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UNIVERSIDAD DEL
ESTADO DE COLORADO
(CSU)

ESTUDIOS SOBRE LA OPERACION Y SEGURIDAD DEL SISTEMA DE EMBALSES DE VALDESIA

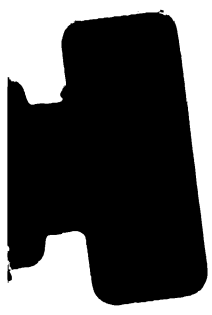
INFORME FINAL

VOLUMEN V

ORGANIZATION AND FUNCTIONS FOR OPERATING
THE VALDESIA RESEVOIR SYSTEM^{1/}

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INFORME FINAL

VOLUMEN V

**ORGANIZATION AND FUNCTIONS FOR OPERATING
THE VALDESIA RESEVOIR SYSTEM^{1/}**

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PRESENTACION

Los estudios de Operación y Seguridad del Sistema de Embalses de Valdesia fueron ejecutados conjuntamente por el Instituto Nacional de Recursos Hídricos (INDRHI) de la República Dominicana, la Universidad del Estado de Colorado (CSU) y el Instituto Interamericano de Cooperación para la Agricultura (IICA) a través del Contrato IICA/INDRHI/CSU firmado el 6 de abril de 1984. Los estudios se iniciaron el 6 de agosto de 1984 y finalizaron el 31 de agosto de 1986.

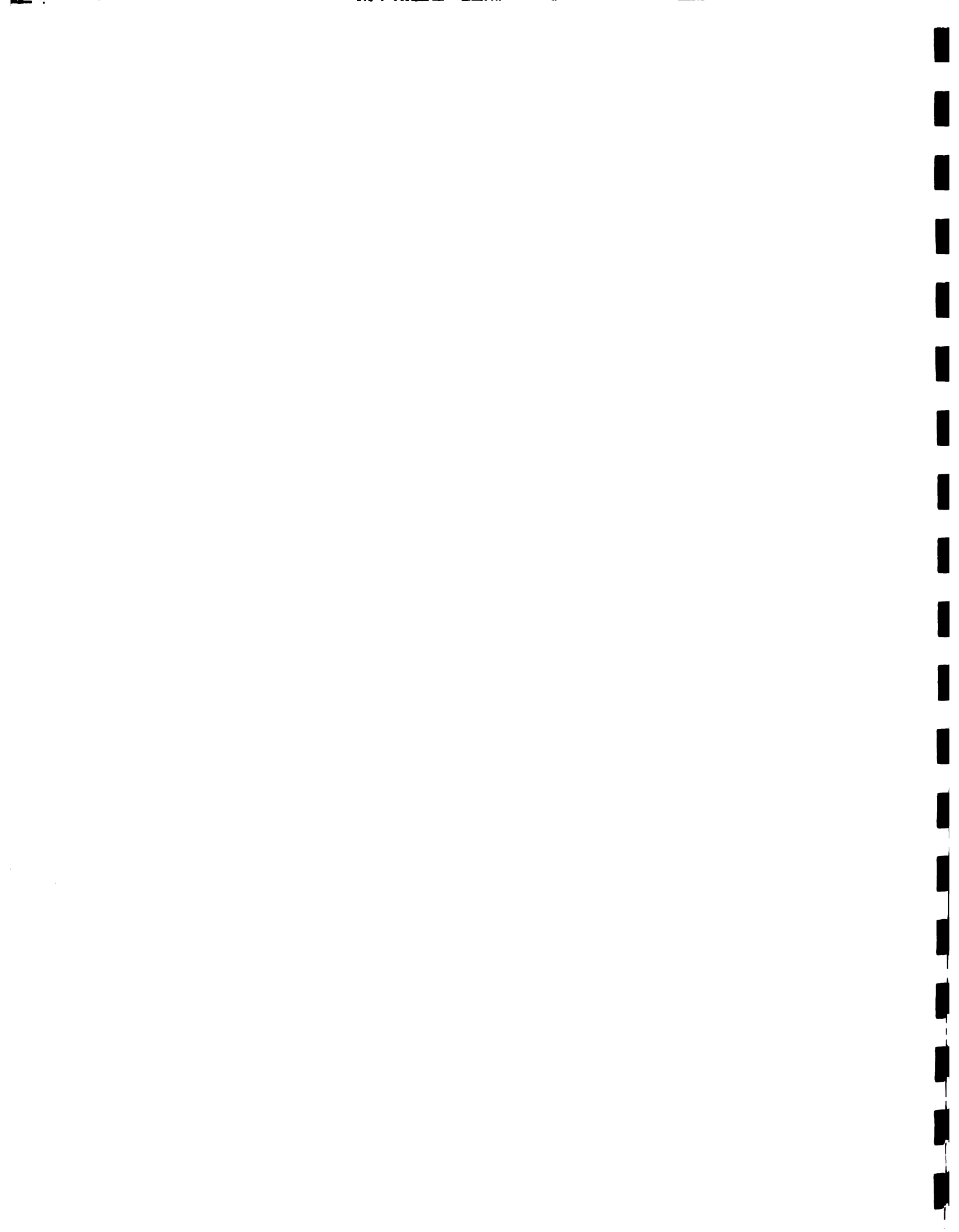
Los estudios fueron financiados por el INDRHI a través del préstamo 1655-DO del Banco Mundial.

La ejecución de los estudios se desarrolló en seis áreas:

- a) Estudios Hidrológicos
- b) Operación Normal
- c) Operación de Emergencia
- d) Inspección, Mantenimiento y Seguridad de Presas
- e) Organización para la Operación del Sistema de Embalses
- f) Entrenamiento y Transferencia de Tecnología

En este documento se incluye parte del material técnico del Informe Final, el cual consta de los siguientes volúmenes:

- Resumen
- Estudios Hidrológicos
- Operación Normal
- Estudios de Operación de Crecidas
- Estudios de Inspección, Mantenimiento y Seguridad de Presas
- Organización y Funciones para la Operación del Sistema de Embalses de Valdesia.



-Transferencia de Tecnología y Capacitación.

-Plan de Operación de Emergencia para el Sistema de Embalses de Valdesia.

-Plan de Operación Normal para el Sistema de Embalses de Valdesia:
(1) Riego y Energía, (2) Control de Crecidas.

-Manuales de Operación de Modelos Computarizados para la Operación Normal del Sistema de Embalses.

-Manual de Usuario de Modelos de Sistemas Hidrológicos.

Santo Domingo, República Dominicana
31 de agosto de 1986

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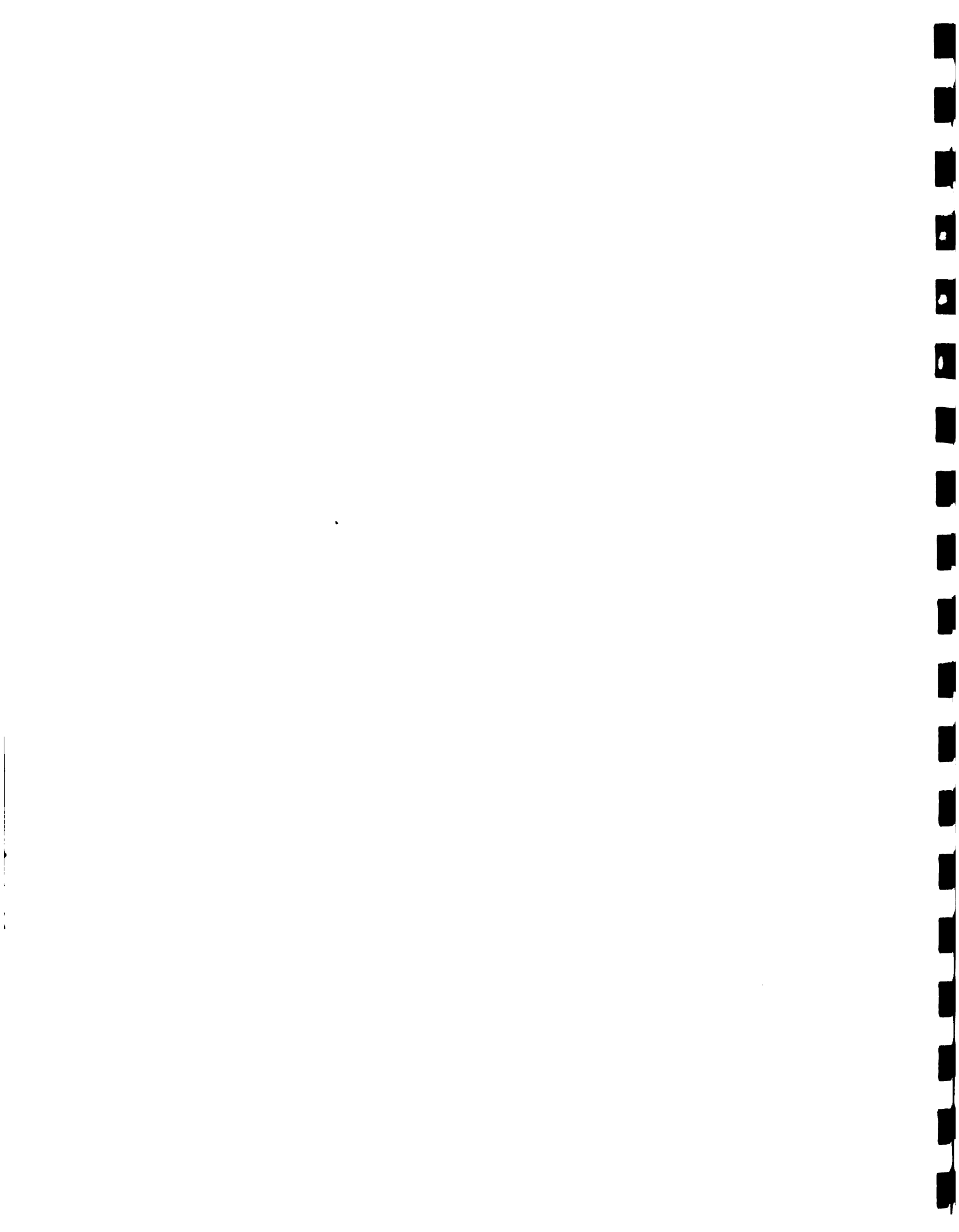
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VOLUME V
ORGANIZATION AND FUNCTIONS FOR OPERATING
THE VALDESIA RESERVOIR SYSTEM

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VOLUME V

ORGANIZATION AND FUNCTIONS FOR OPERATING
THE VALDESIA RESERVOIR SYSTEM5.1 INTRODUCTION

One of the objectives of this project was to investigate the current organization for operating the Valdesia reservoir system and to make recommendations so that its operation and management be optimized considering that it must satisfy both irrigation and hydropower demands and dam safety conditions.

In order to accomplish this objective, the institutional framework around which the Operation and Management of Valdesia reservoir has evolved has been analyzed. This is discussed in the second section of this volume and the problems identified are summarized in the third section. Then, the proposed organizational plan is described in the fourth section. The plan includes a Normal Operating Manual and an Emergency Operating Manual, which are summarized in this section. The manuals are presented in detail in separate reports.

5.2 BACKGROUND5.2.1 Institutions Involved in Reservoir Operations in the Dominican Republic

The Dominican Republic has seven public institutions which are directly related with the planning and management of water resources. These are: the National Institute for Water Resources Development (INDRHI), the Dominican Corporation for Electricity (CDE), the Secretary of Agriculture (SEA), the National Institute for Water Supply and Waste Disposal (INAPA), the Dominican Agrarian Institute (IAD), the Corporation for Water Supply and Waste Disposal for Santo Domingo (CAASD) and the Corporation for Water supply and Waste Disposal for Santiago



(CORAASAN). Furthermore, the government created specific corporations essentially for building dams and in some cases for operating them, however, it appears that historically such corporations (Corporación de Hatillo, Corporación de Valdesia, Corporación de Rincon, Corporación de Sabaneta and Corporación de Sabana-Yegua) have become inactive or dissolved once the dams construction were terminated (IICA/INDRHI/CSU, 1986).

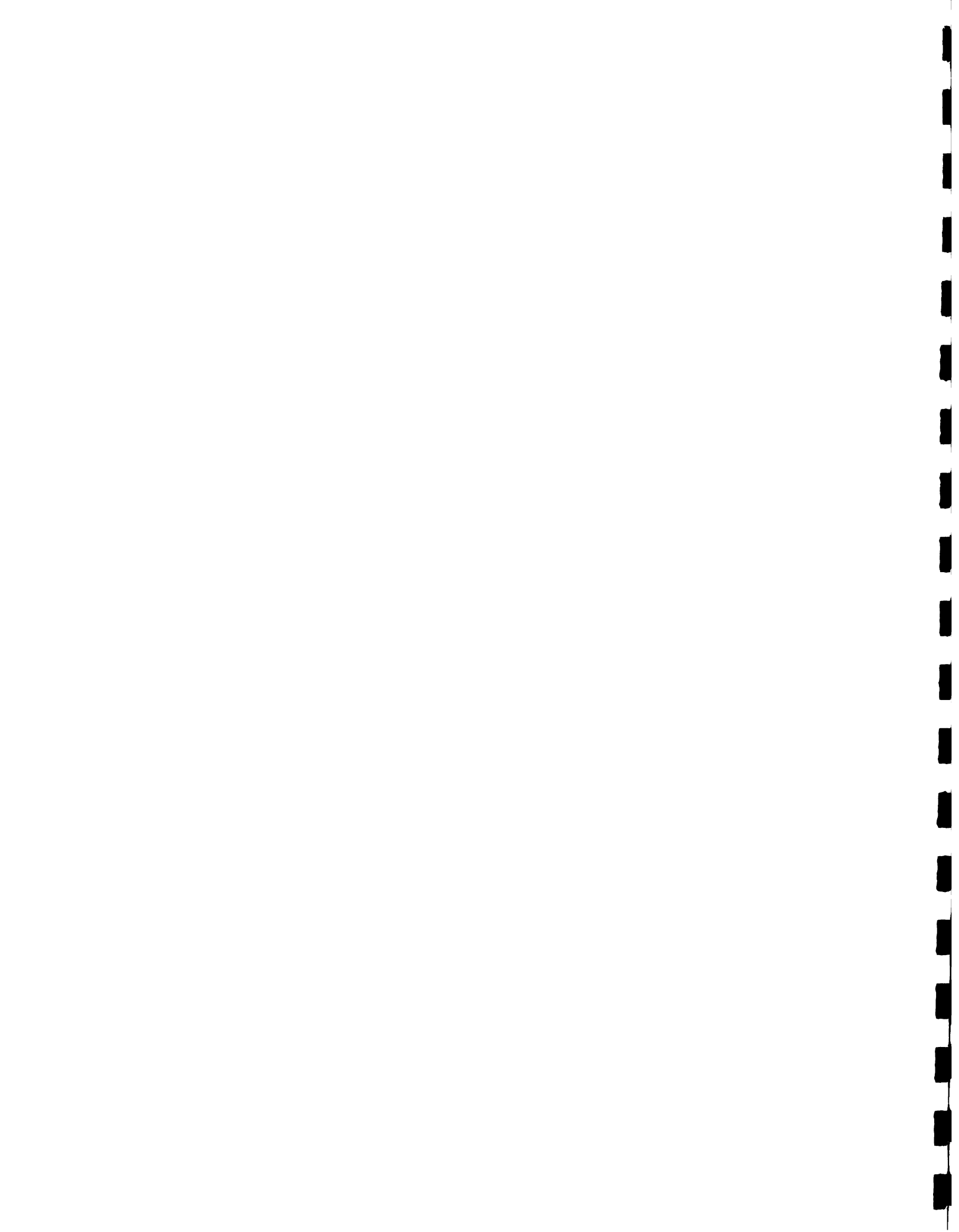
INDRHI was created by law in 1965 as the major authority for the control and regulation of surface and groundwater resources of Dominican Republic. Subsequent laws have reinforced such authority and responsibility (Esquea, 1984). Accordingly INDRHI has the primary responsibility for planning, execution, operation and management of hydraulic projects such as for irrigation and hydroelectric development. In the same year, SEA was created. One of the major responsibilities of SEA are to formulate and conduct the agricultural policies of the country and to cooperate with the corresponding institutions in the use and distribution of water for irrigation. However, prior to 1965 other institutions were already in existence. For instance, CDE was created in 1955 with the major responsibility for producing, transmitting and distributing electric energy throughout the country and INAPA was created in 1962 with the major responsibility for planning and operating water supply and drainage systems for urban and rural communities. Subsequently, CAASD was created in 1973 and CORAASAN in 1977 to be in charge of the planning, operation and management of the water supply and drainage systems of the cities of Santo Domingo and Santiago, respectively. Likewise, IAD was created in 1972 essentially to be in charge of the programs of agrarian reform in the country. As such it



has some responsibility for planning and coordinating the crop and irrigation schedules for some parts of the country.

Needless to say with seven institutions involved in some capacity in the planning, operation and management of water resources systems in the country, some serious overlap of responsibilities and functions has developed over the years as well as duplication of resources and efforts. Examples of numerous existing problems among the institutions have been well documented for instance in Esquea (1984) and IICA/INDRHI/CSU (1986) and will not be repeated here. A major problem which must be mentioned though is that between INDRHI and CDE, in relation to the right to operate the major reservoirs. This problem has developed historically since, on the one hand INDRHI was created to plan, develop and operate water resources systems including irrigation and hydropower projects and in fact by law INDRHI owns all irrigation and hydropower projects except Las Damas and Jimenoa hydroelectric projects. On the other hand, also by law CDE has been assigned the construction and administration of the Tavera-Bao system. This fact, has given CDE a major influence in operating reservoir systems to the point that it actually operates the major systems in current operation in the Dominican Republic. Deciding who has the right to operate this or that reservoir system is beyond the scope of this study. This must be decided under the framework of the law and political system in the country.

Attempts to bring together at least some of these institutions into a single one aimed at eliminating or at least ameliorating some of these problems, have been made in the past without success (Esquea, 1984). Bilateral agreements of cooperation, for instance between INDRHI and CDE



(INDRHI/CDE, 1980), also have been made, with the intention to smooth out some of the differences and to develop some joint programs for operation and management of reservoir systems of common interest. Recently, the Dominican Republic government has created the "Comision Nacional de Aguas Publicas" (Presidential Decree, 1984) constituted by the Directors or Administrators of INDRHI, CDE, INAPA, CASSD and CORAASAN, which among others has the responsibility for searching for unified criteria about the management and control of the water resources of the country and to smooth out any differences that may arise among the institutions in relation to use of the water resources of the country. It is expected that eventually this committee will be able to guide the rational and equitable development, operation and management of the water resources of the country.

5.2.2 Current Organization and Practice for Operating Reservoir Systems in the Dominican Republic

The two major organizations involved in the operation of reservoir systems in the Dominican Republic are INDRHI and CDE. Thus, the analysis below concentrates in these two institutions only.

The National Institute for Water Resources Development (INDRHI).

INDRHI is an agency which plays an important role in planning, operation and management of reservoir systems in the country. The operation and management of reservoirs is carried out essentially by the Departamento de Distritos de Riego, Departamento de Planificación, and the Departamento de Proyectos (see Fig. 5.1). The Division de Operaciones of the Departamento de Distritos de Riego has the responsibility for developing the plans of water deliveries for the irrigation systems in accordance with the crop schedules and water requirements that must be established by the Secretaria de Agricultura (SEA) and the Instituto



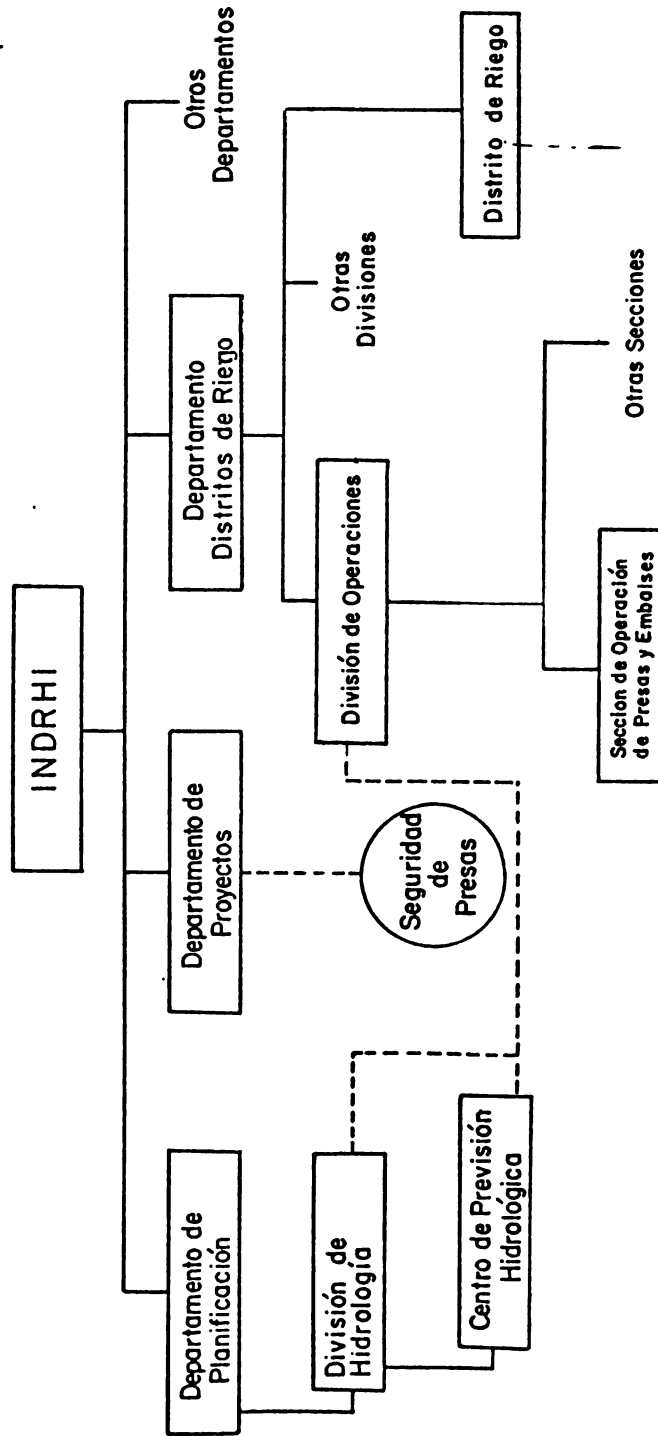
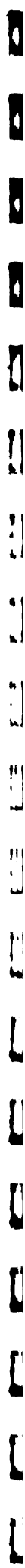


Figure 5.1. Actual Organization of INDRHI for Operating Reservoir Systems



Agrario Dominicano (IAD) depending on the particular case. Unfortunately, there is very little or no relationship and coordination among these institutions. Consequently, in actual practice irrigation water demands and schedules are made almost entirely by the Division de Operaciones of INDRHI. The information on needed water requirements for irrigation is then supplied to CDE or used by the Grupo de Operación de Presas (see Section 5.2.3 below) to agree on the water schedules during the next time period (usually for the following month). The Sección de Operaciones de Presas y Embalses of the Division de Operaciones of INDRHI has been created recently for planning the operations of reservoir systems. This section should play an important role in the near future specially in operational studies of reservoirs for water conservation purposes.

The Division de Hidrologia of the Departamento de Planificación provides the support needed for forecasting water supplies to the reservoirs on a monthly and weekly basis. In fact a major development which has taken place in the Division de Hidrologia is the establishment of the Centro de Prevision Hidrológica with assistance of WMO. The pilot project is the Yaque del Sur basin which is being implemented with a network of DCP's for transmitting hydrometeorological information by using the GOES-5 satellite system which relays the information to a receiver station located in the Division de Hidrologia of INDRHI. Likewise, a similar network of DCP's is currently being installed in the Nizao basin. The equipment obtained by the WMO project consists of a multiplexer and decoding of information, an IBM-XT and a backup power system. An IBM-AT and a modem was added to the equipment with assistance of the IICA/CSU/INDRHI project. With the hardware capability



currently installed at the Centro de Previsión Hidrológica and with the software implemented as a result of this project, it is expected that the Division de Hidrología of INDRHI will play a major role in the real time operations of reservoir systems in general and the Valdesia system in particular.

The Division de Geotecnia of the Departamento de Proyectos is involved in some degree in following the safety conditions of hydraulic structures (dams, canals, etc.) in the country. However, since the major structures are under the direct operation and supervision of CDE it appears that up to now the role of INDRHI's personnel on this aspect has been secondary.

The Dominican Corporation of Electricity (CDE). CDE is another agency responsible for operating reservoir systems in the Dominican Republic. This is carried out essentially by the Dirección de Operaciones, the Dirección de Producción and the Dirección de Desarrollo Hidroeléctrico as shown in Fig. 5.2. The reservoir is regulated under the rules and instructions of the Dirección de Operaciones (Gerencia de Operaciones y Despacho) while the actual execution of such instructions is carried out by the Dirección de Producción (Gerencia de Operaciones de Plantas). This unit is in charge of the maintenance and supervision of the personnel involved in actual reservoir operations. The Gerencia de Operaciones y Despacho of the Dirección de Operaciones is in charge of the long-term and short-term scheduling of reservoir operations for conservation. It instructs the reservoir operator about the day to day and hour to hour operations of the gates and related units. In such scheduling it is assisted by the division de Hidrología of the Dirección de Desarrollo Hidroeléctrico. In addition, such scheduling must reflect



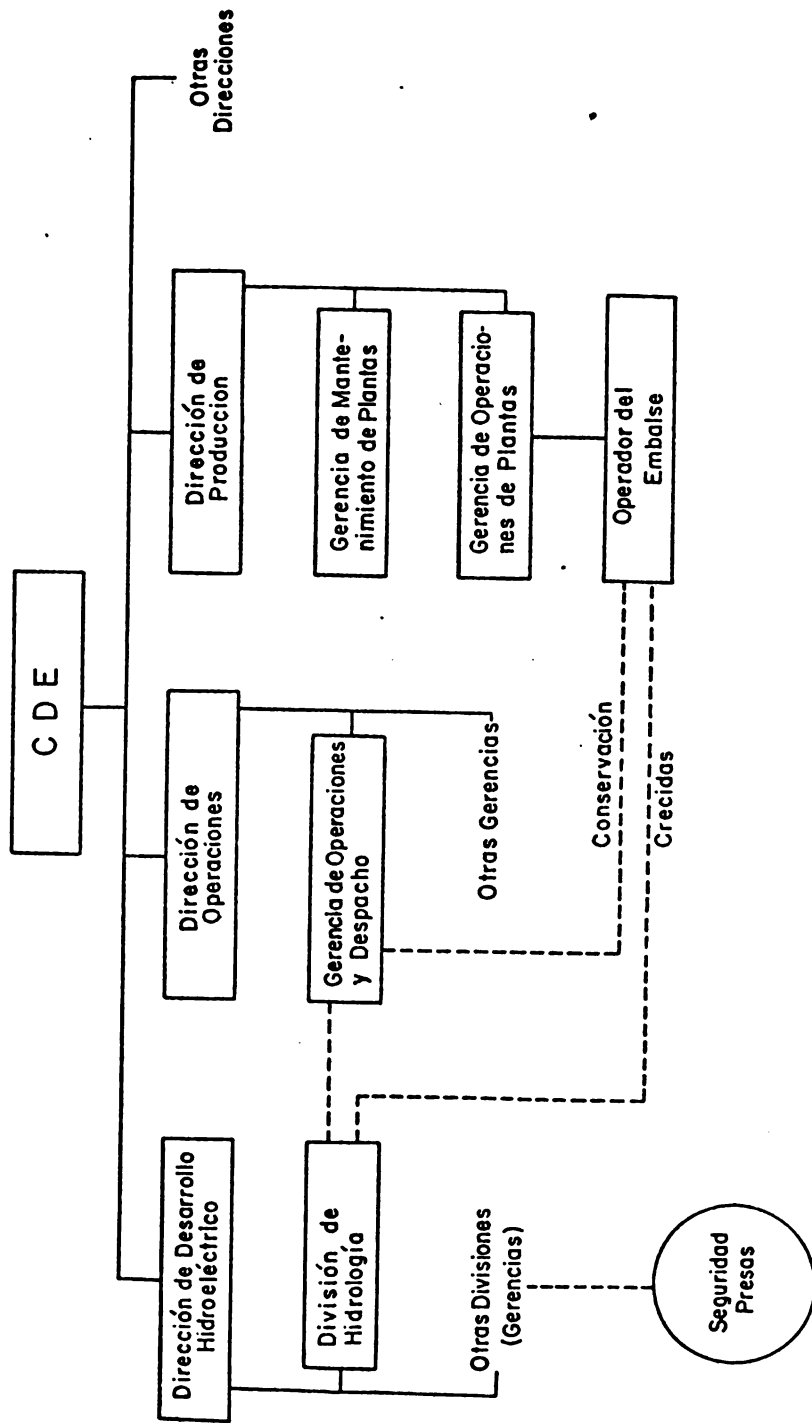


Figure 5.2. Actual Organization of CDE for Operating Reservoir Systems

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the agreements with INDRHI. Unfortunately, this is not always the case as reported by INDRHI's personnel.

