

January 29, 2004

MEMORANDUM TO: Glenn M. Tracy, Director
Division of Nuclear Security
Office of Nuclear Security and Incident Response

FROM: Joseph W. Shea, Project Director */RA/*
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SUBJECT: REVIEW PLAN FOR EVALUATING THE PHYSICAL SECURITY
PROTECTION MEASURES NEEDED FOR MIXED OXIDE FUEL AND
ITS USE IN COMMERCIAL NUCLEAR POWER REACTORS

PURPOSE

This review plan provides guidance to the Nuclear Regulatory Commission (NRC) staff in the Office of Nuclear Security and Incident Response (NSIR), who will perform safeguards and security reviews of license applications to possess and use mixed oxide (MOX) fuel in a power reactor.

BACKGROUND

As part of the ongoing Surplus Plutonium Disposition Program of the United States and the Russian Federation, NRC licensees may participate in the Department of Energy (DOE) Surplus Plutonium Disposition Project, whereby excess plutonium will be disposed of by fabrication into MOX fuel assemblies and irradiation in power reactors.

For example, by letter dated February 27, 2003, Duke Energy Corporation (Duke Energy) submitted an application for amendments to the operating licenses for the McGuire Nuclear Station, Units 1 and 2 and the Catawba Nuclear Station, Units 1 and 2. The proposed amendments would revise the Technical Specifications to allow the use of four MOX fuel Lead Test Assemblies (LTAs) at either Catawba or McGuire. By letter dated September 23, 2003, Duke Energy amended the February 27, 2003, application so that it now applies only to the Catawba Nuclear Station in York County, South Carolina.

By letter dated September 15, 2003, Duke Energy supplemented its February 27, 2003, application by submitting a proposed revision to the physical security plan and a request for exemptions from certain regulations in 10 CFR Part 11 and Part 73 for the Catawba and McGuire stations. In accordance with NRC letter dated October 31, 2003, the staff review and findings regarding the submittal dated September 15, 2003, will be applicable only to the LTA program at Catawba.

REGULATORY ANALYSIS

Pursuant to 10 CFR 73.6, nuclear power reactors licensed under 10 CFR Part 50 possessing Special Nuclear Material (SNM) in certain forms are currently exempt from the physical protection requirements of 10 CFR 73.20, 73.25, 73.45 and 73.46, and thus are not subject to the requirements of 10 CFR 11.11(a). The specific forms of SNM at power reactor sites that are exempt include: (1) uranium enriched to less than 20% in the uranium-235 isotope, (2) SNM that is not readily separable from other nuclear material and which has an external dose rate of 100 rem per hour at a distance of 3 feet, (3) SNM in a quantity not exceeding 350 grams of uranium-235, uranium-233, plutonium, or any combination thereof, and (4) SNM that is being transported by the DOE transport system. Licensees proposing to irradiate MOX fuel in commercial power reactors will not meet the exemption criteria stated in 10 CFR 73.6 because the plutonium content in the MOX fuel exceeds the 350 grams criterion mentioned above. Consequently, licensees planning to irradiate MOX fuel will likely request relief from certain regulations in 10 CFR Parts 11, "Criteria and Procedures for Determining Eligibility for Access to or Control Over Special Nuclear Material," and 73, "Physical Protection of Plants and Materials."

Requests for relief from Part 11, "Criteria and Procedures for Determining Eligibility for Access to or Control Over Special Nuclear Material," will be evaluated against the standard specified in 10 CFR 11.9, "Specific Exemptions," which states, in relevant part, that "The Commission may, upon application of any interested party, grant an exemption from the requirements of this part. Exemptions will be granted only if they are authorized by law and will not constitute an undue risk to the common defense and security."

Requests for relief from Part 73, "Physical Protection of Plants and Materials," will be evaluated against the standard specified in 10 CFR 73.5, "Specific Exemptions," which states, "The Commission may, upon application of any interested person or upon its own initiative, grant such exemption from the requirements of the regulations in this part as it determines are authorized by law and will not endanger life or property or the common defense and security, and are otherwise in the public interest."

