

RESPONSE TO QUESTION FROM DR. GOODMAN
REGARDING EMERGENCY POWER SUPPLY SYSTEM

Dr. Goodman's Question (Tr. 2920):

" . . . based on extensive past experience of any kind of standby power systems, whether it's a hospital or anything else, how many redundant systems do they have per unit that has to be manned?"

Answer:

The necessity of providing efficient generation of adequate electric power in emergencies and other short term situations has received increasing attention by industry in recent years. Typical installations requiring such emergency power sources are hospitals, rest homes, communication centers, aircraft control and warning systems, and air and marine navigational systems.

In order to determine the basis on which the number of diesel generators for various standby uses is determined, information was solicited from two of the major suppliers of automatic start diesel generator sets, Alco Engine Division of White Industrial Power Inc. and Fairbanks-Morris, and from a number of facilities at which such generator sets had been installed.

The installation experience of the suppliers was that it has not been the practice to require, or provide, redundant systems for hospital service. This subject was further pursued by direct contact with four hospitals in the San Francisco Bay area, one in New York City, and one

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in Baltimore in order to determine if the number of standby units provided bore any relationship to the number of facilities served, i.e., operating rooms.

In each instance, it was determined that redundancy was not provided and that load grouping on each unit was not selected to provide diversity of supply for a particular function. For example, all operating rooms may be supplied by only one diesel generator while all elevators may be supplied by another.

With regard to standby power systems for airport facilities, a study is currently in progress for the FAA to establish new recommended standards for design of high reliability power systems with safety of aircraft movement and handling the prime concern. Current criteria for the fifty U. S. airports designated by the FAA as continuous power airports does not require redundant systems but does require a standby engine generator. Because of the long distances between facilities at airports which necessitate long cable interconnections, FAA rules express a preference for installations utilizing a small diesel generator at each outlying facility. Under such a criterion, redundancy of engine generator sets is not provided.

Dalles airport is an example of an airport that does utilize a redundant power system. This system consists of two full capacity diesel engine generators each capable of serving all facilities at the airport. Thus in this case the number of generators is based on redundancy but not on the number of electricity-consuming facilities. During the time in service there have been no reported failures of the diesels to start.

Shipboard emergency diesel generator sets for passenger ships were also considered since this application places total dependence on

the standby power system, no "off site" power source being feasible. The regulations of the U. S. Coast Guard and rules of The American Bureau of Shipping place particular emphasis on independence of the emergency source of supply from normal ship service and propulsion engines and reliability of starting (multiple cranking cycles) but redundancy is not a requirement.

Further statistical background regarding diesel starting regarding diesel starting reliability was obtained from the Alco Engine Division of White Industrial Power Inc. Alco has made 12 automatic diesel generator sets for emergency standby service since 1955. Five of these are in hospital standby, one in a prison, two in a telephone exchange, one at the end of a power line serving several towns, one in an airline terminal and two in nuclear facilities. Except for initial debugging, and one specific failure and later removal of a catalytic afterburner, no failures to start have been reported to the manufacturer. Based upon the total time in service and an assumed test frequency of at least once every month, it appears that these units may have aggregated in excess of 750 starts without failure.

The results of this comparison of industry practice may be summarized as follows:

1. In no application that we are aware of, other than as standby power supplies for nuclear power generating stations, is redundancy of emergency generators presently a design requirement. The absence of such a requirement appears to be to a large extent based on satisfactory performance of standby systems over the last twenty years. It should also be noted that in

the case of land installations, the emergency diesel generator is generally viewed as redundant to the off site source of supply.

2. The number of diesel generators required is in no case determined by units or facilities to be manned, but rather by:

- a) Total load requirements (i.e., if the load requirement exceeds the capacity available in a single suitable unit more units are required).
- b) Physical separation of facilities dictating use of separate diesel generators.
- c) Expansion or addition of new facilities requiring additional standby power.
- d) Diverse load requirements such as large single phase loads versus three phase loads.

It is our opinion that the criteria as developed for the design of standby power supplies for nuclear power generating stations, and as applied in the design of Midland Plant, has in fact drawn on the best available experience in industry. And further that in meeting the overall design requirements of independence, separation, and redundancy of standby sources the number of standby diesel generators is properly determined by the need for compatibility with the number of redundant load groups and ability to provide the required design basis capacity not by the number of facilities served.