OFFICE OF THE INSPECTOR GENERAL

U.S. NUCLEAR REGULATORY COMMISSION

REVIEW OF NRC'S SPENT FUEL POOL INSPECTION PROGRAM AT DECOMMISSIONING NUCLEAR POWER PLANTS

OIG-00-A-01 August 16, 2000

AUDIT REPORT

August 16, 2000

MEMORANDUM TO: William D. Travers
Executive Director for Operations

FROM: Stephen D. Dingbaum **/RA/**
Assistant Inspector General for Audits

SUBJECT: REVIEW OF NRC'S SPENT FUEL POOL INSPECTION PROGRAM AT DECOMMISSIONING NUCLEAR POWER PLANTS

Attached is the Office of the Inspector General's (OIG) audit report titled, *Review of NRC's Spent Fuel Pool Inspection Program at Decommissioning Nuclear Power Plants*.

This report reflects our evaluation of the agency's implementation of inspection policy and guidance for spent fuel pools (SFP) at Regions I, III, and IV and decommissioning nuclear power reactors that OIG visited. There are no power reactors being decommissioned in Region II. Overall, we found that these regions are adequately implementing inspection policy and guidance for SFP safety, and no discernible evidence of SFP deterioration was found at the sites visited. Although this report contains no recommendations, OIG provided observations and examples in the Matters for Consideration section which should be helpful to the agency as it continues to improve the decommissioning program.

This report includes the response from the Deputy Executive Director for Reactor Programs who intends to follow up on OIG's observations and examples presented in the Matters for Consideration section.

If you have any questions, please contact me at 415-5915.

Attachments: As stated

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EXECUTIVE SUMMARY

Purpose

In 1994, an incident at Dresden Nuclear Power Station Unit 1, a nuclear power plant located in Illinois, raised questions about whether the Nuclear Regulatory Commission (NRC) and its licensees had exercised adequate oversight of spent fuel pools (SFPs) at decommissioning plants. Partly in response to this incident, NRC has improved its inspection program by developing an inspection procedure directed at spent fuel pool safety at permanently shutdown reactors. The Office of the Inspector General initiated this audit to determine whether (1) NRC's inspection requirements for SFPs at decommissioning nuclear power reactors are being met, (2) there is discernible evidence of deterioration at the SFPs, and, (3) if so, NRC's initiatives pertaining to SFP risks will address the deficiencies.

Background

After a commercial nuclear power plant is retired and fuel is removed from the reactor, the main source of potential risk involves accidents associated with the irradiated spent fuel that was used during operations. The spent fuel has an elevated temperature and contains some highly radioactive gases. Spent fuel is stored in spent fuel pools which are steel-lined, concrete vaults filled with water. The SFPs act as a shield to reduce the radiation levels that people working outside the pool may be exposed to and to cool the spent fuel that continues to produce heat for several years after removal from the reactor.

NRC regulations pertaining to nuclear power reactors are primarily directed toward the safety of facilities that are licensed to operate. As reactors are permanently shutdown and enter decommissioning, licensees have had to rely on seeking regulatory relief, in the form of exemptions and amendments to their licenses. As a result, after years of ad hoc decisions on reactor decommissioning, NRC staff are developing regulations that take into account the different risks posed by decommissioning plants, including updated risk insights with regard to spent fuel pools.

Results in Brief

We judgmentally selected three nuclear power reactors licensed by NRC which are undergoing decommissioning, and visited each reactor and toured the facility, including the SFP. NRC Regions I, III, and IV are adequately implementing inspection policy and guidance for SFP safety at permanently shutdown reactors. There are no power reactors being decommissioned in Region II. No discernible evidence of spent fuel pool deterioration was found at the sites visited.

Recommendations

This report does not provide any recommendations.

Matters for Consideration

Several related areas were identified where the agency could benefit from examining the practices being used at NRC headquarters and regional offices. This information is provided to the agency for consideration as it continues to improve the decommissioning program.

