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(Wednesday, May 22, 1996)

NRC STAFF COMPLETES SURVEY OF REFUELING PRACTICES  
AT NATION'S NUCLEAR POWER PLANTS

A Nuclear Regulatory Commission staff survey has found that most of the 110 nuclear power plants in the nation are conducting refueling practices consistent with their license requirements.

The survey further found, however, that 15 nuclear power plants at nine sites may not have acted consistent with license commitments when they moved all the fuel from the reactor to the spent fuel storage pool during refueling, rather than a partial offload. Since the survey was completed, utilities which operate these plants have either updated their license documents to reflect the refueling practices or have firm commitments to NRC that such action will be completed before the next refueling outage.

Unloading the full reactor core during refueling is practiced by the majority of nuclear power plant licensees. NRC considers the practice one which can be beneficial to safety, particularly in reducing the hazard to workers who perform maintenance in or around the reactor vessel during outages. The agency's concern is that, before it is used, the practice be properly analyzed and documented.

NRC staff conducted this survey as part of a wider project to measure the extent to which problems encountered at the Millstone Unit 1 plant in Connecticut exist at other facilities.

A copy of the survey report is attached.

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Attachment:  
As stated

May 21, 1996

MEMORANDUM TO: Chairman Jackson  
Commissioner Rogers  
Commissioner Dicus

FROM: James M. Taylor  
Executive Director for Operations

SUBJECT: REPORT ON SURVEY OF REFUELING PRACTICES

In my memorandum to Chairman Jackson dated December 28, 1995, I committed the staff to conducting two activities that would measure the extent to which problems encountered at Millstone Unit 1 regarding compliance with the Final Safety Analysis Report (FSAR) existed at other facilities. The first activity, which is the focus of the attached report, compared current refueling practices against the licensing basis (drawn from the FSAR, Technical Specifications, license amendments and other docketed correspondence) for decay heat removal from spent fuel pools for all operating reactors. The second activity was to review licensee compliance with other aspects of the facility description contained in the FSAR through revised NRC inspection guidance. The results of this latter activity will be presented separately.

The staff's goal was to complete the spent fuel pool related survey for those plants with pending outages before refueling and no later than May 1996 for all other facilities. Although there were several plants that had started refueling before the staff's review, the review results from these plants were consistent with the comments and findings noted herein for other plants.

As described in the attached report, the staff has completed its review of core offload practices for each operating reactor. Based on the survey, the staff has concluded that plants have spent fuel pool cooling systems and backup cooling capability that the NRC staff had reviewed and approved. System design features and licensee operating practices were found to be adequate in assuring protection for public health and safety. It is noted that margins of safety, although adequate, and the clarity of requirements varied from plant to plant. In addition, the staff concludes that, based on the information collected and reviewed and the specific licensee actions taken and commitments made during the course of this review, core offload practices are currently consistent with the spent fuel pool decay heat removal licensing basis for all plants or will be prior to the next refueling outage. However, during the course of the review, the

staff determined that nine sites (fifteen units) needed to modify their licensing bases or plant practices, pursuant to 10 CFR 50.59 or 10 CFR 50.90, to ensure that their reload practices were in compliance with their licensing basis. This is an indication that, similar to Millstone, Unit 1, a number of other plants appear to have previously performed full core offloads inconsistent with their licensing basis.

To gain additional perspective on these nine sites, the staff is examining the results of the recent broad scope FSAR compliance regional inspection activities to see if these sites show evidence of potential programmatic FSAR non-compliance problems. The broad base FSAR compliance review at all plants and the comparison of existing FSAR compliance data for the nine sites documented in the attached fuel pool survey report is ongoing. The results of these activities will be presented separately.

