INSPECTION PROCEDURE 60801

SPENT FUEL POOL SAFETY AT PERMANENTLY SHUTDOWN REACTORS

PROGRAM APPLICABILITY: 2561

SALP FUNCTIONAL AREA: N/A

60801-01 INSPECTION OBJECTIVE

To verify the safe wet storage of spent fuel at permanently shutdown reactors.

60801-02 INSPECTION REQUIREMENTS

02.01 Siphon and drain protection. Evaluate the configuration of the spent fuel pool (SFP), SFP piping, and any interconnected piping systems to ascertain whether conditions represent a siphon or drain path. Assess licensee procedures to ensure that active or passive drain systems are properly maintained and temporary hoses are appropriately controlled. Assess the safety significance of the worst-case inadvertent siphon or drain event. Verify that appropriate compensatory measures, procedures, training, or engineered features have been implemented.

02.02 SFP instrumentation, alarms, and leakage detection. Review and evaluate whether the SFP instrumentation, alarms and leakage detection systems are adequate to assure the safe wet storage of spent fuel. This review should include SFP water level instrumentation, calibration, alarm setpoints, alarm response procedures, data taking and tending, and related operator rounds. SFP leakage collection systems, associated alarms, level and/or flow instrumentation and logging and trending of data should also be evaluated.

02.03 SFP chemistry and cleanliness control. Review the SFP chemistry and cleanliness control programs. Utilizing field observations and record reviews, verify satisfactory implementation of the programs as applied to systems and components necessary for safe spent fuel storage. Determine whether water purity standards, radionuclide concentration, and boron concentration (if applicable) are on accordance with technical specification (TS) requirements and docketed commitments. Ascertain whether the licensee's foreign

material exclusion, combustible material control, and SFP chemistry procedures adequately protects the integrity and cooling of spent fuel.

02.04 Criticality controls. Review and evaluate the licensee's controls for criticality monitoring of wet spent fuel storage. This assessment should include receipt, storage, and transfer records; inventory records; criticality geometry controls; soluble boron management and non-soluble poison design features; and, heavy load restrictions, worst-case drop analysis, and seismic considerations to prevent adverse geometry reconfiguration.

02.05 SFP Operation and Power Supply. Review licensee procedures, drawings, and Post-Shutdown Decommissioning Activities Report (PSDAR) descriptions regarding SFP operation and power supplies. Ascertain whether SFP operation is equivalent to that when the system was in operation during reactor power operations. Identify situations where differing operational strategies, system line-ups, etc. could be outside system design or be detrimental to long-term system operability or safe fuel storage. Assess the reliability of the SFP electrical power supply.

60801-03 INSPECTION GUIDANCE

General Guidance

This inspection procedure resulted, in part, from long-term actions taken by the NRC in response to Bulletin 94-01, "Potential Fuel Pool Draindown Caused by Inadequate Maintenance Practices at Dresden Unit 1," and a determination by the NRC staff that NRC inspection of power reactors undergoing decommissioning provides additional assurance that licensed activities will not be adverse to public health and safety. A primary objective of this inspection procedure (IP) is to verify that each licensee maintaining spent fuel in wet storage provides appropriate controls and maintains adequate systems to prevent adverse radiological conditions. This IP applies to all states of decommissioning from the permanent cessation of reactor operations until the fuel is safely transferred from the SFP to a independent spent fuel storage installation or other licensed fuel storage system.

The inspector is not required to complete all the inspection requirements listed in this IP nor is the inspector limited to those inspection requirements listed if safety concerns are identified. However, the objectives of this IP shall be met and the initial performance of this inspection shall be commensurate with the staff effort associated with the NRC's assessment of licensee performance regarding the safety concerns described in Bulletin 94-01. Subsequent inspections may be less comprehensive, based on the controls and adequacy of structures, systems, and components maintaining spent fuel integrity and radiation shielding. These latter inspections should correspond to the number of licensee modifications made, the extent of any SFP problems (including leakage), and any completed or planned fuel movements.

Temporary Instruction (TI) 2561/002 inspections provided a baseline review of the siphon and drain potential at most permanently shutdown reactors. When implementing this IP at these licensees, the inspector should examine any changes made to SFP systems and

interconnecting systems since the conduct of TI 2561/002. If TI 2561/002 has not been performed, this IP should be completed in its entirety to ascertain whether wet spent fuel storage is safe.

This IP tends to balance the relatively low safety significance of a loss of SFP cooling with providing adequate assurances through inspection and verification that spent fuel in wet storage is safe. The inspector should understand licensee evaluations, assumptions, and acceptance criteria regarding safe spent fuel storage and make conclusions based on, in part, the information provided in the Final Safety Analysis Report (FSAR), PSDAR, or discussions with the NRC staff.