TECHNICAL ANALYSIS

In accordance with 10 CFR 73.2, the material in the MOX fuel assemblies is a formula quantity of Strategic Special Nuclear Material (SSNM) due to the plutonium (Pu) content. However, the staff's assessment is that the MOX material, while meeting the criteria of a formula quantity, is not attractive to potential adversaries from a proliferation standpoint due to its low plutonium concentration, composition, and form. The SSNM material consists of Pu oxide particles dispersed in a ceramic matrix of depleted uranium with a plutonium concentration of less than six weight percent. The MOX fuel will be packaged in standard fuel assemblies designed for a commercial light water power reactor, which are over 12 feet long and weigh approximately 1500 pounds. A large quantity of MOX fuel and an elaborate extraction process would be required to accumulate enough material to fabricate an improvised nuclear device or weapon. Therefore, the MOX fuel assemblies represent a significantly less attractive theft or diversion target from a proliferation standpoint compared to the materials at the Category I fuel fabrication facilities.

Current NRC regulations for plutonium do not distinguish between the composition (e.g., pure Pu product, >85% assay, versus material with low Pu concentration) or form (e.g., metals and oxides versus fuel assemblies). The concept of attractiveness in the NRC regulations relates to uranium and enrichment, as opposed to plutonium. Therefore, the staff position is that subjecting MOX fuel at power reactor sites to all the requirements associated with Category I SNM is neither appropriate nor necessary. Consequently, this technical basis will also be used to evaluate requests for relief from 10 CFR Part 11.

To inform the evaluation of the use of MOX fuel at power reactors, the staff referred to related DOE requirements (DOE Manual 474.1-1B, *Manual for Control and Accountability of Nuclear Materials*, dated June 13, 2003) that utilize a "graded safeguards" approach. This graded safeguards approach provides the greatest amount of protection and control to the most attractive material (e.g., the types and quantities of SNM that can be most effectively used in a nuclear explosive device). The safeguards categorization for Pu, defined in DOE Manual 474.1-1B, is based upon the economic and strategic value, and consequences of loss. According to DOE references, the fresh MOX fuel assemblies with an SNM content less than 10% would be designated as a DOE Category II quantity of Attractiveness Level D (low-grade) material. Also, per the DOE Manual 474.1-1B, Attractiveness Level D SNM would not be considered DOE Category I.

SIMILAR REGULATORY APPROACHES

The NRC previously considered SNM composition and form (attractiveness) in order to determine material categorization level and thus, establish the physical protection requirements in connection with an exemption request. Specifically, on January 19, 1989, the NRC issued an exemption to the Public Service Company of Colorado, operators of the Fort St. Vrain Nuclear Generating Station. The exemption and associated license amendments dealt with physical protection and security personnel performance regulations and its design basis threat for fuel facilities possessing formula quantities of SSNM to require protection equivalent to that in place at comparable DOE fuel facilities. The Commission noted that although Fort St. Vrain used highly enriched uranium fuel, it was not subject to the safeguards requirements for licensed fuel facilities possessing formula quantities of SSNM. The technical bases for this exemption were documented, in part, as "... the extensive processing required to yield weapons usable material, the weight of the fuel elements, and the low concentration of uranium."

In another case, NRC in conjunction with DOE, considered material form at the Portsmouth Gaseous Diffusion Plant, X-326 facility. In 1999, the facility operator (United States Enrichment Corporation) requested that the NRC allow them to operate as a Category III facility. This request was technically based on the fact that uranium oxide was scattered throughout the processing facility in the form of holdup (material left after the process was cleaned). Even though the total quantity of holdup material in this facility was in fact a formula quantity, the material was not an attractive target (not easily collected and removed). Therefore, the NRC issued a condition to the existing facility Certificate, specifying Category III safeguards, along with additional safeguards and security controls. The staff intends to follow a similar approach in the review of safeguards for the receipt, handling, and storage of MOX fuel assemblies at commercial power reactors such as the Catawba Nuclear Station.

