NRC INSPECTION MANUAL

INSPECTION PROCEDURE 69009

CLASS I RESEARCH AND TEST REACTOR FUEL MOVEMENT

PROGRAM APPLICABILITY: 2545

69009-01 INSPECTION OBJECTIVE

To determine whether fuel was inspected, handled and maintained as required, since the last inspection.

69009-02 INSPECTION REQUIREMENTS

02.01 Fuel Handling Procedures. Determine whether the licensee's fuel handling procedures are adequate to perform intended functions.

02.02 Fuel Handling and Inspection. Determine whether fuel is moved and inspected consistent with the requirements of the TS and the licensee's procedures.

02.03 Radiological Controls. Determine whether fuel handling activities are conducted in accordance with 10 CFR Part 20 and the licensee's procedures and programs for radiation protection.

02.04 Security Plan. Determine whether the licensee satisfied security plan requirements for fuel movement activities.

02.05 Fuel Movement Problem Resolution. Determine whether significant fuel movement or inspection problems are identified and resolved in accordance with the licensee's procedural controls.

02.06 Tests and Checks. Determine whether the licensee was within TS limits and met procedural requirements before resuming normal operation after fuel movement.

69009-03 INSPECTION GUIDANCE

General Guidance

Be aware of the facility's plans and schedules for refueling or other major fuel movement. It is not necessary to directly observe the entire fuel movement activity. However, observation of a portion of the fuel movement activities is desirable. Under no circumstances is the licensee to adjust schedules for these activities to fit the inspection schedule. At some facilities, the licensee may move fuel only once a year, which emphasizes the need to know the licensee's plans and schedules. Review the safety analysis report (SAR) or as-built facility descriptions, the TS, the licensee's procedure(s), and the Security Plan for fuel design information, fuel movement methods, and requirements. If practical, these documents may be reviewed prior to the onsite inspection. During the onsite inspection, be alert for significant differences in the SAR, or the TS descriptions of fuel and equipment as compared to the actual fuel and equipment. If such differences are identified, design change review and approval is required in accordance with 10 CFR 50.59 and the licensee's procedures. If differences are found, are they reflected in the as-built description of the facility?

For guidance on new, plate-type fuel refer to ANSI/ANS-15.2, "Quality Control for Plate Type Uranium Aluminum Fuel Elements," 1974, and Regulatory Guide 2.3, "Quality Verification for Plate-type Uranium-Aluminum Fuel Elements for Use in Research Reactors." General guidance may be found in the ANSI/ANS Standards listed in Appendix B to Inspection Procedure 69001, "Class II Research and Test Reactors." Additional general guidance may be found in the Division 2 Regulatory Guides, and the "Other Regulatory Guides of Possible Interest to Division 2 Recipients" listed in the Division 2 Regulatory Guides Table of Contents. Reference to this guidance is to aid in the technical evaluation of licensee programs and is not to be used as requirements unless the licensee has committed to them in writing.

The sample sizes in this inspection procedure are provided for broad planning purposes and to define the typical depth of the inspection. They are not intended to be rigid requirements on the inspector.

Specific Guidance

03.01 Fuel Handling Procedures. The licensee's fuel movement activities are governed by the licensee's procedures. These procedures may be written when needed rather than being standard procedures at facilities where refueling is infrequent or where the core configuration changes with each fuel movement. The use of approved procedures are required in accordance with TS and security plan requirements.

03.02 Fuel Handling and Inspection. Facilities use varying types of fuel, different fuel handling methods, and different tools. The observation of one fuel movement activity is an acceptable sample for this inspection requirement. If direct observation of a fuel movement activity is not possible at the time of inspection, verification of the final fuel location, the review of respective records, and discussions with personnel involved in the most recent fuel movement activity will provide an acceptable sample for inspection. Is the final location of the fuel consistent with that specified in the licensee's records?

Safe fuel handling includes assurance that the fuel is not damaged, that accidental criticality does not occur, and that radiation and contamination hazards are minimized. The failure of a fuel element can be dramatic. For example, a blister on a TRIGA fuel element of about ¾ of an inch in diameter developed a crack about ½ of an inch long at one facility. The first indication of this failure was a high air particulate alarm that required evacuation of the facility. Radioactivity in the water activity rose to about 0.2 microcuries per milliliter and airborne particulate activity was substantial.

