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UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

BEFORE THE ATOMIC SAFETY AND LICENSING BOARD

In the Matter of:	)	
	)	
Northeast Nuclear Energy Company	)	Docket No. 50-423-LA-3
	)	
(Millstone Nuclear Power Station,	)	
Unit No. 3)	)	ASLBP No. 00-771-01-LA

SUMMARY OF FACTS, DATA, AND ARGUMENTS ON WHICH NORTHEAST NUCLEAR ENERGY COMPANY PROPOSES TO RELY AT THE SUBPART K ORAL ARGUMENT

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NUCLEAR REGULATORY COMMISSION

BEFORE THE ATOMIC SAFETY AND LICENSING BOARD

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SUMMARY OF FACTS, DATA, AND ARGUMENTS ON WHICH NORTHEAST NUCLEAR ENERGY COMPANY PROPOSES TO RELY AT THE SUBPART K ORAL ARGUMENT

VOLUME 1 (Written Summary and Sworn Testimony)

June 30, 2000

UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

BEFORE THE ATOMIC SAFETY AND LICENSING BOARD

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I. Introduction

In accordance with the schedule established by the Atomic Safety and Licensing Board ("Licensing Board") in its Memorandum and Order (Schedules for Proceeding), dated April 19, 2000, Northeast Nuclear Energy Company ("NNECO") hereby submits its "Summary of Facts, Data, and Arguments on which Northeast Nuclear Energy Company Proposes to Rely at the Subpart K Oral Argument" ("NNECO's Summary"). NNECO's Summary addresses all three admitted contentions in this proceeding. As required by 10 C.F.R. § 2.1113(a), NNECO's Summary includes this written summary as well as attachments with supporting facts and data in the form of sworn written testimony and referenced documents.

This Subpart K proceeding concerns the proposal by NNECO to increase the capacity of the spent fuel pool ("SFP") of the Millstone Nuclear Power Station, Unit No. 3 ("Millstone Unit 3" or "Unit 3") through the use of additional high-density storage racks. The License Amendment Application ("Application") at issue was submitted to the NRC on March

19, 1999 (Reference 1). The Application was supplemented by NNECO submittals of April 17, 2000 (Reference 2), May 5, 2000 (Reference 3), and June 16, 2000 (Reference 4).

The Millstone Unit 3 SFP currently utilizes high-density storage racks with a capacity of 756 fuel assemblies. Following the discharge of spent fuel assemblies into the SFP during the next refueling outage, currently scheduled for the first quarter of 2001, Unit 3 will no longer have the reserve capacity for a full core off-load. NNECO proposes to use additional high-density fuel storage racks that would increase the SFP capacity to 1,860 assemblies (an increase of 1,104). The proposed amendment would change several Technical Specifications ("TS") and TS Bases to specify appropriate restrictions related to storage of spent fuel in the new and existing storage racks.

NNECO's proposal would leave in place the existing high-density spent fuel racks and use 14 high-density racks with a capacity of 1,023 assemblies.[1] The new racks would be divided into two regions. In Region 1, fuel would be stored in either a 3-out-of-4 array or a 4-out-of-4 arrangement, depending upon enrichment and burnup considerations. Region 2 would be utilized for 4-out-of-4 storage, with more restrictive enrichment/burnup limitations than Region 1. For criticality purposes, the new racks in both Regions 1 and 2 will utilize Boral panels as fixed neutron absorbers. Under NNECO's proposal, the existing storage racks would be re-designated as Region 3. Fuel would be stored in Region 3 in a 4-out-of-4 array, subject to restrictive enrichment/burnup/decay limits. The Boraflex presently employed in those racks would remain but would no longer be credited as a neutron absorber.

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1 A 15th high-density rack, with a capacity of 81 assemblies, is analyzed as part of the Application safety evaluation, but may not be immediately installed.

In this filing, NNECO will demonstrate that the spent fuel storage proposal is safe and consistent with NRC requirements, regulatory guidance, and longstanding practice. NNECO will demonstrate that the proposed SFP configuration and fuel handling procedures provide reasonable assurance that fuel assemblies will not be misplaced into regions where the assemblies are not qualified. NNECO will further demonstrate that postulated scenarios involving soluble boron dilution are not likely. And, most compelling, NNECO will show by undisputed criticality analysis that, in any event, postulated misplacements of fuel assemblies and boron dilution events will not lead to a criticality event. Accordingly, there is no genuine and substantial issue of fact that requires further exploration in evidentiary hearings. All admitted contentions should be resolved in NNECO's favor.

II. Procedural History for this Subpart K Proceeding

On October 6, 1999, the Connecticut Coalition Against Millstone ("CCAM") and the Long Island Coalition Against Millstone ("CAM") (collectively, "Intervenors") filed a request for hearing and petition for leave to intervene with respect to NNECO's Application. On October 19, 1999, the Licensing Board was established to preside over the proceeding. On October 21, 1999, NNECO filed its answer to the request for hearing/petition to intervene, and opposed the petition for lack of an adequate demonstration of standing. On October 26, 1999, the NRC Staff filed its answer to the petition, and opposed it on the same grounds as did NNECO.

On October 28, 1999, the Licensing Board issued a Memorandum and Order, which concluded that the CCAM/CAM Petition failed to adequately set forth the standing of the organizations to intervene, failed to identify any individual members by name and address, and failed to show that the organizations were authorized to represent any such members. The

Licensing Board, pursuant to 10 C.F.R. § 2.714(a)(3), permitted CCAM and CAM to file a supplement to its petition to address standing deficiencies and to propose contentions for this proceeding. The Licensing Board also scheduled a prehearing conference, which was later held in New London, Connecticut, on December 13, 1999. CCAM and CAM filed their supplemental petition on November 17, 1999, proposing eleven contentions for litigation. NNECO filed its answer on November 30, 1999; the NRC Staff filed its response on December 7, 1999.

On February 9, 2000, the Licensing Board issued Memorandum and Order (Granting Request for Hearing), LBP-00-02, ruling that both CCAM and CAM have standing to intervene, admitted Intervenors' Contentions 4, 5, and 6, and established a 90-day discovery period beginning on February 28, 2000, and ending on May 30, 2000. Accordingly, the three contentions became subject to further proceedings. On February 22, 2000, NNECO notified the Licensing Board that it would invoke the hearing procedures of 10 C.F.R. Part 2, Subpart K, and requested an oral argument on the three admitted contentions in accordance with 10 C.F.R. § 2.1109(a)(1).

On April 18, 2000, a telephone conference call was conducted among the Licensing Board and counsel for the Intervenors, NRC Staff, and NNECO for the purposes of establishing future schedules. The following day, April 19, 2000, the Licensing Board issued Memorandum and Order (Schedule for Proceeding) that established deadlines of June 30, 2000, for the filing of parties' written summaries, and July 19, 2000, for oral argument. The 90-day discovery period was subsequently extended for the limited purpose of allowing NNECO time to respond to certain late interrogatories and requests for production of documents filed by the Intervenors on May 19, 2000.

During the initial discovery period, NNECO conducted discovery on the Intervenors in the form of interrogatories, document production requests, and depositions of two of the Intervenors' witnesses, Mr. Lochbaum and Dr. Thompson. Included as Reference 5 to this paper is a compilation of the pages of the transcripts of Mr. Lochbaum's and Dr. Thompson's sworn depositions that NNECO believes are relevant to the issues discussed in this summary paper.

III. Strict Threshold for an Adjudicatory Hearing in a Subpart K Proceeding

The procedures in 10 C.F.R. Part 2, Subpart K, were established in response to a congressional mandate found in the Nuclear Waste Policy Act of 1982, 42 U.S.C. § 10101, *et seq.* ("NWPA"). The NWPA was passed to establish a federal program for funding and development of a permanent disposal repository for spent nuclear fuel and other high-level nuclear waste. See H.R. Rep. No. 97-785, pt. 1, at 32 (1982). Congress determined that the operators of civilian nuclear power reactors have "primary responsibility" for interim storage of spent fuel, and that they should do so "by maximizing, to the extent practical, the effective use of existing storage facilities at the site of each civilian nuclear power reactor, and by adding new onsite storage capacity in a timely manner where practical." 42 U.S.C. § 10151(a)(1). Congress also declared that the purpose of the NWPA was to promote the "addition of new spent nuclear fuel storage capacity" at civilian reactor sites. Id. at § 10151(b)(1). The NWPA directed federal agencies to "encourage and expedite the effective use of available storage, and necessary storage" at reactor sites. Id. at § 10152. Congress recognized that several methods could be used to increase the spent fuel storage capacity, specifically including the "use of high-density fuel storage racks." Id. at § 10154.

The NWPA § 134(a)-(b), 42 U.S.C. § 10154(a)-(b), further states that for any reactor operating license amendment "to expand the spent nuclear fuel storage capacity at the site of a civilian nuclear power reactor," the Commission was to provide parties to any hearing on the expansion amendment with the opportunity to present facts, data, and arguments, by way of written summaries and sworn testimony, and an oral argument. Based on the summaries sworn testimony and the argument, the Commission then would designate "any disputed questions of fact, together with any remaining questions of law, for resolution in an adjudicatory hearing" — but only if the Commission finds that "there is a genuine and substantial dispute of fact which can only be resolved with sufficient accuracy by the introduction of evidence at an adjudicatory hearing" and "the decision of the Commission is likely to depend in whole or in part on the resolution of such dispute."

The NRC implemented NWPA through a 1985 rulemaking that added Subpart K to 10 C.F.R. Part 2. 50 Fed. Reg. 41,662 (1985). The statutory requirements related to limiting adjudicatory hearings on spent fuel storage matters are incorporated in the Commission's regulations at 10 C.F.R. §§ 2.1113 and 2.1115. Section 2.1115(a)(1)-(2) specifically provides that the presiding officer shall "[d]esignate any disputed issues of fact, together with any remaining issues of law, for resolution in an adjudicatory hearing," and "[d]ispose of any issues of law or fact not designated for resolution in an adjudicatory hearing." Under the Commission's regulations, 10 C.F.R. § 2.1115(b), an issue may be designated for an adjudicatory hearing only if:

- there is a genuine and substantial dispute of fact; *and*
- the dispute can be resolved with sufficient accuracy only through introduction of evidence at an adjudicatory hearing; *and*

- the NRC's ultimate decision is likely to depend in whole or in part on the resolution of the dispute.

Any issues that do not meet all three of these criteria are to be disposed of by the Licensing Board promptly after the oral argument. Id. at § 2.1115(a)(2).

The NRC made it clear in the 1985 rulemaking that the threshold for an adjudicatory hearing in Subpart K is quite high:

> The Commission continues to believe that the statutory criteria are sufficient. As the Commission pointed out in connection with the proposed rules, the statutory criteria are quite strict and are designed to ensure that the hearing is focused exclusively on real issues. They are similar to the standards under the Commission's existing rule for determining whether summary disposition is warranted. They go further, however, in requiring a finding that adjudication is necessary to resolution of the dispute and in placing the burden of demonstrating the existence of a genuine and substantial dispute of material fact on the party requesting adjudication.

50 Fed. Reg. at 41,667. See also Carolina Power & Light Company (Shearon Harris Nuclear Power Plant), LBP-00-12, __ NRC __, 2000 NRC LEXIS 61, at 2 (quoting 50 Fed. Reg. 41,662, 41,667 (1985)) (May 5, 2000). As a result, in the present case the Intervenors bear the heavy burden of demonstrating that they are entitled to an adjudicatory hearing.

First, the Intervenors must demonstrate that there is a factual dispute; the Licensing Board can dispose of pure questions of law without the need for an adjudicatory hearing. As will be discussed below, Contention 6 can be disposed of on this basis.

Second, the Intervenors must demonstrate a genuine and substantial fact issue in dispute, and that the NRC's decision is likely to depend on the resolution of that dispute. With respect to Contentions 4 and 5, the Intervenors have failed in this regard. Based on responses to discovery in this case, the Intervenors will not dispute any fact offered here by NNECO. Rather, their case revolves around postulated misloads of fuel assemblies and boron dilution events.

NNECO concludes, based on evidence presented here, that these matters do not present genuine and substantial disputes of fact. In addition, Intervenors will rely on various past problems at Millstone and related allegations, all of which have no relevance to the Commission's decision on NNECO's current Application. While the NRC's summary disposition regulation, 10 C.F.R. § 2.749, requires a factual issue that is "material" to justify an evidentiary hearing, the Subpart K requirement is that an adjudicatory hearing be held only if the NRC's decision "is likely to depend in whole or in part" on the resolution of the factual dispute. This Subpart K threshold is a much stricter threshold than "materiality." The factual dispute must play a central role in the ultimate disposition of the proceeding. Otherwise, no adjudicatory hearing is required. The Licensing Board can dispose of the Intervenors' issues on the basis of the sworn testimony and written submissions because the issues are neither substantial nor central to the Commission's decision.

Third, even if the Licensing Board were to find a factual dispute that is genuine and substantial, an adjudicatory hearing is not required unless it is shown that the dispute can only be resolved through traditional adjudicatory procedures, such as live testimony subject to cross-examination. With respect to Contentions 4 and 5, this is not the case. NNECO here presents a substantial record on which the Licensing Board can render a decision in NNECO's favor. There is no basis whatsoever to conclude that further hearings are warranted.

IV. Contention 4: "Complex Administrative Controls"

A. Restatement of Contention 4 and Bases

The Intervenors assert in Contention 4 that the additional spent fuel pool racks proposed for Millstone Unit 3 would create an "undue and unnecessary risk to worker and public health and safety," specifically because the proposal allegedly involves trading physical protection against criticality for a "complex array" of "administrative controls." The Intervenors further assert that past experience at Millstone suggests that NNECO's ability to carry out such controls successfully is suspect. The Licensing Board, in its Prehearing Conference Order (LBP-00-02, slip op. at 19-20), adopted the following restatement of Contention 4:

> The new set of administrative controls trades reliance on physical protection for administrative controls to an extent that poses an undue and unnecessary risk of a criticality accident, particularly due to the fact that the licensee has a history of not being able to adhere to administrative controls with respect, inter alia, to spent fuel configuration.

As a basis for the contention, the Intervenors principally rely on the opinion of David Lochbaum that "complex" fuel storage patterns may lead to loading errors and the views of Dr. Gordon Thompson regarding the inappropriateness of "administrative controls" rather than "physical" controls to prevent criticality events. Based on discovery in this proceeding, it has emerged that the problems these individuals foresee are essentially two fold: (1) the potential for misplacements of fuel; and (2) the potential for dilution of soluble boron that would reduce margin to a criticality event. Indeed, Dr. Thompson posits scenarios involving multiple and undetected fuel assembly misplacements *concurrent* with a dilution of soluble boron.

As support for the theory that NNECO will not effectively implement the procedural controls related to placing fuel in appropriate regions and for maintaining the soluble boron concentration, the Intervenors will point to past performance problems at Millstone Station leading to an extended recovery period prior to NRC authorization to restart Millstone Unit 3 in July 1998. And the Intervenors will apparently rely on allegations of environmental violations and the fact that NNECO previously pleaded guilty to federal environmental and nuclear regulatory violations and agreed to pay $10 million in fines.

B. Summary of Facts and Arguments in Response to Contention 4

The relevant facts related to NNECO's proposal for expansion of the spent fuel storage capacity at Millstone Unit 3 are provided in the License Amendment Application of March 19, 1999 (Reference 1), in the supplements to the Application dated April 17, 2000 (Reference 2), May 5, 2000 (Reference 3), and June 16, 2000 (Reference 4), in the affidavits of Messrs. Joseph Parillo, Robert McDonald, Michael Jensen, David Dodson, and in the affidavit of Dr. Stanley Turner of Holtec International ("Holtec"). Essentially, there are no material and significant facts in dispute. Rather, much of what the Intervenors will offer on this contention is immaterial and of no possible decisional significance. This contention can be decided based upon facts offered by NNECO that are not in dispute.

NNECO maintains that the facts demonstrate a proposal that is safe, based on a defense-in-depth approach, and that is consistent with the intent of the NWPA, with accepted industry norms, and with NRC regulatory guidance. Proven fuel handling procedures, as well as the practical implications of the proposed physical layout for the Unit 3 SFP, provide ample controls to ensure that fuel assemblies will be placed in appropriate regions in the SFP. The potential for boron dilution in the SFP has been addressed so that a dilution event is extremely unlikely at Millstone Unit 3. Furthermore, NNECO's undisputed criticality analyses show a substantial margin of safety. These analyses show that — even in very unlikely cases involving postulated concurrent misplacements of multiple, limiting reactivity fuel assemblies and substantial dilution of insoluble boron — criticality will not result. In this light, the Intervenors' assertions regarding complexity, the potential for human error, minor fuel handling events and equipment problems, past enforcement issues at Millstone, and allegations of past misconduct are all immaterial or of no decisional significance.

1. Overview of Millstone Unit 3 SFP Proposal

a. Enrichment/Burnup/Decay Restrictions

NNECO's proposal for expanded storage of spent fuel in the Millstone Unit 3 Spent Fuel Pool ("SFP") is described in detail in the Application of March 19, 1999 (Reference 1). Consistent with the NWPA, which specifically encouraged increasing spent fuel storage capacity and the use of high-density fuel storage racks.[2] NNECO's proposal involves the insertion of up to fifteen additional high-density storage racks into a currently open area in the Unit 3 SFP. Once the new racks are installed, the SFP will be divided into three reconfigured regions, with storage in each of the regions governed by fuel burnup and/or decay time limits established in Unit 3 Technical Specifications ("TS"). The new restrictions are included in the Application as proposed TS Figures 3.9-1, 3.9-3, and 3.9-4.

An illustration of the layout of the re-configured Unit 3 SFP is included as Figure 2 in Mr. Parillo's affidavit. Mr. Parillo's affidavit also includes a detailed comparison of the present storage scheme and the proposed storage arrangement. Parillo Affidavit, ¶¶ 7-12, Table 1. The following provides an overview.

The current Millstone Unit 3 SFP is already divided into two regions, with storage governed by burnup limits established in current TS Figure 3.9-1. The current Region 1 configuration allows fuel to be stored in a 3-out-of-4 configuration with the fourth location physically blocked by a cell blocker device. The current Region 2 allows fuel to be stored in a 4-out-of-4 configuration, with each assembly required to meet the fuel burnup requirements of current TS Figure 3.9-1.

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2 42 U.S.C. §§ 10151, 10152, and 10154.

Under the proposed configuration, the new racks would incorporate Boral panels, which are fixed neutron absorbers for criticality control. The new racks would be divided into two regions. Proposed Region 1 would allow fuel to be stored in either a 3-out-of-4 array or a 4-out-of-4 array. The 3-out-of-4 arrangement would allow storage of fresh, unirradiated fuel of up to 5 weight-percent ("w/o") U-235. Fuel of this type is the most reactive fuel to be stored in the SFP. The 3-out-of-4 pattern would accommodate any combination of new fuel and spent fuel. A cell blocking device would be required under TS Figure 3.9-2 (as at present for Region 1) for the fourth storage location, so that fuel assemblies physically could not be placed in that location. The 4-out-of-4 storage would be allowed in Region 1 only for fuel that meets the burnup requirements of proposed TS Figure 3.9-1.

The proposed Region 2 (again, physically located in the new racks) would allow fuel to be stored in a 4-out-of-4 configuration, with each assembly stored in the region required to meet fuel burnup requirements of proposed TS Figure 3.9-3.

Under the proposal, the existing racks would be re-designated as Region 3. These high-density racks presently include Boraflex panels for criticality control. However, because of industry experience related to the degradation of Boraflex, NNECO will not credit those panels. In proposed Region 3, fuel would be stored in a 4-out-of-4 pattern with restrictive burnup and decay time limits, as specified in proposed TS Figure 3.9-4.

As discussed by Mr. Parillo, NNECO has utilized burnup credit in the SFP at Unit 2 since 1986, and at Unit 3 since 1990. Parillo Affidavit, ¶¶ 6, 39. The current proposal actually involves adding two TS burnup/enrichment curves (TS Figures 3.9-3 and 3.9-4) to the current TS burnup/enrichment curve (TS Figure 3.9-1), and the addition of a Quality Assurance ("QA") calculation for fuel decay time in one curve (TS Figure 3.9-4). Id. at ¶ 12. The proposed TS will not alter the existing procedures to calculate burnups, to move fuel, or to verify soluble boron concentration. The current procedures will simply be modified to apply to the new regions and to incorporate the decay time limits in one region. Id. at ¶¶ 13-18, and Figure 1.

As discussed by Mr. Parillo and Dr. Turner, the enrichment/burnup/decay curves do not "trade off" physical controls for "administrative controls." Fuel burnup and decay time are physical characteristics of fuel assemblies. They are indices of fuel reactivity, which, by known physical processes, provides criticality control. Parillo Affidavit, ¶¶ 19-20; Turner Affidavit, ¶¶ 9-19. As will be discussed further in the context of Contention 6, NNECO's proposal incorporates fuel reactivity and the associated physical processes in the SFP into a physical system for criticality control. The Intervenors' labeling of the physical processes and the criticality control system as "administrative" is inaccurate, simplistic, and ultimately misleading. Every physical system for criticality control requires some administrative procedures to implement, and NNECO's proposal is no different. Parillo Affidavit, ¶ 61; Turner Affidavit, ¶¶ 20-30. Indeed, every system, structure, and component at a nuclear plant requires some administrative procedures to implement. But this does not alter the physical nature of the processes and system applied, or the physical fact of the criticality control provided.

b. Soluble Boron Credit

As discussed in the affidavit of Mr. Parillo, and as discussed in more detail in Section V.B.2 below as it relates to Contention 5, NNECO's proposal credits soluble boron in the Millstone Unit 3 SFP only for the fuel handling accident condition in the licensing basis criticality analyses, with substantial margin applied. Parillo Affidavit, ¶ 21. To address the Intervenors' Contention 5, which expressed the concern that the required boron would not be verified at all times, NNECO has revised proposed TS 3.9.1.2 so that it will require a minimum

SFP boron concentration of 800 ppm whenever fuel is stored in the SFP. Proposed TS Surveillance Requirement 4.9.1.2 will require that the boron concentration be verified every seven days. McDonald Affidavit, ¶ 8.

Chemistry surveillance procedure SP 3866, "Spent Fuel Pool Boron Concentration" will also continue to include a Millstone administrative requirement for a boron concentration of 2,600 ppm. McDonald Affidavit, ¶ 11. This concentration is consistent with the value for boron concentration that would be required by TS and Millstone procedures during plant refueling operations, when the reactor cavity and spent fuel pool are in communication. Id. at ¶ 13. There is no operational reason to vary the boron concentration in the period between refueling operations.

In response to interrogatories in this proceeding,[3] the Intervenors stated that:

- "Petitioners do not challenge the proposed 800 ppm boron concentration" (except with respect to the legality under GDC 62 in Contention 6); and

- The "Standard Technical Specifications [for] Westinghouse Plants [NUREG-1431, Rev. 1] specifies a 7-day frequency for the surveillance of boron concentration in the spent fuel pool water" and that "Intervenors would have no objection to a 7-day surveillance frequency" (again, apart from the appropriateness of such credit under GDC 62). Mr. Lochbaum expressed similar views during his deposition. Lochbaum Deposition Tr. 25-26.

Thus, the sufficiency of the proposed requirements related to the concentration and surveillance of soluble boron in the Unit 3 SFP is not in dispute.

Like the reactivity restrictions discussed above, soluble boron credit is not "new" at Millstone Unit 3. Parillo Affidavit, ¶ 51. The Unit 3 TS currently require a 1,750 ppm boron

[3] "Connecticut Coalition Against Millstone and Long Island Coalition Against Millstone Supplemental Reply to Northeast Nuclear Energy Company's First Set of Interrogatories," dated April 25, 2000 (at 4-5).

concentration. Soluble boron credit has been approved by the NRC for Unit 3 for the licensing basis fuel handling accident since initial licensing in 1986. The original TS requirement was for 800 ppm. This requirement was increased to 1,750 ppm in April 1998, in response to Boraflex degradation issues. Id. The current proposal no longer credits Boraflex and restores the original required concentration. The purely conceptual Contention 4, arguing that the proposal involves an inappropriate or undesirable "trade off," is again a mis-labeling based on a faulty premise.

2. *NNECO's Proposal is Consistent with Regulatory Guidance and Industry Precedents*

NNECO's proposal is consistent with longstanding nuclear industry practice and NRC regulatory guidance. Any conclusion otherwise would contravene the express intent of the NWPA. As discussed in the affidavit of Dr. Turner, the use of burnup credit for criticality control is prevalent throughout the industry. At least 20 nuclear power plants utilize this approach under license and technical specification amendments issued by the NRC. Turner Affidavit, ¶ 50.

As discussed in the affidavit of Mr. Parillo (at ¶ 63), the NRC has consistently applied, over a long period of time, regulatory guidance allowing credit for soluble boron and fuel burnup in spent fuel pool criticality analyses. In 1978, the NRC Staff issued a position paper[4] recognizing that "[r]ealistic initial conditions (*e.g.*, the presence of soluble boron) may be assumed for the fuel pool and fuel assemblies." Reference 6, Section 1.2 at III-1. Fuel enrichment and burnup, like the presence of soluble boron, are initial conditions of fuel

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4 NRC letter, Brian K. Grimes to All Power Reactor Licensees, "OT Position for Review and Acceptance of Spent Fuel Storage and Handling Applications" (April 14, 1978) (Reference 6).

assemblies. In 1981, the NRC Staff issued Regulatory Guide 1.13, draft Revision 2,[5] and more specifically allowed credit for burnup in storage rack design and analysis. Reference 7, Enclosure at 1.13-13 through 1.13-15. And finally, in 1998, the NRC Staff issued a new guidance memorandum on storage rack criticality control[6] which specifically allows for soluble boron credit, fuel burnup limits, and fuel decay time limits. Reference 8, Enclosure at Section 5.A and 5.B.

The licensing basis criticality analyses supporting NNECO's proposal are also entirely in compliance with NRC requirements and guidance. To summarize, the licensing basis criticality analyses for the Millstone Unit 3 proposal demonstrate the following:[7]

- For the design basis normal conditions, for each region of the SFP with fuel in the most restrictive configuration, and *no credit for soluble boron*, the K-effective ("K_{eff}") is less than 0.95. Loss of all soluble boron is therefore an analyzed event.

- For the design basis accident case, involving *the most conservative misplacement of one fuel assembly*, and crediting 425 ppm soluble boron, the K_{eff} is less than 0.95. (As discussed above, based on this calculation, and applying substantial margin, NNECO is proposing a Technical Specification whereby soluble boron would be maintained at all times at 800 ppm.)

The results of these criticality calculations are unrefuted. <u>See</u> Thompson Deposition Tr. 13-14; Lochbaum Deposition Tr. 9-10 (Reference 5). Intervenors' experts acknowledged that they would accept the results as calculated by NNECO and its contractor. <u>Id</u>.

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5 Proposed Revision 2 to Regulatory Guide 1.13, "Spent Fuel Storage Facility Design Basis" (December 1981) ("Draft Reg. Guide 1.13") (Reference 7).

6 Memorandum, Lawrence Kopp (NRC) to Timothy Collins (NRC), "Guidance on the Regulatory Requirements for Criticality Analysis of Fuel Storage at Light-Water Reactor Power Plants" (August 19, 1998) ("1998 Criticality Guidance") (Reference 8).

7 <u>See</u> Parillo Affidavit, ¶ 21.

NNECO maintains that the analyses of these standard licensing basis cases meet 10 C.F.R. § 50.68 and the applicable NRC regulatory guidance. See Turner Affidavit, ¶¶ 42-49. The NRC Staff's regulatory guidance for implementing criticality controls endorses the Double Contingency Principle. Specifically, Draft Reg. Guide 1.13, Appendix A, Section 1.4,[8] defines the Double Contingency Principle as follows:

> At all locations in the LWR spent fuel storage facility where spent fuel is handled or stored the nuclear criticality safety analysis should demonstrate that criticality could not occur without at least two unlikely, independent, and concurrent failures or operating limit violations.

The Double Contingency Principle has also been stated in other relevant NRC Staff guidance documents. The 1998 Criticality Guidance[9] defines the Double Contingency Principle as follows:

> The criticality safety analysis should consider all credible incidents and postulated accidents. However, by virtue of the double-contingency principle, two unlikely independent and concurrent incidents or postulated accidents are beyond the scope of the required analysis. The double-contingency principle means that a realistic condition may be assumed for the criticality analysis in calculating the effects of incidents or postulated accidents. For example, if soluble boron is normally present in the spent fuel pool water, the loss of soluble boron is considered as one accident condition and a second concurrent accident need not be assumed. Therefore, credit for the presence of the soluble boron may be assumed in evaluating other accident conditions.

Dr. Turner has been employing the Double Contingency Principle in performing criticality analyses for spent fuel storage racks for over 20 years. He states in his affidavit (at ¶ 47) that the most recent Staff guidance on this issue, the 1998 Criticality Guidance, is the most simple and easy to understand explanation of the Double Contingency Principle. Its meaning,

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8 Reference 7, at 1.13-9.

9 Reference 8, Enclosure at 4.

however, is the same as that in the prior Staff guidance documents. It has been Dr. Turner's experience that the Double Contingency Principle has been interpreted as nearly the same as the conventional single failure criterion, provided that the accident conditions are not related or directly caused by other accident conditions. Turner Affidavit, ¶ 48. In particular, the example identified in the 1998 Criticality Guidance provides a clear description of conventional practice. The instantaneous loss of all soluble boron from the pool water is considered as one accident condition, not as an initial condition prior to another assumed accident. Thus, credit for the presence of soluble boron may be included in the evaluation of any other single accident condition. Conversely, in the evaluation of the consequence of loss of soluble boron, the Double Contingency Principle would preclude any requirement to consider a simultaneous fuel misloading accident. Id. However, at a minimum, the fuel misloadings and the loss of soluble boron are independent accident conditions and both are unlikely incidents (for reasons amplified below), so that the concurrent occurrence of both accidents need not be considered. Id.[10]

Furthermore, as discussed by Mr. Parillo in his affidavit (at ¶¶ 43-45), the licensing basis criticality analyses are very conservative and the calculated reactivity effects in these cases will bound other scenarios. For example, the limiting single fuel mishandling event — because of the conservative assumptions regarding the reactivity and placement of the assembly — will have a reactivity effect that bounds cases involve a multiple number of misloaded fuel assemblies. Parillo Affidavit, ¶ 43. The Intervenors have not identified any

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[10] In addition to the traditional single failure criterion, there are other analogous precedents in NRC practice. For example, the Commission has held that it is not necessary to consider the complicating effects of an earthquake on a simultaneous emergency response. San Luis Obispo Mothers for Peace v. Nuclear Regulatory Commission, 789 F.2d 26 (D.C. Cir. 1986), cert. denied 479 U.S. 923, 107 S. Ct. 330 (1986).

particular misload case or boron dilution case and demonstrated that that case is not bounded by NNECO's licensing basis analysis cases.

In sum, NNECO's proposal is consistent with NRC regulations, regulatory guidance, and longstanding NRC and industry practice — including current practice at Millstone. The supporting criticality analyses demonstrate adequate margin of safety with respect to postulated accidents. The regulatory history related to NRC's requirements is discussed in more detail in Sections VI.C.4, VI.C.5, and VI.C.6 below, as it relates to Contention 6. Suffice it to say here, NNECO's proposal — including the criticality analysis — is consistent with this guidance.

3. *NNECO Employs Procedures to Control and Verify Fuel Movements that Provide Reasonable Assurance that Fuel Assemblies Will Not Be Misloaded*

NNECO's proposal for regional storage, based upon fuel burnup/decay limitations, will be implemented using proven calculation techniques and fuel handling procedures. The current Millstone procedures to implement burnup restrictions are described in NNECO's May 5, 2000 supplement to the Application (Reference 3), and in the affidavits of Mr. Jensen and Mr. Parillo. These procedures call for, among other things, 10 C.F.R. Part 50, Appendix B (Quality Assurance) independent calculations to determine fuel burnup and dual verification of fuel assembly moves. These procedures are currently utilized for the Millstone Unit 3 two-region spent fuel pool and will simply be adapted for the three-region proposal. Parillo Affidavit, ¶¶ 15-17. They are summarized below.

First, with respect to the determination that fuel assemblies have attained proper burnup for storage in the burnup dependent regions, NNECO currently utilizes Surveillance Procedure SP 31022, "Spent Fuel Pool Criticality Requirements." This procedure will be revised to cover the 3-region proposal and to incorporate fuel decay time in the evaluation. Jensen Affidavit, at ¶ 18; see also Reference 3, Attachment 1, at 2-3. The proposal will not change the existing QA process used to calculate fuel burnup, as described by Mr. Jensen (at ¶ 20). This involves:

- A Westinghouse QA computer code is used to generate measured core power distribution maps;
- A Westinghouse QA computer code is used to generate measured individual fuel assembly burnups, using the measured power distribution maps. Analytical inputs are determined using QA calculations; and
- The resulting measured fuel assembly burnups are documented in QA calculations.

In accordance with SP 31022, the measured fuel burnup value is documented, reduced by an appropriate uncertainty value, and checked against regional TS limits. Jensen Affidavit, ¶ 21. If the fuel burnup is greater than that required by a regional TS limit, the fuel is qualified for storage in that region. The fuel assembly identification ("ID" or "fuel group ID") is entered on a controlled Qualified Fuel Assembly form, which lists all fuel assemblies qualified for storage in each burn-up dependent region. Id.; see also Reference 3, Attachment 1 at 3.

As further discussed in the affidavit of Mr. Jensen, all fuel assembly movements are controlled under the direct supervision of qualified Reactor Engineering or licensed Operations personnel. Jensen Affidavit, ¶¶ 25-27. Fuel assembly moves are specified on a Material Transfer Form ("MTF") and are made one at a time and in accordance with Engineering Procedure EN 31001, "Supplemental SNM Inventory and Control." Id. at ¶ 27. EN 31001 requires two individuals — an SNM Executor and an SNM Checker — for all fuel assembly movements. Therefore, there is dual verification that the correct assembly is moved and that the assembly is placed in the correct storage location. Id.

As discussed in Reference 3 (Attachment 1 at 4-5), and in the affidavits of Mr. Jensen (¶¶ 28-35) and Mr. Parillo (¶ 14), the process can be summarized as follows:

- Given the physical limitations of the fuel handling equipment, all assembly moves are performed one at a time, by qualified personnel. Move sheets (MTFs) are prepared to track the move;

- A new fuel assembly is verified by serial number prior to moving it to a designated SFP storage location. When moved to the location, a second verification of the correct location is made. This provides an initial baseline for each assembly;

- After the reactor core is reloaded (either an initial load or a reload), a fuel assembly serial number verification is made for assemblies in the core. This maintains the baseline;

- In the SFP, after a core load is complete, a piece count in the SFP is made to verify that there is fuel in each designated location and no fuel in a storage location that should be empty;

- During core off-load, there is dual verification (by an SNM Executor and an SNM Checker) that the assembly is removed from the proper core location to the transfer canal; and

- There is another SNM Checker, with an identical set of MTFs, performing a verification of the placement of the fuel assembly from the transfer canal into the proper SFP storage location.

As discussed in the affidavit of Mr. Parillo, the procedures to be used for the proposed SFP configuration are not different than the procedures currently in effect at Millstone Unit 3. Parillo Affidavit, ¶ 15-17.

The Intervenors' concerns for "complexity" and the potential for human error (and misconduct) all are expressed as support for the concern that there will be human errors that will lead to criticality. During discovery, however, the Intervenors' expert pointed to only one perceived deficiency in NNECO's fuel handling procedure: after a core load is complete, there is a serial number verification of assemblies loaded in the core, but only a piece count of fuel assemblies, and not a serial number verification, in the SFP. Lochbaum Deposition Tr. 34-35. As discussed by Mr. Jensen in his affidavit (at ¶ 30), a serial number verification in the SFP is not necessary. The serial number verification in the core and the dual verification process for fuel moves are sufficient to assure that moves have been correctly accomplished. Experience at Millstone has confirmed this. Jensen Affidavit, ¶ 39. NNECO has also periodically completed baseline verifications of the SFP inventory by serial number. The last verification was during the 1999 refueling. No misloadings were identified. Jensen Affidavit, ¶ 30. Moreover, with the boron required in the SFP, there is adequate margin such that this conservatism would be unnecessary. Id.[11]

In sum, in regard to the potential for fuel assemblies being misplaced, the Intervenors have not identified a particular, genuine deficiency and have not raised a genuine or substantial issue.