Due to previously identified concerns regarding FSAR compliance at the Millstone and Haddam Neck plant, the staff has issued letters pursuant to 10 CFR 50.54(f) to Northeast Utilities regarding compliance with the FSAR for those plants. The problems identified to date at the shutdown Millstone Units 1, 2 and 3 are broader in scope and more serious in nature than the core offload compliance discrepancies noted in the attached report. The staff has not identified any concerns at Haddam Neck regarding compliance with the core offload and spent fuel pool decay heat removal licensing basis as a result of its spent fuel pool survey. However, through the 10 CFR 50.54(f) request mentioned above, the staff is seeking information which is broader in scope than the spent fuel pool survey and the resulting information could potentially alter our current findings on Haddam Neck.

In addition to the nine plants mentioned above, the staff noted that the FSARs for ten sites (eighteen units) did not reflect the most recent licensing basis information as required by 10 CFR 50.71(e). However, since the affected information was already captured elsewhere in the licensing basis (i.e., in docketed submittals and staff safety evaluations), the staff considers the non-timely updating of the FSAR to be an indication of administrative program failures to maintain plant documentation. Such administrative program failures could have safety significance if they were widespread and resulted in violations of other requirements such as 10 CFR 50.59.

The staff is taking steps to ensure that the details of the staff findings for these plants are documented in inspection reports. It is expected that the characterization of the report findings for individual plants may be revised as the staff completes the detailed documentation activity. The staff will complete documentation of spent fuel pool survey discrepancies in plant-

specific inspection reports by June 28, 1996. Concurrently, the staff is developing enforcement guidance to address the instances of non-compliance with the FSAR identified in the spent fuel pool survey and the broader FSAR compliance review. Application of any enforcement guidance to the findings of potential non-compliance identified through the fuel pool survey would follow accordingly.

In addition to the compliance issues identified, the staff will review the data collected as part of the survey and will identify specific plant design features and operating practices which are candidates for safety enhancements using the backfit process (10 CFR 50.109). An example of potential candidates for design enhancement is spent fuel pool instrumentation. The staff will develop its plans for plant-specific backfit activities or generic improvements in the regulation of spent fuel pool decay heat by June 28, 1996.

After addressing the compliance issues and potential safety enhancements, the staff will consider ways to improve the clarity and consistency of our spent fuel pool requirements. One approach currently under consideration is to include spent fuel pool design and operational issues in the shutdown rule-making activity which is already well underway.

This will be made publicly available in five working days from the date of this memo. SECY please track.

Attachment: Refueling Practice Survey: Final Report

cc: SECY  
OGC  
OCA

## REFUELING PRACTICE SURVEY: FINAL REPORT

### 1.0 INTRODUCTION

In July 1995, Northeast Utilities submitted a proposed license amendment for Millstone Unit 1 requesting that the staff approve a full core offload as a normal refueling practice, approve certain new methods for analyzing decay heat removal, and approve certain new technical specification (TS) requirements. In August 1995, a petition was filed, pursuant to 10 CFR 2.206 which sought, among other things, the denial of the Millstone 1 license amendment request. The staff conducted an extensive review of the Millstone application and the issues raised in the 2.206 petition. To address the amendment request and the petition, the staff examined a number of design issues, operating and administrative procedural issues, and licensing basis issues.

One of the fundamental issues in both proceedings concerned the operational limits on core offload practices as documented in the Millstone 1 licensing basis. The Millstone 1 spent fuel pool cooling system is designed to remove heat from the spent fuel pool, and the system design capabilities are documented in various licensing documents. During the review, the staff became concerned about whether the licensee's practice of conducting full core offloads was consistent with the licensing basis of the spent fuel pool decay heat removal systems. The staff was concerned that routine refueling offload practices may not have been consistent with licensing basis assumptions regarding routine or normal operation.

Through the fall of 1995, the staff became aware of several discrepancies between the current spent fuel pool licensing basis and the refueling practices at other nuclear plants. The staff issued Information Notice 95-54, "Decay Heat Management Practices During Refueling Outages," dated December 1, 1995, to inform the industry of the discrepancies observed at Millstone 1 and the other facilities. Based on the staff's ongoing "Task Action Plan for Spent Fuel Storage Pool Safety," which is intended to address technical concerns, and the continued confidence of the staff in the substantial, though variable, safety margin provided by the design of existing spent fuel pools and their associated support systems, the staff did not consider immediate regulatory actions appropriate to address the observed licensing basis discrepancies.

