only the substation, but also power transmission lines on the primary side and the power transmission and distribution lines on the secondary side must be taken into consideration.

(ii) The series of investments in the long run must be considered. The second investment usually depend upon the way the initial investment is made. Thus, various series of investments should be studied.

(b) Clear presentation of alternatives

The alternatives should be made clear in such a way as to make the comparison of alternatives easy, and should be realistic enough. Therefore, the following items should be clearly shown in the presentation of each alternatives.

(i) Outline of the plan including the general description of design, location and dates for start of the construction and commercial operation.

(ii) Construction cost and expenditure

It is sufficient for this purpose to calculate the construction cost and the expenditure using the standard unit cost.

(iii) Technical characteristics and their effects on the quality of supply

It is desirable to formulate alternatives which have similar effects as much as possible. But, as it is actually often quite impossible to do so, the characteristics of each alternative should be clearly described.

c. The method of economic evaluation

(a) The method of the economic evaluation of investment in facilities is as follows.

(i) Rate of return method

The benefit ratio of investment in facilities, that is,

$$\frac{\text{Benefit} - \text{Cost}}{\text{Investment amount}}$$

should be compared with the benefit ratios of other alternatives. As a rule, the alternative which has the highest benefit ratio is adopted.

(ii) Minimum cost method

If the same benefit can be expected from alternatives, the economic evaluation is made by comparing the cost of respective alternatives. Needless to say, the alternative with the minimum cost is most economical and should be adopted.

(b) In the economic evaluation of alternatives, the following considerations should be given.

(i) The comprehensive economic evaluation should be made for the range and period of cost calculation considering the related facilities and the series of investments, as mentioned in b-(a).

(ii) It cannot be helped that there still remain some elements which cannot be easily calculated with the existing techniques. But, it must be noted that careful consideration of such elements are necessary for the decision making.

(4) Comprehensive check

The draft of the facility plan of the electric power industry can be made into the comprehensive facility plan only after it is checked by the major contraints of fund raising and general cost trend.

a. Check from fund raising

No matter how economical a proposed project may be, if it requires a large amount of initial investment and if it is impossible to raise the whole investment fund, the proposed project cannot be implemented.

In such a case, an alternative which is within the contraint of fund raising should be adopted. The check from fund raising must be done systematically not only for a large project, but also for all projects.

b. Check from general cost trend

As a rule, the economic evaluation of project should be made from the long-term viewpoint.

Nevertheless, the calculation of general cost depends upon various systems such as accounting system and tax system, and is done every fiscal year. Consequently, the amount of expenditure calculated for the accounting purpose is usually different from the equalized annual cost of project which is calculated for the purpose of economic evaluation. Thus, even if a project is economical in the long run, so long as it requires a large amount of initial investment, it is quite possible that the cost level of electric power enterprise rises in a short term, which brings about the deterioration of the financial situation. In the choice of alternative, the influences on the short-term cost level and the financial situation should be taken into consideration, and the decision should be made after careful study of long-term and short-term effects of the project.

2-2-5 Collection of Planning Data

(1) Method of collection

a. Basic consideration

PLN head office should collect the basic data which can be used at each step of long term planning including the preparation, analysis, and compilation

from the following basic considerations.

(a) Understanding of present situation

(b) Grasping of the changing condition by the analysis of trend (time series analysis) and comparison of various region (cross section analysis)

(c) Analysis and synthesis by using the coefficient or index which are derived from the combination of different data, such as the load factor, internal reserve/investment, at each step of planning

b. Data collection

Usually, the basic data to be collected can be classified as follows.

(a) Data concerning the daily routine

The review of existing reporting system concerning the daily routine is required. For the time being, the additional reports from each exploitasi should be collected and rearranged.

(b) Data from the specific investigation

Data can also be obtained by sampling surveys (by actual measurement, questionnaires, etc.).

(c) Data from outside

The statistics of the national economy, foreign electric power industries and so on are collected and analyzed.

In order to collect the data accurately and promptly, an emphasis should be placed on the selective collection.

(2) Basic data for planning

a. Data concerning load

The following data should be collected and rearranged in time series based upon the annual records. The total and average for the whole country, each region, each system, and each category of demand are to be obtained.

(a) Data necessary for establishment of target of electrification and estimation of the peak load and the load curve

(i) Energy production and peak load, including self-generation facilities

(ii) Annual loss rate and load factor

(iii) Load curves

System load curve at the generating end and load curves at power supplying end for various categories of demand on which calculation of demand factor and diversity factor are based

(iv) Distribution of customer's voltage

(v) Contracted KVA

Contracted KVA should be classified by the categories of demand and industrial sectors, and the installed capacity of self-generation units, should be also classified by industrial sectors.

Probable contracted KVA for waiting consumers should be classified in accordance with the reasons either of the lack of consumer's ability for payment, or the shortage of power and supply capacity.

(vi) Population and number of houses

These factors shall be considered for establishing the target of the electrification.

(vii) Index of economic activity

GNP, investment ratio (investment/GNP), fund sources, actual results of authorized foreign investments, production quantities of major products, necessary KWH/unit of product, contracted KVA/investment (in accordance with the industrial sector) and so on

(viii) Statistics of international economy and of foreign electric power industries

(b) For calculation of revenue

(i) Energy sales

(ii) Number of consumers

(iii) Contracted KVA, contracted KVA per number of consumer and KWH per contracted KVA

(c) For the calculation of necessary facilities and materials for distribution

The changes of contracts in number and KVA, classified in accordance with the following category, such as new connection, increase (decrease) of contracted KVA, disconnection, reconnection, change in the category of demand, and so on

b. Data concerning power supply

(a) Data for grasping the actual condition of facilities

(i) Facilities

For power stations, power transmission lines and substations:
the rated capacity, quantity and available capacity of main equipment indicated separately for each station and each line

For power distribution:
the categories and quantities of major facilities and materials indicated separately for each exploitasi (Exploitasi is subdivided into major cities and others.)