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INTRODUCTION

In 1994, an incident at Dresden Nuclear Power Station Unit 1,[1] raised questions about whether the Nuclear Regulatory Commission (NRC) and its licensees had exercised adequate oversight of spent fuel pools at decommissioning[2] plants. Partly in response to this incident, NRC has taken steps to improve its inspection program. One step was to develop an inspection procedure directed at spent fuel pool safety at permanently shutdown reactors. The main objective of this procedure is to verify that each licensee maintaining spent fuel in the pools provides appropriate controls and maintains adequate systems to prevent adverse radiological conditions. Because of the importance of these efforts, the Office of the Inspector General included a review of NRC's spent fuel pool (SFP) inspection program at decommissioning nuclear power plants in its fiscal year 2000 Annual Plan. This report presents the results of that review.

The objectives of this review were to determine whether (1) NRC's inspection requirements for SFPs at decommissioning nuclear power reactors are being met, (2) there is discernible evidence of deterioration at the SFPs, and, (3) if so, NRC's initiatives pertaining to SFP risks will address the deficiencies. Appendix I contains additional information about our objectives, scope, and methodology.

BACKGROUND

After a commercial nuclear power plant is retired and fuel is removed from the reactor, the main source of potential risk involves accidents associated with the irradiated spent fuel that was used during operations. When nuclear fuel is removed from a reactor, it has an elevated temperature and contains some highly radioactive gases. The spent fuel is in fuel assemblies, which consist of arrays of metal-clad fuel rods 12-15 feet long. Spent fuel assemblies are stored in SFPs which are steel-lined, concrete vaults filled with borated water.[3]

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1 The facility is located near Morris, Illinois. At the time of the event, Dresden had been shut down for approximately 15 years. Because of inadequate maintenance practices, a water pipe, which was supposed to have been drained, burst after freezing due to the temperature inside the containment building. This situation could have resulted in a drain down of the spent fuel pool, and potentially adverse radiological conditions.

2 Title 10, §50.2, Code of Federal Regulations (CFR), defines decommissioning as the safe removal of a facility from service and the reduction of residual radioactivity to a level that permits release of the property for unrestricted use and termination of the license, or release of the property under restricted conditions and termination of the license.

3 Boron is a chemical element particularly suited to absorbing neutrons to help control the splitting, or fission, of atoms present in the fuel.

Spent fuel pools are typically 40 or more feet deep to provide safety and allow fuel assemblies to be moved while submerged. The SFPs act as a shield to reduce the radiation levels that people working outside the pool may be exposed to and to cool the spent fuel that continues to produce heat for several years after removal from the reactor. At some locations the spent fuel accumulated during years of operation will remain in the SFP for an extended period of time. Therefore, it is essential that NRC verify that licensees continue to maintain adequate safety systems to support the spent fuel in the pools.

NRC regulations for nuclear power reactors are primarily directed toward the safety of facilities that are licensed to operate. As reactors are permanently shutdown and enter decommissioning, licensees have had to rely on seeking regulatory relief, in the form of exemptions and amendments to their licenses. As a result, after years of ad hoc decisions on reactor decommissioning, NRC staff are developing regulations that take into account the different risks posed by decommissioning nuclear power plants, including updated risk insights with regard to spent fuel pools.

RESULTS OF AUDIT

NRC Regions I, III, and IV are adequately implementing inspection policy and guidance for SFP safety at permanently shutdown reactors. There are no power reactors being decommissioned in Region II. No discernible evidence of spent fuel pool deterioration was found at the sites visited. As a result, this report does not provide any recommendations. However, several related areas were identified where the agency could benefit from examining the practices being used at NRC headquarters and regional offices. This information is provided to the agency for consideration as it continues to develop its initiatives in the decommissioning program.

