BUILDING ELECTRICAL SYSTEMS

PLANNING

CONTENTS PAGE

1. GENERAL

1.01 This section covers the planning concepts for the design and construction of Alternating Current (AC) electrical distribution systems for telephone equipment, computer, and administrative buildings. Systems designed in accordance with these recommendations will achieve the degree of safety and reliability required at the most economical cost.

1.02 This section has been reissued to clarify planning considerations and to conform with updated information in the Building Electrical Systems Sections. Since this is a major revision, change arrows ordinarily use to indicate changes have been omitted.

1.03 The planning concepts include the following:

- Safety
- Reliability
- Load Analysis
- Voltage Selection
- Utility Coordination
- Jurisdictional Coordination
- Sizing
- Layout
- Single Line Diagrams.

2. SAFETY

2.01 The building engineer is responsible for the safe design of the electrical system. Safety cannot be overemphasized and must not be compromised where lives may be endangered.

2.02 In designing the system, the engineer should consider the following safety factors:

(a) Use only NEC approved raceways.

(b) Use circuit protective equipment which is adequately rated and properly coordinated for its specific application. The design of the system must consider preventive maintenance requirements. Accessibility and availability for inspection and repair with safety are important considerations.

(c) To assure personnel and equipment safety, the distribution system shall have a solidly grounded neutral and the equipment must be grounded in accordance with Section 802-001-198,

General Equipment Ground Requirements for AC Service Distribution Systems.

(d) Ground fault protection shall be provided on all new systems using a 480Y/277 volt distribution system. Retrofitting existing systems for ground fault protection should be considered. For more detailed information, refer to Section 760-400-500, Ground Fault Protection.

(e) Consider how the system will be operated under normal conditions, during a power outage, and under periodic test conditions.

(f) Conform to all national, state, and local safety codes and ordinances, eg, National Electric Code (NEC); Testing Laboratories, ie, UL, FM; Occupational Safety and Health Act; and others that may be applicable.

3. RELIABILITY

3.01 Reliable electrical service is second only in importance to safety. It should be noted, however, that the emphasis on safety and reliability does not necessarily mean that more costly equipment and construction methods be specified.

3.02 As a fundamental rule, reliability is generally obtained via simplicity, with quality equipment, properly installed, simple operating procedures, and simple maintenance procedures.

4. LOAD ANALYSIS

4.01 Estimation of the various anticipated loads in a Telephone Company (Telco) building is necessary in the planning stage in order to determine the size and type of electrical service and the manner in which it is to be brought into the building and distributed to assure that present and future requirements are adequately met.

4.02 Section 760-400-200, Electrical Load Analysis for Telecommunications Buildings, and Section 760-400-210, Electrical Load Analysis for Data Processing Centers, cover in detail the basic preparation of preliminary load analysis. For administrative buildings, an estimate can be made using 5-7VA per square foot.

4.03 Although loads can only be estimated at the preliminary stage, the estimates should be refined as design details are formulated. After the building is constructed, actual load figures should be checked to help improve the accuracy of future estimating.

5. VOLTAGE SELECTION

5.01 Service and distribution voltage levels used in a given system should be selected primarily on the basis of economics.

5.02 As a general rule, 480Y/277 volts should be used as the service and distribution voltage in all but the smallest buildings (those with loads less than 100-200 KVA). Using 480 volts adds little to the cost while the lower amperage required, as compared to a 208 volt system, will permit substantial savings in equipment and conductor cost.

5.03 A possible exception to this rule is a small or moderate size computer building (10,000 to 20,000 square feet). Since computers will comprise the bulk of the load, usually at 208 volts, a service voltage of 208 volts might be economically justified.

5.04 It is possible that in some very large buildings where large blocks of power must be transmitted for long distances, medium voltages (above 1,000 volts) should be considered. It is recommended that any decision to utilize medium voltage be based on a CUCRIT economic comparison with a 480 volt system.

5.05 Section 760-400-110, Voltage, covers in more detail the concepts of selection and types.

6. UTILITY COORDINATION

6.01 As soon as possible after the electrical loads have been estimated, consult with the electric utility company to determine what types of services are available and notify them when utility service is required.

6.02 A special point should be made of being sure the metering arrangement and rate schedule selected result in the greatest overall economies.

