U.S. NUCLEAR REGULATORY COMMISSION

STANDARD REVIEW PLAN

OFFICE OF NUCLEAR REACTOR REGULATION

15.7.5 SPENT FUEL CASK DROP ACCIDENTS

REVIEW RESPONSIBILITIES

Primary - Accident Evaluation Branch (AEB)

Secondary - Auxiliary Systems Branch (ASB)
Effluent Treatment Systems Branch (ETSB)

I. AREAS OF REVIEW

The review under this SRP section covers the radiological consequences of the release of fission products from irradiated fuel in a spent fuel cask that is postulated to drop during cask handling operations. SRP Section 15.7.4 covers the radiological consequences of fuel handling accidents in which an object is dropped onto irradiated fuel resulting in the release of fission products from the stored fuel. SRP Section 15.7.4 also includes the consequences of a fuel cask dropping or tipping onto irradiated fuel in the spent fuel pool.

The ASB evaluates the spent fuel cask handling system under SRP Section 9.1.4. The AEB reviewer, as explained below, will verify various design and operations aspects of the system with the ASB as a secondary review branch. The points covered in the AEB review are as follows:

1. ASB is consulted to verify the potential drop height during handling of a loaded cask and the procedures for handling the cask with respect to the impact limiter. If the handling procedures meet all applicable criteria, then the radiological consequences of a spent fuel cask drop accident need not be estimated.

2. A design basis radiological analysis is performed if a cask drop exceeding 30 feet can be postulated or if limiting devices are removed during cask handling within the plant so the 30-foot drop height is exceeded. If the radiological consequences of a cask drop accident are to be computed, then information on whether building leaktightness can be expected after a cask drop is obtained from ASB (e.g., whether the technical specifications require large doors to be closed during fuel handling or whether ventilation

systems should be operating and whether the building leaktightness would be violated by the cask drop).

3. The SAR and technical specifications are reviewed and the relevant plant parameters are evaluated for incorporation into the dose computation model. The model incorporates conservative transport mechanisms and rates from the fuel release to the atmosphere, suitable breathing rates, dose conversion factors, and other data that may affect the dose. The X/Q data are obtained from the assigned meteorologist.

4. The Effluent Treatment System Branch (ETSB) provides the filter efficiencies for the ESF atmospheric cleanup systems to AEB for use in the analysis of the radiological consequences resulting from spent fuel cask drop accidents. This is a secondary review effort by ETSB.

5. The calculated doses are compared with exposure guidelines to determine the acceptability of the exclusion area and low population zone (LPZ) distances and to confirm the adequacy of engineered safety features (ESF) provided for the purpose of mitigating potential doses from spent fuel cask drop accidents.

6. ASB is consulted for verification that a cask drop or tipping will not damage fuel in either the spent fuel storage building or in the containment building, if applicable. If the handling procedures are such that spent fuel can be damaged, an analysis of the resulting offsite doses will be performed under SRP Section 15.7.4.

II. ACCEPTANCE CRITERIA

The AEB acceptance criteria for this SRP section are based on the requirements of 10 CFR Part 100 (Ref. 1) with respect to the calculated radiological consequences of a spent fuel cask drop accident and General Design Criterion 61 (Ref. 2) with respect to appropriate containment, confinement and filtering systems.

1. The plant site and dose mitigating ESF systems are acceptable with respect to the radiological consequences of a postulated spent fuel cask drop accident if the calculated whole-body and thyroid doses at the exclusion area and low population zone boundaries are well within the exposure guideline values of 10 CFR Part 100, paragraph 11. "Well within" means 25 percent or less of the 10 CFR Part 100 exposure guideline values, i.e., 75 rem for the thyroid and 6 rem for the whole-body doses.

2. The radioactivity control features of the fuel storage and spent fuel cask handling system in the fuel building are acceptable if they meet the requirements of General Design Criterion 61, "Fuel Storage and Handling and Radioactivity Control," (Ref. 2) with respect to appropriate containment, confinement and filtering systems.

3. The model for calculating the whole-body and thyroid doses is acceptable if it incorporates the appropriate conservative assumptions in Regulatory Guide 1.25 (Ref. 3) with respect to gap inventory as stated in positions C.1.d,e, and f of the guide. The acceptability of the atmospheric dispersion factors, X/Q values, is determined under SRP Section 2.3.4.

4. An ESF grade atmospheric cleanup system is required for the fuel handling building to reduce the potential radiological consequences of the fuel cask drop accident.