4. *Practical Considerations Further Minimize the Potential for Misloading Event*

The Intervenors' argument also is overly simplistic, with the inherent assumption that a misloaded assembly is, in and of itself, significant. In fact, a misloaded fuel assembly is

[11] Upon initial implementation of the new racks and TS, approximately 125 assemblies currently in the SFP (in what will become Region 3) must be relocated to the new Region 1 or Region 2. This initial relocation will be conducted in accordance with standard, dual verification procedures. Additionally, serial numbers for these assemblies will be verified at the time of the moves to confirm the proper selection. Jensen Affidavit, ¶ 15.

only of potential significance if it is misloaded into a region for which the fuel is not qualified.[12] In addition to the dual verifications built into the fuel handling procedures, certain practical considerations inherent in the Unit 3 proposed SFP configuration will minimize the likelihood of a fuel assembly misload into an unintended region where it will not be qualified. These are described in NNECO's supplemental filing of May 5, 2000 (Reference 3, Attachment 1 at 5-7) and in the affidavit of Mr. Parillo (see ¶¶ 30-37).

First, new fuel is the most reactive fuel. The design basis, limiting misplacement event involves placing new fuel in new Region 3. However, new fuel will be stored in Region 1. Region 1 racks will be grouped together and placed in front of the fuel transfer canal to facilitate new fuel loading. New fuel will pass only over Region 1, and not over Region 2 or 3. Parillo Affidavit, ¶ 31. Further, the designated location for new fuel will be the Region 1 3-out-of-4 storage locations. The new fuel is shiny and distinctive (compared to spent fuel); the intended locations have distinctive and visually obvious cell blockers. Therefore, it is unlikely that new fuel would be accidentally placed in a location in Region 2 or 3, where it would not be qualified. Id. at ¶ 32.

With respect to movements of used fuel during refueling, most movements will be between Region 1 and the fuel transfer machine. Because the Region 1 racks are directly in front of the transfer canal, most fuel during refueling will never pass over Region 2 or Region 3. Id. at ¶ 33. Region 1 is conservatively designed so that, absent an unusual and unlikely situation involving a premature off-load after a refueling, any fuel assembly coming out of the core should

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12 As is also discussed in Section IV.B.7 below, criticality analyses definitively show that worst case misplacements of fuel into regions for which it is not qualified will *not* lead to criticality events.

be qualified for Region 1 4-out-of-4 storage. Therefore, there is little likelihood of fuel being misloaded in Region 1. Id. at ¶ 34.

Region 2 is designed to accommodate any spent fuel that is at least twice-burned. After a core reload, absent unusual circumstances involving prematurely discharged fuel, the remaining fuel in the SFP would ordinarily be three times burned and would be qualified for either Region 1or Region 2. Therefore, there should be little likelihood of a "misplacement" of remaining fuel in Region 1 or Region 2 that would have any consequence. Id. at ¶ 35.

Region 3 is the limiting region with respect to criticality affects of a postulated misplacement. But Region 3 racks are located the farthest from the transfer canal and the only reason to pass over Region 3 is to move fuel there for permanent storage. This minimizes the likelihood of a fuel drop or misplacement in this region. Id. at ¶ 36. Moreover, movements into the region are subject to the dual verification process previously described. The Region 3 racks also incorporate the uncredited Boraflex as an additional conservatism against criticality. Id. at ¶ 37.

Based upon this uncontested evidence, as well as the dual verification process for fuel moves, the Licensing Board should find that there is reasonable assurance that fuel assemblies will not be misplaced into a region for which they are not qualified. The entire issue of undetected, misplaced fuel assemblies, is neither genuine nor substantial.

5. *Operating Experience Does Not Support the Contention*

The Intervenors apparently will rely on various events at Millstone and elsewhere in the nuclear industry to attempt to demonstrate that equipment problems and fuel handling errors occur. These events have been reported in condition reports, non-conformance reports, licensee event reports, and the like. NNECO, under the supervision and direction of Mr. Parillo and Mr. Jensen, has prepared a Matrix of Operating Experience ("OE"), including events that both NNECO and the Intervenors identified during discovery. This OE Matrix incorporates NNECO's assessment of the relevance of each event to the Unit 3 SFP proposal at hand. The OE Matrix is included as Reference 9. It is sponsored as part of the sworn testimony of Mr. Parillo and Mr. Jensen. Parillo Affidavit, ¶ 40; Jensen Affidavit, ¶ 37.

Fuel burnup credit is not new at Millstone. As previously discussed, NNECO has been authorized to utilize burnup credit in the SFP storage system for Millstone Unit 2 since 1986, and for Unit 3 since 1990. Parillo Affidavit, ¶ 39. *In this time, there has never been a case at Millstone where a fuel assembly was placed into a storage region for which it was not qualified.* Id.; see also Jensen Affidavit, ¶ 39. Again, as discussed above, this has been confirmed by periodic serial number verifications, most recently for Unit 3 in 1999. Id. There can be no evidence more relevant or probative than this.

The OE Matrix demonstrates how the events identified during discovery fail to raise a genuine issue with respect to the Application. As shown in the OE Matrix, many of the Millstone events identified during discovery have no bearing on the SFP at all. For example, many relate to orientation or rotation of an assembly in the reactor core. Many involve single fuel handling errors, where (at most) a single fuel assembly was placed in an unexpected condition, the condition was immediately evident, and corrective actions were taken. A single fuel handling misplacement, as discussed above, is an analyzed event bounded by the Unit 3 SFP licensing basis criticality analysis.

As discussed in the affidavit of Mr. Parillo (at ¶ 40), NNECO identified only two Millstone events — one for Unit 2 in October 1985, and one for Unit 3 in April 1994 — where even a *potential* for a misplacement occurred. In both of these cases, a fuel assembly was brought to the wrong location; when lowered, it came into contact with a correctly stored assembly in the location. Therefore, a misplacement did not occur. Moreover, in both cases the fuel assembly was qualified for the location involved — and therefore fuel enrichment/burnup limitations would not have been violated. Parillo Affidavit, ¶ 40. In addition, for the 1994 event at Unit 3, a plant incident report was generated at the time, a cause analysis was completed, and corrective actions were taken. Jensen Affidavit, ¶ 38.

The OE Matrix also addresses a few incidents at nuclear plants other than Millstone cited by the Intervenors during discovery, where a few fuel assemblies were stored, at the same time, in a region for which they were not qualified. Mr. Parillo, in his affidavit, acknowledges these events and explains that the overall reactivity effect of the misplacements was far less than the reactivity effect in the limiting licensing basis single fuel mishandling event discussed above, because of the conservative assumptions of the criticality analyses. Parillo Affidavit, ¶¶ 43-45. The licensing basis single misload for Millstone Unit 3 is a 5 weight-percent U-235 fresh fuel assembly misloaded into an otherwise completely filled rack of maximum permitted reactivity. The K_{eff} increase in this case would bound the K_{eff} increase caused by multiple fuel assembly misplacements such as those experienced in the industry. Id.

The mere recitation of this industry experience involving misplaced assemblies does not raise a genuine or substantial issue that would require further hearings. If there is any thrust to the contention, it is that added "complexity" will increase the potential for human error. While no foundation has ever been established by the Intervenors that NNECO's proposal actually increases the potential for human error, we will assume for sake of argument that this may be true. Still, however, the contention leads nowhere. Human error potential can never be eliminated in any proposed spent fuel storage system or procedure. NNECO could opt for dry cask storage or for a larger spent fuel pool with unrestricted storage and more comfortable physical spacing. However, there would still be human error potential. Human error potential cannot be eliminated; it can only be addressed — consistent with the regulatory guidelines — by margin-of-safety and defense-in-depth, such as that provided by soluble boron. In the evidence included with this paper, NNECO shows that adequate procedures are provided to control and verify fuel movements. Based on the assumption that human errors can nonetheless occur, licensing basis criticality calculations demonstrate the substantial margin-of-safety, based on defense-in-depth, provided by the proposal.[13]

6. *There is Reasonable Assurance that Soluble Boron Dilution Events Will Not Occur*

The Intervenors have raised an issue regarding the potential for soluble boron dilution, or even errors in the boron concentration surveillance, which in theory would lead to nuclear criticality in the SFP. However, on discovery, the Intervenors did not identify any specific boron dilution mechanism for Millstone Unit 3, notwithstanding NNECO's request that it do so. See, e.g., Thompson Deposition Tr. 23-28 (Reference 5). And at least one of the Intervenors' witnesses acknowledged that the boron surveillance procedure "is a relatively simple procedure to do." Lochbaum Deposition Tr. 23 (Reference 5).

In any event, significant boron dilution events are not likely at Millstone Unit 3. As discussed in the affidavit of Mr. Parillo (at ¶ 25), it would take at least 500,000 gallons of unborated water to dilute the SFP from 2,600 ppm (by administrative limit, the SFP would be at

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13 Similarly, the Intervenors may point to equipment problems documented in internal NNECO reports and logs. Some of these are addressed in the affidavit of Mr. Jensen (at ¶ 40). Equipment problems will always occur. That is one reason internal corrective action programs exist to identify causes and corrective actions. There has been no showing of any equipment problem at Millstone that has caused a misplaced fuel assembly or a boron dilution event.

least 2,600 ppm) to 800 ppm by some postulated continuous (*e.g.*, "feed and bleed") dilution method. It would take another 280,000 gallons of unborated water to dilute the SFP to 425 ppm boron. Such dilution is highly unlikely. Any leakage from nearby water sources would most likely flow through the spent fuel building stairwell or floor grating and away from the SFP. An elevated curb that lines the edge of the SFP would also protect against incidental leakage. Moreover, any dilution of this magnitude would quickly be detected by high water level alarms, worker observations, or periodic surveillances of the boron concentration. Parillo Affidavit, ¶ 25; Turner Affidavit, ¶¶ 58-61; McDonald Affidavit, ¶ 16.

As also discussed by Mr. Parillo in his affidavit (at ¶ 27), NNECO performed a structural evaluation of piping systems around the SFP as part of its 1998 TS amendment that increased the soluble boron requirement for the Unit 3 SFP to 1,750 ppm. This structural evaluation assured that a seismic event would not lead to pipe leaks that would dilute the SFP boron. The Intervenors on discovery did not offer any evidence or expertise to dispute the structural analyses.

The Intervenors during discovery expressed some interest regarding the roof drain pipe and pipes associated with a heating unit located in the area above the SFP. In fact, however, as a result of the 1997-98 structural evaluation discussed above, certain piping modifications were made, including a modification to cap the roof drain pipe above the SFP and modifications to two glycol preheating system lines, to assure that there were not pathways for water to cause a boron dilution scenario. Parillo Affidavit, ¶¶ 27-28. Additionally, NNECO's analysis assured that sufficient drain capacity exists within the modified roof drain configuration to manage the removal of rainwater from the building roof. Id. at ¶ 28.

Dr. Turner in his affidavit (at ¶ 62) addressed one case in the nuclear industry cited by the Intervenors where a licensee inadvertently diluted the boron in the SFP. In July 1994, at the McGuire plant, station personnel added a quantity of unborated water to the SFP which reduced the boron concentration below the 2,000 ppm required by technical specifications, to 1,957 ppm. However, this reduced concentration was detected and criticality safety was not compromised. Turner Affidavit, ¶ 62.

At the prehearing conference and during discovery, as support for this contention, the Intervenors referenced an incident at Millstone Unit 2 which they characterized as a loss of boron or boron dilution event. Prehearing Conference Tr. 100-101. On discovery it emerged that the reference was to an event in January 1999 at Millstone Unit 2 in which the operators inadvertently reduced SFP water level by two inches. As discussed by Mr. Parillo in his affidavit (at ¶ 29), what actually occurred was a system alignment problem that led to the transfer of approximately 2,370 gallons of SFP water to the clean liquid radioactive waste system. The flow was observed by a plant equipment operator (prior to a level alarm threshold even being reached) and was subsequently secured. The SFP water level remained above the SFP low level alarm setpoint. Had the transfer of water continued, the low level alarm and operator action would have ensured that adequate water would remain for SFP cooling and for shielding of the stored fuel. Thus, the risk significance of the event was low. With respect to boron dilution, there was none — the boron concentration under these circumstances would remain constant.

In sum, with respect to boron dilution scenarios, NNECO's records show that the boron concentration for Unit 3 has been very consistent over the years. <u>See</u> Reference 3, Attachment 1, at page 1; <u>see also</u> McDonald Affidavit, ¶ 10. No credible basis for a boron dilution event was ever identified by the Intervenors during discovery. In fact, given the volumes of water involved, the physical considerations that would prevent flow from pipes in the SFP building from entering the SFP, and the structural analyses and modifications previously made by NNECO to eliminate the potential for pipe breaks due to an earthquake, there is reasonable assurance that a significant boron dilution event will not occur. There is no basis to require evidentiary hearings on this issue now.

7. *Additional Criticality Calculations Demonstrate the Substantial Margin of Safety to Accommodate Fuel Placement Errors and Boron Dilution Scenarios*

Stripped of all of the semantic arguments, the assertions of added "complexity," the recitations of minor fuel handling incidents and fuel handling equipment problems, and the suspicions regarding NNECO's ability and willingness to comply with administrative controls, the contention distills to what might occur should procedural controls break down. Intervenors hypothesize a criticality event that would result from: (1) multiple undetected fuel assembly misplacements; (2) the dilution of the soluble boron is the SFP; or (3) a combination of undetected assembly misplacements and boron dilution. NNECO's criticality analyses for Millstone Unit 3, however, conclusively demonstrate that these are not genuine or substantial issues. Notwithstanding the conservative licensing basis criticality analyses already discussed above, the adequacy and safety of the procedures to be utilized to implement the proposed 3-region spent fuel storage system, and the extreme unlikelihood of a significant boron dilution event, the storage system is designed with a substantial margin of safety such that — even in the event highly unlikely conditions related to concurrent misplacements of multiple fuel assemblies and dilution of soluble boron — there will be no criticality in the SFP.

As presented by Dr. Turner in his affidavit (¶ 63, Tables 1-3), NNECO has performed additional criticality calculations for this proceeding that assume concurrent multiple fuel assembly misplacements, and that assume misplacements concurrent with boron dilution. *The criticality calculations definitively demonstrate the substantial margin of safety and are not challenged by the Intervenors.* These cases demonstrate:

- For a *beyond-design-basis case* involving the entire spent fuel pool filled with fresh fuel with the maximum fuel enrichment, and assuming a boron dilution to 2,000 ppm soluble boron (from the more than 2,600 ppm that will be maintained by administrative limit), the storage racks will remain sub-critical (K_{eff} less than 1.00).

- For *beyond-design-basis cases* involving concurrent, undetected misplacement of a finite number of fuel assemblies (*i.e.*, misplacement of between 5 and 8 fuel assemblies, depending on the assumptions) of the maximum permissible reactivity (*i.e.,* 5 weight-percent fresh fuel) and in the most conservative configuration, and assuming boron dilution from more than 2,600 ppm to the 800 ppm soluble boron that will be verified at Millstone Unit 3 under the plant Technical Specifications, the storage racks will remain sub-critical (K_{eff} less than 1.00).

- For a *beyond-design-basis* case involving the single most conservative misplacement of an assembly (*i.e.*, a fresh fuel assembly is placed in Region 3 with all other Region 3 locations filled with spent fuel of the maximum permissible reactivity), and taking *no credit for any soluble boron*, the K_{eff} remains sub-critical (*i.e.*, less than 1.00).[14]

Similar to the licensing basis case results discussed above, the results of these criticality calculations are not in dispute. Thompson Deposition Tr. 13-14; Lochbaum Deposition Tr. 9-10 (Reference 5).

These analyses include many conservatisms, such as the assumption that fresh fuel will be misplaced in Region 3. For reasons discussed in Mr. Parillo's affidavit (at ¶¶ 30-36) and above, this is very unlikely. As also discussed by Mr. Parillo (at ¶ 37), these analyses also

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14 As noted by Dr. Turner, in this conservative case if there is a concurrent, abnormal increase in spent fuel temperature, and all biases and uncertainties are included, K_{eff} could slightly exceed 1.0. Approximately 30 ppm soluble boron would be enough to preclude even this potential. See Turner Affidavit, ¶ 63, Table 3.

do not credit the Boraflex present in Region 3. In the end, the Intervenors arguments involve piling failure upon failure. NNECO's criticality analyses show nonetheless that — even assuming that incredibly dire scenarios involving combinations of failures were to come to pass — no criticality would result in the SFP. These analyses, more than any other uncontroverted fact offered here, render the arguments offered with respect to this contention to be of no decisional significance whatsoever.

8. *Past Performance Issues and Allegations of Misconduct at Millstone Have No Bearing on the Amendment at Issue*

As a final basis for Contention 4, the Intervenors cite the past performance and regulatory issues at Millstone that led to extended shutdowns of the Millstone units, as well as an associated NRC civil enforcement action. The Intervenors also cite a past criminal plea accepted by NNECO related to violations of NRC requirements and the Clean Water Act. And finally, the Intervenors apparently also will raise the specter of other allegations of past environmental violations and misconduct. Unrefuted facts relevant to these matters are addressed in the affidavit of Mr. David Dodson. As will be demonstrated, there is no reason for the Licensing Board to go beyond these unrefuted facts.

Without delving into the details regarding the Intervenors' characterizations of past NRC regulatory issues at Millstone, the most important, undisputed and incontrovertible facts can be summarized as follows:

- In January 1996, Millstone Unit 3 was placed on the NRC's "Watch List." Subsequently, in early 1996, Unit 3 (along with Unit 2) was voluntarily shut down by NNECO. NNECO committed, prior to restart of any of the units, to implement substantial improvements and demonstrate to the satisfaction of the NRC that there was reasonable assurance that the units would be operated in accordance with the NRC operating licenses, NRC regulations, and the design and licensing basis documents. Dodson Affidavit, ¶ 7.

- No Millstone Unit could be restarted until the NRC — by formal vote of the Commission — approved. Id.

- NNECO completed a substantial recovery program for Millstone Unit 3, which included actions to verify and restore the design basis, to improve the corrective action and configuration management programs, to improve procedures, to restore the safety conscious work environment, to revitalize internal nuclear oversight, and to set standards and to improve individual management and leadership skills. Id. at ¶¶ 8-13.

- The Millstone recovery included satisfactory completion of two significant third-party verifications ordered by the NRC: the Independent Corrective Action Verification Program, whereby a contractor verified that NNECO had identified and implemented corrective actions for past design basis and configuration management discrepancies; and the Independent Third Party Oversight Program, requiring a third party to oversee management actions to ensure a safety conscious work environment at Millstone and to enhance the Employee Concerns Program. Id. at ¶ 14.

- The NRC Staff exercised substantial oversight of the Millstone recovery in accordance with NRC Inspection Manual Chapter 0350. The process called for close monitoring of key issues by a Millstone Restart Assessment Panel, as well as numerous public briefings and opportunities for public input. Id. at ¶¶ 15-16.

- Based on the NRC Staff's recommendation, restart of Millstone Unit 3 was approved by the Commission in July 1998. Restart of Unit 2 was approved by the Commission in mid-1999. Id. at ¶ 17.

- The NRC Staff has conducted ongoing oversight at Millstone Unit 3 since the restart. In particular, Unit 3 had been considered an NRC "regional focus" plant, indicating augmented NRC inspection activities. Dodson Affidavit, at ¶ 18. However, since restart the NRC inspection reports document a trend of improved performance such that, on May 25, 2000, the NRC Staff announced to the Commission that it was reclassifying both operating Millstone units in the "routine focus" category. Id. at ¶¶ 18-19. For Millstone management, this change in NRC oversight status marked a significant achievement in the recovery at the station and a validation of the commitment to continuous improvement. Id. at ¶ 19.

- One of the Intervenors' witnesses, Mr. Lochbaum, during discovery, characterized Contention 4 as a concern for "complexity" in administrative controls that is generic; that is, not specific to Millstone Unit 3 or

NNECO's past performance. He did not oppose restart of Unit 3 in 1998 based on any lack of confidence in NNECO, and he does not contest NNECO's trustworthiness now. Lochbaum Deposition Tr. 58-60.[15]

The facts regarding certain NRC enforcement actions related to this past performance at Millstone are as follows:

- A December 1997 NRC enforcement action, including a $2.1 million civil penalty, as referenced by the Intervenors, addressed historic violations generally related to configuration management and design basis issues at all three Millstone units. None of the violations addressed in this action cited deliberate violations. Id. at ¶ 23.

- The causes of the violations addressed in the December 1997 action can be traced to design control and/or corrective action program deficiencies — matters which were explicitly addressed in the extensive Millstone recovery program and which were resolved to the satisfaction of the NRC Staff and Commissioners prior to restart. Id. at ¶ 24.

- Intervenors also point to historic refueling issues at Millstone Unit 1 which were addressed in a TIME magazine article and later in an NRC enforcement action and exercise of enforcement discretion in May 1999. The NRC cited a Severity Level III problem and proposed no civil penalty. Id. at ¶ 29-30. This enforcement action addressed core off-loads *between 1974 and 1991 at Millstone Unit 1.* The NRC identified the causes of this condition as consistent with those leading to the $2.1 million civil penalty. Id. at ¶ 30.

- The historic Unit 1 off-load issues related to maintaining the design documentation and procedures consistent with the as-operated plant. This was not a matter involving failure to heed existing, prescriptive administrative controls. Id. The controls proposed for the current Application related to burnup and decay restrictions, as well as boron surveillances, will be clearly specified in the proposed TS. In addition, the use of hold-times prior to core off-load has been addressed for Unit 3. Id. at ¶ 31.

With respect to the Intervenors' recitation of past Millstone regulatory and performance problems, and the past NRC enforcement history, these matters have no bearing on

[15] Dr. Thompson stated during his deposition that he has no knowledge of these matters. Thompson Deposition Tr. 17 (Reference 5).

the amendment Application at hand. There is no showing that any of those issues relates to spent fuel pool burnup restrictions or soluble boron concentrations. Moreover, the Millstone shutdown occurred in 1996. The subsequent, intense period of recovery at the station ultimately led to Commission approval to restart Unit 3 in 1998, and to restart Unit 2 in 1999.[16]

As discussed in Mr. Dodson's affidavit (at ¶¶ 21, 25-28), there are thousands of ongoing administrative controls employed at Millstone. Improving the quality of these controls, as well as procedure adherence, were key elements of the Millstone recovery program. The specific administrative controls associated with the Application at issue, including those associated with spent fuel assembly transfers and boron concentration surveillances, are well-established with very prescriptive requirements and acceptance criteria. In contrast to the conditions leading to many of the issues in the past, for these controls there is reasonable assurance of successful implementation. Dodson Affidavit, ¶¶ 25-27, 31.

Furthermore, the fact that Millstone is operating successfully, with full NRC approval, ultimately refutes *any* claim that past performance establishes that NNECO will not successfully implement the proposed license amendment. If the NRC Staff or Commission had any basis to believe otherwise, the agency certainly would not have approved restart of the units, would not have reclassified the units as "routine oversight," and in all likelihood, would not allow continued operation today. Indeed, the NRC Staff, in its ongoing oversight function, will retain the responsibility to continuously observe performance at Millstone. The Staff's decision

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16 The Licensing Board in this proceeding has already recognized the more appropriate, limited scope of materiality of past issues at Millstone. In its June 8, 2000 Memorandum and Order (Discovery Rulings, 5/26/00 Telephone Conference), the Licensing Board limited further discovery into past events to those that are: related to Unit 3, related to the SFP rather than the reactor core; and occurred since the Unit 3 restart or during the last refueling, whichever is earlier. This view of limited materiality should stand as the law of the case.

to re-classify the Millstone units as "routine oversight" plants reflects a recent, informed view of the *current* state of Millstone.

In addition to past NRC regulatory issues, the Intervenors have alluded to a criminal plea that NNECO entered in 1999, related to certain violations of NRC requirements and certain violations of the Clean Water Act. The undisputed facts with respect to these matters are presented by Mr. Dodson and are as follows:

- In September 1999, Northeast Utilities entered a guilty plea and agreed to pay a total of $10 million in fines related to alleged violations of the Clean Water Act and alleged violations of NRC regulations related to nuclear training records. Dodson Affidavit, ¶ 32.

- The charges with respect to NRC regulations related to 19 specific applications for individual operator licenses that were not complete and accurate with respect to training. The charges focused on inaccuracies in applications arising out of two training classes in 1996. They related only to Millstone Units 1 and 2 (*i.e.*, not to Unit 3). Id. at ¶ 33.

- As a result of the company's internal review of these matters, NNECO had concluded that certain records were maintained and filed with the NRC before the responsible persons performed the necessary checks to ensure that the records were complete and accurate. Although NNECO concluded that no one intentionally falsified a record, management disciplined those responsible for unacceptable performance and replaced several supervisory and managerial personnel in the nuclear training area. Id.

- Training deficiencies at Millstone were addressed by the NRC Staff as a requirement for restart by a Confirmatory Action Letter ("CAL"). NNECO responded to the CAL with a detailed corrective action plan. Id. at ¶ 34. The NRC Staff has reviewed and accepted NNECO's corrective actions and closed out the training matter in an inspection report of March 2000. Id.

- The environmental violations cited in the plea agreement involved two incidents at Millstone Station, in the years from 1994-1996. Id. at ¶ 35. NNECO, company-wide, has since initiated aggressive corrective actions in the environmental arena, including: policies and procedures; auditing and training; assignment of environmental responsibility to specific positions at facilities; annual environmental goal setting; and an annual environmental safety and ethics report. Id. at 36. As one measure of progress, Millstone was recently certified against the international ISO 14001 standard for environmental management systems, a distinction previously conferred on only one other nuclear facility in the United States. Id. at ¶ 37.

The Intervenors also indicated during discovery that they would also provide testimony from James Plumb, a former chemistry technician at Millstone, regarding alleged environmental misconduct in the past. As discussed by Mr. Dodson in his affidavit (at ¶¶ 38-40), Mr. Plumb's employment at Millstone ended in January 1996, when he was released, along with about one hundred other employees, as part of a nuclear workforce reduction. Many of Mr. Plumb's allegations were made in a state court wrongful discharge action he brought against the company. The state wrongful discharge case was later resolved without any admission or finding of culpability by the company, and the complaint was withdrawn.[17]

Mr. Plumb's environmental compliance allegations relate to events during the time-frame of his employment at Millstone, and were known to both state and federal government authorities. Dodson Affidavit, ¶ 38. The Connecticut Department of Environmental Protection ("DEP"), in particular, requested information from NNECO on those matters in 1996 and subsequently in 1997, chose to initiate an action in Connecticut Superior Court in Rocque, Arthur J., Jr., Commissioner of Environmental Protection v. Northeast Utilities Service Co., et al., CV-575567 (Superior Court, State of Connecticut, Judicial District of Hartford), citing some of the matters. As discussed by Mr. Dodson (at ¶ 38), the DEP environmental case has since

17 The NRC's Office of Investigations ("OI") reviewed the process used by the company for the 1996 workforce reduction, as well as several cases of alleged discrimination arising out of that reduction. In correspondence to the company in July 1998, OI reported that it had concluded its comprehensive review and concluded that it could not substantiate alleged discrimination. Dodson Affidavit, ¶ 40.

been resolved between the company and the government by stipulated judgment. NNECO made no admissions of culpability or liability with respect to the allegations, but committed to pay certain civil penalties and make environmental contributions, to take environmental corrective actions, and to conduct audits and independent reviews. Id. The international ISO 14001 certification for environmental management systems, as mentioned above, demonstrates the progress the company has made. Id. at ¶ 37.

In regard to all of these matters — the criminal plea and the environmental allegations — the "evidence" the Intervenors are presenting is of no decisional significance with respect to the present Application. This is not a forum to litigate past mistakes. Past criminal issues and bald allegations of misconduct do not in any way establish a foundation for a conclusion of: (1) a company-wide predilection to future environmental or regulatory violations; or (2) violations in any way germane to the SFP proposal at hand. The Intervenors are in effect seeking, in this forum, to re-open and to second-guess inspection and enforcement matters that are the responsibilities of the NRC Staff and other state and federal government agencies.[18] These are matters far beyond what is material here, far beyond this Licensing Board's present jurisdiction, and far beyond what the Commission will need to decide in order to pass on NNECO's Application.[19]

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18 In particular, there can be no dispute that environmental compliance matters under the Clean Water Act are the responsibility of the Environmental Protection Agency. See, e.g., Tennessee Valley Authority (Yellow Creek Nuclear Plant, Units 1 and 2), ALAB-515, 8 NRC 702, 713-14 (1978) (holding that the NRC's environmental responsibility does not extend to "regulating polluters" under the Federal Water Pollution Control Act).

19 To the extent individuals are ever found culpable for misconduct, they are subject to personnel policies applicable to NNECO employees. Dodson Affidavit, ¶ 41.

The scope of this proceeding is limited to the license amendment at hand.[20] The Commission has previously observed that every NRC licensing action does not throw open an opportunity to engage in a free-ranging inquiry into the "character" of the licensee. Rather, there must be "some direct and obvious relationship between the character issues and the licensing action in dispute." Georgia Power Company, et al. (Vogtle Electric Generating Plant, Units 1 and 2), CLI-93-16, 38 NRC 25, 32 (1993).[21] Similarly, in Georgia Institute of Technology (Georgia Tech Research Reactor), CLI-95-12, 42 NRC 111, 119-20 (1995), the Commission determined that allegations of management improprieties must be of more than historical interest; there must be a direct nexus between the issues and the proposed licensing action. Here, the relationship between the past issues and the license amendment at hand is neither direct nor obvious. This is not an initial licensing proceeding, nor is it a license transfer case (like Vogtle), nor is it a license renewal case (like Georgia Tech). There is (and could be) no admitted contention on "management character." The Licensing Board does not need to determine here whether NNECO management and operating personnel have the necessary character to operate the plant, or even to implement administrative controls. The Commission, in authorizing restart of Unit 3 in 1998, and in authorizing restart of Unit 2 in 1999, has already — forcefully and

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20 See Statement of Policy on Conduct of Adjudicatory Proceedings, CLI-98-12, 48 NRC 18, 22 (1998) ("the scope of a proceeding, and, as a consequence, the scope of contentions that may be admitted, is limited by the nature of the application and pertinent Commission regulations").

21 Similarly, and more recently, the Commission held that wholesale claims that management is ineffective, corrupt, lacks integrity, etc., cannot be the basis for a standing for intervention in a licensing proceeding. Otherwise, any petitioner could insert integrity issues into all license amendment proceedings simply by alleging that the management's character is unworthy and therefore no requested action should be granted. Commonwealth Edison Company (Zion Nuclear Power Station, Units 1 and 2), CLI-99-04, 49 NRC 185, 189-91 (1999) (finding that petitioner lacked standing to intervene in Zion license amendment proceedings post-shutdown/defueling).

directly — made that determination. The broad attack based on past violations, and unsubstantiated allegations of past violations, is inappropriate for the amendment Application, and the admitted contentions, as narrow as those at hand.

With respect to the allegations of environmental violations, it is also important that the allegations of Mr. Plumb have been raised repeatedly in several forums. His allegations are not new; they date from his employment at Millstone through 1996. The criminal plea agreement addressed some of these allegations, as did the stipulated judgment in the case brought against the company by the DEP. The wrongful discharge case was also resolved between NNECO and Mr. Plumb. This Licensing Board does not need to be drawn into these matters to provide a forum to re-open the scope and sufficiency of the actions already taken.[22]

At bottom, this license amendment proceeding cannot be a forum to litigate whether NNECO made mistakes in the past. And it is not a forum to replace other offices of the NRC and other federal and state agencies that have continuing oversight responsibilities at Millstone. An appropriate focus is on the system and the procedures proposed by NNECO for the Unit 3 SFP, and on the defense-in-depth and the margin-of-safety provided by the system and procedures. A decision on these issues will not depend, in whole or in part, on past events and unsubstantiated allegations. With respect to appropriate issues, and as discussed above, the Licensing Board must conclude that there is no genuine and substantial issue in dispute and that

22 To the extent the Intervenors are alleging ongoing individual wrongdoing (and NNECO is not aware of any such allegations), they are raising matters that should be addressed in other forums. If the concern relates to matters subject to NRC jurisdiction, the Intervenors should pursue a petition for NRC enforcement action under 10 C.F.R. § 2.206. If the concern relates to ongoing environmental matters, the Connecticut DEP is a more appropriate forum.

the proposal provides reasonable assurance that there will not be a criticality event in the Unit 3 SFP.

C. Responses to Licensing Board Questions

The following provides specific cross-references to NNECO's sworn testimony that responds to the Licensing Board's questions for the parties on Contention 4, as set forth in the Licensing Board's Memorandum of May 23, 2000:

ASLB QUESTION	AFFIDAVITS
A.1	Parillo Affidavit, ¶¶ 41-42
A.2	Jensen Affidavit, ¶¶ 23-35
A.3	Jensen Affidavit, ¶ 33
A.4	Parillo Affidavit, ¶¶ 14-18 Reference 3, Attachment 1 at 2-3
A.5	Parillo Affidavit, ¶ 69
A.6	Parillo Affidavit, ¶ 70
A.7	Parillo Affidavit, ¶ 71

D. Conclusion on Contention 4: No Substantial Issue of Fact Central to the Commission's Decision

Based upon the above, there is no genuine and substantial dispute of fact as to any aspect of Contention 4. While the Intervenors have raised the specter of undetected misloading of fuel assemblies, boron dilution events, and misconduct, there is no issue raised in Contention 4 that requires further process before this Licensing Board. The introduction of evidence in a formal adjudicatory proceeding is not necessary to dispel the Intervenors' specters. Those matters are either wholly rebutted by NNECO's unrefuted evidence or they are of no decisional significance with respect to NNECO's Application.

V. Contention 5: Boron Surveillance

A. Restatement of Contention 5 and its Bases

The Intervenors assert in Contention 5 that the license amendment request is inadequate because the TS, as originally proposed by NNECO in the Application, would require surveillance of soluble boron in the SFP only during fuel movements. As a basis for this contention, the Intervenors posited that two independent events could occur and lead to criticality in the Unit 3 SFP. First, a single fuel assembly misloading could occur in the SFP and remain undetected. Then, the soluble boron concentration in the SFP, if not verified by surveillance, could drop sufficiently to result in a criticality.

In the Licensing Board's view, as stated in its Prehearing Conference Order, LBP-00-02, slip op. at 23-24, the contention raises a single unresolved question of fact:

> Will the proposed change in schedule of surveillance of the soluble boron in the fuel pool lead to a significantly increased likelihood of a criticality accident stemming from a misloaded fuel element, during the interval between fuel movements?

The Licensing Board further recognized that, "[i]f there were confidence that a misloaded fuel assembly would be reliably detected at the time of fuel movement, this issue would be resolved. Hence, establishing the degree of confidence that can be placed in detection of a misloaded fuel element is a key part of resolving the question at hand." Id. at 24.

B. Summary of Facts and Arguments in Response to Contention 5

The relevant facts concerning Contention 5 are provided in the Application dated March 19, 1999 (Reference 1), in the supplements to the Application dated April 17, 2000

(Reference 2), May 5, 2000 (Reference 3), and June 16, 2000 (Reference 4), as well as in the affidavits of Messrs. Robert McDonald, Joseph Parillo, Michael Jensen, and Dr. Stanley Turner. In summary, NNECO maintains that the contention is mooted because NNECO has already committed, in the April 17, 2000 supplement to the Application (Reference 2), to precisely the relief originally requested by the Intervenors — a TS surveillance to verify 800 ppm soluble boron in the SFP every seven days. This will be in addition to the existing TS requiring verification of 2,600 ppm boron during refueling activities. The commitment to incorporate the revised TS boron surveillance also moots the Licensing Board's inquiry, made in admitting the contention, with respect to the ability to reliably detect misloads at the time of fuel movement. As already discussed above with respect to Contention 4, the soluble boron in the Unit 3 SFP, to be verified in accordance with TS, provides a large margin of safety with respect to potentially misloaded fuel.

1. Contention 5 is Mooted by the Revised TS Surveillance Requirement

In response to Contention 5, NNECO specifically modified the proposed TS to address the Intervenors' concern that was the premise for the contention. By the April 17, 2000 supplement to the Application (Reference 2), and as further discussed in the June 16, 2000 supplement (Reference 4), the Surveillance Requirement accompanying the proposed TS 4.9.1.2 has been revised to require NNECO to "[v]erify that the soluble boron concentration is greater than or equal to 800 ppm every 7 days." This is in contrast to the original proposed TS amendment, which would have required surveillance of SFP boron concentration only during times of fuel movement within the SFP. Surveillance Procedure SP 3866, "Spent Fuel Pool Boron Concentration," will also be revised to require performance of the boron concentration surveillance once every seven days. McDonald Affidavit, ¶ 11. It is significant to again note that the 800 ppm concentration is based upon the licensing basis criticality analysis, with a substantial margin applied. Parillo Affidavit, ¶ 21.

In response to interrogatories in this proceeding,[23] and as discussed above, the Intervenors have stated during discovery that:

- "Petitioners do not challenge the proposed 800 ppm boron concentration" (except with respect to the legality under GDC 62 in Contention 6); and
- The "Standard Technical Specifications [for] Westinghouse Plants [NUREG-1431, Rev. 1] specifies a seven-day frequency for the surveillance of boron concentration in the spent fuel pool water" and that "Intervenors would have no objection to a seven-day surveillance frequency."

