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UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION
BEFORE THE COMMISSION

In the Matter of:	:	Docket No. 50-423-LA-3
NORTHEAST NUCLEAR ENERGY	:	ASLBP No. 00-771-01-LA
COMPANY	:	
(Millstone Nuclear Power Station,	:	
Unit No. 3; Facility Operating	:	
License NPF-49)	:	FEBRUARY 7, 2001

CONNECTICUT COALITION AGAINST MILLSTONE

AND LONG ISLAND COALITION AGAINST MILLSTONE

BRIEF ON REVIEW OF LBP-00-26

Submitted on behalf of the Connecticut Coalition Against Millstone
and the Long Island Coalition Against Millstone by:

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CONNECTICUT COALITION AGAINST MILLSTONE AND LONG ISLAND COALITION AGAINST MILLSTONE BRIEF ON REVIEW OF LBP-00-26

I. INTRODUCTION

Pursuant to Memorandum and Order CLI-01-03 of the U.S. Nuclear Regulatory Commissioners issued on January 17, 2001, the Connecticut Coalition Against Millstone ("CCAM") and the Long Island Coalition Against Millstone ("CAM) (collectively, "CCAM/CAM") herewith submit their brief on review of LBP-00-26. This brief addresses the lawfulness of the Licensing Board's decision to terminate this proceeding with respect to the issue of criticality prevention in the spent fuel pools at the Millstone Nuclear Power Station.

II. FACTUAL AND PROCEDURAL BACKGROUND

A. Millstone License Amendment

These proceedings concern the license amendment application of the licensee, Northeast Nuclear Energy Company ("NNECO") to NRC on March 19, 1999 seeking to

increase the storage capacity of the Millstone Unit 3 spent fuel pool ("SFP") from 756 assemblies to 1860 assemblies.[1]

NNECO proposes to rely upon the following administrative measures of criticality control at Millstone Unit 3: (1) maintenance of a given content of soluble boron in pool water; (2) limits on fuel burnup in Region 1 4-out-of-4 racks and Region 2 racks; and (3) limits on fuel burnup and fuel decay time in Region 3 racks.[2] NNECO proposes to take credit for burnup and decay time as criticality control measures during normal conditions. These administrative measures would substitute for physical measures of criticality control that are available to NNECO. Indeed, NNECO proposes to rely on physical measures of criticality control - the geometric configuration of the racks and the presence of solid boron in the rack structure - in Region 1 3-out-of-4 racks. The existing Technical Specifications for Millstone 3 divide the presently installed racks into two regions.[3]

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[1] Condition Report #M3-99-1148, attached to the CCAM/CAM "Detailed Summary of Facts, Data and Arguments and Sworn Submission on Which Connecticut Coalition Against Millstone and Long Island Coalition Against Millstone Intend to Rely at Oral Argument to Demonstrate the Existence of a Genuine and Substantial Dispute of Fact with the Licensee Regarding the Proposed Expansion of Spent Fuel Storage Capacity at the Millstone Unit No. 3 Nuclear Power Plant" ("hereinafter CCAM/CAM Summary"), and referenced in footnote 1 therein, suggests that the expansion is sought in part to provide additional storage capacity for Unit 2 spent fuel as well as Unit 3 spent fuel. The application itself and the Federal Register Notice published on September 7, 1999 make no mention of transfer of fuel from the Unit 2 SFP to the Unit 3 SFP, nor is the Millstone facility licensed to move spent fuel from Unit 2 to Unit 3. However, information was submitted by NNECO during recent proceedings before the Connecticut Department of Public Utility Control suggesting that expansion of Unit 3 fuel storage capacity to accommodate Unit 2 waste may have been a factor in decision-making by Dominion Resources, Inc. when it recently bid to purchase the Millstone Nuclear Power Station. DPUC, Docket No. 99-09-12REO1.

[2] NNECO's present and proposed limits on fuel burnup vary according to the initial enrichment of the fuel. For convenience, the limits are referred to here simply as burnup limits.

