INTRODUCTION

On October 31, 2002, Duke Cogema Stone and Webster (DCS or the applicant), a limited liability company, submitted to the U.S. Nuclear Regulatory Commission (NRC) a revised request to construct a Mixed Oxide (MOX) Fuel Fabrication Facility (MFFF or the facility) on the U.S. Department of Energy's (DOE) Savannah River Site (SRS) in Aiken, South Carolina. DCS is a DOE contractor. If its revised construction authorization request is approved, DCS plans to submit to the NRC a request for a license to possess and use special nuclear material (SNM). In support of its revised construction authorization request, DCS had previously submitted several items to the NRC, including a Quality Assurance Plan, Revision 3 (dated March 26, 2002) and a revised Environmental Report (dated July 11, 2002).

The revised construction authorization request (CAR) replaces, in its entirety, the CAR submitted by DCS on February 28, 2001. The purpose of this revised CAR is to describe changes necessary to process plutonium feed materials from DOE sources other than the Pit Disassembly and Conversion Facility (PDCF), incorporate information previously provided in DCS' response to NRC's requests for additional information and provide additional information to address open items identified in NRC's Draft Safety Evaluation Report, dated April 30, 2002.

If approved by the NRC, MFFF would be a key asset of DOE's Surplus Plutonium Disposition Program (SPDP), which is being implemented as a result of a bilateral agreement with the Russian Federation. Pursuant to this agreement, the U.S. and the Russian Federation would each convert 37.5 tons (34 metric tons) of weapons-grade plutonium (declared excess to national security needs) into forms less usable in nuclear weapons. As part of the SPDP, surplus U.S. weapons-grade plutonium would be converted into MOX fuel, and irradiated in commercial reactors to produce electricity. Following irradiation, the resulting spent fuel would contain plutonium in a form less usable in nuclear weapons.

The MFFF would consist of three major functional areas: 1) shipping and receiving; 2) aqueous polishing where the plutonium dioxide would be purified; and 3) MOX production where the fuel pellets, fuel rods, and fuel assemblies would be fabricated. The facility would receive depleted uranium (DU) dioxide (DUO_2) and plutonium dioxide (PuO_2), purify the PuO_2 to remove impurities such as gallium and americium, fabricate MOX fuel, containing uranium and plutonium dioxides, assemble fuel rods and fabricate fuel assemblies. The completed fuel assemblies would be subsequently irradiated in commercial nuclear power plants authorized by the NRC to use MOX fuel.

Under the applicable 10 CFR Part 70 requirements, before a license to possess and use SNM may be issued, the NRC must first authorize construction of the facility. This revised draft safety evaluation report (DSER) documents the NRC staff's review of the revised CAR and supplemental supporting information provided by the applicant. This revised DSER only addresses regulatory requirements for approval of construction, and does not address operational aspects of the proposed facility.

The following discussion summarizes the regulatory requirements applicable to the NRC staff's review of the revised CAR. In this regard, 10 CFR 70.23(b) states that NRC will approve construction of a plutonium processing and fuel fabrication facility if it finds that the design bases of the principal structures, systems and components (PSSCs) and the quality assurance

(QA) program provide reasonable assurance of protection against natural phenomena and the consequences of potential accidents. The revised DSER discusses the applicant's selection of design basis functions and values and how the applicant determined that the design bases will provide reasonable assurance of protection against natural phenomena and the consequences of potential accidents. Each revised DSER chapter contains one or more of the NRC staff's 10 CFR 70.23(b) safety findings on the applicable PSSCs and design bases being evaluated. Whether the staff's preliminary safety findings are positive or negative depends on the nature and extent of the relevant unresolved technical issues (designated in the revised DSER as "open" issues or items).

Regarding the term "design bases," NRC stated in a letter to DCS dated October 26, 1999, that the design basis definition in 10 CFR 50.2 will be applied to the proposed facility. Section 50.2 of 10 CFR defines design basis as:

> Design basis means that information which identifies the specific functions to be performed by a structure, system, or component of a facility, and the specific values or range of values chosen for controlling parameters as reference bounds for design. These values may be (1) restraints derived from generally accepted "state of the art" practices for achieving functional goals, or (2) requirements derived from analysis (based on calculation and/or experiments) of the effects of a postulated accident for which a structure, system, or component must meet its functional goals.