Even though the revised TS will require the boron concentration in the Unit 3 SFP to be greater than or equal to 800 ppm, NNECO will also maintain the concentration at greater than 2,600 ppm, providing even further margin of safety. McDonald Affidavit, ¶ 11. This is done as a conservatism and as an operational convenience because the SFP boron concentration must be greater than 2,600 ppm during refuelings (pursuant to TS 3.9.1.1) when the SFP and refueling cavity are connected. Id. at ¶ 13. SP 3866 requires that the Shift Manager, Reactor Engineering, and Chemistry be notified if the boron concentration in the SFP is less than 2,600 ppm at any time. Id. at ¶ 12.

In sum, NNECO has accommodated exactly the relief requested by the Intervenors. The Intervenors' witness that initially sponsored the contention appears satisfied,

23 "Connecticut Coalition Against Millstone and Long Island Coalition Against Millstone Supplemental Reply to Northeast Nuclear Energy Company's First Set of Interrogatories," dated April 25, 2000 (at 4-5). Mr. Lochbaum expressed similar views during his deposition. Lochbaum Deposition Tr. 25-26 (Reference 5).

with the assumption that the TS will be adopted as now proposed by NNECO. Contention 5 is therefore moot.

2. *The Need to Establish High Confidence that a Misloaded Fuel Assembly Would Be Reliably Detected at the Time of Fuel Movement is Also Mooted Because the Soluble Boron Provides a Sufficient Margin of Safety*

The criticality analyses previously discussed, prepared by Dr. Turner and referenced in ¶ 55, ¶ 63, and Tables 1, 2, and 3 of his affidavit, show the calculated K_{eff} for various postulated scenarios in each of the three proposed regions of the Unit 3 SFP. Dr. Turner's calculations show that, at the required TS limit of 800 ppm boron concentration, as many as five to eight fresh fuel assemblies could be misloaded into Region 2 or Region 3, in the most conservative configuration, without any risk of a criticality event. Moreover, with 2,000 ppm soluble boron (a significant dilution from the 2,600 ppm concentration that NNECO has and will maintain in the Unit 3 SFP by TS during refueling and by administrative limit at all times), all three regions could be *completely* misloaded with fresh fuel assemblies, and the storage racks for all three regions would remain subcritical. Accordingly, the presence of the TS-required soluble boron in the Unit 3 SFP ensures that the SFP would remain subcritical, even in the event of beyond-design-basis multiple undetected assembly misloadings. As previously noted, the boron concentration will be verified weekly, whenever fuel assemblies are in the SFP. And the Intervenors do not dispute the 800 ppm TS requirement. Consequently, given NNECO's commitment and Dr. Turner's calculations, there is no longer a need, under Contention 5, to establish high confidence that a misloaded fuel assembly would be reliably detected at the time of fuel movement.

Moreover, as discussed in NNECO's response to Contention 4, there is no basis to assume either a significant boron dilution or multiple assembly misloads. With respect to the former, the Intervenors have not identified any specific boron dilution mechanism for Millstone Unit 3, notwithstanding NNECO's request that it do so. See, e.g., Thompson Deposition Tr. 23-28. The Intervenors have also stated, as cited above, that they do not challenge the 7-day proposed surveillance frequency. And, as discussed above in connection with Contention 4, significant boron dilution events are not likely at Millstone Unit 3. See Parillo Affidavit, ¶¶ 25-29; Turner Affidavit, ¶¶ 56-62; McDonald Affidavit, ¶ 16. In fact, given the volumes of water involved, the physical considerations that would prevent flow from pipes in the SFP building from entering the SFP, and the structural analyses and modifications previously made by NNECO to eliminate the potential for dilution due to an earthquake, there is reasonable assurance that a significant boron dilution event will not occur.

The Intervenors may argue that mistakes in the boron concentration surveillance could occur. But at least one of the Intervenors' witnesses acknowledged that the boron surveillance procedure "is a relatively simple procedure to do." Lochbaum Deposition Tr. 23. Moreover, there has been no basis offered during discovery on which to assume a mistake of any significant magnitude or to assume that this would not be detected and corrected at the time of a subsequent weekly surveillance. In fact, the evidence shows that the soluble boron concentration at Millstone Unit 3 has been very consistent over the years. McDonald Affidavit, ¶ 10; see also Reference 3, Attachment 1, at 1.

With respect to the hypothesis of multiple misloads, as discussed above with respect to Contention 4, NNECO's procedures provide that fuel assembly moves are subject to dual verification, and serial numbers are verified each time an assembly is moved to the reactor core. See Section IV.B.3, above. Physical considerations related to the proposed SFP configuration further limit the likelihood of misloads into a region where an assembly is not qualified. See Section IV.B.4, above. The operating experience at Millstone further confirms the low likelihood of fuel assembly misloads. See Section IV.B.5, above. Based on these procedures, physical considerations, and the operating experience at Millstone, there is reasonable assurance that assemblies will be appropriately placed in a region where they are qualified.

C. Responses to Licensing Board Questions

The following provides specific cross-references to NNECO's sworn testimony that responds to the Licensing Board's questions for the parties on Contention 5, as set forth in the Licensing Board's Memorandum of May 23, 2000:

ASLB QUESTION	AFFIDAVITS
B.1	McDonald Affidavit, ¶ 14
B.2	McDonald Affidavit, ¶ 15
B.3	McDonald Affidavit, ¶ 16
B.4	McDonald Affidavit, ¶ 10
B.5	McDonald Affidavit, ¶ 12
B.6	Parillo Affidavit, ¶ 72

D. Conclusion on Contention 5: No Substantial Issue of Fact

Based upon the above, Contention 5 is moot and should be dismissed. Under the TS 3.9.1.2, as currently proposed (Reference 2), the soluble boron concentration of 800 ppm would be required whenever fuel is stored in the Unit 3 SFP. Contention 5 was premised on a proposed TS surveillance frequency that no longer exists. Moreover, the Licensing Board's inquiry regarding the degree of confidence that a misloaded fuel assembly would be reliably detected at the time of fuel movement is also mooted. The TS-required soluble boron provides a sufficient margin of safety such that multiple fuel assemblies could be misloaded and undetected without causing a criticality event.

VI. Contention 6: Compliance With General Design Criterion (GDC) 62

A. Restatement of Contention 6 and its Bases

The Intervenors assert in Contention 6 that the criticality control measures proposed by NNECO would violate Criterion 62 of the General Design Criteria ("GDC") set forth in 10 C.F.R. Part 50, Appendix A. Specifically, they argue that GDC 62 requires that "[c]riticality in the fuel storage and handling system shall be prevented by physical systems or processes, preferably by use of geometrically safe configurations," and that the NNECO proposal violates this Criterion in that it would utilize "administrative controls" related to fuel reactivity (*i.e.,* fuel enrichment, fuel burnup, and decay time) in defining limits for regional fuel storage in the Unit 3 Spent Fuel Pool ("SFP"). As accepted by the Licensing Board in its Prehearing Conference Order, the "litigable issue posed by Contention 6 essentially boils down to a question of law: *Does GDC 62 permit a licensee to take credit in criticality calculations for enrichment, burnup and decay time limits, limits that will ultimately be supported by administrative controls?"* LBP-00-02, at 35-36 (italics added).

The basis for the contention, as admitted by the Licensing Board, derives from the language of GDC 62 and the opinion of Dr. Gordon Thompson. See Prehearing Conference Tr. 139-144. Dr. Thompson essentially argues that GDC 62 does not contemplate use of "administrative controls" and that fuel reactivity restrictions for storage in regions of the SFP are precluded under the regulation. Moreover, on discovery, Dr. Thompson has extended that argument to preclude credit for soluble boron in the SFP, given the "administrative controls" associated with that method of criticality control. Thompson Deposition Tr. 18-24 (Reference 5). Since the NNECO proposal would credit reactivity limits and soluble boron for certain design basis accident criticality calculations, he would argue that the proposal is not consistent with GDC 62.

In the Prehearing Conference Order, the Licensing Board discussed another issue that underlies this contention: whether, notwithstanding GDC 62, 10 C.F.R. § 50.68 expressly contemplates credit for reactivity limits as well as soluble boron in design basis criticality calculations. Without commenting on the relevance of Section 50.68, the Licensing Board observed that 10 C.F.R. § 50.68(b)(2), which applies to fresh fuel storage racks, refers to "administrative controls;" 10 C.F.R. § 50.68(b)(4), which refers to irradiated fuel, does not use the term "administrative controls," though reference *is* made to soluble boron and to fuel reactivity. Dr. Thompson, in discovery in this proceeding, now takes the position that the reference to "reactivity" in Section 50.68 is a "bad use of the word" and ambiguous, and that it should be limited to considering the maximum fuel enrichment permitted at a plant. Thompson Deposition Tr. 33-35 (Reference 5).

One final basis for this contention was offered by the Intervenors in the Supplemental Petition, but was not acknowledged or relied upon by the Licensing Board in admitting the contention. Specifically, the Intervenors referred to Draft Reg. Guide 1.13 (Rev. 2) (Reference 7). Paragraph 1.4 of Appendix A specifies that the nuclear criticality safety analysis for the spent fuel storage should demonstrate that "criticality could <u>not</u> occur without at least two unlikely, independent, and concurrent failures or operating limit violations." Supplemental Petition at 20. The connection of this basis to the admitted Contention 6 is not at all clear in the

Supplemental Petition. Unlike the similar Shearon Harris contention (discussed below), the Licensing Board did not admit this as a separate basis for Contention 6.[24]

B. Undisputed Facts Relevant To Contention 6

There are no facts in dispute for this contention. However, the relevant facts related to NNECO's proposal, criticality calculations, and the use of reactivity limits are addressed in the affidavits of Mr. Joseph Parillo and Dr. Stanley Turner. They are summarized below.

1. Millstone Unit 3 SFP Proposal

NNECO's proposal for storage of spent fuel in the Millstone Unit 3 spent fuel pool is discussed in Section IV.B.1, above. It is described in detail in the license amendment application of March 19, 1999 (Reference 1), and is summarized in the affidavit of Mr. Parillo (at ¶¶ 7-12). Suffice it to say, NNECO's proposal involves placing additional storage racks in the SFP. The new racks would be divided into two regions. In Region 1, fuel would be stored in either a 3-out-of-4 array or a 4-out-of-4 arrangement, depending upon enrichment and burnup considerations. Region 2 would be utilized for 4-out-of-4 storage, with more restrictive burnup/enrichment limitations than Region 1. For criticality purposes, the new racks in both Regions 1 and 2 will utilize Boral panels, which are fixed neutron absorbers. Under NNECO's proposal, the existing storage racks would be re-designated as Region 3. Fuel would be stored in Region 3 in a 4-out-of-4 array, subject to restrictive burnup/enrichment/decay limits. The

24 NNECO does address in the context of Contention 4 above (in Section IV.B.2) its view of the design basis criticality calculations required for Millstone Unit 3. In addition, NNECO below discusses how draft Regulatory Guide 1.13 actually supports NNECO's position that boron credit and reactivity restrictions are consistent with both GDC 62 and 10 C.F.R. § 50.68.

Boraflex presently employed in these Region 3 storage racks would remain, but would no longer be credited as a neutron absorber.

2. *Undisputed Nuclear Criticality Analyses*

The nuclear criticality analyses that support the Millstone Unit 3 proposal are discussed in Section IV.B.2 above. Beyond-design-basis analyses are described in Section IV.B.7 above. The analyses are described in detail in the affidavit of Dr. Turner, the affidavit of Mr. Parillo, and the Application of March 19, 1999 (Reference 1).

The licensing basis criticality analyses for the Millstone Unit 3 proposal demonstrate the following:

- For the design basis normal conditions, for each region of the SFP with fuel in the most restrictive allowed configuration, and no credit for soluble boron, the K_{eff} is less than 0.95.
- For the design basis accident case, involving the most conservative misplacement of one fuel assembly, and crediting only 425 ppm soluble boron, the K_{eff} is less than 0.95.

While NNECO maintains that these analyses meet 10 C.F.R. § 50.68 and the applicable NRC regulatory guidance, NNECO has performed additional criticality calculations that demonstrate, among other cases, the following:

- For a *beyond-design-basis case* involving the entire spent fuel pool filled with fresh fuel with the maximum fuel enrichment, and assuming a boron dilution to 2,000 ppm soluble boron (2,600 ppm will be maintained by administrative limit), the storage racks will remain sub-critical (K_{eff} less than 1.00).
- For *beyond-design-basis cases* involving concurrent, undetected misplacement of a finite number of fuel assemblies (*i.e.*, misplacement of between 5 and 8 assemblies depending on the assumptions) of the maximum permissible reactivity and in the most conservative configuration, and assuming a dilution of soluble boron from the normal value (in excess of 2,600 ppm) to 800 ppm, the storage racks will remain sub-critical (K_{eff} less than 1.00).

The results of these criticality calculations are not in dispute. See Thompson Deposition Tr. 13-14; Lochbaum Deposition Tr. 9-10 (Reference 5).

3. *Undisputed Facts Regarding Criticality Control*

There are several additional relevant, undisputed facts that are important in applying the Commission's regulations relevant to this contention. These are discussed in the affidavits of Mr. Parillo and Dr. Turner and have been acknowledged by Dr. Thompson during discovery. Thompson Deposition Tr. 18 (Reference 5).

First, there are only four methods available for criticality control in spent fuel storage pools: (1) geometric separation; (2) solid neutron absorbers (*e.g.*, Boral, Boraflex); (3) soluble neutron absorbers (*e.g.*, soluble boron); and (4) fuel reactivity limits. Fuel reactivity is determined by three factors: (1) fuel assembly structure; (2) initial (or "fresh") fuel enrichment; and (3) fuel depletion (or "burnup"). See Turner Affidavit, ¶¶ 9-19.

Second, each of the four criticality control measures — at some level — involves a physical system or process. Turner Affidavit, ¶¶ 20-30; Parillo Affidavit, ¶¶ 53-61. Absent such a physical component, the method would not and could not control criticality. Moreover, as a practical matter, every one of the physical systems or processes for criticality control is implemented using some administrative measures. Id. As discussed below, these unrefuted facts render Dr. Thompson's characterization of NNECO's proposal as an "administrative control" inaccurate, simplistic, and ultimately misleading.

C. Legal Arguments In Response To Contention 6

GDC 62 states:

> *Criterion 62 — Prevention of criticality in fuel storage and handling.* Criticality in the fuel storage and handling system shall be prevented by

> physical systems or processes, preferably by use of geometrically safe configurations.

As acknowledged by the Licensing Board in admitting the contention, the admitted issue is a question of law: does GDC 62 permit a licensee to take credit in criticality calculations for enrichment, burnup and decay time limits — limits that must be supported by administrative controls? NNECO maintains that the answer is "yes." NNECO's proposal involves physical processes within a physical system for criticality control. The use of procedures to implement the system does not alter this fundamental fact. This is supported by the plain language of GDC 62, by 10 C.F.R. § 50.68, and by the long course of practice of the agency, which is reflected in prior NRC approvals, the public comment draft of Reg. Guide 1.13, Revision 2, and in more recent NRC guidance. The Intervenors' argument relies upon a semantic construct that has no basis in the regulation or the regulatory history, and was recently rejected by an Atomic Safety and Licensing Board in another proceeding. Congress in the NWPA fully endorsed the use of high-density spent fuel storage racks and GDC 62 should not be interpreted in any way that would frustrate that purpose.

1. This Issue Was Recently Rejected By An Atomic Safety and Licensing Board

A contention identical to Contention 6 was recently raised by an intervenor in a proceeding related to proposed spent fuel pools at Carolina Power and Light Company's Shearon Harris Nuclear Plant. The admitted contention in that case, Technical Contention 2 ("TC-2"), Basis One, stated:

> CP&L's proposed use of credit for burnup to prevent criticality in pools C and D is unlawful because GDC 62 prohibits the use of administrative measures, and the use of credit for burnup is an administrative measure.

The contention was supported by an affidavit from Dr. Thompson, expressing the same opinion as he has expressed in the present case. The presiding Atomic Safety and Licensing Board — in its Subpart K ruling on issues for an evidentiary hearing — rejected the contention. Carolina Power and Light Company (Shearon Harris Nuclear Power Plant), LBP-00-12, ___ NRC ___ (slip op., May 5, 2000). While this may not be binding precedent, it is a strong indicator that the identical CCAM/CAM Contention 6 also has no merit.

The Shearon Harris licensing board specifically examined the regulatory history for GDC 62, the recent agency adoption of 10 C.F.R. § 50.68, the longstanding NRC Staff interpretation embodied in Draft Reg. Guide 1.13 (Rev. 2), and adjudicatory precedents on GDC 62. Shearon Harris, LBP-00-12, slip op. at 28-32. The licensing board concluded that there was no genuine and substantial issue of fact or law meriting an evidentiary hearing. The exact same considerations pertain to the present case, and these are discussed again below. The Licensing Board here should reach the same result.

In the Shearon Harris case, the licensing board also considered a second basis for Contention TC-2. This basis involved Dr. Thompson's argument that the Double Contingency Principle of draft Reg. Guide 1.13 calls for analysis of scenarios involving two, or even more, failures or violations of operating limits. The intervenors argued that the use of credit for burnup is proscribed (presumably by GDC 62) because misplacement of a fuel assembly could cause criticality. In light of the criticality analyses submitted by CP&L, including an analysis of concurrent misplacement of multiple fuel assemblies, the Shearon Harris licensing board resolved this issue in favor of CP&L. Shearon Harris, LBP-00-12, slip op. 51-56. The Shearon Harris licensing board found that "there is no requirement that K_{eff} must be kept at or below 0.95 under all conditions, including the scenario involving a fresh fuel assembly misplacement concurrent with the loss of soluble boron." Id. at 54. As discussed above, NNECO has prepared similar criticality analyses, including analyses of multiple misplacements and concurrent loss of soluble boron, for the purpose of this proceeding. See Turner Affidavit, ¶ 63, Tables 1-3. Without conceding that these analyses are within the Millstone Unit 3 design/licensing basis, they certainly resolve any issue raised here regarding the Double Contingency Principle.

2. *Credit For Enrichment, Burnup, and Decay Time Limits Involves A Physical System Or Process, Fully Consistent With GDC 62*

As discussed above, there are only four available methods for nuclear criticality control in spent fuel pool storage racks: geometry, insoluble neutron absorbers, soluble neutron absorbers, and fuel reactivity considerations. NNECO's proposal employs all four — utilizing geometry, fixed Boral panels, soluble boron, and regional storage restrictions based on fuel assembly enrichment, burnup, and decay. Each of these four methods for criticality control is physical and involves — at some level — a physical system or process. Moreover, each of these methods requires — at some level — administrative controls. Absent a physical system or process at work, the method would not control criticality. And absent procedural controls in implementation, there would not be assurance of effectiveness.

Specifically, the physical systems and processes at work are as follows:

- Geometric separation physically affects neutron coupling between assemblies in storage.
- Solid neutron absorbers physically affect neutron absorption.
- Soluble neutron absorbers physically affect neutron absorption.
- Fuel reactivity (enrichment, burnup, and decay) physically affects neutron production and absorption.

NNECO maintains that each of these criticality control measures is "physical;" each of these measures involves a "physical process" to prevent criticality within the meaning of GDC 62; and each of these measures is incorporated into a "physical system" within the meaning of GDC 62. The issue of whether any of these measures are implemented by "administrative controls" is irrelevant under the GDC. In particular, because fuel reactivity is physical, because it does involve a physical process for criticality control, and because it is incorporated into a physical system for criticality control, it fully meets GDC 62. Similarly, because soluble boron is physical, does involve a physical process to control criticality, and is incorporated in a physical system, it fully meets GDC 62.

In admitting this contention, the Licensing Board questioned NNECO's prior assertion that its proposal involves physical systems or processes. The Licensing Board reasoned as follows (LBP-00-02, at 35):

> NNECO in its answer refers to burnup and decay time as "physical processes" in the sense used in GDC 62. The dictionary definition of process most applicable here is: "a particular method of doing something, generally a number of steps or operations." Although a condition of fuel burnup may be the outcome of a process, calling burnup a "physical process" confuses the end with the means.
>
> Burnup and decay time are indicia of physical processes: burnup occurs in the core and decay in the core and spent fuel rack. This raises the question of scope of the physical processes mentioned in GDC 62.

This discussion misses NNECO's point. Criticality control is the issue. The criticality control is provided by a physical characteristic: the condition of the fuel (including its reactivity) physically affects neutron production and absorption by *a known physical process*. In engineering the spent fuel racks, as in engineering any other aspect of the power plant, NNECO is entitled to consider the conditions that the engineered system will in fact encounter, and to rely upon the *physical implications of these conditions.* The fact that the conditions (*i.e.,* the fuel reactivity) may be the result of processes outside the spent fuel pool does not render the subsequent processes inside the spent fuel pool, or the system that would take advantage of those processes, any less real, less physical, or less entitled to credit.

Taking another example, geometric spacing provided by the racks, there is a process that creates the racks (*i.e.,* fabrication). But the result is a physical system that prevents criticality. Likewise, there is a process that produces enrichment and burnup. But the effect of the result on criticality is no less <u>physical</u>. The reactivity effect of enrichment and burnup involves a physical "process" to prevent criticality. Moreover, the <u>combination</u> of the physical characteristics of the fuel, the procedural controls, and the physical processes related to reactivity would seem to be, by normal usage, a physical "system." Fuel assemblies that do not meet the reactivity limits are kept physically separate from other assemblies for which proximity could create criticality. The enforced spacing is physical, geometric, and real, maintained by the rack system itself. Because NNECO's proposal involves physical processes within a physical system for criticality control, it is fully consistent with the plain language of GDC 62. No further analysis is necessary to address this contention as a matter of law.

3. <u>GDC 62 Does Not Preclude The Use Of Administrative Controls</u>

The Intervenors argument on this contention, and the question admitted by the Licensing Board, focuses on the fact that fuel enrichment and burnup restrictions require — in implementation — "administrative controls." These controls, described in Section IV.B above, involve assuring that only fuel of the permitted reactivity is moved to a particular storage location. Intervenors maintain that GDC 62 does not permit reliance on these controls. On discovery, Dr. Thompson expanded the reach of this contention, arguing that soluble boron credit is likewise precluded by GDC 62, because it requires surveillance to assure that the concentration is maintained. Thompson Deposition Tr. 14-22 (Reference 5). This theory, however, for either reactivity limits or soluble boron credit, lacks any basis in the law.

Nothing in the plain language of GDC 62 would lend support to the argument that reactivity limits or soluble boron are not permitted simply because these measures require some administrative measures. Indeed, GDC 62 states only that criticality should be prevented by physical systems or processes. Therefore, the regulation does not preclude implementation measures and other administrative controls — so long as the system or process is physical. There is nothing in the GDC that forecloses "administrative controls."

The term "administrative controls" does not appear in the regulation. Therefore, the Intervenors' argument is fabricated without support in the regulation. Any interpretation of GDC 62 that would prohibit a method of criticality control because it requires administrative controls would not make any sense as a practical matter. As discussed above, all four of the available methods for criticality control are implemented using some administrative measures. Controls are required in the fabrication and installation of racks. Controls are utilized with respect to solid neutron absorbers — including both fabrication controls and surveillances. Soluble boron is maintained in accordance with administrative controls. Moreover, fuel reactivity restrictions are implemented by administrative controls. While the type, degree, and timing of the administrative controls may vary among the four options, the fact remains that each involves some administrative measure in implementation. See, e.g., Turner Affidavit, ¶¶ 20-30;

Parillo Affidavit, ¶¶ 53-61. The argument that reliance on "administrative controls" renders reactivity restrictions unlawful simply proves too much.[25]

Dr. Thompson essentially concedes that all methods of criticality controls require some administrative controls. Dr. Thompson tries to sidestep this deficiency in his argument by semantic distinction. He would distinguish different types of "administrative controls" — for example, those controls that are, by his lights, "one time" or "set at the time of manufacture," versus those "that are required on an ongoing basis." Prehearing Conference Tr. 139-144. Apart from having no regulatory basis, this distinction between one-time and ongoing administrative controls cannot stand logic.

First, maintaining reactivity limits will really only require a one time action: placement of fuel in the appropriate region. Once in the appropriate storage location, intrinsic, purely physical processes will naturally ensue to prevent criticality. No surveillance is required to assure that the fuel assemblies later do not move by themselves. Therefore, by Dr. Thompson's own distinction, this is a "one time" administrative control that would be allowed by GDC 62.

Second, Dr. Thompson recognizes that even controls such as geometric racks and fixed plate neutron absorbers require periodic "ongoing" inspections. He would distinguish these "ongoing" administrative controls because they are comparatively "modest" or "straightforward." Thompson Deposition Tr. 20-22 (Reference 5).[26] But consider: Why is a

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25 The Intervenors also argue, of course, that the restrictions are simply too complex (presumably, even if lawful). This is Contention 4 and is addressed above.

26 Similarly, in the Shearon Harris case, the intervenor acknowledged that all criticality controls require some ongoing administrative measures. The intervenors argued that prevention of criticality by reactivity levels is different because it requires continuing actions, such as inputting information into a computer system, and operating and

coupon surveillance of Boraflex plates more straightforward than a soluble boron surveillance? Why is it more straightforward than a verification that an assembly has been placed in its proper location, or a confirmation that, once in its location, it is not moving by itself to a disallowed region? At this point, Dr. Thompson's argument proves too much — it is an elaborate construct, with no regulatory basis, based on overly-intellectualized distinctions — distinctions that in the end do not even hold up.

Dr. Thompson would, in effect, invite the Licensing Board in this proceeding and the NRC Staff in future licensing reviews to engage in the philosophical, semantic exercise of deciding whether administrative controls related to the selected methods of criticality control are "one time" or "ongoing", and further, whether they are "modest" or not. While this is perhaps an intellectually challenging puzzle, it is one with absolute no regulatory basis. There is nothing in GDC 62 that would support — as a matter of law — the need for such a binning process. The essence of Dr. Thompson's argument was distilled, addressed, and dismissed in the Shearon Harris case. The argument should be rejected here as well.

4. *Reactivity Limits And Boron Credit Have Been Previously Accepted By The Commission, Establishing A Long Course Of Practice*

The NRC Staff has consistently interpreted GDC 62 to encompass the use of fuel enrichment and burnup limits for criticality control. Likewise, the Staff has also allowed boron credit as a criticality control method, notwithstanding that these methods require some administrative measures to implement. NRC practice over almost 20 years establishes a

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maintaining equipment. Unlike other ongoing controls, these ongoing steps are perceived as more than "straightforward" tasks.

continuous interpretation of GDC 62 — one that is far more consistent with the practical realities of fuel storage and the NWPA than the interpretation of Dr. Thompson.

The NRC Staff has implemented its guidance permitting fuel enrichment and burnup limits in approving numerous license amendment requests to expand the capacity of spent fuel pool storage, beginning in the early 1980s. Dr. Turner in his affidavit has identified at least 20 nuclear power plants across the country where the Staff has approved the use of fuel enrichment and burnup limits as a criticality control method for spent fuel pool storage. See Turner Affidavit, at ¶ 50. In approving each of these license amendments approvals, the NRC Staff, apparently made a case-by-case determination that fuel enrichment and burnup limits comply with GDC 62. Each of these license amendment approvals was founded on a safety analysis by the NRC Staff and a determination of compliance with all applicable NRC regulations, including GDC 62.[27]

The NRC Staff initially permitted fuel enrichment and burnup limits for spent fuel pool criticality control through Reg. Guide 1.13, draft Revision 2, issued in 1981 (Reference 7). Appendix A of the Draft Reg. Guide 1.13 provides specific guidance on the nuclear criticality safety analysis. Storage rack analysis assumptions are described in Reference 7, Section 4, which (at 1.13-13) calls for a fuel burnup determination. Credit for burnup in storage rack design is further discussed in Section 5 (at 1.13-14). Although Draft Reg. Guide 1.13 was never issued in final form, the NRC Staff's practice of implementing the provisions of this document for two decades demonstrates that it is *de facto* final NRC Staff policy and guidance.

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[27] As a condition precedent to approving these license amendments, the Staff is required to determine that all the General Design Criteria have been satisfied. 36 Fed. Reg. 3,255 (1971).

Guidance was also provided on spent fuel storage as early as April 14, 1978, in a letter from Brian K. Grimes of the NRC Staff to all power reactor licensees (Reference 6). While this guidance did not address reactivity restrictions such as burnup credit, it did recognize in Section 1.2 (Reference 6, Enclosure at III-1) that "[r]ealistic initial conditions (*e.g.*, the presence of soluble boron) may be assumed for the fuel pool and fuel assemblies" for the postulated accident analysis. The fuel enrichment, burnup, and decay are — like soluble boron — realistic initial conditions. Further, this guidance also reflected an understanding that administrative controls would be needed for criticality control methods. For example, in Section 1.5 (Reference 6, Enclosure at III-3), the NRC Staff described the need for "coupon or other type of surveillance testing" for fixed neutron absorbing materials. Nowhere has the Staff ever disallowed reliance on criticality methods because they involve related administrative procedures.

The NRC Staff recently confirmed its interpretation that fuel enrichment and burnup limits comply with GDC 62 in is most recent guidance document. The NRC Staff issued its new guidance memorandum on criticality control in 1998 referenced above ("1998 Criticality Guidance") (Reference 8). The 1998 Criticality Guidance approves fuel enrichment and burnup limits, and outlines the administrative measures required to implement these methods. See Reference 8, Enclosure at Sections 5.A.2, 5.A.5, and 5.B.

In sum, the NRC Staff has established a long-standing pattern and practice of interpreting GDC 62 to include the use of fuel enrichment and burnup limits for criticality control in spent fuel pool storage. See Parillo Affidavit, ¶¶ 63-64. Likewise, NRC Staff practice has allowed the use of soluble boron credit. The NRC Staff has done so both through guidance documents and numerous case-by-case license amendment approvals involving detailed safety analyses. The NRC Staff's interpretations of GDC 62 should be accorded "considerable weight."[28] When a General Design Criterion is being interpreted, the Commission has directed that where "there is conformance with regulatory guides, there is likely to be compliance with the GDC."[29]

5. *10 C.F.R. § 50.68 Affirms That The Commission Permits Administrative Measures, Fuel Enrichment Limits, and Fuel Burnup Limits For Criticality Control*

The Commission issued 10 C.F.R. § 50.68 in late 1998. Section 50.68, like GDC 62, carries the force of law. The rulemaking history and the new regulation itself clearly and explicitly demonstrate that the Commission endorses the use of administrative measures to implement criticality control, and permits fuel reactivity limits as well as soluble boron credit as methods of criticality control for spent nuclear fuel.

As adopted in final form in November 1998,[30] 10 C.F.R. § 50.68 explicitly acknowledges and permits the use of fuel enrichment limits as a criticality control method for fuel storage in pools. 10 C.F.R. § 50.68(b)(7) specifically permits the use of fuel enrichment limits for criticality control. The Commission determined that a fuel enrichment limit addresses criticality concerns.[31] Fuel enrichment limits are by necessity implemented using administrative measures similar to those that would be employed by NNECO.

As adopted, 10 C.F.R. § 50.68(b)(4) also specifically directs that "spent fuel storage racks loaded with fuel of the maximum fuel assembly reactivity" be considered for

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28 Consumers Power Co. (Big Rock Point Nuclear Plant), ALAB-725, 17 NRC 562, 568 (1983).

29 Petition for Emergency and Remedial Action, CLI-78-6, 7 NRC 400, 406-07 (1978).

30 Final Rule, 63 Fed. Reg. 63,127 (November 12, 1998) (Reference 10).

31 See 63 Fed. Reg. 63,127, at 63,128 (Reference 10); see also Turner Affidavit, ¶ 40.

criticality control purposes. Spent fuel assembly reactivity, as referenced in 10 C.F.R. § 50.68(b)(4), includes the effects of fuel burnup. Thus, the regulation implicitly permits the use of fuel burnup limits as a method of criticality control. See Turner Affidavit, ¶ 39; Parillo Affidavit, ¶¶ 65-66. Section 50.68(b)(4) also explicitly recognizes that credit can be taken for soluble boron — notwithstanding the normal surveillance procedures that would be associated with that control method. Turner Affidavit, ¶ 41.

The rulemaking history of 10 C.F.R. § 50.68 further demonstrates that the Commission permits the use of administrative measures to implement reactivity limits. The rule was originally promulgated as a direct final rule. The direct final rule, as proposed, would have required that spent fuel storage analyses be evaluated using "the maximum permissible U-235 enrichment." The maximum U-235 enrichment represents fresh fuel, before it undergoes any burnup. One public commenter, Northern States Power ("NSP"), specifically addressed this issue.[32] The commenter requested that the phrase "maximum permissible U-235 enrichment" in proposed 10 C.F.R. § 50.68(b)(4) be replaced by the phrase "maximum fuel assembly reactivity" because, in part, fuel assembly reactivity is comprised of a number of factors, of which enrichment is only one.[33] In the final rule, the Commission revised 10 C.F.R. § 50.68(b)(4) to allow licensees to use "maximum fuel assembly reactivity," which includes the effects of fuel burnup and decay, in place of "maximum permissible U-235 enrichment," in demonstrating criticality control.[34] As adopted by the Commission, 10 C.F.R. § 60.68 therefore contemplates and permits the use of fuel reactivity limits as a method for criticality control in spent fuel

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32 NSP Comment Letter, dated January 2, 1998 (Reference 11).

33 Reference 11, at 1.

storage, and necessarily permits administrative measures to implement such criticality control methods for fuel pool storage.[35] In sum, the Intervenors' legal position regarding GDC 62 is inconsistent with the Commission's pronouncements on criticality control as adopted in 10 C.F.R. § 50.68 in 1998.

The Licensing Board, in its Prehearing Conference Order admitting this contention (LBP-00-02, at 34), draws distinctions between the language of 10 C.F.R. § 50.68(b)(2), (b)(3), and (b)(4). Section (b)(2) and (b)(3), which relate to fresh fuel storage racks, specifically refer to administrative controls to prevent flooding of racks with unborated water. However, the Licensing Board observed that administrative controls to prevent flooding are only one example of procedures that might be employed for the storage of fresh and irradiated fuel. On the other hand, Section (b)(4), which applies to the criticality analysis for irradiated fuel, does not use the term "administrative controls." Yet it specifically contemplates soluble boron and consideration of fuel "reactivity." As previously discussed, the soluble boron and reactivity control methods cannot be implemented without some form of procedural controls. Therefore, it would be nonsense to conclude that the regulation would not allow administrative controls — of either a one time or ongoing nature. Such a reading would negate the plain terms of the rule.

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34 63 Fed. Reg. at 63,128, 63,130 (Reference 10).

35 The Commission in the Section 50.68 direct final rule and in the subsequent rulemaking also expressly acknowledged and permitted the use of administrative measures or procedural controls related to criticality. In the statements of consideration for the direct final rule, the Commission noted that "[n]uclear power plant licensees have procedures and the plants have design features to prevent inadvertent criticality." 62 Fed. Reg. at 63,825. The Commission also observed that "fuel handling at power reactor facilities occurs only under strict procedural control." Id. at 63,826.

6. *The Commission's GDC 62 Rulemaking Demonstrates No Intent To Preclude Procedural Controls*

The Atomic Energy Commission ("AEC") Staff published what is now GDC 62 as a proposed rule in July 1967.[36] The text of the proposed rule reads:

> Criticality in new and spent fuel storage shall be prevented by physical systems or processes. Such means as geometrically safe configurations shall be emphasized over procedural controls.

It is clear from the text, as proposed, that every criticality control method acceptable must be a "physical system or process." Any methods mentioned in the second sentence, the preference sentence, must, of necessity, be encompassed in "physical systems or processes." The inclusion of "procedural controls" in the second sentence establishes that the AEC Staff and Commission understood "procedural controls," one type of administrative measure, to be encompassed in "physical systems or processes," within the meaning of the GDC.

The Commission received two public comments addressing the proposed GDC. The first public comment, from Oak Ridge National Laboratory ("ORNL"), took issue with the Commission's acceptance of "procedural controls to prevent accidental criticality in storage facilities of power reactors."[37] To this end, the commenter specifically requested the Commission to delete "processes" from "physical systems or processes" in the first sentence, and "procedural controls" from the second sentence.[38] The Commission, however, did not accept this comment. The final version of GDC 62 retains the terminology "physical systems or processes."

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36 32 Fed. Reg. 10,213, at 10,217 (July 11, 1967) (Reference 12). The final rule was adopted in 1971. See 36 Fed. Reg. 3,255, 3,260 (February 20, 1971) (Reference 13).

37 ORNL Comment Letter, "Review of USAEC General Design Criteria for Nuclear Power Plant Construction Permits" (September 6, 1967) (Reference 14). See page 11.

38 Id.

The Commission did delete the term "procedural controls" from the preference statement, but there is no support for the theory that this was intended to eliminate any method relying on administrative controls. The plain language of the final GDC 62 maintains simply a preference for "geometrically safe configurations." The Shearon Harris licensing board found this regulatory history alone "arguably dispositive" on the matter of Dr. Thompson's argument. Shearon Harris, LBP-00-12, slip op. at 30.