5. The plant design with regard to spent fuel cask drop accidents is acceptable without calculation of radiological consequences if potential cask drop distances are less than 30 feet and appropriate impact limiting devices are employed during cask movements, as determined by ASB.

III. REVIEW PROCEDURES

The reviewer selects and emphasizes specific aspects of this SRP section as are appropriate for a particular plant. The areas to be given attention and emphasis in the review are determined by the similarity of the information provided in the SAR to that recently reviewed on other plants and whether items of special safety significance are involved.

Upon request from the AEB reviewer, the ASB and ETSB as secondary review branches will provide input for the areas of review stated in subsection I of this SRP section. The AEB reviewer obtains and uses such input as required to assure that this review procedure is complete.

The first step in the review procedure is to determine, with the assistance of the ASB as described in subsection I, whether radiological consequences of a spent fuel cask drop accident need be evaluated. If a radiological consequence calculation is found to be necessary, the procedure is as follows:

1. The fuel element gap inventory is determined in a manner similar to that for a fuel handling accident (see Ref. 3). The differences are that a longer decay time is allowed (earliest time after reactor fueling that cask loading operations commence) and the number of fuel elements involved is based on the largest capacity cask available or projected to be available.

2. If the drop is assumed to occur inside the refueling facility at a time when the facility is closed, and ESF-grade charcoal filtration is available, credit may be allowed for iodine filtration. For the filters themselves, verification of acceptability and efficiencies is provided by the ETSB. In a dual containment design where the fuel building may be exhausted through the standby gas treatment system (SGTS), AEB determines the relationship of the operational modes of the SGTS to the time sequence of the accident in order to give proper credit.

3. If the spent fuel drop is assumed to occur at a time when the facility is open to the outside atmosphere, an untreated puff release is assumed.

4. If a spent fuel cask is utilized in a containment structure which is not isolated during fuel cask transfer and ASB has determined that cask drop or tipping on spent fuel can occur, the radiological doses from all failed fuel will be evaluated.

5. The assigned meteorologist furnishes suitable X/Q values to determine the consequences of the accident. X/Q values are obtained for the exclusion area boundary and the boundary of the LPZ.

6. The relevant plant parameters and the X/Q values are used to compute doses. The doses due to a postulated spent fuel cask drop accident are calculated at the exclusion area boundary and the boundary of the LPZ.

7. The calculated doses are compared with the acceptance criteria in subsection II. Where results of the dose calculations indicate the guidelines may be exceeded, the applicant will be requested to modify the design or procedures which would reduce the doses to acceptable levels.

IV. EVALUATION FINDINGS

The reviewer verifies that sufficient information has been provided by the applicant and the staff's independent dose calculations to support conclusions of the following type, to be included in the staff's safety evaluation report for the case that the cask drop height is 30 feet or more:

> The staff finds that the applicant has provided an adequate system to mitigate the radiological consequences of a postulated spent fuel cask drop accident in the fuel building. The staff concludes that the spent fuel cask drop accident is acceptable and meets the relevant requirements of General Design Criterion 61. This conclusion is based on the following:
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> The staff concludes that the distances to the exclusion area and to the low population zone boundaries for the (INSERT PLANT NAME) site, in conjunction with the operation of dose mitigating ESF and implementation of plant procedures, are sufficent to provide reasonable assurance that the calculated offsite radiological consequences of a postulated spent fuel cask drop accident are well within the 10 CFR Part 100 exposure guidelines.
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> The staff's conclusion is based on (1) the staff's determination that the design features and plant procedures at the (INSERT PLANT NAME) facility meet the requirements of General Design Criterion 61 with respect to radioactivity control; (2) the staff review of the applicant's assumptions and analyses of the radiological consequences from the spent fuel cask drop accident and (3) the staff's independent analysis using conservative assumptions including those in Regulatory Guide 1.25 Position C.1.d, e, and f with respect to gap inventory.

If the cask drop height is less than 30 feet, this will be stated in the AEB Safety Evaluation Report, but no evaluation finding with respect to radiological consequences need be included.

V. IMPLEMENTATION

The following provides guidance to applicants and licensees regarding the staff's plans for using this SRP aection.

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 by the staff in its evaluation of conformance with Commission regulations.

Implementation schedules for conformance to parts of the method discussed herein are contained in the referenced regulatory guides.

VI. REFERENCES

1. 10 CFR Part 100, §100.11, "Determination of Exclusion Area, Low Population Zone, and Population Center Distance."

2. 10 CFR Part 50, Appendix A, General Design Criterion 61, "Fuel Storage and Handling and Radioactivity Control."

3. 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."