NRC'S INSPECTION REQUIREMENTS FOR SPENT FUEL POOLS

NRC's Inspection Manual contains policies and procedures that must be followed when inspecting operating and retired nuclear power plants. Two inspection requirements were applicable to this review. First, Manual Chapter 2561, *Decommissioning Power Reactor Inspection Program,* provides overall inspection policy and guidance for decommissioning power reactors. Second, Inspection Procedure (IP) 60801, *Spent Fuel Pool Safety at Permanently Shutdown Reactors,*[4] contains objectives to verify that each licensee maintaining spent fuel in wet storage provides controls and maintains adequate systems to prevent adverse radiological conditions.

4 This procedure resulted, in part, from actions taken by NRC in response to the potential SFP drain down at Dresden Station Unit 1.

During scheduled inspections, regional inspectors verify that each licensee maintains adequate controls to prevent adverse radiological conditions at the SFPs. NRC inspectors evaluate SFP-related safety systems, instrumentation, alarms, and controls over water temperature, level, and clarity. The inspectors also interview licensee personnel, review documentation, and document observations and conclusions in NRC inspection reports.

We judgmentally selected three decommissioning power plants[(5)] for review and spoke with officials from the three NRC regional offices with oversight and inspection responsibilities for those plants. Also examined were the inspection records for those licensees.

SPENT FUEL POOL CONDITIONS AT THREE NUCLEAR POWER PLANTS

SFP operating requirements are set out in the licensing basis and technical specifications[(6)] (TS) for each plant. These provide guidance to ensure decommissioning is conducted safely and in accordance with regulatory requirements. The licensing basis is a set of NRC requirements applicable to each plant, including a licensee's written commitments for ensuring compliance with and operation within applicable NRC requirements and the plant-specific design basis.

Each licensee that we visited had controls in place and maintained systems to prevent adverse radiological conditions at their SFPs. Also, parameters critical to SFP integrity (such as water temperature, level, evaporation rates, clarity, chemistry, and foreign materials controls) were monitored by the licensee through direct observation and through displays and alarms provided by plant monitoring systems. No discernible evidence of spent fuel pool deterioration was found at the plants visited. These observations were consistent with analysis of inspection reports and discussions with NRC regional and facility licensee staff during our tours of the spent fuel pools and adjacent facilities.

MATTERS FOR CONSIDERATION

Our review showed that the agency could benefit at this time from examining decommissioning-related activity, including administrative practices being used at NRC headquarters and regional offices. This information would be helpful to the agency as it continues to improve the decommissioning program. These observations are the result of interviews with NRC headquarters and regional

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5 Maine Yankee in Region I; Zion Nuclear Station Units I and II, in Region III; and Trojan Nuclear Plant, in Region IV. There are no commercial nuclear power reactors in decommissioning in Region II.

6 TSs are an appendix to the plant's facility license that contain safety requirements and limits, limiting conditions for operation, and administrative requirements. Terminology such as *defueled technical specifications* are used to describe TSs that have been amended to reflect the permanent shutdown condition of the nuclear power reactor.

staff, licensee officials, and our review of related documentation. Examples of these observations are shown below. For purposes of this report, they are presented in three groups: (1) Tracking and Recording, (2) Organization, and (3) Consistency and Quality. These examples only represent a small cross-section of broad decommissioning activities; therefore, we encourage the agency to look beyond these areas in its efforts to further improve the program.

(1) Tracking and Recording

In their inspection reports, one regional office identifies and records completed inspection procedures by individual objectives (e.g., siphon and drain control, SFP instrumentation, leakage detection, etc.). This methodology provides a record in the inspection report of all inspection items (core and discretionary inspection objectives) reviewed at each reactor, not just those that were significant or represented a problem. This practice not only provides an audit trail for subsequent inspections, but also serves as a guide or checklist to ensure that new inspectors can accurately determine past inspection activity. This same NRC regional office develops, records, and analyzes information for each decommissioning plant for both target and actual accumulated decommissioning inspection hours expended. This practice provides a more accurate projection for future budgeting and staffing needs.