The Staff SECY paper recommending the final rulemaking supports the interpretation that the ORNL proposal to eliminate procedural controls was rejected.[39] The ORNL comment, requesting that procedural controls no longer be permitted under GDC 62, would have made a very significant substantive change to the meaning and scope of GDC 62. However, in discussing the changes made between the proposed rule and the final rule, the SECY states[40] that:

> Most of the comments received were in the form of suggested improvements in language to facilitate understanding of the intent of the criteria, with few suggestions to change or delete many requirements. The more significant comments and our resolution of them [are discussed below].

The discussion of significant comments in the SECY does not discuss any of the text changes to GDC 62, indicating that the changes made to GDC 62 were not considered substantive, but rather just improvements in language to facilitate understanding.[41] Certainly, a

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39 SECY-R 143, "Amendment to 10 C.F.R. 50 - General Design Criteria for Nuclear Power Plants" (January 28, 1971) (Reference 15).

40 Id. at 2-3.

41 Id. at 3-6.

change of the magnitude requested by ORNL would have been discussed as a significant change, had it been made.

A second public comment, from Atomics International, sheds light on the modification to the rule that was made. This commenter perceived ambiguity with respect to the scope of the preference established in the second sentence of proposed GDC 62.[42] The commenter requested the Commission to revise the second sentence to read "Inherent means should be used where practicable."[43] In this way, the second sentence would address only one type of measure, "inherent means," and would state the Commission's intent that this is a preference, to be used "where practicable."[44] While the Commission did not adopt the specific words offered by this commenter, it did incorporate the commenter's intent. In the final rule,[45] the Commission revised the preference statement to state simply "preferably by use of geometrically safe configurations." The preference statement therefore does not itself rule any other measures out, and certainly does not rule out "procedural controls."

Dr. Thompson, as he did in the Shearon Harris case, may rely on certain internal AEC drafts of what is now GDC 62, issued prior to the proposed and final rule. These drafts were circulated within the AEC Staff and the Advisory Committee on Reactor Safeguards ("ACRS"). A draft of October 6, 1967,[46] stated:

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42 Atomics International Comment Letter, Reference No. 67A-5374 (September 25, 1967) (Reference 16). See page 4.

43 Id.

44 Id.

45 See Reference 13.

46 AEC Memorandum from G.A. Arlotto to J.J. DiNunno and Robert H. Bryan (October 7, 1966) and attached "Revised Draft of General Design Criteria for Nuclear Power Plant Construction Permits" (October 6, 1966) (Reference 17).

> Possibilities for inadvertent criticality must be prevented by engineered systems or processes to every extent practicable. Such means as geometric safe spacing limits shall be emphasized over procedural controls.

Similarly, a draft in February 1967[47] stated:

> Possibilities for criticality in new and spent fuel storage shall be prevented by physical systems or processes to every extent practicable. Such means as favorable geometrics shall be emphasized over procedural controls.

These drafts, however, do not prove Dr. Thompson's point. They do nothing to support the notion that reactivity limits, and the implementing procedures, are not physical systems or processes as allowed by the current, final version of GDC 62. At most, these versions reflect that procedural controls, while appropriate, were something to be de-emphasized. Moreover, too much should not be made of pre-decisional documents from over 30 years ago, long before Congress enacted the NWPA. At that time the AEC Staff and ACRS had no basis to believe high-density storage would ever be necessary, and reactivity limits were not discussed. Nonetheless, it is clear that the AEC understood that procedural controls could be employed.

D. Responses to Licensing Board Questions

The following provides specific cross-references to NNECO's sworn testimony that responds to the Licensing Board's questions for the parties on Contention 6, as set forth in the Licensing Board's Memorandum of May 23, 2000:

ASLB QUESTION	AFFIDAVITS
C.1	Parillo Affidavit, ¶ 73

47 Letter, J.J. DiNunno to Nunzio J. Palladino (ACRS), dated February 8, 1967 (Reference 18).

ASLB QUESTION	AFFIDAVITS
C.2	Parillo Affidavit, ¶¶ 74, 66 Turner Affidavit, ¶¶ 14-18
C.5	Parillo Affidavit, ¶¶ 53-66
C.6	Parillo Affidavit, ¶¶ 53-66
C.7	Parillo Affidavit, ¶ 77

E. Conclusion on Contention 6: No Basis for Legal Issue

Based upon the above, there is no genuine or substantial dispute of fact as to Contention 6. Contention 6 does not require the introduction of evidence in a formal adjudicatory proceeding. Contention 6 raises a purely legal matter that has no support in the regulation, the regulatory history, or longstanding NRC practice. Contention 6 can be resolved in favor of NNECO based upon this position paper and the included sworn testimony and supporting references.

VII. Conclusion

For the reasons discussed in this written summary, and based upon the sworn testimony and the references attached hereto, NNECO concludes that the Intervenors' Contentions 4, 5, and 6 do not raise a genuine and substantial dispute of fact that can only be resolved with sufficient accuracy by the introduction of evidence in an adjudicatory hearing, or a factual issue requiring a resolution for the Commission to make a decision on NNECO's Application. Therefore, none of the three admitted contentions should be designated for resolution in an adjudicatory hearing. In addition, based on the record presented in NNECO's written summary and the attachments, Contentions 4, 5, and 6 should be resolved in NNECO's favor.

Respectfully submitted,

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ATTORNEYS FOR NORTHEAST NUCLEAR ENERGY COMPANY

Dated in Washington, D.C.
this 30th day of June 2000

DOCKETED
USNRC

UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

'00 JUL -5 A10:25

BEFORE THE ATOMIC SAFETY AND LICENSING BOARD

In the Matter of:	)	
	)	
Northeast Nuclear Energy Company	)	Docket No. 50-423-LA-3
	)	
(Millstone Nuclear Power Station,	)	
Unit No. 3)	)	ASLBP No. 00-771-01-LA

CERTIFICATE OF SERVICE

I hereby certify that copies of "SUMMARY OF FACTS, DATA, AND ARGUMENTS ON WHICH NORTHEAST NUCLEAR ENERGY COMPANY PROPOSES TO RELY AT THE SUBPART K ORAL ARGUMENT" in the captioned proceeding, have been served on the following by deposit in the United States mail, first class, or as designated by an asterisk (*), by messenger delivery, this 30th day of June 2000. Additional e-mail service has been made this same day as shown below.

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David A. Repka
Attorney for NNECO

UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

BEFORE THE ATOMIC SAFETY AND LICENSING BOARD

In the Matter of:	)	
	)	
Northeast Nuclear Energy Company	)	Docket No. 50-423-LA-3
	)	
(Millstone Nuclear Power Station,	)	
Unit No. 3)	)	ASLBP No. 00-771-01-LA

AFFIDAVIT OF JOSEPH J. PARILLO

I, Joseph J. Parillo, being duly sworn, state as follows:

1. I am a nuclear engineer employed by Northeast Utilities (NU) since 1976. I am currently a Senior Engineer in the Nuclear Analysis Section at Millstone Nuclear Power Station (Millstone).

2. The Atomic Safety and Licensing Board (ASLB) has admitted three contentions raised by the Connecticut Coalition Against Millstone and the Long Island Coalition Against Millstone (Intervenors) with respect to the proposal of Northeast Nuclear Energy Company (NNECO) to increase the capacity of the Millstone Unit 3 Spent Fuel Pool (SFP). These issues are referred to as Contentions 4, 5, and 6. In this affidavit I respond to certain aspects of the contentions, particularly as they relate to the nuclear criticality safety aspects of NNECO's proposal and to issues of compliance with NRC regulations and guidance in this area.

Experience and Qualifications

3. I hold a Bachelor of Science degree in Nuclear Engineering from Rensselaer Polytechnic Institute, which I received in 1976. I have been employed by NU since that time, and have worked principally in the areas of reactor engineering, reactor core design, fuel storage, and nuclear criticality analyses. I have been involved with the Millstone Unit 3 re-rack project since it was started, with responsibility for the criticality discipline. I have been responsible to ensure that the correct design inputs are provided to the criticality analysis supplier, Holtec International (Holtec), and to ensure that the criticality analyses performed by the supplier are correct and consistent with the facility. I have performed this same function for about ten years for the Millstone and Connecticut Yankee plants. I have been responsible for the criticality aspects of many Millstone Units 1, 2, and 3, and Connecticut Yankee spent fuel pool design and technical specification changes. For example, I was the responsible plant engineer for the complete re-rack of the Millstone Unit 2 spent fuel pool in 1985. I have used the KENO and CASMO computer codes, which are commonly used in criticality calculations. A copy of my professional qualifications is provided as Attachment A to this affidavit.

4. I am also generally familiar with the process used to manage fuel movements at Millstone, including movements into and out of the spent fuel pools. In a previous position, I was the Reactor Engineer at Millstone Unit 2. I have held, in the past, a Senior Reactor Operator License at Millstone Unit 2. I also have extensive core design experience with the Connecticut Yankee and Millstone Unit 3 reactor cores.

Contention 4: Administrative Controls

5. The ASLB Prehearing Conference Order in this matter re-stated Contention 4 as:

> *"The new set of administrative controls trades reliance on physical protection for administrative controls to an extent that poses an undue and unnecessary risk of a criticality accident, particularly due to the fact that the licensee has a history of not being able to adhere to administrative controls with respect, inter alia, to spent fuel pool configuration."*

6. The main points I wish to make regarding this contention are:

- The proposed Unit 3 storage racks and regional storage system will not add significant complexity to the spent fuel storage system. The net effect of the proposal will be the addition of two new burnup vs. enrichment curves (new Technical Specification (TS) Figures 3.9-3 & 3.9-4). Millstone Unit 3, however, has had a burnup vs. enrichment curve (TS Figure 3.9-1) since 1990. The administrative procedures in place to meet the existing TS burnup vs. enrichment curve will simply be replicated for the two new regions. The addition of fuel decay time for one region is a trivial change to this process.
- Fuel burnup and decay time are the indices that are used to implement *fuel reactivity* in a physical system for criticality control. The fuel reactivity is continually decreasing as a function of fuel burnup and decay time due to changes in the fuel isotopic inventory.

We are crediting known physical processes related to fuel reactivity into a physical system for criticality control. Administrative controls are used to implement any physical system for spent fuel storage, not to serve as a substitute.

- The proposed spent fuel storage was designed to ensure K-effective (K_{eff}) in the spent fuel pool would be less than 0.95, with no credit for soluble boron, assuming compliance with TS limits for the fuel allowed in each region of the SFP.
- The licensing basis limiting single fuel assembly misloading event could cause K_{eff} to exceed 0.95; hence the proposal requires at least 425 ppm of soluble boron. To provide margin, this minimum has been rounded up to 800 ppm in the proposed TS.
- NRC regulations and guidance documents do not require the consideration of two unlikely, concurrent and independent events to be considered. We do not consider it credible that we would have a dropped/misplaced fuel assembly and a substantial spent fuel pool boron dilution event (*i.e.*, dilution below 800 or 425 ppm) at the same time.
- The spent fuel pool soluble boron concentration will be maintained at a value of 2,600 ppm by Millstone administrative procedure. A dilution of the Millstone Unit 3 spent fuel pool from this administrative limit to the TS limit of 800 ppm would require at

least 500,000 gallons of unborated water by some hypothetical dilution method. A further dilution of the Millstone Unit 3 spent fuel pool from the TS limit of 800 ppm, to the credited criticality analysis value of 425 ppm, would require at least another 280,000 gallons of unborated water. In reality, a dilution involving either of the above volumes of water would be quickly detected by a high water level alarm and eventually, if uncorrected, an overflow of the spent fuel pool.

- While it is well beyond design basis, if the entire spent fuel pool was filled with the maximum fresh fuel enrichment allowed in domestic reactors, which is 5 weight-percent (w/o) fresh U-235, and there was a soluble boron dilution from the normal concentration of more than 2,600 ppm to 2,000 ppm, the spent fuel pool would still be sub-critical.
- The location of the racks in the spent fuel pool and the design criteria used in the rack criticality analyses were thought out in advance to minimize both the impact and likelihood of fuel misplacement events. Examples of this are discussed later in this affidavit.
- At Millstone Unit 2 and Millstone Unit 3, NNECO has had extensive experience with the use of fuel burnup vs. enrichment curves. Millstone Unit 2 has had fuel burnup vs. enrichment curves

in the TS since 1986. Millstone Unit 3 has had a fuel burnup vs. enrichment curve in the TS since 1990. To date, there has never been a case at either Millstone Unit 2 or 3 where a fuel assembly was placed into a fuel storage region for which it was not qualified. This experience encompasses 15 years at Millstone Unit 2 and 10 years at Millstone Unit 3.

The above issues are dealt with in more detail below.

Current vs. Proposed Configuration

7. The Unit 3 SFP proposal is documented in a license amendment application of March 19, 1999 (Reference 1), as supplemented on April 17, 2000 (Reference 2), May 5, 2000 (Reference 3), and June 19, 2000 (Reference 4). In order to understand what is changing in the proposed re-rack, a comparison needs to be made between the existing and proposed criticality controls. Table 1 is a comparison between the current spent fuel pool storage configuration (CURRENT CONFIGURATION) and the proposed spent fuel pool configuration (PROPOSED CONFIGURATION). The following is a detailed explanation of Table 1.

8. The proposed spent fuel pool Region 1 3-out-of-4 storage configuration allows fuel to be stored in a 3-out-of-4 configuration, with every 4^{th} location physically blocked with a blocking device to prevent fuel insertion. The proposed Region 1 3-out-of-4 pattern can store fresh unirradiated fuel up to 5 w/o U-235. The requirements for placement of blocking devices is specified in proposed TS Figure 3.9-2. The corresponding region in the current spent fuel pool is Region 1. (Physically, the proposed Region 1 and current Region 1 do not occupy the same racks or space in the pool.) The

current Region 1 configuration allows fuel to be stored in a 3-out-of-4 configuration, with every 4th location physically blocked with a blocking device. The current Region 1 can store fresh unirradiated fuel up to 5 w/o U-235. The requirements related to placement of blocking devices are specified in TS Figure 3.9-2. Therefore, the proposed Region 1 3-out-of-4 storage configuration has no difference in administrative controls from the current Region 1.

9. The proposed spent fuel pool Region 1 4-out-of-4 storage configuration allows fuel to be stored in a 4-out-of-4 configuration, with each fuel assembly stored in this region required to meet the fuel burnup requirements of proposed TS Figure 3.9-1. The corresponding region in the current spent fuel pool is Region 2, which also allows fuel to be stored in a 4-out-of-4 configuration, with each fuel assembly stored in this region required to meet the fuel burnup requirements of current TS Figure 3.9-1. The new TS Figure 3.9-1 has virtually the same burnup requirements as the existing TS Figure, 3.9-1, but the new TS Figure 3.9-1 has slightly larger (more conservative) burnup requirements. Therefore, the proposed spent fuel pool Region 1 4-out-of-4 fuel storage configuration has the same administrative controls as the current Region 2.

10. The proposed spent fuel pool Region 2 allows fuel to be stored in a 4-out-of-4 configuration, with each fuel assembly stored in this region required to meet the fuel burnup requirements of proposed TS Figure 3.9-3. Their is no corresponding region in the current spent fuel pool.

11. The proposed spent fuel pool Region 3 allows fuel to be stored in a 4-out-of-4 configuration, with each fuel assembly stored in this region required to meet the fuel

burnup and fuel decay time requirements of proposed TS Figure 3.9-4. There is no corresponding region in the current spent fuel pool.

12. Based on the above comparison, the only new administrative controls associated with the proposal are two new TS Figures. They involve:

- The addition of a new burnup curve for the new Region 2, TS Figure 3.9-3.
- The addition of new burnup/decay-time curves for the new Region 3, TS Figure 3.9-4.

Proposed Region 1 will function with the same administrative controls as the current spent fuel pool.

TABLE 1

Comparison of the PROPOSED CONFIGURATION of the Unit 3 SFP to the CURRENT CONFIGURATION.

PROPOSED CONFIGURATION		CURRENT CONFIGURATION		DIFFERENCES
REGION NAME	**FUEL STORAGE CONFIGURATION**	**REGION NAME**	**FUEL STORAGE CONFIGURATION**	**COMPARISON OF PROPOSED vs. CURRENT**
REGION 1 3-OUT-OF-4	3-OUT-OF-4 FUEL STORAGE WITH CELL BLOCKER, 5 W/O FRESH FUEL STORAGE	REGION 1	3-OUT-OF-4 FUEL STORAGE WITH CELL BLOCKER, 5 W/O FRESH FUEL STORAGE	NO DIFFERENCE IN ADMIN CONTROLS
REGION 1 4-OUT-OF-4	4-OUT-OF-4 FUEL STORAGE WITH BURNUP CURVE, NEW TS FIGURE 3.9-1	REGION 2	4-OUT-OF-4 FUEL STORAGE WITH BURNUP CURVE, TS FIGURE 3.9-1	NO DIFFERENCE IN ADMIN CONTROLS
REGION 2	4-OUT-OF-4 FUEL STORAGE WITH BURNUP CURVE, NEW TS FIGURE 3.9-3			NEW REGION WITH NEW BURNUP CURVE
REGION 3	4-OUT-OF-4 FUEL STORAGE WITH BURNUP AND DECAY TIME CURVES, NEW TS FIGURE 3.9-4			NEW REGION WITH NEW BURNUP AND DECAY TIME CURVES

Current vs. Proposed Procedural Controls

13. The next question to answer is what administrative controls will result from implementing the proposed TS Figure 3.9.3 and proposed TS Figure 3.9-4. Figure 1 shows the current process, in block diagram form, showing how fuel burnup is currently credited (steps 1 to 4 in Figure 1), and its relationship to key fuel movement events (steps 5 to 7 in Figure 1). The shaded boxes and dark-dotted lines on Figure 1, show the proposed portions of the procedures which will be added for the new Region 2 and new Region 3.

14. As shown in Figure 1, the eight basic steps involved in the current procedural process are:

- Obtain the nominal initial enrichment for the fuel assembly being evaluated. This nominal initial enrichment is obtained from Quality Assured (QA) design documents (step 1 on Figure 1).
- Obtain measured fuel burnups from QA calculations. These QA calculations utilize a qualified Westinghouse computer code to calculate the measured fuel burnups. These measured fuel burnups are based on measured incore power distributions, which are also calculated using a qualified Westinghouse computer code. The accuracy of these incore power distributions are described in NRC approved Westinghouse Topical Reports. Appropriate uncertainties are applied to the measured fuel burnups. The burnup uncertainty used is directly tied to the power distribution uncertainties from the

NRC approved power distribution topical report. These QA calculations involve preparation, independent review, and approval by qualified individuals (step 2 on Figure 1).

- Determine, using the initial enrichment and measured fuel burnup just described, whether the fuel assembly's initial enrichment and measured burnup is above the line or below the line shown in TS Figure 3.9-1. This check is performed by one individual, and reviewed by another individual (step 3 on Figure 1).
- If a fuel assembly is qualified for storage in the region controlled by TS Figure 3.9-1, then a TS Surveillance form is completed, which updates the list of qualified fuel assemblies for storage in the region controlled by TS Figure 3.9-1. This TS surveillance is completed and then sent to the Reactor Engineering Supervisor for review and approval (step 4 on Figure 1).
- Should fuel movement be necessary, a Material Transfer Form (MTF) (or equivalent form) is prepared to authorize the fuel move (step 5 on Figure 1).
- An "executor" moves the fuel assembly from the specified MTF location to the specified MTF location (step 6 on Figure 1).
- A "checker," who is physically present to witness the move, verifies the fuel assembly has been moved "from" and "to" the correct location (step 7 on Figure 1).

15. The administrative procedure changes that would be necessary to implement the new Region 2 are shown in Figure 1 as the dark dotted lines and the shaded boxes. For the new Region 2, which utilizes the new TS Figure 3.9-3, the process would be the same as the process currently used for TS Figure 3.9-1. A new form would be developed to document which fuel assemblies are qualified for the new Region 2. Hence, this "new" process is just a replication of the existing process.

16. For the new Region 3, which utilizes the new TS Figure 3.9-4, the process would be the same as the process currently used for TS Figure 3.9-1, with the exception of the addition of fuel decay time. For fuel decay time, as shown in Figure 1, first QA calculations are performed to document the actual fuel decay time. These QA calculations determine the fuel decay time (in years) from the time the fuel was last irradiated, to the current time. Thus, these calculations amount to determining the decay time by subtracting 2 numbers for each fuel assembly, which is not a difficult calculation. Next, a procedural step will be added to select which of the four burnup curves on TS Figure 3.9-4 should be used for a given fuel assembly. TS Figure 3.9-4 shows four burnup curves, one each for 0, 5, 10 and 20 years fuel decay time. The selected curve for a given fuel assembly should have less decay time credited than the fuel assembly's actual decay time. For example, for a given fuel assembly, if the actual fuel decay time was documented in a QA calculation to be 6 years, then the burnup curve from TS figure 3.9-4 with the 5 year decay time would be the appropriate and conservative curve to use. Again, this is not a difficult or complicated process.

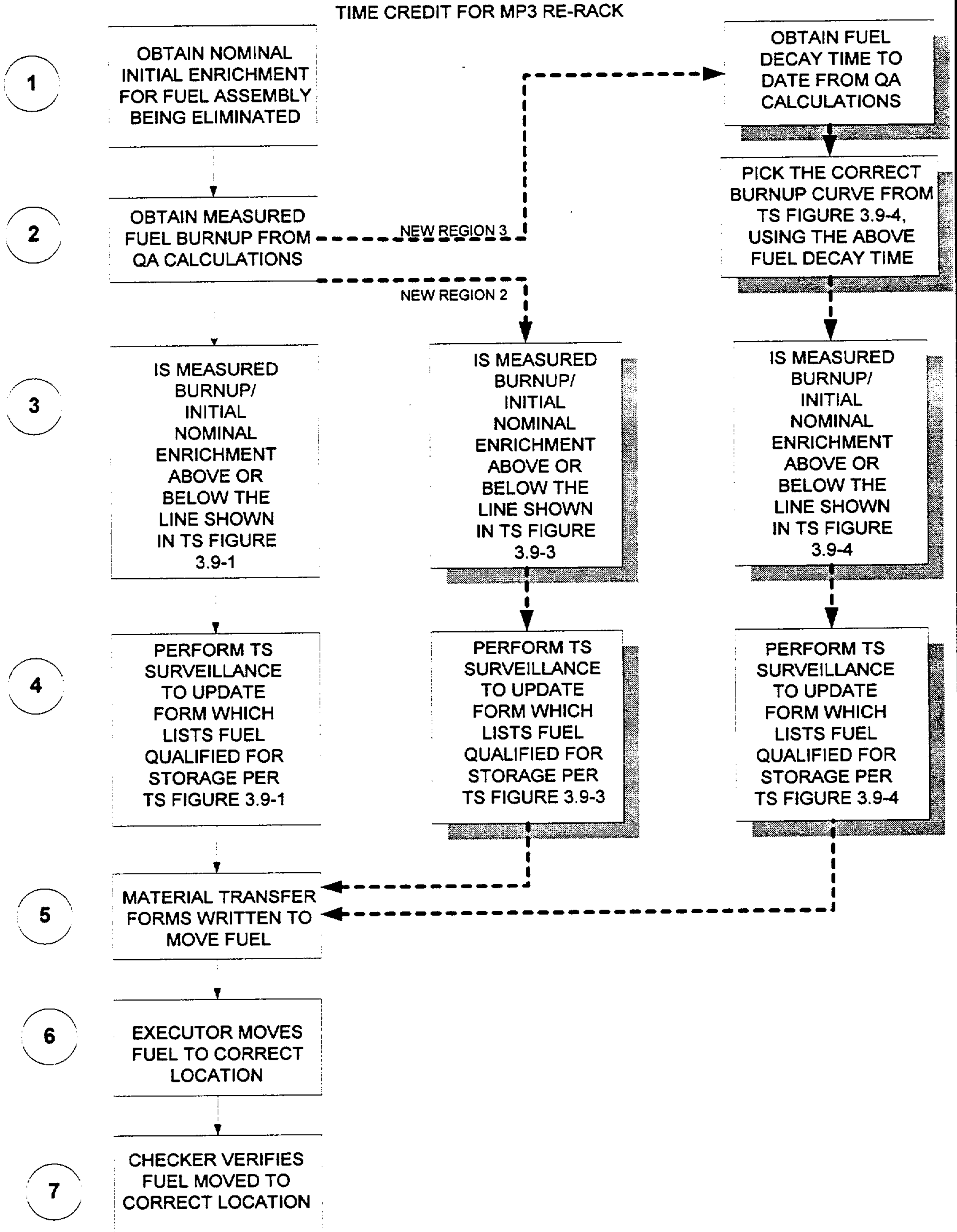
17. Other than the above calculation of fuel decay time and the selection of the appropriate burnup/decay time curve, the process for the new Region 3 would be the same

as the process currently used for TS Figure 3.9-1. A new form would be developed to document which fuel assemblies are qualified for the new Region 3. Hence this "new" process is just a replication of the existing process, with the addition of fuel decay time and the selection of the correct burnup curve from the four shown in TS Figure 3.9-4.

18. As can be seen from the above discussion, the expansion from currently one TS burnup/enrichment curve (TS Figure 3.9-1) to three TS burnup/enrichment curves (TS Figures 3.9-1, 3.9-3 and 3.9-4), with the exception of decay time, is the same process we have been using, replicated two additional times. The addition of a QA calculation for fuel decay time, and based on that decay time, selection of the correct burnup curve from TS Figure 3.9-4, is not a complicated process addition.

FIGURE 1

CURRENT AND PROPOSED PROCESS FOR FUEL BURNUP AND DECAY TIME CREDIT FOR MP3 RE-RACK



Physical Systems v. Administrative Controls

19. Crediting of fuel burnup and decay time involves crediting the current *fuel reactivity.* The current fuel reactivity, which is a reflection of the current fuel isotopic inventory, involves physical processes with physical effects. Fuel burnup and decay time are indices of the fuel reactivity, or fuel isotopic inventory. The fuel reactivity is as real and as physical as the Boral neutron absorbers to be employed in the proposed racks. For example, fuel burnup creates fission products that absorb neutrons and act as poisons. *There is no difference if a neutron is absorbed by a Boron-10 atom in Boral, or if it is absorbed in a fission product atom in a fuel rod.* In both cases, the neutron has been absorbed by a physical process and by a physical system. And, when used in a regional wet storage system, fuel reactivity is part of a broader physical system for criticality control. The proposed storage rack amendment therefore does not involve substituting administrative controls for physical controls.

20. Administrative controls are an integral part of implementing any physical system for criticality control. For example, the new Unit 3 racks will incorporate Boral neutron absorbers. Administrative controls are used to implement the physical system of Boral neutron absorbers in the spent fuel storage racks during the design, construction and continued operation of the Boral racks. As examples, during the design phase, the correct amount of Boral must be calculated, which is an administrative process; during the construction phase, the measurement of the actual Boron-10 concentration in the Boral is an administrative process; during the operational phase of the racks, the pool chemistry must be properly controlled and there is on-going surveillance of Boral coupons, which are administrative in nature.

Criticality Analyses

21. The Millstone Unit 3 spent fuel pool re-rack licensing basis criticality analysis demonstrates the following design characteristics:

- Each region was designed to ensure K_{eff} would be less than 0.95 *with no credit for soluble boron,* assuming compliance with TS limits of fuel allowed in each region. Multiple computer codes were used to cross-check the results. Each computer code is benchmarked against critical experiments.
- A design basis *accident analysis* determined that the worst credible criticality event was a single dropped or misplaced fuel assembly into Region 3, with all other Region 3 fuel storage locations filled with fuel of the maximum permissible reactivity. This event does result in exceeding a K_{eff} of 0.95 if there is no credit for soluble boron. As a result, a minimum of 425 ppm of soluble boron in the spent fuel pool water was determined to be necessary to ensure K_{eff} does not exceed 0.95 for this licensing basis analysis. This value was rounded up to 800 ppm for the proposed TS surveillance. No further boron dilution analysis was required. NRC regulations do not require that two unlikely, concurrent and independent events be considered. We did not consider it likely that we would have a dropped/misplaced fuel assembly and a spent fuel pool boron

dilution event at the same time. Nonetheless, there is margin provided by the 800 ppm TS minimum.

22. The spent fuel pool soluble boron concentration at Millstone Unit 3 is currently maintained at a value of 2,600 ppm by administrative procedure. This administrative limit will be continued. As such, it is apparent that an enormous conservatism is present in maintaining the spent fuel pool subcritical. To put this conservatism in perspective, NNECO asked its contractor to perform certain beyond - design-basis analyses. The results are discussed in the Affidavit of Dr. Stanley Turner of Holtec. Dr. Turner's results demonstrate that the entire spent fuel pool could be filled with the maximum fresh fuel enrichment allowed in domestic reactors, which is five weight-percent U-235, and with a dilution of the soluble boron in the water to 2,000 ppm, the spent fuel pool would still be sub-critical. Fresh fuel of 5 weight-percent enrichment is the limiting fuel reactivity. Further, with the normal 2,600 ppm of soluble boron, and the <u>entire</u> spent fuel pool filled with 5 weight-percent U-235 fresh fuel, the spent fuel pool K_{eff} would not exceed 0.95.

23. Normal makeup to the SFP, necessitated by losses due to evaporation, is primary grade water (unborated) from the primary grade water system. Borated water from the Refueling Water Storage Tank can also be used. Both of these systems connect to the SFP through the purification system. Use of unborated makeup water for small evaporative water volume losses is acceptable, because evaporative losses do not remove boron from the SFP water.

24. Should a low level condition exist in the SFP, the applicable emergency operating procedure (EOP) specifies the preferable use of borated water for makeup to the

pool. Should unborated water addition be necessary to restore level, the EOP provides guidance on ensuring that the volume of unborated water added does not reduce the boron concentration below the minimum required concentration.

Beyond-Design-Basis Boron Dilution Scenarios

25. As stated above, the spent fuel pool soluble boron is administratively maintained at greater than 2,600 ppm. It would take at least 500,000 gallons of unborated water to dilute the spent fuel pool from 2,600 ppm to 800 ppm by some hypothetical continuous dilution method. It would take an additional 280,000 gallons of unborated water to dilute the spent fuel pool from 800 ppm to 425 ppm. Recall that 425 ppm was the necessary boron concentration to ensure that K_{eff} would be less than 0.95 for a limiting single fuel misplacement/drop event. A dilution is highly unlikely because any leakage from nearby sources would most likely flow through floor grating and away from SFP. An elevated curb that lines the edge of the SFP would also protect against incidental leakage. Moreover, a dilution involving either of the above volumes of water would be quickly detected by a high water level alarm in the control room, and eventually if uncorrected, an overflow of the spent fuel pool.

26. A postulated boron dilution event, even if it could occur, does not pose a risk related to criticality. First, soluble boron is not necessary in the spent fuel pool provided the TS limits on fuel burnup/decay time are adhered to. Therefore, a soluble boron dilution to 0 ppm could take place with no safety impact. There is also enormous margin between the normal boron concentration (> 2600 ppm) and the boron concentration value needed to maintain $K_{eff} < 0.95$ (> 425 ppm) in the case of the licensing basis limiting single fuel misplacement/drop event.

27. NNECO has also addressed the potential for boron dilution that might result from a seismic event that might rupture one of the pipes in and around the spent fuel pool. As part of its past resolution of Boraflex integrity concerns, NNECO amended the Millstone Unit 3 TS in 1998 to credit soluble boron during accident conditions (seismic event) for the licensing basis criticality analyses. In conjunction with the 1998 amendment, NNECO evaluated the design capability of piping systems in the vicinity of the spent fuel pool for their capability to remain leak tight following a seismic event. The acceptance criteria used in the analysis were: (1) piping will not leak following a seismic event; (2) piping may leak but flow will not enter the spent fuel pool; or (3) piping may lose pressure boundary integrity, but locations of overstress have been isolated from flow. While the analysis indicated that the majority of the piping on and around the SFP would not leak under a design basis earthquake load, as a result of this analysis NNECO did implement plant modifications. These modifications included capping of the fuel building elevation 106'-0" roof drain, which is directly above the spent fuel pool, and modification of two glycol preheating system lines.

28. The Intervenors during discovery expressed considerable interest regarding the roof drain pipe above the SFP. As discussed above, this pipe has been capped and therefore does not carry rainwater. In addition, the potential for rain on the roof was analyzed at the time the modification to cap the pipe was made. As documented in the analysis, the Millstone Unit 3 design basis probable maximum precipitation ("PMP") value of 6.5 inches per hour was used in the supporting calculations associated with the modifications to the fuel building roof drain. In all cases, rainwater will accumulate on the elevation 106"0" roof (*i.e.*, the area with the capped drain) to the point where it overflows

the elevation 106"-0" roof parapet to the adjacent roof area at elevation 93"-6" which is provided with three roof drains. This adjacent roof area does not overlap the spent fuel pool and the associated drain piping was shown to remain leaktight following a seismic event. The original design basis required three roof drains to divert the PMP design flow for the two roof areas combined, with a total of four drains provided. Consequently, the analysis concluded that sufficient drain capacity exists within the current configuration to manage the removal of rain water under PMP conditions. Additionally, the roof at elevation 106'-0" is designed to accommodate the dead load associated with an accumulation of water up to the level of the parapet, so failure of the roof is not a concern. As a final matter, calculations were performed to demonstrate that the water passing through the elevation 93'-6" roof drains would not back up the common header to the elevation of an unqualified flange associated with the capped roof drain line and thereby leak into the spent fuel pool.

29. In raising the issue of the potential for a boron dilution event, I am aware that the Intervenors have referenced an event in January 1999 at Millstone Unit 2 in which the operators inadvertently reduced SFP water level by two inches. The theory seems to be that this eliminated boron from the SFP and therefore was a boron "dilution" event. What actually occurred was a system alignment problem that led to the transfer of approximately 2,370 gallons of SFP water to the clean liquid radioactive waste system. The flow was observed by a plant equipment operator and was subsequently secured. The SFP water level remained above the SFP low level alarm setpoint. Had the transfer of water continued, the low level alarm and operator action would have ensured that adequate water would remain for SFP cooling and for shielding of the stored fuel. Thus, the risk

significance of the event was low. And, with respect to boron dilution, there was none -- the boron concentration would remain constant in these circumstances. Upon makeup to the SFP, boron would have been added as necessary to ensure that the required boron concentration was maintained.

SFP Layout and Rack Design Minimize Complexity

30. The location of the racks and three proposed regions in the spent fuel pool, and the design criteria used in the rack criticality analyses, were thought out in advance to minimize both the impact and likelihood of fuel misplacement events. Many of these considerations were discussed in NNECO's response to NRC questions related to the TS amendment application (NNECO letter B18025, dated May 5, 2000) (Reference 3), but will be repeated here.

31. The new Region 1 racks were all grouped together and placed in front of the fuel transfer canal to facilitate new fuel loading. See the attached Figure 2, which shows the location of the Region 1, 2 and 3 racks in the proposed spent fuel pool layout. New fuel is transferred to the spent fuel pool by placing new fuel in the new fuel elevator, which is located in the transfer canal, and then moving the new fuel to the designated spent fuel storage location. By placing Region 1 racks directly in front of the transfer canal, new fuel passes only over Region 1 storage racks, and not over Region 2 or 3 storage racks. Therefore, the design basis new fuel misplacement event in Region 3 (or Region 2) is even more conservative, since new fuel should not be going over Region 2 or 3.

