Chapter 1
Introduction

1-1. Purpose

This manual provides information and criteria pertinent to the design and selection of mechanical and electrical systems for flood-control pumping stations. It is applicable to all such work within the Corps of Engineers' responsibility.

1-2. Applicability

This manual applies to all HQUSACE elements, major subordinate commands, districts, laboratories, and field operating activities having civil works responsibilities.

1-3. References

Required and related publications are listed in Appendix A.

1-4. Limitations

a. Information covered in other manuals. The procurement and specifying of certain major items of equipment, including pumps, electric motors, switchgear and slide/roller gates are covered in other engineer manuals and guide specifications. Information contained herein is to aid in the preparation of design memoranda and contract plans and specifications.

b. Detailed design. This manual is not intended as a comprehensive step-by-step solution to pumping station design. The designer is responsible for exercising sound engineering resourcefulness and judgment while using this manual. Used as a guide, it provides experience-oriented guidance and a basis for resolving differences of opinion among the competent engineers at all levels. Other material useful in pumping station design, which is readily available in standard publications, is not generally repeated or referenced herein.

1-5. Design Procedures

a. General design practices. Plate 1 provides the recommended procedure for development of flood control pumping station design. The chart prescribes the design sequence and preparation and approval procedure.

(1) The design should include the quality of the materials to be used and the workmanship involved. Designs should be as simple as practicable. Increased complexity tends to increase initial and future operation and maintenance costs. Designs and equipment and material selection that require less frequent maintenance are recommended.

(2) All design computations should be provided. Design computations should be clear, concise, and complete. The design computations should document assumptions made, design data, and sources of the data. All references (manuals, handbooks, catalog cuts, existing stations), alternate designs investigated, and planned operating procedures should also be provided. Computer-aided design programs can be used but should not be considered a substitute for the designer's understanding of the design process.

(3) Equipment backup requirements should be evaluated both on the probability and the effect of a malfunction. Usually a backup is provided only for equipment that would cause the entire pumping station to be inoperable. Spare equipment should be considered for equipment whose design is unique or one of a kind construction which would make replacement lengthy or very costly. Spare equipment for most pump stations should consist of bearings, shaft sleeves, temperature probes, relays, switches, lubricators, and any other types of auxiliary equipment being used on the pumping unit. Spare equipment could also include a spare impeller and pump bowl section if there are a large number of pumping units at the project (five or more) or there are multiple stations using the same size and type of pump procured under the same contract. Spare parts should also be provided for the prime mover.

(4) During construction, the designer should be involved in the review of shop drawings and as-built drawings, preparation of the operation and maintenance manual, and field and shop inspections. The designer should also be consulted when a field change is recommended or required.

b. Alternative studies. The selection of the type of equipment to be used should be based on alternative studies. When a choice of different equipment is available and will perform the same function, all applicable types should be considered. The selection should be based on reliability and least annual costs. Since

reliability cannot be easily assigned a cost, it should be evaluated on the basis of what effect an equipment failure would have on the operation of the station. A piece of equipment whose failure would still permit partial operation of the station would be more desirable than an item that would cause the entire station to be out of operation. The annual costs should include the first costs, operating costs, maintenance costs, and replacement costs based on project life. As certain items of equipment may affect the layout of the station including the location and suction bay and discharge arrangement, the structural costs associated with these designs should be included in the cost analysis. On major equipment items, this study should be included as part of the Feature Design Memorandum. For stations over 30 cubic meters per second (m^3/s) (1,060 cubic feet per second (cfs)) capacity, a separate Feature Design Memorandum should be prepared for the pumping equipment before the design is started on the station.

c. Other design information.

(1) Sources. Important design information is available from sources besides the prescribed Corps of Engineers manuals and standard handbooks. Design memoranda and drawings from other projects, manufacturers' catalog information, sales engineers, project operation and maintenance reports, field inspectors, operation and maintenance personnel, and the pumping station structural design personnel are all valuable and readily available sources. Communication with HQUSACE and other USACE District and Division offices can often provide information to solve a particular problem.

(2) Evaluation. All existing information should be carefully examined and evaluated before applying a new product. Relying on previous satisfactory designs requires that the design conditions and requirements be carefully compared for applicability. The design engineer should consult with field engineers and make field trips to pumping stations under construction. Consultation with pump station operators is also very helpful. Obtaining and evaluating information from field sources is improved by making personal acquaintances and observations at stations under construction or operating stations as well as by making visits to pump manufacturers' plants. Office policies should permit and encourage these visits.

d. Large pumping plant designs. For pumping plants 30 m^3/s (1,060 cfs) or larger, the engineering and design will be performed by the Hydroelectric Design Center in accordance with ER 1110-2-109.

1-6. Deviations

This manual allows the designer considerable design flexibility. Some requirements, such as sump design, must be followed. When a deviation to stated requirements is believed necessary, the designer should completely document the deviation and request higher authority approval.

1-7. Safety Provisions

Certain safety provisions will be required by EM 385-1-1, Safety and Health Requirements Manual, guide specifications, trade standards, codes, and other manuals referenced herein. Additionally, the requirements of the Occupation Safety and Health Administration (generally referred to as OSHA Standards) are to be considered minimum requirements in Corps of Engineers design. Areas of particular concern to mechanical and electrical design are safety, noise levels, personnel access provisions, working temperature conditions, air contamination, load handling provisions, and sanitary facilities. OSHA Standards are continuously being modified and expanded. Conformance to the latest published requirements is essential.

1-8. Appendices

Required and related references are provided in Appendix A. Appendix B presents a method to determine the size of a pump to meet pumping requirements; it also provides the dimensions for the sump and station layout once the pump has been selected. Three general categories of trash-raking equipment are described in Appendix C. In Appendix D, the procedures used in determining the size of gate closure, stem size, and operator size, and loads to be carried by the structure at the gate location are explained. The different methods and formulas used to determine the head losses occurring in a pumping station are given in Appendix E. Appendix F provides the format for an operation and maintenance manual for a typical stormwater pump station, and Appendix G contains an electrical data request. Appendix H is a glossary.