(2) Organization

When an operating reactor shuts down, it generally has a single project manager (PM) assigned in the Office of Nuclear Reactor Regulation (NRR). However, to ensure a smooth transition, prior to when the spent fuel is removed from the SFP (the current transition point), the Office of Nuclear Material Safety and Safeguards (NMSS) generally designates a staff member as the future PM, while NRR still has the responsibility for the plant. Finally, separate from the Part 50 reactor license, a licensee may proceed to obtain a site-specific or a general license for an independent spent fuel storage installation (ISFSI) under Part 72 for storage of spent fuel. In such cases, the NMSS Spent Fuel Projects Office assigns a 10 CFR Part 72 project manager to coordinate licensing of the ISFSI.[7] A plant may have, therefore, three PM's assigned at the same time, which may present communication problems to licensees.

[7] The ISFSI is a complex designed and constructed for the interim storage of spent nuclear fuel and other radioactive materials associated with spent fuel storage. The complex usually consists of a concrete storage pad for the casks which store the spent fuel. The complex also includes piping and the related instrumentation for monitoring the pressure within the casks. The ISFSI must be licensed by NRC in accordance with 10 CFR Part 72.

During this review, both licensee and regional office personnel offered different opinions about the best timing for transitioning decommissioning responsibility from NRR to NMSS.[8] We identified difficulties associated with a licensee operating under an NMSS PM while still being required to comply with 10 CFR Part 50 which is under NRR's jurisdiction. In particular, changes in required expertise and communications among several NRC PMs can create challenges during decommissioning because of the current transition point. One licensee official believed that better results might be obtained by placing the transition point at the time the License Termination Plan is submitted to NRC. Also, one regional office official believed that the transition should be as soon as the plant permanently shuts down, with NMSS responsible (assuming a transfer of NRR personnel to ensure adequate expertise). Because it has been over five years since transition activities were delineated, and the number of decommissioning plants continues to increase, the time may be right to re-visit how NRC allocates decommissioning program responsibilities.

(3) Consistency and Quality

All of the inspection reports written in Regions I, III, and IV were helpful in providing a summary of inspection activities at the plants visited. However, one of the regional offices prepared reports that provided more detail and relevant information about the safety of the stored spent fuel and inspection efforts related to IP 60801. These reports made it easier to determine significant activities concerning the licensee's spent fuel pool.

One of the plants had received several violations from a regional office. Licensee personnel told us that the violations were well written, their basis was clear, and, as a result, the violations were not contested. In the past year, NRC headquarters issued four other violations to the same plant. The licensee successfully contested two of the four. Licensee personnel told us that the contested violations related to ISFSI matters were poorly written, controversial, and without clear basis. Review of such contested violations at decommissioning plants where NRC has transitioning responsibilities would be beneficial to help ensure they are clear and provide a sound regulatory basis.

8 NRR and NMSS signed a Memorandum of Understanding on March 10, 1995, that stipulates that NRR, along with the appropriate region, is responsible for project management and inspection oversight until the spent fuel is permanently removed from the SFP. Once the spent fuel is permanently transferred from the SFP, the facility is transferred to NMSS.

CONCLUSIONS

As commercial nuclear power reactors are shut down and enter decommissioning, it is essential that the risks associated with spent fuel are mitigated. NRC oversight is necessary to ensure each licensee maintaining spent fuel in SFPs provides appropriate controls and maintains adequate systems to prevent adverse radiological conditions. NRC has improved the inspection program by developing SFP inspection procedures for retired reactors.

NRC Regions I, III, and IV are adequately implementing inspection policy and guidance for SFP safety at permanently shutdown reactors. There are no power reactors being decommissioned in Region II. There was no discernible evidence of spent fuel pool deterioration at the sites visited. As a result, this report does not provide any recommendations. However, several areas were identified where the agency could benefit from examining the practices being used at NRC headquarters and regional offices. This information is provided to the agency for consideration as it continues to improve in the decommissioning program.