[3] Per Technical Specification Definition 1.40, the Region I racks use a 3-out-of-4 configuration with a fuel cell blocker in the fourth location. Per Technical Specification Definition 1.41, the Region II racks do not have fuel cell blockers. Technical Specification Surveillance Requirement 4.9.13.1 controls placement of fuel in Regions I and II. When the fuel assembly enrichment and burnup parameters are to the right of the line drawn on Technical Specification Figure 3.9-1, a fuel assembly cannot be stored in a Region II rack.

NNECO seeks permission to install up to fifteen (15) additional racks in the spent fuel pool at Millstone Unit 3.[4]

The proposed amendment would double the number of parameters requiring administrative control to prevent criticality in the Millstone Unit 3 spent fuel pool. The current administrative controls affect one parameter (burnup) while the proposed administrative controls would affect two parameters (burnup and decay time). Moreover, the proposed amendment would involve three separate sets of burnup limits instead of one set as at present. As illustrated in CCAM/CAM's Summary,[5] the proposed amendment significantly increases the complexity of administrative controls on the positioning of fuel in the pool – and, consequently, provides significantly more opportunities for a criticality event – by creating a variety of new enrichment, burnup and decay time combinations. The implementation of administrative controls on burnup and decay time requires: (i) that the burnup and decay time are known accurately for each fuel assembly at all times when the assembly is present in the pool; (ii) that the effects of

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[4] Five (5) of the proposed new racks will be 7 X 10 arrays using Boral as the neutron absorption material. NNECO proposes to designate these five new racks as Region 1 of the SFP. The company seeks to use Region 1 to store fuel assemblies with a nominal 5.0 w/o U-235 enrichment in a 3-out-of-4 configuration without burnup restrictions. In the 3-out-of-4 configuration, a fuel cell blocker is proposed for criticality control. The application also provides for fuel assemblies to be stored in Region 1 in a 4-out-of-4 configuration (i.e., no cell blockers) when restrictions are placed on burnup.

The remaining ten (10) proposed new racks have varying array dimensions using Boral as the neutron absorption material. NNECO proposes to designate these ten new racks as Region 2 of the spent fuel pool. The application provides for fuel assemblies to be stored in Region 2 in a 4-out-of-4 configuration (i.e., no cell blockers) with restrictions placed on burnup. These restrictions are more restrictive than those imposed on storage in Region 1 racks.

NNECO proposes to re-designate the 21 existing racks as Region 3 of the SFP. The application provides for fuel assemblies to be stored in Region 3 with more restrictions on burnup and enrichment than imposed on the Region 2 (and 1) racks. In addition, the application provides for credit to be taken for the decay time of the irradiated fuel stored in the Region 3 racks.

[5] See CCAM/CAM Summary, Table IV-1 and notes thereto.

burnup and decay time on criticality are accurately calculated before each relevant fuel placement or movement; and (iii) that each fuel placement or movement is performed without placing the fuel in an inappropriate location.

B. Procedural Background

On February 9, 2000, the Licensing Board admitted Contention 6 in LBP-00-02, 51 NRC 25.[6] Contention 6 stated as follows:

> Proposed Criticality Control Measure
> Would Violate NRC Regulations
> The criticality control measures proposed by NNECO would violate Criterion 62 of the General Design Criteria (GDC) set forth in Part 50, Appendix A. GDC 62 requires that: "Criticality in the fuel storage and handling system shall be prevented by physical systems or processes, preferably by use of geometrically safe configurations." In violation of this requirement, NNECO proposes to seek to prevent criticality at Millstone Unit 3 by the use of ongoing administrative measures.

As permitted by 10 CFR Section 2.1111, NNECO invoked the hybrid hearing process. Following a discovery period, the parties filed summaries of their factual evidence and legal arguments, along with sworn statements by their technical experts.[7]

On October 26, 2000, the Licensing Board issued LBP-00-26, which denied CCAM/CAM's request for an evidentiary hearing, dismissing CCAM/CAM's pending contentions and terminating the proceeding. In dismissing Contention 6, the Board ruled that GDC 62 "does not bar the type of administrative controls sought to be used by NNECO." Id., slip op. at 42. The Licensing Board decision recognized that the Commission has not previously addressed the issue. Id., slip op. at 43.