On the other hand, during flood and emergency conditions the Division de Hidrologia of CDE is the unit which assumes a major responsibility in reservoir operations. Flood and emergency conditions are established either by the Division de Hidrologia, the CDE Administrator, the Gerencia (Division) de Operaciones de Plantas, or the Dirección de Operaciones. During flood conditions the Gerencia (Division) de Operaciones y Despacho plays a minor role. Depending on the seriousness of the flood condition, representatives of the foregoing units meet and decide on the actions to be taken. In regard to the modes and procedures for operation during flood and emergency conditions, they vary according to the particular system. CDE has made operational studies for developing operating rules for the Tavera-Bao system (see for instance Ramirez, 1985). However, other systems such as the Valdesia Reservoir, have no similar rules supported by specific reservoir operation studies. Most of them were developed empirically and in fact it was reported that some of them are not even used in real operations.

To support the reservoir operations, the Division de Hidrologia of CDE currently receives information about satellite pictures (facsimil) every 3 hours during flood conditions. In addition, it receives information via Telex from the Gulf Coast Weather Service of Tampa, Florida about the position of tropical storm systems and corresponding track forecasts for the next 6 and 12 hours as well as the estimate of the corresponding precipitation potential.

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In addition, it was reported that CDE is about to start a project funded by the Interamerican Development Bank (BID) to implement a "Center for Energy Control" with the objective to develop an optimal and automatic system of power dispatch. As part of this project there is a subproject for automatizing the transmission of hydrologic information via satellites. It is anticipated that the project will have as the pilot system the Tavera-Bao-Lopez basin and the hardware and software for management of such system will be developed.

The normal (regular) maintenance and inspection of the dams and related works are responsibility of the Gerencia de Operaciones de Plantas of the Dirección de Producción. Although functions of each unit exist, however no adequate written procedures are available for some of the dam systems such as the Valdesia dam. In general, maintenance and inspection programs of the dams are inherent parts of the dam safety programs. Apparently, adequate safety programs for the dam systems are not available either. However, current efforts are being made by CDE personnel of the Dirección de Desarrollo Hidroelectrico and Dirección de Production in order to implement some of the recommendations of the Consulting Board regarding the Valdesia dam system (see Section 4.3 of Vol. IV).

5.2.3 Current Organization and Practice for Operating the Valdesia Reservoir

The Valdesia Reservoir system has been directly operated by CDE since the construction of the dam and related works were finished. However, INDRHI as the leading water resources institution in the country and responsible for the overall administration and management of the water resources in the Nizao Basin, plays some role in the management of the Valdesia Reservoir. The ongoing organization for the



operation of the Valdesia Reservoir system is depicted in Fig. 5.3. It essentially shows the units that are involved for both CDE and INDRHI and the lines of communication during normal and flood conditions. The responsibilities of each of the units involved in reservoir operations has been previously described in Section 5.2.2. Thus, the Dirección de Operaciones (Gerencia de Operaciones y Despacho) is the unit which is in charge of the day-to-day operations.

The water conservation "operating rules" of the system are established by the so-called "Grupo de Operacion de Presas" which consists of representatives of the Division de Operaciones and Division de Hidrologia of INDRHI and representatives of the Gerencia de Operaciones y Despacho and Division de Hidrologia of CDE. This group was established about 5 years ago as a result of a broad Agreement of Cooperation INDRHI-CDE signed in August, 1980. Originally the group used to meet every 15 days, however, due to some apparent dissatisfaction as to the faithful execution of the operating schedules agreed upon between the parties, the meetings were interrupted between 1982-1984. The group contacts were re-established in August 1984 and currently there appears to be better working relations between the representatives of the units involved. In reality, the meetings do not take place anymore. Instead, agreements are made by telephone.

In regard to the operation of the Valdesia reservoir under conservation conditions the mechanism is as follows. Considering that the first part of the year is the period of greater agricultural water demand, the Division de Operaciones of INDRHI begins, about November of each year, planning the projected irrigation water deliveries for the following year. This is done based on the projected cropping patterns

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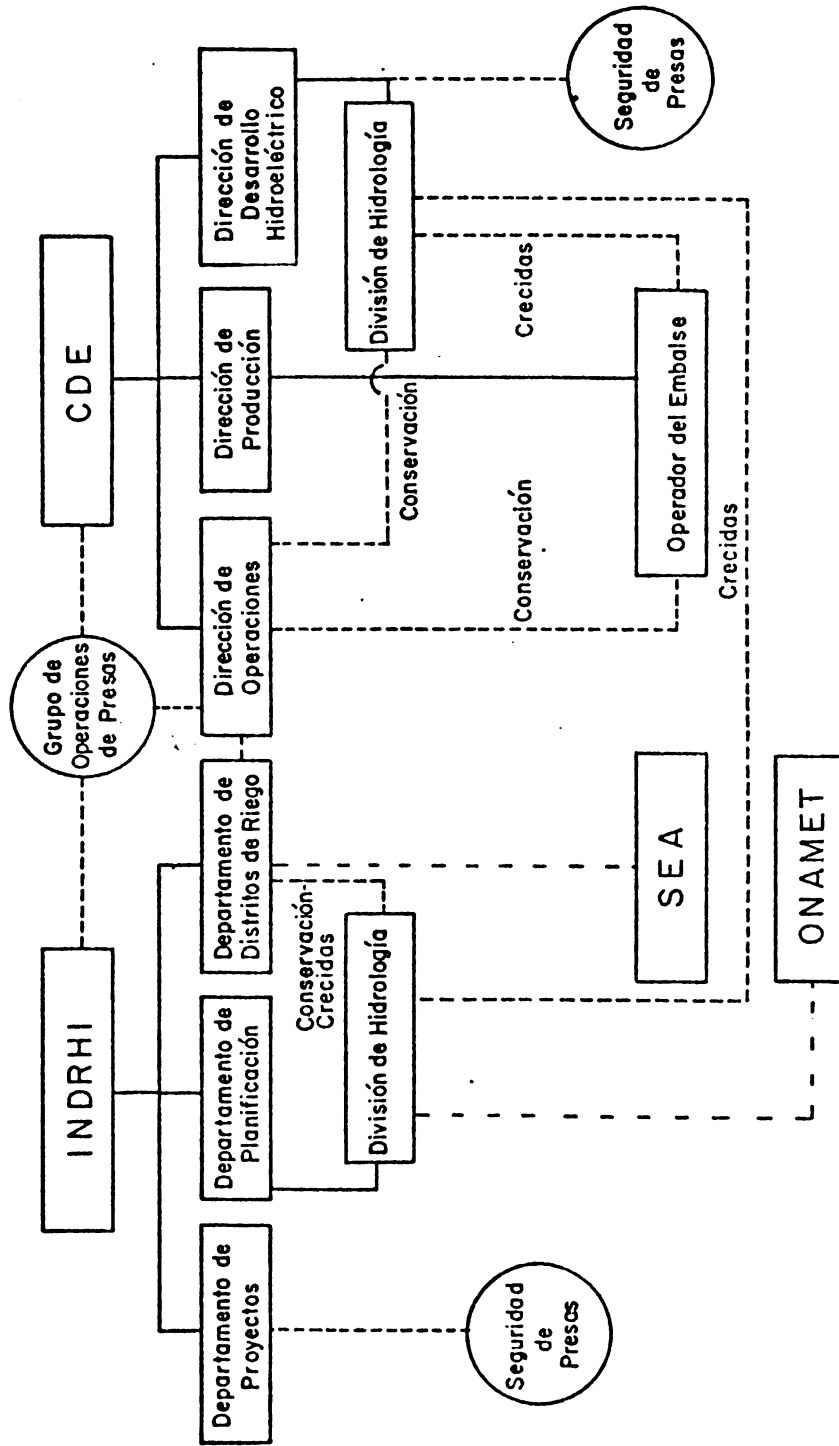


Figure 5.3. Actual Organization for Operating the Valdesia Reservoir



expected for the following year, information which must be obtained from SEA and IAD. It was reported that this is one of the first problems which arises in planning for irrigation water deliveries since apparently there is very little coordination among INDRHI, SEA and IAD. This lack of coordination is also apparent throughout the year during actual operations of irrigation water deliveries. Anyway, the Division de Operaciones of INDRHI prepares monthly reservoir levels needed at Valdesia for supplying irrigation water demands, which are then presented during the meeting of the end of the year of the "Grupo de Operación de Presas." Normally these requests are agreed upon and signed by the members of the Grupo. This agreement is updated every month as new information becomes available on current water supplies. Copies of the agreements are sent to the Executive Director of INDRHI, the General Administrator of CDE and the Irrigation Districts.

Generally, the months of February and March are of greater irrigation water demands. This requires that the operation of the Valdesia reservoir be such that the Las Barías after-bay level be kept full or at least be kept between the levels 76 and 78. This operating procedure is agreed on during the monthly meetings of the Grupo de Operaciones de Presas. Unfortunately, INDRHI personnel reports that CDE does not consistently respect the agreements. A typical scenario is as follows. When there is no head at Valdesia, the dam operator restricts the reservoir outflows aimed at increasing the water level at Valdesia. But this often causes the level at Las Barías to drop below the level 76, consequently the diversion is not enough to supply the irrigation water demands. On the other hand, when there is sufficient head at Valdesia, the dam operator generates power even during the night



(when diversion at Las Barrias is not needed), consequently some water is spilled at Las Barrias, which otherwise could be saved for later use. Thus, it appears that a serious lack of coordination exists and persists during actual normal operation of the Valdesia reservoir system, although it was recognized by personnel of the Division de Operaciones of INDRHI that there is better coordination during water shortages and drought periods.

It was mentioned that the "operating rules" to provide water for the Nizao irrigation project and to generate hydroelectric power at Valdesia are agreed upon by the Grupo de Operación de Presas. This is done on a monthly basis as new information on the state of the system is obtained. However, such rules or guides have not been developed under any optimal criteria. They are essentially agreed based on short-term projections of irrigation requirements of INDRHI and apparently based on obtaining the maximum generated hydroelectric power to supplement the power generated by CDE at other systems, such as the Tavera-Bao system, or to make up for the power loss due to breakdowns at other systems. Under this situation, and since the operating agreements often are not met anyway, the system operations are inefficient and only adds to the inherent hydrologic and economic uncertainties of the Valdesia project. It is expected that the results obtained in the present study will redirect the current operating guides and criteria of the Valdesia reservoir system.

During flood conditions the Division de Hidrologia of CDE takes the lead in guiding the Valdesia reservoir operation. When an emergency condition arises or is expected as in the case of flooding due to hurricanes, an ad-hoc group is established usually composed of the CDE's

General Administrator, and the heads of the Gerencia de Operaciones de Plantas, the Division de Operaciones and the Division de Hidrologia. Forecast information in the case of hurricanes is obtained from Gulf Coast Weather Service of Tampa. The Division de Hidrologia also receives satellite pictures as an additional information concerning the development and progress of tropical storms. Coordination with ONAMET (National Office of Meteorology) about storm forecasting in general is poor except in hurricane conditions in which ONAMET functions as a center of information and coordination among different government organizations. Apparently operating decisions during flood and emergency conditions are made empirically based on the experience of personnel of the Division de Hidrologia of CDE and based on the experience of the members of the above mentioned ad-hoc group. There are no adequate operating rules developed based on studies of reservoir operations during flood conditions. However, as a spinoff of the flood operation studies made for the Tavera-Bao system some simplified rules were written for Valdesia. It was reported though that in actual flood operations such rules are not used either.

Maintenance and inspection of the dams and related works are carried out by personnel of the Gerencia de Operaciones de Plantas of the Dirección de Producción of CDE, while interpretation and analysis of equipment for monitoring the state of the dams and related structures are made by personnel of the Dirección de Desarrollo Hidroelectrico involved in dam safety. Specific issues concerning maintenance, inspection and safety of the Valdesia reservoir system are described and analyzed in Volume IV "Inspection, Maintenance and Safety Studies" and will not be repeated here. However, it must be mentioned that no



adequate formal procedures for maintenance and inspection of the Valdesia dam system is available. Likewise, adequate formal interpretation and analysis of data related to the safety of the dams and related structures are lacking.

5.3 EXISTING PROBLEMS IN OPERATING THE VALDESIA RESERVOIR SYSTEM

The analysis presented in the previous sections reveals a number of relevant problems in operating Valdesia dam. They are summarized below.

- (a) A major problem in relation to the operation of the Valdesia dam for water conservation purposes is the lack of a formal long-term operating rules to optimize the water use for both irrigation and hydropower.
- (b) There is a lack of an appropriate methodology to operate the system based on actual power and irrigation water demands and forecasted information on water supplies so that the Valdesia system can respond timely to the long-term targets.
- (c) There is a lack of an appropriate coordination between INDHRI, SEA and IAD in determining the projected and actual irrigation water demands.
- (d) The so-called Grupo de Operacion de Presas has not successfully worked in the past. Two major reasons for this lack of success have been identified: first is the informal nature of the group without specific written responsibilities and functions and second is the consistent departure by the Gerencia de Operaciones y Despacho of CDE of the operating agreements, established by the Grupo de Operacion de Presas.



- (e) Operations of the Valdesia reservoir under flood conditions are done empirically. A simple manual for flood operations was developed but has not been used during actual floods.
- (f) There is no adequate manual for emergency operation of the Valdesia system which would include emergency conditions due to floods, earthquakes, landslides and any other situation related to the safe operation of the dam.
- (g) There is no adequate written programs for maintenance and inspection of the Valdesia dam system. Likewise, there is no adequate formal programs concerning the monitoring and analysis of the safety of the dams and related works.
- (h) It is notorious the different priority and importance that CDE gives to the operation and management of the Tavera-Bao system as compared to other systems such as Valdesia. While CDE has developed well studied manuals for operating the Tavera-Bao system, this has not been the case with the Valdesia system. The only conclusion of such disparity is the lack of resources (human and material) to be able to handle in an efficient manner various systems at once. Since this situation can not continue without jeopardizing the optimal and safe operation and management of the Valdesia system, both CDE and INDRHI must join efforts and resources for improving the operation of reservoir systems in general and the Valdesia system in particular.
- (i) In all aspects of the operation and management of the Valdesia reservoir there is a lack of written reports documenting and analyzing the state and response of the system after major events such as floods and earthquakes.

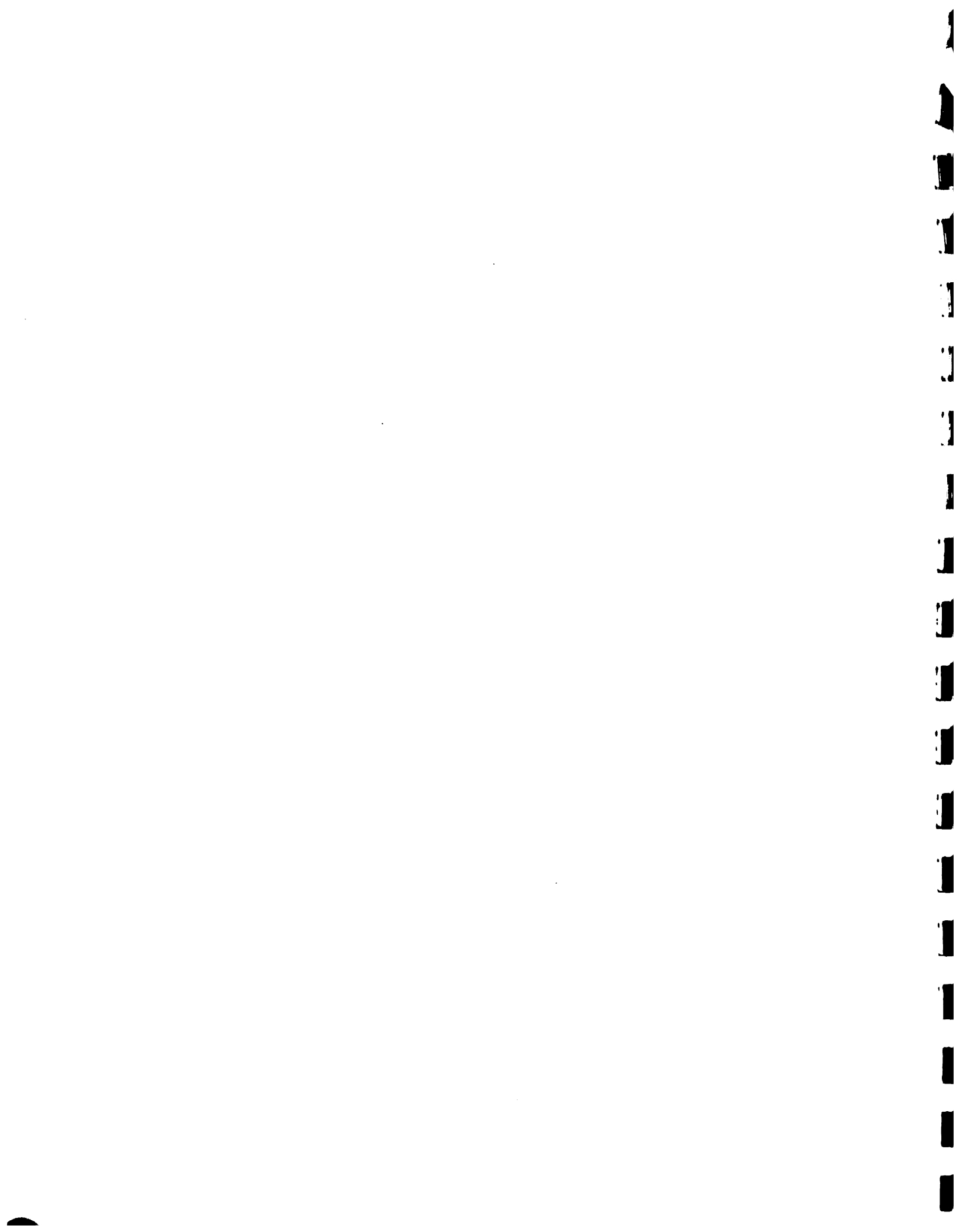


5.4 PROPOSED ORGANIZATION AND FUNCTIONAL PLAN FOR THE OPERATION OF THE VALDESIA SYSTEM

5.4.1 General Considerations

In general, government (national, regional or local) and private organizations may own and operate reservoir systems. For instance, in the United States two of the most important federal agencies that own and operate reservoirs are the U.S. Army Corps of Engineers and the U.S. Bureau of Reclamation. Likewise, in the Dominican Republic INDRHI and CDE are two of such organizations. Regardless of which agency owns and operates a particular reservoir system, interagency cooperation is a necessity and responsible management of such systems rests upon formal and informal arrangements and agreements among them. In addition, other organizations, committees and groups interested in some aspects of the water use and operation of the reservoirs may be involved in coordinating and deciding their operating plans and management. What is optimum management for one special group or organization may not be optimum for another, and it is often difficult to reduce conflicts to a common economic denominator. In striving for optimum multiple-purpose regulation, some controversy and conflict occasionally is generated. It may be resolved by Congress, the Courts, or the public; however, in most cases, these issues should be settled through interagency cooperation by reason, logic and goodwill. It is expected that the same will be true in the Dominican Republic.

The intent herein is to capitalize on the experience and resources of CDE and INDRHI as well as other institutions in order to come up with an organizational and functional scheme for optimal reservoir operations. One should not look at a given organization as a fixed and once for all entity. It may evolve as the need arises and experience is



gained. At the same time, one should allow enough time for a given organizational setup to grow and mature. One must be very clear that any proposed organization will not succeed unless its members and the institution they represent are willing to cooperate and respect mutual agreements. Otherwise, any proposed scheme will never work regardless of how good it is. If each institution can learn to respect the responsibilities of the others, ultimately they will benefit from the experience of the other. It is under the above principles and understanding that the organization discussed below is proposed.

5.4.2 Organizational Structure

The ideal organizational setup for the optimal operation and management of the Valdesia Reservoir system is to create a Reservoir Control Center as outlined in detail in Appendix B of this volume. However, since such an organization may take a long time to develop due to institutional and financial considerations, in the meantime a transitional organizational scheme is proposed herein.

It is proposed that two committees be established, the Normal Operating Committee (NOC) and the Emergency Operating Committee (EOC). Although the proposed organization setup is directly related to the Valdesia Reservoir system, eventually it must include all major reservoirs of the country as well. A schematic representation of such organization is shown in Fig. 5.4.

The Normal Operating Committee will provide guidance and supervision for the efficient and equitable operation of Valdesia Reservoir system under normal conditions. This will include such conditions when there is ordinary floods and water shortages and

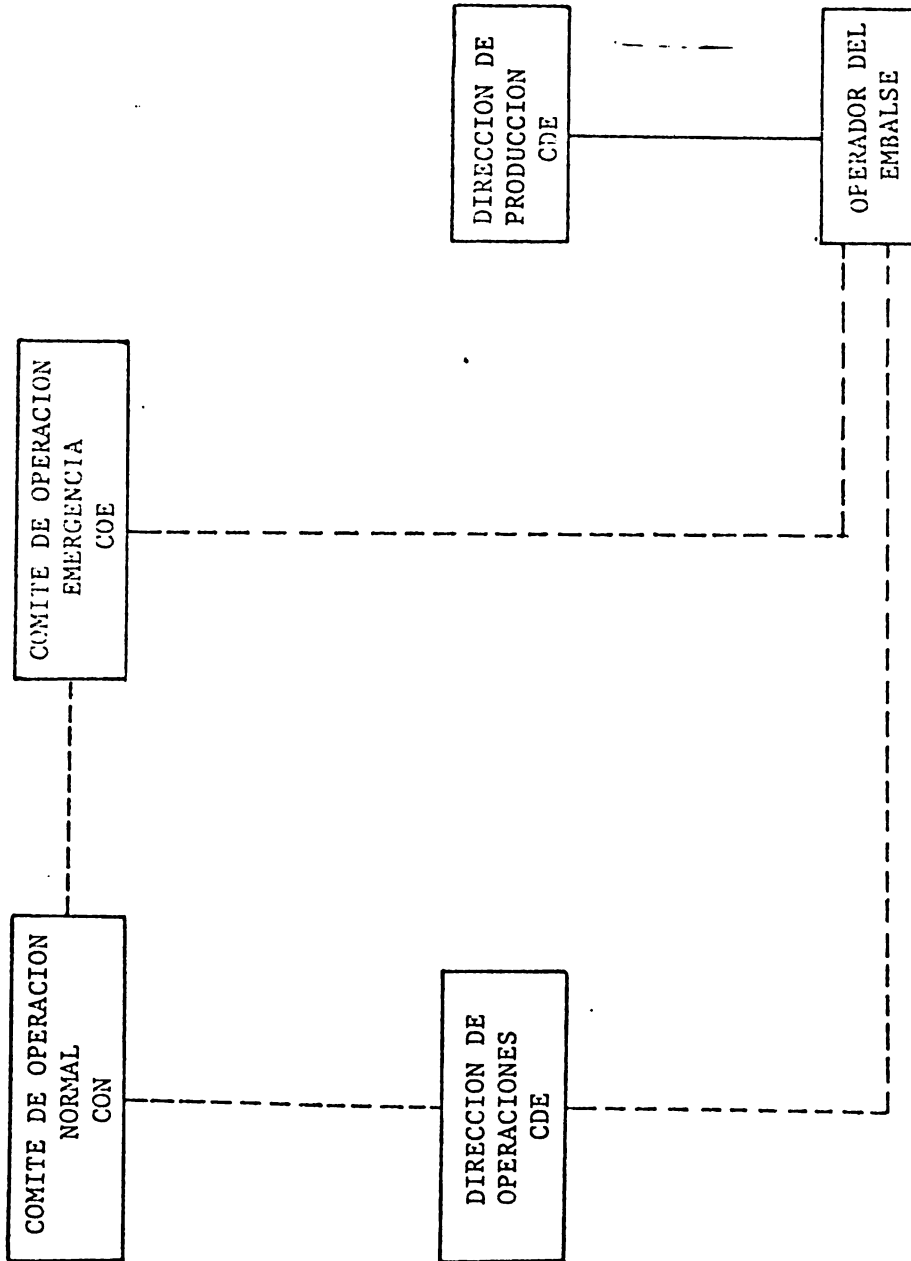


Fig. 5.4 Proposed Organization for the Operation and Management of the Valdesia Reservoir System

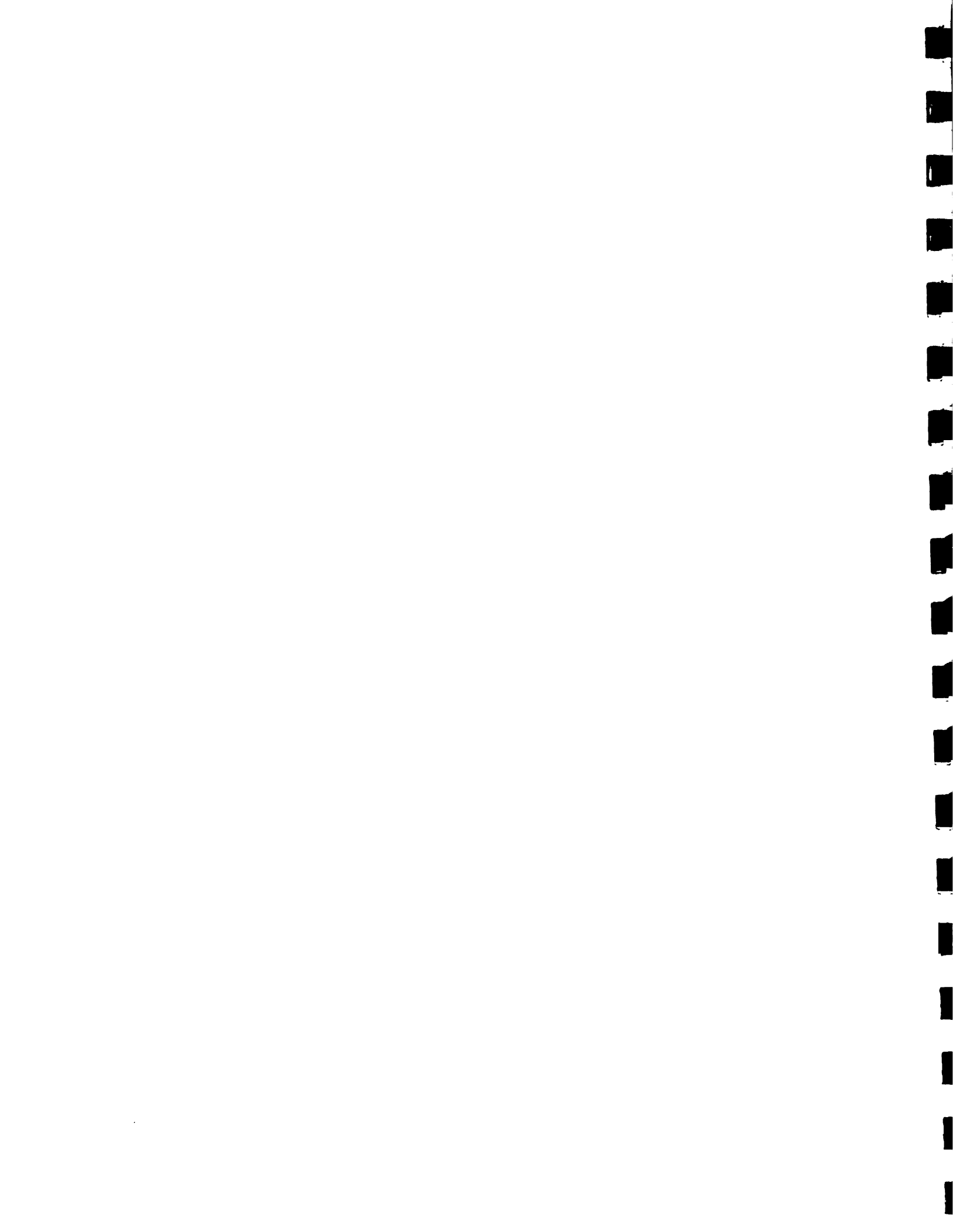


droughts. Members of the Normal Operating Committee (see Fig. 5.5) will be representatives of the following institutions:

INDRHI:	Two members: - Division de Operaciones - Division de Hidrologia
CDE:	Two members: - Gerencia de Operaciones y Despacho - Division de Hidrologia
ASOCIACION DE USUARIOS DE RIEGO	One member - Representante de Usuarios del Distrito de Riego Ozama-Nizao
PODER EJECUTIVO	One member - Representante del Poder Ejecutivo (excluye INDRHI/CDE)

The representative of the Executive Branch (Poder Ejecutivo) will be appointed from any organization excluding INDRHI and CDE. He will fiscalize the fulfillment of the agreements reached by the Normal Operating Committee. Eventually as Nizao River water resources will serve other purposes beyond irrigation and hydropower, additional members of NOC may be necessary.