The licensee is required to handle fuel in accordance with the TS and applicable procedures during refueling, fuel shuffling, and fuel inspection. It is important for participants to be trained and understand their tasks. Dry runs may be necessary for operations of potential safety concern or of an unusual nature. The dry runs normally include discussion of actions needed to avert or mitigate accidents. The licensee's fuel handling tools are required to be consistent with TS requirements and licensee procedures.

Fuel handling activities and procedures normally provide for:

a. Fuel transfer into a core configuration, or to racks or containers that have been designed to prevent accidental criticality. The threat of inadvertent criticality varies from facility to facility. Many Research and Test reactors are designed to be near the optimum size. This means that if the core had a greater or lesser number of fuel assemblies per unit volume, the shutdown margin would increase. However, the design may be such that additional moderation increases multiplication. Normally, removing fuel would provide more shutdown margin, but on a highly under moderated core, the water replacing the removed fuel rod adds more reactivity than the fuel removal takes away. While minimum critical volume varies considerably, the specific moderation, enrichment, poison and core structure may allow much less than a cubic yard of typical fuel and water to have a critical mass. For example, four fuel bundles in a line could be touching. Even under optimum moderation conditions this would present no problem, yet the same four bundles in a square matrix do pose a problem. Usually these concerns are minimized by transferring fuel to storage pits, racks, or containers that have been designed for the purpose, or by removing only one bundle at a time to be inspected underwater and then replaced before proceeding. The licensee's procedures generally require either the calculation of the minimum number of fuel bundles for a critical mass with optimum moderation, or that the bundles simply be separated by the use of fuel racks designed for this purpose.

b. Is neutron monitoring accomplished as required? When the licensee is changing the core configuration, procedures generally specify requirements for monitoring changes in the level of neutron flux. For example, when 1/M calculations are required, they are usually performed independently by more than one person.

c. The licensee is required to inspect fuel and control rods in accordance with the TS and their procedures. Some licensees may have TS requirements for the frequency of inspection based on time or pulsing criteria and some may have specific acceptance criteria such as fuel bow or elongation. The TS normally require the licensee to periodically inspect the fuel and visually determine its integrity. The facility may or may not have specific acceptance criteria. If there are no specific acceptance criteria for fuel inspection, the literature from the fuel supplier or the SAR may contain the information.

It is important for the licensee to check the control rods to determine their capability to continue to function. In most cases, if the rod or its linkage broke, it would fall in a safe position. However, some vane-type control blades might fall out of the core if broken. Since the rods are all roughly of the same design in a facility, a failure in one could indicate that another might fail by the same mechanism. Therefore, it is imperative that the licensee investigate and resolve such failures to insure that control rods perform their intended function to shut down the reactor. The observation of this type of problem resolution will satisfy the requirements of Section 02.05 above.

If an installed neutron source is removed during refueling, it is also important for the licensee to have provisions to inspect it for leakage paths such as splitting or pitting.

03.03 Radiological Controls. The observation of radiological controls during one fuel movement activity is an acceptable sample for this inspection requirement. If direct observation is not possible at the time of inspection, the review of radiation protection records and discussions with responsible personnel for the most recent fuel movement activity will provide an acceptable sample for inspection. Fuel movement can cause significant radiological hazards. A single fuel element can easily emit radiation at levels above 100 rem per hour at one foot. Radiation levels are related to power history and the decay time after shutdown. The movement of fuel also includes the requirement, in part, to maintain occupational doses as low as reasonably achievable (ALARA).

Completion of this portion of the inspection procedure does not supersede all of the requirements to examine the radiation controls in other inspection procedures. However, inspection effort in this area is not to be duplicated in other Class I Research and Test reactor inspection procedures. Credit may be taken for meeting respective requirements in Inspection Procedure 69012 “Class I Research and Test Reactors Radiation Protection” by performing this portion of the inspection.