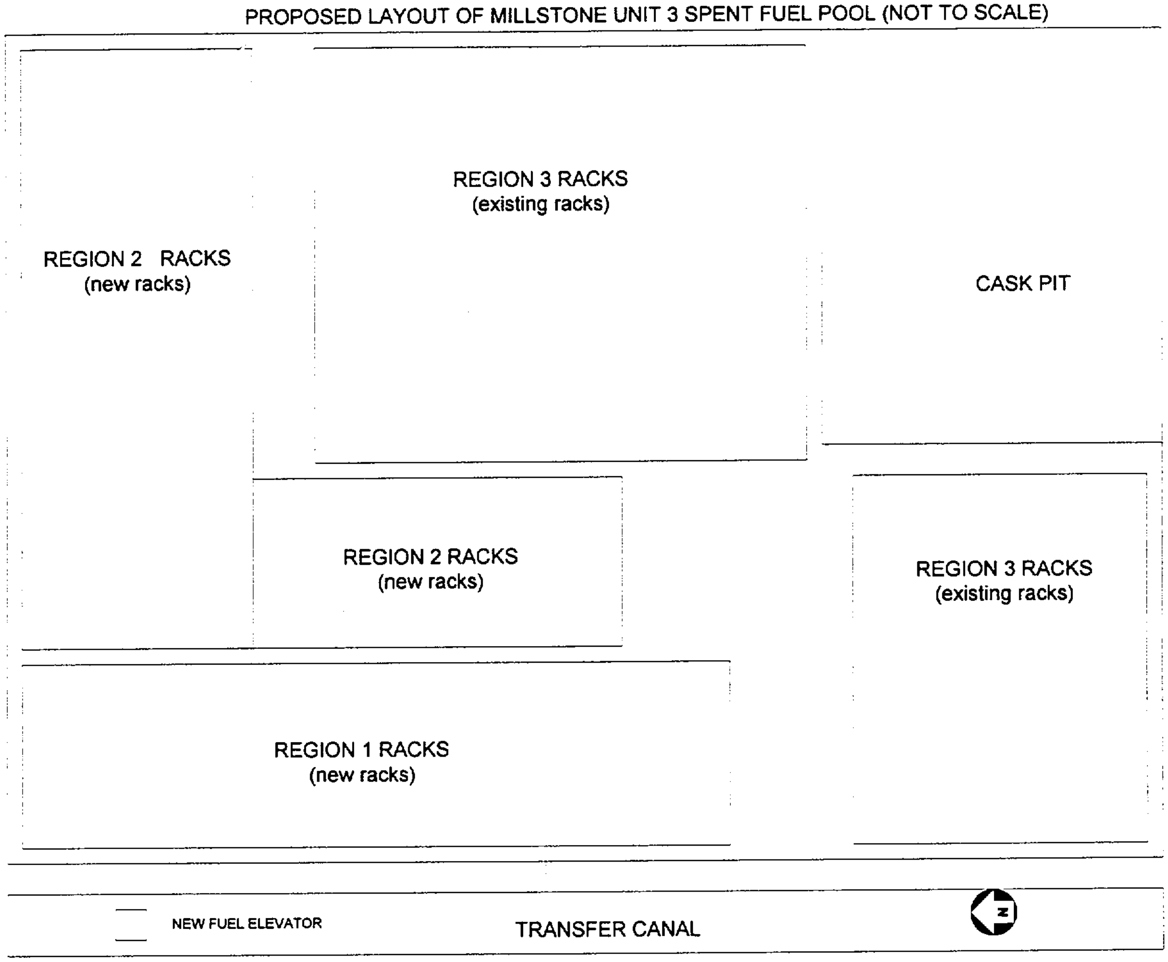
32. Further, the designated locations for new fuel storage in the spent fuel pool are Region 1 3-out-of-4 storage locations, which are located in the Northwest corner of the

spent fuel pool, and which will have distinctive and visually obvious cell blockers in every 4th location. Given that new fuel is shiny and distinctive, and the storage locations for new fuel will have distinctive cell blockers, it is highly unlikely that new fuel could be placed in any location other than a location designated for new fuel.

33. Practical considerations also reduce the likelihood of misplacement of used fuel. The new Region 1 racks were all grouped together and placed in front of the fuel transfer canal, and these are the racks which will be used for most fuel movement during a refueling. Fuel which is offloaded from the reactor core arrives in the spent fuel pool from the transfer machine, which is located in the transfer canal, and then is moved to the designated spent fuel storage location. Conversely, fuel which is reloaded to the reactor core is sent from a spent fuel pool storage location to the transfer machine. By placing Region 1 racks directly in front of the transfer canal, most fuel movement during a refueling will take place between Region 1 and the fuel transfer machine, without ever having to pass over Region 2 or Region 3.

FIGURE 2

PROPOSED LAYOUT OF MILLSTONE UNIT 3 SPENT FUEL POOL (NOT TO SCALE)



34. Region 1 4-out-of-4 storage is conservatively designed such that, absent an unusual and unlikely situation involving a premature off-load shortly after a refueling, any fuel assembly coming out of the core should be able to be stored in any Region 1 fuel storage location. Further, Region 1 is conservatively designed such that any single fuel misload in Region 1 will not exceed a 0.95 K_{eff}, even without soluble boron. Further, Region 1 is conservatively designed such that even if it was full of fresh 5 w/o U-235 fuel, with no soluble boron in the spent fuel pool water, it would still be sub-critical. Further, after reload of the reactor core, absent the unusual circumstances discussed above, the remaining fuel in the spent fuel pool should be qualified for any Region 1 location, and therefore there should be no possibility of unqualified fuel being "misplaced" in Region 1 storage racks. As an example, all of the fuel which is currently stored in the Millstone Unit 3 spent fuel pool would be qualified for storage in the proposed Region 1 racks.

35. Region 2 fuel storage racks have been conservatively designed such that only fresh or once-burned fuel would not qualify for storage in them. Fresh and once-burned fuel would be stored in Region 1, and thus should never pass over Region 2. After reload of the reactor core, the remaining fuel in the spent fuel pool would ordinarily be at least twice-burned and therefore qualified for Region 2. There should be little likelihood of fuel being misplaced in Region 2 storage racks. As an example, all of the fuel which is currently stored in the Millstone Unit 3 spent fuel pool would be qualified for storage in the proposed Region 2 racks.

36. Region 3 racks are physically located farthest from the transfer canal, and the only reason for fuel to be passing over Region 3 should be to move fuel to Region 3

for permanent storage. This minimizes the likelihood of a fuel drop or misplacement event in this Region.

37. Boraflex is still present as a neutron absorber in the Region 3 storage racks, which are the existing storage racks in the spent fuel pool. NNECO has conservatively elected not to credit the Boraflex in these racks in the criticality analyses. Nonetheless, the presence of Boraflex provides an additional qualitative, but physical, conservatism for this region.

Millstone Operating Experience With Fuel Burnup Credit

38. One aspect of Contention 4 is a presumption that Millstone will not adhere to administrative controls. However, there is a demonstrated history of acceptable performance at Millstone Unit 2 and Millstone Unit 3 of compliance with burnup vs. enrichment curve requirements of spent fuel pool criticality analyses. That direct experience speaks directly and forcefully to this contention.

39. As previously discussed, use of fuel burnup credit is not new at Millstone. Millstone Unit 2 and Millstone Unit 3 have both used fuel burnup credit for an extensive period of time. Millstone Unit 2 has used fuel burnup credit since 1986. Millstone Unit 3 has used fuel burnup credit since 1990. Millstone Unit 1, which is a BWR, does not use fuel burnup credit. *There has never been a case at Millstone where a fuel assembly was placed into a fuel storage region for which it was not qualified.* Such an event would have been, when detected, reportable to the NRC by Licensee Event Report. In addition, NNECO has periodically performed serial number verifications of assemblies in the spent fuel pool (the last for Unit 3 was after the last outage, RFO 6, in 1999). No misplacements were identified.

40. NNECO supplied as part of the document request of the intervenors, a listing of known fuel handling events and "errors" associated with Millstone, based upon a good faith search of available databases. There were no events listed for Millstone Unit 2 or Unit 3 where a violation of a fuel burnup/enrichment curve took place. For this proceeding, I have helped to prepare NNECO's Operating Experience (OE) Matrix of known fuel handling events associated with Millstone Units 1, 2, and 3 (see Reference 9), and I agree with its contents. As shown in the OE Matrix, there were two events, one each at Millstone Unit 2 (10/12/85 event) and Millstone Unit 3 (4/27/94), where a potential existed for a single fuel misplacement event to occur. In both, fuel misplacement events did not actually occur. (The Millstone Unit 2 event in 1985 was before fuel burnup credit was ever used.) In each of these two cases, a fuel assembly was brought to the wrong fuel storage location, and when lowered came into contact with a correctly stored fuel assembly. It is reasonable to assume that, had the stored fuel assembly not been present, that a fuel misplacement event would have occurred. Even had that occurred, however, the fuel was still qualified for the incorrect location, and would not have caused any violation of a required fuel burnup/enrichment curve. This demonstrates that even if a fuel misplacement event occurs, it does not necessarily have any material impact to the criticality analysis.

41. Associated with each refueling, I would estimate there are about, on average, 500 fuel movements in the spent fuel pool. Millstone Unit 2 has had 7 refuelings and 1 mid-cycle core offload/reload, since the institution in 1986 of fuel burnup credit. Hence, there have been an estimated 4,000 fuel moves in the Millstone Unit 2 spent fuel pool during this time frame. Millstone Unit 3 has had 4 refuelings since the institution in

1990 of fuel burnup credit. Hence, there have been an estimated 2,000 fuel moves in the Millstone Unit 3 spent fuel pool during this time frame. Using the 2 events described above, one each for Millstone Unit 2 and Millstone Unit 3, I would estimate that the probability of a fuel assembly being improperly placed in a spent fuel rack storage location at about 1 in 3,000 (*i.e.*, 2 events per 6,000 moves).

42. Again, even with an estimated probability of 1 in 3,000 for a potential fuel misplacement event, for a fuel assembly misplacement event to matter to the criticality analysis of the spent fuel pool, the fuel assembly must be moved to an incorrect location, the location must be empty (so that a misloading can occur), and the assembly must be loaded into a region for which the fuel assembly is not qualified. A single fuel assembly misplacement is a credible event that can occur at some small frequency. Therefore, the licensing basis criticality analysis has considered it, and the event is bounded. But, in fact, at Millstone Unit 2 and Unit 3, there have been no cases where the burnup vs. enrichment curve requirements have not been met.

43. There have been a few rare cases I am aware of, not at Millstone, but at other plants, where a few assemblies, at the same time, were stored in a region for which they were not qualified. I have reviewed these events and it is important to note that the overall reactivity effect from each of these few multiple misloading events was still far less than the reactivity effect that is assumed in the *limiting* single fuel mishandling event. To explain further, the limiting design basis single fuel assembly misplacement/drop event at Millstone Unit 3 results in a K_{eff} increase of about .05. This is a very large K_{eff} increase for a single fuel misloading because of the very conservative assumptions used. It is extremely unlikely that even if a multiple number of misloaded fuel assemblies actually

occurred, that the resulting K_{eff} increase would exceed the criticality analysis K_{eff} increase due to the *limiting* single misloading event.

44. As an example, I am aware that in March 2000, a fuel misloading event took place at the Farley Unit 1 nuclear plant. This event is documented in Farley Unit 1 Licensee Event Report (LER) 2000-004-00. I have reviewed the applicable Farley Technical Specifications, procedures, and the LER. The LER documents that three fuel assemblies were placed in an incorrect fuel storage configuration. Each of the fuel assemblies was improperly located because each had, at most, 3,300 mwd/mtu of burnup less than required for the storage location in which it was placed. The LER also documents that one of the principal causes of the error was an inadequate independent review that was performed on the fuel qualification determination.

45. If the same event happened at Millstone Unit 3 (*i.e.*, if three fuel assemblies were misplaced anywhere in the spent fuel pool, and they were 3,300 mwd/mtu of burnup short of the required burnup), the increase in spent fuel pool K_{eff} would still be less than the design basis single fuel misloading event. This is because the design basis single fuel loading event is a single 5 weight percent U-235 *fresh* fuel assembly misloaded into an otherwise completely filled rack of maximum reactivity fuel. This design basis event needs 425 ppm of soluble boron (rounded up to 800 ppm for the TS) to ensure K_{eff} is less than 0.95. In fact, the entire Millstone 3 spent fuel pool could be loaded with fuel which was 3,300 mwd/mtu of burnup short of the required burnup, and the resulting K_{eff} increase still would not exceed the K_{eff} increase caused by the design basis single fuel misloading event. Therefore, the mere fact that more than one fuel assembly was improperly located, by itself, does not invalidate the criticality analysis.

46. In addition, proper independent review of the qualification of fuel when crediting fuel burnup is an important issue. People occasionally make mistakes, and proper independent review should catch those mistakes. In recent years, for our units where substantial credit for fuel burnup is used (specifically, Millstone Unit 2 and Connecticut Yankee), we have performed QA calculations to ensure the proper level of detailed review in qualifying fuel for storage in regions with large burnup credit. We intend to use QA calculations for the re-racked Millstone Unit 3 SFP to qualify fuel for regional storage. We believe that the level of review required by QA calculations will prevent the type of misloading that occurred at Farley. The Farley process uses an independent review contained within one of their procedures. We believe this to be an adequate process, but believe that more rigorous QA calculations would reduce the likelihood of an event of this type.

47. In summary, Millstone Units 2 and 3 operating experience with fuel burnup credit to date is as follows:

- There has never been a case at either Millstone Unit 2 or 3 where a fuel assembly was placed into a fuel storage region for which it was not qualified.
- The two events at Millstone Units 2 or 3 that we documented in our discovery response, which could have resulted in a fuel misplacement event, still did not involve a situation where fuel would have been placed in a region for which the fuel was not

qualified. Even had this occurred, it would have been bounded by the single misplacement assumption of the criticality analysis.

- The probability of any fuel misplacement event based on Millstone Units 2 and 3 experience is about 1 in 3,000. This is, therefore, an extremely infrequent event.

Contention 5

48. In the Prehearing Conference Order, the ASLB admitted Contention 5 and stated (in part):

> *"The Board has determined that this basis for the contention does indeed raise an unresolved question of fact:*
>
> > *Will the proposed change in schedule of surveillance of the soluble boron in the fuel pool lead to a significantly increased likelihood of a criticality accident stemming from a misloaded fuel element, during the interval between fuel movements?*
>
> *There is no debate as to the efficacy of boron monitoring during fuel movement, but Petitioners point to the fact that changes in fuel pool water constituents can and do occur in the interval between fuel movements."*

49. The focus of the contention is on the proposed TS requirements for spent fuel pool soluble boron monitoring. The present Millstone Unit 3 TS requirements for a surveillance of boron concentration have an applicability of:

- *"Whenever fuel assemblies are in the spent fuel pool*" (existing TS 3.9.1.2)

At the time the ASLB admitted this contention, the proposed TS surveillance requirement contained an applicability of :

- "*During all fuel assembly movements within the spent fuel pool*" (proposed TS 3.9.1.2).

To resolve this contention, NNECO has submitted to the NRC a revised TS for SFP soluble boron monitoring which would retain the existing TS surveillance applicability of:

- "*Whenever fuel assemblies are in the spent fuel pool*" (revised TS 3.9.1.2).

50. As stated above, the ASLB previously concluded that "*There is no debate as to the efficacy of boron monitoring during fuel movement....*" Therefore, NNECO's proposed boron monitoring during fuel movement was not in question; rather, the contention focused on the need for surveillance in the time period between fuel movements. Since NNECO is now proposing to monitor SFP soluble boron concentration at all times (*i.e.*, whenever fuel assemblies are in the spent fuel pool), the contention should be resolved.

51. Further, as discussed above in the context of Contention 4, the TS requirement of 800 ppm of boron is provided to ensure that K_{eff} does not exceed 0.95 in the event of the licensing basis single limiting fuel misplacement event. By analysis, only 425 ppm is necessary for this purpose, and therefore there is substantial margin. In effect, the proposed TS requiring 800 ppm soluble boron restores the Unit 3 TS boron requirement that existed since initial plant licensing. The original TS, requiring 800 ppm, was also credited for the licensing basis limiting fuel handling accident, to maintain K_{eff} less than 0.95. The TS was increased to 1,750 ppm as an interim measure in 1998 to address what, at the time, was a more limiting accident -- a seismic event that was presumed to fail the Boraflex.

Contention 6

52. In the Prehearing Conference Order, the ASLB stated the issue raised by Contention 6 as follows:

> "*The litigable issue posed by Contention 6 essentially boils down to a question of law: Does GDC 62 permit a licensee to take credit in criticality calculations for enrichment, burnup, and decay time limits, limits that will ultimately be enforced by administrative controls ?*"

53. GDC 62 requires criticality control by physical systems or processes. Administrative controls are used to implement any physical system and are not prohibited by GDC 62. Fuel burnup and decay time are the indices that are used to implement the *fuel reactivity* as part of a physical system for criticality control. The term "fuel reactivity" refers to the state of a fuel assembly due to its existing fuel isotopic inventory. For example, as fuel burnup or decay time increases, the fuel assembly isotopic inventory changes, causing the fuel assembly's neutron multiplication ability to decrease. Since the fuel assembly's neutron multiplication ability has decreased, we say that the "fuel assembly reactivity" has decreased. That is to say that the inherent fuel assembly ability to affect K_{eff} has decreased, due to the change in fuel isotopic inventory. Like the Boral that will be used in the racks as a fixed neutron absorber, *fuel reactivity*, incorporated into a scheme of regional storage, is an example of a physical system for criticality control. Fuel burnup creates fission products that absorb neutrons. Whether a neutron is absorbed by a Boron-10 atom in a Boral plate, or a neutron is absorbed by a fission product in a fuel rod, it has been absorbed by a physical process in either case. The negative reactivity from Boron-10 in Boral is just as real as the negative reactivity from the change in fuel isotopics. Thus, as discussed earlier, the Unit 3 proposal is not one of substituting

administrative controls for physical controls. Rather, we are incorporating the known physical processes associated with fuel reactivity into a physical system for criticality control. Administrative controls are used in the design, construction, installation, surveillance, and continued operation of any physical system used for criticality control.

54. To state, as the Intervenors have stated, that administrative controls are acceptable at certain times but not others, is not logical. The Intervenors' argument appears to imply that once a piece of equipment is installed, no further administrative actions are appropriate. With regard to fuel burnup and fuel decay time, Intervenors refer to these as "on-going administrative controls." However, if administrative controls involved in the construction of the rack are acceptable, then administrative controls after the rack is installed should also be acceptable. The same compliance with 10 C.F.R. Part 50, Appendix B is required in the construction of the racks as is required with any activity associated with the racks after they are installed. I do not see anything unique about the installation of the racks that makes subsequent administrative controls inappropriate.

55. The dictionary definition of the words "physical," "systems" and "processes," which are most applicable to this circumstance, are:

physical: "(1) of or relating to nature or the laws of nature, (2) material as opposed to mental or spiritual, (3) of, relating to, or produced by the forces and operations of physics" (from The Merriam-Webster Dictionary, copyright 1998 by Merriam-Webster Incorporated)

systems: "(1) a group of units so combined as to form a whole and to operate in unison, (2)… (3) a definite scheme or method of procedure or classification, (4): regular method or order." (from The Merriam-Webster Dictionary, copyright 1998 by Merriam-Webster Incorporated)

process: " a particular method of doing something, generally a number of steps or operations" (from ASLB Prehearing Conference Order)

Using these terms, a comparison of fixed neutron absorbers, such as Boral plates, and the use of reactivity limits as proposed by NNECO is useful.

56. Boral plates meet the dictionary requirement for a *physical system*. First, per the dictionary definition above, Boral plates are *physical*: Boral plates are material (as opposed to mental or spiritual). Second, per the dictionary definition, they have physical effects on criticality based on a known physical *process*. Third, per the dictionary definition above, Boral plates are part of a *system*. They are a group of units (Boron-10 atoms in the boral plates) so combined as to form a whole (all the Boral plates in the storage rack) and to operate in unison (to ensure that the spent fuel rack K_{eff} is limited). They are placed in a definite regular scheme (the plates are placed in the storage racks at regular intervals), and have a minimum specified Boron-10 concentration to perform their function. Thus, they meet the GDC 62 requirement of a physical system.

57. The Boral physical system requires administrative controls in the construction process to construct the physical system. For example, measurements were taken on the Boron-10 content in the Boral. These measurements were controlled by administrative procedures. The racks also require "ongoing administrative controls" to maintain the system, such as SFP water chemistry controls and a Boral coupon surveillance program to monitor the performance of the material. Intervenors accept the administrative controls involved in the construction of the Boral plates, but incorrectly state that there are no on-going administrative controls after installation of the Boral plates/storage racks.

58. Fuel burnup and fuel decay time meet the requirements of GDC 62. A specific fuel burnup is an index which refers to a specific set of fuel isotopic concentrations due to the burnup of the fuel in the reactor core (fuel burnup). Fuel decay time is an index which refers to a specific set of fuel isotopic concentrations due to the decay of the fuel, from the time the fuel was last operated in the reactor, to the current time, with such decay time mostly occurring in the spent fuel pool. The current fuel reactivity is therefore a reflection of the current fuel isotopic concentrations, of which fuel burnup and decay time are indices. Fuel reactivity (*i.e.*, current fuel isotopic inventory) meets the dictionary definition of "physical." Isotopes are material (as opposed to mental or spiritual). Isotopic concentrations relate to, and are produced by, the forces and operations of physics. Second, as a result of a known "physical process," fuel isotopic concentration physically affects reactivity and the potential for criticality. Third, per the dictionary definition above, the fuel isotopic concentrations are incorporated into a "system." They are a group of units (individual isotopes in fuel rods) so combined as to form a whole (all the isotopes contained within the array of fuel assemblies) and, in the context of a regional storage array, operate in unison to ensure that the spent fuel rack K_{eff} is limited. They are placed in a definite regular scheme (the same minimum isotopic concentrations are assumed present in every fuel assembly) and have a minimum specified set of fuel isotopics (burnup or decay time indexed) to perform their function. In total, NNECO's proposal involves physical processes within a physical system of criticality control. Fuel burnup and decay time are the indices that are used to implement the *fuel reactivity* as part of a physical system and process for criticality control.

59. Physically, consider the difference between a Boral plate, with a minimum assured Boron-10 concentration (measured in Boron-10 density), and a fuel rod with a minimum assured isotopic concentration (measured in burnup or decay time). The purpose of GDC 62 is to ensure criticality compliance. Burnup creates fission products that act as a poison. If a neutron is absorbed by a Boron-10 atom in a Boral plate, or a neutron is absorbed by a fission product in a fuel rod, it has been absorbed by a physical system, by a physical process, in either case. The effect -- the negative reactivity from the change in fuel isotopics -- is just as physical and real as the negative reactivity from Boron-10 in Boral.

60. The Intervenors argue that only the initial fuel enrichment, which is nothing more than the initial fuel isotopic concentration, should be used in calculating the required criticality limits. They argue that no additional credit should be allowed for depleted fuel isotopic concentrations (burnup and decay time credit). With regard to this issue, the enrichment that is used in the proposed Technical Specifications is the <u>initial nominal U-235 enrichment</u>. This is the initial enrichment of the fuel assembly as it is designed, and later verified by fuel vendor measurements, before it is ever received on-site. This enrichment value does not change on an ongoing basis. Different fuel assemblies may have different initial enrichments, but the initial U-235 enrichment for a given fuel assembly is fixed at fabrication and does not change. Thus, no ongoing administrative controls are needed, since the initial enrichment of a fuel assembly does not change.

61. Crediting fuel burnup and decay time requires administrative controls (*i.e.*, operating procedures) to establish the physical system of criticality control. But administrative controls are also necessary to build fuel storage racks, to measure boron

concentration in Boral, to verify as-received new fuel enrichment, or to segregate fuel by enrichment. These controls are governed by 10 C.F.R. Part 50, Appendix B, QA requirements. If administrative controls are acceptable for these systems, then administrative controls should also be acceptable to implement other systems -- such as a system incorporating fuel reactivity to prevent criticality -- provided those controls are compliant with 10 C.F.R. Part 50, Appendix B.

62. Moreover, fuel burnups can only increase; they cannot decrease. Fuel decay times can only increase; they cannot decrease. Since fuel burnup can only increase, the fuel reactivity can only decrease. Since decay time can only increase, the fuel reactivity can only decrease. Therefore, at the refueling intervals of about 1.5 years, as the fuel burnup and decay time of individual fuel assemblies change, credit will be taken for this step fuel reactivity decrease. Thus, fuel burnup or decay time reactivity credit can only conservatively increase, and not decrease.

63. The NRC has consistently applied guidance allowing soluble boron and reactivity limits in spent fuel pool storage systems. This is discussed in the Affidavit of Dr. Turner and includes the 1978 NRC Staff position paper (Reference 6) which allows soluble boron credit for accident conditions; the 1981 draft NRC Regulatory Guide 1.13, Rev. 2 (Reference 7) which allows fuel burnup credit; and the 1998 NRC Staff position paper by L. Kopp (Reference 8) which provides a summary of NRC Staff criticality requirements and which specifically allows for both fuel burnup credit and fuel decay time credit. The NRC Staff has approved the use of both fuel burnup credit and fuel decay time credit at many other nuclear power plants, and there is nothing unusual about this

application of fuel burnup credit or fuel decay time credit as proposed for Millstone Unit 3.

64. Indeed, at Millstone Units 2 and 3, the NRC has applied the above guidance and has previously allowed administrative controls. Specifically, Millstone Unit 2 was granted, by TS Amendment 109 in 1986, the ability to credit fuel burnup in spent fuel pool criticality calculations for the first time. Millstone Unit 2 was granted additional credit for fuel burnup in 1987, by TS Amendment 117, adding an additional burnup vs. enrichment curve for consolidated fuel. In 1992, by TS Amendment 158, Millstone Unit 2 was allowed to add a new burnup vs. enrichment curve for Region A; and in 1994 by TS Amendment 172, Millstone Unit 2 was allowed to add a new burnup vs. enrichment curve for fuel assemblies with installed poison rodlets. Millstone Unit 3 was granted, by TS Amendment 39 in 1989, the ability to credit fuel burnup in spent fuel pool criticality calculations for the first time.

65. Compliance with 10 C.F.R. § 50.68 also demonstrates that administrative controls are acceptable to meet criticality requirements. In 10 C.F.R. § 50.68, several examples are evident where administrative controls are used to comply with 10 C.F.R. § 50.68. If administrative controls can be used to comply with the criticality requirements of 10 C.F.R. § 50.68, then the same controls should be acceptable for use in GDC 62. Specifically:

- 10 C.F.R. § 50.68(b) (1) acknowledges that plant procedures are used to ensure that handling and storage at any one time of more fuel assemblies than have been designed for, is not allowed.

- 10 C.F.R. § 50.68(b) (2) and (3) acknowledge that administrative controls may be used to replace certain evaluations in new fuel storage racks.
- With regard to administrative controls related to soluble boron concentration, 10 C.F.R. § 50.68(b)(4) provides requirements for criticality control of spent fuel pools. This regulation clearly states that soluble boron may be credited under certain conditions. The proposed re-rack of Millstone Unit 3 does meet all the requirements listed in 10 C.F.R. § 50.68(b) (4).

66. It is also important to point out that 10 C.F.R. § 50.68(b) (2), (3) and (4) refers to "maximum fuel assembly *reactivity.*" The regulation does not state "maximum fuel assembly *enrichment.*" This is an important distinction. This acknowledges that less than the maximum enrichment can be used in the analysis of new fuel or spent fuel storage racks, but fuel of the maximum reactivity for a particular storage rack must be used. Only in 10 C.F.R. § 50.68(b) (7) is the maximum *enrichment* referred to. This is because 10 C.F.R. § 50.68(b) (7) requires that the maximum *enrichment* in use shall be 5 w/o U-235, but 10 C.F.R. § 50.68(b) (2), (3) and (4) uses the words maximum *reactivity* to acknowledge that lower reactivity fuel than the maximum fuel enrichment may be allowed in a given new fuel or spent fuel storage rack. *If lower reactivity fuel than the maximum enrichment is allowed in a given storage rack, then it necessarily follows that administrative controls must be used to enforce them.* The maximum fuel assembly reactivity is measured by ensuring that the measured fuel enrichment, measured fuel

burnup, and actual fuel decay time meets the criticality analysis requirements. The criticality analysis defines what the maximum fuel assembly reactivity is for each fuel storage region, to ensure that K_{eff} is maintained < 0.95.

Responses to ASLB Questions

67. ASLB Question A.1: See Paragraphs 41 through 42 above.

68. ASLB Question A.4: See Paragraphs 14 through 18 above. See also Reference 3, Attachment 1 at 2-3.

69. ASLB Question A.5: Fresh fuel of 5 weight percent U-235 is the maximum reactivity fuel in use at Millstone Unit 3. The reactivity associated with 5 w/o U-235 fresh fuel bounds any irradiated fuel reactivity, at any fuel burnup or fuel decay time.

70. ASLB Question A.6: The use of the terms "weight percent U-235" and "w/o U-235" were meant to be interchangeable. For example, if a fuel assembly contains 400 kilograms of total Uranium, with a U-235 enrichment of 5 weight-percent, then there is 400 *.05 = 20 kilograms of U-235. Both the measurement processes and the analytical calculations are performed consistently using weight percent.

71. ASLB Question A.7: It is correct to conclude that Figures 4.1.1, 4.1.2 and 4.1.3 of the non-proprietary version of the license amendment application are the principal vehicles by which placement determination is made for the storage of fuel assemblies. This process is discussed in detail in Paragraphs 14 through 18 above.

72. ASLB Question B.6: The refueling cavity, in containment, has its own Technical Specification requirement, TS 3.9.1.1, which requires that the refueling soluble boron concentration be maintained at least to 2,600 ppm. At Millstone Unit 3, NNECO

keeps the minimum spent fuel pool soluble boron concentration administrative value at 2,600 ppm, so that when the refueling cavity and spent fuel pool are commingled, since each volume is initially above 2,600 ppm, they will both stay above 2,600 ppm when mixed.

73. ASLB Question C.1: The definition of reactivity per Glasstone and Sesonske, "Nuclear Reactor Engineering", equation (5.10) is: reactivity = $(K_{eff}-1)/K_{eff}$. The NRC's design limit for spent fuel pool is a K_{eff} value of < 0.95. Therefore, all calculations are performed so as to ensure that a K_{eff} value of < 0.95 is maintained, and "reactivity" is not something that is determined either as an intermediate or final goal. NNECO's use of the word "reactivity" is usually to denote the positive or negative trend of K_{eff} due to some event, variable or condition. We also use the term "fuel reactivity" to refer to the state of a fuel assembly due to its existing fuel isotopic inventory. For example, as fuel burnup or decay time increases, the fuel assembly isotopic inventory changes, causing the fuel assembly's neutron multiplication ability to decrease. Since the fuel assembly's neutron multiplication ability has decreased, we say that the "fuel assembly reactivity" has decreased. That is to say that the inherent fuel assembly ability to affect K_{eff} has decreased, due to the change in fuel isotopic inventory.

74. ASLB Question C.2: The term spent fuel "reactivity" as used in 10 C.F.R. 50.68 (b)(4) refers to the effects of fuel enrichment, fuel structure, fuel burnup, and fuel decay. See also Paragraph 66 above and Paragraphs 14 through 18 in the Affidavit of Dr. Turner.

75. ASLB Question C.5: See Paragraphs 53 through 66 above.

76. ASLB Question C.6: Procedural controls are contemplated in the scope of "physical processes" and "physical systems" as used in GDC 62, in that procedural controls are necessary to implement any physical process or physical system to prevent criticality. See Paragraphs 53 through 66 above.

77. ASLB Question C.7: When a change is made from a 18-month to a 24-month fuel cycle, the validity of the criticality analysis for the spent fuel storage racks must be re-examined. Specifically, if the fuel design mechanical parameters have changed, or the maximum fuel enrichment has changed, this should be evaluated. By itself, a change from 18-month to 24-month fuel cycle does not invalidate the spent fuel pool storage fuel enrichment/burnup and decay time curves, unless an input to the original criticality analysis is no longer bounding.

Conclusion

78. Based on the foregoing, I conclude that the criticality analysis performed for the proposed Millstone Unit 3 demonstrate compliance with all NRC requirements and guidance for licensing basis normal and abnormal events. Moreover, procedural controls and the physical layout of the proposed regional storage minimize the potential for fuel misplacement events and for boron dilution events. Further, extremely conservative, beyond-design-basis criticality evaluations show that even in the most extreme cases of multiple misplacement or boron dilution (and even in combination) there is adequate margin of safety to provide reasonable assurance that criticality will be prevented. Finally, the NNECO proposal fully meets GDC 62 and related NRC regulatory guidance.

79. The foregoing statements are true and correct to the best of my knowledge and belief.

Joseph J. Parillo

Joseph J. Parillo

Sworn and subscribed to before me on this 27 day of June, 2000.

Notary Public

My Commission expires: Jun 30 2004

Attachment A

Professional Qualifications
Joseph J. Parillo

Professional Affiliation

Mr. Parillo is employed by Northeast Utilities and is located at the Millstone Nuclear Power Station. Mr. Parillo is currently a senior engineer in the Nuclear Analysis Section, and has been employed by Northeast Utilities for about 24 years in the Nuclear Engineering and Operations Disciplines.

Area of Professional Expertise

Mr. Parillo has expertise in the following areas:

- Nuclear criticality discipline, including familiarity with the KENO and CASMO computer codes.
- Reactor core design discipline, including performance of safety related core design calculations for Millstone Unit 3 and Connecticut Yankee using the Westinghouse Nuclear Design System.
- Extensive familiarity with Millstone Unit 2 spent fuel pool operations and fuel movement as former Reactor Engineer for Millstone Unit 2.
- Operator training. Has held a Senior Reactor Operator license at Millstone Unit 2, and was a former supervisor of Operator Training.

Education

BS in Nuclear Engineering from RPI in 1976

Professional Experience

- 1990 to present
  Responsible for performing NU scoping criticality calculations, and review of outside vendor criticality calculations for Millstone and Connecticut Yankee Spent Fuel Pools. Knowledgeable in KENO and CASMO use. Has been responsible for the criticality aspects of many Millstone 1, 2 & 3, and Connecticut Yankee spent fuel pool design and technical specification changes. Was responsible for Connecticut Yankee to produce reactor core designs for each individual fuel cycle, and all related safety calculations, using the Westinghouse Nuclear Design code system. Responsible for Millstone Unit 3 to produce many safety related Nuclear Design calculations using the Westinghouse Nuclear Design code system.

- 1985 to 1990
  Operator training supervisor for Millstone Unit 2. Responsible for simulator training and various other aspects of Operator Training. Continued to hold a Senior Reactor Operator (SRO) license at Millstone Unit 2.

- 1981 to 1985
  Reactor Engineer for Millstone Unit 2. Held a Senior Reactor Operator (SRO) license at Millstone Unit 2, as well as being a PORC member and duty officer. Extensive Millstone Unit 2 spent fuel pool experience as reactor engineer, with much involvement in spent fuel pool activities. Extensive experience with movement of fuel in the spent fuel pool. Responsible plant engineer for the complete re-rack of the Millstone Unit 2 Spent Fuel Pool in 1985.

- 1976 to 1981
  Engineer in the nuclear fuel and nuclear analysis sections. Participated in Millstone Unit 1 and Millstone Unit 2 fuel movements, in the spent fuel pool and containment during refuelings.

UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

BEFORE THE ATOMIC SAFETY AND LICENSING BOARD

In the Matter of:	)	
	)	
Northeast Nuclear Energy Company	)	Docket No. 50–423–LA–3
	)	
(Millstone Nuclear Power Station,	)	
Unit No. 3)	)	ASLBP No. 00–771–01–LA

AFFIDAVIT OF STANLEY E. TURNER, Ph.D., PE

I, Stanley E. Turner, being duly sworn, do on oath state as follows:

1. I am the Senior Vice President and Chief Nuclear Scientist of Holtec International ("Holtec"). I have been employed by Holtec since 1987, shortly after the formation of Holtec. I have also supplied the nuclear analyses used by Holtec's principal and founder, Dr. Krishna P. Singh, before the formation of Holtec, beginning about 1980. My business address is 138 Alt. 19 South, Palm Harbor, Florida, 34683.

2. I make this affidavit to explain the physical systems or processes available as criticality control methods for spent fuel storage, and the administrative measures used to implement each method. I also discuss, and provide my understanding of, the NRC's regulations governing criticality control for spent fuel pools, including General Design Criterion 62 (10 C.F.R. Part 50, Appendix A) and 10 C.F.R. § 50.68. I address specific aspects of the NRC Staff's regulatory guidance concerning spent fuel pool criticality control, including the Double Contingency Principle and the implementation of burnup credit. I also provide information concerning the prevalence of the use of burnup credit

for spent fuel pool criticality control at numerous nuclear sites across the country and overseas. Finally, I have performed a series of analyses for this proceeding to illustrate the high level of criticality safety in the Millstone Unit 3 spent fuel storage racks.

Experience and Qualifications

3. Holtec is a diversified energy technology company working for the electric power industry both in the United States and in many countries around the world. Holtec performs the majority of its work for nuclear power plants. Holtec develops and markets turnkey equipment for the nuclear power industry. Holtec performs all of the design and engineering, obtains necessary governmental regulatory approvals, effectuates manufacturing, and performs on-site installation, testing, and commissioning into service of the products it sells. Holtec currently employs over 50 professional employees. A large number of Holtec's employees hold graduate degrees from prestigious national and international universities, with approximately 30 percent holding Ph.D.s in science and engineering.

4. Holtec designs and markets both wet storage and dry storage systems for spent fuel storage and transport. Holtec's expertise in spent fuel storage system development and supply includes expertise in solid mechanics, heat transfer, nuclear physics, and nuclear components fabrication. One of Holtec's principal business areas is the design and installation of spent fuel storage racks for wet storage of spent fuel at nuclear power plants. Holtec's capability in these projects includes all of the design, analysis, and licensing reports required to obtain approval and to implement the spent fuel storage racks. Holtec has nearly a 100% market share in wet storage of spent nuclear

fuel. Holtec has completed turnkey projects for wet pool spent fuel storage in over 50 spent fuel pools in nuclear plants around the world.

5. I am Holtec's Chief Nuclear Scientist, with responsibility for the majority of nuclear analyses performed by Holtec. Included in my role as Senior Vice President and Chief Nuclear Scientist is responsibility for all nuclear criticality analyses for spent fuel storage systems.