The Emergency Operating Committee will have the primary responsibility to execute the actual operation of the reservoir system during emergency conditions due to extreme floods (hurricane or non-hurricane), landslides, earthquake, sabotage and any other situation related to the safe operation of the dam which requires special attention and actions. The Committee (see Fig. 5.6) will consist of representatives of the following institutions:



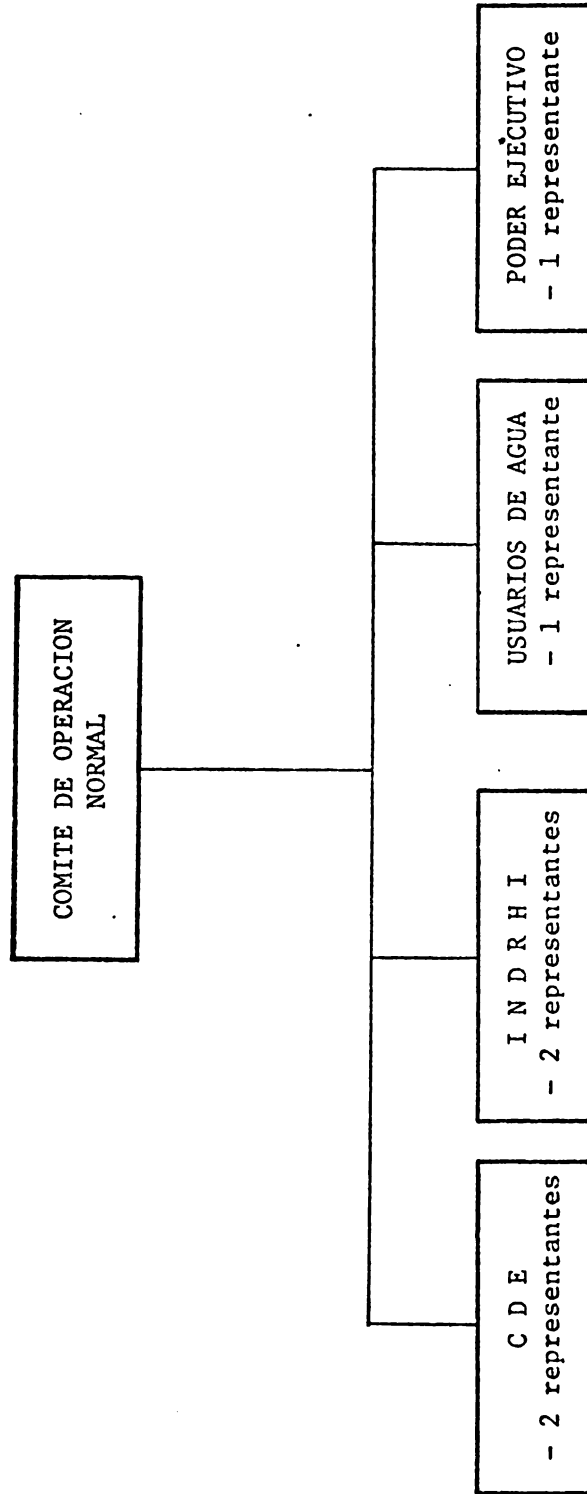
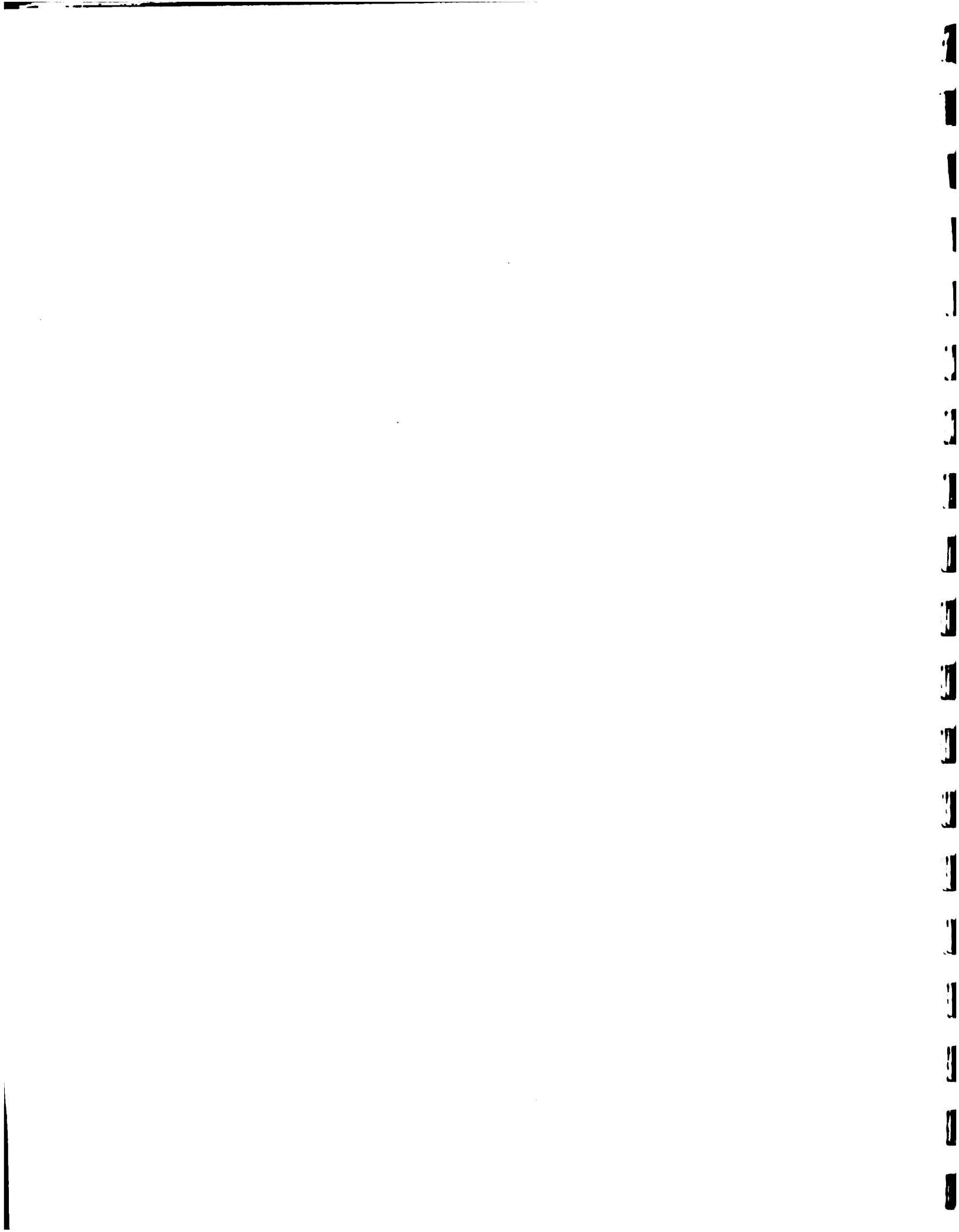


Fig. 5.5 Proposed Committee for Operation and Management of Valdesia Reservoir Under Normal Conditions



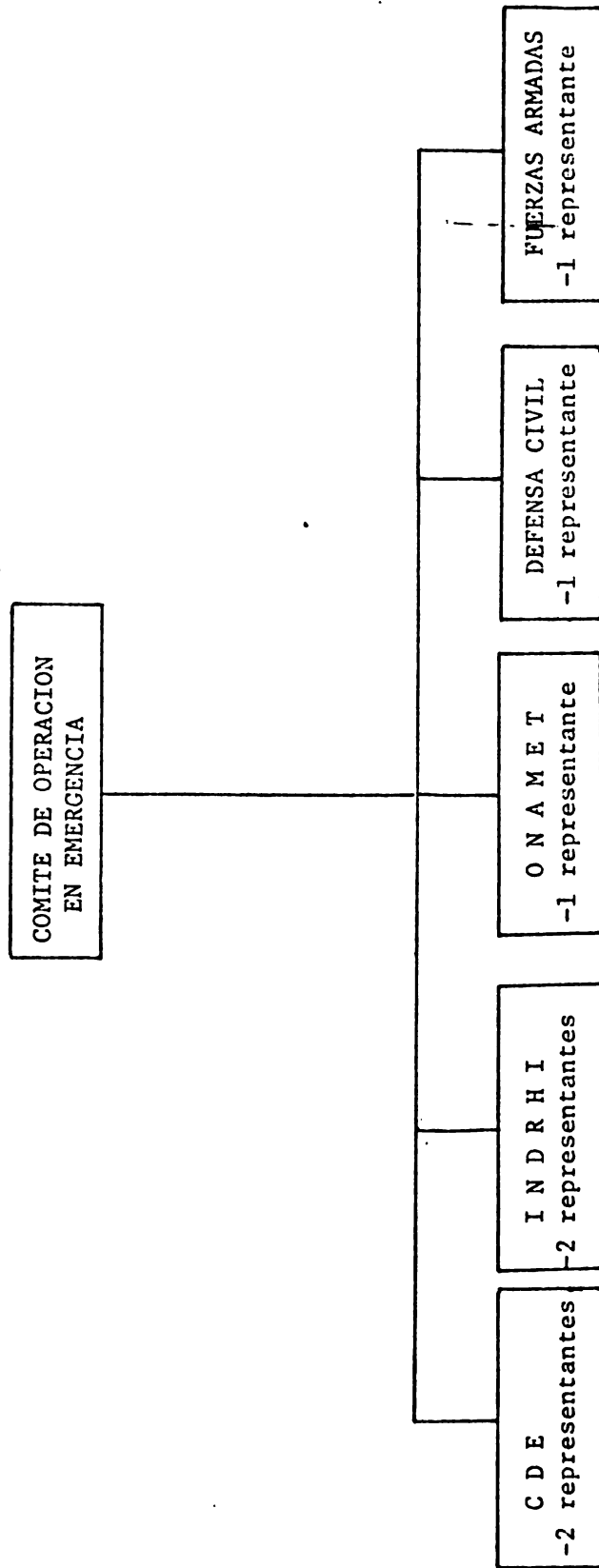


Fig. 5.6 Proposed Committee for Operation and Management of Valdesia Reservoir System Under Emergency Conditions



INDRHI:	Two members: - Division de Hidrologia - Grupo Seguridad de Presas
CDE:	Two members: - Division de Hidrologia - Grupo Seguridad de Presas
DEFENSA CIVIL:	One member
ONAMET:	One member
FUERZAS ARMADAS	One member

Both the Normal and the Emergency Operating Committees will have a Chairman and a Secretary who will be the same for both committees.

5.4.3 Specific Functions

A. Normal Operating Committee

The primary responsibility of this committee is to provide guidance and supervision for the efficient and equitable operation of Valdesia Reservoir system under normal conditions. The specific functions of this committee will be:

- (1) To establish and authorize the general criteria, guidelines and procedures for operating Valdesia reservoir system under normal conditions considering that it must serve several purposes such as irrigation and hydropower, according to the general principles set forth by the Comité Nacional de Aguas Públicas.
- (2) To determine and authorize the specific long-term operating rules of Valdesia Reservoir to supply water for irrigation and hydropower as well as other water uses that may develop in the future such as water supply for urban and rural communities.
- (3) To formulate and authorize the specific procedures for updating and scheduling the reservoir operations on a weekly basis.



- (4) To determine and authorize the specific procedures for daily and hourly scheduling of reservoir operations.
- (5) To review and authorize the specific procedures for operating the reservoir system under flood conditions.
- (6) To secure the committment of institutions such as INDRHI and CDE so that they provide technical services for specific elements of the normal and emergency operations as well as for the inspection and maintenance programs of Valdesia Reservoir system. Specific agreements can be arranged for such purpose.
- (7) To supervise and review on a monthly basis the actual operations of the reservoir system as well as the maintenance and inspection programs related to the safety of the dams.
- (8) To prepare monthly and annual written reports of the actual operation and management of the Valdesia Reservoir system.
- (9) To suggest specialized training of personnel needed for Valdesia Reservoir operations.
- (10) These functions can be updated and modified by the Committee as the need arises.

B. Emergency Operating Committee

The primary responsibility of this committee is to execute the actual operation of the reservoir system during emergency conditions.

The specific functions of this committee will be:

- (1) To establish and authorize the Emergency Operating Plan of Valdesia Reservoir System.
- (2) To execute the specific actions outlined in the Emergency Operating Plan.



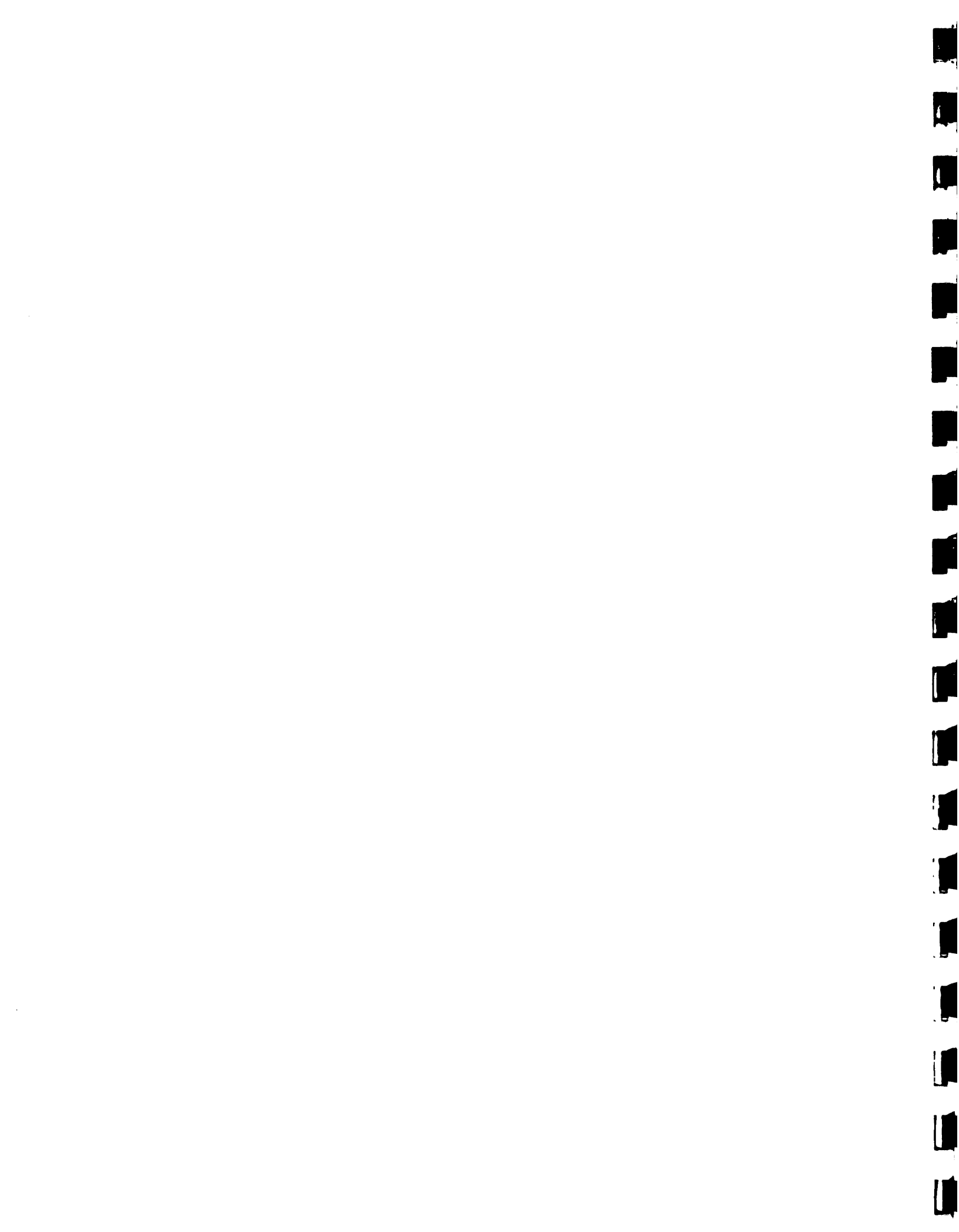
- (3) To review the state of the security conditions of the dams and related works based on the written reports on the normal inspections and maintenance programs and reports provided by special inspection teams and dam operators during ongoing emergencies.
- (4) To coordinate with the appropriate office of ONAMET the emergency operating plan of Valdesia Reservoir system and the National Emergency Plan (currently ONAMET is formulating a National Emergency Plan).
- (5) To coordinate the specific emergency actions for Valdesia Reservoir system with those emergency actions executed by other institutions such as ONAMET, Civil Defense, Armed Forces and Red Cross (on a national, regional or local context).
- (6) To request special agreements needed to perform certain emergency actions as a part of the agreements specified by the Normal Operating Committee. During emergencies, after the formulation of those special agreements, the Emergency Operating Committee will directly contact the corresponding agencies to perform specific emergency actions.
- (7) To formulate and authorize the specific instructions for actions to be followed by the chief dam operator during emergencies.
- (8) To coordinate and execute drills (simulation) to assess and re-evaluate the emergency operating plan.
- (9) To contact directly to specific agencies involved in evacuation and other emergency measures as specified in the Emergency Operating Plan.



5.4.4 Functioning Mechanisms

A. Definitions

- Normal Operating Committee (NOC): Governing board to provide guidance and supervision to the Reservoir Control Center for normal reservoir operations.
- Emergency Operating Committee (EOC): Committee to provide assistance to the Reservoir Control Center during emergency reservoir operations.
- Division of Operations and Despatch (DOD): Division of CDE that communicates to the dam tender the actions for operating and managing the Valdesia reservoir system.
- Normal Reservoir Operation: Operation of the reservoir system to provide water for irrigation and hydropower and controlled releases of ordinary floods.
- Emergency Reservoir Operation: Operation of the reservoir system during emergency conditions such as major floods, earthquakes and landslides which may compromise the safety of the dams or cause damages to human life and property.
- Normal Operating Plan (NOP): Refers to the manual "Normal Operating Plan for the Valdesia Reservoir System."
- Emergency Operating Plan (EOP): Refers to the manual "Emergency Operating Plan for the Valdesia Reservoir System."
- Valdesia Reservoir System: Includes the Valdesia and Las Barias dams.
- CDE: Corporación Dominicana de Electricidad
- INDRHI: Instituto Nacional de Recursos Hidraulicos
- ONAMET: Oficina Nacional de Meteorologia
- INAPA: Instituto Nacional de Aguas Potables y Alcantarillados
- CAASD: Corporación del Acueducto y Alcantarillado de Santo Domingo
- CORAASAN: Corporación del Acueducto y Alcantarillado de Santiago
- CONAP: Comité Nacional de Aguas Publicas
- CPH: Centro de Prevision Hidrologica



B. NormsNorms Concerning the Normal Operating Committee (NOC)

- (1) The members of NOC will be appointed by the institutions they represent, except that one member will be appointed by The Executive Branch (excluding INDRHI and CDE).
- (2) The Chairman and Secretary of NOC will be representatives of INDRHI and CDE, one from each institution and the term will be for one year on a rotating basis.
- (3) The Chairman of NOC must designate a substitute from his own agency to substitute for him in case of a planned or an accidental absence. Likewise, for the same reasons every member of the committee must have a substitute designated in advance by the institutions they represent.
- (4) All members of NOC can vote except the member appointed by The Executive Branch who is a non-voting member.
- (5) The regular meetings of NOC will take place at a location agreed upon by the Committee during the first meeting.
- (6) NOC will regularly meet once a month. More frequent meetings may be necessary in case of water shortages or droughts, or in case of unexpected situations which may lead to temporary changes of the agreed daily and/or weekly water schedules. NOC should eventually establish such possible situations and the corresponding instructions to handle them.
- (7) The specific dates for the regular monthly meetings of NOC will be established during the first meeting. The Chairman of NOC will notify all members of the committee in the case that the reservoirs are in emergency mode. In such case the



Chairman of NOC will reschedule the meeting as soon as the emergency condition ceases.

- (8) All matters for discussion by NOC will be directed by the Chairman of the Committee. Decisions and agreements by NOC will be made by a simple majority vote.
- (9) For any serious dispute that can not be solved by this committee, the member appointed by The Executive Branch should bring the dispute to the judgment of the Executive Director of INDRHI and the General Administrator of CDE.
- (10) A majority of this Committee (including the Chairman and the member appointed by the Executive Branch) must be present for all normal committee meetings. During the absence of the Secretary of this Committee, the other member of NOC representing the same institution as the Secretary will substitute for him. In the case that no majority of NOC is present, the Chairman will schedule another meeting at the earliest possible time.
- (11) The minutes of the meetings of NOC will be drafted by the Secretary of NOC at the end of the meeting. All members present must sign the preliminary draft of the minutes. The final draft will be signed by all members of the committee at the beginning of the following regular meeting. Copies of the minutes must be provided to each permanent member of NOC.
- (12) These norms and functions will be reviewed and authorized by NOC. Subsequent update and modifications of the norms and functions must receive at least four votes of the Committee.



Norms Concerning the Emergency Operating Committee (EOC)

- (1) The members of EOC will be appointed by the respective institutions they represent. The Chairman and Secretary of the committee will be representatives of INDRHI and CDE one from each institution, and ~~the~~ term will be one year on a rotating basis. The Chairman and Secretary of EOC will be the same as the those of NOC, respectively.
- (2) In case of absence of the Chairman of the Committee, the other member of EOC representing the same institution as the Chairman will substitute him. Similar arrangement will be made in case of the absence of the Secretary. Likewise, any other member of the committee must have a substitute which must be designated in advance by the institutions they represent.
- (3) The regular meetings of EOC will take place once a year in anticipation of the hurricane season. Thereafter, special meetings will take place whenever EOC is activated as specified in the Emergency Operating Plan.
- (4) All meetings of EOC will take place at a location specified by the Chairman of EOC.
- (5) The Chairman of EOC will direct all discussions, decisions and actions to be taken by EOC during emergency conditions. The Secretary will prepare minutes of all discussions, decisions, and actions.
- (6) All the matters of this Committee will be decided by simple majority vote. The Committee will specify the special



conditions for which more than a simple majority vote is required.

- (7) During special emergency situations that require immediate attention and the Chairman of EOC is not able to secure the presence of the members of the Committee, he will act for the Committee to execute the emergency measures according to the Emergency Operating Plan.
- (8) These norms and procedures described below will be reviewed and authorized by EOC. Subsequent update and modifications will be made by EOC as the need arises.

C. Procedures

Procedures Concerning the Normal Operations

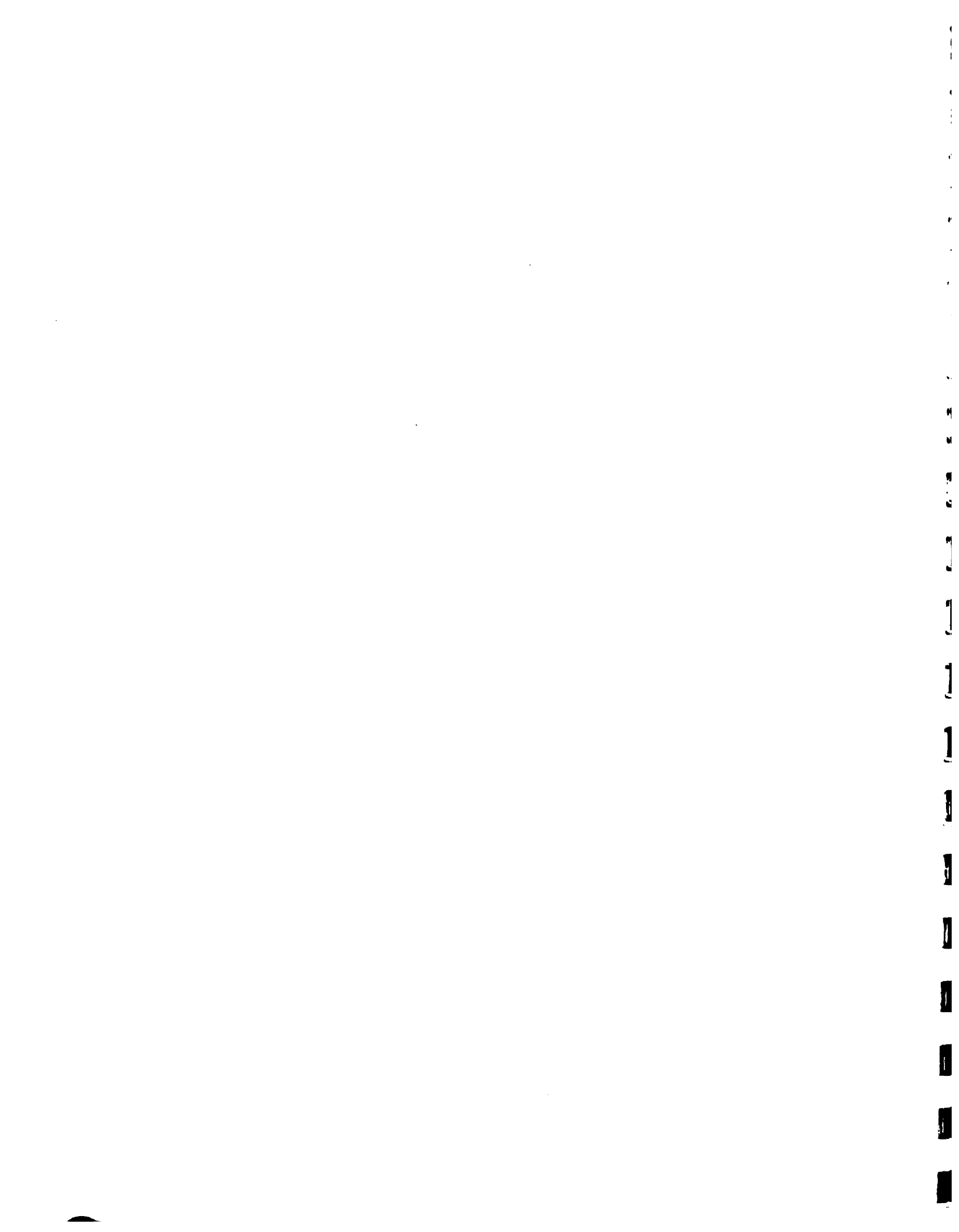
- (1) In advance of each monthly meeting of NOC, four members of NOC, namely: Division de Operaciones and Division de Hidrologia of INDRHI, and Division de Operaciones y Despacho and Division de Hidrologia of CDE will meet in order to plan the reservoir operation for the following month according to the instructions specified in the Normal Operating Plan, Part 1. The Chairman of NOC will designate the member who will coordinate the meeting and the activities of this working group. They will perform the following tasks:
 - a. Review the forecasts of water inflows to Valdesia reservoir for the following month and each of the following four weeks.
 - b. Review the scheduling of reservoir operations that each agency may have done independently.



- c. Make additional computer runs if necessary to verify or complete the scheduling of the reservoir system.
 - d. Write a draft of the plan of reservoir operations for the following month and weeks to be submitted for review and authorization to Normal Operating Committee.
- (2) The same personnel indicated in (1) will meet once a week (Friday afternoon) in order to plan the operation scheduling of Valdesia reservoir for the following week based on the instructions specified in the Normal Operating Plan, Part 1. They will perform the following tasks:
- a. Review the forecasts of water inflows to Valdesia Reservoir for the following week based on new available information.
 - b. Make the necessary computer runs to schedule the reservoir operation for the next week.
 - c. Decide the water allocations according to specific guidelines established by Normal Operating Committee during water shortages (available supply is not enough to satisfy the water demands).
 - d. Prepare a report documenting the decisions reached about the scheduling of Valdesia Reservoir system for the following week.
- (3) During severe shortages and drought conditions the working group referred to in (2) may decide to meet more often than the regular weekly meetings. Likewise in these situations the working group may decide to ask for consultation and supervision to Normal Operating Committee. In this case the

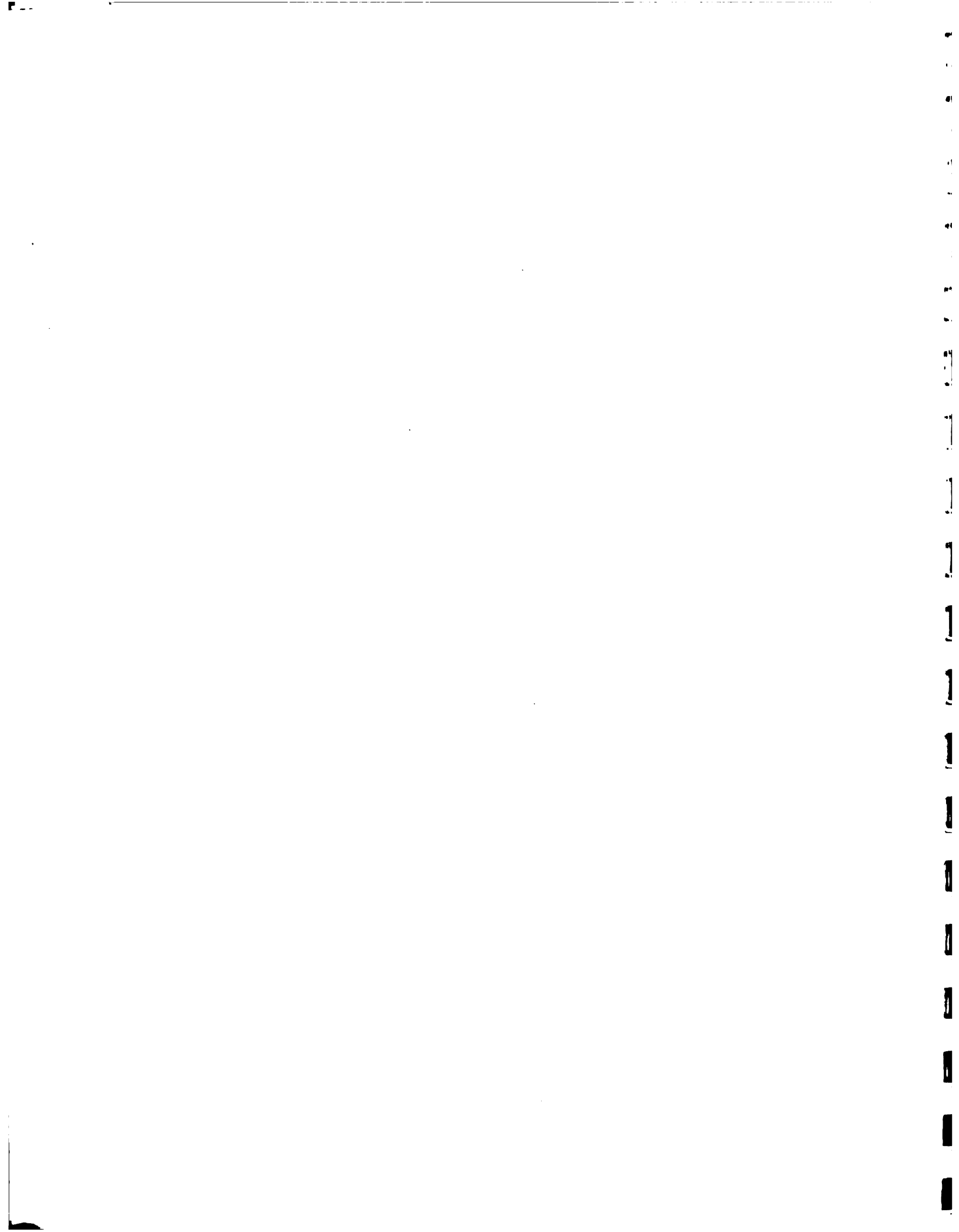
coordinator of the working group will contact the Chairman of NOC to request and arrange a special meeting.

