BUILDING ELECTRICAL SYSTEMS
SWITCHING ARRANGEMENTS FOR STANDBY POWER

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1. GENERAL

1.01 This section covers switching arrangements for transfer of telephone building Alternating Current (AC) power supply to stand-by power. It discusses the factors which affect the choice of the most suitable switching arrangement.

1.02 Whenever this section is reissued, the reason(s) for reissue will be given in this paragraph.

1.03 The design of any switching arrangement will depend upon the serving utility, the stand-by power plant, and the load requirements. For small buildings with few blocks of load, a simple arrangement is satisfactory. More complex arrangements may be necessary in buildings having large complex load requirements.

1.04 The overall system should be designed to enable transfer from a commercial power source and back again in a simple, quick, and reliable manner.

2. CRITERIA

2.01 The following criteria apply for all Telephone Company (Telco) buildings.

2.02 The building engineer is responsible for the total planning concept of the electrical distribution equipment as detailed in Section 760-400-100, Planning.

2.03 ***Flexibility:*** The power distribution system should be flexible enough that changes in the system due to load growth will not cause an interruption of service.

2.04 Telecommunications and computer loads tend to increase with time. Provision for load growth, which may be reflected in the future by increased transformer capacity and higher available short circuit currents, should be made in the planning stage. A design should provide for reasonable expansion of the system with a minimum investment and interruption of service.

2.05 ***Maintainability:*** The power distribution system should be designed with properly chosen equipment so that it will operate with a minimum of maintenance.

2.06 In planning the system, careful consideration should be given to the accessibility and availability of all components for inspection and normal maintenance procedures. In all but the smallest systems, access to the rear of the electric service switchboard should be provided.

2.07 ***Economics:*** Overall economic factors should be considered in the power distribution system design. First cost should be a factor in planning the power distribution system but should not be the controlling factor.

2.08 Operating and maintenance costs are a continuing expense and should be controlled by careful selection of equipment and by providing simplicity in operating procedures.

3. STAND-BY POWER

3.01 Specific terminology (ie, essential, nonessential, etc) as used here is covered in Section 790-100-659, Stand-by Power Plants.

3.02 Although Section 790-100-659 is directed more specifically to the design of the stand-by power plant, which in most operating companies is done by network engineering, building engineers should be thoroughly familiar with it.

3.03 The design and provision of the transfer device(s) is usually the responsiblity of the building engineer. However, as the design of the stand-by power plant is so closely related to the transfer equipment, close collaboration between the two designers is essential.

3.04 The need to provide stand-by power in Telco buildings to energize essential loads during outages of commercial power and the means of transferring from one source to the other are important considerations in the planning and design of the electrical distribution system. Where more than one stand-by engine-alternator is installed initially or as the loads increase, the transfer arrangements become more involved. Under these conditions, parallel operation of stand-by engine-alternators is often necessary and should be considered in the initial design. Refer to Section 790-100-659, Stand-by Power Plants, and paragraphs 2.03 through 2.06 for considerations on paralleling.

3.05 A basic consideration in the design of the switching arrangement is the method used to limit loading of the stand-by power source. Limiting is commonly required because the normal practice is to supply standby capacity to carry only essential loads. The arrangement must, therefore, be designed to limit the load actually connected to the standby source during commerical power failures and routine tests.

3.06 Another consideration in the transfer of loads from one power source to the other is the sudden application of large blocks of load to the new power source with the resulting inrush current. Standard circuit arrangements are available per Section 802-035-150 to permit sequence starting of voltage regulated battery-charging rectifiers to reduce the inrush current. Sequence starting of rectifier groups may be accomplished in steps of 25, 50, 75, or 100 percent of the entire charger load.

4. SWITCHING ARRANGEMENTS

4.01 There are several basic factors which are common to all distribution arrangements. These should always be considered by the building engineer responsible for the planning of the distribution system.