PROTECTION REQUIREMENTS

The requirements in 10 CFR 73.45, "Performance Capabilities for Fixed Site Physical Protection Systems," and 73.46, "Fixed Site Physical Protection Systems, Subsystems, Components, and Procedures," were intended for Category I fuel fabrication facilities and contain different requirements from those normally applied to commercial power reactor sites. The physical security requirements at Category I fuel cycle facilities differ because fuel cycle facilities possess formula quantities of SSNM in a variety of concentrated forms that could be easily concealed and transported. The physical security requirements at Category I fuel cycle facilities focus on the prevention of theft or diversion of SNM, whereas the focus of the physical protection at commercial power reactor sites is for the prevention of radiological sabotage.

Since the MOX fuel will be at a power reactor site, physical protection during the receipt, handling, and storage of the MOX fuel will occur in a physical protection environment that is currently subject to the requirements of 10 CFR 73.55, "Requirements for physical protection of licensed activities in nuclear power reactors against radiological sabotage," including additional compensatory measures and actions directed by recent orders. Overall compliance to 10 CFR 73.55 requirements and applicable orders are not part of this review. However, despite the low attractiveness of this material, supplemental measures are deemed necessary for the MOX fuel assemblies because safeguards to prevent theft or diversion are not currently explicitly required.

Based on the above considerations, the staff will use a graded approach to safeguards and security when evaluating requests for exemptions from 10 CFR 73.45 and 73.46 associated with the use of MOX fuel and when reviewing conforming changes to required site security plans. As such, appropriate protective measures may include administrative controls, procedural controls, physical controls, alarms and surveillance that in combination ensure that the threat of attempted theft and diversion or radiological sabotage associated with the use of MOX fuel is acceptably addressed. The proposed protection measures may vary for different aspects of the MOX fuel receipt, handling, and storage until the MOX fuel is irradiated, at a power reactor site. The various stages include: (1) when the fresh MOX fuel is received at the site, (2) while it is awaiting placement into the spent fuel pool, and (3) while it is stored in the pool prior to irradiation. These measures may include, but should not be limited to: the use of highly trained, armed DOE transportation personnel; physical barriers or locks to limit access; or security alarms and administrative controls to detect unauthorized access.

The purpose of these measures is to detect and assess unauthorized activities and/or access involving the fresh MOX fuel assemblies and provide a system to communicate the detection of such activities, so a timely response is initiated. The additional safeguards measures should provide an overall acceptable level of safeguards system performance for MOX fuel assemblies to prevent theft, diversion and radiological sabotage.

REVIEW CRITERIA

The NSIR staff review will focus on whether appropriate security measures are implemented for fresh MOX fuel. The following items will be evaluated for MOX fuel assemblies at a commercial power reactor site:

- Implementation of appropriate controls and procedures when fresh MOX fuel is received at the site
- Implementation of appropriate controls and procedures until fresh MOX fuel is transferred into the spent fuel pool.
- Implementation of the appropriate controls and procedures for fresh MOX fuel during storage in the spent fuel pool.
- Familiarization/training of personnel on the appropriate controls and procedures for fresh MOX fuel.
- Performance testing to validate whether controls for fresh MOX fuel are appropriate.

CONCLUSION

Based on satisfactory completion of the above activities, the NSIR reviewer should be able to conclude that the safeguards system in place for the MOX fuel assemblies will not endanger life or property or the common defense and security, and are otherwise in the public interest. The review will be focused on the additional safeguards measures in place due to the fresh MOX fuel from the time it is received on-site until it is irradiated in the reactor. The review will determine if the exemptions are authorized by law. The review will address the adequacy of any conforming changes to the required site security plans.

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G. Tracy

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