On November 13, 2000, the Intervenors petitioned the NRC Commissioners for review of the Licensing Board's decision dismissing Contentions 4 and 6. Three weeks

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[6] The Board also admitted Contentions 4 and 5 which are not at issue here.
[7] See CCAM/CAM Summary.

after the Licensing Board decision was released and three days after the Intervenors filed their Petition for Review, NNECO informed the NRC that it was unable to account for two spent fuel rods at Millstone Unit 1.[8]

On January 17, 2001, in CLI-01-13, the NRC Commissioners granted the Petition for Review with respect to Contention 6.[9]

C. History of Criticality Prevention at Nuclear Power Plants

1. Nature of Criticality Accidents

In operating a nuclear power plant, it is necessary to protect the facility against a criticality accident. Criticality occurs when neutrons emanating from atoms of special nuclear material, as a result of fission of their nuclei, bombard other atoms and cause fission of their nuclei, setting off a chain reaction. Criticality can be prevented by providing adequate spacing of special nuclear material, and by introducing neutron-absorbing material to shield the special nuclear material and absorb the neutrons.

A nuclear fission reactor generates power because criticality is achieved under controlled conditions. At all times when fresh or spent fuel is outside a reactor, criticality must be prevented. In the case of light-water reactor fuel, a criticality event can occur if fresh or spent fuel assemblies are brought sufficiently close together in the presence of a neutron-moderating material such as water, without the presence of sufficient neutron-

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[8] The NRC has publicly acknowledged that NNECO's disclosure that it has lost track of irradiated fuel rods, as reported in License Event Report (LER) 2000-002-00 on docket 50-245 on January 16, 2000, is unprecedented in the U.S. commercial nuclear industry. On December 18, 2000, CCAM/CAM moved to reopen the proceedings for further development of the record with respect to the missing spent fuel rods. On January 17, 2001, the Licensing Board denied the motion to reopen; however, it granted CCAM/CAM leave to move for reconsideration on or before January 29, 2001. On January 29, 2001, the Intervenors filed a motion for reconsideration with supporting materials with the Licensing Board. The motion for reconsideration is pending before the Licensing Board.

absorbing material to suppress criticality. The neutron-absorbing material could be solid boron or other material incorporated into the structure of the racks where fuel assemblies are stored, or soluble boron in the water surrounding fuel assemblies.

2. Regulations and agency guidance

Criticality control at nuclear power plants is governed by General Design Criterion ("GDC") 62, which requires that:

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

10 C.F.R. Part 50, Appendix A, Criterion 62. This language clearly precludes the use of ongoing procedural or administrative controls for criticality prevention. The NRC also has regulations at 10 C.F.R. § 70.24 and § 50.68, which permit licensees to forego criticality monitors if they comply with certain measures for criticality prevention. These measures are consistent with GDC 62, and the Commission reaffirmed GDC 62 when it promulgated the regulations.

In 1978, the NRC Staff issued a guidance document which sought to extend the requirements of GDC 62 into the realm of accident conditions, by introducing the "Double Contingency Principle" and the concept of "realistic initial conditions."[10] The guidance is attached to a letter from Brian K. Grimes of the NRC Staff to "All Power Reactor Licensees," dated April 14, 1978 (hereinafter "Grimes Letter").[11] The Grimes letter acknowledges that "[d]ue to an increased demand on storage space for spent fuel assemblies, the more recent approach is to use high density storage racks and to better

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[9] The NRC Commissioners denied review of the Licensing Board's original ruling on Contention 4 "without prejudice to our consideration of Contention 4 issues in the context of the pending motion to reopen."

[10] *See* Appendix A to the Summary for a further discussion of the source and development of these terms.

[11] A copy of the Grimes Letter is attached to the Summary as Exhibit 2.

utilize available storage space."[12] The Letter provides the following guidance for evaluation of criticality prevention under postulated accident conditions:

> The double contingency principle of ANSI N 16.1-19754 shall be applied. It shall require two unlikely, independent, concurrent events to produce a criticality accident.
> Realistic initial conditions (e.g., the presence of soluble boron) may be assumed for the fuel pool and fuel assemblies.[13]

As discussed in the CCAM/CAM Summary in Appendix A, these terms are not further discussed or defined in the Grimes Letter. However, it is clear that the Grimes Letter did not allow reliance on the presence of soluble boron as a criticality prevention measure under normal conditions. Instead, the presence of soluble boron was intended to be considered solely as an initial condition in an accident scenario.