Specific Guidance

03.01 Siphon and drain protection. The licensee should be knowledgeable of any potential siphon or drain paths and have plans or procedures that can identify, resolve, and minimize the probability of occurrence of an inadvertent/undetected drain or siphon. This and other considerations should have been documented by the licensee in their response to Bulletin 94-01. The licensee should have also summarized their SFP inventory management and emergency response strategies; addressed radiation protection and spent fuel cooling during abnormal situations; provided information on SFP leakage; and, detailed their siphon and draindown evaluations. In the case where the plant has been shutdown for a number of years, spent fuel cooling may no longer be a significant safety issue, therefore the licensee's response strategy could be focused primarily on minimizing radiation exposure. Bulletin 94-01 and Information Notices 93-83, 88-65, and 87-13 discuss some mechanisms for loss of SFP inventory and potential consequences.

If the bulletin response had not received NRC inspection, the inspector should review the licensee's response, verify implementation of docketed actions, and assess the license's safety evaluations. TI 2561/002 should be used as a guide.

The licensee should conduct appropriate training to respond and mitigate a loss of SFP inventory. Response actions should be commensurate with safety and maintaining radiation exposure as low as reasonably achievable (ALARA). The inspector should walkdown and inspect the SFP system (including all accessible points and liner penetrations) for material conditions and integrity; review any repairs conducted on the SFP liner; evaluate SFP system configuration control based on field conditions and licensing basis documentation; and, ascertain the seismic qualification of the SFP systems. Particular focus should be on the evaluation of system low points, active and passive drain pathways, primary and secondary makeup water supplies, and SFP boundary integrity control. The inspector should also assess the licensee's actions in response to a SFP zirconium fire resulting from a draindown of the SFP.

03.02 SFP instrumentation, alarms, and leakage detection. The SFP water level instrumentation and alarms should ensure that any significant loss of inventory will be promptly detected by operations personnel. Response to alarm procedures should require

a leakage assessment and contingency actions including makeup, cooling, and radiological considerations, as appropriate. The instrumentation and alarms should be periodically calibrated in accordance with the TSs, procedures, or Bulletin 94-01 response actions. Operator rounds and control room logs should provide a data base sufficient to identify SFP leakage problems. If installed, a SFP leakage collection system will usually be described in licensing basis documentation. If this system is alarmed, an instrument check and operability check of the instrumentation and alarms should be performed periodically. If the licensee uses operator rounds to survey the leakage collection volume, review the logged data, and assess the data trend.

Within the scope of this inspection, the inspector should evaluate the tests or analytical calculations performed to determine SFP leakage and evaporation rates. The assumptions in these tests and calculations should be assessed and evaluated. For example, a licensee may bound their analyses by a worst-case situation and normalized environmental conditions. These analyses may be described in the licensee's response to Bulletin 94-01. Although sound engineering practices may have been used by the licensee, the inspector should be particularly aware of any licensee assumptions, instrument accuracies, or surveillance frequencies that tend to mask or diminish calculational accuracy.

The inspector should also review data from the licensee's environmental monitoring program, if applicable, to determine if there are indications of SFP leakage into the environment. The inspector should communicate with the headquarters staff regarding findings involving ground water transport of radiological effluents from the SFP.

03.03 SFP chemistry and cleanliness control. SFP water purity, radionuclide, and dissolved boron limits will typically be stated in the TSs or docketed commitments. Water purity limits for pH, conductivity, chlorides, fluorides, and sulfates are generally stated in NRC requirements or in ANSI standards. The inspector should review the results of chemical analyses, evaluate the data, and assess identified trends. Although the scope of this chemistry review does not ascertain the rigor or technique of chemical analyses, the inspector should verify that standards, reagents, and analytical chemicals are in date and adequately controlled. The inspector should also verify that analytical equipment used for SFP chemistry analyses are calibrated and meet surveillance requirements. A primary focus of a SFP chemistry program should protect against inadvertent criticality (e.g., soluble boron analysis) and prevent an accelerated degradation of spent fuel and SFP liner integrity.

The inspector should ascertain whether the licensee has implemented a foreign materials exclusion control program or other housekeeping measure to provide assurance that the inadvertent introduction of foreign materials into the SFP is not adverse to the safe wet storage of spent fuel. These materials could either be chemical or mechanical in nature. Program considerations could include, in part, housekeeping, cleanliness boundaries, and administrative accountability of loose materials.

A tour of the SFP should be performed to ascertain the quality of housekeeping in and about the SFP. Particular attention should be focused on the identification of materials that do not add value to the safe storage of spent fuel. These materials could include, but are not limited to: heavy materials supported in the SFP from the SFP curb or rail without structural or seismic analysis; excessive combustible loading beyond that described in the Fire Hazards Analysis or Fire Protection Plan; clear plastic bags within the pool that could go undetected and reduce spent fuel channel cooling; and, uncontrolled material in or about the SFP that could chemically or mechanically degrade the fuel, SFP liner, or support systems. Further guidance regarding the storage of components on the inner sides of the SFP or hanging from the SFP curb or handrail can be found in Information Notice 87-13. Information in this notice includes a discussion of "short hangers" which involved the storage of highly irradiated materials above the top of the spent fuel. Inadequate control of highly irradiated components can represent a safety concern. Regulation Guide 8.38, "Control of Access to High and Very High Radiation Areas in Nuclear Power Plants," section C.4.2., provides additional information regarding controls for storage of materials in spent fuel pools.

