CHAPTER 1

INTRODUCTION

1-1. Purpose. This manual provides guidance on the technical aspects of hydroelectric power studies, from the preauthorization level through the General Design Memorandum (GDM) stage. It also defines the appropriate level of effort required, and the study requirements and technical procedures required for each stage of study. Specific areas covered include need for power, determination of streamflows and other project characteristics, estimation of energy potential, sizing of powerplants, cost estimating, and power benefit analysis. Subjects such as powerhouse design and selection of turbines and generators are treated in other manuals.

1-2. Applicability. This manual is applicable to all field operating activities having civil works design responsibilities.

1-3. References.

a. ER 10-1-41, Corps-Wide Centralized Functions and Special Missions Assigned to Divisions and Districts

b. ER 37-2-10, Accounting and Reporting Civil Works Activities

c. ER 1105-2 series, Planning Guidance Notebook

d. ER 1110-2-1, Provisions for Hydroelectric Installation at Corps of Engineers Projects

e. ER 1110-2-1402, Hydrologic Investigation Requirements for Water Quality Control

f. EM 1110-2-1301, Cost Estimates - Planning and Design Stages

g. EM 1110-2-3001, Planning and Design of Hydroelectric Power Plant Structures

h. EM 1110-2-3106, Selecting Reaction Type Hydraulic Turbines and Pump-Turbines at Corps of Engineers Projects

i. EM 1110-2-3600, Reservoir Regulation

1-4. Bibliography. Appendix T consists of a selected bibliography of literature pertaining to hydropower studies. References in the text to specific publications are indicated throughout the manual by bracketed numbers which correspond to the publication number as listed in Appendix T.

1-5. Glossary. Appendix S contains definitions of terms relating to hydropower and electric power systems.

1-6. Conversion Factors. Appendix R contains a listing of some of the common conversion factors used in hydropower studies. Factors for converting English system units to metric units are also included.

1-7. Hydroelectric Design Centers. Three Corps of Engineer offices have been designated as Corps-wide Hydroelectric Design Centers: North Pacific Division, Omaha District, and Mobile District. These offices have special expertise in powerhouse design and can provide services ranging from preliminary layouts and cost estimates through turbine selection and preparation of construction plans and specifications. In accordance with ER 10-1-41 (Change 2), these offices have responsibility for all Corps powerhouse design work beyond the feasibility stage. To insure continuity throughout the planning and design stages, it is recommended that the Design Centers also be utilized where possible at the reconnaissance and feasibility stages. The primary Design Center, North Pacific Division, will be given first priority for work performed for all districts within the Corps, except that Omaha District will generally perform work within Missouri River Division and Mobile District will perform work within South Atlantic Division. The Design Centers also have supporting offices which can provide assistance in power studies and power benefit analyses.

1-8. Organization of a Power Study. Figure 1-1 outlines in flowchart form the basic steps in a power study. A brief discussion of each step follows, with references to the section(s) in this manual that describe the technical studies required for each step.

a. Need for Power. Define the power system and compare projected loads with projected resources to determine the type, amount, and scheduling of additional power (Chapter 3).

b. Hydrologic Data Preparation. Develop streamflows, reservoir characteristics, and related data for the proposed site (Chapter 4).

c. Preliminary Power Studies. Using the data from step (b), determine the approximate energy potential of the proposed site (Chapter 5).

d. Environmental/Operational Studies. Based on environmental characteristics and non-power river uses and project functions, identify factors which may limit operation for power (Chapters 4 & 6).

e. Type of Project. Using physical site characteristics and data gathered during steps (a) through (d), determine what type of project(s) should be considered for the site (Chapter 6).

f. Range of Plant Sizes. With data from steps (c) and (e), determine the range of installed capacities that should be examined (Chapter 6).

g. Detailed Power Studies. With data from steps (b), (d), (e), and (f), conduct power studies to determine energy output and dependable capacity for each alternative development (Chapters 5 & 6).

h. Cost Estimates. Make a preliminary estimate of annual cost for each alternative development (Chapter 8).

i. Basis for Benefits. With information on project size, type of power supplied, and characteristics of the local power systems, determine the appropriate method for measuring hydropower benefits, considering the likely alternative means of meeting projected demand in the absence of the proposed hydro project (Chapter 9).

j. Power Values. Determine unit value of hydropower project output using data on the market value of power or the alternative cost of meeting demand (Chapter 9).

k. Power Benefits. Compute power benefits using energy output and dependable capacity values from step (g) and unit power values from step (j) (Chapter 9).

l. Net Benefits. Determine net benefits for each alternative development using cost data from step (h) and benefit data from step (k).

m. Marketability Study. Using data from steps (d), (g), and (h), the regional Federal Power Marketing Administration makes marketability study (Chapters 3 & 9).

n. Select Plan. With net benefit data from step (l), environmental and operational data from step (d), marketability data from step (m), and any other relevant data, select plan to be recommended for development (Chapter 9).

o. Successive Iterations. Figure 1-1 depicts a power study as a single-pass analysis. In most cases, selection of the best power installation is an iterative process, with some of the steps being repeated two or more times in successively greater detail for a successively smaller number of alternative plans. It should also be noted that the above discussion relates to a single-purpose power study. When hydropower is one of several functions being considered for a proposed project, the steps shown on Figure 1-1 would be integrated into a multi-objective planning study. This manual touches only briefly on environmental studies, net benefit analysis, and plan selection. Primary guidance on these subjects and on multi-objective planning is found in the Planning Guidance Notebook (49).

