

## **5.0 NUCLEAR CRITICALITY SAFETY**

### **5.1 REGULATORY REQUIREMENTS**

The regulatory basis for the review of Virgil C. Summer Nuclear Station (VCSNS) nuclear criticality safety (NCS) is contained in Title 10 of the *Code of Federal Regulations* (10 CFR) 70.22, "Contents of Applications;" 10 CFR 70.23, "Requirements for the Approval of Applications;" 10 CFR 70.24, "Criticality Accident Requirements;" and 10 CFR 70.52, "Reports of Accidental Criticality."

### **5.2 REGULATORY ACCEPTANCE CRITERIA**

The acceptance criteria for the U.S. Nuclear Regulatory Commission's (NRC's) Part 70 review of VCSNS's NCS program for Units 2 and 3 are outlined in Section 5.4 of NUREG-1520, Rev. 1 (NRC, 2010). The staff determined that few of the acceptance criteria in NUREG-1520 were applicable to the Part 70 operations proposed at VCSNS and, therefore, limited the review to that necessary to assure compliance with the applicable 10 CFR Part 70 requirements noted previously.

### **5.3 STAFF REVIEW AND ANALYSIS**

South Carolina Electric and Gas (SCE&G) has submitted a combined operating license (COL) application for two new advanced pressurized light water reactors (AP1000s) to be designated VCSNS Units 2 and 3. This review is to focus on criticality safety for the receipt, possession, inspection, and storage of special nuclear material (SNM) in the form of fresh fuel assemblies as applicable under 10 CFR Part 70. The operations relevant to the Part 70 portion of the license include the uncrating and inspection of the fuel assemblies and storing them in the new fuel racks and spent fuel storage pool prior to loading into the reactor. The applicant has prepared a Final Safety Analysis Report (FSAR) (SCE&G, 2011) to be consistent with NUREG-0800, "Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants: LWR Edition" (NRC, 2007). Consistent with the format of that guidance, Section 9.1 of the FSAR discusses criticality safety of fresh and spent fuel storage and handling.

A COL applicant may reference a standard design certification in accordance with 10 CFR 52.55(c). On that basis, SCE&G referenced Westinghouse's AP1000 Design Control Document (DCD) (Westinghouse, 2011) in its COL application for VCSNS Units 2 and 3. On January 27, 2006, NRC issued the final design certification rule for the AP1000 design in the *Federal Register* (71 FR 4464). NUREG-1793, "Final Safety Evaluation Report Related to Certification of the AP1000 Standard Design," (NRC, 2004), documented the NRC staff's approval of the AP1000 design. Westinghouse has since revised the DCD (currently at Rev. 19); and the NRC has similarly completed Supplement 2 to NUREG-1793 evaluating the DCD, through Rev. 19, and which is pending publishing at this time (see Agencywide Documents Access and Management System [ADAMS] Accession Nos. ML111920459 and ML112061231).

The Fuel Cycle Safety and Safeguards's (FCSS) staff reviewed the criticality safety summaries, evaluations, and conclusions in Supplement 2 of NUREG-1793 (NRC, 2011), Sections 9.1.1.2.3 and 9.1.2.2.4. These sections present the Office of New Reactor (NRO) staff's criticality safety review of the AP1000 fuel storage and handling capabilities for fresh fuel and spent fuel. Included in the evaluation were seismic considerations, dropped loads, and fuel placement outside of the designated storage locations—as well as the evaluations required to be compliant

with 10 CFR 50.68. It was noted that the spent fuel pool has two regions with differing rack designs: Region 1 is qualified for the storage of 243 fresh fuel assemblies of 4.95 percent assay; while fuel stored in the Region 2 portion will be limited to a combination of initial enrichment and burnup as specified in Section 3.7.12 of the Technical Specifications. Fuel assembly loading into Region 2 would be administratively controlled. For this reason, the licensee is expected to utilize the fresh fuel storage pit/racks, as well as Region 1 racks, in the spent fuel pool for the initial fuel storage. The evaluations presented encompass criticality safety considerations for fresh fuel handling and storage under Part 70. The FCSS staff concur with the general conclusion that subcriticality will be assured during fresh fuel handling and storage operations as the applicant meets General Design Criteria 62, as it relates to the prevention of criticality by physical systems or processes using geometrically safe configurations and will be compliant with 10 CFR 50.68.

Sections 9.1.1.2.3.2 and 9.1.2.2.4.2 of Supplement 2 of NUREG-1793 (NRC, 2011a) includes statements that compliance with regulatory requirements under 10 CFR 50.68 was either verified or satisfied. After discussing with NRO's staff, the FCSS staff concluded that, as specified in 10 CFR 70.24(d)(1) and 10 CFR 50.68(a), the requirements of 70.24 will not apply because VCSNS Units 2 and 3 elected to comply with 10 CFR 50.68(b).

Finally, the staff determined that reporting compliant with 10 CFR Part 70.52 would be self evident and no elaboration in the application should be required to assure compliance with those regulations.

#### **5.4 EVALUATION FINDINGS**

The information submitted by the applicant and reviewed by the staff assures the applicant's equipment, facilities and procedures will be adequate to assure subcriticality of the fresh fuel consistent with 10 CFR 70.23(a)(3) and (4), thus adequately protecting health and minimizing danger to life or property.

Also, pursuant to 10 CFR 70.24(d)(1), "the requirements in paragraphs (a) through (c) of this section do not apply to a holder of a construction permit or operating license for a nuclear power reactor issued under Part 50 of this chapter or a combined license issued under Part 52 of this chapter, if the holder complies with the requirements of paragraph (b) of 10 CFR 50.68." In accordance with 10 CFR 50.68(b)(6), radiation monitors will be provided in the storage and associated handling areas when fuel is present.

The staff finds that the applicant's nuclear criticality safety program with respect to the initial fresh fuel elements for the first reactor core, as described in its application and in the staff's Final Safety Evaluation Report, is adequate to protect the environment and the health and safety of the public, complies with regulatory requirements in 10 CFR Parts 50 and 70 referenced above, adequately addresses the applicable acceptance criteria in Section 5.4.3.2 of NUREG-1520, Rev. 1; and is, therefore, acceptable to the staff.

#### **5.5 REFERENCES**

(NRC, 2004) U.S. Nuclear Regulatory Commission, NUREG-1793, "Final Safety Evaluation Report Related to Certification of the AP1000 Standard Design," September 2004.

(NRC, 2007) U.S. Nuclear Regulatory Commission, NUREG-0800, "Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants: LWR Edition," 2007.

(NRC, 2010) U.S. Nuclear Regulatory Commission, NUREG-1520, Rev.1, "Standard Review Plan for the Review of a License Application for a Fuel Cycle Facility," 2010.

(NRC, 2011) U.S. Nuclear Regulatory Commission, NUREG-1793, "Final Safety Evaluation Report Related to Certification of the AP1000 Standard Plant Design," Supplement 2, ADAMS Accession No. ML112061231, August 2011.

(SCE&G, 2011) South Carolina Electric and Gas, "V.C. Summer Nuclear Station Units 2 and 3 COLA (Final Safety Analysis Report)," Rev. 5, ADAMS Accession No. ML11187A074, 2011.

(Westinghouse, 2011) Westinghouse Electric Company, AP1000 Design Control Document, Rev. 19, ADAMS Accession No. ML11171A500, June 21, 2011.