On December 28, 1995, the staff forwarded a memorandum to the NRC Chairman on the lessons learned from the Millstone 1 review. In this memorandum, the staff committed to review the refueling practices at all operating reactors against the current spent fuel pool decay heat removal licensing basis (as documented in

the Final Safety Analysis Report (FSAR) and other documents) for those facilities. The staff committed to review each operating plant before the next scheduled refueling outage, but no later than May 1996 for all plants. Although there were several plants that had started refueling before the staff's review, the review results from these plants were consistent with the comments and findings noted herein for other plants.

## 2.0 SCOPE OF REVIEW AND PROJECT EXECUTION

To meet the spent fuel pool survey commitments described in the December 28, 1995, memorandum, the staff developed a program to evaluate each operating reactor's refueling practices relative to each reactor's current spent fuel pool decay heat removal licensing basis. Table 1 lists the plants that were included in the survey as well as the routine offload practice at that plant.

### 2.1 Licensing Basis Review

To determine the licensing basis, the staff reviewed relevant licensing documents that discussed the capability to remove decay heat from the spent fuel pool including:

- relevant Final Safety Analysis Report (FSAR) sections
- relevant Technical Specifications
- documentation associated with license amendments related to the spent fuel pool (Common examples of this are amendments that increase the licensed storage capacity of the spent fuel pool ("rerack" amendments), amendments that increase a reactor's licensed thermal power ("power uprate" amendments), and amendments that increase the licensed enrichment or energy production density ("burnup") of fuel.)
- other docketed correspondence addressing spent fuel pool decay heat removal capabilities that further defined the systems or practices

The staff focussed on certain specific areas in determining the licensing requirements for each plant:

- descriptive phrases that imply the frequency of certain offload sequences (e.g., normal, abnormal or emergency)
- configuration of spent fuel pool cooling systems assumed to be operating in the design analyses (e.g., single failure considerations, backup systems)
- assumptions that affected spent fuel pool heat load (e.g., delay time and operating history)
- plant specific spent fuel pool temperature limits and the bases for those limits.

The staff observed that the licensing basis for spent fuel pool decay heat removal varied among plants. This variation in licensing bases stems from differences in spent fuel decay heat removal system design accepted by the staff, from differences in

the level of detail provided in the licensing documents and from evolving NRC review criteria. As a result, the margin of safety with respect to system capacity and reliability differs from plant to plant.

## 2.2 Operating Practice Review

To determine the operating practices of each operating reactor during refueling, the staff visited the plant site or the utility corporate office and reviewed plant specific operating procedures, administrative controls and engineering analyses. The staff compared the operating practices with the licensing basis developed for each operating reactor to identify discrepancies with the design basis assumptions for the spent fuel pool cooling system.

As part of the survey, the staff also gathered detailed design information on the spent fuel pool storage facilities at all operating reactors. This information will be used in developing plans for resolution of the staff's "Task Action Plan for Spent Fuel Storage Pool Safety."

## 3.0 COMMENTS AND FINDINGS

### Operating Practice Reviews

Except as noted in the attached Tables 2 and 3, the staff found that for most plants, core offload practices were consistent with the licensing basis and the FSAR reflected most recent changes to the licensing basis. Also, applicable procedures and administrative controls were found to be adequate. The staff did note, however, that many plants were considering or processing changes to the FSAR to correct minor inconsistencies and were enhancing applicable procedures to better control outage operations.

However refueling practices at several plants were potentially in conflict with that plant's spent fuel pool decay heat removal licensing basis. Plants that the staff concluded were in this condition are listed in Table 2. In some cases, the licensee had independently recognized the discrepancy and took steps to modify the plant's spent fuel pool decay heat removal design basis or the plant's refueling practices. In other cases, the staff promptly informed the licensee about its understanding of both the plant's licensing basis and the plant's operating practices and identified the discrepancies between the two. In all cases, affected licensees took action or committed to take action to reconcile refueling offload practices with licensing requirements before the next core offload activity took place.