In 1981, the Staff issued a draft regulatory guide containing further guidance for the evaluation of criticality prevention measures: Draft 1, Regulatory Guide 1.13, Revision 2, "Spent Fuel Storage Facility Design Basis (December 1981) (hereinafter "Draft Reg. Guide 1.13")[14]. Although Draft Reg. Guide 1.13 has never been issued in final form, the Staff has applied it extensively to the review of spent fuel pool expansion applications. Like the 1978 Grimes Letter, this Draft Reg. Guide has never been approved by the Commission, but is solely a Staff guidance document.

> In §§ 4.5 and 6 of Appendix A, Draft Reg. Guide 1.13 implies that credit may be taken for fuel burnup as a criticality prevention measure under normal conditions. Section 5.2 of Appendix A states that the presence of soluble boron can be regarded as a realistic initial condition under certain accident conditions, namely those associated with "Condition IV faults," which are not defined in the Draft Reg. Guide. As in the case of the Grimes Letter, it is clear that this Draft

12 *Id.*, Enclosure 1 at I-1.
13 *Id.*
14 A copy of Draft Reg. Guide 1.13 is attached to the Summary as Exhibit 3.

Reg. Guide does not allow reliance on the presence of soluble boron as a criticality prevention measure under normal conditions.[15]

A more recent guidance document on criticality prevention in spent fuel storage pools is a Memorandum from Laurence Kopp, NRC, to Timothy Collins, NRC, re: Guidance On The Regulatory Requirements For Criticality Analysis Of Fuel Storage At Light-Water Reactor Power Plants (August 19, 1998) (hereinafter "Kopp Memorandum").[16] The Kopp Memorandum asserts the Staff's acceptance of various administrative measures for criticality prevention, such as credit for burnup and soluble boron

Thus, as the pressure has increased for higher and higher density fuel storage, the NRC Staff has increasingly relaxed the standards for criticality prevention, allowing the use of administrative controls and reducing the rigor of the accident analysis required.

3. Evolution of Criticality Prevention in Fuel Pools

There is no centralized, publicly accessible database that provides detailed information about the rack configuration at each nuclear power plant spent fuel storage pool and the history of rack installation at each pool. Nevertheless, CCAM/CAM's survey of correspondence and safety reports for individual plants shows how the stringency of measures for criticality prevention at nuclear power plants has eroded over time in response to increasing demand for higher and higher density spent fuel storage. This evolution has gone beyond the bounds of measures that are consistent with GDC 62. The NRC Staff has condoned violations of GDC 62 by issuing regulatory guidance that countenances these violations, and by approving many license amendment applications

[15] As discussed in Attachment A to the Summary, the American Nuclear Society ("ANS") also provides guidance regarding the presence of soluble boron as an initial condition for the purposes of criticality analysis pertinent to accident conditions.

[16] A copy of the Kopp Memorandum is attached to the Summary as Exhibit 4.

that permit the use of administrative controls for criticality prevention in the high-density storage of spent fuel.

a. Low-density storage

When U.S. nuclear power plants of the present generation were designed, and when many of the currently operating plants were commissioned, fuel pools were equipped with low-density fuel storage racks. The racks were designed with open frames of steel or aluminum. Center-center distances between fuel assemblies were typically 10-13 inches in BWR racks and 18-22 inches in PWR racks. By using a relatively low fuel storage density -- less than 0.25 tonne U per square foot -- licensees achieved a high level of safety against criticality. The center-center distances were large enough to prevent criticality even if fresh fuel was placed in the racks and the pool was filled with unborated water. In other words, criticality prevention relied entirely on the use of a geometrically safe configuration.

As spent fuel began to accumulate at power plants, there was growing interest in achieving higher storage densities in fuel pools. This implied smaller center-center distances in the racks, resulting in a greater propensity for criticality. Beginning in the 1970s and continuing through the 1980s and 1990s, center-center distances in fuel pools were reduced in several steps. Additional means of criticality prevention were introduced at each step.[17]

b. Reliance on the neutron-absorbing properties of storage racks and the incorporation of flux traps

[17] *See* U.S. Department of Energy, Spent Fuel Storage Fact Book, DOE/NE-0005, April 1980; and U.S.N.R.C., Draft Generic Environmental Impact Statement on Handling and Storage of Spent Light Water Power Reactor Fuel, NUREG-0404 (2 volumes) Appendices B and D (March 1978).