- (4) Deviations from the agreed weekly schedules may occur during the day to day reservoir operations depending on the current water available conditions in the reservoir. Such deviations will be based on guidelines agreed upon by the Normal Operating Committee.
- (5) Eventual direct communication of the power control center of CDE (Division of Operations and Dispatch) with the controls at the Valdesia dam system can be arranged once an automatic control center is established by CDE. Special instructions and regulations for such automatic control between CDE and the dams will be authorized by the Normal Operating Committee.
- (6) During real time operations of the reservoirs large storms (hurricane and non-hurricane) may develop in the Nizao watershed requiring some specific actions for flood operation mode of the reservoir. The procedures to follow in such cases are outlined in the section under flood control of the Normal Operating Plan, Part 2. They are summarized as follows:
 - a. During minor floods, the dam operator in consultation with the hydrologists of CDE and INDRHI will direct the reservoir operations.
 - b. Alerts for possible major storms which could lead to serious flooding, or communications of ongoing major floods may be issued by ONAMET, CDP operators, dam tenders or other independent sources, to the Center of



Hydrologic Forecasting of INDRHI (CPH) and the Division of Hydrology of CDE.

- c. In response to the alerts or communications specified in (b), hydrologists of CPH and CDE will implement the flood forecasting and flood operation procedures described in the Normal Operating Manual, Part 2.
 - d. The hydrologists of INDRHI and/or CDE will notify the Normal Operating Committee that the reservoir is in flood operation mode. Likewise, the Committee will be notified when the flood operation mode has ended.
 - e. The hydrologists of INDRHI and/or CDE will alert and notify the Emergency Operating Committee when flood emergency conditions are established as indicated in the Normal Operating Plan, Part 2.
 - f. The hydrologists of INDRHI and CDE will coordinate the preparation of a report whenever a major flood occurs, specifying details of the storm, flood, operation mode, reservoir response and flood impacts and damages.
- (7) A monthly report about the normal inspection programs including informal, intermediate, formal and special inspections as recommended in the Emergency Operating Plan must be prepared by the safety groups of CDE and INDRHI. Such report must be normally sent to the Chairman of NOC in advance to the monthly meeting of the Normal Operating Committee. However, if any inspection discovers certain weaknesses as listed in the Emergency Operating Plan, it must be reported



immediately to the Chairman of NOC for coordinating the appropriate actions.

- (8) Likewise, a monthly report about the regular maintenance program as recommended in the Emergency Operating Plan must be prepared by the safety groups of INDRHI and CDE. This report must be normally sent to the Chairman of NOC in advance of the monthly meeting of NOC. However, if significant changes occur in the readings of the monitoring instruments for dam safety, it must be reported immediately to the Chairman of NOC for appropriate action.

Procedures Concerning the Emergency Operations

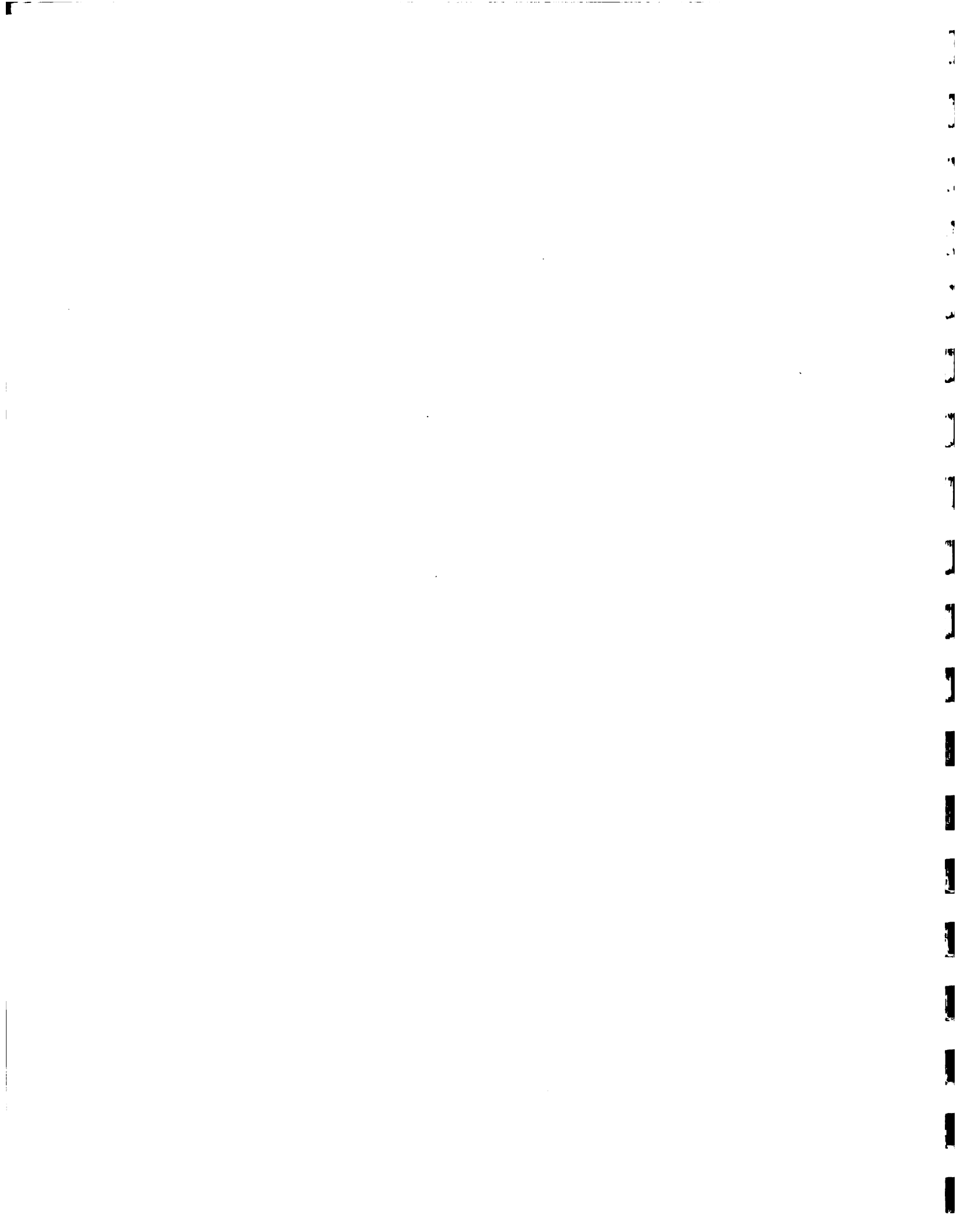
- (1) A number of factors may lead to emergency conditions of the Valdesia Reservoir system. These are listed in the Emergency Operating Plan. Members of the Emergency Operating Committee, the dam tenders, the hydrologists of CPH (Division of Hydrology of INDRHI) and CDE and the safety groups of CDE and INDRHI must become familiar with the Emergency Operating Plan.
- (2) Specific steps must be followed during conditions leading to and during flood emergencies. The steps to follow in such cases are outlined in the Emergency Operating Plan. They are summarized as follows:
- a. Alerts for the occurrence of major storms which could lead to emergency flooding or communications of ongoing flooding may be issued by ONAMET, CDP operators, dam tenders or other independent sources, to the Center of Hydrologic Forecasting of INDRHI (CPH) and the Division of Hydrology of CDE.



- b. In response to the alert or communication specified in (a), hydrologists of CPH and CDE will implement the forecasting procedures and flood reservoir operations depending whether the storm alerts are hurricane or non-hurricane, as specified in the Emergency Operating Plan.
 - c. The hydrologists of INDRHI and/or CDE must notify the Emergency Operating Committee when flood emergency conditions are established as indicated in the Emergency Operating Plan. The Committee must meet immediately at the location designated by the Chairman of EOC.
 - d. The Chairman of EOC must inform the Normal Operating Committee that Valdesia Reservoir system is in flood emergency condition. Likewise, he must inform the Committee when the flood emergency condition has ended.
 - e. The Chairman of EOC will coordinate the preparation of a report whenever the flood emergency condition results into a major flood. The report must specify details of the storm, flood, reservoir operation history during the flood and flood impacts and damages.
- (3) The Emergency Operating Committee (EOC) must be alerted in case of any rapid change of the weakness conditions and/or continuous progressive change as listed in Section 5.1 of the Emergency Operating Plan. Likewise, EOC must be alerted if significant changes occur in the readings of the monitoring instruments for dam safety.



- (4) The alert for emergency action may be initiated by any of the following parties: the Chairman of EOC, the dam tender or any member of the Emergency Operating Committee.
- (5) The Chairman of the Emergency Operating Committee has the responsibility and the authority to declare emergency according to the guide rules (conditions) developed by the Committee. Every effort should be made to contact the Chairman of EOC or his substitute during his absence. If both the Chairman and his substitute are absent for any unforeseen reason (or they cannot be contacted), any other member of EOC may be contacted and may call the meeting of the Committee for conducting the appropriate actions.
- (6) The procedures for emergency notification depend on the type of emergency as specified in the Emergency Operating Plan. They are summarized as follows:
- (a) For Type I emergency. Controlled flood flow releases from Valdesia dam system:
- Dam operators should notify the Chairman of EOC, CDE (person to be named) and INDRHI (person to be named).
 - The Chairman of EOC should notify the Emergency Operating Committee.
 - The Chairman of EOC should notify the agencies involved with evacuation operation plans at downstream locations from the dams.
- (b) For Type II emergency. Possible dam failures:
- The operators of the dams and anyone may contact the Chairman of EOC to report any signs of possible dam failures.



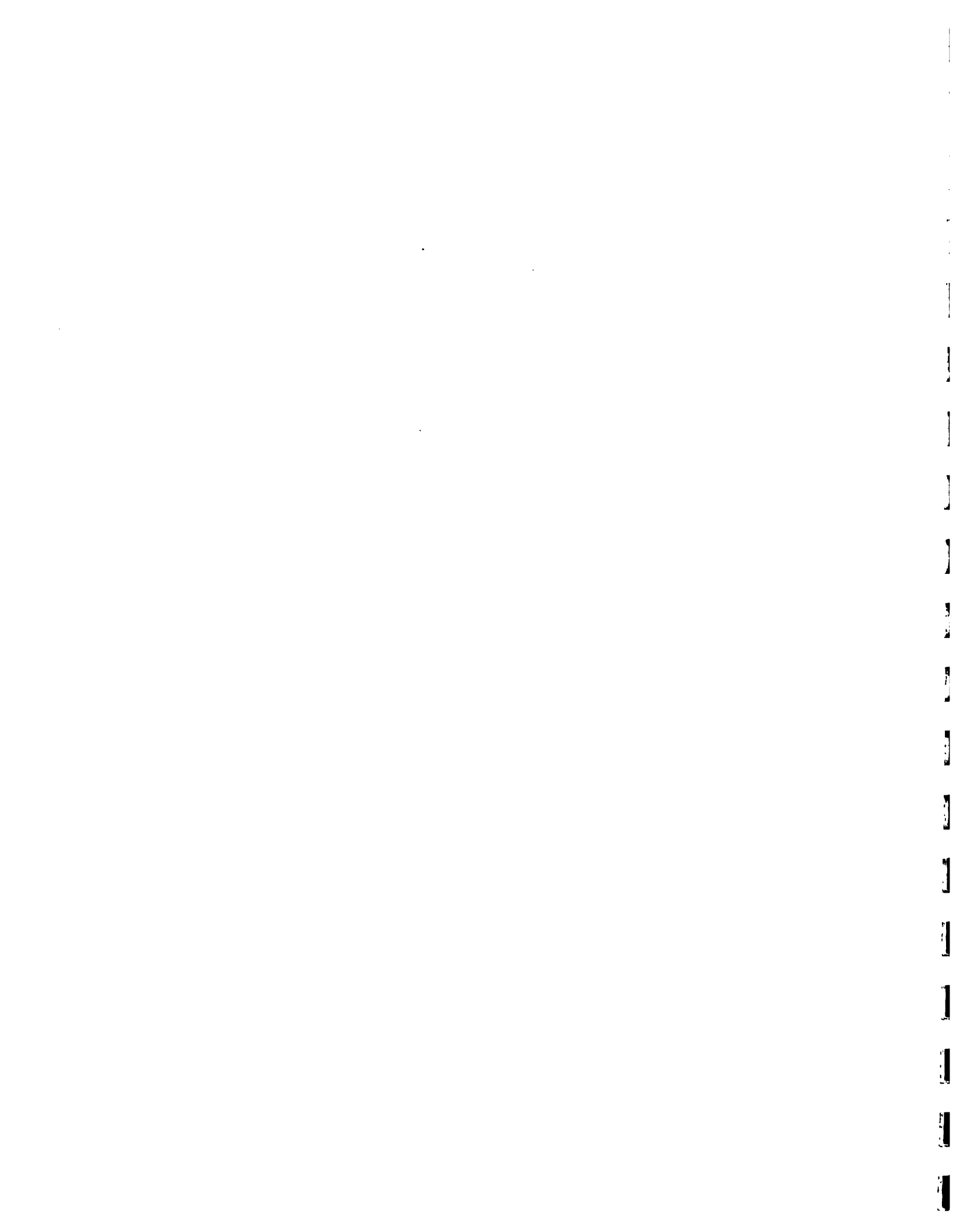
- The Chairman of EOC should notify the Emergency Operating Committee.
- The Emergency Operating Committee in coordination with the appropriate unit of CDE should order immediately a special inspection.
- If emergency should be declared, the emergency notification procedure as specified in (a) above must be followed.

(c) For Type III emergency. Dam or dams under the process of failure.

- The chief dam operator may declare dam failure under certain conditions that must be specified by the Emergency Operating Committee.
- If dam failure is declared, the damtender must implement both notification and evacuation plans. The damtender must notify the Chairman of EOC or any of its members.

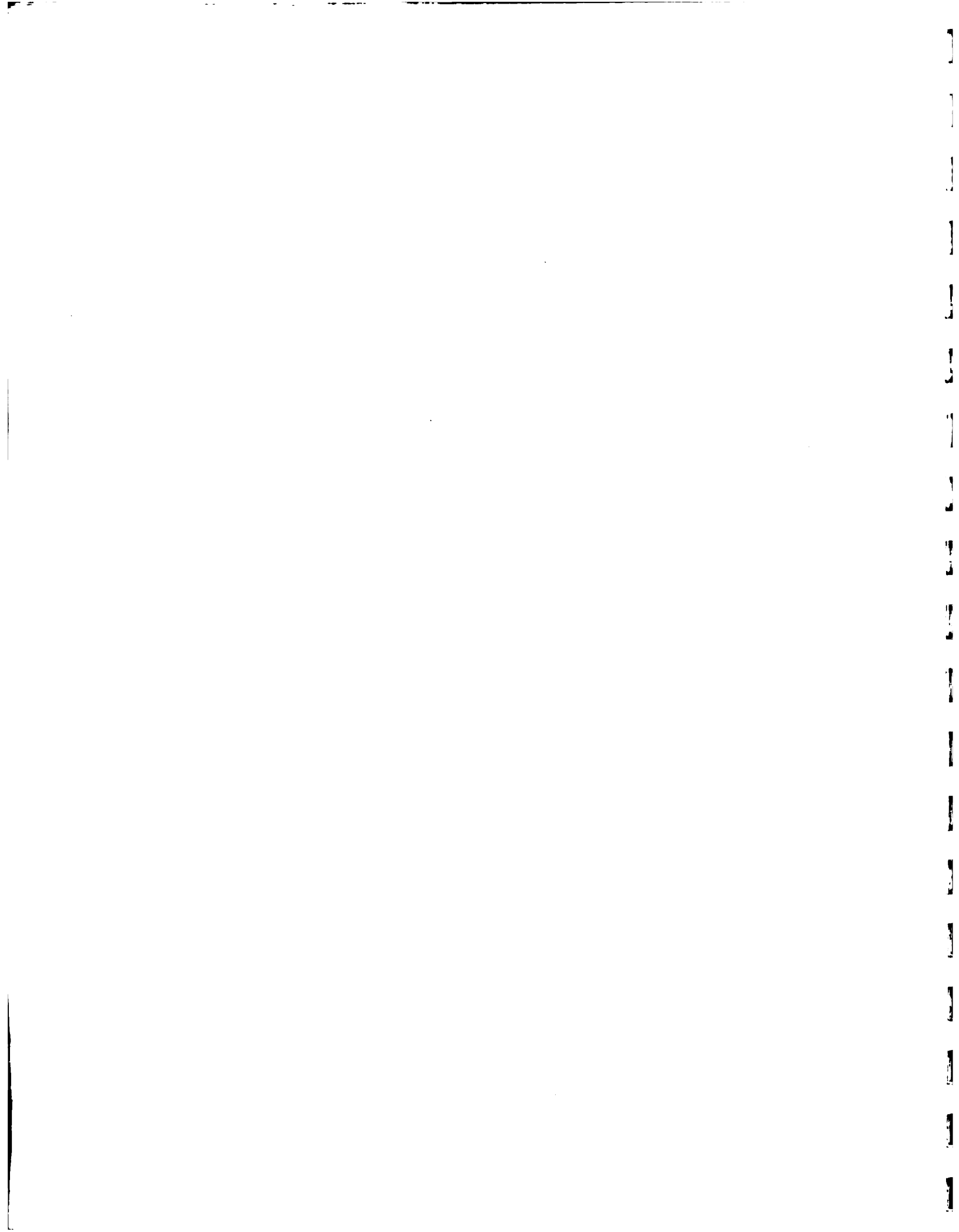
D. Agreement of Technical Services

The Normal and Emergency Committees must assist CDE in formulating specific agreements with government agencies and other national and international organizations to secure technical services for specific elements of the normal and emergency operation of the Valdesia reservoir system. The Normal Operating Committee in consultation with the Emergency Operating Committee will decide on those specific technical matters related to dam safety that must be arranged in advance with specialized firms or consultants. A list of the most important technical services that must be arranged may include the following.



(1) Technical Services from INDRHI

- a. INDRHI shall prepare the irrigation water demands on a yearly, monthly, weekly and daily levels. They must be prepared in anticipation to the monthly meetings as specified in Part C(1) and weekly meetings as specified in C(2). This service is to be provided by the Division of Operations.
- b. INDRHI shall implement and update the computer models developed in this project for scheduling reservoir operations for Valdesia reservoir. This service is to be provided by the Division of Operations. The models must be made available to the Division of Operations and Dispatch of CDE.
- c. INDRHI shall prepare forecasts of monthly, weekly and daily inflows into Valdesia reservoir. This service is to be provided by the Center of Hydrologic Forecasting (CPH). The models and programs must be made available to the Division of Hydrology of CDE.
- d. INDRHI shall provide the hydrologic services necessary for operation of the Valdesia system under flood conditions. The major requirement of these services are the following:
 - The Center of Hydrologic Forecasting (CPH) of INDRHI shall maintain all the hydrologic models used in flood operation. These models are included in the CSU-HMS software package which was developed for flood operational and other hydrologic studies of Valdesia



system. Prior to beginning the evaluation of a Storm Alert and/or an Emergency Committee Alert, the models must be calibrated and updated using the most recent data available at INDRHI and/or other agencies. These models must be made available to the Division of Hydrology of CDE.

- During a Storm Alert and/or Emergency Committee Alert, INDRHI shall provide the services of a hydrologist, and necessary support staff. The hydrologist must be familiar with running and interpreting the results of all the hydrologic models used in flood operation.
- Using the automated data collection facilities available at CPH, INDRHI's hydrologist shall initiate a Storm Alert and/or Emergency Committee Alert based on forecasts or existing storm conditions leading to such alert.
- CPH shall maintain the automated data collection facilities in such a way that their most recent data are readily available prior to and during a Storm Alert and Emergency Committee Alert.
- CPH shall provide the technical services necessary to develop new operating rules and/or modifying existing rules as new information or techniques become available in the future.
- e. INDRHI shall provide services for conducting intermediate inspections of the Valdesia and Las Barias dams as specified in the Emergency Operating Plan. In addition, INDRHI shall provide specialists for conducting specific

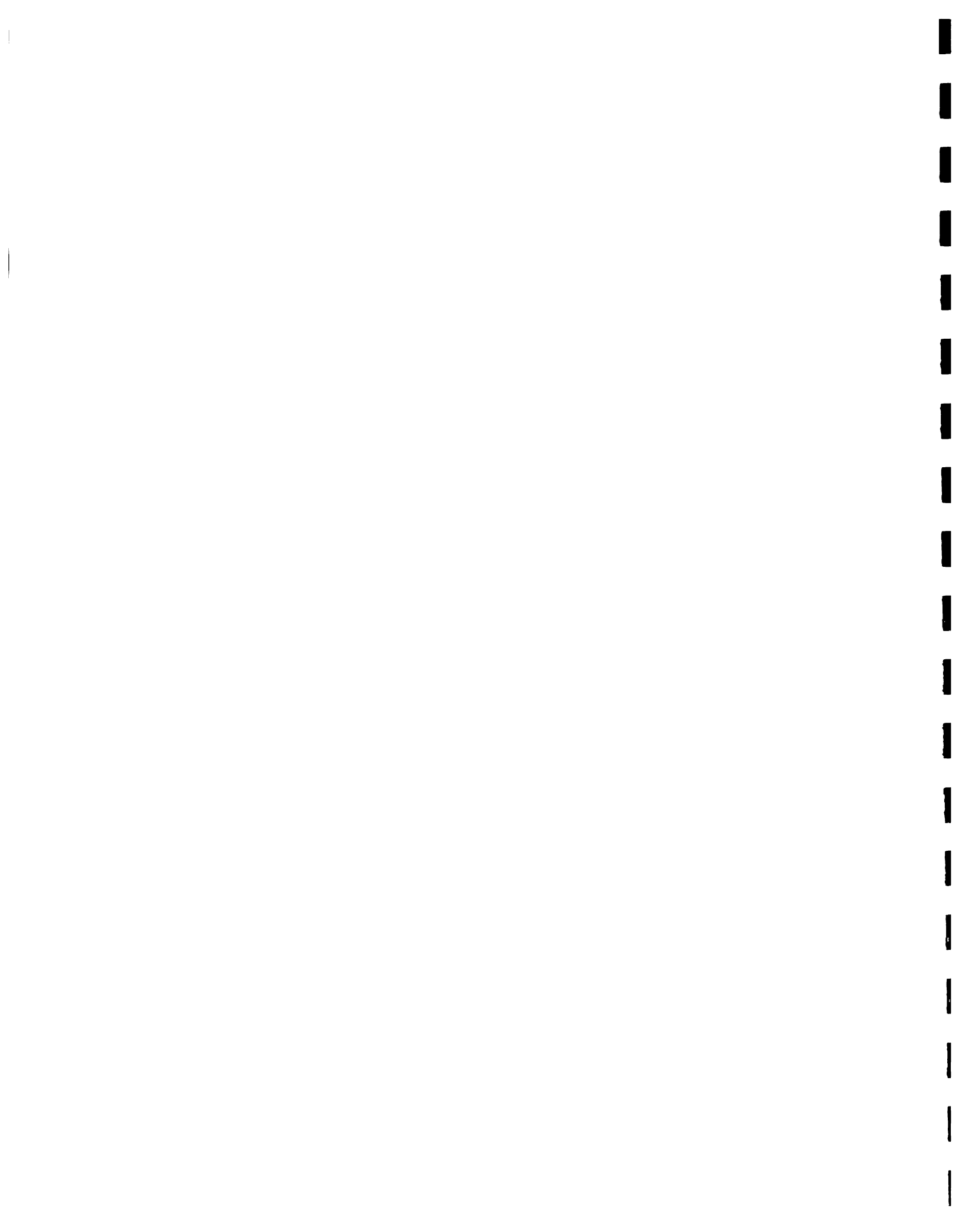


formal and special inspections on request of the Normal and Emergency Operating Committees.

- f. INDRHI shall provide in coordination with CDE the expertise required for interpretation and analysis of data obtained from monitoring equipment related to the safety of the dams.

(2) Technical Services from CDE

- a. CDE shall prepare the power demands on a yearly, monthly, weekly, daily and hourly levels. They must be prepared in anticipation of the monthly meetings as specified in Part C(1) and weekly meetings as specified in C(2). This service will be provided by the Gerencia de Operaciones y Despacho of CDE.
- b. CDE shall provide the services of a hydrologist during a Storm alert and/or Emergency Committee Alert. If CDE develops new models or acquires existing models which may be useful for operations of Valdesia system they should be made available to the Division of Hydrology of INDRHI.
- c. CDE shall provide Storm Alerts to the RCC by using existing data monitoring facilities and the automated data collection systems that may be acquired in the future.
- d. The hydrologic services and information that are obtained through ongoing agreements with independent sources in and outside the Dominican Republic must be shared with the Division of Hydrology of INDRHI. Such services may



include hurricane track forecasts, forecasts of precipitation potential, satellite imagery, etc.

- e. CDE shall provide services for operating the facilities and equipment of the dams. Supervision of needed personnel will be the ~~the~~ direct responsibility of the Direccion de Produccion of CDE.
- f. CDE shall provide services for conducting informal inspections of the Valdesia and Las Barrias dams as specified in the Emergency Operating Plan. In addition, CDE shall provide specialists for conducting specific intermediate, formal and special inspections on request of the Reservoir Control Center.
- g. CDE shall provide services for conducting the regular maintenance programs as recommended in the Emergency Operating Plan.