OIG COMMENTS ON AGENCY RESPONSE

On August 9, 2000, the Deputy Executive Director for Reactor Programs (DEDR) responded to our draft report (see Appendix III). Although the report did not contain any recommendations, the DEDR stated that he intends to follow up on OIG's observations presented in the Matters for Consideration section.

OBJECTIVES, SCOPE, AND METHODOLOGY

The objectives of this review were to determine whether (1) the Nuclear Regulatory Commission's (NRC) inspection requirements for spent fuel pools (SFP) at decommissioning nuclear power reactors are being met, (2) there is discernible evidence of deterioration at the SFPs, and, (3) if so, NRC's initiatives pertaining to SFP risks will address the deficiencies.

To accomplish these objectives, we reviewed NRC regulations pertaining to decommissioning nuclear power reactors and identified inspection requirements for SFPs. These requirements were used as a basis for reviewing spent fuel pool operations at decommissioning plants. We judgmentally selected three commercial nuclear power reactors[9] licensed by NRC which are undergoing decommissioning. We visited each reactor and toured the facility, including the SFPs and analyzed NRC inspection reports for these plants.

We conducted interviews with licensee personnel and met with agency personnel in Regions I, III, and IV[10] who are responsible for inspection activities at those sites. We also spoke with NRC headquarters' officials who are responsible for decommissioning program activities, including officials with the Office of Nuclear Reactor Regulation (NRR), the Office of Nuclear Materials Safety and Safeguards (NMSS) and the Office of Nuclear Regulatory Research (RES). We also discussed NRC's inspection program for spent fuel pools with officials at the Nuclear Energy Institute.

We attended a meeting of NRC's Decommissioning Management Board (the Board) which provides management input on decommissioning activities and issues. This Board, composed of managers from NRR, NMSS, RES, the Office of the General Counsel, and the regions, serves as a mechanism for integrating inter-office and regional coordination of program activities and issue resolution.

We evaluated the management controls related to NRC's SFP inspection program and conducted our audit from December 1999 through January 2000 and March through June 2000 in accordance with generally accepted Government auditing standards.

ABBREVIATIONS AND ACRONYMS

9 All three locations were in various stages of decommissioning, had spent fuel in wet storage onsite, and their power reactors had been shutdown over a period of 2-7 years in length.

10 During the course of this review, there were no commercial nuclear power reactors in decommissioning in Region II.

CFR	Code of Federal Regulations
IP	Inspection Procedure
ISFSI	independent spent fuel storage installation
NMSS	Office of Nuclear Material Safety and Safeguards
NRC	Nuclear Regulatory Commission
NRR	Office of Nuclear Reactor Regulation
PM	project manager
RES	Office of Nuclear Regulatory Research
SFP	spent fuel pool
TS	technical specifications

AGENCY RESPONSE TO DRAFT REPORT

August 9, 2000

MEMORANDUM FOR: Stephen D. Dingbaum
Assistant Inspector General for Audits

FROM: Frank J. Miraglia, Jr. ***/RA/***
Deputy Executive Director
for Reactor Programs

SUBJECT: DRAFT AUDIT REPORT -- REVIEW OF NRC'S SPENT FUEL POOL INSPECTION PROGRAM AT DECOMMISSIONING NUCLEAR POWER PLANTS

This responds to the July 27, 2000, memorandum transmitting the subject audit report. I am pleased to note your preliminary conclusion that the regions are adequately implementing inspection policy and guidance for spent fuel pool (SFP) safety at decommissioning power plants. You also found no discernable evidence of SFP deterioration at the three sites your auditors visited. While your staff did not have any recommendations, we have reviewed your Matters of Consideration. Specifically, the staff highlighted Tracking and Recording, Organization, and Consistency and Quality as areas the staff intends to pursue and discuss in the near term and at the annual Decommissioning Counterparts Meeting to be held in Region IV in November 2000.

cc: Chairman Meserve
Commissioner Dicus
Commissioner Diaz
Commissioner McGaffigan
Commissioner Merrifield

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