Radiological controls during fuel handling activities include, but are not limited to, the following:

a. Monitoring or sampling for airborne radioactive particulate matter. Grab samples may substitute for continuous air monitors to verify compliance with 10 CFR Part 20 and the TS. Grab sampling is to be performed in accordance with approved licensee procedures.

b. Monitoring exits from controlled areas in accordance with the 10 CFR Part 20 and the licensee's procedural requirements. A Geiger Muller (GM) detector is normally used for exit surveys. If area radiation levels are so high that a difference of about 0.2 millirem per hour (mr/hr) cannot be detected, the detector area may need shielding or the controlled area should be extended to a low radiation area. An increase of 0.2 mr/hr generally represents contamination that would normally be considered gross contamination. 10 CFR Part 20, Subpart F requires surveys and ANSI/ANS 15.11, 1993 provides additional guidance in the section on "Radioactive Contamination Monitoring." 10 CFR Part 20, Subpart J provides the posting and labeling requirements for several radiation areas. Licensee procedures provide specific guidance for each facility.

c. Surveys for contamination are required to be performed in accordance with licensee procedures. The frequency for the performance of the surveys is specified in the licensee's procedures and is normally based on the potential hazard associated with fuel handling activities and the contamination levels of handled objects. It is also prudent for the licensee to consider the amount of traffic into and out of the controlled area. For example, if personnel enter the controlled area in the morning and do not leave until noon, it would be meaningless to perform surveys at the work exit area every two hours. However, if people are continuously entering and exiting the area to observe the work, it is necessary to check the work exit area for contamination when each one leaves. Are licensee personnel, tools and equipment surveyed for contamination upon exit of the work area?

d. Radiation areas are to be monitored in accordance with Subpart F of 10 CFR Part 20, the TS and the licensee's procedural requirements. Most facilities have continuous area radiation monitors with pre-set alarm set points. While these may be helpful, they may be an unnecessary nuisance by being set so low that procedures would require evacuation during even a well controlled situation. However, if the set point is too high, the potential exists for the overexposure of workers without the benefit of a warning. Acceptable set points and monitoring help the licensee to comply with 10 CFR Part 20 exposure limits and are consistent with ALARA requirements. Does the licensee survey periodically to determine whether actual radiation levels are consistent with area radiation monitors to avoid unnecessary or excessive exposures to individuals?

e. Personnel dosimetry is required by 10 CFR 20.1502 and is to be used as specified by the licensee's procedures. Licensee personnel are normally instructed to check direct reading dosimeters frequently. Are personnel monitoring devices, such as film badges, TLDs, direct reading dosimeters and extremity monitors, worn correctly and appropriate for expected radiation fields and the type of work to be done?

03.04 Security Plan. The observation of security controls during one fuel movement activity is an acceptable sample for this inspection requirement. If direct observation is not possible at the time of inspection, the review of records, and discussions with responsible personnel for the most recent fuel movement activity will provide an acceptable sample for this portion of the inspection.

The structural integrity of some reactors may be a required security barrier. While the reactor is dismantled during fuel movement, the defined security area and patrols is specified in the facility the security plan. Generally, new fuel is required to be kept in the security area and locked in a fuel vault or in some way secured so that it cannot not be carried away by hand. Spent fuel is normally controlled in storage racks in a spent fuel pool or in the reactor pool.

03.05 Fuel Movement Problem Resolution. The observation of the resolution of one fuel movement problem is an acceptable sample for this inspection requirement. If direct observation is not possible at the time of the inspection, problem areas may be identified by the review of the licensee's logs and records, and discussions with responsible personnel for the most recent fuel movement activity. The licensee is required to resolve identified problems (e.g., fuel integrity) to meet TS requirements.

03.06 Tests and Checks. The observation of one reactor startup, after fuel movement, is an acceptable sample for this inspection requirement. If direct observation is not possible at the time of inspection, the review of respective licensee logs and records, and discussions with responsible personnel for the most recent fuel movement activity will provide an acceptable sample for this inspection requirement. If the detailed records of the tests and checks were covered under the Inspection Procedure on "Class I Research and Test Reactor Surveillance", it need not be repeated here. Changes to core configuration may require calibration of control rods, and determination of excess reactivity and shutdown margin.

69009-04 RESOURCE ESTIMATE

For planning purposes, the direct inspection effort to complete this inspection procedure is estimated to be four hours. Actual inspection at any facility may require more or less effort depending on past inspection history, conditions at the facility, and safety significance of the inspection findings.

END