(3) Technical Services from ONAMET

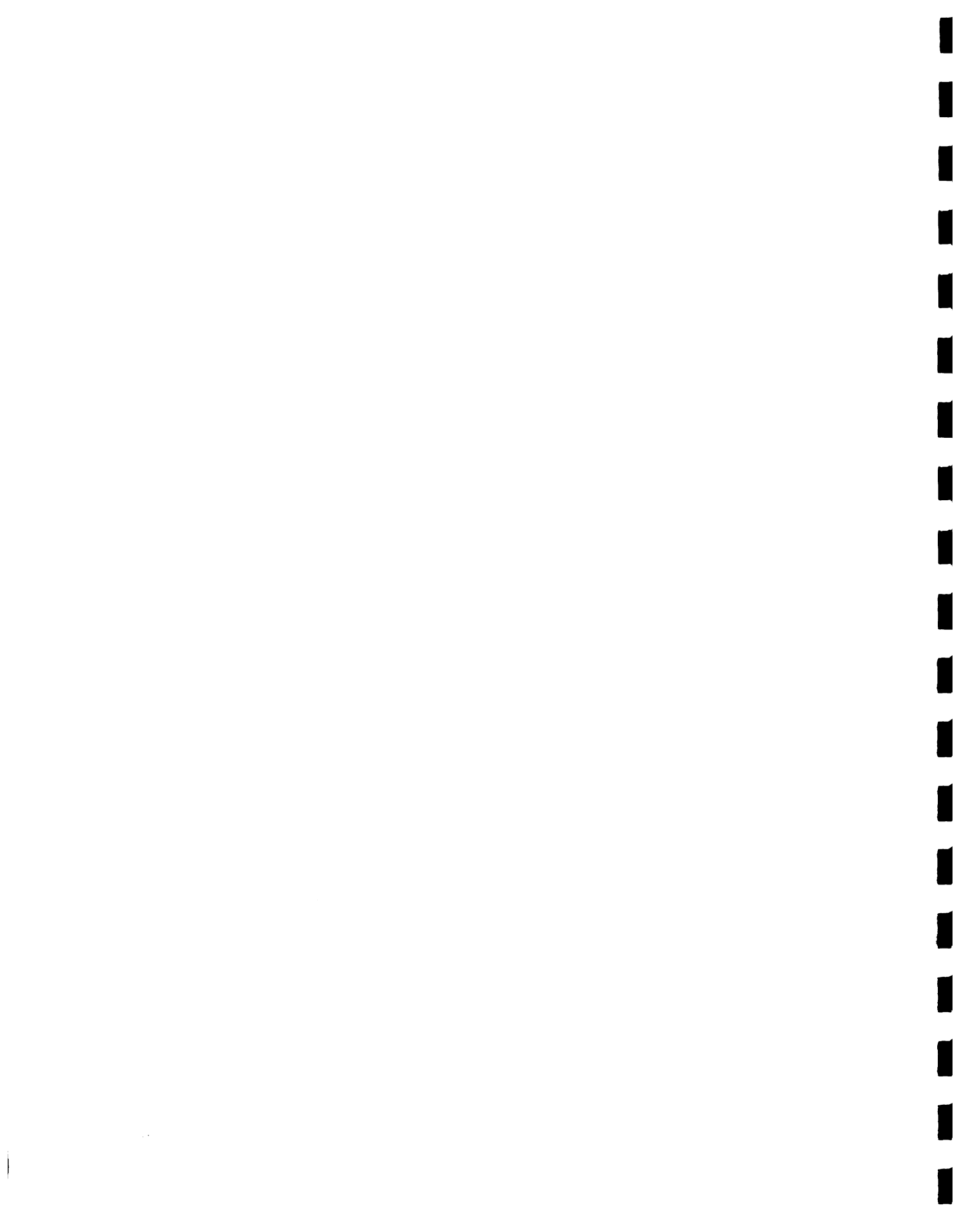
- a. ONAMET shall alert the hydrologists of INDRHI and/or CDE of a potentially threatening storm that is heading towards Nizao or that is being developed in and around Nizao. Forecasts of accumulated precipitation must be informed particularly if it is over 100 mm at any point over Nizao if such forecast capability exists with ONAMET.
- b. ONAMET shall alert hydrologists of INDRHI and/or CDE of tropical cyclones in the Atlantic Ocean which have a potential to strike Dominican Republic. Whenever possible, such an alert must have a lead time of at least



five days. If track forecasts are available from the National Hurricane Center of Miami or other independent services they must be provided and updated at intervals of 6 hours or less. ONAMET shall also provide the track positions, speed of motion, maximum sustained wind speed and other synoptic information (if available) at intervals of 6 hours or less. Upon request from INDRHI's and/or CDE's hydrologists, ONAMET shall provide the continuous services of a meteorologist during the critical period of a hurricane.

4. Technical Services from Other Sources

- a. Real-time information on the movement and condition of Atlantic tropical cyclones must be obtained from the National Hurricane Center in Miami. If ONAMET or any other organization in Dominican Republic currently receives such information, it must be made available to hydrologists of INDRHI and CDE.
- b. Technical services of independent organizations such as the Gulf Coast Weather Service must be arranged for receiving information on hurricane tracks and precipitation forecasts made for Dominican Republic using the latest techniques available. Such services should be obtained in real-time during hurricane Storm Alert and Emergency Committee alert periods.
- c. Technical services from national or international experts on specific elements of inspection programs and analysis and interpretation of data related to dam safety must be



arranged when such expertise is not available at CDE or INDRHI.

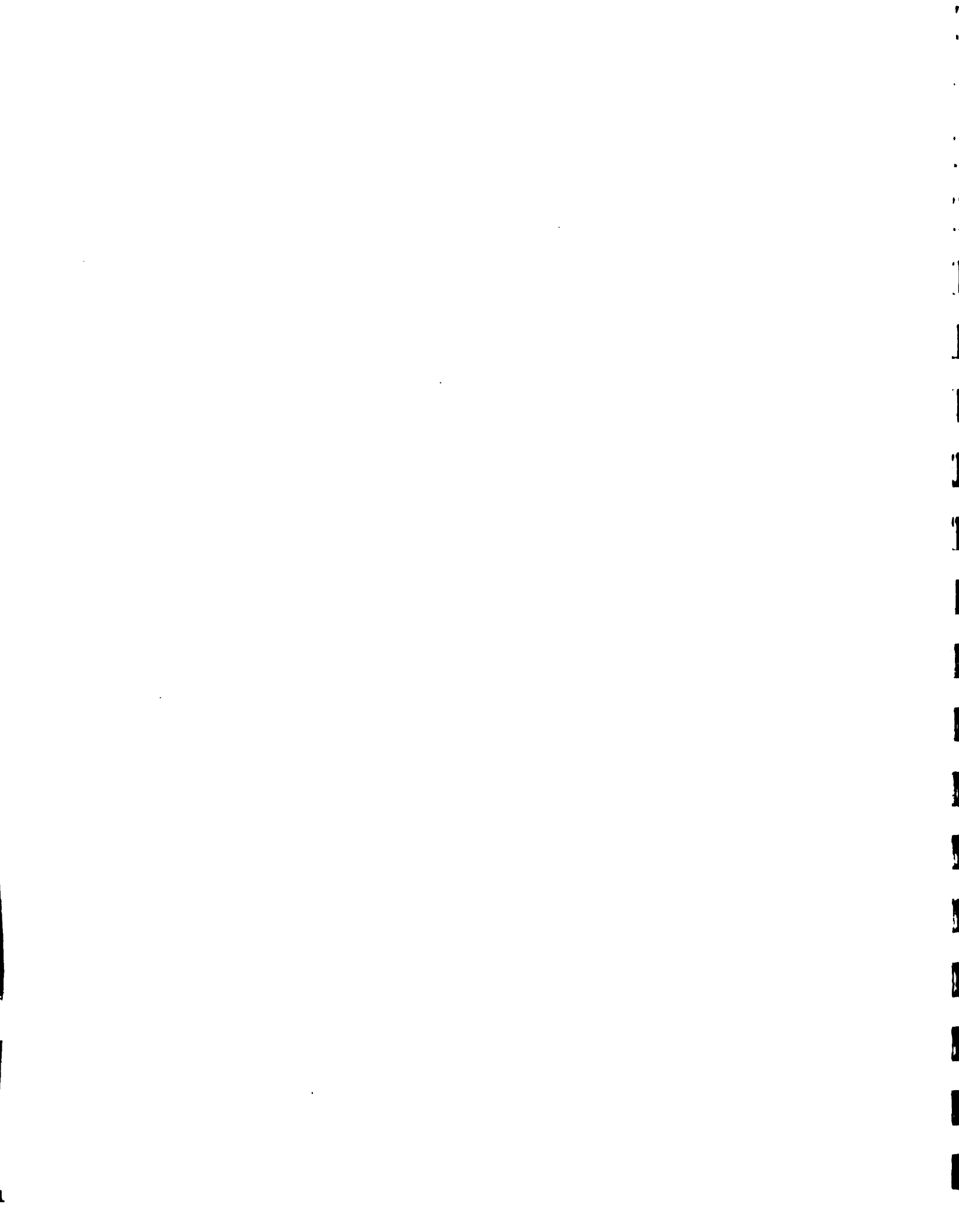
5.4.5 Plan for Normal Operating Conditions

A Normal Operating Plan for the Valdesia reservoir system has been developed which describes the overall approach for obtaining and using the guides and rules for operating the system under normal conditions. These include reservoir operations to deliver water for irrigation and hydropower on monthly and weekly time scales, and operation under flood conditions.

The Normal Operating Plan has been prepared in two separate volumes: first is the volume entitled "Normal Operating Plan for the Valdesia Reservoir System, 1. Irrigation and Hydropower," by Labadie et al. (1986) and second is the volume entitled "Normal Operating Plan for the Valdesia Reservoir System, 2. Flood Control," by Obeysekera et al. (1986).

5.4.6 Plan for Emergency Operating Conditions

An emergency plan entitled "Emergency Operating Plan for the Valdesia Reservoir System," by Shen et al. (1986) has been developed which describes the actions and procedures to be followed prior to and during emergencies. It includes mainly the following: normal inspection and maintenance programs, conditions leading to emergency operations, declaration of emergencies, emergency notification procedures, emergency operation plans and procedures and standing instructions to damtender.



APPENDIX A

CURRENT ORGANIZATIONS IN USA FOR
OPERATING RESERVOIR SYSTEMS



A.1 U.S. Army Corps of Engineers

The U.S. Army Corps of Engineers is a Federal organization responsible for planning and operating reservoir systems primarily for flood control. However, some of the dams have other purposes as well, such as conservation, navigation or recreation. This Federal agency is divided into a number of Divisions (for instance the North Pacific Division) which are in charge of planning and operating large reservoir systems. Furthermore, each division is divided into a number of districts which are responsible for planning and operating smaller systems usually in tributaries of large rivers.

The organization for the operation of a system at the Division level is schematically depicted in Figure A.1. The reservoir regulation is a function of the Engineering Division and the maintenance and supervision of operating personnel at dams is a function of the Operations Division. The Water Management Branch of the Engineering Division is in charge of the operation and management of reservoir systems. This is carried out through the Reservoir Control Center which is supported by the Hydrology Section, the Water Quality Section and the Power Section. Reservoir operating rules are developed by the Water Management Branch as a joint effort with other agencies if the project is multi-purpose. Within the Water Management Branch, the section which takes the lead in developing such operating rules is that which is more directly related to the function. For instance, if the rules are for flood operation, the Hydrology Section will normally be responsible for it; while if the rules are for conservation, the Power Section may be responsible with assistance of the Hydrology and Water Quality Sections. In addition, the U.S. National Weather Service provides forecasting



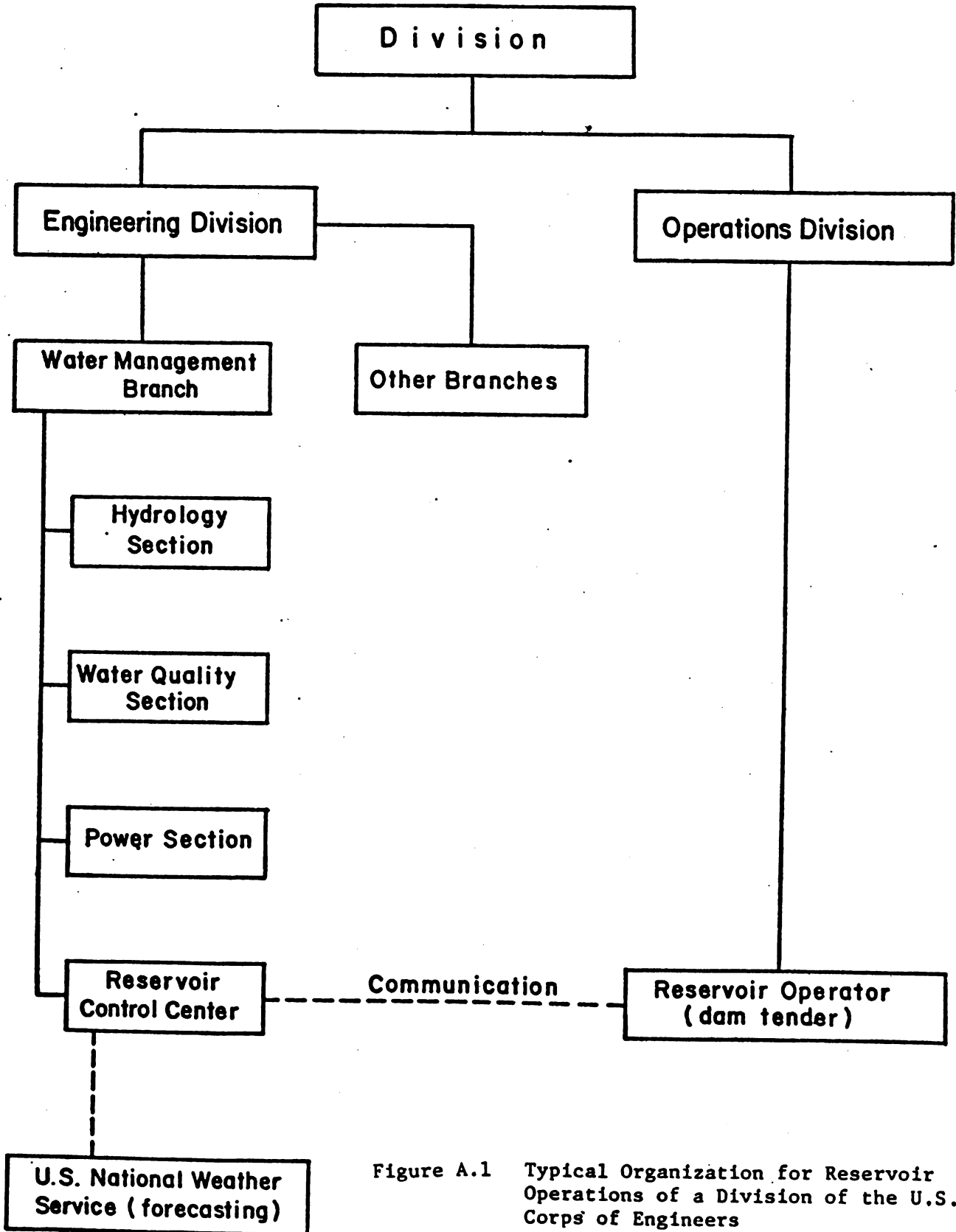


Figure A.1 Typical Organization for Reservoir Operations of a Division of the U.S. Corps of Engineers

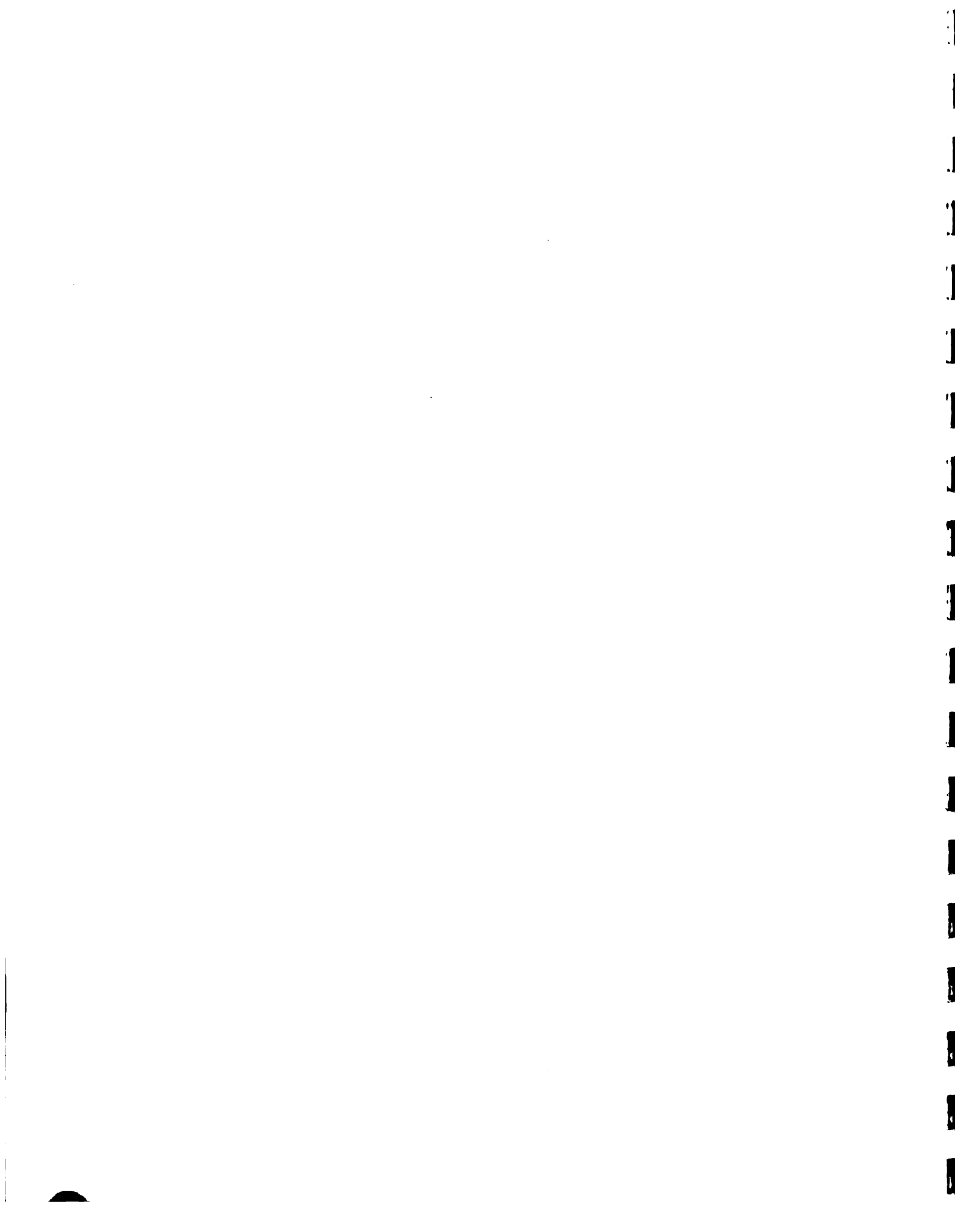


information to the Reservoir Control Center. The Reservoir Control Center is the unit which directly communicates the reservoir operator (damtender) the instructions for opening or closing the gates.

The organization for the operation of a system at the District level is somewhat similar to that of the Division level, as depicted in Figure A.2. The reservoir regulation is a function of the Engineering Division through the Water Control Section and the maintenance and supervision of personnel is a function of the Operations Division. Also in this case, the U.S. National Weather Service provides information on forecasting rainfall and floods and a direct communication exists between the Water Control Section and the reservoir operator.

A.2 U.S. Bureau of Reclamation

The U.S. Bureau of Reclamation is another Federal agency responsible for planning and operating reservoir systems, primarily for conservation purposes. It is divided into a number of regional offices covering the western part of the United States. Operation and management of reservoirs are carried out by the Division of Water and Land Operations (see Figure A.3). Under this division is the Water Scheduling Branch which is responsible for developing the long-term (annual and monthly) and short-term (weekly and daily) operating plans for conservation regulation (normal operation). This is done in agreement with the Western Area Power Administration (WAPA) of the Department of Energy, the regional or local irrigation offices or districts and other institutions concerned with the use of water resources in the system under consideration. Often during day-to-day operations, once the daily water deliveries for power and irrigation are



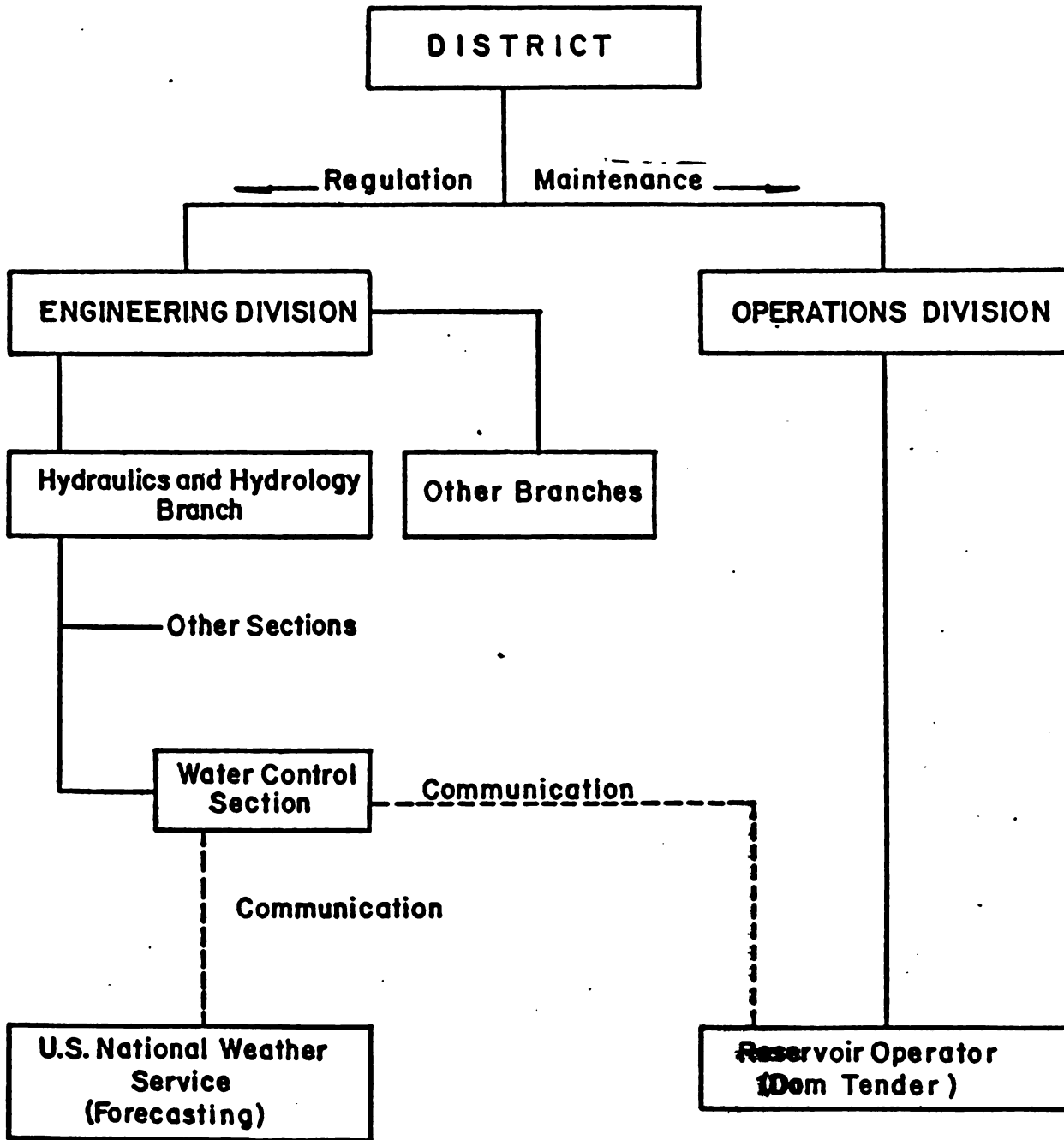
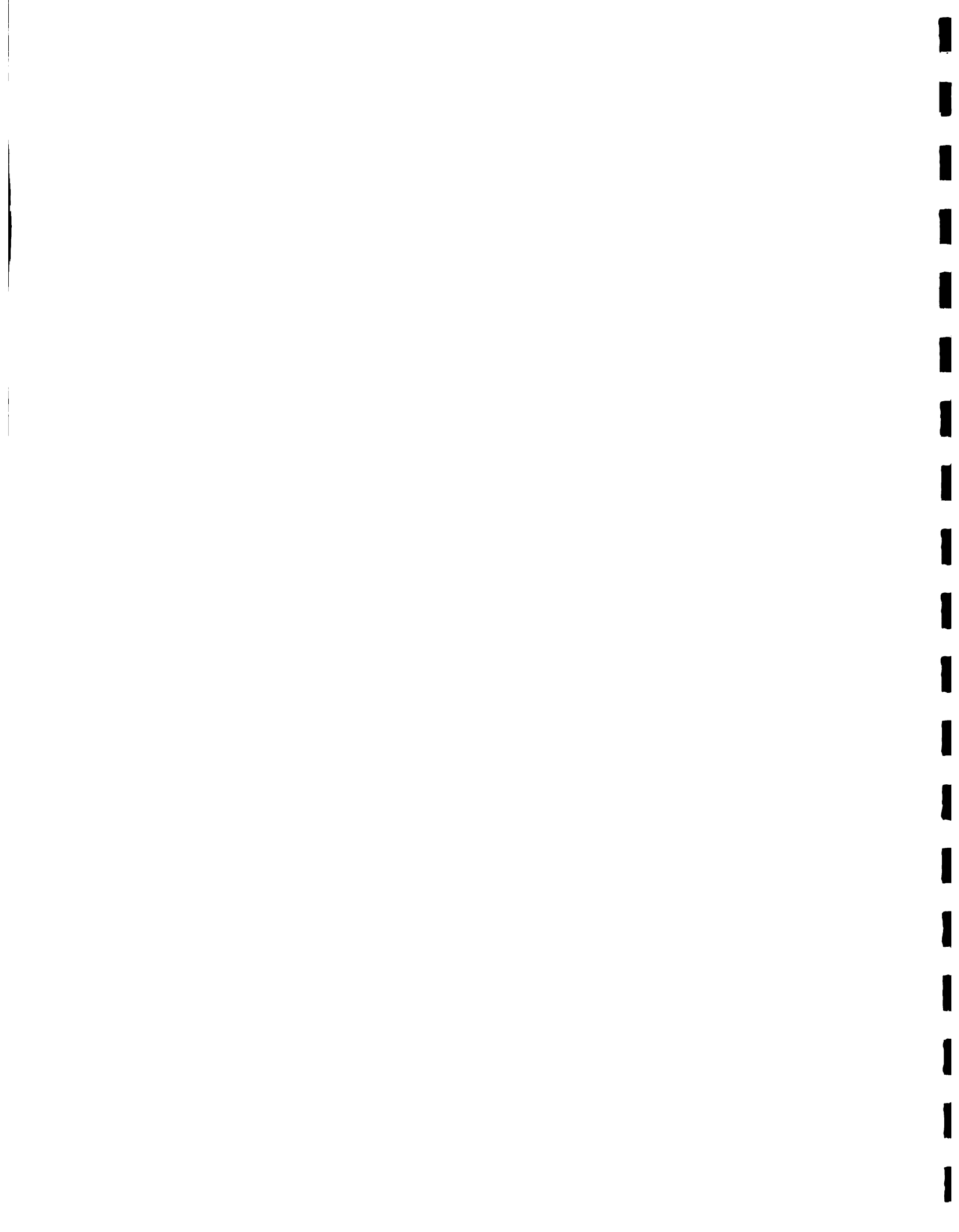


Figure A.2 Typical Organization for Reservoir Operations of a District of the U.S. Corps of Engineers