Other 10 CFR Part 70 requirements applicable to authorizing construction of the facility are discussed below. Section 70.64(a) lists baseline design criteria (BDC) covering ten design issues: (1) quality standards and records; (2) natural phenomena hazards; (3) fire protection; (4) internal environmental conditions and dynamic effects; (5) chemical protection; (6) emergency capability; (7) utility services; (8) inspection, testing and maintenance; (9) criticality control; and (10) instrumentation and controls. In revised DSER sections where one or more of the BDC are applicable, the staff states whether or not the facility preliminary design satisfies the BDC, pursuant to 10 CFR 70.64(a). The staff's revised DSER describes how these BDC requirements are satisfied by the proposed facility design bases. The BDC specify design features that are required and acceptable under the conditions specified in 10 CFR 70.64(a).

Under 10 CFR 70.64(b), the facility design and layout must be based on defense-in-depth practices. As used in 10 CFR 70.64, defense-in-depth practices at new facilities means a design philosophy, applied from the outset and through completion of the design, that is based on providing successive levels of protection such that health and safety will not be wholly dependent upon any single element of the facility design. The net effect of incorporating defense-in-depth practices is a conservatively designed facility that will exhibit greater tolerance to failures and external challenges. In revised DSER Chapter 5, the staff discusses whether or not the facility preliminary design is properly based on defense-in-depth practices.

Section 70.64(b) of 10 CFR further requires that, to the extent practicable, the facility design must incorporate (1) a preference for engineered controls over administrative controls, to increase overall system reliability; and (2) features that will enhance safety by reducing challenges to items which will be relied upon for safety. In revised DSER Chapter 5, the staff discusses whether or not the facility preliminary design adequately incorporates a preference for engineered controls over administrative controls, and whether design features will adequately enhance safety.

In Section 5.5.5 of the revised CAR, the applicant describes its general design philosophy and defense-in-depth practices used in formulating the preliminary design of the facility. Pursuant to 10 CFR 70.64(b), in order to ensure that engineered controls are relied upon over administrative controls, to the extent practicable, DCS states it has established a hierarchy of controls. In further adherence to 10 CFR 70.64(b), DCS states it has incorporated defense-in-depth practices in its preliminary facility design. In Section 5.5.5.2 of the revised CAR, DCS states that it has incorporated defense-in-depth practices through use of the double contingency principle for protection against criticality events, and use of the single failure criterion. Under the latter criterion, DCS states that for the PSSCs it has identified, each is required to be capable of carrying out its function in the event any single active component fails, whether such failure occurs within the applicable system, or in an associated system that supports the component's operation. In Section 5.5.5.4 of the revised CAR, DCS states that the BDC are incorporated into the facility design. The NRC staff evaluates these DCS statements in the revised DSER .

As discussed below, the set of requirements contained in 10 CFR §§ 70.61(b-d) and (f) are also applicable to authorizing construction of the facility. Pursuant to the 10 CFR 70.61(b-d) performance requirements, the risk of accidents at the proposed facility must be limited. To properly determine the nature of such risks, and whether the proposed facility design effectively controls such risks, requires an evaluation of the safety assessment of the design bases submitted by DCS for construction approval. In revised DSER Chapter 5, the staff reviews the methodology used by DCS in performing the safety assessment of the facility design bases, to determine if the safety assessment adequately considered all appropriate natural phenomenon, external man-made, and internal process hazards. Identifying -- and later implementing -- the required controls to meet the 10 CFR §§ 70.61(b)-(d) performance requirements ensures that an acceptable level of risk will be maintained during any facility operation. DCS may satisfy these performance requirements through a combination of limiting the chance that accidents at the facility would occur (prevention), and reducing the consequences of such events (mitigation). To approve the revised CAR, the staff will need to find that the DCS safety assessment describes an adequate strategy which, if effectively applied, will ensure that the 10 CFR § 70.61 performance requirements will be met, should the facility later be authorized to operate.

Section 70.61(b) of 10 CFR sets forth the performance requirements for "credible high-consequence event[s]," *i.e.*, potential accidents involving high levels of radiation or hazardous chemicals, and its provisions pertain to the protection of both on-site workers and off-site individuals. Section 70.61(b) requires the use of controls sufficient to either make the occurrence of such accidents "highly unlikely," or make the consequences of such accidents less severe than (1) an acute 100 rem total effective dose equivalent (TEDE) to a "worker" (defined term in 10 CFR § 70.4); (2) an acute 25 rem TEDE to a person outside the "controlled area" (a defined term in 10 CFR 20.1003, which DCS is required to designate for the proposed facility pursuant to 10 CFR § 70.61(f)); (3) an intake of 30 mg of soluble uranium to a person outside the controlled area; or (4) either an acute chemical exposure that could endanger the life of a worker, or an acute chemical exposure that could lead to irreversible or other serious long-lasting health effects to a person outside the controlled area. See 10 CFR § 70.61(b)(1-4).