1-9. Hydropower Reports. In accordance with the Planning Guidance Notebook, the basic results of the hydropower studies must be summarized in reconnaissance and feasibility reports. It is recommended that hydropower reports also contain a technical appendix which includes the material necessary to understand assumptions and procedures underlying the power studies. This appendix should also include sufficient data and back-up computations to permit tracking the determination of (a) need for power (where required), (b) power output, and (c) power benefits. This allows effective review and facilitates follow-up studies. Appendix A presents an outline of material which should be considered for inclusion in a hydropower technical appendix.

1-10. Small Hydro Projects. The procedures included in this manual are applicable to small hydro projects (less than 25 MW), as well as to larger installations. Additional information on the analysis of small hydro projects can be found in references (6), (17), (36), and (39).

1-11. Coordination with Other Agencies.

(1) The normal coordination procedures with Federal, State, and local agencies apply to hydropower studies. Special mention should be made of coordination with the Federal Energy Regulatory Commission (FERC), and the regional Federal Power Marketing Administrations (Section 15-4 of reference (37)).

(2) The Corps of Engineers cooperates with the FERC in evaluating power benefits on the basis of unit power values developed by that agency (Section 9-5k). FERC reviews cost allocations for Corps hydro projects and, where authorizing legislation requires, is responsible for preparation of the final cost allocation. FERC is also responsible for assessing the falling water charges that apply to non-Federal entities that construct powerplants at Corps of Engineers

facilities (Section 9-10h), and they are involved in the evaluation of minimum provisions for future power at Corps projects (Section 9-10b).

(3) The 1944 Flood Control Act and related Acts give the Secretary of Energy the responsibility for marketing the power from Corps of Engineers hydro projects, and this is handled by the five regional Power Marketing Administrations (PMA's) (Sections 3-5c, 3-12, and 9-9). As a part of the feasibility level planning study, the PMA prepares a marketability report in order to determine if the costs of the proposed hydro project can be recovered as required by law. Close coordination with the PMA should be maintained at all levels of planning.

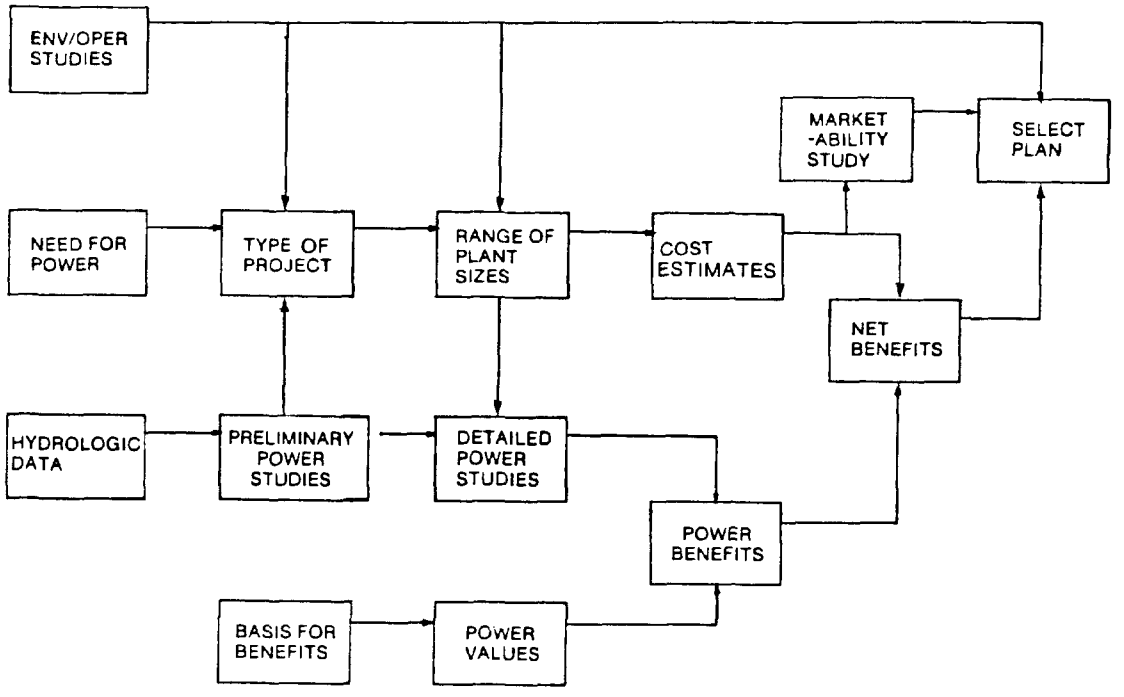

Figure 1-1. Power planning flow chart

Figure 1-2. Generator installation at Wilson Lock and Dam, the first major hydroelectric project to be designed and constructed by the Corps of Engineers. The project was placed in service in 1925 and was transferred to the Tennessee Valley Authority in 1933 (Nashville District).