Because these plants may have operated outside their licensing basis during previous refueling outages, the staff will document the detailed findings for these facilities in appropriate inspection reports and will take appropriate regulatory action.

#### Periodic FSAR Updates

Some plant-specific FSARs did not reflect information associated with spent fuel pool decay heat removal from applicable license amendments. An NRC regulation, specifically 10 CFR 50.71(e), requires that the FSAR be periodically updated to reflect such information. Plants where this discrepancy was observed are listed in Table 3 although such plants may be within the update periodicity provided in 10 CFR 50.71(e) and thus may not be in violation of 10 CFR 50.71(e). The staff will document the detailed findings for these facilities in appropriate inspection reports and will take appropriate regulatory action.

#### Control of Design Basis Assumptions

At a number of plants, the staff identified weaknesses in the procedural control of design basis assumptions. An example of this includes weak procedure control of in-vessel decay time prior to fuel transfer. In some cases, licensees upgraded procedures to directly implement the design basis assumption, in other cases the licensee revised existing procedures and performed engineering analyses, documented pursuant to 10 CFR 50.59, as necessary, to ensure the planned activities would not exceed design basis assumptions. In addition, some plants perform outage-specific analyses as a matter of routine, while other plants performed (or plan to perform) such analyses in response to the staff's survey.

#### Other Observations

A number of facilities were found to remove spent fuel pool cooling systems and/or support systems from service for maintenance during refueling outages. While the staff did not identify any specific instances of potential non-compliance in this regard, the staff will consider the appropriate level of operational controls during refueling outages as part of the Task Action Plan on Spent Fuel Storage Pool Safety. Such an issue may be appropriately addressed within the context of shutdown risk rulemaking activities.

Also, a number of facilities had installed significant additional spent fuel pool decay heat removal capability pursuant to 10 CFR 50.59 (Table 4). For example, one plant installed a two-train, alternate decay heat removal system such that either train could reject the heat associated with the full core offload. The system was installed to facilitate performance of full core

offloads while allowing simultaneous maintenance of RHR systems which might otherwise be needed for spent fuel pool cooling.

The staff reviewed the 10 CFR 50.59 evaluations for several of these modifications and found them adequate. In general, it is expected that this kind of modification could be performed under 50.59 without prior staff approval. However, plant specific circumstances may require a license amendment.

#### 4. CONCLUSIONS

During the course of the survey, the staff evaluated the compliance of refueling operating practices at each operating reactor with respect to that plant's spent fuel decay heat removal licensing basis. The staff concludes that, based on the information collected and reviewed and the specific licensee actions taken and commitments made during the course of this review, refueling operating practices are currently consistent with the spent fuel pool decay heat removal licensing basis for all plants or will be prior to the next refueling outage. However, the survey determined that nine sites (fifteen units) needed to modify their licensing bases or plant practices, pursuant to 10 CFR 50.59 or 10 CFR 50.90, during the course of the review to ensure that their reload practices were in compliance with their licensing basis. This is an indication that some of these plants may have previously performed core offloads inconsistent with their licensing basis. In addition, the staff noted that the Final Safety Analysis Reports for ten sites (eighteen units) did not reflect the most recent licensing basis information.

The staff is taking steps to ensure that the details of the staff findings for these plants are documented in inspection reports. It is expected that the characterization of the report findings for individual plants may be revised as the staff completes the detailed documentation activity. The staff will complete documentation of spent fuel pool survey discrepancies in plant-specific inspection reports by June 28, 1996. Concurrently, the staff is developing enforcement guidance to address the instances of non-compliance with the FSAR. Application and implementation of any enforcement activities to the findings of potential non-compliance identified through the fuel pool survey would follow accordingly.

The staff did not identify any safety issues regarding spent fuel pool decay heat removal of core offload practices that have not been captured for resolution as part of the staff's "Task Action Plan for Spent Fuel Storage Pool Safety." As part of the action plan, the staff concluded that the existing design and operation of spent fuel pool systems do not pose an undue risk to public health and safety. Because of the variation in spent fuel pool

cooling system design bases accepted by the staff in the past, the staff concluded that compliance with design limits does not reflect a consistent margin of safety. To address this conclusion and other technical concerns, the staff is examining spent fuel pool design and operation to identify safety enhancements through the implementation of the staff's action plan for spent fuel storage pool safety.

