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U.S. Nuclear Regulatory Commission
Attn.: Document Control Desk
Washington, DC 20555

Docket No.72-11
Rancho Seco Independent Spent Fuel Storage Installation
License No. SNM-2510

SPECIAL REPORT REGARDING A VIOLATION OF 10 CFR PART 72 TECHNICAL SPECIFICATION 2.1.1

Attention: Randy Hall

Rancho Seco Independent Spent Fuel Storage Installation (ISFSI) Technical Specification Section 2.1.1 "Fuel Stored at the ISFSI" states that only "intact" spent fuel assemblies may be placed in an FO-DSC[1] or FC-DSC[2]. Technical Specification Section 1.1 defines an intact fuel assembly as an assembly with no known or suspected cladding defects greater than hairline cracks or pinhole leaks. A fuel assembly with known or suspected cladding defects greater than hairline cracks or pinhole leaks must be stored in an FF-DSC[3].

On November 6, 2006, Rancho Seco management determined that, contrary to Technical Specification Section 2.1.1, at least one fuel assembly stored in an FC-DSC appears to have cladding damage greater than a hairline crack. Five other assemblies, stored in FC-DSCs, were also identified as having the potential for having cladding damage greater than a hairline crack or pinhole leak. Technical Specification Section 2.2.1 states that if the limits of Technical Specification Section 2.1.1 are violated, notify the NRC Operations Center within 24 hours and, within 30 days, submit a special report describing the cause of the violation, actions taken to restore compliance, and actions taken to prevent recurrence.

Accordingly, the District notified the NRC Operations Center on the afternoon of November 6, 2006, and is submitting the attached special report.

[1] Fuel Only Dry Shielded Canister (FO-DSC)
[2] Fuel with Control Component Dry Shielded Canister (FC-DSC)
[3] Failed Fuel Dry Shielded Canister (FF-DSC)

IE72

If you, or members of your staff, have questions requiring additional information or clarification, please contact Bob Jones at (916) 732-4843.

Sincerely,

Steve Redeker
Manager, Plant Closure & Decommissioning

Cc: Randy Hall, NRC Headquarters
NRC, Region IV

Attachment

Non-conformance

Rancho Seco Independent Spent Fuel Storage Installation (ISFSI) Technical Specification Section 2.1.1 "Fuel Stored at the ISFSI" states that only "intact" spent fuel assemblies may be placed in an FO-DSC[1] or FC-DSC[2]. Technical Specification Section 1.1 defines an intact fuel assembly as an assembly with no known or suspected cladding defects greater than hairline cracks or pinhole leaks. A fuel assembly with known or suspected cladding defects greater than hairline cracks or pinhole leaks must be stored in an FF-DSC[3].

On November 6, 2006, Rancho Seco management determined that, contrary to Technical Specification Section 2.1.1, at least one fuel assembly stored in an FC-DSC appears to have cladding damage greater than a hairline crack. Five other assemblies, stored in FC-DSCs, were also identified as having the potential for having cladding damage greater than a hairline crack or pinhole leak. The six assemblies are stored in five FC-DSCs. Technical Specification Section 2.2.1 states that if the limits of Technical Specification Section 2.1.1 are violated, notify the NRC Operations Center within 24 hours and, within 30 days, submit a special report describing the cause of the violation, actions taken to restore compliance, and actions taken to prevent recurrence.

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Cause

The procedure used to inspect and classify fuel, Rancho Seco Administrative Procedure RSAP-0112 "Fuel Assembly Visual Inspections," was inconsistent with 10 CFR Part 72 Technical Specification Section 2.1.1. The pre-fuel loading administrative checks that were performed in 2000 to verify that all Technical Specifications were met did not identify that the fuel inspection procedure used to inspect the fuel in 1996 was not consistent with the Technical Specifications.

There were contributory factors. It is suspected that the reason RSAP-0112 was not reviewed prior to fuel loading is that it had been voided in 1997, after the fuel inspection was complete and all records produced had been filed. The Special Nuclear Materials Custodian retired in late 1998, after the issuance of the fuel loading plans. This individual had been the custodian for over ten years, had developed the fuel inspection criteria, and was personally involved in the fuel inspection/classification. Turnover to the subsequent custodian apparently did not emphasize classification or loading requirements for fuel,

[1] Fuel Only Dry Shielded Canister (FO-DSC)
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since the classifications were completed, the procedure voided, and the canister loading schemes finalized.

