

U.S. NUCLEAR REGULATORY COMMISSION

REGULATORY GUIDE

REGULATORY GUIDE 1.81

SHARED EMERGENCY AND SHUTDOWN ELECTRIC SYSTEMS FOR MULTI-UNIT NUCLEAR POWER PLANTS

A. INTRODUCTION

General Design Criterion 5, "Sharing of Structures, Systems, and Components," of Appendix A, "General Design Criteria for Nuclear Power Plants," to 10 CFR Part 50, "Licensing of Production and Utilization Facilities," prohibits structures, systems, and components important to safety from being shared among nuclear power units unless it can be shown that such sharing will not significantly impair their ability to perform their safety functions. These safety functions include the capability to perform an orderly shutdown and cool-down of the remaining units in the event of an accident in one unit. This regulatory guide describes a method acceptable to the NRC staff for complying with the Nuclear Regulatory Commission's requirements with respect to the sharing of onsite emergency and shutdown electric systems for multi-unit nuclear power plants. With respect to the sharing of d.c. systems, this guide applies to all multi-unit plants. With respect to the sharing of a.c. systems, this guide applies to the multi-unit plants whose a.c. power is supplied by diesel generators. The Advisory Committee on Reactor Safeguards has been consulted concerning this guide and has concurred in the regulatory position.

B. DISCUSSION

The staff has determined that, because of the low probability of a major reactor accident, a suitable design basis for multi-unit nuclear power plants is the assumption that an accident occurs in only one of the units at a time, with all remaining units proceeding to an orderly shutdown and a maintained cooldown condition. Use of this design basis in conjunction with the requirements of

General Design Criterion 5 has resulted in development of onsite emergency electric power systems that are shared among the units of the plant. The degree of sharing in these designs has varied from sharing of only one source to sharing of all sources and their distribution systems. A device is considered to be shared among units if it is designed to perform the same function in all units as required.

Sharing of onsite power systems at multi-unit power plant sites generally results in a reduction in the number and capacity of the onsite power sources to levels below those required for the same number of units located at separate sites. The reduced capacity could cause undesirable interactions. Examples of such interactions are (1) the interconnection of engineered safety feature (ESF) control circuits of each unit such that failures and maintenance or testing operations in one unit affect the availability of ESF in other units, (2) coordination required between unit operators in order to cope with an accident in one unit and safe shutdown of the remaining unit(s), and (3) system overload conditions as a consequence of real accident in a unit coincident with a false or spurious accident signal in another unit.

All of the applicants with shared onsite power systems at multi-unit plants reviewed to date have been required by the staff to provide improvements in capacity and/or a reduction in system interactions in order to resolve concerns with regard to these undesirable interactions. Further, the staff has, since 1973, advised several applicants for construction permits that sharing of onsite power systems should not be incorporated into their designs. Inasmuch as most, if not all, of the applications for construction permits presently under review and those in the planning stages are for multi-unit plants comprising from two to six units, the staff has concluded that the onsite emergency electric power systems for these plants should be designed to minimize undesirable interaction effects.

This revision reflects comments received from the public and additional staff review.

*Lines indicate substantive changes from previous issue.

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C. REGULATORY POSITION

1. D.C. systems in multi-unit nuclear power plants should not be shared.

2. Multi-unit nuclear power plants now under construction or for which construction permit application was made before June 1, 1973, will be reviewed on an individual-case basis. For these plants, the design of shared onsite emergency and shutdown a.c. electric systems should satisfy the following:

a. The sharing of onsite a.c. electric systems should be limited to two units.

b. A single failure (a false or spurious accident signal at the system level in the non-accident unit should be considered as a single failure) should not preclude the capability to automatically supply minimum engineered safety feature (ESF) loads in any one unit and safely shut down the remaining unit, assuming a loss of the offsite power.

c. Onsite power capacity should be provided to energize sufficient Seismic Category I equipment to attain a safe and orderly cold shutdown of all units, assuming the loss of offsite power and the most severe (in terms of power drain) design basis event and a single failure in the onsite electric system.

d. The interaction between each unit's engineered safety feature electric circuits should be limited such that any allowable combination of maintenance and test operations in the units will not preclude the capability to automatically supply power to minimum ESF loads in any unit, assuming a loss of offsite power.

e. Coordination between the unit operators should not be necessary in order to meet Regulatory Positions 2.b and 2.c. Coordination required to meet Regulatory Position 2.d should be minimized.

f. Complete information regarding the status of the shared systems should be provided for each unit operator.

g. The design should conform to the recommendations contained in Regulatory Guides 1.6 (Safety Guide 6), 1.9 (Safety Guide 9), and 1.47.

3. In the case of multi-unit nuclear power plants for which the construction permit application was made on or after June 1, 1973, each unit should have separate and independent onsite emergency and shutdown electric systems, both a.c. and d.c., capable of supplying minimum ESF loads and the loads required for attaining a safe and orderly cold shutdown of the unit, assuming a single failure and loss of offsite power.