The first step toward higher density was to employ stainless steel racks with center-center distances of about 8 inches in BWR racks and 13 inches in PWR racks. Roughly speaking, this step occurred in the 1970s. The new configuration increased the fuel storage density to a level of up to 0.39 tonne U per square foot. The reduced center-center distances in this configuration yielded a greater propensity for criticality than was exhibited by the previous open-frame racks. Nevertheless, the rack designers were able to achieve a subcritical margin of reactivity, relying in part on the absorption of slow neutrons by the stainless steel in the rack structures. This neutron-absorption phenomenon was in turn assisted by the moderation of fast neutrons by water confined in passages ("flux traps") between the fuel assemblies. At this stage of evolution in fuel storage density, criticality prevention relied partly on the distance between fuel assemblies and partly on the neutron-absorbing properties of the racks.

c. Incorporation of boron in the structure of storage racks

The second step toward higher density in fuel pools was to employ stainless steel racks which incorporated boron in solid form within the rack structures. Roughly speaking, this step occurred in the 1980s. Boron is an absorber of neutrons, and thereby suppresses criticality. Thus, the incorporation of solid boron allowed center-center distances to be further reduced. A common method of incorporating solid boron is to attach Boral panels to the racks. To construct a Boral panel, boron carbide is dispersed in aluminum, and this material is fabricated into sheets which are clad with aluminum. These "panels" are then attached to the spent fuel storage racks.

Incorporation of solid boron within the rack structures allowed a subcritical margin of reactivity to be maintained while center-center distances were reduced to 6.5 inches in

BWR racks and 10.5 inches in PWR racks, thereby achieving a fuel storage density up to 0.58 tonne U per square foot. In this configuration, criticality prevention relied to a lesser degree than previously on the distance between fuel assemblies and to a greater degree on the neutron-absorbing properties of the racks. [18] Most, perhaps all, fuel pools at US nuclear plants have been equipped for some years with racks that incorporate solid boron within the rack structures, often in the form of Boral panels.

d. Ongoing administrative controls

In recent years, a number of licensees have further increased the density of spent fuel pool rack storage. As the fuel is packed closer and closer together, fixed neutron-absorbing material such as Boral panels becomes less and less effective in preventing criticality. Therefore, licensees have introduced ongoing administrative procedures for criticality prevention. These controls consist of (a) relying on the presence of soluble boron into the spent fuel pool water, (b) controlling the burnup level of the fuel, and (c) controlling the decay time of the fuel assemblies. Using these ongoing administrative controls, the density of storage of intact fuel assemblies in fuel pools has been increased

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[18] In pursuit of even higher storage densities in fuel pools, the nuclear industry has also studied fuel storage options involving a reduced presence of water between the fuel rods. Water moderates fast neutrons, so a reduced presence of water can yield a subcritical margin of reactivity even as the spacing between fuel assemblies or rods is reduced. One water-displacing option is to place spent fuel assemblies inside cans and to fill all empty space inside each can with small metal beads, thereby achieving a fuel storage density of 0.75 tonne U per square foot. A second option is to compact fuel assemblies by crushing the fuel spacers until rods are nearly touching, thus achieving a fuel storage density of about 0.95 tonne U per square foot. A third option is to dismantle the fuel assemblies and store the rods in close contact with each other inside cans, thus achieving a fuel storage density of about 1.1 tonne U per square foot. None of these options has been generally adopted. *See* U.S. Department of Energy, Spent Fuel Storage Fact Book, DOE/NE-0005 (April 1980). There is an alternative to adopting ever-higher densities of fuel storage in an existing fuel pool. That alternative is to construct an independent spent fuel storage installation ("ISFSI"). ISFSI's have been built at several US nuclear plant sites. In each case, a dry storage technology has been employed. As of September 1998, installations of this kind were licensed at 11 nuclear plant sites. *See* NRC Information Digest: 1998 Edition, NUREG-1350, Volume 10, Appendix H (November 1998).

beyond the level that was achieved by adopting center-center distances of 6.5 inches in BWR racks and 10.5 inches in PWR racks.