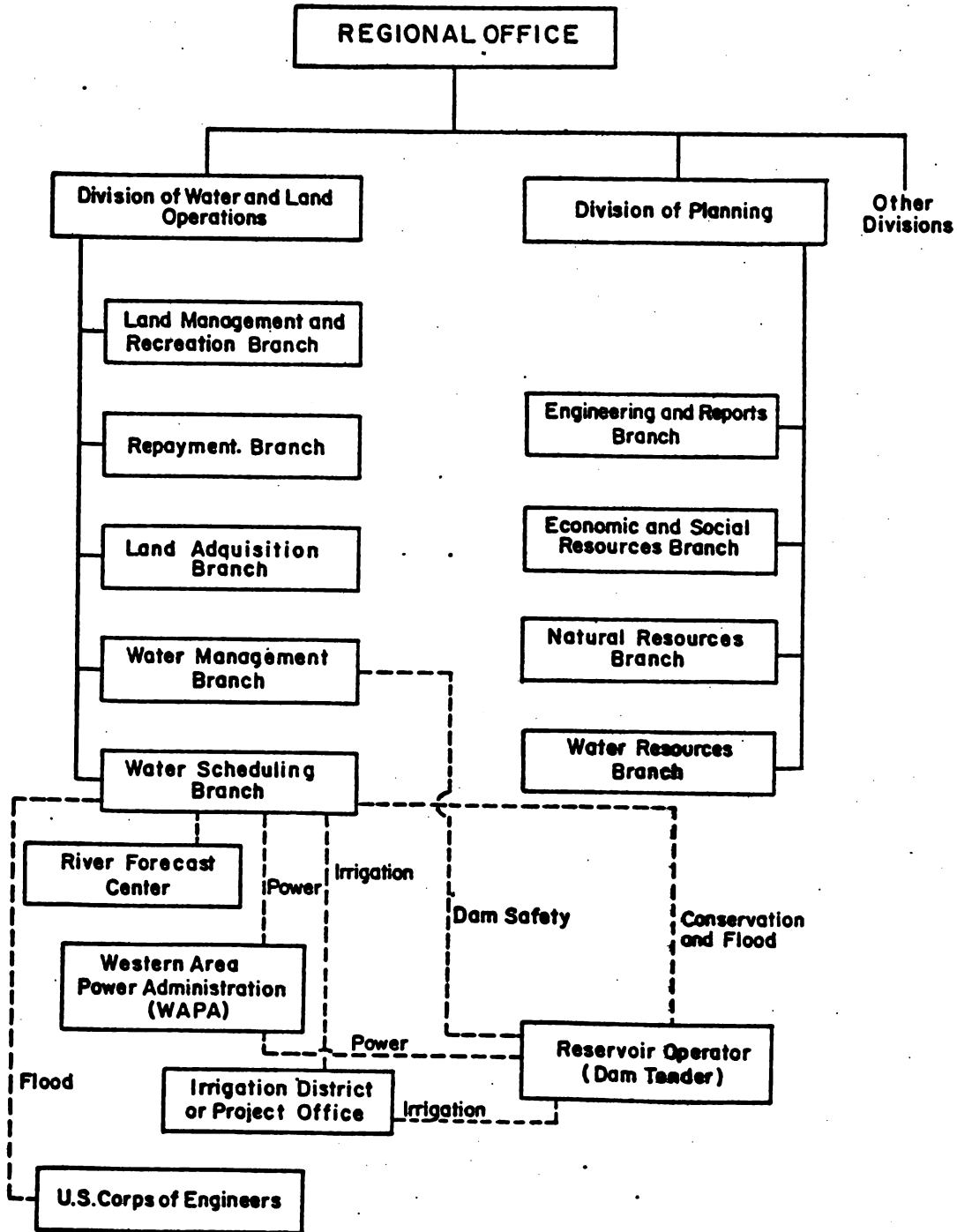
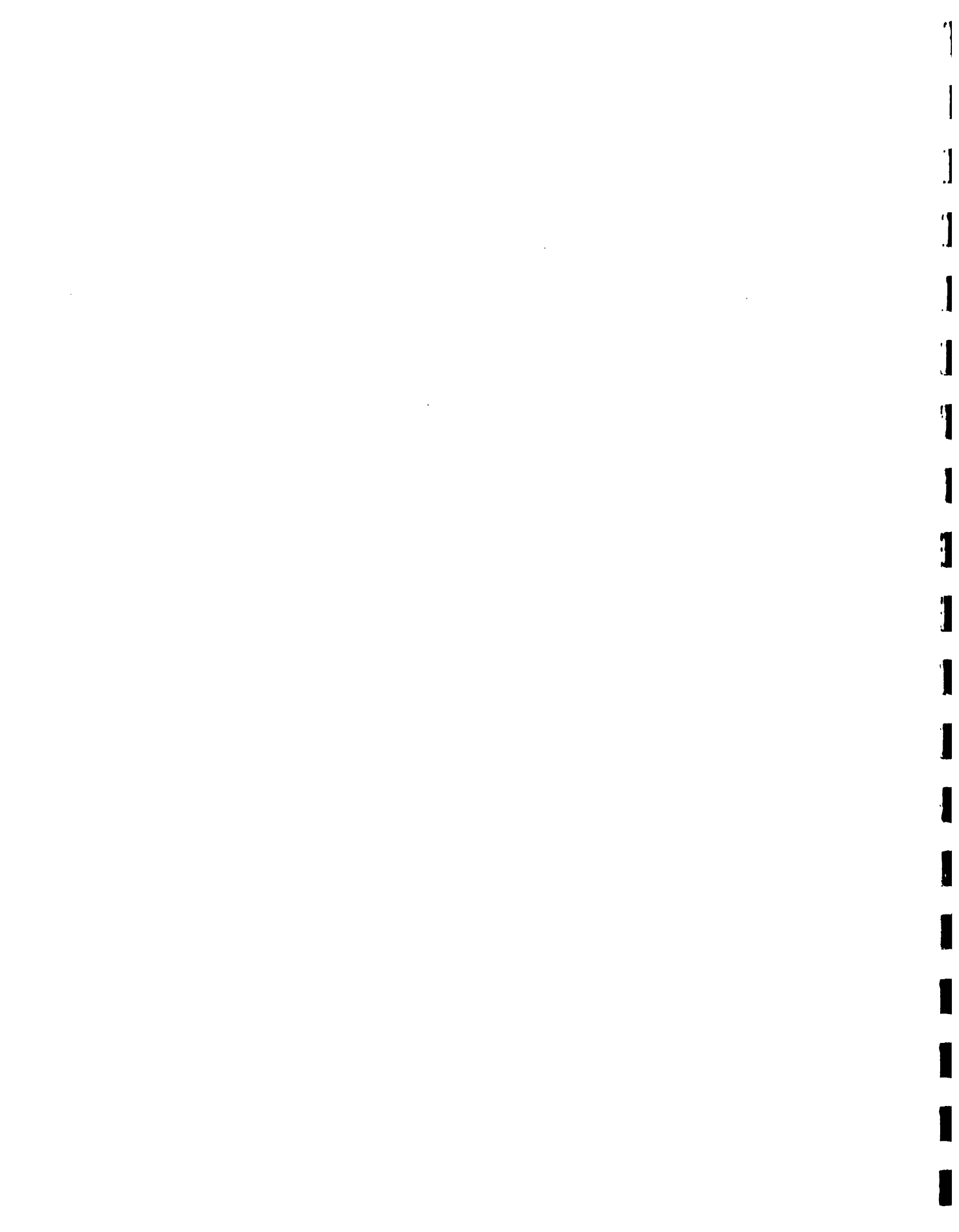


Figure A.3 Typical Organization for Reservoir Operations of a Regional Office of the U.S. Bureau of Reclamation.



established, then WAPA and the irrigation offices or districts may contact directly to the dam operator to get such water deliveries.

Likewise, the Water Scheduling Branch is responsible for operation of the system during floods. The flood operating rules are determined and agreed upon jointly with the U.S. Corps of Engineers. However, ultimately, the responsibility and actual instructions to the reservoir operator lies on the Water Scheduling Branch. The dam safety aspects and other emergency conditions are the responsibility of the Water Management Branch. The supervision and maintenance of the operating personnel is usually handled by the Project Office, although recently, such functions are being transferred to other regional or local offices such as the irrigation district as shown in Figure A.3. The Water Scheduling Branch receives forecast information from the corresponding River Forecast Center which essentially is under the jurisdiction of the U.S. National Weather Service.

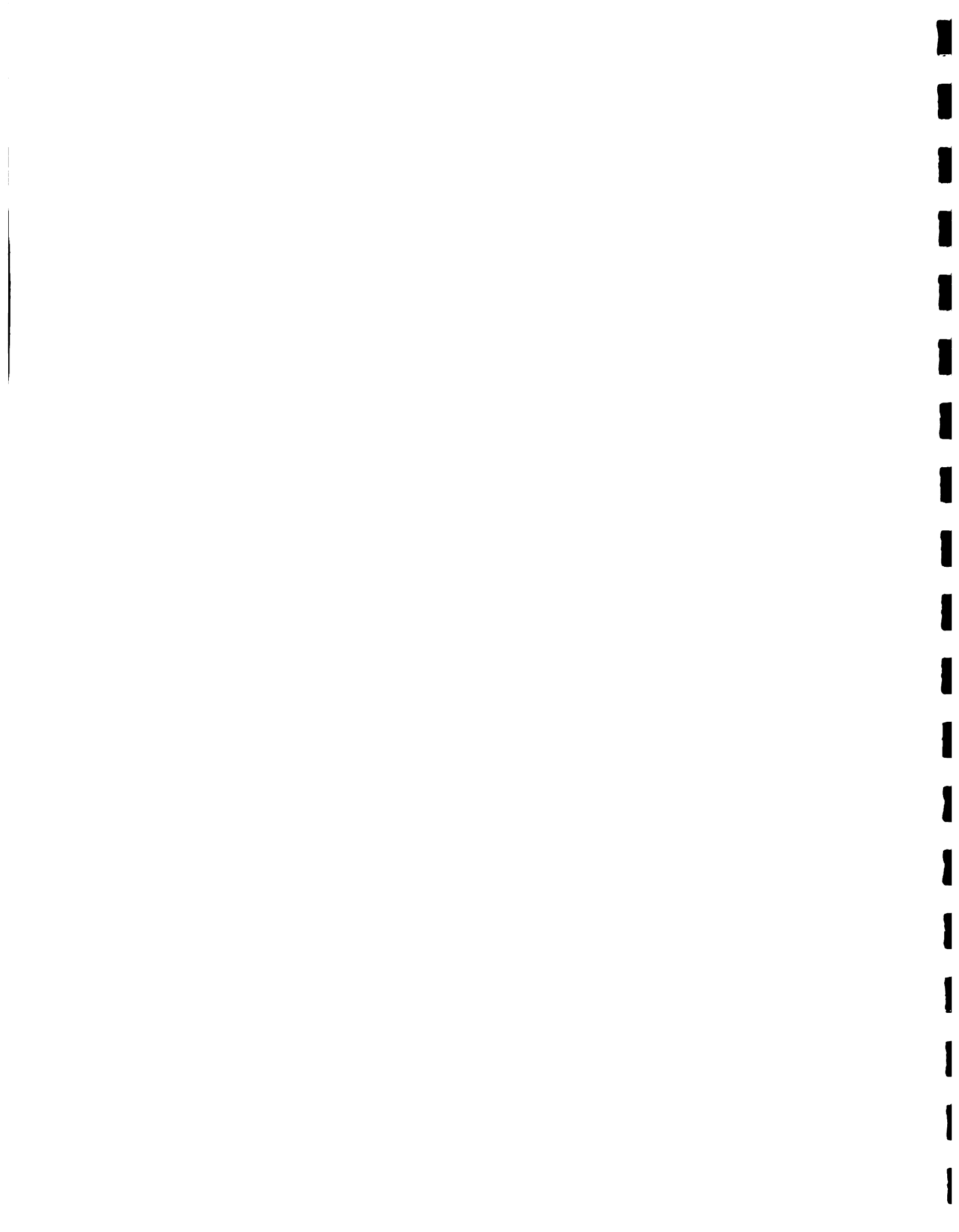
A.3 Tennessee Valley Authority (TVA)

The integrated water control system in ~~the~~ Tennessee River Basin consists of 26 major dams and reservoirs built ~~or~~ acquired by TVA; 9 on the main stem of the Tennessee River and 12 on tributaries. In addition, 6 other projects owned by private parties are operated under TVA instructions by agreement. The major ~~purpose~~ of the reservoir system is to control floods, promote navigation and produce power as consistent therewith. Reservoirs and streamflow are also regulated to maintain mosquito control standards.

The responsibility for determining and scheduling reservoir operations is delegated to the Division of Water Control Planning in Knoxville (T.V.A., 1961). The physical operation of the outlet works at



the various dams is the responsibility of the Division of Power Systems Operation in Chattanooga. Hence, instructions for the operation of the system originates at the Division of Water Control Planning and are issued to the Division of Power Systems Operation for execution (see Figure A.4). Instructions of a broad nature or those involving special operations are issued formally by a written memorandum. Instructions on day-to-day scheduling and operation are transmitted by telephone and facsimile.



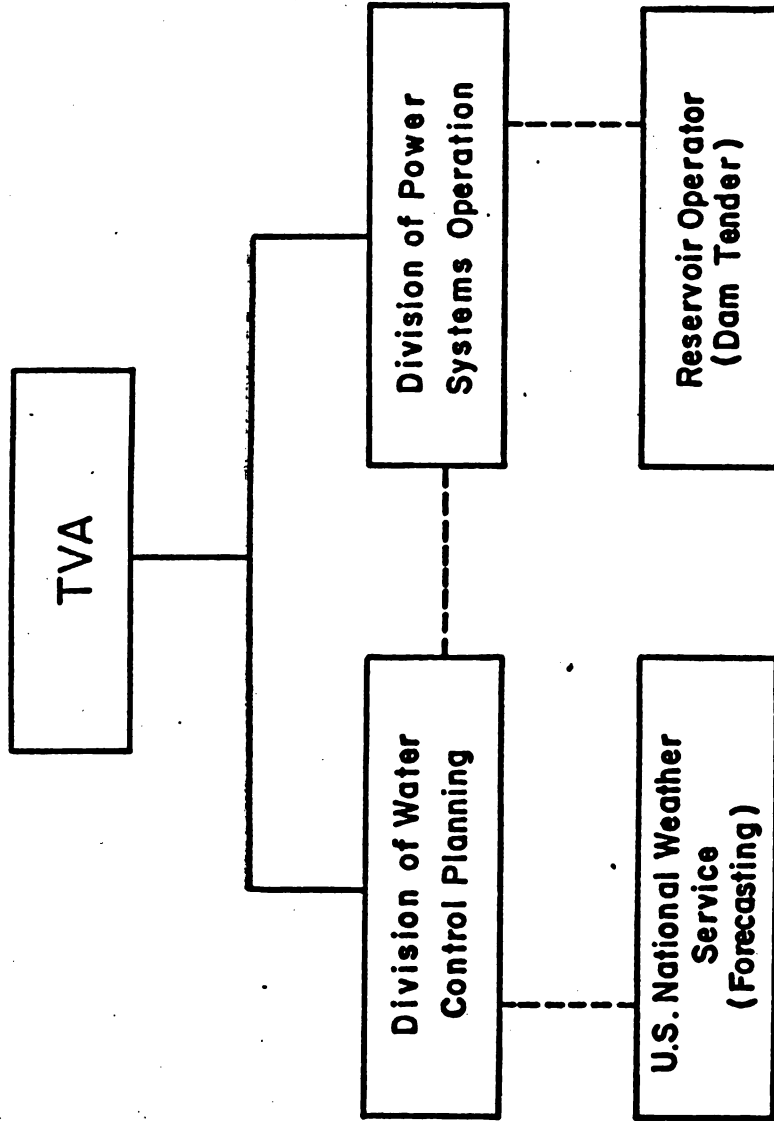


Figure A.4 Organization for Reservoir Operations of the Tennessee Valley Authority (TVA).



APPENDIX B

PROPOSED FUTURE ORGANIZATION AND FUNCTIONAL PLAN
FOR THE OPERATION OF THE VALDESIA SYSTEM

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1. General Considerations

In general, government (national, regional or local) and private organizations may own and operate reservoir systems. For instance, in the United States two of the most important federal agencies that own and operate reservoirs are the U.S. Army Corps of Engineers and the U.S. Bureau of Reclamation. Likewise, in the Dominican Republic INDRHI and CDE are two of such organizations. Regardless of which agency owns and operates a particular reservoir system, interagency cooperation is a necessity and responsible management of such systems rests upon formal and informal arrangements and agreements among them. In addition, other organizations, committees and groups interested in some aspects of the water use and operation of the reservoirs may be involved in coordinating and deciding their operating plans and management. What is optimum management for one special group or organization may not be optimum for another, and it is often difficult to reduce conflicts to a common economic denominator. In striving for optimum multiple-purpose regulation, some controversy and conflict occasionally is generated. It may be resolved by Congress, the Courts, or the public; however, in most cases, these issues should be settled through interagency cooperation by reason, logic and goodwill. It is expected that the same will be true in the Dominican Republic.

The intent herein is to capitalize on the experience and resources of CDE and INDRHI as well as other institutions in order to formulate an organizational and functional scheme for optimal reservoir operations in the Dominican Republic. The organizational set up presented herein is referred to specifically to the Valdesia Reservoir system, however it can be simply extended to all major reservoir systems in the country.



The proposed organization may evolve as the need arises and experience is gained. However, one must be very clear that any proposed organization will not succeed unless its members and the institution they represent are willing to cooperate and respect mutual agreements. Otherwise, any proposed scheme will never work regardless of how good it is. If each institution can learn to respect the responsibilities of the others, ultimately they will benefit from the experience of the other. It is under the above principles and understanding that the organization discussed below is proposed.

2. Organizational Structure

It is proposed that a Reservoir Control Center (Centro de Control de Embalses) be established to be responsible for executing the actual operation of the Valdesia reservoir system. In addition it is proposed that two committees be established, the Normal Operating Committee for guiding the operation of the reservoir system under normal conditions and the Emergency Operating Committee for assisting the Reservoir Control Center in executing the appropriate actions during emergency conditions. Although the proposed organization setup is directly related to the Valdesia Reservoir system, eventually it must include all major reservoirs of the country as well. A schematic representation of such organization is shown in Fig. B.1.

The Reservoir Control Center will have an Executive Unit composed of a Director, an Assistant to the Director and support staff. It will receive technical support services on matters related to hydrology from INDRHI and CDE, hydroelectric power demand and scheduling from CDE, irrigation water demand and scheduling from INDRHI, urban water demand and scheduling from INAPA (and other organizations such as CASSD and



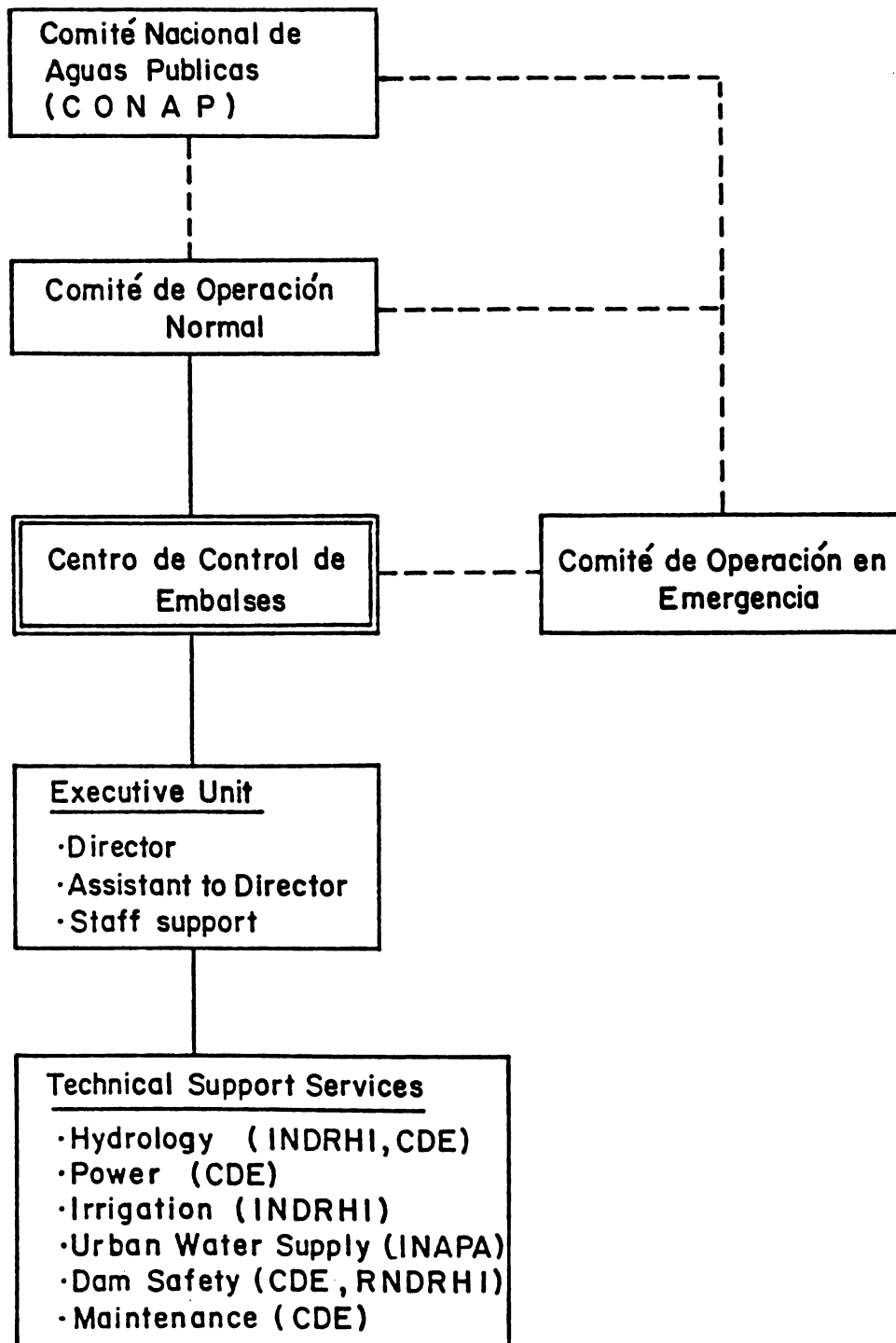


Figure B.1 Proposed Organization for the Operation and Management of the Valdesia Reservoir System



CORAASAN as the case may be), dam safety from CDE and INDRHI and maintenance and supervision of the dam tender and related personnel from CDE.

The Normal Operating Committee will serve as the governing Board of the Reservoir Control Center. It will provide guidance and supervision for the efficient and equitable operation of Valdesia Reservoir system under normal conditions. This will include such conditions when there is ordinary floods and water shortages and droughts. Members of the Normal Operating Committee (see Fig. B.2) will be representatives of the following institutions or interest groups:

Secretaria Tecnica de La Presidencia:	Presidente del Comite
INAPA:	Secretario del Comité
INDRHI:	Miembro del Comité (Un representante)
CDE:	Miembro del Comité (Un representante)
Power users:	Miembro del Comité (Un representante)
Centro de Control de Embalses:	Miembro del Comité (Director del Centro)

The Emergency Operating Committee will have the primary responsibility to assist the Director of the Reservoir Control Center in the actual operation of the reservoir system during emergency conditions due to extreme floods (hurricane or non-hurricane), landslides, earthquake, sabotage and any other situation related to the safe operation of the dam which requires special attention and actions. The Committee will consist of representatives of the following institutions (see Fig. B.3):



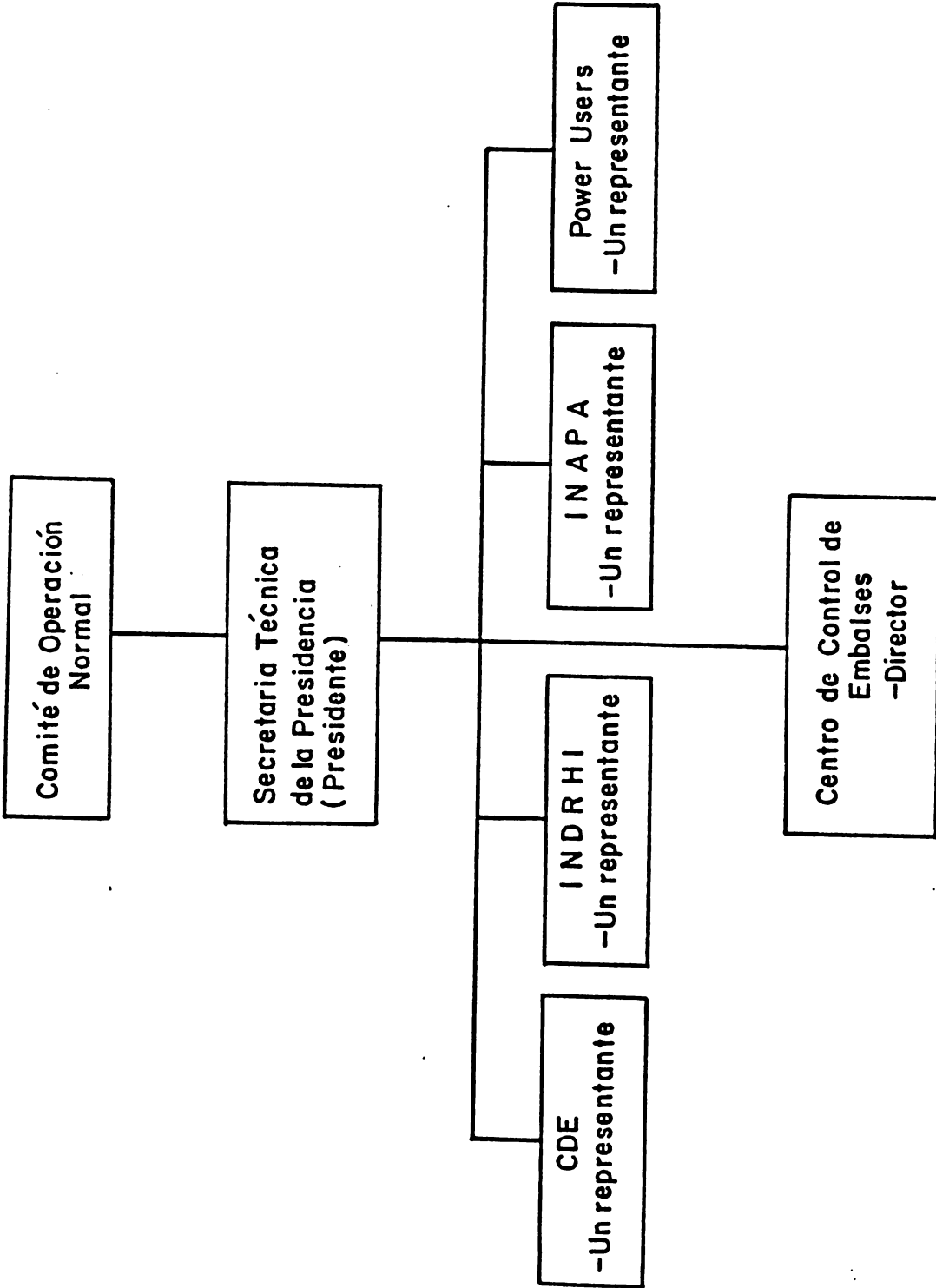
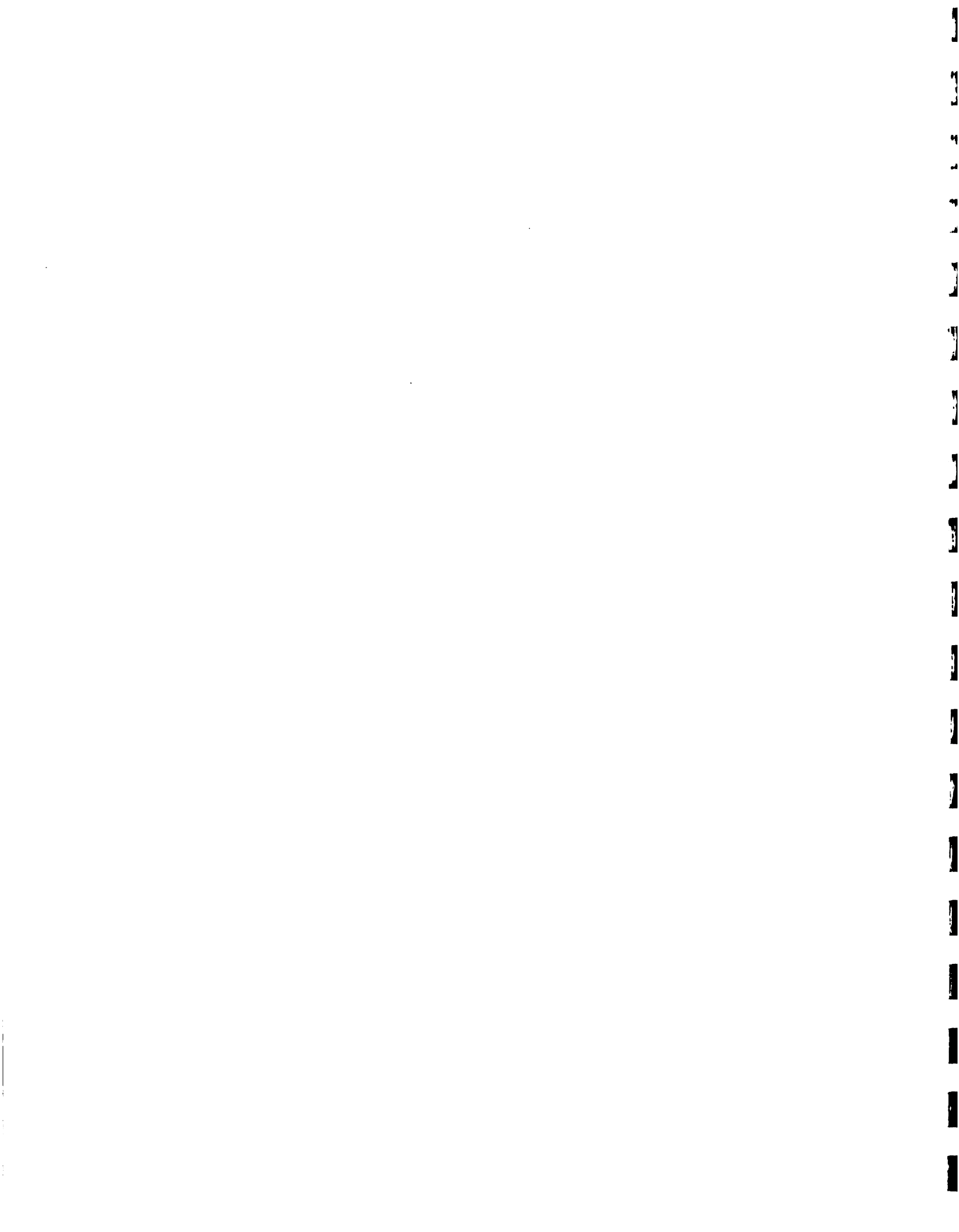


Figure B.2 Proposed Committee for Operation and Management of Valdesia Reservoir System under Normal Conditions