Provide for:

- Safety of operation
- Simplicity of operation
- Ease of maintenance and repair
- Reliability
- Flexibility in operation and growth
- Adequate means for transferring loads from one source of power to another
- Adequate control to limit the load on the stand-by power plant. This is particularly important when using multiple unit power plants.

4.02 The following paragraphs cover specific switching arrangements. These arrangements differ considerably because Telco buildings differ greatly. A scheme for one size or type of building will not necessarily be the optimum design for another.

4.03 The arrangements shown are one-line diagrams and show only the basic distribution and switching arrangements. No attempt is made to show details such as types or size of feeders, types or size of protective devices, metering, controls, and so forth.

4.04 ***Single Bus—(Fig. 1):*** This arrangement is a simple radial system. The entire load is transferred to the stand-by system. It is recommended for small buildings having a load of 50 KVA or less. With this small load, the savings in stand-by plant cost that might be achieved by not transferring some of the load are offset by the complexities introduced by such a design.

4.05 This scheme will usually employ wall mounted panels and switches. The stand-by plant could be a portable unit, connected to an outside receptacle provided for the purpose. Transfer to the stand-by power plant is made by a transfer switch.

4.06 Both essential and nonessential loads are served by the same bus and it is simple to operate. It is adequate for small one-story buildings such as DMS-10's, small No. 5 ESS's, Remote Switching Systems, etc.

4.07 ***Split Bus—(Figures 2A-D):*** These arrangements should be used for loads from 50 to 1000 KVA, ie, in most buildings. More than one transfer device and essential bus will usually be required in larger buildings to coordinate with starting and loading multiple alternator sets. Figures 2A through D show schemes which have been successfully used. Load control is obtained by limiting access to the stand-by plant to only the essential loads, and by dividing the essential loads among the transfer devices.

4.08 Figure 2A is applicable in a large percentage of small telephone equipment buildings and employs a single generator set with sufficient capacity to power the entire load. Starting of the generator and load transfer can be automatic or manual but automatic operation is recommended for all new buildings and many existing manual transfer systems are being converted to automatic operation.

4.09 Figure 2B is arranged so that some essential load is automatically powered in the event of a power failure. The remaining essential load is manually transferred after an additional engine is started and paralleled manually.

4.10 Figure 2C utilizes two essential busses, each automatically powered by its own generator. The normally open tie breaker can be closed if one engine fails.

4.11 Figure 2D is a fully automated system including automatic paralleling features designed into the standby power plant.

4.12 These Figures (2A-D) have varying degrees of sophistication in starting, transferring and paralleling. Section 790-100-659, Stand-by Power Plants, and paragraphs 2.03 through 2.06 covers the considerations for the above features.

4.13 ***Dual (Double) Bus, (Fig. 3):*** This arrangement utilizes the DUAL or DOUBLE BUS concept. It provides for requirements in a Telco building having many large loads requiring access to standby power. It will normally be applicable only to the largest telecommunications and computer buildings. The commercial power source is connected to one bus, and the standby plant is connected to the second bus. Major load blocks are served by interlocked paired breakers connected to these busses. Access to the standby bus can be provided for all loads in the building thus providing maximum flexibility to facilitate generator loading and for easy conversion of circuits from nonessential to essential in the future, if necessary. However, stand-by breakers should be provided only for those loads which are required to have access to stand-by power under company policy. This will save the cost of one circuit breaker for each circuit, as well as associated equipment for automatic transfer.

4.14 Perhaps more important, it will reduce the tendency for standby generating capacity to be installed based on the transfer device capability rather than real need. In some cases, transfer devices have been provided to permit utilizing "spare" generator capacity, which might have actually been provided to take advantage of "spare" transfer capability—something of a vicious cycle, resulting in unwarranted expenditures for increased standby power capacity.

4.15 This system has high reliability, since even in the event of a total or partial physical loss of one bus or breaker, the loads can be served via the second bus provided the commercial and standby (essential) busses are physically separated.