These three methods exploit phenomena as follows. First, increased burnup of a fuel assembly will, over a broad range of conditions, decrease the assembly's reactivity because of the ingrowth of neutron-absorbing isotopes and the reduced enrichment in U-235 that occur with increased burnup.[19] Second, the presence of soluble boron in the pool water will decrease reactivity because the soluble boron absorbs neutrons. Third, aging of a fuel assembly will decrease the assembly's reactivity due to the decay of Pu-241 (with a 14-year half-life) and the ingrowth of its decay product Am-241.

e. Experience with Administrative Controls

Since administrative controls were introduced to prevent criticality in fuel pools in the United States, there has been no documented criticality event in a pool. However, there have been numerous failures of relevant administrative controls.[20] The historical record summarized in Appendix B is almost certainly incomplete. Thus, the true record of failures of administrative controls is more severe, in terms of the potential for a criticality event, than Appendix B indicates.

[19] Burnup is the accumulated fission energy released by a fuel assembly. Its effects on criticality are exploited by restricting the combined burnup/enrichment parameters of fuel assemblies that are placed in the fuel storage racks. Note that in some instances, the reactivity of a fuel assembly will initially increase with burnup, then decrease with higher levels of burnup.

[20] Appendix B of CCAM/CAM's Summary describes some of those failures. Appendix B shows that fuel assemblies have been mispositioned on a number of occasions, resulting in the violation of burnup and/or enrichment limits. At Oyster Creek in 1987, a total of 184 fresh fuel assemblies were mispositioned in a pool. Appendix B also describes incidents of error in criticality calculations, and incidents where the concentration of soluble boron in fuel pool water has been improperly managed. At McGuire Unit 1 in 1994, the soluble boron concentration dropped from 2,105 ppm to 1,957 ppm (a 7 percent drop), violating the plant's Technical Specifications. Some of the incidents described in Appendix B involve failures of administrative controls that are not directly intended to prevent criticality. These failures show that administrative controls, as a class of safety measures, can and do fail.

Neither the NRC Staff nor any other entity has compiled a systematic database on the failure of administrative controls that are relevant to criticality prevention. In the absence of such a database, one cannot provide historically-based estimates of the likelihood of failure of relevant administrative controls.

ARGUMENT

III. THE LICENSING BOARD ERRED IN CONCLUDING THAT PROPOSED LICENSE AMENDMENT COMPLIES WITH GDC 62.

This appeal turns on the interpretation of the wording and regulatory history of GDC 62, which provides that:

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

In their Summary, CCAM/CAM demonstrated that both the plain language and the regulatory history of GDC 62 preclude reliance on procedural controls, *i.e.*, ongoing administrative measures, for criticality prevention. Interpreting the facial language of GDC 62, the Licensing Board rejected CCAM/CAM's arguments, and held that GDC 62 "does not bar the types of administrative controls sought to be used by NNECO." *Id.*, slip op. at 42. [21]

As discussed below, the Licensing Board's decision is inconsistent with fundamental principles of statutory and regulatory interpretation, by reading the phrase "physical systems or processes" out of the regulation. As will be discussed in Orange County's *amicus* brief, the Board's interpretation of GDC 62 also ignores critical evidence in the rulemaking history that the Commission intended GDC 62 to bar procedural criticality measures.

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[21] In reaching this conclusion, the Board relied exclusively on its interpretation of the plain language of the regulation. Although the Board reprised CCAM/CAM's argument regarding the rulemaking history of GDC 62 [*see* LBP-00-26, slip op. at 31-33], it did not respond to the argument other than to make a cursory reference to the role of ORNL. This issue is addressed in the *amicus* brief filed in support of CCAM/CAM by the Board of Commissioners of Orange County. Nor did the Board address CCAM/CAM's arguments regarding the consistency of other regulations related to criticality, 10 C.F.R. §§ 50.68 and 72.104, other than to state that § 50.68 does not govern the questions before it. *See* LBP-00-26, slip op. at 45. These arguments *were* addressed in *Carolina Power & Light Company* (Shearon Harris Nuclear Power Plant, Unit 1), LBP-0-12, 51 NRC 247, 259-60 (2000), on which the Board generally relied in LBP-00-26. *See* LBP-