The lack of an industry-wide definition of damaged fuel during the initial fuel assembly inspection in 1996, compounded by revised definitions in 1997 through 2000, contributed to the discrepancy between the initial inspection criteria and the eventual definition of intact fuel in the 10 CFR Part 72 Technical Specifications. The industry standards at the time of the initial fuel inspection were vague and there was no clear definition of what constituted "damaged" fuel. Until 1998 -1999, the definition of damaged fuel or intact fuel was more broadly defined as those assemblies with minor defects, that could be greater than hairline cracks or pinhole leaks, as long as there was no credible potential for the loss of fuel material or catastrophic failure of a fuel pin.

Background

In 1996, a visual inspection of the Rancho Seco spent nuclear fuel was performed in accordance with Rancho Seco Administrative Procedure RSAP-0112 "Fuel Assembly Visual Inspections." This inspection was performed to assess the condition of the fuel and to determine the extent of cladding damaged on the visible fuel pins.

Five classifications were assigned to the fuel inspection criteria as follows:

1. Class A fuel: No defective fuel and no questionable observations

2. Class B fuel: Fuel shows spacer grids or end fitting damage

3. Class C fuel: Questionable pin observations not meeting defective fuel criteria F1 or F2

4. Class F2 fuel: Gross cladding failures where such breeches are greater than 25% of the circumference of the pin and at least the length of a fuel pellet (i.e., $\approx$ 0.34 inches across the cladding and 0.7 inches along the cladding).

5. Class F1 fuel: Assemblies that are structurally deformed to the extent that special handling may be required. Also, any fuel assembly with more than 15 visible failed fuel pins.

The results of the inspection were used to determine which assemblies would be inserted into the "failed" fuel canister (FF-DSC). The conclusion of the fuel inspection resulted in 9 fuel assemblies being classified as F2. This was documented in Rancho Seco memo RWC 96-014, dated July 16, 1996, and in Potential Deviation from Quality PDQ 96-0047. All fuel inspections were systematically videotaped and are currently in records storage.

Shortly after the fuel inspection, EPRI was contracted to perform an independent review and assessment of the fuel inspection and its results. EPRI reviewed the fuel inspection tapes and, based on the criteria in RSAP-0112, one more assembly was added to the list of assemblies with Class F2 gross cladding failures. With this additional fuel assembly, a total of 10 assemblies were specifically earmarked for insertion into the FF canister.

The initial fuel inspection was performed during the time period when the NRC was reviewing the 10 CFR Part 71 Safety Analysis Report (SAR) for the MP187 transportable storage cask and 10 CFR Part 72 SAR for the site-specific Rancho Seco ISFSI license. The inspection criteria in RSAP-0112 were based upon the best available guidance at the time. These guidelines, regulations, and commitments evolved over time and are discussed below.

Chronology of Damaged Fuel Criteria

1995 - The first noted clarification of cladding failure was documented in SMUD letter MPC&D 95-053, dated April 6, 1995, in response to an NRC Request for Additional Information (RAI). On page 12 of the letter, SMUD made the following response:

> *A gross cladding failure is a localized loss or peeling of cladding material of a fuel pin that represents a credible potential loss of fuel material or catastrophic failure of a pin. Such breeches would be greater than 25% of the circumference of the pin and at least the length of a fuel pellet...*

1996 – RAI dated September 27, 1996: As part of their review of the 10 CFR Part 71 SAR, the NRC requested a description of the physical condition of the damaged fuel to be loaded. The response to this RAI could not be located.