4.16 This distribution scheme is more expensive than the single bus (Fig. 1) or the split bus (Fig. 2). Since each load is individually transferred, the transfer devices can be smaller than would be necessary if an arrangement similar to Fig. 1 or 2 were used for the same load. Growth can be provided for by planning for additional breakers to be added when required.

5. REFERENCES

5.01 This material was based on the following references:

Industrial Power Systems Handbook - Beeman-McGraw-Hill, 1965

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

Recommended Practices for Electrical Power Distribution in Commercial Buildings, IEEE STD 241-1983 "Gray Book"

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

Section 760-400-100 - Planning

Section 790-100-659 - Standby AC Plants

Section 802-035-150 - Rectifier Sequency Control Unit

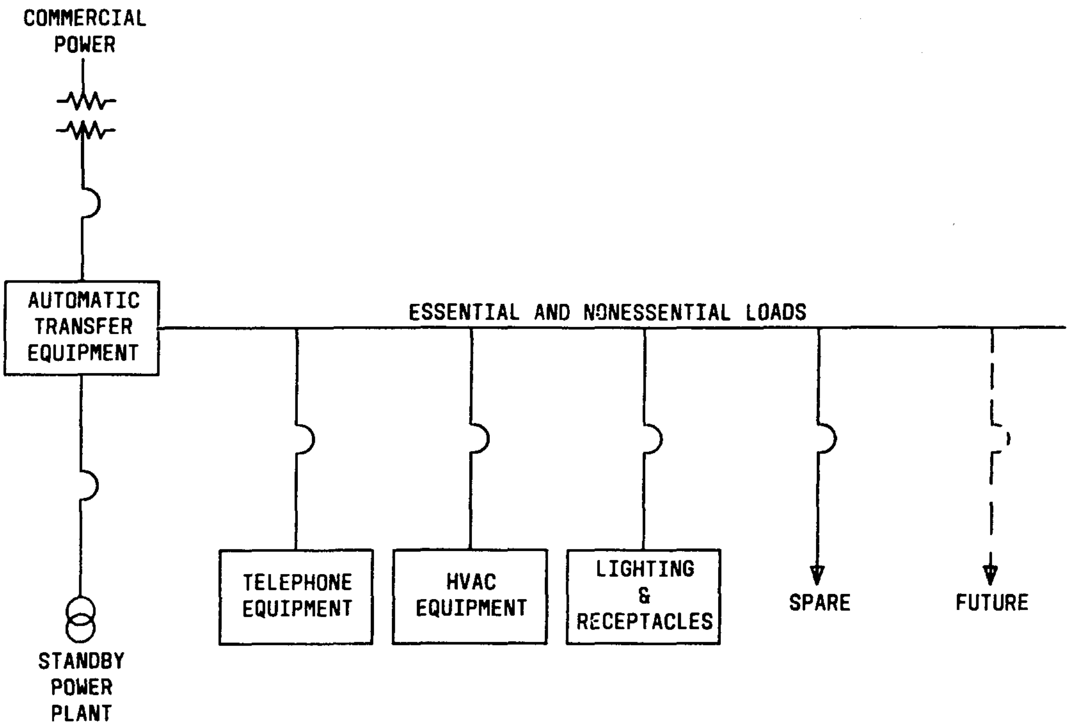

Fig. 1—Single Bus