A. The General Design Criteria Establish Minimum Design Requirements for Nuclear Power Plants.

At the outset, it is important to recognize that GDC 62 is an important and mandatory criterion for nuclear power plant design. The General Design Criteria constitute:

> *minimum requirements* for the principal design criteria for water-cooled nuclear power plants similar in design and location to plants for which construction permits have been issued by the [Nuclear Regulatory] Commission.

Appendix A to 10 C.F.R. Part 50, Introduction (emphasis added). Although the Commission allows flexibility in developing methods for compliance with the general requirements of the General Design Criteria, the fundamental principles of the GDC must be adhered to in choosing those methods.[22] Thus, for example, in *Nader v. Ray*, the Court of Appeals held that a set of detailed standards for prevention of a loss of coolant accident was consistent with the broad requirement of GDC 35 for a "system to provide abundant emergency core cooling." 513 F.2d at 1051-53.

B. The Licensing Board's Interpretation of the Plain Language of GDC 62 Violates Fundamental Principles of Statutory and Regulatory Interpretation.

1. The plain language of GDC 62 requires the use of physical systems or processes to prevent criticality.

GDC 62 instructs that: "Criticality in the fuel storage and handling system shall be prevented by physical systems or processes, preferably by the use of geometrically safe

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00-26, slip op. at 42. Accordingly, they are discussed in the *amicus* brief filed in support of CCAM/CAM by the Board of Commissioners of Orange County.

22 The General Design Criteria constitute basic guidance for the more detailed NRC safety regulations. They are "intended to provide engineering goals rather than precise tests or methodologies by which reactor safety [can] be fully and satisfactorily gauged." *Petition for Emergency and Remedial Action*, CLI-78-6, 7 NRC 400, 406 (1978), *quoting Nader v. Nuclear Regulatory Commission*, 513 F.2d 1045 (D.C. Cir. 1975). As the Commission noted in that case, there are a "variety of methods for demonstrating compliance with GDC," including regulatory guides, standard format and content guides for license applications, the Standard Review Plan, and Branch Technical Positions. *Id.*

configurations." The language of GDC 62 is quite clear: criticality control measures must be carried out by physical systems or processes. The phrase "preferably by means of a geometrically safe configuration" identifies the physical system or process that is preferred by the Commission for implementing the requirement.

As demonstrated in CCAM/CAM's Summary, the plain language of GDC 62, standing alone, clearly dictates that NNECO must rely solely on physical measures to avoid criticality. Because NNECO intends to rely in part on ongoing administrative controls, *i.e.*, control of burnup and decay time, its license amendment application must be rejected based on the plain language of GDC 62.

In LBP-00-26, the Licensing Board rejected CCAM/CAM's interpretation of GDC 62. In interpreting the language of GDC 62, the Licensing Board relied heavily on a dictionary definition of the word "process" in order to conclude that administrative controls "are inherently comprehended within the phrase 'physical systems and processes.'"[23] As explained by the Board:

> [A]s defined by the Merriam Webster Third New International Dictionary, the term 'process,' used as a noun, means 'an artificial or voluntary progressively continuing operation that consists of controlled actions or movements systematically directed toward a particular result or end – with the end in this case being adequate criticality control, as set forth in GDC 62. [footnote omitted] It follows that there is no basis in law or language for differentiating between one type of administrative control and another.

LBP-00-26, slip op. at 43.

The Board's decision is based on three fundamental errors: it violates basic principles of statutory construction by depriving words of their meaning; it relies on the arbitrary

[23] LBP-00-26, slip op. At 43. The Board also recognized that the Commission has not explicitly adopted this interpretation of GDC 62, and that the only Appeal Board decision interpreting GDC 62, Consumers Power Co. (Big Rock Point Nuclear Plant), ALAB-725, 17 NRC 562, 567-571 (1983), is "not directly on point." LBP-00-26 at 43-44, citing CCAM/CAM Summary at 56. The Board also correctly noted that NRC Staff guidance documents have no binding or precedential effect. Id. At 44.

and inappropriate selection of one dictionary definition of the word "processes;" and it fails to recognize the obvious distinction between measures that are fundamentally "physical" and those that are fundamentally procedural or administrative.

a. LBP-00-26 ignores basic principles of statutory and Regulatory interpretation.