1997 - NUREG-1536 'Standard Review Plan for dry cask storage systems," dated January 1997, loosely defined gross cladding defect but leaves the responsibility to the licensee for meeting its design-basis criteria for dry cask storage. The definition of "intact cladding" is cladding that does not have gross cladding defects and the "gross cladding defect" definition states, in part:

> *A known or suspected cladding condition that results in the fuel not meeting its design-basis criteria for dry cask storage. The cask shielding, criticality, thermal, and radiological design analyses typically assume that the cladding provides sufficient structural integrity to retain the fuel pellets in the fuel assembly geometry for normal and accident conditions.*

1998 – NRC issued Interim Staff Guidance (ISG-1) "Damaged Fuel," Revision 0 which defines damaged fuel as:

> *Spent nuclear fuel with known or suspected cladding defects greater than hairline crack or a pinhole leak.*

1999 – Revision 4 to the 10 CFR Part 72 ISFSI SAR included changes to SAR Section 10.3.1 "Spent Fuel Specifications." The revision to Section 10.3.1.1 "FO and FC Fuel Specifications" deleted the discussion of the operating limits that defined which fuel assemblies could be placed in an FO- or FC-DSC. The revision to Section 10.3.1.1 also deleted Footnote 1, which defined intact fuel as:

> *Intact fuel assemblies include those with minor cladding damage, including pinhole leaks and hairline cracks, provided that the cladding integrity is sufficient to prevent significant fuel particle release.*

Instead, the revised Section 10.3.1.1 provided a reference to Technical Specification Section 2.1.1, which now contained the discussion of a damaged fuel assembly as having known or suspected cladding defects greater than hairline cracks or pinhole leaks.

2002 – The NRC issued Interim Staff Guidance (ISG-1) Revision 1 which expanded the definition of damaged fuel. Damaged fuel assemblies now include:

- Cladding damage greater than pinhole leaks or hairline cracks
- Cladding or structural component degradation
- Missing or displaced spacer grids
- Altered assemblies that compromised the structural integrity
- Assemblies not capable of being handled and moved by normal means

ISG-1, Revision 1 also provided an alternative (performance based) method for classifying spent fuel. A fuel assembly classified as damaged under the guidance in ISG-1 could be analyzed against the storage and transportation conditions to determine if it can treated as intact fuel. Such analysis must demonstrate with reasonable assurance that the damaged assembly can withstand those conditions without loss of cladding confinement capability or becoming reconfigured.

Investigation

Based on the differences in the definition of damaged fuel in RSAP-0112 and in the final definition in the 10 CFR Part 72 Technical Specifications, it was determined that a potential existed that damaged assemblies may have been placed in a fuel canister licensed only for intact assemblies.

The potential problem existed with fuel assemblies that had been categorized as class "C." Class C assemblies were those assemblies that did not meet the criteria for category F2 assemblies (i.e., Class C assemblies did not have cracks that exceeded dimensions of approximately 0.34 inches across and 0.7 inches high). Flaws not meeting both dimensional criteria for F2 fuel assemblies were noted as "non-dimensional" cracks and therefore would not have had any restrictions on the type of canister into which they could be placed. Accordingly, the focus of the investigation was on those assemblies that

could contain flaws that exceeded pinholes and hairline cracks but were less that 0.34 inches across or less than 0.7 inches high.

Based upon a re-review of the videotapes for the class C fuel assemblies, six fuel assemblies were identified as potentially having flaws greater than pinholes leaks or hairline cracks. Five assemblies have an indication of one pin with one flaw and one assembly has indications of one flaw in each of two pins.

With the exception of one fuel assembly (assembly 2G6), the video portion of the tape is not conclusive that a crack greater than a hairline exists. The film quality is generally not sufficiently clear to provide evidence on its own merit. Assembly 2G6 appears to be damaged because a crack can be seen on a corner fuel pin from two different angles. Based upon the video images of assembly 2G6, the crack on this assembly was scaled to be approximately 0.04 inches wide by 0.25 inches long. The film quality of the remaining 5 assemblies is not sufficient to provide such detailed scaling or to differentiate between cladding damage vs. discoloration of the cladding surface.

Evaluation of Safe Storage

Based on the nature, extent, and quantity of clad defects of the six fuel assemblies (using worst-case assumptions), as well as the storage of more significantly damaged assemblies in the FF-DSC and the static nature of storage, it is concluded that there is no imminent concern for the continued safe storage of the fuel in a non FF-DSC.