6.03 In deciding what type of service entrance transformer (ie, Pole, Pad, or Vault) to provide for a specific location, the public and aesthetic viewpoint should also be considered. Refer to Section 760-400-220, Service Entrance and Electric Service Switchboards, for more details.

7. JURISDICTIONAL COORDINATION

7.01 Electrical work for new building service or alterations is generally performed by the electrical contractor. Central office installation work is performed by Western Electric (WE). Building operations personnel arrange for electrical work in the maintenance category. This includes repair work and minor changes to the building electrical circuits.

7.02 The building engineer must carefully evaluate the division of work on each project to avoid jurisdictional controversy. Allocation of the work to the contractor or WE should be clear-cut. This allocation should be based on past precedent and local custom. Where gray areas exist, the subject should be resolved with the Industrial Relations Organization in that area.

8. SIZING

8.01 Specifying the proper size for the service entrance and power distribution facilities is one of the most important elements of good design. Design for realistic load estimates allow for growth but do not try to provide for large unforeseen contingencies.

Design for flexibility, which means the ability to economically add to the system to accommodate unexpected growth. One of the worst aspects of overdesign is that even if unforeseen requirements do materialize some day, usually the overdesigned facility is not adequate. The design should cover a period of at least 10 years and may be as long as 20 years where growth is expected to be slow and stable.

8.02 When designing a new electrical service, it is always a good practice to compare the load analysis with the actual load of a similar building. Although no two buildings are exactly alike, similarities do exist and this type of verification can help reduce serious sizing errors.

8.03 As a general rule, no single switchboard should be larger than 2000 amps at 480 volts. If more power is required, provide additional switchboards. This incremental sizing provides the advantage of possibly deferring additional switchboards until actual load growth dictates in addition to improving safety and reliability.

8.04 Normally, Telco buildings will not require more than three 2000 ampere, 480 volt switchboards. Very large administrative buildings (over 500,000 square feet) and major equipment and data processing buildings might require more power. The design for such buildings is rather specialized and beyond the scope of this practice.

9. LAYOUT

9.01 It is important for the building engineer to be involved in the floor plan layout from the start. To the extent that it does not interfere with other more important building layout considerations, the service entrance equipment should be located to minimize the length of the major circuits, ie, from the service transformer and to the central office power equipment, computer equipment, mechanical equipment, and the stand-by power plant.

10. SINGLE LINE DIAGRAM

10.01 After the configuration and load classifications have been decided upon, a simplified, single line (one-line) diagram of the system should be prepared by the building engineer.

10.02 The simplified single line diagram (see Fig. 1) should show:

(a) The basic circuits with all types of switching and protective devices used and preliminary estimates of the sizes of major components:

- Breakers
- Fuses
- Transfer switches
- Load centers
- Power distribution panels
- Lighting panels, etc.

(b) The types of loads being served:

- Essential
- Nonesstenial
- Special.

(c) The kinds of loads being powered and approximate size:

- Central Office power
- Motors, HVAC
- Elevators
- Lighting
- Computers.

11. DESIGN REQUIREMENTS

11.01 At this point the building engineer has sufficient information to furnish the "design requirements" to the consulting engineer for preparation of the detailed design. The design requirements should cover much of the information developed thus far. At a minimum, it should include:

(1) Service entrance location

(2) Switchboard location and size

(3) Preferred service voltage

(4) Generator location and size

(5) Central office and data processing loads

(6) Lighting levels

(7) Specialized telephone company requirements such as frame and aisle lighting supply, central office grounding, etc

(8) Preliminary single line diagram.

11.02 Some companies also include a "design guide" or a typical specification, if they wish to exercise additional control over the design details.

12. REFERENCES

12.01 This material was based on the following references:

Industrial Power Systems Handbook - Beeman McGraw-Hill, 1955

Recommended Practices for Electrical Power Distribution for Industrial Plants IEEE STD 141-1976 "Red Book"

Mechanical and Electrical Equipment for Buildings - McGuinness, Stein, Reynolds - Wiley Press, 6th Edition

NFPA 70, National Electrical Code (NEC)

Section 760-400-200, Electrical Load Analysis for Telecommunications Buildings

Section 760-400-210, Electrical Load Analysis for Data Processing Centers

Section 760-400-100, Voltage

Section 760-400-220, Service Entrance and Electric Service Switchboards.

