CHAPTER 1

INTRODUCTION

1-1. Purpose and scope.

This manual provides guidance to facilities maintenance personnel in the maintenance of interior electrical systems of 600 volts and less. These systems include such components as illumination, low voltage systems, rotating equipment, motor control centers, solid-state equipment, transformers, and switchgear. It also applies to low voltage controlled devices on high-voltage systems. The procedures presented in this manual are basic and can be applied to the equipment of any manufacturer. Detailed information and instructions should be obtained from the instruction book for the particular type of equipment being serviced.

1-2. References.

Appendix A contains a list of references used in this manual.

1-3. Codes and specifications.

Maintenance on electrical systems and equipment must adhere to the codes and specifications as they apply to the work to be performed. Also, manufacturers' maintenance instructions which accompany select electrical components must be applied in conjunction with the codes and specifications listed below and the departmental specifications listed in appendix A.

a. The National Electrical Code [National Fire Protection Association #70 (NFPA 70)]. This code is the most widely adopted set of electrical safeguarding practices. It defines approved types of conductors and equipment, acceptable wiring methods, mandatory and advisory rules, operating voltages, limitations on loading of conductors, required working spaces, methods of guarding energized parts, interrupting capacity requirements of system protective and control devices, requirements for connections and splices, insulation resistance requirements, and grounding requirements.

b. Recommended Practice for Electrical Equipment Maintenance (NFPA 70 B).

c. American National Standards Institute/ Institute of Electrical and Electronics Engineers Standard (ANSI/IEEE Std.) chapter 15, 242-1986, IEEE Recommended Practice for Protection and Coordination of Industrial and Commercial Power Systems. This code provides preventive maintenance practices for electrical systems and equipment used in industrial-type applications.

1-4. Maintenance requirements.

Preventive maintenance should not be confused with repairs after a breakdown. The definition of maintenance implies that the equipment or system is inspected to discover its weaknesses and then repair or replace the necessary elements before a breakdown occurs. A maintenance program for protective devices and the electric system could be divided into the following steps: inspecting, cleaning, tightening, lubricating, testing, and recording.

a. The effectiveness of the distribution system is measured in terms of voltage regulation, power factor, load balance, reliability, efficiency of operation, and costs. To ensure the system's efficiency, lessen failures, and maximize safety, an effective maintenance program must be employed. This program should include and/or consider the following:

(1) Scope of work.

(2) Intervals of performance.

(3) Methods of application.

(4) Safety requirements, practices and procedures.

(5) Adherence to codes, specifications and directives.

(6) Maintenance management procedures regarding tools, records, and follow-up procedures.

(7) Hazards associated with work and the facility.

(8) Emergency operating instructions.

(9) Requirements for periodic review to determine additional loading in circuits such as in family housing, bachelor quarters, and maintenance and administrative buildings.

b. A well executed maintenance program will provide benefits in terms of:

(1) Economic operation.

(2) Improved safety.

(3) Longer equipment life.

(4) Reduced repair and overhaul time.

(5) Fewer unplanned outages.

(6) Early detection of undesirable changes in the power system.

(7) Improved operation of the facility.

1-5. Records.

A good record keeping system is essential for safe, efficient and economical operation of electrical facilities and for planning and executing an effective

preventive maintenance program. It is recommended to use the Work Information Management System (WIMS) or other data-automated systems to keep records rather than paperwork files. Suitable forms and reports requirements should be developed to suit local needs. When facilities are built, instruction documents and spare parts lists for all equipment installed should be obtained prior to beneficial occupancy acceptance.

a. In addition to charts, work orders, and real property records, the following records have been found useful in analysis and correction of recurring trouble areas.

(1) *Diagrams.* Accurate single-line and schematic diagrams of the distribution system should be readily accessible in the electrical shop. These are essential references when switching circuits and rerouting electric power in emergencies. Such diagrams also provide a simple means of locating facilities and determining the characteristics of electric supply to buildings requiring maintenance. Electrical personnel must have access to latest "as-built" building drawings for use in tracing out circuitry within buildings.

(2) *Equipment lists/logs.* These lists should be maintained on all items of equipment such as motors, motor controllers, meters, panelboards, electrical controls, and switchgear. Lists should reflect detailed information such as the density of all like items, item ratings and physical locations. Lists/logs will facilitate scheduling of inspections and maintenance services.

(3) *Equipment maintenance records.* These records should be maintained on every individual item of electrical equipment that requires maintenance services. Records should include detailed information such as scheduled maintenance and inspection requirements, previous test results, maintenance repairs performed and any other related information that would facilitate analyzing the equipment performance. Maintenance records should be retained on file for as long as needed to allow collection of sufficient data to perform the equipment performance analyses. By observing the equipment performance, downward trends can be identified and problem areas corrected before major breakdowns occur.

(4) *Emergency operating instructions.* Emergency operation of electrical facilities is safer and quicker when instructions are prepared and posted in advance. There should be instructions for each general type of anticipated emergency, stating what each employee in the electrical section should do, setting up alternatives for key personnel, and establishing follow-up procedures for use after an emergency has passed. Instructions should be posted in the electrical shop, security guard office, all emergency generating or operating areas, and other locations as the responsible supervisor deems necessary. Employees should be listed by name, title, official telephone number, home address and home telephone number (where permissible). These instructions should emphasize safety under conditions of stress, power interruptions and similar emergencies.

1-6. Priority and scheduling.

In regard to the support of the installed physical facilities, it is the policy of the Military Departments that, in order of priority, maintenance should be second only to operations. It must be systematic and timely. Subsequent sections in this document provide generaI suggestions on service frequencies and procedures. Although these proposed actions and frequencies may appear to be excessive, these suggestions are based upon experience and equipment manufacturers' recommendations. They are not intended to supersede instructions that electrical manufacturers normally provide. Every realistic effort should be made to adhere to these suggestions considering existing manpower levels and available test equipment. It is generally good practice to inspect equipment three to six months after it is first put into service and then to inspect and maintain it every one to three years, depending on its service and operating conditions. Conditions that make frequent maintenance and inspection necessary are:

a. High humidity and high ambient temperature.
b. Corrosive atmosphere.
c. Excessive dust and dirt.
d. High repetitive duty.
e. Frequent fault interruption.
f. Older equipment.

1-7. Hazards.

Material specifications, construction criteria, installation standards, and safe working procedures should be applied to minimize hazards. All work should be performed by qualified electricians and conform to the latest accepted procedures and standards.

a. Building electrical systems. Fire and safety hazards in building electrical systems often result from tampering by unqualified personnel. Probably the greatest example of tampering is the unauthorized changing or replacing of fuses. Careful observation by maintenance personnel is needed to control excessive use of items such as extension cords, heaters, air conditioners, and improper grounding which cause overloading of the wiring system. Whenever possible, installation of additional receptacles is preferable to the use of extension cords.

Each building should be inspected for loose wires, poor connections, bare conductors, unauthorized or nonstandard attachment cords, use of wiring or fixtures as support for extraneous items, any conditions likely to cause fires and lamps larger than the standard size prescribed for outlets.

b. Hazardous locations. Special occupancy areas include garages, aircraft hangars, gasoline dispensing and service stations, bulk storage plants, and health care facilities. Such areas designed as "Hazards Locations," as specified in Article 500 of the National Electrical Code, require special and equipment considerations. These considerations include the use of special fittings, rigid conduit, and explosion-proof apparatus. Maintenance personnel must ensure that all work performed in a hazardous area complies with the code requirements for the area's particular hazard classification.