(ii) System diagram

(iii) System map

(b) Data for grasping the actual operational conditions

(i) Power generation

(ii) Loading

Substation:

the maximum load and loading factor for each substation

Power distribution system:

distribution of loading factors for the feeders and transformers indicated for each exploitasi

(iii) Power flow diagram

(c) Data for grasping the relationship between facilities and service

(i) Statistics of accidents

Data concerning the causes, phenomena, frequencies, and occurance ratios

(ii) Transition in the number and capacity of facilities

(iii) Trend of power generation and load

(iv) Changes in the distribution of customer's voltages, voltage drops of feeders, and service interruptions (Number of consumers, total hours, and total number of interruption x minutes)

(d) Data for the calculation of available hydro power capability

Volume of water flow, energy production, and water level of reservoirs, at each power plant

(e) Technical trend in foreign countries

In the cases of items (a), (b) and (c), the data for the self-generation facilities not belonging to PLN should be included.

c. Data concerning projects

(a) Data concerning the natural resources

(i) Observation data on water flow and water level at each gauging station

(ii) Data on precipitation at each weather observatory

(iii) Data on the contents, characteristics and prices of domestic fuels

(iv) Various kinds of maps of different scales

(b) Project data

(i) Reports of various studies for electric power development

(ii) Ideas, studies and plans made for other related fields

River basin development plans for irrigation and flood control, harbour plans, master plans of development for major cities, plans for development of large size industrial self-generation power plants and so on

d. Data concerning investment

(a) Annual records of total investment with sub-totals for each exploitasi and for power generation, power transmission, substation and power distribution

(b) The list of projects under construction and plans decided,

description of works, total costs, and yearly budgets

For the projects of power sources, power transmission and substations, all projects should be listed. In the case of distribution system, the grouping of construction work is done for each exploitasi, and for high tension lines and low voltage distribution lines.

(c) Actual data on construction cost

Construction cost should be separated into material cost and other items, and the unit construction costs for every fiscal year should be calculated. (See Appendix 2-17)

(d) Market prices of major materials

e. Data concerning revenue and cost and data for economic calculation

The following data should be collected and rearranged in time series based upon the annual records.

(a) Revenue data

(i) Monthly and yearly revenues from electric charges

Data should be collected in accordance with the categories of contracts based on the distinction of demand charge and energy charge.

(ii) Miscellaneous operating revenues and the revenue from the shares for the construction work

(b) Cost data

(i) The records of actual cost divided into categories of facilities and cost elements

(ii) Level of interest rate and price level

(iii) Cost elements common to other industries

(iv) Cost data of foreign electric power industry

(c) Economic calculation data

The expenditure per construction cost for each category of facilities

f. Data for overall check

The following data should be prepared for the judgement from the viewpoint of top management.

(a) Index of capital condition

(i) Ratio of internal reserve (internal reserve/revenue, internal reserve/increased asset, and internal reserve/investment)

(ii) Ratio of external loan (loan/investment)

(iii) Ratio of foreign capital (foreign loan/annual investment, total foreign capital/total liability and net worth)

(b) Effectiveness of capital

(i) Capital turnover (total revenues/total liabilities and net worth)

(ii) Ratio of investment (increased asset/revenue, and investment/revenue)

(iii) Inventory turnover (yearly delivery/average inventory in a year)

(iv) Incremental unit cost (investment in each category of facilities/incremental peak load at the generating end)

(c) Service index

(i) Waiting consumers

- Number and probable contracted KVA of waiting consumers
- Number of waiting consumers/number of existing consumers
- Probable contracted KVA of waiting consumers/contracted KVA of existing consumers

(ii) Actual records of electric power supply interruptions (frequency and hours of electric power supply interruptions per one consumer in a year)

(iii) Proportion of consumers supplied at improper voltage

2-2-6 Preparations for the First Long-term Planning

(1) How to forward the planning

a. The basic approach for the formulation of the long-term plan and the urgent measures required are already mentioned at the beginning of this section. The early establishment of the plan is strongly desired. Therefore, the consolidation of planning system and the sellective collection of data in accordance with a schedule are urgently necessary.

b. The following considerations are required for the establishment of the first long-term plan.

- Data could be collected in the process of planning without intending to collect the data completely before the commencement of the planning.
- Precise contents of the plan should be made step by step while revising the first long-term plan.

However, thorough study should be made on the basic design of facility formation and projects which require prompt decisions.

c. The period from the preparation to the completion of the long-term planning is influenced by the number and the ability of staffs and other factors.

In the case of the first planning, even if the above-mentioned considerations are given, it seems to require about two years.

An example of the phasing of planning is shown in Appendix 2-12.

(2) The consolidation of planning system

a. It is a matter of course to clarify which department is in charge of planning and to obtain the necessary number of persons for the planning. Planning staffs must have wide knowledge, an adequate experience and an aggressiveness. They are limited to the persons who have educations higher than the high school level, and who have more than two or three years of experiences.

b. The following measures are thought to be effective in the formulation of the first long-term plan.

(a) A committee which consists of the staff members of PLN head office and Directorate General for Power and Electricity and some chiefs of exploitasi offices should be established.

(b) Some young and capable members should be dispatched to the planning department from exploitasi offices.

(c) It is necessary to invite the advisors from developed countries in order to have a proper guidance.

c. It is effective to have the assistance of consultants for the surveys of major projects which are fundamental to the establishment of the long-term plan.

d. Simple computers and printing machines shall be provided to increase the efficiency of works.