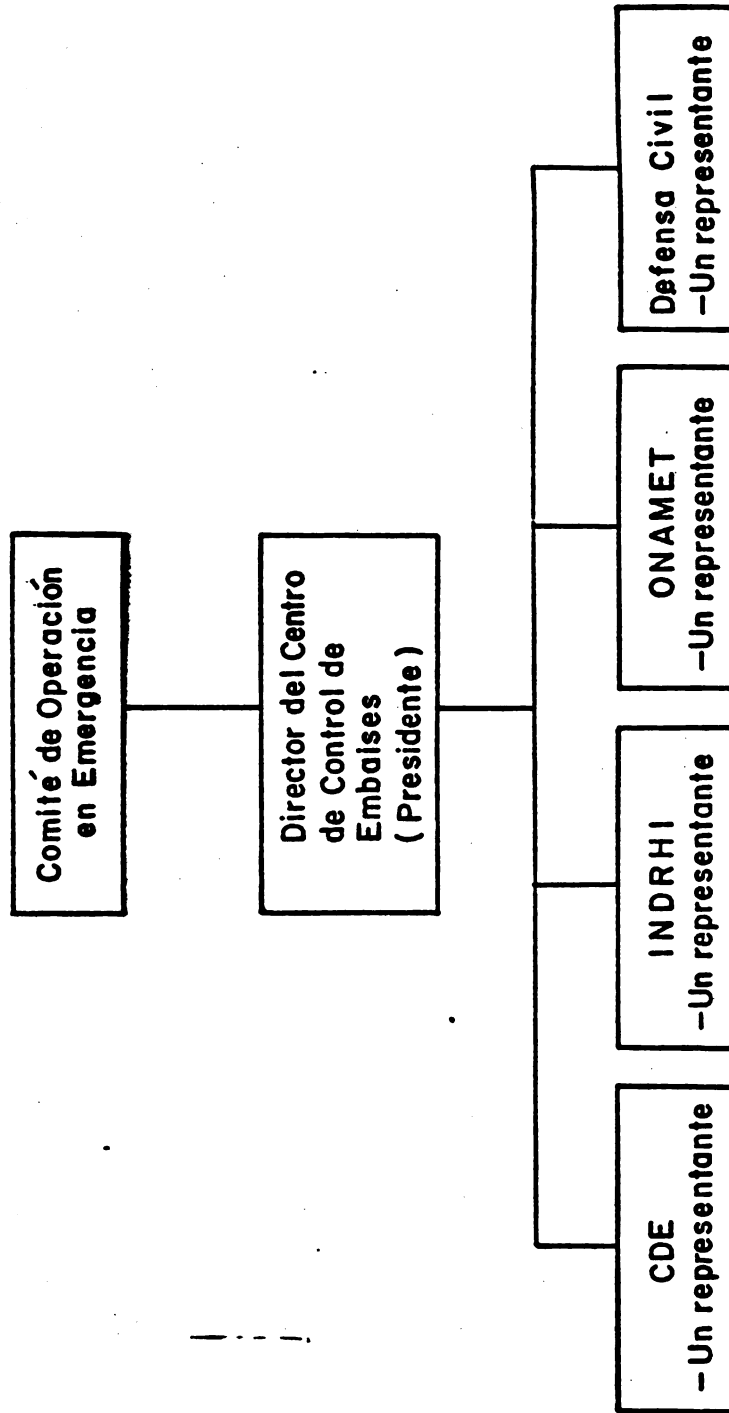


Figure B.3. Proposed Organization for Operation and Management of Valdesia Reservoir System under Emergency Conditions



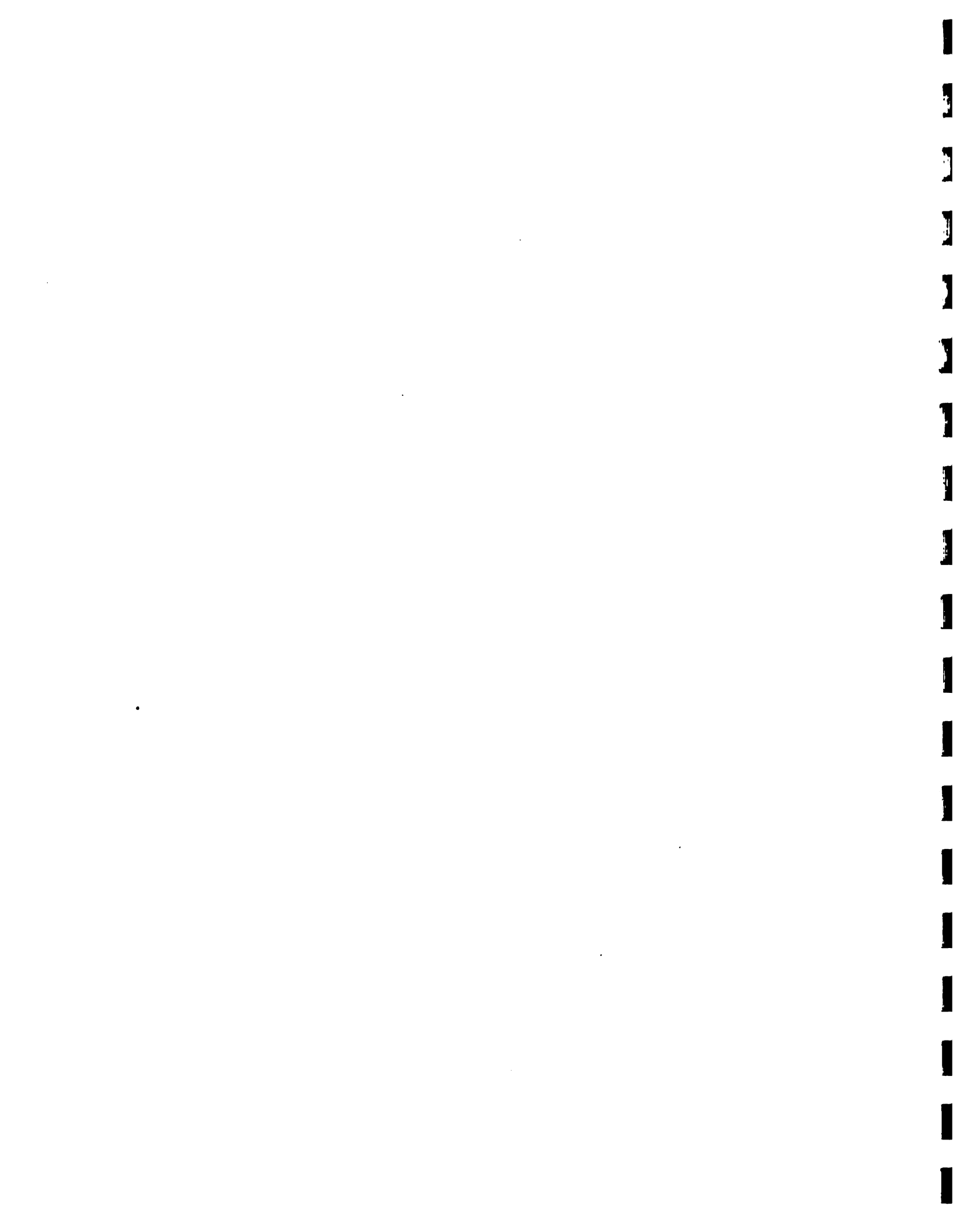
Centro de Control de Embalses:	Presidente del Comité (Director del Centro)
ONAMET:	Secretario del Comité (Un representante)
INDRHI:	Miembro del Comité (Un representante)
CDE:	Miembro del Comité (Un representante)
Defensa Civil:	Miembro del Comité (Un representante)

3. Specific Functions

A. Reservoir Control Center.

The primary responsibility of the Center is to direct and execute the operation and management of the Valdesia Reservoir system under normal and emergency conditions. This will be carried out through the Executive Unit of the Center under the direct supervision and guidance of the Normal Operating Committee in matters pertaining to the normal operation of the reservoir; and under the assistance of the Emergency Operating Committee in matters pertaining to the emergency operation of the reservoir. The specific functions of the Executive Unit will be:

- (1) To coordinate the preparation of the reservoir operating guides, rules and instructions for normal and emergency conditions of the reservoir.
- (2) To participate in the Normal Operating Committee meetings and report the reservoir operations of the previous amount and present the plan for the next month.
- (3) To prepare monthly and annual written reports of the actual operation of the reservoir under normal conditions.



- (4) To prepare written reports of the actual operation of the reservoir under emergency conditions.
- (5) To participate and direct the weekly meetings for updating and scheduling the reservoir operations for the following week.
- (6) To direct the daily, hourly, and real time operation of the reservoir system according to the guidelines set forth by the Normal Operating Committee.
- (7) To participate and direct the Emergency Operating Committee meetings. The Director of the Reservoir Control Center will serve as the President of this committee.
- (8) To coordinate and supervise the execution of the normal inspections and maintenance programs as specified in the "Emergency Operating Plan for the Valdesia Reservoir System."
- (9) To coordinate and supervise the operation and maintenance of the hydrometeorologic network of the Nizao watershed including those installed at the dam sites, reservoirs and diversion structures.
- (10) To prepare, revise and follow up the agreements with other institutions such as INDRHI and CDE to provide technical services for specific elements of the normal and emergency operations of the reservoir system.
- (11) To coordinate and direct the communications with the damtenders and related personnel for the proper execution of the operation of the dams.
- (12) To plan and implement the administrative and technical support of the Reservoir Control Center and to maintain the corresponding facilities.

- (13) To prepare the annual report of the activities of the Center including the accounting report.
- (14) To prepare the annual operating plan for the Center including the required budget.

B. Normal Operating Committee

The primary responsibility of this committee is to serve as the governing board of the Reservoir Control Center and provide guidance and supervision for the efficient and equitable operation of Valdesia Reservoir system under normal conditions. The specific functions of this committee will be:

- (1) To secure the funding from the appropriate agencies of the government for the operation of the Reservoir Control Center.
- (2) To establish and authorize the general criteria, guidelines and procedures for operating Valdesia reservoir system under normal conditions considering that it must serve several purposes such as irrigation and hydropower, according to the general principles set forth by the Comité Nacional de Aguas Públicas.
- (3) To review and authorize the specific long-term operating rules of Valdesia Reservoir to supply water for irrigation and hydropower as well as other water uses that may develop in the future such as water supply for urban and rural communities.
- (4) To review and authorize the specific procedures for updating and scheduling the reservoir operations on a weekly basis.
- (5) To review and authorize the specific procedures for daily and hourly scheduling of reservoir operations.



- (6) To review and authorize the specific procedures for operating the reservoir system under flood conditions.
- (7) To review and authorize the specific agreements that the Reservoir Control Center will formulate with other institutions such as INDRHI and CDE to provide technical services for specific elements of the normal and emergency operations as well as for the inspection and maintenance programs of Valdesia Reservoir system.
- (8) To supervise and review on a monthly basis the actual operations of the reservoir system as well as the maintenance and inspection programs related to the safety of the dams.
- (9) To review and authorize the annual report of the operation and management of the Valdesia Reservoir system.
- (10) To authorize the annual operating plan including the budget of the Reservoir Control Center.
- (11) To authorize specialized training of personnel of the Reservoir Control Center.
- (12) To formulate the specifications and qualifications for all the personnel of the Reservoir Control Center.
- (13) To search and appoint the Director of the Reservoir Control Center. The terms of the appointment will be specified by the Committee. It is also the responsibility of the Committee to evaluate the performance of the Director. The Committee has also the authority to discharge the Director of this duties.
- (14) The Normal Operating Committee will approve the appointment of the Assistant Director of the Reservoir Control Center and other important technical personnel as the case may be, upon



the recommendation of the Director. Appointment of other personnel will be made directly by the Director of the Center.

- (15) These functions can be updated and modified by the Committee as the need arises.

C. Emergency Operating Committee

The primary responsibility of this committee is to assist the Director of the Reservoir Control Center in the actual operation of the reservoir system during emergency conditions. The specific functions of this committee will be:

- (1) To review and authorize the Emergency Operating Plan of Valdesia Reservoir System.
- (2) To execute the specific actions outlined in the Emergency Operating Plan.
- (3) To review the state of the security conditions of the dams and related works based on the written reports on the normal inspections and maintenance programs and reports provided by special inspection teams and dam operators during ongoing emergencies.
- (4) To coordinate with the appropriate office of ONAMET the emergency operating plan of Valdesia Reservoir system and the National Emergency Plan (currently ONAMET is formulating a National Emergency Plan).
- (5) To coordinate the specific emergency actions for Valdesia Reservoir system with those emergency actions executed by other institutions such as ONAMET, Civil Defense, Armed Forces and Red Cross (on a national, regional or local context).

- (6) To request special agreements needed to perform certain emergency actions as a part of the agreements specified by the Normal Operating Committee. During emergencies, after the formulation of those special agreements, the Emergency Operating Committee will directly contact the corresponding agencies to perform specific emergency actions.
- (7) To formulate and authorize the specific instructions for actions to be followed by the chief dam operator during emergencies.
- (8) To coordinate and execute drills (simulation) to assess and re-evaluate the emergency operating plan.
- (9) To contact directly to specific agencies involved in evacuation and other emergency measures as specified in the Emergency Operating Plan.

4. Functioning Mechanisms

A. Definitions

- Normal Operating Committee (NOC): Governing board to provide guidance and supervision to the Reservoir Control Center for normal reservoir operations.
- Emergency Operating Committee (EOC): Committee to provide assistance to the Reservoir Control Center during emergency reservoir operations.
- Reservoir Control Center (RCC): Organization to direct and execute the actions for operating and managing the Valdesia reservoir system.
- Normal Reservoir Operation: Operation of the reservoir system to provide water for irrigation and hydropower and controlled releases of ordinary floods.
- Emergency Reservoir Operation: Operation of the reservoir system during emergency conditions such as major floods, earthquakes and landslides which may compromise the safety of the dams or cause damages to human life and property.
- Normal Operating Plan (NOP): Refers to the manual "Normal Operating Plan for the Valdesia Reservoir System."

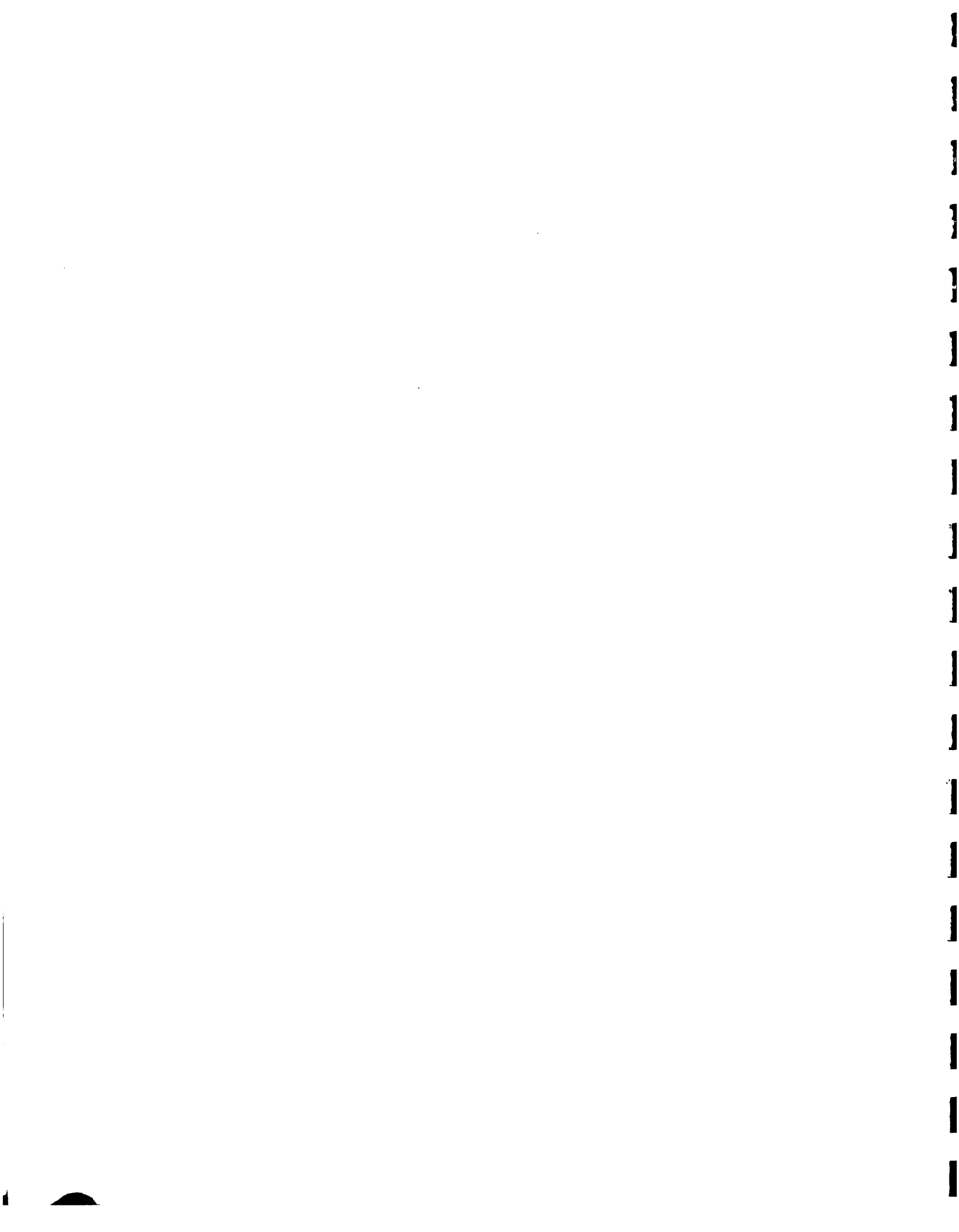


- Emergency Operating Plan (EOP): Refers to the manual "Emergency Operating Plan for the Valdesia Reservoir System."
- Valdesia Reservoir System: Includes the Valdesia and Las Barias dams.
- CDE: Corporación Dominicana de Electricidad
- INDRHI: Instituto Nacional de Recursos Hidraulicos
- ONAMET: Oficina Nacional de Meteorologia
- INAPA: Instituto Nacional de Aguas Potables y Alcantarillados
- CAASD: Corporación del Acueducto y Alcantarillado de Santo Domingo
- CORAASAN: Corporación del Acueducto y Alcantarillado de Santiago
- CONAP: Comité Nacional de Aguas Publicas
- CEPRHI: Centro de Prevision Hidrologica

B. Norms

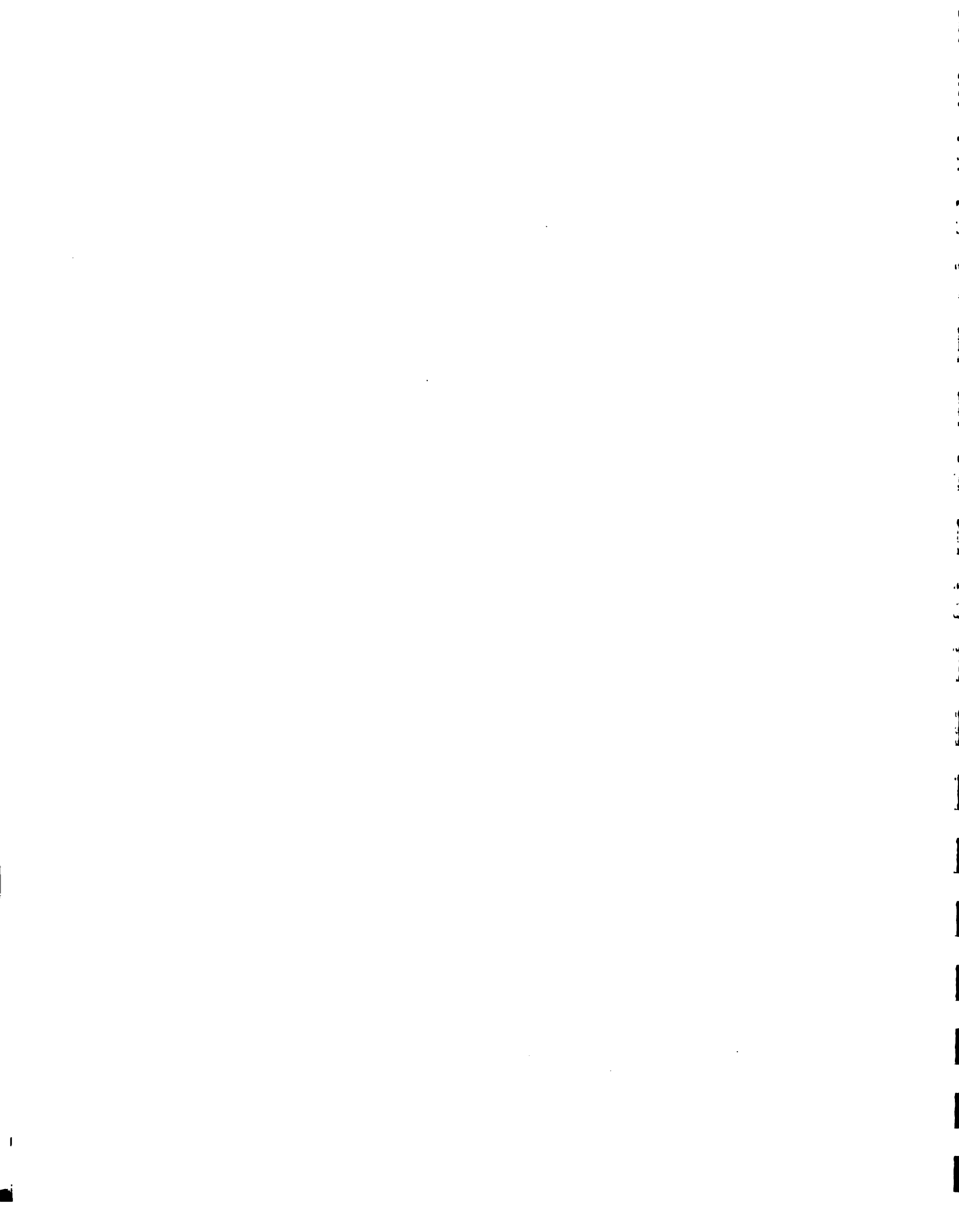
Norms Concerning the Normal Operating Committee (NOC)

- (1) The Chairman of NOC will be a representative of the Secretaria Tecnica de la Presidencia. He will be appointed upon recommendation by CONAP. The other members of NOC will be appointed by the respective institutions they represent. The secretary of the Committee will be the representative of INAPA. The Director of Reservoir Control Center (RCC) will be a non-voting member of NOC.
- (2) The Chairman of NOC must designate a substitute from his own agency to substitute for him in case of a planned or an accidental absence. Likewise, for the same reasons every member of the committee must have a substitute designated in advance by the institutions they represent. The Director of



RCC will be substituted by the Assistant to the Director in case of absences.

- (3) All members of NOC can vote except the Director of RCC who is a non-voting member.
- (4) The regular meetings of NOC will take place at the Conference Room of the Reservoir Control Center.
- (5) NOC will regularly meet once a month. More frequent meetings may be necessary in case of water shortages or droughts, or in case of unexpected situations which may lead to temporary changes of the agreed daily and/or weekly water schedules. NOC should eventually establish such possible situations and the corresponding instructions to handle them.
- (6) The specific dates for the regular monthly meetings of NOC will be established during the first meeting. The Director of RCC will notify all members of the committee in the case that the reservoirs are in emergency mode. In such case the Chairman of NOC will reschedule the meeting as soon as the emergency condition ceases.
- (7) All matters for discussion by NOC will be directed by the Chairman of the Committee. Decisions and agreements by NOC will be made by a simple majority vote.
- (8) For any serious dispute that can not be solved by this committee, the Chairman should bring the dispute to the judgment of CONAP.
- (9) A majority of this Committee (including the Chairman) plus the Director of RCC must be present for all normal committee meetings. During the absence of the Secretary of this



Committee, the Chairman of the Committee will appoint a temporary substitute as the Secretary from the members present. Otherwise, the Chairman will schedule another meeting at the earliest possible time.

- (10) The minutes of the meetings of NOC will be drafted by the Secretary of NOC at the end of the meeting. All members present must sign the preliminary draft of the minutes. The final draft will be signed by all members of the committee at the beginning of the following regular meeting. Copies of the minutes must be provided to each permanent member of NOC. The files of NOC will be kept at the offices of RCC.
- (11) These norms and functions will be reviewed and authorized by NOC. Subsequent update and modifications of the norms and functions must receive at least four votes of the Committee.

Norms Concerning the Emergency Operating Committee (EOC)

- (1) The members of EOC will be appointed by the respective institutions they represent. The Chairman of the committee will be the Director of the Reservoir Control Center. The representative of ONAMET will act as the Secretary.
- (2) In case of absence of the Chairman of the Committee, the Assistant to the Director of RCC will substitute him as the Chairman of EOC. Likewise, any other member of the committee must have a substitute which will be designated in advance by the institutions they represent.
- (3) The regular meetings of EOC will take place once a year in anticipation of the hurricane season. Thereafter, special



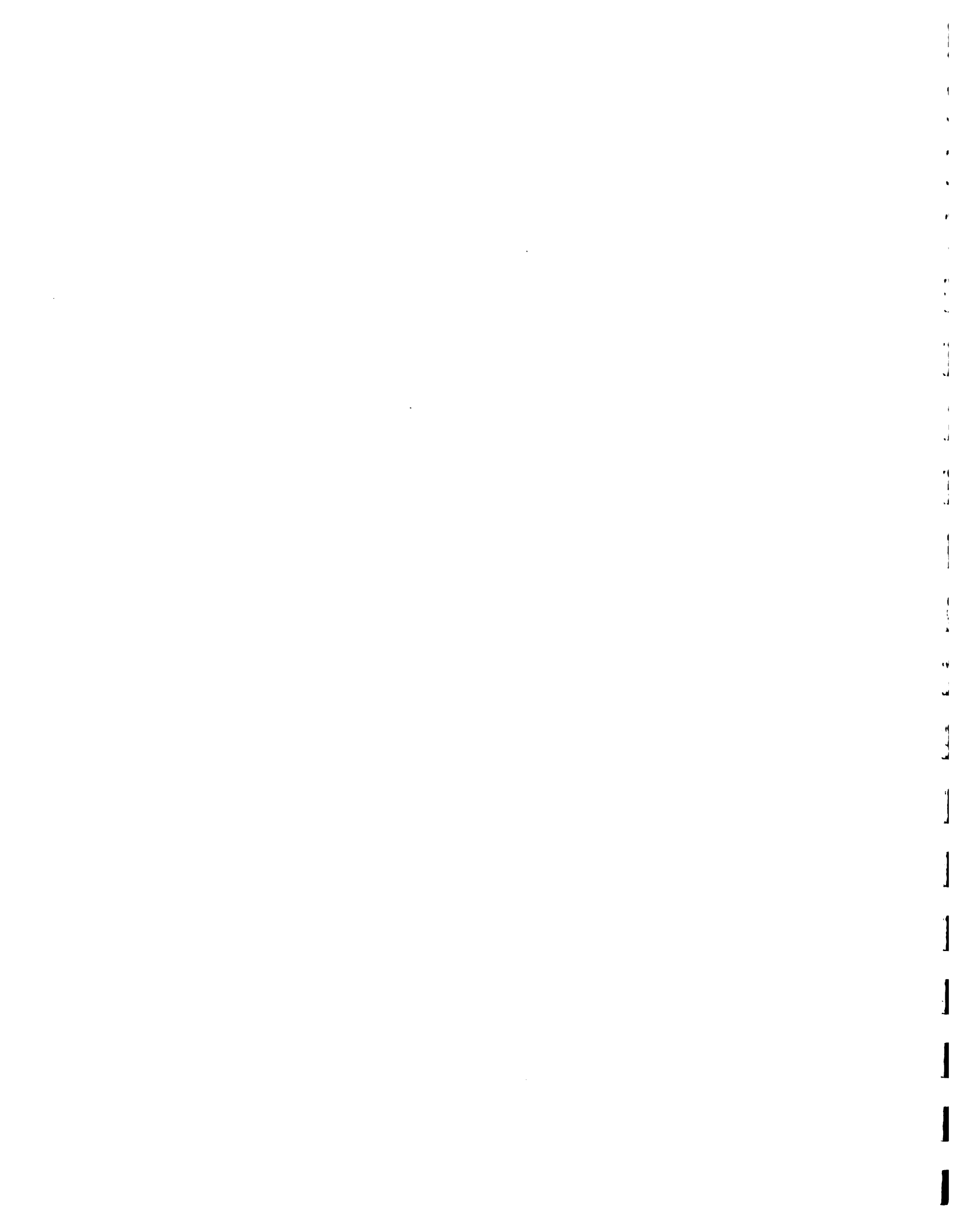
meetings will take place whenever EOC is activated as specified in the Emergency Operating Plan.