6. I received my Ph.D. in Nuclear Chemistry from the University of Texas in 1951. I have been elected to the academic honor societies of Sigma Pi Sigma, Phi Lambda Epsilon, Blue Key, and Sigma Xi. I have been a registered Professional Engineer in the field of Nuclear Science for over 25 years. I am, and have been, a member of several Standards Committees in the American Nuclear Society ("ANS"). I have been a member of the ANS Standards Committee on Nuclear Criticality Safety since 1975. I am an Elected Fellow of the American Institute of Chemists. A copy of my resume is included as Attachment A to this affidavit.

7. I have been performing nuclear criticality analyses since 1957. Since 1987, I have been the Chief Nuclear Scientist for Holtec. Prior to that, from 1977 to 1987, I was a Senior Consultant for the Southern Science Office of Black & Veatch Engineers-Architects. Prior to that, from 1973 to 1977, I was a Senior Consultant for NUS Corporation. Prior to that, from 1964 to 1973, I was the Vice President for Physics for Southern Nuclear Engineering, Inc., and from 1957 to 1964, I was a Senior Reactor Physicist for General Nuclear Engineering. Every one of these positions has included, among other things, responsibility for nuclear criticality safety for reactor core operations as well as for new and spent fuel storage and for reactor core operations.

8. In my four decades of work on nuclear criticality safety, I have both developed methods for assessing nuclear criticality safety and performed the analyses to demonstrate criticality safety. I have developed nuclear analysis techniques used in criticality safety analyses. I have performed the detailed calculations to benchmark the KENO5a and MCNP4a computer codes that are widely used for criticality safety analyses. I have developed and written computer codes to generate input for nuclear criticality safety analyses. I have also performed numerous nuclear criticality safety analyses. I have performed numerous calculations of spent fuel fission product inventories using the CASMO2E, CASMO3, CASMO4, ORIGEN, ORIGEN-II, and ORIGEN-S codes. I have performed numerous criticality safety analyses for wet spent fuel storage rack installations, dry cask storage, and transportation casks. I have personally performed criticality safety analyses, and authored the related reports to support approximately 60 to 70 NRC license amendment requests related to spent fuel pool storage.

Physical Systems or Processes Available for Criticality Control in Spent Fuel Pools

9. Every criticality control method involves, by necessity, some physical system or process. Criticality control can only be achieved through physical measures that affect the neutron multiplication factor ("k-effective" or "k_{eff}"). This is achieved through controlling the production, absorption, and leakage of neutrons. All of these are physical measures. Neutrons will not recognize, much less obey, procedures and other administrative measures alone. Some physical measure or system is required to achieve criticality control.

10. There are a limited number of means available to control criticality of fuel assemblies stored in spent fuel pools. In practice, the four methods available are: 1) geometric separation; 2) solid neutron absorbers; 3) soluble neutron absorbers; and 4) fuel reactivity limits. These methods involve physical processes which have a physical effect on the neutron multiplication factor, or "k-effective," in the spent fuel pool and are incorporated into physical systems to prevent criticality.

11. Geometric separation is a physical system or process. Geometric separation physically affects neutron coupling between assemblies in storage. Wider spacing of the individual fuel assemblies neutronically decouples the fuel assemblies and thus decreases reactivity of the system. Geometric separation takes the form of steel racks installed in the spent fuel storage pool with fixed locations and fixed separation between the fuel assemblies in storage.

12. Solid neutron absorbers are a physical system or process. Solid neutron absorbers physically affect neutron absorption. Absorption of neutrons in the solid neutron absorbers, also referred to as neutron "poisons," remove neutrons from the system, which eliminates neutrons that could cause fission and this removal of neutrons decreases reactivity of the system. Boron, and specifically the isotope Boron-10, is the standard absorbing element used in solid neutron absorbers. Solid neutron absorbers take the form of fixed panels containing boron that are installed in the spent fuel storage racks during their manufacture.

13. Soluble neutron absorbers are a physical system or process. Just like solid neutron absorbers, soluble neutron absorbers physically affect neutron absorption. Absorption of neutrons in the soluble neutron absorbers, also referred to as neutron

"poisons," remove neutrons from the system, which eliminates neutrons that could cause fission and thus decreases reactivity of the system. Boron, and specifically the isotope Boron-10, is the standard absorbing element used in soluble neutron absorbers. Soluble neutron absorbers take the form of soluble boric acid dissolved in the spent fuel pool water.

14. Fuel reactivity limits are a physical system or process. Specifically, fuel reactivity is a physical characteristic, with physical effects. By a physical process, fuel reactivity affects the production, absorption, and leakage of neutrons. Fuel reactivity is determined by four factors: 1) fuel assembly structure; 2) initial (or "fresh") fuel enrichment; 3) fuel depletion (or "burnup"); and 4) the period of time that spent fuel is stored (post-operational decay). All four of these factors must be taken into account to determine fuel reactivity. When fuel reactivity limits are used in a storage system to prevent criticality, it is a physical system as discussed below.

15. Fuel assembly structure, part of fuel reactivity, is a physical characteristic, with physical effects. By a physical process, fuel assembly structure affects the reactivity of the assemblies. The spacing of fuel rods within the fuel assembly structure determines neutron interactions, which physically affect reactivity of the system. The materials in the fuel assembly structure also act as neutron absorbers, which physically affect the reactivity of the system. Fuel-assembly structure takes the form of fuel (usually uranium dioxide, or UO_2) in metal cladding, as well as grid spacers, tie rods, and end fittings.

16. Fresh fuel enrichment, part of fuel reactivity, is a physical characteristic, with physical effects. By a physical process, fresh fuel enrichment affects neutron production and absorption. Higher fresh fuel enrichment results in greater production of

neutrons, which increases reactivity of the system. Fresh fuel enrichment is usually described in terms of weight percent of the fissile isotope Uranium-235, out of the total uranium in the fuel, prior to loading into the reactor core and undergoing power operations.

17. Fuel depletion, or burnup, part of fuel reactivity, is a physical characteristic, with physical effects. Like fresh fuel enrichment, by a physical process fuel burnup affects neutron production. In the burnup process, uranium initially loaded in the fresh fuel is converted, through the nuclear fission and absorption processes, into fission product nuclides and transuranic nuclides. Higher fuel burnup inherently results in lower production of neutrons, which decreases reactivity of the system. The fuel burnup process depletes the amount of fissile Uranium-235 in the fuel, while at the same time replacing the uranium with fission products and transuranics that are, in many cases, strong neutron absorbers. While some fissile Plutonium-239 and Plutonium-241 are generated during fuel burnup, the combined quantity of fissile uranium and fissile plutonium (the "fuel") continually decreases with increasing burnup, in a predictable manner. Fuel burnup, including the depletion of uranium and thus the decrease in reactivity, is a well understood physical process. Fuel burnup takes into account the actual physical contents of the nuclear "fuel" material, which includes unburned fissile Uranium-235, non-fissile uranium isotopes, fission products, and transuranics (including fissile plutonium).

18. Following removal of spent fuel from the reactor core and moving the burned fuel to the spent fuel storage rack, the reactivity of the spent fuel continually and predictably decreases with time due to the natural decay of the transuranic nuclides that

had been produced during the in-core power operation. This continuous decrease in reactivity is due almost entirely to the radioactive decay of Plutonium-241 (a fissle nuclide) and consequent production of its daughter nuclide, Americum-241, a strong neutron absorber. Other radioactive fission products and transuranics are either stable elements, have long half-lives, or decay to other elements with comparable neutron absorption properties. The net effect of this inherent radioactive decay is to result in a predictable decrease in reactivity over time, by a well-understood physical process.

19. A storage system that incorporates reactivity limits (*i.e.*, enrichment, burnup, and/or decay limits) is a physical system to prevent criticality. The storage system involves physical spacing (*i.e.*, segregation) of fuel into appropriate regions. Within regions, the system relies upon known physical characteristics, physical processes, and the physical effects of the reactivity of the fuel to physically prevent criticality. The one-time measure of placing the fuel into the appropriate region does not change the inherent physicality of the system.

Every Physical System or Process for Criticality Control is Implemented Using Some Administrative Controls

20. Each of the physical systems or processes, identified above as physical measures for criticality control, requires some administrative controls for implementation. I know of no criticality control measure for fuel storage pools that can be implemented without some degree of administrative control.

21. Spent fuel storage racks used for geometric separation are designed, constructed, and inspected according to procedural controls. The effect of the spent fuel storage racks on criticality is verified using validated computer codes. Administrative

controls are used to ensure that the storage racks are constructed to match the approved design. Fabrication quality, including items such as manufacturing tolerances, is assured through the use of quality control inspections required by administrative controls. The storage racks are installed in the spent fuel pool pursuant to administrative controls, such as inspections, to ensure the racks are properly assembled and positioned.

22. Solid neutron absorber panels installed in the storage racks are likewise designed, constructed, and inspected according to procedural controls. The effect of the solid neutron absorber panels on criticality is verified using computer codes, validated by comparison with experimental observations (called critical experiments). Administrative inspections are used to ensure that the proper amount of boron neutron absorber is loaded into each panel, and that the boron is uniformly distributed within the panel. Administrative controls, including fabrication inspections, are used to ensure that the storage racks are constructed to conform to the approved design. The solid neutron absorber panels are installed in the storage racks pursuant to administrative controls, such as inspections, to ensure the panels are properly located.

23. Some continuing form of the surveillance of the presence and integrity of solid neutron absorbers is generally required, under ongoing administrative control. As a result of such continuing surveillance, the nuclear industry has determined that one solid neutron absorber material, known as "Boraflex", has shown unacceptable deterioration or degradation. In contrast, comparable surveillance programs at numerous plants have established that an alternative solid neutron absorber material, known as "Boral", has maintained its integrity and performance capability over many years of surveillance testing.

24. At Millstone Unit 3 in particular, Boraflex solid neutron absorber material was used in one region of the storage racks. The Millstone Unit 3 Boraflex surveillance program provided timely detection of the degradation of the Boraflex solid neutron absorber material. Although a considerable amount of Boraflex solid neutron absorber remains, Northeast Nuclear Energy Company prudently elected to re-analyze the racks, conservatively assuming that all of the Boraflex neutron absorber material had been lost. This re-analysis and re-qualification of the racks was performed by Holtec.

25. I have personally performed tests on the Boraflex surveillance coupons from the Millstone Unit 3 racks and have periodically performed or directed the performance of in-situ tests (called "Blackness Tests") of the Boraflex in the racks. The tests revealed the presence of some gaps in the Boraflex neutron absorber panels that were beginning to reduce the effectiveness of the Boraflex absorber material. I have also performed similar tests at numerous reactor plant facilities.

26. Soluble boron used in the spent fuel pool water is manufactured, added, and inspected according to the associated soluble boron control system and monitoring procedures. The effect of the soluble boron neutron absorber on criticality safety is verified using validated computer codes. The soluble boron control system initially installs a specified concentration of soluble boric acid in the spent fuel pool water pursuant to administrative controls, such as tests and inspections, to ensure that the proper amount of soluble boron has been added. Following initial installation, administrative controls, such as regular periodic testing, are used to verify that the level of soluble boron remains consistent with the specified concentration.

27. Fuel assembly structure is also designed, constructed, and inspected according to procedural controls. The effect of the fuel assembly structure on criticality is verified using validated computer codes. Administrative controls are used to ensure that the fuel assembly structure is constructed in conformance with the approved design. Fabrication quality, such as manufacturing tolerances, is assured through the use of quality control inspections according to administrative controls. The loading of the fuel pellets into the fuel assembly structure is monitored and inspected pursuant to administrative controls.

28. Fresh fuel enrichment is designed, produced, inspected, and tracked according to procedural controls. The effect of the fresh fuel enrichment on criticality is verified using validated computer codes. Administrative controls are used to ensure that fresh fuel enrichment is produced to no more than the level permitted in the approved design. Enrichment quality, such as production tolerances, is assured through the use of quality control inspections required by administrative controls. The fresh fuel enrichment in different fuel assemblies is tracked using administrative controls such as material control and accounting procedures and related databases for control of special nuclear material. Administrative controls track the movements, location, and fuel characteristics affecting reactivity, including fresh fuel enrichment, discharge fuel burnup, and decay time of all fuel assemblies throughout their entire history at the reactor sites.

29. The decay time in storage is accurately retained in the storage records. Fuel burnup is an inherent consequence of power operation in the reactor core. It is designed, produced, monitored, and tracked according to procedural controls. The effect of the fuel burnup and decay time on criticality is verified using validated computer

codes. Administrative controls are used to ensure that fuel burnup is produced to no less than the level permitted in the approved design with conservative allowances for tolerances. Fuel burnup is verified through the use of in-core reactor power monitors used to measure the rate of fission, and therefore fuel burnup, in the reactor core. Decay time is determined from the record of when each spent fuel assembly is placed in storage. These records are developed and retained according to administrative controls. The fuel burnup is used to determine the fuel contents using verified and validated computer codes. The fuel burnup in different fuel assemblies is tracked using the material control and accounting procedures and related databases for control of special nuclear material. Administrative controls for tracking the movements, location, and fuel characteristics, including fuel burnup and decay time of all fuel assemblies throughout their entire history at the reactor sites.

30. While the type, degree, and timing of administrative controls vary for each of the physical systems or processes that can be used to prevent criticality, it is a fact that every one of these physical measures for criticality control is implemented using some administrative controls.

NRC's Regulations Governing Spent Fuel Pool Criticality Control

General Design Criterion 62

31. One NRC regulatory requirement for spent fuel pool criticality safety is 10 CFR 50, Appendix A, "Prevention of Criticality in Fuel Storage and Handling" ("GDC 62"); GDC 62 was added to Appendix A of 10 C.F.R. Part 50 in 1971 and 10 CFR 50.68 in 1998. GDC 62 is one of the 64 general design criteria for nuclear power plants and reads as follows:

> *Criterion 62 – Prevention of criticality in fuel storage and handling.* Criticality in the fuel storage and handling system shall be prevented by physical systems or processes, preferably by use of geometrically safe configurations.

32. I have read, and am familiar with, the provisions of GDC 62. I have implemented the provisions of GDC 62 for over 28 years, since it was initially promulgated in 1971. I have also worked with the NRC Staff, during this same time period, to implement GDC 62 in light water spent fuel storage technologies developed to meet the requirements for expanded spent fuel storage since the early 1980s.

33. GDC 62 requires that all spent fuel pool criticality control measures should be physical systems or processes. As I stated above, the four methods available in practice for criticality control in spent fuel pool storage — 1) geometric separation; 2) solid neutron absorbers; 3) soluble neutron absorbers; and 4) fuel reactivity, including 4.1) fuel assembly structure, 4.2) fresh fuel enrichment, 4.3) fuel burnup, and 4.4) storage decay time — are all physical systems or processes.

34. Also, as I stated above, every one of these physical measures for criticality control requires some type of administrative controls to implement. In my 28 years of experience with GDC 62, I have always understood GDC 62 to encompass criticality control by physical measures that are implemented with the use of some administrative controls. As a practical matter, there can be no other way to interpret GDC 62. An interpretation that GDC 62 prohibits physical systems or processes that involve administrative measures would render GDC 62 a nullity, because none of the available criticality control methods could comply with such an interpretation. If this were the interpretation, GDC 62 would prohibit any method of criticality control.

35. The four different physical measures available for spent fuel pool criticality control do require different types, degrees, and timing of administrative controls for implementation. For example, the administrative controls required to implement geometric separation and solid neutron absorbers predominately (but not all) occur before the storage racks are initially loaded with fuel, while the administrative controls attendant to soluble neutron absorbers and fuel reactivity occur both before the racks are initially loaded as well as after. However, this is a difference only in timing and duration of the administrative measures. Nothing in GDC 62 differentiates between physical systems or processes for criticality control based on the timing, duration, or relative complexity of the administrative measures required to implement the physical measures.

36. Specifically, fuel enrichment limits, fuel burnup limits, and decay time for spent fuel storage are consistent with the requirements of GDC 62. All three are aspects of fuel reactivity, which is clearly a physical property with physical effects. The use of reactivity limits in a regional SFP is a physical system or process within the intent of GDC 62.

10 C.F.R. § 50.68

37. The other NRC regulatory requirement governing spent fuel pool criticality control is 10 C.F.R. § 50.68, "Criticality Accident Requirements." This regulation, which is more recent and specific than GDC 62, was added to Part 50 in 1998. 10 C.F.R. § 50.68 establishes requirements for criticality control in fuel storage and handling in lieu of a requirement for criticality monitors. The purpose of 10 C.F.R. § 50.68 is to prevent nuclear criticality during fuel storage and handling, and should be

considered in interpreting the intent of GDC 62, which serves a similar purpose. Though 10 C.F.R. § 50.68 does not specifically address every postulated accident, it does address the criticality control issues that are relevant to this proceeding.

38. 10 C.F.R. § 50.68 acknowledges and permits the use of *soluble boron* as a criticality control method for fuel stored in storage pools. 10 C.F.R. § 50.68(b)(4) specifically states:

> If credit is taken for soluble boron, the k-effective of the spent fuel storage racks loaded with fuel of the maximum fuel assembly reactivity must not exceed 0.95, at a 95 percent probability, 95 percent confidence level, if flooded with borated water, and the k-effective must remain below 1.0 (subcritical), with a 95% probability at a 95 percent confidence level, if flooded with unborated water.

The use of the soluble boron system for criticality control is comparable to the use of fuel burnup limits for criticality control. Both are physical measures or systems that are implemented through the use of some ongoing administrative controls.

39. 10 C.F.R. § 50.68 implicitly acknowledges and permits the use of limits on spent fuel assembly *reactivity* as a criticality control method for fuel stored in pools. 10 C.F.R. § 50.68(b)(4) specifically directs that "spent fuel storage racks loaded with fuel of the maximum fuel assembly reactivity" be considered for criticality control purposes. As discussed above, spent fuel assembly reactivity includes the effects of fuel burnup (as well as fuel structure, initial fuel enrichment, and decay time). In that 10 C.F.R. § 50.68(b)(4) does not restrict the assessment of fuel reactivity to only the initial fresh fuel enrichment, it implicitly acknowledges the potential for burnup limits.

40. 10 C.F.R. § 50.68 further acknowledges and permits the use of fresh fuel *enrichment limits* as a criticality control method for fuel storage in pools, in that 10

C.F.R. § 50.68(b)(7) specifically permits the use of a limit on fresh fuel enrichment as a criticality control method for fuel storage.

41. 10 C.F.R. § 50.68(b) also acknowledges and permits the use of *administrative controls*, including plant procedures, to implement criticality control methods for fuel stored in pools. 10 C.F.R. § 50.68(b)(1) specifically endorses the use of plant procedures to implement geometric separation of fuel assemblies. 10 C.F.R. § 50.68(b)(4) specifically permits the use of soluble boron for criticality control, which requires administrative controls to implement. 10 C.F.R. § 50.68(b)(4) specifically permits spent fuel assembly reactivity to be used in criticality control. Fuel reactivity includes the effects of fuel burnup, which necessarily require administrative controls to implement. 10 C.F.R. § 50.68(b)(7) specifically permits the use of enrichment limits for criticality control, which requires administrative controls to implement.

Double Contingency Principle

42. The NRC Staff's regulatory guidance for implementing criticality control methods specifically endorse the Double Contingency Principle. The Double Contingency Principle is defined in Section 1.4 of Appendix A to Draft Revision 2 to in Regulatory Guide 1.13, issued in 1981. While Reg. Guide 1.13 was never formally issued in final form, its provisions concerning criticality control, and specifically allowances made for credit for burnup, have been implemented by the NRC Staff over the past 18 years in approving spent fuel storage rack license amendment requests for many nuclear power plants across the country. In this sense, though not formally issued in final form, the Staff's actions using Reg. Guide 1.13 as a basis in approving license amendments made it, through practice, the accepted regulatory guidance.

43. Reg. Guide 1.13, Appendix A, Section 1.4, defines the Double Contingency Principle as follows:

> At all locations in the LWR spent fuel storage facility where spent fuel is handled or stored, the nuclear criticality safety analysis should demonstrate that criticality could not occur without at least two unlikely, independent, and concurrent failures or operating limit violations.

The Double Contingency Principle, as defined in Reg. Guide 1.13, is a Staff term established in Staff guidance. It's definition can be determined through a review of Staff statements regarding the term and Staff actions implementing it.

44. The Double Contingency Principle is also stated in other relevant NRC Staff guidance documents. The Double Contingency Principle was first formally adopted by the Staff in the 1978 generic letter from Brian K. Grimes of the Staff's Division of Operating Reactors to all power reactor licenses ("1978 Fuel Storage Guidance"). In Section 1.2 of the NRC 1978 Fuel Storage Guidance, titled "Postulated Accidents", the Staff adopts the Double Contingency Principle by reference to an industry ANSI standard, stating:

> The double contingency principle of ANSI N 16.1-1975 shall be applied. It shall require two unlikely, independent, concurrent events to produce a criticality accident.

Section 1.2 of the 1978 NRC Guidance continues by stating that:

> Realistic initial conditions (*e.g.* the presence of soluble boron) may be assumed for the fuel pool and assemblies.

45. The ANSI standard, ANSI N 16.1-1975, referenced by the NRC Staff provides the original definition of the Double Contingency Principle. A copy of ANSI N

16.1-1975 is included as Attachment F to this affidavit. Section 4.2.2 of ANSI N 16.1-1975 defines the Double Contingency Principle as follows:

> Double Contingency Principle. Process designs should, in general, incorporate sufficient factors of safety to require at least two unlikely, independent, and concurrent changes in process conditions before a criticality accident is possible.

The definition of Double Contingency Principle in Section 4.2.2 remained unchanged when ANSI N 16.1-1975 was revised into ANSI/ANS-8.1-1983 in 1983.

46. The Staff provided further elucidation of its Double Contingency Principle in the Staff guidance on fuel storage criticality control issued in the 1998 memorandum from Laurence I. Kopp of the Staff's Reactor Systems Branch ("1998 Criticality Guidance"). The 1998 Criticality Guidance does not introduce any new requirements, but is a clear and unambiguous compilation of earlier Staff position documents that had become acceptable interpretation and practice over the previous 20 years. The 1998 Criticality Guidance has been approved by the NRC Staff and made available to all licensees as guidance on implementing criticality control for fuel storage. Section 3 of the 1998 Criticality Guidance defines the Double Contingency Principle as follows:

> ABNORMAL CONDITIONS AND THE DOUBLE-CONTINGENCY PRINCIPLE
>
> The criticality safety analysis should consider all credible incidents and postulated accidents. However, by virtue of the double-contingency principle, two unlikely independent and concurrent incidents or postulated accidents are beyond the scope of the required analysis. The double-contingency principle means that a realistic condition may be assumed for the criticality analysis in calculating the effects of incidents or postulated accidents. For example, if soluble boron is normally present in the spent fuel pool water, the loss of soluble boron is considered as one accident condition and a second concurrent accident need not be

> assumed. Therefore, credit for the presence of the soluble boron may be assumed in evaluating other accident conditions.

The 1998 Criticality Guidance is the Staff's most recent, and most thorough, statement of the definition of the Staff's Double Contingency Principle.

47. I have been employing the Double Contingency Principle in performing criticality analyses for spent fuel storage racks for over 20 years. I have implemented the Double Contingency Principle for dozens of license applications since it was first developed. I have always understood the Double Contingency Principle to have the same meaning. While the wording used in each of the documents above is slightly different, the meaning of the Double Contingency Principle in each is the same. The most recent Staff guidance on this issue, the 1998 Criticality Guidance, is the most simple and easy to understand explanation of the Double Contingency Principle. Its meaning, however, is the same as that in the prior Staff guidance documents.

48. In practical application over the past 18 years, it has been my experience that the Double Contingency Principal has been interpreted as nearly the same as the conventional single failure criterion, provided that the accident conditions are not related or directly caused by other accident conditions. In particular, the example identified in the 1998 Criticality Guidance provides a clear description of conventional practice. The loss of soluble boron from the pool water is considered as one accident condition. Thus, credit for the presence of soluble boron may be included in the evaluation of any other single accident condition. Conversely, in the evaluation of the consequence of loss of soluble boron, the Double Contingency Principle would preclude any requirement to consider the simultaneous incident of a fuel misloading accident. Both a fuel misloading

incident and the loss of all soluble boron are independent accident conditions and both are unlikely incidents, so that the concurrent occurrence of both accidents need not be considered.

49. There is no requirement in the Double Contingency Principle for applicants to demonstrate that criticality <u>will</u> occur with two or more unlikely, independent and concurrent incidents or accident conditions. The purpose of the Commission's criticality control regulations is to <u>prevent</u> criticality from occurring. It would be contrary to the Commission's intent, and would serve no useful regulatory purpose, to define and evaluate the universe of possible scenarios of multiple concurrent accident conditions in which criticality might occur. The Double Contingency Principle clearly does not require this to be done.

Prevalence of Burnup Credit

50. The use of burnup credit as a criticality control method for spent fuel pool storage is prevalent throughout the nuclear industry in this country and abroad. License amendments using burnup credit for spent fuel storage were approved by the NRC beginning in the early 1980's. The need for burnup credit as a method for criticality control has become even more acute following the Department of Energy's failure to meet its obligation to begin accepting spent nuclear fuel beginning in 1998. I am aware of at least 20 nuclear power plants that currently use burnup credit as a criticality control method for their spent fuel pool storage. The following list identifies these 20 plants where burnup credit is used, along with the approximate year of NRC approval:

	Plant	Year
1.	V.C. Summer	1983
2.	Braidwood	1983
3.	Diablo Canyon	1986
4.	St. Lucie 1	1987
5.	Byron	1987
6.	Indian Point 2	1989
7.	San Onofre	1989
8.	TMI 1	1991
9.	D.C. Cook	1991
10.	Zion	1991
11.	Maine Yankee	1992
12.	Sequoyah	1993
13.	Fort Calhoun	1993
14.	ANO 1 & 2	1994
15.	Salem	1994
16.	Beaver Valley	1994
17.	Comanche Peak	1994
18.	Haddam Neck	1996
19.	Vogtle	1998
20.	Waterford	1998

**Specific Features of the Millstone Unit 3
Spent Fuel Storage Racks**

51. The spent fuel storage racks at Millstone Unit 3 are arranged with 3 different Regions

52. Region 1 is designed with 2 absorber panels (Boral) and a water-gap between storage cells, and is capable of safely accommodating fuel of the highest allowable reactivity, remaining subcritical even without any credit for the soluble boron present in the pool water.

53. Region 2 uses a single absorber panel (Boral) between storage cells and is designed to safely accommodate spent fuel with credit for depletion in reactivity due to

burnup. Analyses under postulated accident conditions have been performed and will be discussed later in this affidavit.

54. Region 3 is a previously existing rack which was designed using a solid neutron absorber called Boraflex, located between the storage cells. Subsequently, Northeast Nuclear Energy Company and the nuclear industry discovered (largely through tests and measurements performed by Holtec) that gamma radiation from spent fuel stored in the rack causes shrinking and gap formation in the Boraflex absorber material. This degradation of Boraflex decreases its effectiveness and results in an increase in reactivity. Other mechanisms for Boraflex degradation, such as erosion by flowing water, have also been observed. As part of corrective action, the Region 3 racks were re-analyzed to define safe and useable configurations, prudently assuming the loss of all Boraflex. This was a very conservative assumption since a substantial amount of Boraflex will remain in the racks. No credit is taken for the residual Boraflex since the amount remaining would be difficult to define quantitatively.

55. Under the proposed license amendment, and consistent with the NRC Staff-required licensing basis, all three regions in the Millstone Unit 3 SFP will remain subcritical, with $k_{eff} < 0.95$, even if all soluble boron were to be lost, assuming compliance with the plant Technical Specifications for allowed storage in each region. Also, with at least 425 ppm soluble boron, for a single, most conservative misloading event, k_{eff} will not exceed 0.95. (As a conservatism, the proposed Technical Specification will require 800 ppm of soluble boron at all times.) Thus, the racks are in full compliance with 10 CFR 50.68 and GDC 62.

Potential for Soluble Boron Dilution Accidents

56. The Millstone Unit 3 spent fuel storage pool contains 450,00 gallons of water, normally containing 2,600 ppm soluble boron as required by administrative procedures. Technical Specifications also require 2,600 ppm soluble boron in the spent fuel storage pool whenever the pool is opened to the refueling canal during re-fueling operations (this level of soluble boron is needed for criticality control in the reactor core and is considerably greater than would otherwise be necessary for criticality control in the spent fuel pool). Once re-fueling is complete and the spent fuel pool isolated from the reactor primary system, the Technical Specification surveillance limit is reduced to 800 ppm soluble boron although administrative procedures will still require 2,600 ppm of soluble boron in the spent fuel pool water.

57. During the period when the storage pool is open to the reactor primary system, verification of the soluble boron concentration is required every 72 hours. After the storage pool is isolated from the reactor primary system, the concentration of soluble boron in the spent fuel pool water will be required to be verified by chemical analysis once every seven days. Since significant variations in boron concentration are very unlikely, this is a reasonable surveillance frequency.

58. Significant dilution of the soluble boron concentration in the spent fuel pool water is highly unlikely and undetected dilution is not a credible scenario. To reduce the soluble boron concentration from 2,600 ppm to the Technical Specification limit of 800 ppm would require well over 500,000 gallons of unborated water, as discussed in the Northeast Nuclear Energy Company letter, B18025, to the NRC dated May 5, 2000.

59. If valve mis-alignment is postulated as a mechanism for soluble boron dilution, the feed-and-bleed process would require many days to several weeks, during which the dilution would be readily detected and timely corrective action taken to restore the soluble boron concentration. At the Technical Specification limit of 800 ppm soluble boron, the system is still safe and the reactivity is well less than critical. To dilute the soluble boron further would require a considerably longer period of time, a much larger volume of unborated water, and would be even more unlikely. Furthermore, as shown in the licensing basis analysis discussed earlier, even at zero soluble boron concentration, the system reactivity would remain below critical and would remain subcritical even with a concurrent misplacement of a fuel assembly of the highest reactivity permitted in the Millstone Unit 3 plant.

60. The most serious boron dilution accident could possibly result from rupture of a fire control header, assuming the un-borated water from an open-ended break of the header pipe sprayed onto the top of the spent fuel pool at the highest possible flow rate. The water level in the pool would rise, triggering the high-level alarm, and then begin flowing over the edge of the pool. After a day or so, and the spilling of several million gallons of water over the edge of the pool, the soluble boron concentration might be postulated to be reduced to a level near the Technical Specification limit of 800 ppm boron, if corrective action was not taken. However, early in the sequence of events for this postulated accident scenario, multiple alarms (*e.g.*, high water level, fire control system operation, high-level in waste system tanks) would alert the operators to the event with adequate time for corrective action. If all of these alarms should be concurrently inoperative, the large quantities of water flowing onto the fuel deck and running down

stairwells would quickly alert workers, inspectors, and others in ample time for the operators to terminate the event and initiate corrective action.

61. The multiplicity of level alarms, the required periodic verification of the soluble boron concentration, and the very large quantities of unborated water that would be required for dilution, all contribute to assuring that significant dilution of the soluble boron concentration is so highly unlikely that it is virtually incredible.

62. A few cases of soluble boron dilution have been reported, none of which compromised spent fuel pool criticality safety. In July 1994, McGuire station personnel inadvertently added a quantity of unborated water (~ 28,000 gallons) to the SFP which reduced the soluble boron concentration to 1,957 ppm or slightly below their Technical Specification limit of 2,000 ppm. This minor reduction in soluble boron concentration was quickly detected and criticality safety was never even potentially compromised.

Beyond Design Basis Criticality Analyses

63. As further evidence of the inherent safety of the spent fuel pool at Millstone Unit 3, I have made a series of calculations for hypothetical illustrative conditions beyond the normal criticality safety analyses required, including multiple concurrent fuel mis-loading accidents. These calculations are listed in Tables 1 to 3 below for each of the three regions of spent fuel storage cells in the Millstone Unit 3 spent fuel pool.

TABLE 1

Criticality Calculations for Region 1

ppm Boron	Fuel Array	k-effective*	Comment
2,600 Normal concentration	Completely filled with fresh fuel of 5% enrichment	0.7611	k_{eff} well below critical
800 Technical Specification limit	Completely filled with fresh fuel of 5% enrichment	0.8916	Remains subcritical at Technical Specification limit of 800 ppm
0 Highly unlikely Loss of all soluble boron	Completely filled with fresh fuel of 5% enrichment	0.9728	Remains subcritical with system filled with fuel of maximum reactivity and concurrent loss of all soluble boron

* The k-effective values do not include bias and manufacturing tolerances, which are usually about 0.015Δk in Region 1.

TABLE 2

<u>Criticality Calculations for Region 2</u>

ppm Boron	Fuel Array	k-effective*	Comment
2,600 Normal concentration	Completely filled with fresh fuel of 5% enrichment	0.9384	Multiple accident condition remains sub-critical
2,000 Boron dilution	Completely filled with fresh fuel of 5% enrichment	0.9842	Minimum Boron concentration of 2000 ppm Boron to assure sub-criticality for multiple accident scenario
800 Technical Specification limit	8 assemblies fresh fuel of 5% enrichment mis-loaded into otherwise empty Region 2 rack	0.9794	Multiple accident with 8 fresh fuel assemblies remains sub-critical at Technical Specification limit of 800 ppm Boron
800 Technical Specification limit	5 assemblies fresh fuel of 5% enrichment mis-loaded into Region 2 otherwise filled with spent fuel	0.9663	Multiple accident with 5 fresh fuel assemblies remains sub-critical at Technical Specification limit of 800 ppm Boron
0 Loss of all soluble Boron	3 assemblies fresh fuel of 5% enrichment mis-loaded into otherwise empty Region 2 rack	0.9241	Maximum number of concurrent accidents in otherwise empty Region 2 with loss of all soluble Boron
0 Loss of all soluble Boron	1 assembly fresh fuel of 5% enrichment accidentally mis-loaded into Region 2 otherwise filled with spent fuel	0.9450	Single mis-placed assembly accident with concurrent loss of all soluble boron

* k-effective values do not include bias and manufacturing tolerances which are usually about 0.01Δk for fresh fuel (Cases 1, 2, 3, and 5 above). For Cases 4 and 6 above, with spent fuel assemblies present in the Region 2 racks, the bias and uncertainties could be as large as 0.019Δk.

TABLE 3

Criticality Calculations for Region 3

ppm Boron	Fuel Array	k-effective*	Comment
2,600 Normal concentration	Completely filled with fresh fuel of 5% enrichment	0.8503	Multiple accident condition – remains sub-critical
1,320 Boron dilution	Completely filled with fresh fuel of 5% enrichment	0.9811	Minimum soluble Boron concentration of 1,320 ppm to assure sub-criticality with multiple accident scenario
800 Technical Specification limit	8 assemblies fresh fuel of 5% enrichment mis-loaded into otherwise empty Region 3 rack	0.9752	Maximum number of concurrent accidents in Region 3 at the Technical Specification limit of 800 ppm Boron
800 Technical Specification limit	5 assemblies fresh fuel of 5% enrichment mis-loaded into Region 3 otherwise filled with spent fuel	0.9528	Maximum number of concurrent accidents in Region 3 at the Technical Specification limit of 800 ppm Boron
0 Loss of all soluble Boron	1 assembly of fresh fuel 5% enrichment mis-loaded into Region 3 otherwise filled with spent fuel	0.9707**	Single misplaced assembly of the maximum reactivity with concurrent loss of all soluble Boron

* k-effective values listed do not include bias and uncertainties which are about 0.018Δk for fresh fuel (Cases 1, 2, and 3 above) and 0.029% Δk when the racks are otherwise filled with spent fuel (Cases 4 and 5 above).

** A single mis-loaded assembly accident remains sub-critical at nominal spent fuel pool water temperatures, including bias and maximum uncertainties. However, because the temperature coefficient of reactivity is positive for Region 3, should a concurrent abnormal increase in pool temperatures occur, Region 3 could potentially reach a critical condition in the absence of all soluble boron. At 150°F, as little as 30 ppm of soluble boron would ensure sub-criticality, including bias and uncertainties.

Industry Experience

64. The nuclear power industry has accumulated many reactor years of operation without a single criticality incident in the spent fuel storage racks. Most, if not all, reactor facilities take credit for fuel depletion (burnup) and pressurized water reactor ("PWR") plants have taken credit for the presence of soluble boron under abnormal or postulated accident conditions. Over the many reactor years of operation, there have been a few abnormal/accident events, although there is no evidence that any of these approached the possibility of a criticality accident.

65. There have been a few instances of a spent fuel assembly or assemblies being found in a location where they should not have been. These were spent fuel whose reactivity differed only slightly from that specified for the location where they had been placed. In most cases, this was a consequence of a change in storage restrictions[1] and the offending assembly – which had initially been stored properly – was not moved to a more acceptable location. Since the revisions to the storage restrictions were minor, the reactivity effect of the offending assembly would have been minimal.