03.04 Criticality controls. Generally, a variety of TS requirements and docketed commitments provides sufficient assurance that spent fuel storage will preclude criticality. These requirements and commitments could be described in the TSs, FSAR, PSDAR, or other licensee documents. Engineered design features that maintain acceptable geometry will generally involve fuel assembly rack spacing, boraflex or other permanent neutron absorbers (Generic Letter 96-04), and physical design features. Administrative considerations may include procedural precautions, instructions, water temperature control, and dual verifications for fuel loading and transfers. Seismic considerations and heavy load handling limitations (including bridge and crane interlocks) will generally be required to preclude a fuel handling event that has the potential for crushing fuel assemblies into a critical geometry.

During fuel transfers to independent spent fuel storage installations, close coordination with the Spent Fuel Project Office, NMSS, is required. As described in NMSS IP 60855, other design considerations and regulatory requirements are applicable during this type of fuel transfer. In particular, the safe transportation of spent fuel would be dependent on, in part, a well controlled and managed fuel loading schedule, timely draindown and cooling of spent fuel while in the interim fuel transfer casks, and heavy lift and load pathway considerations. The inspector may use IP 60855 or other NMSS IPs as guides, if necessary.

The inspection effort should assess licensee control of the heavy loads over the spent fuel. The inspector should review NUREG 0612, "Control of Heavy Loads at Nuclear Power Plants," and assess the quality of the licensee controls and procedures. Appropriate instructions, precautions, and prerequisites should be established to assure that TS requirements are met and the worst-case fuel damage and dose generation would not exceed safety and licensing analyses. An assessment should be performed to determine whether

the licensee appropriately changed their licensing basis based on changes in the worst-case drop analysis. For example, an original license safety evaluation report may not have reviewed the consequences of a spent fuel transfer cask drop in or about the vicinity of a spent fuel pool. The potential safety consequences of this occurrence could exceeded those associated with a spent fuel assembly drop accident.

03.05 SFP Operation and Power Supply. Based on lessons learned, the NRC staff has reviewed industry situations involving less than fully evaluated SFP operation and less than expected reliability of SFP electrical power supplies. For example, a loss of offsite power due to electrical storm caused one utility to lose all SFP indication and system power for a few hours. At two other utilities, dismantlement activities resulted in the temporary loss of electrical power until compensatory actions were implemented. At a another utility, biological growth within the SFP reflected poorly on spent fuel storage conditions. Although the NRC staff confirmed that these situations were not immediately adverse to the safe wet storage of spent fuel and that SFP operation was in accordance with licensed conditions, from a licensee performance perspective they demonstrated vulnerability.

One objective of this IP is to assess the functional operation and design of the SFP electrical systems. Therefore, the inspector should, if possible, obtain the SFP operation procedure from when the power reactor was in operation and vendor system design information and compare this information to the current SFP operation procedure in-use during decommissioning. Differences in operation should have been assessed and justified by the license as a potential 10 CFR 50.59 or defacto modification (reference Manual Chapter 2561, "Decommissioning Power Reactor Inspection Program," for the appropriate reference IP). The inspector should evaluate these changes to system operation and ascertain whether the changes were appropriate. For example, the licensee may: (1) excessively throttle SFP cooling discharge valves to minimize the SFP cooldown rate at the cost of accelerated seat and disk wear and flow cavitation; (2) remove electrical system loads and unknowingly cause higher operating voltages at SFP components and instrumentation resulting in electrical degradation; or, (3) curtail SFP ion exchanger and filter operation to minimize consumable and electrical consumption thereby degrading SFP chemistry and biological conditions.

60801-04 RESOURCE ESTIMATE

The initial semi-annual completion of this procedure (with no TI 2561/002 inspection) is estimated to require 32 onsite inspection hours semi-annually.

60801-05 REFERENCES

Bulletin 94-01: Potential Fuel Pool Draindown Caused by Inadequate Maintenance Practices at Dresden Unit 1 (NUDOCS MF 78923/034-044)

Information Notice 93-83: Potential Loss of Spent Fuel Pool Cooling Following a Loss of Cooling Accident (LOCA) (NUDOCS MF 76799/111-117)

Information Notice 90-33: Sources of Unexpected Occupational Radiation Exposures at Spent Fuel Storage Pools (NUDOCS MF 53742/100-202)

Information Notice 88-65: Inadvertent Drainages of Spent Fuel Pools (NUDOCS MF 69467/004-014)

Information Notice 87-13: Potential for High Radiation Fields Following Loss of Water from Fuel Pool (NUDOCS MF 39784/009-115)

IE Bulletin 79-24 (NUDOCS 04717/280)

ANSI/N14.6-1993, "For Radioactive Materials - Special Lifting Devices for Shipping Containers Weighing 10,000 Pounds (4500 kg) or More."

NUREG-0612, "Control of Heavy Loads at Nuclear Power Plants," July 1980. Licensee implementation of this NUREG will vary and specific commitments to this guidance are covered by licensee review of NRC Generic Letters 80-113 and 85-11.222.

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