Section 70.61(c) of 10 CFR sets forth the performance requirements for "credible intermediate-consequence event[s]," *i.e.*, potential accidents involving lower levels of radiation or hazardous chemicals than referenced in 10 CFR § 70.61(b), and its provisions pertain to environmental protection as well as to protecting the health of on-site workers and off-site individuals. Section 70.61(c) requires the use of controls sufficient to either make the occurrence of such accidents "unlikely," or make the consequences of such accidents less severe than (1) an acute 25 rem TEDE to a worker; (2) an acute 5 rem TEDE to a person outside the controlled area; (3) 24 hour average release of radioactive material outside the "restricted area" (defined term in 10 CFR 20.1003) into the environment in concentrations exceeding 5000 times the values in Table 2 of Appendix B to 10 CFR Part 20; or (4) either an acute chemical exposure that could lead to irreversible or other serious long-lasting health effects to a worker, or an acute chemical exposure that could cause mild transient health effects to a person outside the controlled area. *See* 10 CFR § 70.61(c)(1-4).

Section 70.61(d) of 10 CFR sets forth the performance requirements applicable to nuclear criticality accidents, which are discussed in revised DSER Chapter 6. Under § 70.61(d), the risk of such accidents is limited by requiring the use of an approved margin of subcriticality for safety. Additionally, preventive -- rather than mitigative -- measures and controls must be the primary means of protection against nuclear criticality accident.

Two sections of 10 CFR § 70.61 are not yet applicable to DCS, as they reference 10 CFR § 70.62 safety program requirements which apply to the evaluation of applications for 10 CFR Part 70 licenses to possess and use SNM. Section 70.61(a) references the integrated safety analysis (ISA) requirements set forth in 10 CFR § 70.62(c), under which DCS must later show that it would be in compliance with the above-described performance requirements during any facility operations. Similarly, 10 CFR § 70.61(e) also references the 10 CFR § 70.62 safety program, and requires that each control identified by DCS to meet the performance requirements be designated as an "item relied on for safety" (IROFS). Each IROFS must be available and reliable to perform its intended function when needed. Pursuant to 10 CFR § 70.65, DCS must list all IROFS in its ISA summary, which is submitted as part of its application for a 10 CFR Part 70 license to possess and use SNM.

In the revised CAR, the applicant has evaluated PSSCs primarily at the systems level, and the identified PSSCs are primarily design features/administrative controls that are to be implemented in the final design as IROFS, pursuant to 10 CFR 70.61(e). NUREG-1718, "Standard Review Plan for the Review of an Application for a Mixed Oxide (MOX) Fuel Fabrication Facility" (SRP), defines PSSCs as "safety controls that are identified in the design bases as providing protection against the consequences of accidents or natural phenomena." The SRP further states that designating a control as a PSSC "is effectively synonymous with designating that control as an IROFS." The staff used the August 2000 SRP as guidance in performing its review of the revised CAR and its supporting information. The definition of IROFS in 10 CFR 70.4 states in relevant part that IROFS are "structures, systems, equipment, components, and activities of personnel that are relied on to prevent potential accidents at a facility that could exceed the performance requirements in [10 CFR] 70.61 or to mitigate their potential consequences." As stated in the 10 CFR Part 70 Subpart H rulemaking (Reference I.1), IROFS may be described at the systems level, provided that there is enough detail to understand the function of the system in relation to the performance requirements. Accordingly, as discussed in the revised DSER chapters below, the staff finds it acceptable to identify PSSCs at the systems level. Revised DSER Table 5-2 summarizes each PSSC identified by DCS, the safety functions of each PSSC, and the design bases associated with the PSSCs. As indicated above, the IROFS identified in any subsequent DCS application for an SNM possession and use license would be expected to contain more component-level controls as part of the facility's final design.

Management measures, as defined in 10 CFR 70.4, will be applied to IROFS to assure that they are available and reliable to perform their functions when needed. The ISA summary, the IROFS identified therein, and management measures will be evaluated when the staff reviews any subsequent DCS application for an SNM possession and use license. However, for purposes of determining whether, pursuant to 10 CFR 70.23(b), the applicant's QA program provides reasonable assurance of protection against natural phenomena and the consequences of potential accidents, an evaluation of the management measures described in revised CAR Chapter 15 is set forth in revised DSER Chapter 15.0.

REFERENCE

I.1 Federal Register Notice, Vol. 65, No. 181, September 18, 2000; FRN 56213

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