Section 760-400-500, Ground Fault Protection

Section 802-001-198, General Equipment Ground Requirments for AC Service Distribution Systems.

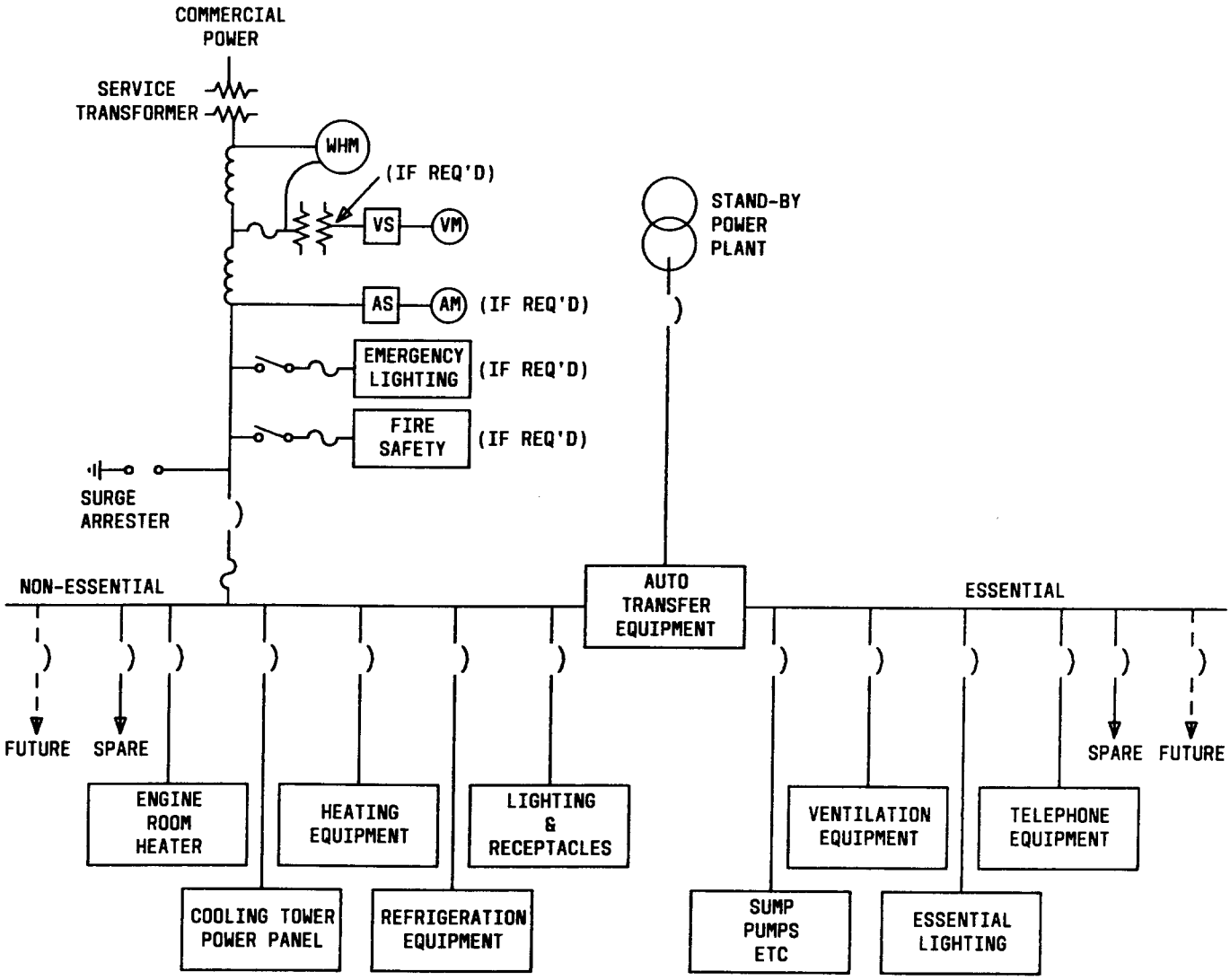

Fig. 1—Single-Line Diagram