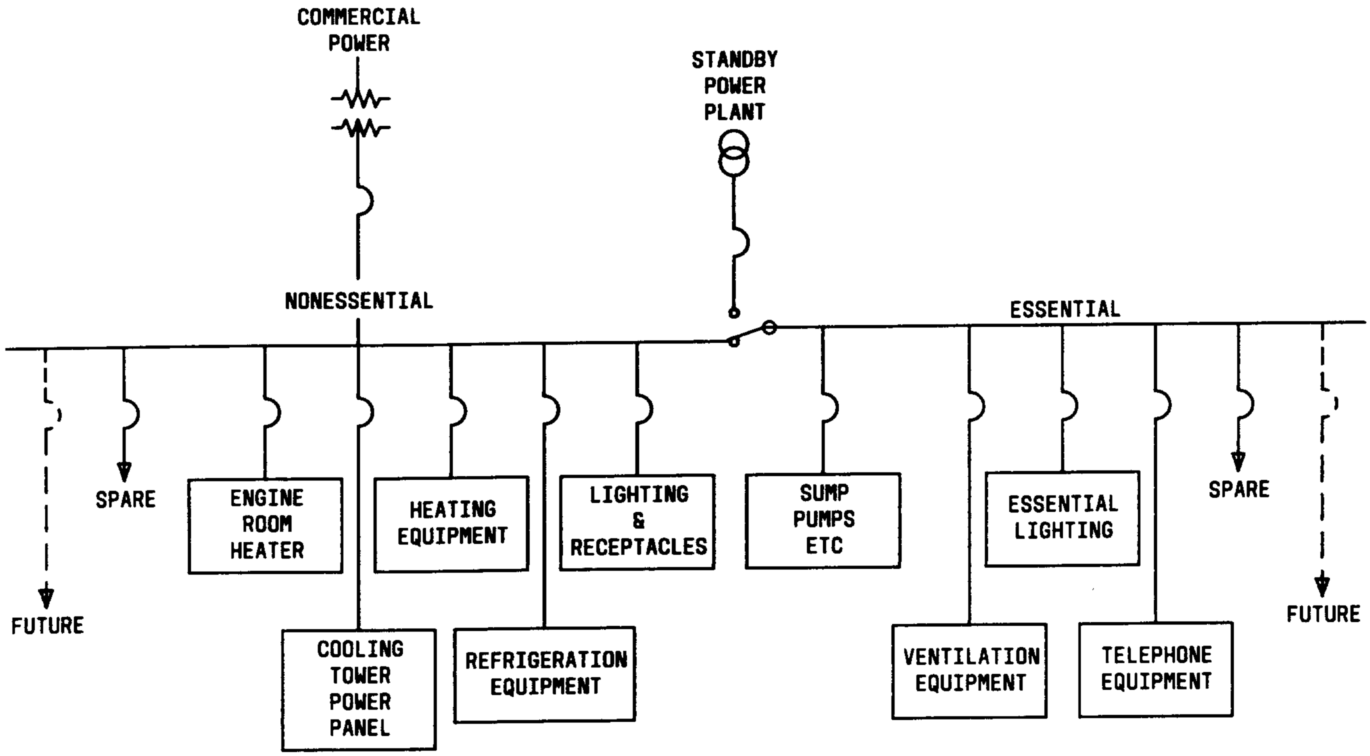

Fig. 2A— Split Bus

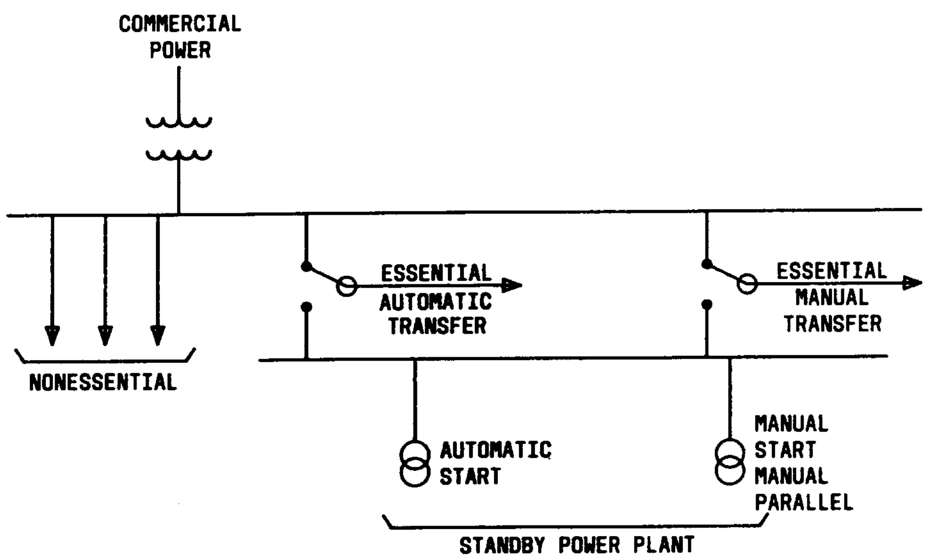

Fig. 2B— Split Bus

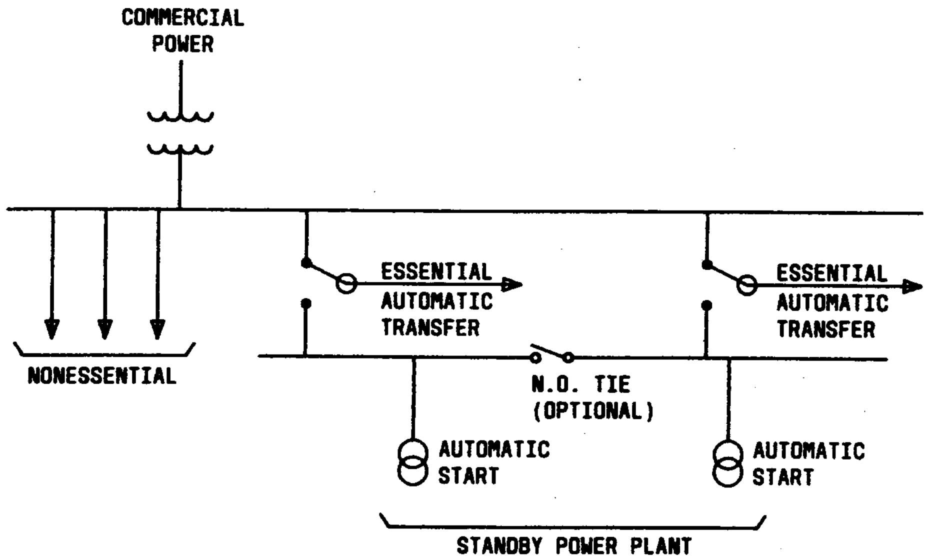

Fig. 2C — Split Bus

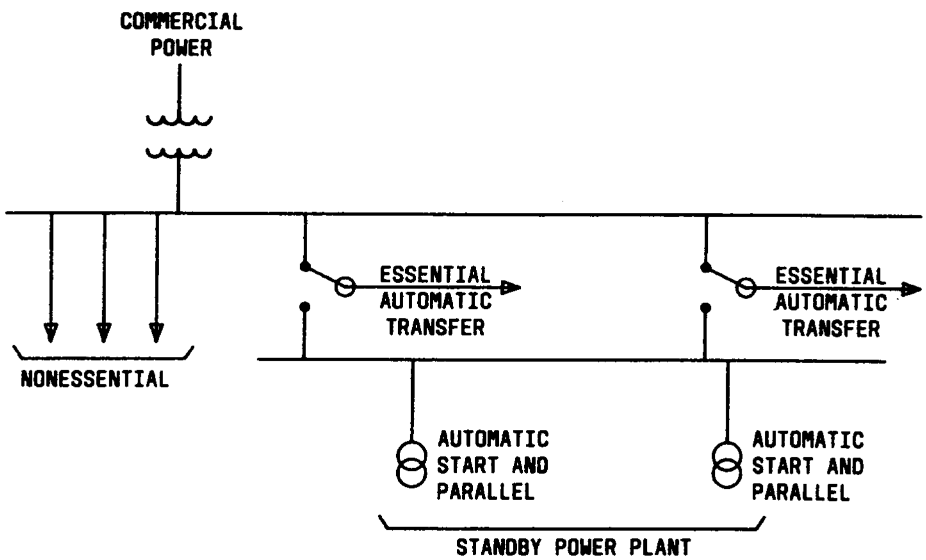

Fig. 2D — Split Bus

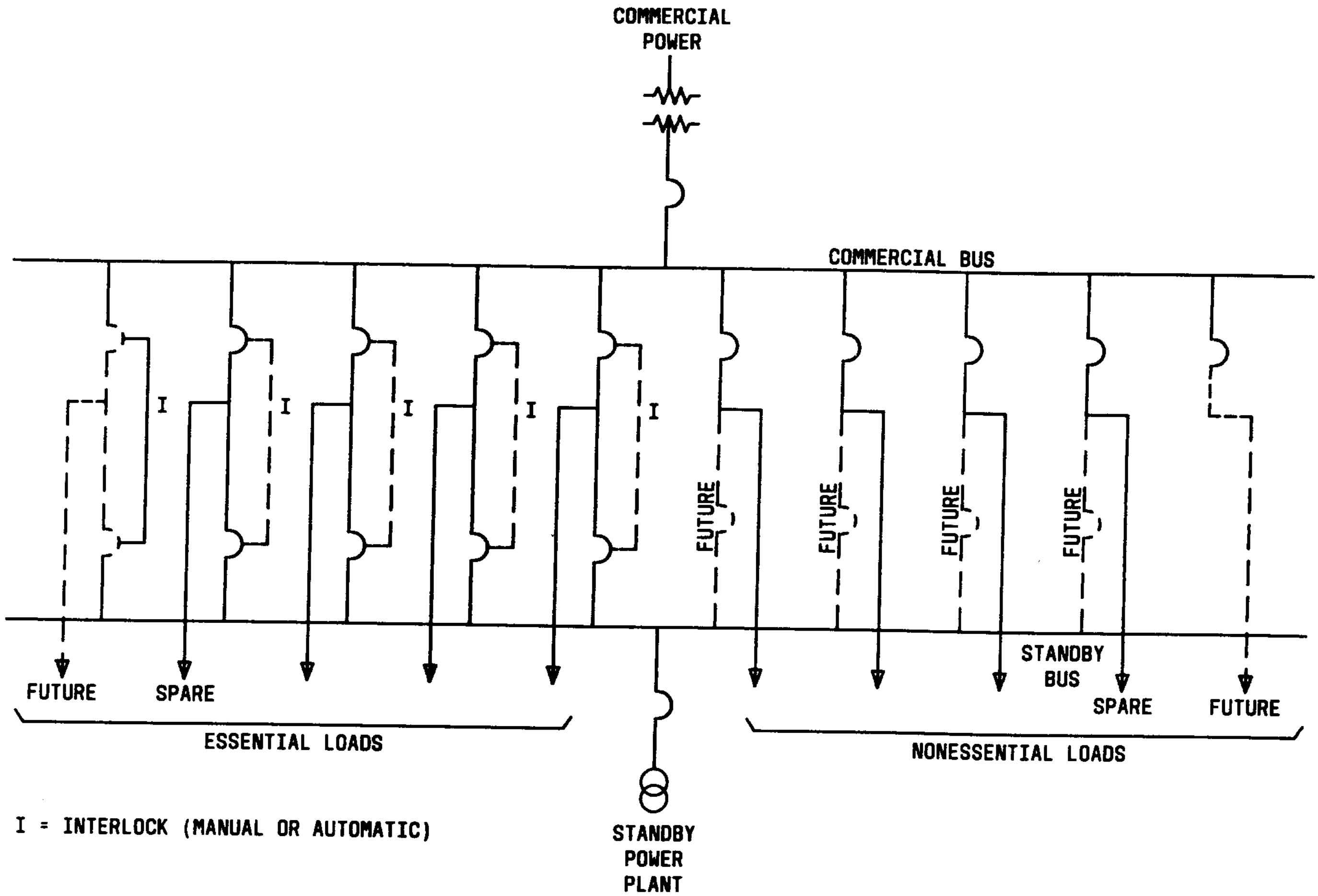

Fig. 3—Dual (Double) Bus