66. To the best of my knowledge, there have never been any incidents involving the mislocation of a fresh unburned assembly of high enrichment. All of the incidents of which I am aware and which are contained in Licensee Event Reports

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1 For example, when degradation of Boraflex fixed absorber material was discovered by the industry, many plants revised the storage restrictions to compensate for the Boraflex degradation.

("LER") have involved spent fuel whose reactivity is considerably less than that of fresh unburned fuel. While undesirable, the reported incidents did not create the possibility of a criticality accident. Furthermore, in all cases for PWRs, soluble boron was present and provided a very large margin of safety relative to criticality.

Conclusion

67. I conclude that the proposed storage system for Millstone Unit 3, including both soluble boron and reactivity (*i.e.*, enrichment, burnup and decay limits), is consistent with NRC regulations (specifically including GDC 62), NRC Staff regulatory guidance, and longstanding nuclear industry practice. The results of beyond-design-basis criticality calculations I have presented above demonstrate the substantial margin of safety with respect to both postulated boron dilution events and fuel placement errors.

68. The information above is true and correct to the best of my knowledge and belief.

Stanley E. Turner

Sworn and subscribed to before me on this 21 day of June, 2000.

Joani B. Kelter

Notary Public

JOANI B. KELTER
MY COMMISSION # CC 665348
EXPIRES: August 18, 2001
Bonded Thru Notary Public Underwriters

My Commission expires:

ATTACHMENT A

STANLEY E. TURNER, Ph.D., P.E.

SENIOR VICE PRESIDENT AND CHIEF NUCLEAR SCIENTIST
HOLTEC INTERNATIONAL

EDUCATION

University of Texas
Ph.D. in Nuclear Chemistry (1951)

University of South Carolina
B.S. in Chemistry (1945)

Georgia Institute of Technology (1943-44) (1946-47)

PROFESSIONAL EXPERIENCE

HOLTEC INTERNATIONAL
Palm Harbor, Florida

1987-1997	Chief Nuclear Scientist
1997-Present	Senior Vice President and Chief Nuclear Scientist

SOUTHERN SCIENCE OFFICE OF BLACK & VEATCH
ENGINEERS - ARCHITECTS
Dunedin, Florida

1977-1987	Project Manager/Senior Consultant

NUS CORPORATION
Dunedin, Florida

1973-1977	Senior Consultant

SOUTHERN NUCLEAR ENGINEERING, INC.
Dunedin, Florida

1964-1973	Vice President, Physics

GENERAL NUCLEAR ENGINEERING
Dunedin, Florida

1957-1964	Senior Reactor Physicist/Project Manager

SOCONY-MOBIL RESEARCH LABORATORY
Dallas, Texas

1952-1957	Research Scientist

U.S. NAVY RADIOLOGICAL DEFENSE LABORATORY
San Francisco, California
1951-1952 Physicist

PROFESSIONAL CERTIFICATIONS

Registered Professional Engineer (Nuclear) - Florida (1974-Present)

PROFESSIONAL SOCIETY MEMBERSHIPS/ACTIVITIES

Elected Fellow, American Institute of Chemists
Member, ANS Standards Committee 8.17 on Nuclear Criticality Safety (1975-Present)
Chairman of ANS 5.3 (Failed Fuel Consequences) (1981-1985) and 5.4 (Fission Product Release) (1978-Present)
Formerly a member of the ANS 5 Committee with oversight on ANS 5.1, Decay Heat

ACADEMIC HONORS

Sigma Pi Sigma, Phi Lambda Epsilon
Blue Key, Sigma Xi

CONTINUING EDUCATION COURSES OFFERED TO PRACTICING GRADUATE ENGINEERS

1. Union Electric Company, St. Louis, Missouri: Use of CASMO and KENO Codes in criticality safety analysis

2. Southern California Edison Company, San Clemente, California: Use of CASMO and KENO Codes in criticality safety analysis

DRY AND WET SPENT FUEL STORAGE TECHNOLOGY

- Developed nuclear analysis techniques for criticality safety analyses

- Performed criticality safety analyses for numerous wet spent fuel storage rack installations

- Performed criticality analyses of numerous fuel designs under normal and accident conditions for the HI-STAR 100 shipping cask and HI-STORM storage cask

- Performed detailed benchmark calculations for KENO5a and MCNP4a computer codes

- Developed and wrote CELLDAN Computer Code to prepare input for NITAWL-KENO5a calculations

- Supervised calculations with the QAD Point Kernal Code for gamma ray shielding

- Performed numerous calculations of fission product inventories using ORIGEN, ORIGEN-II, and ORIGEN-S (ORIGEN-ARP) Codes

- Participated in the development of Holtec's thermal evaluation methodologies for wet storage systems
- Author of numerous reports on dry and wet storage facilities
- Designed equipment for and supervised Blackness Testing at numerous power plants and performed measurements on Boraflex and Boral surveillance coupons
- Performed R&D programs on Holtite-A neutron absorber materials and on HI-COAT coatings
- Performed wet chemical analyses of Boral samples

UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

BEFORE THE ATOMIC SAFETY AND LICENSING BOARD

In the Matter of:	)	
	)	
Northeast Nuclear Energy Company	)	Docket No. 50–423–LA–3
	)	
(Millstone Nuclear Power Station,	)	
Unit No. 3)	)	ASLBP No. 00–771–01–LA

AFFIDAVIT OF MICHAEL C. JENSEN

I, Michael C. Jensen, being duly sworn, state as follows:

1. I am employed by Northeast Nuclear Energy Company ("NNECO") and currently I am the Supervisor of Operator Training for Millstone Nuclear Power Station, Unit 2.

2. The Atomic Safety and Licensing Board ("ASLB") has admitted three contentions raised by the Connecticut Coalition Against Millstone ("CCAM") and the Coalition Against Millstone ("CAM") (collectively, "Intervenors") with respect to NNECO's proposal to increase the capacity of the Millstone Unit 3 Spent Fuel Pool ("SFP"). These issues are referred to as Contentions 4, 5, and 6. In this affidavit I respond to certain aspects of the contentions, particularly, the Intervenors argument that NNECO is "trading physical protection against criticality for a complex set of administrative controls," and that this tradeoff "increases the likelihood of a criticality accident" in the Millstone Unit 3 SFP. I disagree with these arguments.

3. Many other nuclear plants use the same administrative controls that NNECO proposes to implement through the subject license amendment. Moreover, this type of administrative control has been used at Millstone for some time. No fuel mishandling events at

Millstone have ever resulted in a criticality accident, and I am not aware of any such criticality accident at any nuclear plant spent fuel storage pool.

4. To respond to the arguments, I will provide information on the controls NNECO implements with respect to fuel handling and fuel placement, and I will discuss why these controls do not increase the likelihood of a criticality accident in the Millstone Unit 3 SFP. I will also address a few of the specific questions asked by the ASLB in its order of May 23, 2000.

Personal Qualifications

5. I hold a Bachelor of Science degree in Nuclear Engineering and I am a registered professional engineer in the State of Connecticut. I have six years of experience in the U.S. Navy Nuclear Program and four years of experience at the University of Wisconsin Research Laboratory. I also have held a reactor operating license and senior reactor operating license for a TRIGA research reactor, and have held a senior reactor operator license for a commercial General Electric BWR/4.

6. For more than 17 years, I have been employed by NNECO at Millstone Nuclear Power Station. Prior to my current position, I held the position of Reactor Engineering Supervisor for Millstone Nuclear Power Station, Units 2 and 3, for approximately 1 year. Prior to that, I held the position of Unit 3 Reactor Engineering Supervisor for approximately six months. Before that, I held the position of Unit 1 Reactor Engineering Supervisor for approximately two and one half years. I have also held the positions of Senior Operations Engineer and Operator Training Supervisor.

7. In my prior position, I was responsible for monitoring and trending the nuclear, hydraulic, and thermal performance of the Millstone reactor cores, reactivity management, special nuclear materials accountability, refueling operations, coordination of activities within

the Millstone spent fuel pools, and providing reactor engineering expertise and support for the day-to-day operation of Millstone Station.

8. A copy of my professional qualifications is included as Attachment A to this affidavit.

Specific Issues Cited by CCAM/CAM

9. The ASLB Prehearing Conference Order in this matter re-stated Contention 4 as:

> The new set of administrative controls trades reliance on physical protection for administrative controls to an extent that poses an undue and unnecessary risk of a criticality accident, particularly due to the fact that the licensee has a history of not being able to adhere to administrative controls with respect, *inter alia*, to spent fuel pool configuration.

10. Specifically, in admitted Contention 4, the Intervenors allege that the administrative controls NNECO proposes to use in implementing a three-region SFP rely on a complicated array of factors, such as burnup, enrichment, and decay time. The Intervenors allege that the activities associated with the license amendment request represent an undue and unnecessary risk because the additional administrative controls increase the likelihood of a fuel misplacement and possible criticality in the Millstone Unit 3 SFP.

11. The main points I wish to make regarding this contention are:

- The administrative controls that NNECO proposes to implement through the subject license amendment are not complicated and are used throughout the commercial nuclear power industry.
- The administrative controls that NNECO proposes to implement through the subject license amendment have been used at Millstone for some time.

- No fuel mishandling events at Millstone have ever resulted in a violation of the regional burnup/enrichment requirements, much less a criticality accident. I am also not aware of any criticality accident at any nuclear plant spent fuel storage pool.
- The existing controls for proper fuel assembly placement in the SFP are sufficient and, coupled with the Technical Specification ("TS") requirement for 800 ppm boron concentration in the SFP whenever fuel is stored in the SFP, reduce the probability of an inadvertent criticality to a negligibly low value.

The above issues are dealt with in more detail below.

NNECO's Proposed SFP Configuration

12. I am aware that fuel handling is a multi-faceted process that on an industry-wide basis has been subject to various errors. To preclude the occurrence of similar conditions at Millstone Station, NNECO utilizes physical and administrative controls to minimize the probability of such errors.

13. The proposed license amendment will separate the Unit 3 SFP into three Regions, designated Region 1, 2, and 3. Fuel movements are controlled by procedures that include dual verification that a correct assembly has been selected for movement and dual verification that the move is completed to the correct location. These procedures are described further below.

14. Fuel assemblies currently stored in the Unit 3 SFP will be qualified to be stored in any location of the new Region 1 or 2. Consequently, upon initial implementation of the

proposed changes, for new Regions 1 and 2 there can be no assemblies loaded in a region for which they are not qualified.

15. Upon initial implementation of the proposed TS, approximately 125 assemblies currently stored in the SFP in what will become Region 3 must be relocated to the new Region 1 or 2. Relocation of these assemblies will be conducted in accordance with established procedures that require dual verification of the selection and final placement locations. Additionally, the serial numbers for these assemblies will be verified. This will ensure that upon initial implementation of the reconfigured SFP, all the fuel assemblies are in the correct locations.

16. Subsequent opportunities for misloading will occur as part of planned refueling evolutions. The probability of such an event is extremely low as described in the following paragraphs.

Qualification of Fuel Assemblies

17. NNECO uses a controlled process to determine that fuel assemblies have attained proper burn-up for storage in the burn-up dependent racks. Surveillance procedure SP 31022, "Spent Fuel Pool Criticality Requirements," controls the process of ensuring that fuel assemblies have attained proper burnup for storage in a burnup-dependent fuel storage region.

18. As discussed above, the proposed Technical Specification changes will result in a total of three burnup-dependent fuel storage regions in the SFP. SP 31022 will be revised for use with the proposed SFP modifications by expanding the process used to evaluate fuel assemblies for any of the three burnup-dependent fuel storage regions. Provisions to incorporate fuel decay time in the evaluation will also be covered in this procedure so that fuel assemblies may be subsequently relocated based on their actual fuel decay time.

19. NNECO performs calculations to determine measured fuel burnups as described below. These calculations are subject to independent verification consistent with the requirements of 10 C.F.R. Part 50, Appendix B (Quality Assurance (QA)). This aspect of spent fuel management is unaffected by the proposed Technical Specification changes.

20. First, the Westinghouse INCORE (or future equivalent) QA computer code will be used to generate measured core power distribution maps. Then, the Westinghouse TOTE (or future equivalent) QA computer code will be used to generate measured individual fuel assembly burnups, using the INCORE measured core power distribution maps. Analytical inputs to TOTE will be determined using QA calculations. The resulting measured fuel assembly burnups will be documented in QA calculations.

21. Then, each fuel assembly to be placed in a burnup-dependent fuel storage region is evaluated per SP 31022, which includes a requirement for independent review. Fuel assemblies may be qualified either individually or as a group, provided that the combination of highest initial enrichment and lowest burnup is used in the batch qualification process. Fuel enrichments used in this process can be either the design enrichment value, which is documented by the fuel vendor under their QA program, or the as-built enrichments that are also reported by the vendor through their QA program. It should be noted that the as-built enrichment is bounded by the design enrichment that is limited to the licensed enrichment value for Millstone Unit 3. The measured fuel burnup value is documented and then reduced by an appropriate uncertainty value. The result is then checked against the regional Technical Specification limits. If the fuel burnup is greater than that required by a regional Technical Specification limit, the fuel is qualified for storage in that SFP region. When a fuel assembly or group of assemblies is determined to be qualified for storage in a particular burnup-dependent region, the fuel assembly

ID or fuel group ID is entered on a controlled Qualified Fuel Assemblies form that lists all fuel assemblies qualified for storage in each burnup-dependent region.

22. For the proposed spent fuel pool modifications, an alternative to qualifying each fuel assembly per SP 31022, QA calculations may be performed to qualify fuel assemblies for each storage region. In either case, whether SP 31022 or a QA calculation is used, an independent reviewer will be used to ensure that each fuel assembly is correctly qualified for regional storage.

Fuel Assembly Identification and Accountability

23. NNECO believes that the existing controls for proper fuel assembly placement in the SFP are sufficient, and coupled with the requirement for 800 ppm boron concentration in the SFP whenever fuel is stored in the SFP, reduce the probability of an inadvertent criticality to an appropriately low value.

24. Verification of correct fuel assembly location in the SFP is currently accomplished by a combination of several proceduralized inspection and tracking processes. These practices provide reasonable assurance that each fuel assembly in the Millstone Unit No. 3 inventory, whether in the core or in the SFP, resides in its specified location. The processes and procedures used for the current SFP design will be revised for use with the proposed SFP modifications by expanding their application to three burnup-dependent fuel storage regions.

25. All fuel assembly movements are controlled as Special Nuclear Material ("SNM") transactions under the direct supervision of Reactor Engineering or Operations personnel. Procedural controls and physical equipment constraints limit fuel assembly movements in the SFP to only one fuel assembly at a time, in accordance with a Material Transfer Form ("MTF").

26. Individuals that perform the physical tasks associated with fuel handling, whether they are NNECO direct employees or contractors, are required to be qualified for the tasks. NNECO documents individual qualifications in Task Qualification Records ("TQRs"). Individuals are required to complete the associated TQR prior to performing an activity.

27. Fuel assembly movements into and out of the SFP are controlled in accordance with procedures EN 31001, "Supplemental SNM Inventory and Control;" EN 31026, "New Fuel Assembly and Insert Receipt and Inspection;" and MC-5, "Special Nuclear Material Inventory and Control." These procedures require two personnel, the SNM Executor and the SNM Checker, for all fuel assembly movements. The following description illustrates the methodology that confirms the correct placement of fuel assemblies in the SFP.

28. Presently, the serial number of any new fuel assembly is verified prior to moving the new fuel assembly to its assigned SFP storage rack location. When moved into the SFP, there is a second verification that each new fuel assembly is being placed into its specified fuel storage location. This provides an initial baseline location for every new fuel assembly brought into Millstone Unit 3.

29. For fuel assemblies loaded or reloaded into the reactor core, a serial number verification is again performed, in accordance with plant procedures EN 31001, "Supplemental SNM Inventory and Control," and EN 31007, "Refueling Operations," to ensure that each fuel assembly has been placed into its proper reactor core location. In the SFP, after the core load is complete, a verification by piece-count is performed. This piece-count verification in the SFP confirms that there is a fuel assembly in each designated fuel storage location, and that no fuel assembly is present in fuel storage locations that should be empty.

30. NNECO does not check the serial numbers of all the fuel assemblies in the SFP after core loading is complete. NNECO does not believe checking fuel serial numbers in the spent fuel pool is necessary because the dual verification process is sufficient to ensure that the spent fuel pool assembly movements are correctly accomplished. Experience has confirmed the accuracy of this statement. As further confirmation, NNECO has also periodically completed baseline verification of the SFP inventory by serial number. The last such verification at Unit 3 was during the 1999 refueling. No misloadings were found in this verification. Further, NNECO maintains the spent fuel pool boron concentration at such high levels by administrative requirements that criticality under any SFP loading is not possible.

31. During core offload, fuel removal is observed and supervised by a licensed Senior Reactor Operator who has no other concurrent responsibilities during this core alteration operation. As the spent fuel is being removed from the core and moved to the transfer canal, the person moving the fuel in containment (the SNM Executor) has a set of move sheets (the Refueling Worklist Form) specifying the core location from which to remove each spent fuel assembly. There is a second person (the SNM Checker) performing an independent verification of the removal of each fuel assembly from the proper reactor core location. Therefore, there is a second verification that each fuel assembly is being removed from the specified reactor core location. The requirements for second verification are contained in procedures MC-5, "Special Nuclear Material Inventory and Control," EN 31001, and EN 31007.

32. Also during core offload, as the spent fuel is being removed from the transfer canal and placed in the SFP, the person moving the fuel in the SFP (the SNM Executor) has a set of move sheets (the Refueling Worklist Form) specifying the SFP storage rack location in which to place each spent fuel assembly. There is also another person (the SNM Checker) with an

identical set of move sheets performing a dual verification of the placement of each fuel assembly into the proper SFP storage location. Therefore, there is a second verification that each fuel assembly is being placed into the specified fuel storage location. The requirements for second verification are contained in procedures MC-5, EN 31001, and EN 31007.

33. It is important to note that, if during any of the fuel assembly identification and accountability processes described above, there is a difference between the two observers as to the identity of a fuel assembly, the observers are instructed to stop the fuel movement and resolve the discrepancy before continuing. This could be resolved by a review of the associated paperwork, or even by fuel assembly serial number verification if necessary.

34. As a final matter, upon reload of the reactor core, the location of each assembly is verified by serial number to be consistent with the core design specifications. If an assembly was found to be mislocated, an additional review of the assemblies in the SFP would necessarily be performed. Absent such a finding, a final check of storage locations is conducted to establish that an assembly resides in each designated location.

35. This system of checks and balances further reduces the already low probability of an undetected fuel assembly misplacement. In combination with the requirement to maintain soluble boron concentration in the Unit 3 SFP at 800 ppm, the probability of criticality due to an undetected misloading event is vanishingly small.

Operating Experience Program

36. Another safeguard NNECO implements to reduce the likelihood of a fuel handling error is the implementation of the industry Operating Experience ("OE") Program, administered by the independent Nuclear Safety Engineering Group. This is the process by which NNECO identifies and assimilates the lessons learned from events, including fuel

handling, which occur within the nuclear industry into the procedures and practices specific to Millstone.

37. I am aware that fuel mishandling events, although rare, have occurred at Millstone as well as other nuclear plants. Based upon a good faith search of available databases, NNECO provided the Intervenors of a list of such events at Millstone in its April 4, 2000, reply to Interrogatory No. F – 1. The Millstone events, in addition to several that occurred at other nuclear plants that have been identified by the Intervenors, have been included in NNECO's Operating Experience Matrix (Reference 9). In that OE Matrix, NNECO addresses each such fuel mishandling event and describes why it is not applicable to the issues raised by the Intervenors. I have participated in the preparation of the OE Matrix and NNECO's response to each event identified in the OE Matrix, and I agree with the response.

38. One event included in the OE Matrix is an April 27, 1994 event at Millstone Unit 3 where a potential for a single fuel assembly misplacement occurred. Due to a personnel error, a fuel assembly was moved to an incorrect location and lowered onto the top of an assembly already in the location. The error was detected and corrected. A plant information report was subsequently made and a thorough cause analysis was completed. While a single fuel misplacement is an analyzed event and will not lead to criticality, NNECO took a number of actions following this event to prevent recurrence. For example, the fuel handling procedures were modified to the present form to include a step to require that both the SNM Executor and SNM Checker have a copy of the MTF. Procedures were also modified to require tracking of SFP moves from the Control Room with a tag board. Human performance issues were also considered and addressed.

39. In summary, Millstone Units 2 and 3 operating experience with fuel handling controls to date is as follows:

- There has never been a case at either Millstone Unit 2 or 3 where a fuel assembly was placed into a fuel storage region for which it was not qualified.
- The two events at Millstone Units 2 or 3 that we documented in our discovery response that could have resulted in a fuel misplacement event, still did not involve a situation where fuel would have been placed in a region for which the fuel was not qualified. Even had this occurred, it would have been bounded by the single misplacement assumption of the criticality analysis.

Fuel Handling Equipment

40. Several fuel handling components have experienced performance problems in the past. For example, the SIGMA control console on the refueling machine has been unreliable because of an older model computer. In addition, the fuel transfer cart experienced problems with jamming and rubbing of some of its parts. These equipment problems cause outage delays because they interrupt the continuous movement of fuel. This results in further delays to troubleshoot and repair the appropriate parts. I wish to emphasize here that the equipment problems have never resulted in a fuel misloading event. These reliability issues are important to NNECO because of the delays in the outage schedule. These equipment issues have never been related to the safe movement of fuel, they are only related to the timely movement of fuel. NNECO has initiated several corrective actions to improve the reliability of the fuel handling equipment. These corrective actions include: evaluating and improving the preventive maintenance program for the fuel handling equipment, visiting equipment vendors and selected

plants to evaluate the design and performance capabilities of potential upgrades, recommending and performing appropriate equipment upgrades, reviewing all procedures containing pre-operational testing requirements and recommending enhancements where desired, and completing a Technical Evaluation of refueling equipment readiness. When complete, these actions will provide assurance that the fuel handling system performs reliably in future outages.

Conclusions

41. The administrative controls employed at U.S. nuclear plants, including Millstone Station, have been 100 percent effective in preventing a criticality event from occurring in any commercial SFP. Similar controls have been successfully employed at Millstone for a number of years. The activities associated with the license amendment request do not represent an undue and unnecessary risk. The additional administrative controls do not increase the likelihood of a fuel misplacement and possible criticality in the Millstone Unit 3 SFP. Therefore, the Intervenors' assertions that administrative controls related to the SFP will now be ineffective are completely unfounded.

42. The information in these responses is true and correct to the best of my knowledge and belief.

M. C. Jensen

Michael C. Jensen

Sworn and subscribed to before me on this 28 day of June, 2000.

Diane M. Phillipo

Notary Public

My Commission expires:

DIANE M. PHILLIPO
Notary Public
My Commission Expires Dec. 31, 2000

ATTACHMENT A

Michael C. Jensen

Professional Experience

September, 1982 to Present

Northeast Utilities
Millstone Nuclear Power Station
Waterford, Connecticut 06385

Various positions:

OPERATOR TRAINING; Sr. Instructor, Operator Training Supervisor;
- Supervised the following programs: Initial Non-License, Initial License, Non-Licensed Continuing, Licensed Requalification, Generic Fundamentals, Shift Manager, Shift Technical Advisor, and selected Station Emergency Organization Positions
- Performed and Supervised all facets of operator training: Analysis/Design/ Development/Implementation/Evaluation
- Simulator; Initial and Continuing Simulator Certification and Configuration Control Performed Simulator Assessment for outside utilities. Developed Acceptance Test for new simulator Core and NSSS models
- EOP development and implementation, Plant Design Change evaluations, Leadership and Team Skills Training. INPO Peer Evaluator

OPERATIONS; Sr. Operations Engineer;
- Created, Organized, and Headed new Procedures Group. Developed, Reviewed, Validated, and Implemented New and Revised Procedures
- Provided Technical Reviews for Proposed Plant Design Changes, Proposed Technical Specification Changes, Proposed FSAR Changes, Technical Evaluations and Safety Evaluations

ENGINEERING; Reactor Engineering Supervisor, MP-1; MP-3;
- Re-staffed Group, Developed and implemented RE Qualification standard,
- Developed Engineering Procedure Re-write Plan, Developed "Conduct of Reactor Engineering" procedures
- Implemented the following programs: Reactivity Management, SOER 96-02, Boraflex Blackness testing, SNM accountability, Spent Fuel Pool Recovery, Interim and final Stability Solution
- Coordinated Reactor Engineering Group efforts in Refuel Outage Preparations and implementation for MP-3

ENGINEERING; Reactor Engineering Supervisor, Millstone Station
- Coordinated Reactor Engineering Group efforts in Refuel Outage Preparations and current Refuel Work Activities

- Re-organized RE group work activities and Priorities to develop individuals and the group as a team

MANAGEMENT; Corollary Duties and Responsibilities

- Plant Operations Review Committee (PORC) Member
- Nuclear Safety Assessment Board (NSAB), Operations and Maintenance Member
- BWR Owners Group Representative, (Reactivity Controls, Reload Analysis)
- 10CFR50.59 Safety Evaluation, Leadership Team member
- Management Review Team member. Supervisory Oversight group for Corrective Actions Program
- Station Emergency Response Organization (SERO) member. Manager of Technical Support Center
- Station Duty Officer. Site Management Representative during off hours and Emergencies for all Three Units
- Engineering Duty Manager. Coordinate Engineering Support of Work Activities

September, 1978 to
August, 1982

University of Wisconsin
Madison, Wisconsin

NUCLEAR REACTOR RESEARCH LABORATORY

Specialist - Reactor Lab Supervisor

- Conducted Reactor Experiments for Commercial Clients and Graduate Students; Neutron Activation Analysis, Materials testing, Thermodynamics testing, Isotope Production, and Medical Testing
- Designed, Fabricated, and Operated Reactor and Laboratory Instrumentation
- Taught Undergraduate Courses; Radiation Detection and Measurement Laboratory, and Reactor Experiment Laboratory
- Taught "Cold License" Training to Commercial Customers on reactor core nuclear/thermodynamic behavior

September, 1972 to
July, 1978

United States Navy

Reactor Operator, Engineering Watch Supervisor, Proto-Type Instructor

Education

University of Wisconsin
Bachelor of Science in Nuclear Engineering 3.8/4.0

Licenses

NRC Reactor, and Senior Reactor Operator Licenses - TRIGA research reactor

NRC Senior Reactor Operator License - Commercial BWR/4

Professional Engineer License - Connecticut Lic. #16520

UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

BEFORE THE ATOMIC SAFETY AND LICENSING BOARD

In the Matter of:	)	
	)	
Northeast Nuclear Energy Company	)	Docket No. 50–423–LA–3
	)	
(Millstone Nuclear Power Station,	)	
Unit No. 3)	)	ASLBP No. 00–771–01–LA

AFFIDAVIT OF ROBERT G. MCDONALD

I, Robert G. McDonald, being duly sworn, state as follows:

1. I am employed by Northeast Nuclear Energy Company ("NNECO") and currently I am the primary systems chemist for Millstone Nuclear Power Station, Units 2 and 3.

2. The purpose of my affidavit is to respond to several aspects of Contentions 4 and 5 of the Connecticut Coalition Against Millstone ("CCAM") and the Coalition Against Millstone ("CAM") (collectively, "Intervenors") admitted in this proceeding. In particular, the Intervenors raise issues about the ability of Millstone Station to adequately control boron concentration in the spent fuel pool ("SFP"). I reject these contentions. Millstone Station has never experienced a boron dilution event in a SFP. Additionally, a criticality event has never occurred in a SFP. To respond to the Intervenor's arguments, I will provide information on various aspects of the chemistry control program at Millstone Station as it relates to boron concentration control in the Unit 3 SFP, including procedural and administrative controls, and surveillance requirements.

Personal Qualifications

3. Since August 1997, I have been employed by NNECO at Millstone Nuclear Power Station. Prior to my current position, I held the position of primary systems chemist at Millstone Nuclear Power Station, Unit 2 for approximately two years.

4. Prior to my employment by NNECO, I was employed by ABB-Combustion Engineering ("ABB-CE"). From July 1996 to August 1997 I worked for ABB-CE's Nuclear Operations group as a staff augmentation engineer, performing licensing support activities for the Millstone Station and Maine Yankee nuclear power plants. From February 1983 to July 1995, I worked for ABB-CE's Nuclear Systems group as a fluid systems' engineer. During this period my primary responsibility was providing technical support on all ABB-CE nuclear projects with respect to plant chemistry and chemistry-related fluid systems.

5. In my current position, I am responsible for primary system water chemistry for both Millstone Nuclear Power Station Units 2 and 3. This responsibility includes the water chemistry for the reactor coolant systems, reactor coolant auxiliary systems, and spent fuel pools, for both plants. My major duties include the review and evaluation of data for these systems, the development and implementation of actions to correct any water chemistry problems, and the maintenance of the programs and procedures required to maintain the primary system water chemistry.

6. A copy of my professional qualifications is included as Attachment A to this affidavit.

Effective Administrative Controls

7. Intervenors have asserted as part of admitted Contention 4 that the proposed license amendment represents an "undue and unnecessary risk" because of the reliance on

administrative controls. Intervenors correctly recognize that administrative controls are not fool-proof; however, they fail to recognize that the administrative controls employed at NNECO have been 100% effective in preventing criticality in the SFPs at Millstone Station Units 1, 2 and 3. Furthermore, there has never been a boron dilution event in a SFP at Millstone Station.

8. With respect to Contention 5, NNECO's proposed Technical Specification ("TS") 3.9.1.2 will require a minimum SFP boron concentration of 800 ppm *whenever fuel is stored in the SFP.* The proposed TS Surveillance Requirement 4.9.1.2 will require that the boron concentration be determined *every 7 days.* These TS requirements were incorporated into NNECO's modified license amendment request of April 17, 2000 (Reference 2).

9. A boron concentration surveillance procedure (*i.e.*, administrative control) has been performed by NNECO personnel on a routine basis ever since fuel was initially stored in the Millstone Unit 3 SFP. The determination of boron concentration in the revised TS surveillance procedure will be no more complex or burdensome as a result of the proposed license amendment request. The administrative controls that have always been effective will continue to be effective in preventing criticality in the SFP at Millstone Unit 3.

10. Amendment No. 158 to the Unit 3 Technical Specifications on April 9, 1998, revised the Unit 3 SFP boron concentration surveillance frequency to every 72 hours whenever fuel assemblies are in the SFP. Since this amendment, the largest observed change in the SFP boron concentration was a decrease of 49 ppm from 2,850 ppm on December 1, 1999 to 2,801 ppm on December 3, 1999. This decrease in boron concentration was attributed to increasing the SFP level from 38% to 44% (about a 3 inch water level change) on December 2, 1999 (to address evaporative make up), and to normal sample accuracy. See also Reference 3, Attachment 1 at 1.

Boron Surveillance Procedures

11. Notwithstanding the proposed TS discussed above, Millstone administrative procedures establish even further conservatism. Chemistry surveillance procedure SP 3866, "Spent Fuel Pool Boron Concentration," provides instructions for verifying that the boron concentration is greater than or equal to 2,600 ppm every 72 hours. This administrative limit will be maintained (with a 7 day surveillance periodicity). A concentration of 2,600 ppm ensures the current Technical Specification requirement of 1,750 ppm will be met even in the event of emergency makeup from non-borated water sources per Attachment A of emergency procedure EOP 3505A, "Recover From Low Spent Fuel Pool Level." Surveillance procedure SP 3863, "Reactor Coolant and Reactor Vessel Refueling Cavity Analysis for Boron," further provides instructions for verifying the SFP boron concentration is greater than or equal to the value required to achieve a K_{eff} of less than or equal to 0.95, or 2,600 ppm, whichever value is more restrictive, during plant refueling operations (Technical Specification 3.9.1.1).

12. Both SP 3866 and SP 3863 require the completion of a form specifying the SFP boron concentration in ppm, the date the surveillance was completed, the individual performing the surveillance, and whether the surveillance acceptance criteria (applicable Technical Specification boron concentration requirement) was met. The plant Shift Manager or Unit Supervisor, Reactor Engineering, and Chemistry supervision are notified if the boron concentration is less than 2,600 ppm. Completed forms are approved by Chemistry supervision and eventually forwarded to Nuclear Documentation Services for records storage. By procedure, SFP boron surveillance concentrations are also recorded on Chemistry Form 3802C-9, "Spent Fuel Pool." This form is used to record other chemical and radiochemical parameters monitored

in the SFP, but not required by Technical Specification. This form is also approved by Chemistry supervision and forwarded to Nuclear Documentation Services for records storage.

Maintaining Soluble Boron Concentration in the SFP

13. Intervenors have asserted as part of admitted Contention 5 that the proposed revision to the Technical Specifications would no longer require soluble boron to be maintained in the SFP once fuel movements are stopped. This assertion was never true. As originally proposed, boron concentration in the SFP was to be maintained by the same administrative procedures discussed above, to the 2,600 ppm standard. Additionally, TS Surveillance Requirement 4.9.1.1.2 requires that the SFP soluble boron concentration be maintained at greater than or equal to 2,600 ppm (or value required to achieve a K_{eff} of less than or equal to 0.95, whichever value is more restrictive) at all times when the SFP and refueling cavity are connected during Mode 6 operation. This TS surveillance requires boron concentration be verified every 72 hours during the applicable period. This surveillance is accomplished in accordance with a TS surveillance procedure that is not affected by the proposed changes. Under both the original proposal and the revised proposal, following Mode 6 refueling operations, the boron concentration in the spent fuel pool will not be diluted to some lower value, but will remain at or above the Mode 6 value of 2,600 ppm (or value required to achieve a K_{eff} of less than or equal to 0.95, whichever value is more restrictive).

14. The compound used to maintain soluble boron concentrations in the SFP is granular boric acid, H_3BO_3. By specification, boric acid purchased for use in the SFP is at least 56.25% by weight boric oxide (B_2O_3). The remainder is water (~43.65% per specification) and impurities (<0.10% per specification). Boric acid is readily soluble in the SFP as indicated by

the following, and no regions in the pool are cold enough (<32 °F) to cause the boron to come out of solution.

Temperature °C (°F)	Wt % H_3BO_3 in Saturated Solution	Equivalent ppm Boron
0 (32)	2.52	4,406
10 (50)	3.49	6,102
20 (68)	4.72	8,253
30 (86)	6.23	10,893
40 (104)	8.08	14,127
50 (122)	10.27	17,956
60 (140)	12.97	22,677
70 (158)	15.75	27,538
80 (176)	19.10	33,395
90 (194)	23.27	40,686
100 (212)	27.53	48,134
103.3 (217.9)*	29.27	51,176

* This is the boiling point of a saturated boric acid solution.

15. The SFP boron concentration is measured using a potentiometric titration method and autotitrator instrument. A SFP sample is weighed and the results transferred to the autotitrator. Demineralized water and mannitol are added to the sample, and the mannitoboric acid formed is titrated with a standard sodium hydroxide solution to a pH of 8.5. The volume of sodium hydroxide (titrant) required to reach the pH endpoint is proportional to the boron concentration present in the SFP sample. The autotitrator measures the volume of titrant required to reach the pH endpoint (pre-programmed), and calculates the sample boron concentration in ppm boron using the measured titrant volume. Per the Electric Power Research Institute ("EPRI"), unpublished data from a laboratory comparison study of utilities using a potentiometric titration method for boron analyses indicates an accuracy of ±1% is achievable. By procedure, the Millstone Station chemistry labs perform a daily boron standard check of each autotitrator. This check uses a 1,000 ppm boron standard, and requires the autotitrator-

determined boron concentration be within 10 ppm, or 1%, of the standard (*i.e.*, 990 to 1,010 ppm boron).

16. The proposed weekly surveillance frequency is appropriate to provide reasonable assurance of boron concentration because no major replenishment of SFP water or significant change in boron concentration is expected to take place over such a short period of time, a basis that is consistent with the Westinghouse Standard Technical Specifications. During the period between weekly SFP boron surveillances, it would take approximately 500,000 to 1,000,000 gallons, depending on the method of dilution, of unborated water to dilute the SFP boron concentration from 2,600 ppm to 800 ppm. The volume of the SFP is about 450,000 gallons. An unintentional dilution of this magnitude would be quickly detected either at the source of the unborated water, or by its effect on SFP water level.

Conclusions

17. The administrative controls employed at Millstone Station have been 100% effective in preventing a criticality event from occurring. In addition, Millstone Station has never had a boron dilution event in a SFP. Assertions that the boron surveillances are inadequate or that administrative controls related to the soluble boron in the SFP will now be ineffective are totally unfounded.

18. The information in these responses is true and correct to the best of my knowledge and belief.

Robert G. McDonald

Sworn and subscribed to before me on this 21ST day of June, 2000.

Notary Public

My Commission expires:

FEBRUARY 28, 2001

ATTACHMENT A

ROBERT G. McDONALD

EXPERIENCE AND QUALIFICATIONS:

Sixteen years of experience in nuclear power plant design and operation.

Eighteen years of experience successfully interfacing with utility, regulatory and design/construction personnel.

