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REGULATORY GUIDE

OFFICE OF STANDARDS DEVELOPMENT

REGULATORY GUIDE 1.13

SPENT FUEL STORAGE FACILITY DESIGN BASIS

A. INTRODUCTION

* General Design Criterion 61, "Fuel Storage and Handling Criteria for Nuclear Power Plants," of Appendix A, "General Design Criteria for Nuclear Power Plants," to 10 CFR Part 50, "Licensing of Production and Utilization Facilities," requires that fuel storage and handling systems be designed to assure adequate safety under normal and postulated accident conditions. It also requires that these systems be designed with appropriate containment, confinement, and filtering systems and be designed to prevent significant reduction in the coolant inventory of the storage facility under accident conditions. This guide describes a method acceptable to the NRC staff for implementing this criterion.

B. DISCUSSION

It is important that fuel handling and storage facilities be designed to:

a. Prevent loss of water from the fuel pool that would uncover fuel.

b. Protect the fuel from mechanical damage.

c. Provide the capability for limiting the potential offsite exposures in the event of significant release of radioactivity from the fuel.

If spent fuel storage facilities are not located within the primary reactor containment or provided with adequate protective features, radioactive materials could be released to the environs as a result of either loss of water from the storage pool or mechanical damage to fuel within the pool.

1. Loss of Water from Storage Pool

Unless protective measures are taken, loss of water from a fuel storage pool could cause overheating of the spent fuel and resultant damage to fuel cladding integrity and could result in release of radioactive materials to the environment. Natural events, such as earthquakes or high winds, could damage the fuel pool either directly or by the generation of missiles. Earthquakes or high winds could also cause structures, cranes, etc., to fall into the pool. Designing the facility to withstand these occurrences without significant loss of watertight integrity would alleviate these concerns.

Dropping of heavy loads, such as a 100-ton fuel cask, although of low probability, cannot be ruled out in plant arrangements where such loads are positioned or moved in or over the fuel pool. Possible solutions to this potential problem include (1) preventing, preferably by design rather than interlocks, heavy loads from being lifted over the pool; (2) using a highly reliable handling system designed to prevent dropping of heavy loads as a result of any single failure; or (3) designing the pool to withstand dropping of the load without significant leakage from the pool area in which fuel is stored.

Even if the measures described above to prevent loss of leak-tight integrity are followed, small leaks may still occur as a result of structural failure or other unforeseen events. For example, equipment failures in systems connected to the pool could result in loss of water from the pool if such loss is not prevented by design. A permanent fuel-pool-coolant makeup system with a moderate capability, and with suitable redundancy or backup, could prevent the fuel from being uncovered if

*Lines indicate substantive changes from previous issue.

such leaks should occur. Early detection of pool leakage and fuel damage could be provided by pool-water-level monitors and radiation monitors designed to alarm both locally and in a continuously manned location. Timely operation of building filtration systems can be assured by actuating these systems by a signal from local radiation monitors.

2. **Mechanical Damage to Fuel**

The release of radioactive material from fuel may occur during the refueling process, and at other times, as a result of fuel-cladding failures or mechanical damage caused by the dropping of fuel elements or the dropping of objects onto fuel elements.

Missiles generated by high winds can also be a potential cause of mechanical damage to fuel. Designing the fuel storage facility to prevent such missiles from contacting the fuel would eliminate this concern.

A relatively small amount of mechanical damage to the fuel might cause significant offsite doses if no dose reduction features are provided. Use of a controlled leakage building surrounding the fuel storage pool, with associated capability to limit releases of radioactive material resulting from a refueling accident, appears feasible and would do much to eliminate this concern.

C. REGULATORY POSITION

1. The spent fuel storage facility (including its structures and equipment except as noted in paragraph 6 below) should be designed to Category I seismic requirements.

2. The facility should be designed (a) to keep tornadic winds and missiles generated by these winds from causing significant loss of watertight integrity of the fuel storage pool and (b) to keep missiles generated by tornadic winds from contacting fuel within the pool.

3. Interlocks should be provided to prevent cranes from passing over stored fuel (or near stored fuel in a manner such that if a crane failed, the load could tip over on stored fuel) when fuel handling is not in progress. During fuel handling operations, the interlocks may be bypassed and administrative control used to prevent the crane from carrying loads that are not necessary for fuel handling over the stored fuel or other prohibited areas. The facility should be designed to minimize the need for bypassing such interlocks.

4. A controlled leakage building should enclose the fuel pool. The building should be equipped with an appropriate ventilation and filtration system to limit the potential release of radioactive iodine and other radioactive materials. The building need not be designed to withstand extremely high winds, but leakage should be suitably controlled during refueling operations. The design of the ventilation and filtration system should be based on the assumption that the cladding of all of the fuel rods in one fuel bundle might be breached. The inventory of radioactive materials available for leakage from the building should be based on the assumptions given in Regulatory Guide 1.25, "Assumptions Used for Evaluating the Potential Radiological Consequences of a Fuel Handling Accident in the Fuel Handling and Storage Facility for Boiling and Pressurized Water Reactors" (Safety Guide 25).

5. The spent fuel storage facility should have at least one of the following provisions with respect to the handling of heavy loads, including the refueling cask:

a. Cranes capable of carrying heavy loads should be prevented, preferably by design rather than by interlocks, from moving into the vicinity of the pool; or

b. Cranes should be designed to provide single-failure-proof handling of heavy loads, so that a single failure will not result in loss of capability of the crane-handling system to perform its safety function; or

c. The fuel pool should be designed to withstand, without leakage that could uncover the fuel, the impact of the heaviest load to be carried by the crane from the maximum height to which it can be lifted. If this approach is used, design provisions should be made to prevent the crane, when carrying heavy loads, from moving in the vicinity of stored fuel.

6. Drains, permanently connected mechanical or hydraulic systems, and other features that by maloperation or failure could cause loss of coolant that would uncover fuel should not be installed or included in the design. Systems for maintaining water quality and quantity should be designed so that any maloperation or failure of such systems (including failures resulting from the Safe Shutdown Earthquake) will not cause fuel to be uncovered. These systems need not otherwise meet Category I seismic requirements.

7. Reliable and frequently tested monitoring equipment should be provided to alarm both locally and in a continuously manned location if the water level in the fuel storage pool falls below a predetermined level or if high local-radiation levels are experienced. The high-radiation-level instrumentation should also actuate the filtration system.

8. A seismic Category I makeup system should be provided to add coolant to the pool. Appropriate redundancy or a backup system for filling the pool from a reliable source, such as a lake, river, or onsite seismic Category I water-storage facility, should be provided. If a backup system is used, it need not be a permanently installed system. The capacity of the makeup systems should be such that water can be supplied at a rate

determined by consideration of the leakage rate that would be expected as the result of damage to the fuel storage pool from the dropping of loads, from earthquakes, or from missiles originating in high winds.*

*The staff is considering the development of additional guidance concerning protection against missiles that might be generated by plant failures such as turbine failures. For the present, the protection of the fuel pool against such missiles will be evaluated on a case-by-case basis.

D. IMPLEMENTATION

Any of the alternatives in Regulatory Position C.5 of Revision 1 may be applied at the option of applicants for construction permits and operating licenses for all plants, regardless of the date of application.