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REGULATORY GUIDE

OFFICE OF STANDARDS DEVELOPMENT

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TORNADO DESIGN CLASSIFICATION

A. INTRODUCTION

General Design Criterion 2, "Design Bases for Protection Against Natural Phenomena," of Appendix A, "General Design Criteria for Nuclear Power Plants," to 10 CFR Part 50, "Licensing of Production and Utilization Facilities," requires, in part, that structures, systems, and components important to safety be designed to withstand the effects of natural phenomena such as tornadoes without loss of capability to perform their safety functions. Criterion 2 also requires that the design bases for these structures, systems, and components reflect (1) appropriate combinations of the effects of normal and accident conditions with the effects of natural phenomena and (2) the importance of the safety functions to be performed.

This guide describes a method acceptable to the NRC staff for identifying those structures, systems, and components of light-water-cooled reactors that should be designed to withstand the effects of the Design Basis Tornado (see Regulatory Guide 1.76, "Design Basis Tornado for Nuclear Power Plants"), including tornado missiles, and remain functional.

B. DISCUSSION

Nuclear power plants should be designed so that the plants can be placed and maintained in a safe shutdown condition in the event of a Design Basis Tornado, as defined in Regulatory Guide 1.76. Protection of structures, systems, and components necessary to place and maintain the plant in a safe shutdown condition may generally be accomplished by designing protective barriers to preclude missile strikes. For example, the primary containment, reactor building, auxiliary building, and control structures should be designed against collapse and should provide an adequate barrier against missiles. However, the primary containment need not necessarily maintain its leaktight integrity under pressure loadings due to the pressure differentials developed by the tornado. If protective barriers are not installed, the structures and components themselves should be designed to withstand the effects of the tornado, including tornado missile strikes.

It is not necessary to maintain the functional capability of all Seismic Category I structures because the probability of the joint occurrence of low-probability events (loss-of-coolant accident with Design Basis Tornado or smaller tornado, or earthquake with Design Basis Tornado or smaller tornado) is sufficiently small. However, a source of water should be available to provide long-term core cooling.

Similarly, it is not necessary to protect the radioactive liquid waste holdup tanks since, even in the event of gross failure, the spills would be limited to small amounts of waste and would be expected to be collected in the building foundations, which are designed for that purpose.

Structures, systems, and components important to safety that should be designed to withstand the effects of a Design Basis Tornado are those necessary to ensure:

1. The integrity of the reactor coolant pressure boundary.

2. The capability to shut down the reactor and maintain it in a safe shutdown condition.

3. The capability to prevent accidents that could result in potential offsite exposures that are a significant fraction of the guideline exposures of 10 CFR Part 100, "Reactor Site Criteria." Designs that differ substantially from those now in use may require reevaluation with respect to this objective.

The physical separation of redundant or alternative structures or components required for the safe shutdown of the plant is generally not considered an acceptable method for protecting against tornado effects, including tornado-generated missiles.

C. REGULATORY POSITION

The appendix to this guide lists those structures, systems, and components, including their foundations and supports, that should be designed to withstand the effects of a Design Basis Tornado (see Regulatory Guide 1.76), including tornado missiles, without loss of capability to perform their safety function.

Those portions of structures, systems, or components whose continued function is not required but whose failure could reduce to an unacceptable safety level the functional capability of any plant feature included in the items listed in the appendix should be designed and constructed so that the effects of the Design Basis Tornado would not cause failure (for example, of the containment walls).

D. IMPLEMENTATION

The purpose of this section is to provide information to applicants regarding the NRC staff's plans for using this regulatory guide.

Except in those cases in which the applicant proposes an acceptable alternative method for complying with specified portions of the Commission's regulations, the method described herein will be used in the evaluation of construction permit applications docketed after February 15, 1977.

If an applicant wishes to use this regulatory guide in developing submittals for applications docketed on or before February 15, 1977, the pertinent portions of the application will be evaluated on the basis of this guide.

APPENDIX

MINIMUM STRUCTURES, SYSTEMS, AND COMPONENTS TO BE PROTECTED AGAINST TORNADOES

1. The reactor coolant pressure boundary.*

2. Those portions of the main steam and main feedwater systems in PWRs up to and including the outermost isolation valves.

3. The reactor core and reactor vessel internals.

4. Systems** or portions of systems that are required for (1) reactor shutdown, (2) residual heat removal, (3) cooling the spent fuel storage pool, or (4) makeup water for the primary system and all systems that are necessary to support these systems, e.g., service water, cooling water source, component cooling, and auxiliary feedwater.

5. The spent fuel storage facility to the extent necessary to preclude significant loss of watertight integrity of the storage pool and to prevent missiles from contacting fuel within the pool.

6. The reactivity control systems, e.g., control rod drives and boron injection system.

7. The control room, including its associated vital equipment, cooling systems for the vital equipment and life support systems, and any structures or equipment inside or outside the control room whose failure could result in an incapacitating injury to individuals occupying the control room.

8. Those portions of the gaseous radwaste treatment system that by design are intended to store or delay gaseous radioactive waste and portions of structures housing these systems, including isolation valves, equipment, interconnecting piping, and components located between the upstream and downstream valves used to isolate these components from the rest of the system, e.g., charcoal delay tanks in BWRs and waste gas storage tanks in PWRs.

9. Systems or portions of systems that are required for (1) monitoring systems important to safety and (2) actuating and operating systems important to safety.

10. All electric and mechanical devices and circuitry between the process sensors and the input terminals of the actuator systems involved in generating signals that initiate protective action.

11. Those portions of the long-term emergency core cooling system that would be required to maintain the plant in a safe condition for an extended time after a loss-of-coolant accident.

12. Primary reactor containment and other safety-related structures such as the control room building and auxiliary building to the extent that they not collapse. The primary containment need not necessarily maintain its leaktight integrity under pressure loadings due to the pressure differentials developed by the tornado, but the structure should be designed to withstand penetration by tornado-borne missiles that could jeopardize safety-related structures, systems, and components within the containment.

13. The Class 1E electric systems, including the auxiliary systems for the onsite electric power supplies, that provide the emergency electric power needed for the functioning of plant features included in items 1. through 11. above.

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*As defined in §50.2 of 10 CFR Part 50.

**The system boundary includes those portions of the system required to accomplish the specified safety function and connecting piping up to and including the first valve (including a safety or relief valve) that is either normally closed or capable of automatic closure when the safety function is required.