Experienced in the design, specification, operation and licensing of current generation and advanced nuclear power plants.

PROFESSIONAL EXPERIENCE:

NORTHEAST NUCLEAR ENERGY COMPANY, Waterford, CT
1997 to Present

Station Chemistry

Primary Systems Chemist

Responsible for system water chemistry in the Millstone Unit 2 and Unit 3 reactor coolant systems, reactor coolant auxiliary systems, and spent fuel pools.

ABB COMBUSTION ENGINEERING, Windsor, CT
1981 to 1997

Nuclear Operations Engineering

Staff Augmentation Engineer
1996 to 1997

Responsible for providing technical support to ABB-CE Nuclear Operations customers.

Assisted the Northeast Utilities PI-6 team in verifying and re-assembling the licensing bases for the three Millstone units. This activity involved reviewing all NRC-docketed correspondence for commitments by Northeast Utilities, and identifying and categorizing the commitments for implementation verification activities.

Assisted Maine Yankee in a similar NRC commitment re-identification/reverification activity. This effort involved reviewing all SER-related correspondence to identify Maine Yankee commitments, and then verifying these commitments had been implemented, or otherwise dispositioned. This effort was expanded to include all 1996 and 1997 Maine Yankee docketed correspondence to verify recent commitments were appropriately dispositioned prior to unit restart.

Nuclear Systems Engineering

Senior Nuclear Engineer
1987 to 1996

Responsible for providing technical support to all ABB-CE nuclear projects, particularly with respect to plant chemistry and chemistry-related fluid systems.

Represented ABB-CE at Yonggwang Unit 3 in South Korea during start-up testing of the Chemical and Volume Control System, and all pre-testing activities. These activities included test procedure review, valve calibration and testing, and piping design/layout review.

Established the primary and secondary chemistry control programs for ABB-CE nuclear plants being constructed in South Korea. This involved assessing industry knowledge and recommendations, evaluating experience at other ABB-CE plants, and identifying any changes to plant design or operation necessary for successful long-term operation.

Nuclear Engineer II
1983 to 1987

Assisted in producing and documenting the design of major fluid systems for nuclear plants, such as the Reactor Coolant System, and Main Steam and Feedwater Systems. As such, coordinated the activities necessary to revise and re-issue a chapter of the Advanced Light Water Reactor Requirements Document (EPRI report RP 2660-1), a set of detailed design requirements to be utilized for the next generation of nuclear power plants.

Fossil Power Group

Engineer I
1981 to 1983

Responsible for design and analysis studies of the ABB-CE coal gasification process, including the heat and particulate recovery, and product gas desulfurization systems. Assisted in preparing the "Low-BTU Coal Gasification Process Design Report" (DOE Technical Report FE- 1 0047-3 of June 1982).

PERSONAL BACKGROUND:

Bachelor of Engineering in Chemical Engineering, The Cooper Union for the Advancement of Science and Art, 1980

Juris Doctorate, University of Connecticut School of Law, 1988

UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

BEFORE THE ATOMIC SAFETY AND LICENSING BOARD

In the Matter of:	)	
	)	
Northeast Nuclear Energy Company	)	Docket No. 50–423–LA–3
	)	
(Millstone Nuclear Power Station,	)	
Unit No. 3)	)	ASLBP No. 00–771–01–LA

AFFIDAVIT OF DAVID W. DODSON

I, David W. Dodson, being duly sworn, state as follows:

1. I am employed by Northeast Nuclear Energy Company (NNECO) and currently I am the Supervisor - Millstone Unit 3 Licensing.

2. The purpose of my affidavit is to respond to several aspects of the contentions of the Connecticut Coalition Against Millstone (CCAM) and the Long Island Coalition Against Millstone (CAM) admitted in this proceeding. In particular, CCAM and CAM cite to past violations and operational issues at Millstone as a means of validating their expectations of future Millstone performance. In this context CAM and CCAM make various assertions regarding NNECO's willingness and ability to comply with Technical Specifications, operating procedures, and other administrative controls related to handling and storage of spent fuel assemblies at Millstone Unit No. 3. I reject these arguments completely. To respond to the arguments, I will discuss a few of the specific matters referenced by CCAM and CAM, and show how they have no bearing on the spent fuel handling matters at hand.

Personal Qualifications

3. I have 25 years work experience in U. S. Navy and commercial nuclear power applications in the following areas; health physics, primary and secondary plant chemistry control, licensing, design engineering, operations and outage management. My commercial experience consists of five years with an Architect - Engineering firm and 15 years working for commercial nuclear utility companies. I have experience on both Boiling Water and Pressurized Water Reactor designs (Shoreham, Hope Creek, Beaver Valley Unit No. 2, Salem Unit Nos. 1 and 2, and Millstone Unit No. 3). Over the course of my career, I have completed several intensive technical training programs related to commercial nuclear power plant operation including an INPO accredited systems engineering course, the NRC reactor operator fundamentals training course, and a senior reactor operator initial license course. I received a Bachelor of Science degree in Mechanical Engineering from Drexel University in 1993. A copy of my professional qualifications is Attachment A to this affidavit.

4. I joined Northeast Nuclear Energy Co. (NNECO) in December 1997 as a senior engineer in the Regulatory Affairs and Compliance department at the Millstone site. I was promoted to Supervisor - Millstone Unit No. 3 Licensing in 1999.

5. Prior to joining NNECO, I was employed by the Public Service Electric and Gas Co. at the Salem generating station in various technical and supervisory positions beginning in January 1985. Of this time, approximately 10 years was spent in various licensing positions, including supervisor of Salem operational licensing and supervisor of generic licensing activities where I was responsible for the development and processing of changes to plant technical specifications and evaluation of plant specific design and operational issues for conformance with plant design and licensing basis requirements. During this period I was directly involved in

several activities related to spent fuel management, including the rerack of the Salem Unit Nos. 1 and 2 spent fuel pools with high density storage racks manufactured by Holtec. I also spent approximately 2.5 years working in the Salem operations and outage management organizations in various capacities including outage shift manager and non-licensed operations supervisor. At the time I left PSE&G, I was a supervisor in the design engineering organization, balance of plant group, for a period of approximately six months.

6. In my current position, I am responsible for supervising the day to day support of Millstone Unit No. 3 activities related to compliance with the provisions of the unit operating license and appropriate NRC regulatory requirements. This includes the development of plant specific license amendments and technical specification changes, providing support to the operations group for the assessment of operability and reportability of conditions adverse to quality, and review of engineering activities for conformance with applicable regulatory requirements and the facility design and licensing basis as documented in the final safety analysis report.

Millstone Shutdown and Recovery

7. In January 1996, all three units of the Millstone Nuclear Power Station were named by the NRC to the NRC's "Watch List." The Watch List designated those nuclear plants which the NRC would closely monitor. Subsequently, in early 1996, NNECO voluntarily shut down both Millstone Unit 2 and Unit 3. (Unit 1 was already shutdown at that time. NNECO subsequently concluded that the financial investment necessary to recover Millstone Unit 1 was not prudent, and notified the NRC of its intent to permanently cease operations at Unit 1.) To address regulatory and performance matters at Units 2 and 3, NNECO committed to the NRC that prior to restart of any Millstone unit NNECO would implement substantial improvements in

its nuclear program and demonstrate that those improvements had been effective at ensuring that the Millstone units would be operated in accordance with their operating licenses, NRC regulations, the Final Safety Analysis Report (FSAR), and design and licensing basis documentation. No Millstone unit could be restarted until the NRC -- by formal vote of the Commission -- approved.

8. A detailed recovery plan addressing 17 key functional areas was developed for Millstone Unit 3. For each issue, NNECO established detailed performance indicators and success criteria. The effort involved thousands of employees and contractor personnel at Millstone and many others at various contractor offices. As part of this plan, NNECO implemented an unprecedented program of augmented internal and third party oversight. This oversight program included third party verification of NNECO's assessments and corrective actions to address design and licensing basis issues, as well as third party assessment of NNECO's actions to enhance the safety conscious work environment at the Millstone Station. These third party oversight activities were supplemented by internal oversight assessments and evaluations conducted in all of the key functional areas. The results of the numerous assessments were used to validate the completion and effectiveness of NNECO's recovery initiatives and to certify to the NRC that Millstone Unit 3 was ready to return to service.

A brief summary of the Millstone Unit 3 recovery initiatives follows. (Similar initiatives and results were undertaken and achieved at Millstone Unit 2.)

Overview of Millstone Recovery Initiatives

9. Over a recovery period of more than two years, NNECO rebuilt its nuclear organization and programs with an emphasis on developing an improved safety culture, responding in a timely and constructive manner to adverse conditions and employee concerns,

verifying and validating the design basis, and establishing program controls that would ensure compliance with NRC requirements into the future. To accomplish these changes, a new leadership team was selected for Millstone. At the outset of the recovery process this team established high standards and associated performance expectations for work quality and procedural adherence. Throughout the recovery process NNECO management and supervisory personnel were evaluated for their ability to assimilate and promote the cultural changes necessary to assure safe operation of the Millstone units. To supplement this activity, industry peers who had achieved excellence in the operation of their own nuclear units were brought in to act as mentors and to facilitate the assimilation of best operating practices by the Millstone management team. Specialized training was also provided to enhance individual management and leadership skills.

10. Internal oversight functions were revitalized at all levels within the corporation. The Board of Trustees membership was supplemented with individuals experienced in nuclear operations. The Nuclear Safety Advisory Board membership was supplemented with external members with significant operating expertise or prior experience within the NRC. The Millstone site Nuclear Oversight organization was upgraded to support an expanded program of audits and assessments as required to verify and certify that the various functional area recovery plans were complete. A Nuclear Oversight Verification program was instituted during recovery, and continues to be utilized today as a means of communicating with management and the line on trends and insights gleaned through oversight audits and assessments. Senior management also established nuclear safety and performance standards to be reinforced through the internal oversight functions, with an expectation by management that all line organizations respect and respond to oversight findings and recommendations.

11. Restoration of the Millstone configuration management program and verification of the facility configuration against the approved design licensing basis was a principal goal of the recovery. Graded design reviews were conducted for the eighty-eight maintenance rule (10 CFR 50.65) Group 1 and 2 systems. Additionally, 19 engineering topical areas (*e.g.*, Fire Protection, Motor Operated Valves, Inservice Inspection and Testing) were evaluated. These evaluations included reviews of the Final Safety Analysis Report, plant procedures, supporting design calculations, design change records, Technical Specifications, and the Technical Requirements Manual to ensure that design inputs and approved operational alignments were adequately reflected in analysis assumptions and acceptance criteria. Physical verifications of plant configuration against the FSAR were also conducted for those systems and programs evaluated. Additionally, the procedures and programs supporting thirteen key areas associated with configuration management were substantially revised to support ongoing compliance with regulatory requirements. Procedure reviews and enhancements were also accomplished for those related activities supporting configuration management (*e.g.*, work control and planning, procurement quality controls, training and qualification of personnel, design change processes, licensing basis management) to ensure alignment of expectations and processes across the organization.

12. The processes supporting problem identification and resolution at Millstone, specifically including the Corrective Action Program, were an area of focus during the recovery process. Key to this area was the communication and reinforcement of management expectations and support for a low entry threshold for problem identification. The Millstone Corrective Action Program itself was enhanced to emphasize the employee as a key element in the identification and resolution of conditions adverse to quality, to require that conditions adverse to

quality be documented and receive an initial operability and reportability assessment within 24 hours of initiation, and to ensure that nonconforming material conditions are dispositioned in a timely manner. The expectation for continuous improvement was also established and supported through the development of an improved site-wide Self-Assessment Program. The Self-Assessment Program is aligned with the Millstone Corrective Action Program objectives as it requires the initiation of condition reports for adverse conditions identified through the self-assessment processes.

13. Enhancement of a Safety Conscious Work Environment supportive of constructive resolution of individual nuclear and industrial safety concerns was also a key recovery area. Standards and expectations necessary to establish and maintain a safety conscious work environment were developed and communicated to the site population. First line supervisors and above were trained to respond to individual concerns openly and honestly and in a manner that demonstrates respect for the individual. This training remains a requirement for new supervisors and managers at Millstone. The Employee Concerns Program was also enhanced to provide individuals an alternate (*i.e.*, outside their existing management) path for problem resolution. An internal Employee Concerns Oversight Panel was also established to ensure that management expectations for a safety conscious work environment continue to be met.

14. During the recovery period, Millstone Station received two unprecedented NRC orders, resulting in more independent oversight than had previously been required to support the recovery and restart of an operating nuclear unit. First, the NRC ordered that NNECO contract for and implement an Independent Corrective Action Verification Program (ICAVP), whereby the third-party contractor verified that NNECO had identified and implemented corrective

actions for past design basis documentation and configuration management discrepancies. The second order directed NNECO to establish an Independent Third Party Oversight Program (ITPOP) to oversee management actions to ensure a Safety Conscious Work Environment at Millstone and to enhance the Employee Concerns Program. These significant efforts were supplemented by the NRC Staff's own substantial oversight of these and other topics. Both orders were satisfactorily complied with prior to restart.

NRC Restart Authorization Process

15. The NRC classified the Millstone units as Category 3 Watch List plants throughout the recovery period. For a Category 3 plant to restart, the NRC Commissioners needed to evaluate the performance improvements made at the plant and formally vote to permit the plant restart. Public citizens groups, including groups in Connecticut represented by counsel for CCAM and CAM, were permitted to express views to the Commission during that process.

16. The NRC Staff managed its inspection activities in accordance with Chapter 0350 of the NRC Inspection Manual. Manual Chapter 0350 prescribes detailed guidelines for overseeing the restart of nuclear plants after a voluntary or involuntary shutdown. As part of this approach, the NRC Staff established the Millstone Restart Assessment Panel, comprised of senior NRC managers, who defined the key NRC issues to be addressed. The Restart Assessment Panel closely monitored NNECO's progress and was charged with making a formal recommendation to the NRC Commissioners concerning plant safety and the advisability of authorizing restart. The Manual Chapter 0350 process included numerous public briefings and meetings in which interested groups and other members of the public participated.

17. The restart authorization process culminated in the NRC's Staff's recommendation to the Commission that Unit 3 restart be permitted, subject to ongoing oversight and conditions.

Restart of Millstone Unit 3 was approved by the Commission in July 1998. Restart of Millstone Unit 2 was subsequently approved in mid-1999. In approving restart of each of these units, the NRC explicitly recognized that there was reasonable assurance that the units would be operated safely and in compliance with applicable NRC requirements.

Post-Restart Performance Observations

18. The NRC classifications for oversight at Millstone Units 2 and 3 following their return to service were "agency focus" and "regional focus," respectively. Under these classifications, the NRC's Millstone Assessment Panel continued its oversight of Millstone performance. Through this process, augmented NRC inspection activities were conducted to ensure that the performance improvements achieved under the restart initiatives were being sustained. Ongoing inspection results have been made available to the public through docketed correspondence. Regular public meetings continued to be held by the NRC. The broader picture of the NRC's perspective on Millstone performance has been documented in its Plant Performance Review Reports. These reports document a trend of improving performance, with a focus on safe operation of Millstone Units 2 and 3.

19. One measure of the substantial progress made at Millstone and of the current performance is provided by the NRC Staff's recent decision to re-classify both Millstone Units 2 and 3 in the "routine oversight" category. This decision was announced on May 25, 2000, as NRC Staff senior management briefed the Commissioners on the status of operating reactors. The Staff reported, with respect to Millstone Unit 3, that it had been in the "regional focus" category last year, indicating the need for some continuing attention. However, the Staff reported that more recent performance has been very good and that Unit 3 personnel exhibited improvement in reducing the corrective action item backlog and managing the safety conscious

work environment/employee concerns program issues. For Millstone management, this change in oversight status marked a significant achievement in the recovery at the station and a validation of the commitment to continuous improvement.

20. Elements of the independent third party oversight process associated with maintaining a safety conscious work environment have also been maintained since the unit restarted. The assessment results from this activity have been publicly disclosed by NNECO in docketed correspondence and continue to conclude that the improvements made during restart were effective and are being carried forward in current operations.

21. In light of the above considerations, I find CCAM/CAM's fundamental premise that NNECO will not comply with administrative controls related to fuel handling/storage and boron concentrations to be incomprehensible. If the Commission had any basis to believe otherwise, it certainly would not have approved restart of the units, it would not have re-classified the units as "routine oversight," and probably would not now allow continued operation.

Enforcement Issues Cited by CCAM/CAM

22. I am aware that in its Supplemental Petition to Intervene in this matter, filed on November 17, 1999, and at the Prehearing Conference held on December 13, 1999, and in other documents and depositions, CCAM/CAM have alluded to several past issues and enforcement actions at Millstone which, they assert, illustrate their contention that NNECO would willfully not implement administrative controls. I am familiar with those matters and feel it important to respond.

23. First, on December 10, 1997, the NRC assessed on NNECO a $2.1 million civil penalty for a number of violations across the three Millstone units. This enforcement action

addressed, largely, issues related to configuration management and design basis documentation -- issues central to the Millstone recovery program. NNECO did not challenge imposition of the civil penalty; however, to the best of my knowledge, none of the violations addressed in this action involved deliberate failures to comply with NRC requirements.

24. The NRC's December 1997 enforcement action identified violations in several categories. The vast majority of the citations were directly related to inadequate design controls applied over time in the analysis and modification of plant systems, structures, and components. Additional citations were made against Technical Specifications, Quality Assurance program requirements, and reporting requirements under 10 C.F.R. 50.72 and 73 -- the causes of which can all ultimately be traced to design control and/or corrective action program discrepancies. As previously described, NNECO has completed an extensive recovery program at Millstone Unit 3, which included significantly improving its design control and corrective action programs. NNECO's activities in this regard were extensively reviewed by the NRC Staff and by other oversight functions and were found to be effective at restoring performance to a level that met regulatory standards. An increased level of NRC oversight of these processes was maintained following the restart of the Millstone units. The NRC continues to conclude that NNECO's operation of the Millstone units is consistent with regulatory standards. The NRC's confidence in future Millstone performance continuing to meet regulatory standards is evidenced in the recent decision to reduce NRC oversight of Millstone to a level consistent with other well-operated nuclear plants.

25. There are thousands of administrative controls related to nuclear plant operations - controls that NNECO successfully implements every day. Examples of other day-to-day administrative controls employed at Millstone include routine shift rounds or other observations

required by Technical Specifications, the exercise of operating procedures in support of manipulating plant systems and the performance of required equipment surveillance procedures. The procedures related to the Unit 3 spent fuel pool are a small subset of this larger population of administrative controls. Improvements in procedure quality and procedural adherence were elements of the Millstone recovery program.

26. In their contentions, Intervenors make distinctions between one-time and ongoing administrative controls. I think a more meaningful distinction between administrative controls could be made based on the degree to which a control can be reliably exercised. The reliability of any administrative control is dependent, to a large degree, on the extent to which it relies on judgments to ensure success rather than prescriptive steps with explicit performance and acceptance standards. While some of the matters cited in the NRC's December 1997 enforcement action may in some way be said to relate to the implementation of administrative controls, there is a fundamental difference between the nature of the configuration management administrative controls implemented at a programmatic level and those associated with the execution of a spent fuel transaction. Administrative controls utilized in the development of a design or configuration change require many qualitative judgments to be made throughout the exercise of the process -- judgments about which reasonable engineers may differ. Conversely, highly prescriptive controls like those associated with a spent fuel transaction, or a boron concentration surveillance, are far less complex and can be performed with commensurately higher success rates than those which rely heavily on individual judgments.

27. For example, in the performance of a design or configuration change one must define the nature of the change, evaluate the impact of the change on required safety functions of affected systems, structures or components, define limiting assumptions to be used in

establishing the basis for accepting the change, determine which aspects of the facility description or procedures described in the FSAR are impacted, and determine whether the change involves a test or experiment not described in the FSAR. As necessary, additional determinations may be required to establish that the change is safe and whether or not prior NRC approval is required to support implementation. In making determinations within the sub-processes described above, examples or guidelines are utilized extensively as aids in the decision-making process. Consequently, within the structure of these types of administrative controls, individual judgment often plays a significant role in exercising the process. Conversely, conducting a spent fuel transaction relies on more prescriptive controls which leave little or no room for individual judgment. For example, the power history for a fuel assembly or batch of assemblies is developed using benchmarked computer programs with data obtained from the plant process computer, which is in turn derived from hard-wired process inputs. The assembly power history is compared against explicit proceduralized and NRC-approved acceptance criteria to establish the acceptable location for an assembly or batch of assemblies within the spent fuel pool. Instructions are then generated to select the affected assemblies by core grid location, to move them to the spent fuel pool in accordance with established procedures, and to store them in a location which is again designated by specific grid location -- with dual verification throughout the process.

28. As a final matter, I would note that an abiding principle of the nuclear power industry has always been the concept of defense-in-depth. This concept is equally true in the matter of administrative controls. With regards to spent fuel transactions, defense-in-depth has existed for potential administrative control failures since the time the first spent fuel assembly was placed in the Millstone Unit 3 spent fuel pool. This defense-in-depth has been and continues

to be supported by the maintenance of a soluble boron concentration which far exceeds that which is required for a design basis misloading or fuel drop condition. Furthermore, the key steps in the spent fuel transaction process are objectively determined facts and are subject to second verification by a separate individual to confirm accuracy. Monitoring of the reactor core and spent fuel pool following the completion of fuel movement activities also provides a high degree of assurance that these activities have been completed in accordance with the requirements of the core and spent fuel pool design bases. While no single administrative control in and of itself can guarantee error free compliance, the application of defense-in-depth principles provides assurance that a criticality event will not occur in the Millstone Unit 3 spent fuel pool.

Unit 1 Core Off-Load Issues

29. At the Prehearing Conference of December 1999, CCAM and CAM also alluded to past spent fuel pool issues at Millstone Unit 1. These were not addressed in the December 1997 enforcement action and civil penalty discussed above. Rather, in May 1999, the NRC issued an enforcement action and an exercise of enforcement discretion for violations related to *historical* core off-loads at Millstone Unit 1. The NRC cited a number of violations related to the routine practice from 1974 to 1991, at Unit 1, of a full core off-load to the spent fuel pool during refueling outages. In general, the NRC determined that NNECO, in refueling outages prior to 1991, had commenced the off-load more quickly after reactor shutdown than assumed in the design basis spent fuel pool cooling analysis. Although no heat load problem ever occurred, this represented a configuration management issue: the FSAR and related analysis assumptions were not maintained consistent with the as-operated plant. Additionally, the NRC cited NNECO for the historic use of supplemental cooling during core off-load conditions without documented procedures, and for submitting incomplete and inaccurate information in 1988 in connection with

a Unit 1 spent fuel pool rerack application and in a 1993 Licensee Event Report, in that the past off-load practices were not adequately described.

30. The Unit 1 core off-load issues did not involve violations of prescriptive operating procedures or Technical Specification requirements. In this case, the FSAR and associated analysis assumptions were not incorporated into operating procedures or Technical Specifications. As noted in the NRC's enforcement letter in May 1999, the fundamental causes of the Unit 1 core off-load issues were the same as those associated with the $2.1 million civil penalty and, for that reason, the NRC exercised enforcement discretion to propose no further civil penalty. The fundamental causes were addressed by the comprehensive actions taken during the recovery period. Improvements in procedure quality, reconciliation of operating practices with design assumptions, and improved controls to address completeness and accuracy of information submitted to the NRC were all elements of NNECO's Millstone recovery program. The substantial actions taken by NNECO under the recovery program were also specifically targeted at developing a culture where safety and compliance are paramount considerations in all operational matters. The success of NNECO's recovery initiative is well documented in the various restart reviews conducted by the NRC and the various independent oversight groups.

31. The license application submitted by NNECO in support of the planned storage expansion for the Millstone Unit 3 spent fuel pool addresses the issue of hold times prior to off-loads. Controls will be incorporated into existing procedures. The affected procedures and FSAR sections have been identified in the design change package to be evaluated for timely update. Consequently, the specific issues relating to the Unit 1 matter have been addressed. From a broader perspective, the prescriptive requirements at issue in this proceeding -- the

burnup and decay time restrictions, as well as soluble boron surveillances -- will be well documented in procedures and Technical Specifications.

Criminal Sanctions: Operator Training

32. At the Prehearing Conference of December 13, 1999, CCAM/CAM also cited to the fact that in September 1999 Northeast Utilities entered a guilty plea and agreed to pay a total $10 million in fines related to alleged violations of the Clean Water Act and alleged violations of NRC regulations related to nuclear training records. I believe it also important to respond to this matter and state unequivocally that it does not reflect how NNECO conducts operations today or in the future.

33. With respect to the NRC requirements cited in the plea, the charges addressed 19 applications for operator licenses that were not complete and accurate. The charges focused on inaccuracies in individual license applications arising out of two training classes in 1996. They related only to Millstone Units 1 and 2 (not Unit 3). The company concluded that certain records were maintained and filed with the NRC before responsible persons performed the necessary checks to ensure that the documents were complete and accurate. Although company management concluded that no one intentionally falsified a record or acted with intent to deceive the NRC, management also concluded that some persons did not perform their duties at the level expected. As a result of the company's internal review of these matters, NNECO disciplined those responsible for unacceptable performance and replaced several supervisory and managerial personnel in the nuclear training area. Furthermore, management also concluded that it was in the company's best interest to enter a plea to bring to closure a longstanding issue that had been pending through the Millstone recovery.

34. The specific and other broader issues related to training deficiencies were addressed by the NRC Staff as a fundamental requirement of the restart process through a Confirmatory Action Letter (CAL). NNECO responded to the CAL by preparing a detailed corrective action plan against which the NRC monitored progress towards restart readiness. The NRC Staff has resolved the matter of operator training records as a regulatory matter, in an inspection report dated March 10, 2000. The NRC Staff reviewed and accepted NNECO's corrective actions. With respect to the company's culpability, the matter was closed from an enforcement perspective without further enforcement action.

Environmental Compliance Matters

35. The plea agreement also included six counts of violations of the Clean Water Act enforced by the Environmental Protection Agency and Connecticut Department of Environmental Protection (DEP). These violations of the Clean Water Act occurred between 1994 and 1996 and involved three separate incidents: two at Millstone Station and one at Devon Station (a non-nuclear generating station formerly owned by The Connecticut Light and Power Company). At Millstone, in September 1994, a sample point location "006" was moved closer to the point of actual discharge into Long Island Sound. In July 1996, at the DEP's request, NNECO returned the sample point to the original location. However, in the interim, the sample point was subject to tidal flows; hence the resulting samples as reported to DEP were not representative of the discharges. In 1996, hydrazine, a corrosion inhibitor, was improperly discharged from the Millstone "006" location, and Millstone's Clean Water Act permit did not authorize the discharge of hydrazine from that location. Subsequently, authorization was received from the DEP to discharge hydrazine via location "006."

36. Northeast Utilities (NU) has responded aggressively to environmental compliance problems, with a corporate-wide program to improve performance. Over the past three years, NU has created or enhanced a number of environmental programs, including: policies and procedures; auditing and training; assignment of environmental responsibility to specific positions at all facilities; annual environmental goal setting; and an annual environmental safety and ethics report that documents the company's progress towards its environmental objectives. The company also has taken additional steps to hold itself accountable for environmental performance, including the appointment of an external environmental advisor. Additionally, NU recently endorsed the Coalition for Environmentally Responsible Economies (CERES) principles, the first independent corporate code of environmental conduct.

37. The Millstone environmental management program was very recently certified against the ISO 14001 standard for environmental management systems. This is a distinction previously conferred on only one other nuclear facility in the United States. ISO (International Organization for Standardization) is a worldwide federation of national standard-setting bodies which uses technical committees to prepare International Standards. The ISO 14000 series include internationally recognized standards designed to assist an organization in building an Environmental Management System (EMS) and in managing the performance of that system through a structured process for the achievement of continuous improvement. The ISO 14001 environmental management standard, which is voluntary, establishes 17 elements or management processes that must be developed and implemented to promote continuous improvement in environmental performance and pollution prevention. To achieve certification, an audit team from NSF International Strategic Registrations, a firm that is qualified to conduct audits for ISO 14001, conducted an onsite review of work and operational activities performed at all three

Millstone nuclear units. This included a review of all aspects of Millstone's EMS in order to ensure that processes and programs are in place to assist the station in measuring its environmental performance and maintaining compliance with environmental laws and regulations.

38. CCAM/CAM have indicated in discovery that they intend to cite other environmental allegations raised in prior litigation by Mr. James Plumb, a chemistry technician at Millstone until early 1996. The allegations raised in those legal proceedings related to events during the time-frame of Mr. Plumb's employment at Millstone and were known to both federal and state governmental officials. The Connecticut DEP, in particular, requested additional information from NNECO in 1996 with respect to Mr. Plumb's allegations, and NNECO submitted information in November 1996. In late 1997, the DEP chose to initiate an action in Connecticut Superior Court in Rocque, Arthur J., Jr., Commissioner of Environmental Protection v. Northeast Utilities Service Co., et al., CV-575567 (Superior Court, State of Connecticut, Judicial District of Hartford), citing some of these environmental compliance matters. That case was later resolved between the company and the government by stipulated judgment. NU made no admissions of culpability or liability with respect to the allegations, but committed to pay certain civil penalties, make environmental contributions, take environmental corrective actions, and conduct audits and independent reviews.

39. Mr. Plumb's employment at Millstone ended in January 1996 when he was released, along with about one hundred other employees, as part of a station-wide workforce reduction. Many of Mr. Plumb's allegations were made in a state court wrongful discharge case he brought against the company in the same time frame as the federal environmental proceeding and the state DEP case discussed above. It is my understanding that the wrongful discharge case

was resolved without any admission or finding of culpability by the company, and Mr. Plumb's complaint was withdrawn.

40. For its part, the NRC's Office of Investigations reviewed the process used by NU for the January 1996 workforce reduction, as well as several individual cases arising out of that reduction. In correspondence to the company in July 1998, the Office of Investigations reported that it had completed its comprehensive review of the process and the individual cases, and concluded that there was not sufficient evidence to substantiate allegations of discrimination.

Potential for Individual Misconduct

41. In its arguments, CAM/CCAM has also asserted that noncompliances will repeat themselves because individuals at Millstone in the past with responsibilities in the training and environmental areas where past non-compliances occurred are still employed by NU or NNECO. NNECO is not aware of individual wrongdoing by any employee currently at Millstone with respect to either of these two matters. The company, however, has fully cooperated with the NRC government agencies in ongoing investigations. To my knowledge, based on information from others in the company in a position to know, to date these investigations have not resulted in any individual being charged with a criminal offense or being cited by the NRC for individual misconduct. Should such a condition arise in the future, NNECO personnel policies would be followed and appropriate actions taken.

42. It is important also to note that the NRC, in considering restart authorization for Millstone Units 3 and 2, in 1998 and 1999 respectively, was aware of the ongoing federal and state investigations and criminal matters. The NRC's Manual Chapter 0350 restart authorization process discussed earlier specifically required the NRC Staff to prepare a "Restart Checklist" for each unit. The Restart Checklist included steps to ensure that allegations had been appropriately

addressed, that the NRC's Office of Investigations had no restart objection, and that applicable federal agencies (such as the Department of Justice) had no restart objections.

Conclusion

43. From 1996 to 1998, Millstone Unit 3 went through an extended regulatory shutdown. Countless person-hours were expended on equipment, procedure, and documentation reviews and upgrades. New Millstone Station leadership and heightened standards were put in place. Steps were taken to enhance the safety conscious work environment. In 1998, the NRC Staff recommended restart of Millstone Unit 3 and the Commissioners formally voted to approve. In 1999, the Staff and Commission similarly approved restart of Unit 2. In this context, the claim of CCAM and CAM that NNECO will not implement simple Technical Specifications, procedures, and administrative controls related to spent fuel movement and storage are unfounded. The past performance at Millstone has no bearing on the future -- other than as lessons learned and as the basis for corrective actions already taken.

44. The foregoing statements are true and correct to the best of my knowledge and belief.

David W. Dodson

David W. Dodson

Sworn and subscribed to before me on this 29 day of JUNE, 2000.

DIANE M. PHILLIPO
Notary Public
My Commission Expires Dec. 31, 2000

Diane M. Phillipo

Notary Public

My Commission expires:

ATTACHMENT A

David W. Dodson
Resume

Experience Summary

I am currently employed by Northeast Nuclear Energy Co. at the Millstone Nuclear Power Station as the Supervisor of Millstone Unit No. 3 Licensing. I have 25 years experience in U.S. Navy and commercial nuclear power applications in the following areas; health physics, reactor and secondary plant chemistry control, licensing, design engineering, operations and outage management.. My commercial experience consists of five years with an Architect - Engineering firm and 15 years working for commercial nuclear utility companies. I have experience on both Boiling Water and Pressurized Water Reactor designs (Shoreham, Hope Creek, Beaver Valley Unit No. 2, Salem Unit Nos. 1 and 2, and Millstone Unit No. 3).

Education

1993 Bachelor of Science Mechanical Engineering, Drexel University, Philadelphia, PA

Technical Training

PSE&G Nuclear Training Center, Salem, NJ
1991 Salem Systems Engineering Course, INPO Accredited
1992 NRC Reactor Operator Fundamentals
1993 Salem Station Senior Reactor Operator Initial License Course

Experience Detail

December 1997 to Present

Northeast Nuclear Energy Co., Waterford, CT

Regulatory Affairs and Compliance

- Positions held include Senior Engineer and Supervisor - Millstone Unit 3 Licensing
- Currently responsible for the direct supervision of activities associated with Millstone Unit 3 Licensing including:
    - Compliance reviews for design changes and conditions adverse to quality identified through the Millstone Corrective Action Program
    - Supporting ongoing Operability assessments and the preparation of Operability determinations

- Preparation and processing of Technical Specification clarifications, interpretations, and associated change requests
- Preparation of reportability evaluations and associated Licensee Event Reports
- Preparation of Licensing and Design Basis changes to address the resolution of Unreviewed Safety Questions
- Management and support of routine NRC inspections including responses to inspection findings
- Review and comment for proposed changes to NRC rules and regulations
- Resolution of employee concerns

January 1985 to December 1997

Public Service Electric & Gas, Hancock's Bridge, NJ

Nuclear Engineering Design

- As Supervisor - Balance of Plant
- Direct supervision of a team of Engineers, Designers, and Contract Engineers responsible for managing the design basis of the Salem Station Balance of Plant and HVAC systems
    - Evaluating, updating and revising plant configuration documents and specifications
    - Resolution of design-related operational anomalies
    - Identification, evaluation and preparation of system design modification packages, including supporting design analyses and 10 CFR 50.59 Safety Evaluations
    - Responsible for setting short and long range work priorities, managing costs, establishing budgets, interviewing and selection of new employees, development of current staff, and preparation of performance appraisals

Licensing and Regulation Department

- Positions held included Engineer, Senior Engineer, Principal Engineer-Operational Licensing and Principal Engineer-NRR Licensing
- Responsibilities included:
    - Reportability evaluations under 10 CFR 50.72 and 50.73
    - Preparation of plant Operability Determinations and 10 CFR 50.59 Safety Evaluations
    - Interpretation of Operating License requirements and preparation of License Amendment Requests
    - Design and Licensing Basis reconstitution, and
    - Project Manager for NRC inspections and Generic Issue response development
    - Developed on-line text searchable database of critical Licensing Basis documents
    - Managed the initial conversion and update of the Hope Creek Final Safety Analysis Report
    - Past member of WOG Technical Specification Subcommittee, Nuclear Utility Group on Station Blackout

Salem Operations Department

- As a non-licensed Shift Supervisor
  - Completed Senior Reactor Operator and Shift Technical Advisor Training
  - Completed the NRC Reactor Operator Fundamentals examination
  - Supervised Bargaining Unit personnel on shift during performance of daily shift routine
  - Work Control Center Support Supervisor of Salem Unit 2 seventh refueling outage
  - Evaluation of Work packages prior to field release, and Preparation and pre-staging of tagouts

Salem Planning Department

- As Outage Shift Manager
  - Temporary assignment for the Salem Unit 2 eighth refueling outage
  - Managed planning and scheduling resources directly supporting the outage
  - Responsible for resource allocation and schedule conflict resolution

September 1980 to January 1985

Stone & Webster Engineering, Boston, MA

- As an Associate Engineer
  - Coordinated the development and publication of Revisions to the Shoreham and Beaver Valley-Unit 2 Final Safety Analysis Reports during plant construction
  - Provided NRC inspection issue resolution field assistance at the Shoreham site
  - Stone & Webster field liaison for the Shoreham, Atomic Safety and Licensing Board hearings

April 1980 until September 1980

South Charleston Sewer District, Charleston, SC

- As a Laboratory Technician
  - Certified in the performance of Residential and Industrial Wastewater Chemical Analysis
  - Responsible for sample collection and analysis
  - Certified responder for liquid chlorine toxic chemical emergencies

June 1975 to February 1980

United States Navy, Nuclear Machinist Mate

- Served as an Engine Room Supervisor and Engineering Laboratory Technician aboard a Nuclear Attack Submarine