During the course of the survey, the staff also collected detailed design information on spent fuel pool systems for all operating reactors. This information will be used in developing plans for resolving the staff's "Task Action Plan for Spent Fuel Storage Pool Safety." Plans for resolving action plan issues as well as separate plans to address the license compliance issues described in this report will be completed by June 28, 1996.

Table 1: Routine Offload Practices

PLANT	OFFLOAD METHOD
ANO-1	Full Core
ANO-2	Full Core
Big Rock Point	Full Core
Beaver Valley 1,2	Full Core
Braidwood 1,2	Full Core
Browns Ferry 1,2,3	Full Core
Brunswick 1,2	Full Core
Byron 1,2	Full Core
Callaway	Full Core
Calvert Cliffs 1,2	Partial Core
Catawba 1,2	Full Core
Clinton	Partial Core
Comanche Peak 1,2	Full Core
D.C. Cook 1,2	Full Core
Cooper	Full Core
Crystal River	Full Core
Davis Besse	Full Core
Diablo Canyon 1,2	Full Core
Dresden 2,3	Full Core
Duane Arnold	Full Core
Farley 1,2	Full Core
Fermi 2	Full Core
Fitzpatrick	Full Core
Fort Calhoun	Full Core
Ginna	Full Core
Grand Gulf	Partial Core
Haddam Neck	Full Core
Harris	Full Core
Hatch 1,2	Full Core
Hope Creek	Partial Core
Indian Point 2	Full Core
Indian Point 3	Full Core
Kewaunee	Partial Core
LaSalle 1,2	Full Core
Limerick 1,2	Partial Core
Maine Yankee	Full Core
McGuire 1,2	Full Core
Millstone 1	Full Core
Millstone 2	Partial Core
Millstone 3	Full Core
Monticello	Partial Core
Nine Mile Point 1,2	Partial Core
North Anna 1,2	Full Core
Oconee 1,2,3	Full Core
Oyster Creek	Partial Core
Palisades	Partial Core

Palo Verde 1,2,3	Full Core
PLANT	OFFLOAD METHOD
Peach Bottom 2,3	Partial Core
Perry	Partial Core
Pilgrim	Partial Core
Point Beach 1,2	Full Core
Prairie Island 1,2	Partial Core
Quad Cities 1,2	Full Core
River Bend	Partial Core
Robinson	Full Core
Salem 1,2	Full Core
San Onofre 2,3	Full Core
Seabrook	Full Core
Sequoyah 1,2	Full Core
South Texas 1,2	Full Core
St. Lucie 1,2	Partial Core
Summer	Full Core
Surry 1,2	Full Core
Susquehanna 1,2	Partial Core
TMI-1	Partial Core
Turkey Point 3,4	Full Core
Vermont Yankee	Partial Core
Vogtle 1,2	Full Core
Waterford	Partial Core
Watts Bar	Full Core
WNP-2	Partial Core
Wolf Creek	Full Core
Zion 1,2	Full Core

Table 2: Past Offloads in Potential Non-Compliance with Current Licensing Basis

Cooper  
McGuire 1,2  
Millstone 1  
North Anna 1,2  
Oconee 1,2,3  
South Texas 1,2  
Summer  
Turkey Point 3,4  
Vogtle 1

Table 3: FSAR Update Needed to Achieve Consistency Within Licensing Basis

Browns Ferry 1,2,3  
Crystal River  
Fermi 2  
Kewaunee  
LaSalle 1,2  
Millstone 1,2,3  
Salem 1,2  
Sequoyah 1,2  
Vermont Yankee  
Zion 1,2

Table 4: Significant Plant Modifications Under 50.59

Brunswick 1,2  
FitzPatrick  
Hatch 1,2  
Seabrook  
Susquehanna 1,2