The design of fuel assemblies with integrated spacer grids provides an inherently robust configuration that precludes damage during storage conditions. Although the defects in the subject fuel pins are larger than allowed by the Technical Specifications, they are still relatively small. There is no credible mechanism that would result in the loss of fuel pellets during storage. The much larger defects found in the fuel assemblies stored in the FF-DSC have never resulted in the loss of fuel pellets up to and during canister loading. This lack of fuel pellet loss was confirmed during the draining of the fuel pool, refueling canal, and reactor vessel during decommissioning because no fuel pellets were discovered at final drain down. Design loads during storage conditions are minimal and will not result in credible failures. The design loads considered during transportation, including transportation accidents, are much more severe and will be evaluated.

Another significant consideration is that the functional design differences between the FF-DSC and the FO- and FC-DSCs relate not to storage but to transportation and individual fuel assembly handling during canister loading and unloading operations. The FF-DSC has individual internal removable sleeves for each fuel assembly with bottom screens and a top closure to limit movement of loose fuel pellets from up to 15 fuel pins. The sleeves also allow handling assemblies that may have structural damage that prevents handling them "bare." None of the six assemblies has structural or cladding damage that could be expected to result in loose pellets. The total number of pins affected in any FC-DSC canister is two or fewer thus is bounded by the loose fuel pellet analysis (15 pins) performed for the FF-DSC.

The District, along with the canister designer, is proceeding to evaluate the long-term aspects of continued safe storage and eventual transportation of the affected canisters.

Actions Taken to Restore Compliance

An alternative to placing some forms of damaged fuel only into a damaged-fuel-can is allowed by ISG-1, Revision 1, when it can be shown through analysis that the assembly in question is capable of withstanding all design loads without reconfiguring. Such an analysis, and acceptance by the NRC, could provide the basis for an amendment to the Technical Specifications or some other administrative resolution. SMUD and TransNuclear (the dry fuel storage/transportation system vendor) will address the impact relative to the storage and transportation licenses.

Actions Taken to Prevent Recurrence

No action is required to prevent recurrence since all Rancho Seco spent nuclear fuel is stored in the ISFSI and no additional fuel will be stored there. However, as a result of determining that at least one fuel assembly with cladding damage greater than a hairline crack is stored in an FC-DSC, all of the 10 CFR Part 72 Technical Specification spent fuel limits were reviewed. The review is summarized below.

The 10 CFR Part 72 ISFSI Technical Specifications provide the limits for spent fuel stored at the ISFSI. Technical Specification Table 2-1 provides the spent fuel limits, as follows:

Technical Specification Table 2-1

CHARACTERISTIC	VALUE
Fuel design	B&W 15X15
Minimum Cooling Time After Discharge	7 years
Maximum Decay Heat per DSC including control components	13.5 kW
Maximum Enrichment	3.43%
Maximum Burn-up	38,268 MWd/MTU
Cladding Material	Zircaloy-4

The fuel design and cladding material are fixed for the B&W fuel assemblies stored and cannot be altered. The cooling time is satisfied because the plant was shut down in 1989, with fuel loading beginning in April 2001, for 12 years of minimum cooling time. The maximum decay heat for a DSC was 9 kW as of December 1999, which was the time of the last formal calculation prior to loading this canister. The maximum enrichment of the

fuel is 3.43%. The maximum burn-up is 38,268 MWd/MTU for fuel assemblies OEM, OEL, OEJ, and OEH. All other assemblies have lower burn-up.

Technical Specification Table 2-2 lists the allowed control components.

Technical Specification Table 2-2

Fuel Assembly Control Components

1. Control Rod Assemblies
2. Axial Power Shaping Rod Assemblies
3. Burnable Poison Rod Assemblies
4. Neutron Sources
5. Retainer Clips
6. Orifice Rod Assemblies

Placement of these components was controlled by step-by-step procedures that were performed by trained and qualified personnel supervised by a Certified Fuel Handler.

The 10 CFR Part 71 Certificate of Compliance (C of C) also contains limits on the spent fuel that can be transported in the MP187 cask. The results of the review of the limits in the Part 71 C of C are discussed in the disposition to PDQ 05-0003. In addition, SMUD and Transnuclear will address the impact relative to the storage and transportation conditions to determine if the identified fuel aseemblies can treated as intact fuel.

Accordingly, with the exception of the identified non-compliance with Technical Specification 2.1.1, the Rancho Seco spent fuel is stored in accordance with Technical Specification requirements and remains safely stored at the ISFSI.