- (4) All meetings of EOC will be at the Conference Room of the Reservoir Control Center except in special circumstances that must be specified by the Chairman of the Committee.
- (5) The Chairman of EOC will direct all discussions, decisions and actions to be taken by EOC during emergency conditions. The Secretary will prepare minutes of all discussions, decisions, and actions.
- (6) All the matters of this Committee will be decided by simple majority vote. The Committee will specify the special conditions for which more than a simple majority vote is required.
- (7) During special emergency situations that require immediate attention and the Chairman of EOC is not able to secure the presence of the members of the Committee, he will act for the Committee to execute the emergency measures according to the Emergency Operating Plan.
- (8) These norms and procedures described below will be reviewed and authorized by EOC. Subsequent update and modifications will be made by EOC as the need arises.

C. Procedures

Procedures Concerning the Normal Operations

- (1) In advance of each monthly meeting of NOC, personnel of the Division de Operaciones and CEPRHI (Division de Hidrologia) of INDRHI, the Division de Operaciones y Despacho and Division de Hidrologia of CDE and the Director of Reservoir Control Center



will meet at the Conference Room of RCC in order to plan the reservoir operation for the following month according to the instructions specified in the Normal Operating Plan, Part 1. The Director of RCC will coordinate the meeting and the activities of this working group. They will perform the following tasks:

- a. Review the forecasts of water inflows to Valdesia reservoir for the following month and each of the following four weeks.
- b. Review the scheduling of reservoir operations that each agency may have done independently.
- c. Make additional computer runs if necessary to verify or complete the scheduling of the reservoir system.
- d. Write a draft of the plan of reservoir operations for the following month and weeks to be submitted for review and authorization to Normal Operating Committee.

(2) The same personnel indicated in (1) will meet once a week (Friday afternoon) at Reservoir Control Center in order to plan the operation scheduling of Valdesia reservoir for the following week based on the instructions specified in the Normal Operating Plan, Part 1. Director of RCC will coordinate the meeting and activities of this group. They will perform the following tasks:

- a. Review the forecasts of water inflows to Valdesia Reservoir for the following week based on new available information.

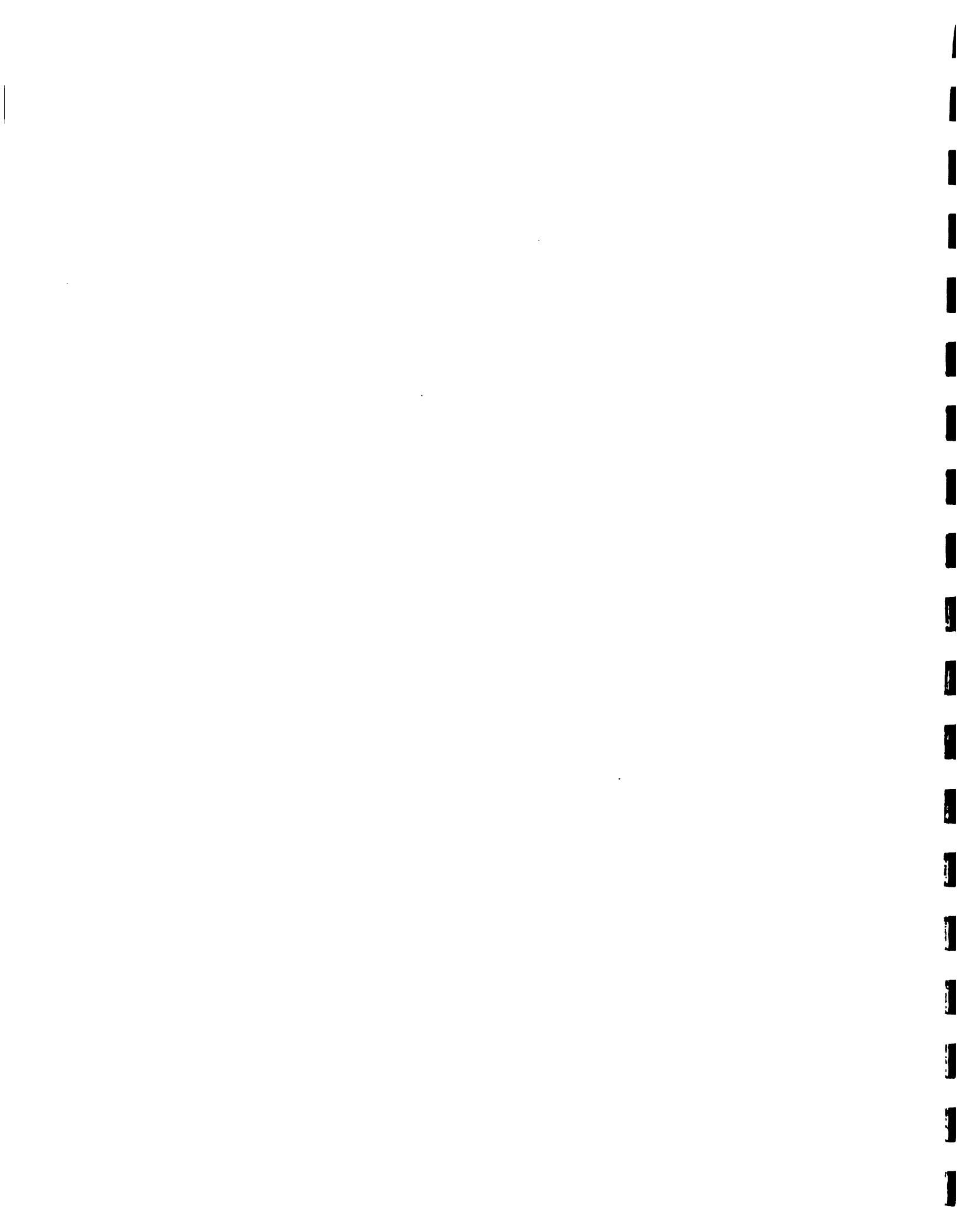


- b. Make the necessary computer runs to schedule the reservoir operation for the next week.
 - c. The Director of the Reservoir Control Center will ultimately decide the water allocations according to specific guidelines established by Normal Operating Committee during water shortages (available supply is not enough to satisfy the water demands).
 - d. The Director of RCC will prepare a report documenting the decisions reached about the scheduling of Valdesia Reservoir system for the following week.
- (3) During severe shortages and drought conditions the working group referred to in (2) may decide to meet more often than the regular weekly meetings. Likewise in these situations the working group may decide to ask for consultation and supervision to Normal Operating Committee. In this case the Director of RCC will contact the Chairman of NOC to request and arrange a special meeting.
- (4) The Director of Reservoir Control Center will have the authority to deviate from the agreed weekly schedules during the day to day reservoir operations depending on the current water available conditions in the reservoir. His decision will be based on guidelines agreed upon by the Normal Operating Committee.
- (5) Eventual direct communication of the power control center of CDE (Division of Operations and Dispatch) with the controls at the Valdesia dam system can be arranged by the Director of the Reservoir Control Center once an automatic control center is



established by CDE. Special instructions and regulations for such automatic control between CDE and the dams will be authorized by the Normal Operating Committee.

- (6) During real time operations of the reservoirs large storms (hurricane and non-hurricane) may develop in the Nizao watershed requiring some specific actions for flood operation mode of the reservoir. The procedures to follow in such cases are outlined in the section under flood control of the Normal Operating Plan, Part 2. They are summarized as follows:
- a. During minor floods, personnel of the Reservoir Control Center will direct the reservoir operations.
 - b. Alerts for possible major storms which could lead to serious flooding, or communications of ongoing major floods may be issued by ONAMET, CDP operators, dam tenders or other independent sources, to the Reservoir Control Center, the Center of Hydrologic Forecasting of INDRHI (CEPRHI) and the Division of Hydrology of CDE.
 - c. In response to the alerts or communications specified in (b), hydrologists of CEPRHI and CDE will meet at the Reservoir Control Center with the Director of the Center. The main purpose is to implement the flood forecasting and flood operation procedures described in the Normal Operating Manual, Part 2.
 - d. The Director of the Center will notify the Normal Operating Committee that the reservoir is in flood operation mode. Likewise, he will notify the Committee when the flood operation mode has ended.



- e. The Director of the Center will alert and notify the Emergency Operating Committee when flood emergency conditions are established as indicated in the Normal Operating Plan, Part 2.
 - f. The Director of the Reservoir Control Center will coordinate the preparation of a report whenever a major flood occurs, specifying details of the storm, flood, operation mode, reservoir response and flood impacts and damages.
- (7) A monthly report about the normal inspection programs including informal, intermediate, formal and special inspections as recommended in the Emergency Operating Plan must be prepared by the safety groups of CDE and INDRHI. Such report must be normally sent to the Reservoir Control Center in advance of the monthly meeting of the Normal Operating Committee. However, if any inspection discovers certain weaknesses as listed in the Emergency Operating Plan, it must be reported immediately to the Reservoir Control Center for coordinating the appropriate actions with the corresponding agencies.
- (8) Likewise, a monthly report about the regular maintenance program as recommended in the Emergency Operating Plan must be prepared by the safety groups of INDRHI and CDE. This report must be normally sent to the Reservoir Control Center in advance of the monthly meeting of NOC. However, if significant changes occur in the readings of the monitoring



instruments for dam safety, it must be reported immediately to the Reservoir Control Center for appropriate action.

Procedures Concerning the Emergency Operations

- (1) A number of factors may lead to emergency conditions of the Valdesia Reservoir system. These are listed in the Emergency Operating Plan. Personnel of the Reservoir Control Center, the Emergency Operating Committee, the dam tenders, the hydrologists of CEPRHI (Division of Hydrology of INDRHI) and CDE and the safety groups of CDE and INDRHI must become familiar with the Emergency Operating Plan.
- (2) Specific steps must be followed during conditions leading to and during flood emergencies. The steps to follow in such cases are outlined in the Emergency Operating Plan. They are summarized as follows:
 - a. Alerts for the occurrence of major storms which could lead to emergency flooding or communications of ongoing flooding may be issued by ONAMET, CDP operators, dam tenders or other independent sources, to the Reservoir Control Center, the Center of Hydrologic Forecasting of INDRHI (CEPRHI) and the Division of Hydrology of CDE.
 - b. In response to the alert or communication specified in (a), hydrologist of CEPRHI and CDE will meet at the Reservoir Control Center with the Director. The main purpose is to implement the forecasting procedures and flood reservoir operations depending whether the storm alerts are hurricane or non-hurricane, as specified in the Emergency Operating Plan.



- c. The Director of the Center must notify the Emergency Operating Committee when flood emergency conditions are established as indicated in the Emergency Operating Plan. This Committee must meet immediately at the Reservoir Control Center.
 - d. The Director of the Center must inform the Normal Operating Committee that Valdesia Reservoir system is in flood emergency condition. Likewise, he must inform the Committee when the flood emergency condition has ended.
 - e. The Director of the Reservoir Control Center will coordinate the preparation of a report whenever the flood emergency condition results into a major flood. The report must specify details of the storm, flood, reservoir operation history during the flood and flood impacts and damages.
- (3) The Reservoir Control Center (RCC) and the Emergency Operating Committee (EOC) should be alerted in case of any rapid change of the weakness conditions and/or continuous progressive change as listed in Section 5.1 of the Emergency Operating Plan. Likewise, RCC and EOC must be alerted if significant changes occur in the readings of the monitoring instruments for dam safety.
- (4) The alert for emergency action may be initiated by any of the following parties: the Chairman of EOC (Director of RCC), the dam tender or any member of the Emergency Operating Committee.
- (5) The Chairman of the Emergency Operating Committee (Director of the Reservoir Control Center) has the responsibility and the



authority to declare emergency according to the guide rules (conditions) developed by the Committee. Every effort should be made to contact the Chairman of EOC. The Assistant to the Director of RCC will substitute for the Chairman of EOC during his absence. If both the Chairman and the substitute are absent for any unforeseen reason (or they cannot be contacted), any other member of EOC may be contacted and may call the meeting of the Committee for conducting the appropriate actions.

(6) The procedures for emergency notification depend on the type of emergency as specified in the Emergency Operating Plan. They are summarized as follows:

(a) For Type I emergency. Controlled flood flow releases from Valdesia dam system:

- Dam operators should notify the Director of Reservoir Control Center, CDE (person to be named) and INDRHI (person to be named)
- The Director of the Center should notify the Emergency Operating Committee
- The Director of the Center should notify the agencies involved with evacuation operation plans at downstream locations from the dams.

(b) For Type II emergency. Possible dam failures:

- The operators of the dams and anyone may contact the Director of the Reservoir Control Center to report any signs of possible dam failures.



- The Director of the Center should notify the Emergency Operating Committee.
- The Emergency Operating Committee in coordination with the appropriate unit of CDE should order immediately a special inspection.
- If emergency should be declared, the emergency notification procedure as specified in (a) above must be followed.

(c) For Type III emergency. Dam or dams under the process of failure.

- The chief dam operator may declare dam failure under certain conditions that must be specified by the Emergency Operating Committee.
- If dam failure is declared, the damtender must implement both notification and evacuation plans. The damtender must notify the Reservoir Control Center.

D. Agreement of Technical Services

The Reservoir Control Center must negotiate specific agreements with government agencies and other national and international organizations to obtain technical services for specific elements of the normal and emergency operation of the Valdesia reservoir system. The Normal Operating Committee in consultation with the Emergency Operating Committee will decide on those specific technical matters related to dam safety that must be arranged in advance with specialized firms or consultants. A list of the most important technical services that must be arranged may include the following.

(1) Technical Services from INDRHI



- a. INDRHI shall prepare the irrigation water demands on a yearly, monthly, weekly and daily levels. They must be prepared in anticipation to the monthly meetings as specified in Part C(1) and weekly meetings as specified in C(2). This service is to be provided by the Division of Operations.
- b. INDRHI shall implement and update the computer models developed for scheduling reservoir operations for Valdesia reservoir. These models such as the MODSIM model developed in this project must be made available to the Computing facilities of the Reservoir Control Center. This service is to be provided by the Division of Operations.
- c. INDRHI shall prepare forecasts of monthly, weekly and daily inflows into Valdesia reservoir. The models and programs developed must be made available to the Reservoir Control Center. This service is to be provided by the Center of Hydrologic Forecasting (CEPRHI).
- d. INDRHI shall provide all the hydrologic services necessary for operation of the Valdesia system under flood conditions. The major requirement of these services are the following:
 - The Center of Hydrologic Forecasting (CEPRHI) of INDRHI shall maintain all the hydrologic models used in flood operation. These models are included in the CSU-HMS software package which was developed for flood operational and other hydrologic studies of Valdesia



system. Prior to beginning the evaluation of a Storm Alert and/or an Emergency Committee Alert, the models must be calibrated and updated using the most recent data available at INDRHI and/or other agencies. The RCC shall ensure that these models residing at the Center for Hydrologic Forecasting at INDRHI are accessible from the computers at RCC.

- During a Storm Alert and/or Emergency Committee Alert, INDRHI shall provide the services of a hydrologist, and if necessary a support staff, at RCC. The hydrologist must be familiar with running and interpreting the results of all the hydrologic models used in flood operation.
- Using the automated data collection facilities available at CEPRHI, INDRHI's hydrologist shall initiate a Storm Alert and/or Emergency Committee Alert by informing the Director of RCC of the forecast or existing storm conditions leading to such alert.
- CEPRHI shall maintain the automated data collection facilities in such a way that their most recent data are readily available prior to and during a Storm Alert and Emergency Committee Alert.
- CEPRHI shall provide the technical services necessary to develop new operating rules and/or modifying existing rules as new information or techniques become available in the future.



e. INDRHI shall provide services for conducting intermediate inspections of the Valdesia and Las Barias dams as specified in the Emergency Operating Plan. In addition, INDRHI shall provide specialists for conducting specific formal and special inspections on request of the Reservoir Control Center.

f. INDRHI shall provide in coordination with CDE the expertise required for interpretation and analysis of data obtained from monitoring equipment related to the safety of the dams.

(2) Technical Services from CDE

a. CDE shall prepare the power demands on a yearly, monthly, weekly, daily and hourly levels. They must be prepared in anticipation of the monthly meetings as specified in Part C(1) and weekly meetings as specified in C(2). This service will be provided by the Gerencia de Operaciones y Despacho of CDE.

b. CDE shall provide the services of a hydrologist at the RCC during a Storm alert and/or Emergency Committee Alert. If CDE develops new models or acquires existing models which may be useful for operations of Valdesia system they should be made available to RCC.

c. CDE shall provide Storm Alerts to the RCC by using existing data monitoring facilities and the automated data collection systems that may be acquired in the future.



- d. The hydrologic services that are obtained through ongoing agreements with independent sources in and outside the Dominican Republic must be provided to RCC. Such services may include hurricane track forecasts, forecasts of precipitation potential, satellite imagery, etc.
- e. The RCC may request technical services of the Hydrology Division of CDE for other hydrologic studies associated with the development and updating of flood operating rules.
- f. CDE shall provide services for operating the facilities and equipment of the dams. Supervision of needed personnel will be the direct responsibility of the Direccion de Produccion of CDE.
- g. CDE shall provide services for conducting informal inspections of the Valdesia and Las Barrias dams as specified in the Emergency Operating Plan. In addition, CDE shall provide specialists for conducting specific intermediate, formal and special inspections on request of the Reservoir Control Center.
- h. CDE shall provide services for conducting the regular maintenance programs as recommended in the Emergency Operating Plan.

(3) Technical Services from ONAMET

- a. ONAMET shall alert the RCC, directly or via the hydrologist of INDRHI and/or CDE of a potentially threatening storm that is heading towards Nizao or that is being developed in and around Nizao. Forecasts of



accumulated precipitation must be informed particularly if it is over 100 mm at any point over Nizao if such forecast capability exists with ONAMET.

- b. ONAMET shall alert the RCC, directly or via the hydrologist of INDRHI and/or CDE of tropical cyclones in the Atlantic Ocean which have a potential to strike Dominican Republic. Whenever possible, such an alert must have a lead time of at least five days. If track forecasts are available from the National Hurricane Center of Miami or other independent services they must be provided and updated at intervals of 6 hours or less. ONAMET shall also provide the track positions, speed of motion, maximum sustained wind speed and other synoptic information (if available) at intervals of 6 hours or less. Upon request from the Reservoir Control Center (RCC) ONAMET shall provide the continuous services of a meteorologist at the RCC during the critical period of a hurrican.

(4) Technical Services from Other Sources

- a. RCC shall obtain real-time information on the movement and condition of Atlantic tropical cyclones from the National Hurricane Center in Miami. If ONAMET, CDE or any other organization in Dominican Republic currently receives such information, RCC may secure their availability at the Center.
- b. RCC shall obtain technical services of independent organizations such as the Gulf Coast Weather Service for



receiving information on hurricane tracks and precipitation forecasts made for Dominican Republic using the latest techniques available. Such services should be obtained in real-time during hurricane Storm Alert and Emergency Committee alert periods.

- c. RCC shall obtain technical services from national or international experts on specific elements of inspection programs and analysis and interpretation of data related to dam safety when such expertise is not available at CDE or INDRHI.

5. Plan for Normal Operating Conditions

A Normal Operating Plan for the Valdesia reservoir system has been developed which describes the overall approach for obtaining and using the guides and rules for operating the system under normal conditions. These include reservoir operations to deliver water for irrigation and hydropower on monthly and weekly time scales, and operation under flood conditions.

The Normal Operating Plan has been prepared in two separate volumes: first is the volume entitled "Normal Operating Plan for the Valdesia Reservoir System, 1. Irrigation and Hydropower," by Labadie et al. (1986) and second is the volume entitled "Normal Operating Plan for the Valdesia Reservoir System, 2. Flood Control," by Obeysekera et al. (1986).

6. Plan for Emergency Operating Conditions

An emergency plan entitled "Emergency Operating Plan for the Valdesia Reservoir System," by Shen et al. (1986) has been developed which describes the actions and procedures to be followed prior to and

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during emergencies. It includes mainly the following: normal inspection and maintenance programs, conditions leading to emergency operations, declaration of emergencies, emergency notification procedures, emergency operation plans and procedures and standing instructions to damtender.

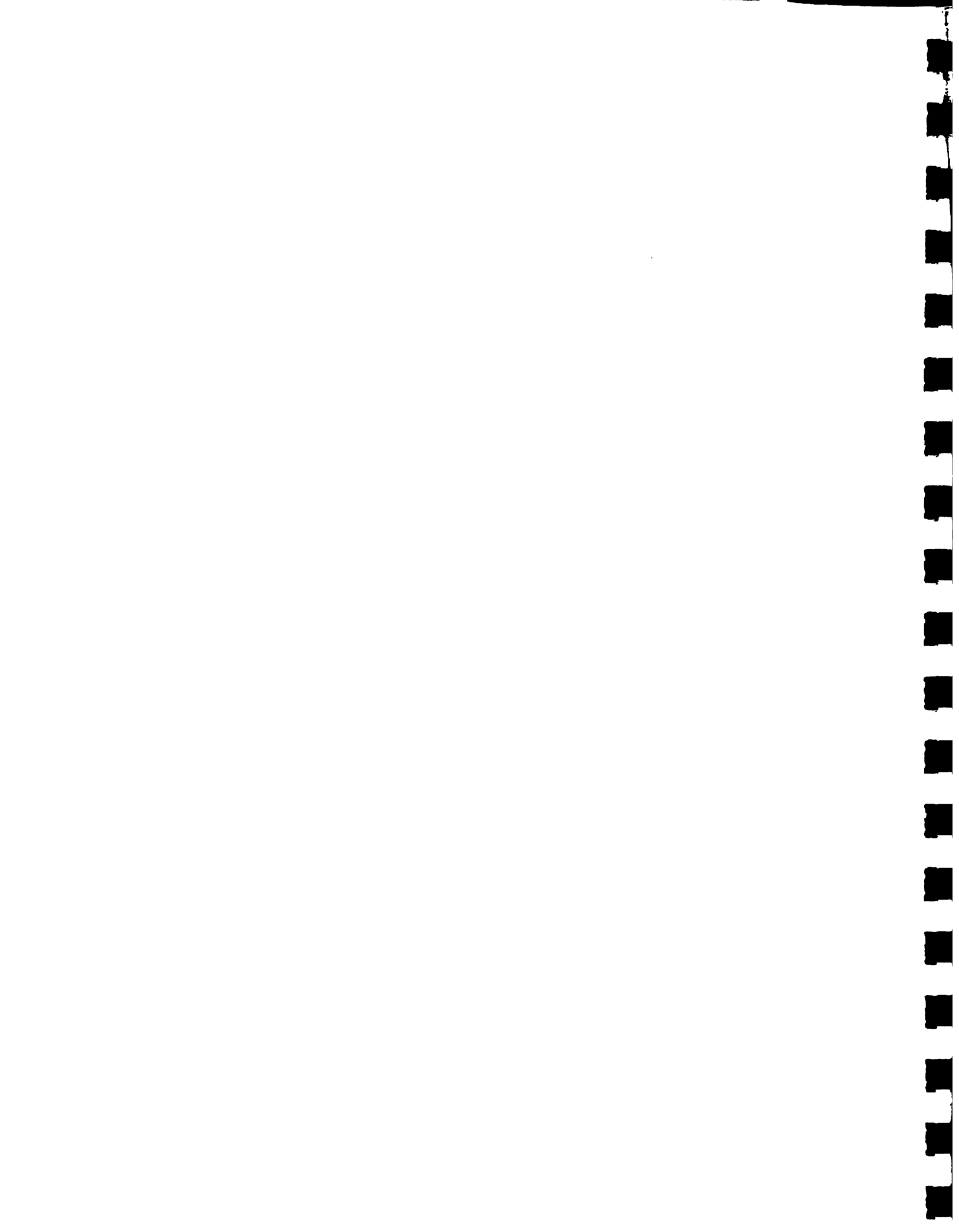
7. Requirement of Personnel, Facilities and Equipment

A. Personnel

The minimum personnel required to implement the Executive Unit of the Reservoir Control Center is: Director of the Center, Assistant to the Director, and Staff Support. The qualifications of the Director and Assistant to the Director will be:

- Director of the Center: Civil engineer with M.S. degree in hydraulic engineering and minimum of 5 years of experience in operation and management of reservoir systems. In addition some experience on dam safety is required. Preferably he should have a good understanding and speaking ability of the English language.
- Assistant to the Director: Civil engineer with a specialization in hydrology and water resources. Minimum of 3 years of experience in hydrologic studies and computer modeling of watersheds. Must have a good experience with the use of microcomputers.
- 3 engineers for providing instruction to the damtender.

Additional technical personnel may be needed depending on whether the above suggested technical services will be conducted by the appropriate agencies. Likewise, additional technical and staff



personnel may be needed if the proposed Reservoir Control Center will operate and manage all major reservoir systems of the Country.

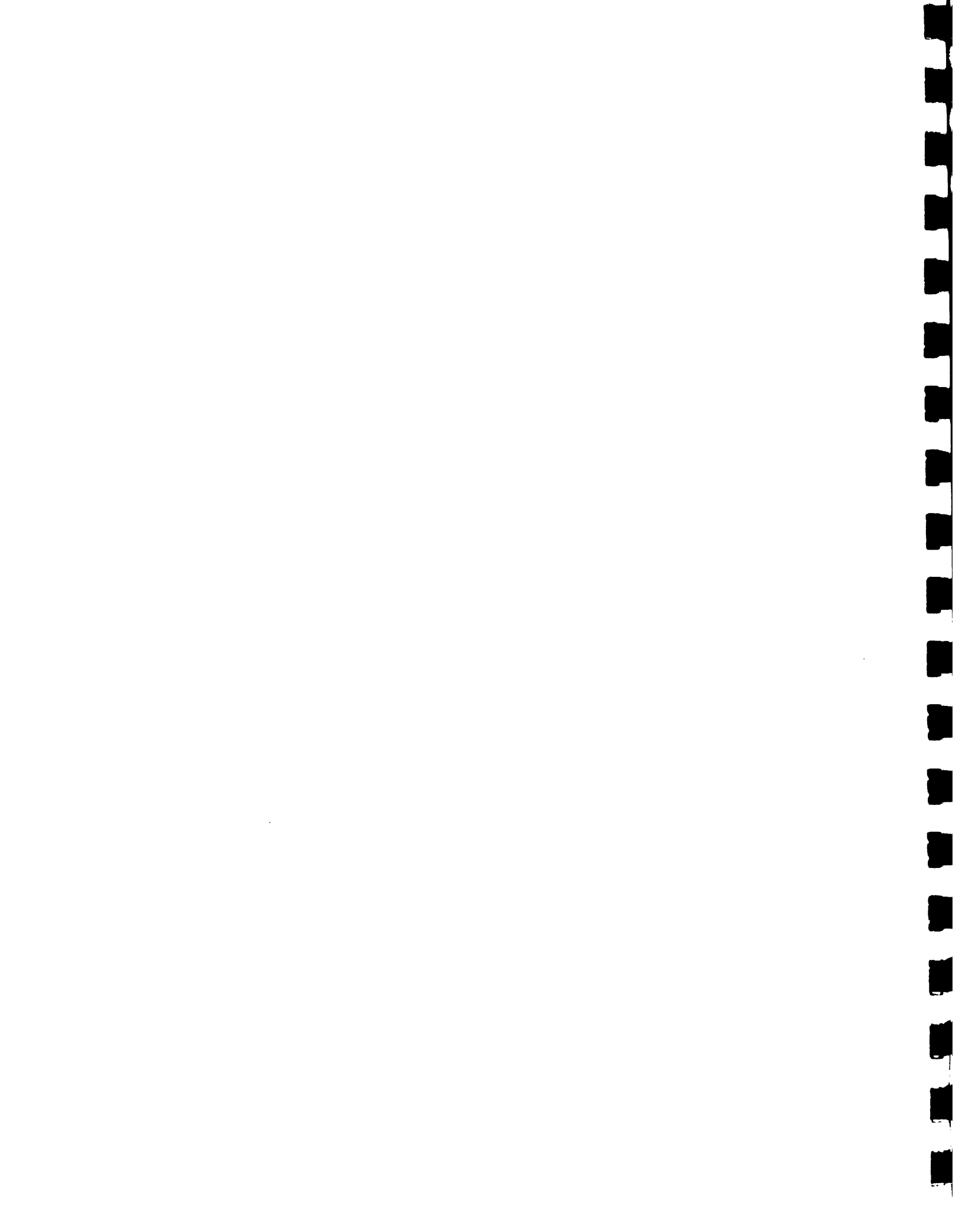
B. Facilities

The minimum space facilities needed for setting up the proposed Reservoir Control Center is:

- office of the Director of the Center
- office of the Assistant to the Director
- office of the Principal Secretary
- office of the administrative clerk
- conference room
- control room
- technical library and copier room
- services

C. Equipment

- 1 automobile
- 1 van
- 1 copy machine
- 1 overhead projector
- 2 IBM PC-AT with 30 MB hard disk
- 132 color printer
- 1 six pen plotter
- 1 Fortran compiler
- 3 mono or color monitors
- 3 graphics card
- 2 AT multifunction card
- 1 XT multifunction card
- 2 1200 band modem



- 1 IBM selectric typewriter
- 1 IBM PC-XT
- hardware for local area network
- equipment for communication with damtender and other personnel