By holding that administrative controls are inherently comprehended within the phrase "physical systems or processes," the Board deprives the word "physical" of any meaning. Under the Board's interpretation of GDC 62, the phrase "physical systems and processes" encompasses the universe of criticality prevention measures that have been identified as available to the nuclear industry, including essentially physical measures such as rack spacing and panels impregnated with boron; as well as administrative measures such as burnup control and the addition of boron to spent fuel pool water. The Board leaves unanswered the question: what did the Commission intend to exclude by prescribing the use of "physical" systems or processes? There is nothing left to exclude. Under the Board's interpretation, the exception has swallowed the rule.

The Board's interpretation violates basic principles of statutory and regulatory construction. Applying the well-established principle of *inclusio unis est exclusio alterius* (the inclusion of one is the exclusion of another)[24], the Commission's specific use of the word "physical" to describe acceptable systems and processes must be found to exclude systems and processes that are not essentially "physical" in nature. In LBP-00-26, the Licensing Board does not even attempt to identify any non-physical criticality prevention measures that would be excluded by GDC 62. To the contrary, GDC 62 is

[24] *See* Singer, *Statutes and Statutory Construction*, Vol. 2A, § 47:23 (2000 Revision).

interpreted to embrace *any* criticality control measure that is currently available.[25] Thus, the Board effectively rewrites the standard to a more general and permissive standard: "Criticality must be prevented." Of course, such a revision is impermissible. By itself, this constitutes sufficient grounds to reverse the Licensing Board.

b. The Board arbitrarily relies on an inappropriate dictionary definition of the word "process."

The Board further compounds its error by arbitrarily selecting a dictionary definition of the word "process" ("an artificial or voluntary progressively continuing operation that consists of controlled actions or movements systematically directed toward a particular result or end") that happens to fit the Board's extremely broad interpretation of GDC 62, and then pointing to it as justification for the interpretation. LBP-00-26, slip op. at 43. As demonstrated in footnote 92 of the Board's decision (at page 43), the MerriamWebster Third New International Dictionary imbues the word "process" with at least ten different meanings, including a definition that is consistent with a more limited interpretation of GDC 62, *i.e.*, "a particular method or system of doing something, producing something, or accomplishing a specific result." (Definition 1(e)). Under this definition, the installation of low-density racks or neutron-absorbing panels in a rack would constitute "processes," but the word would not necessarily encompass ongoing administrative measures. The Board does not explain why it is appropriate to choose a definition of "process" which is so broad as to negate the effect of the word "physical," when another definition of the word "process" would be in harmony with the entirety of GDC 62.

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[25] As noted in LBP-00-26, the Licensee asserts that there are only four methodologies for criticality control in spent fuel 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 (enrichment, burnup, and decay). *Id.*, slip op. at 38.

Indeed, the Board does not explain why it settled upon the Merriam Webster Third New International Dictionary at all as the authoritative source for its interpretation of the meaning of the word "process."[26] Webster's New International Dictionary (Second Edition), for example, provides this definition, *inter alia*, of the word "process":

> 4b. A series of actions, motions, or operations **definitely conducing to an end**, whether voluntary or involuntary; progressive act or transaction; **continuous operation or treatment**; a method of operation or treatment, esp. in manufacture; as, the process of vegetation or decomposition; a chemical process; a process of reasoning; a process of making steel. [Emphasis added.]

Under this definition, the installation of low-density racks or neutron-absorbing panels in a rack would constitute a process "definitely conducing to an end." They would remain in "continuous operation or treatment." The use of ongoing administrative measures would be surplusage.

The Board's decision is heavily influenced by its interpretation of the word "process," while its selection of an authoritative source defining the term appears to have been a product of arbitrary selection.

c. The Board ignores the fact that physical systems and processes are distinct in nature from ongoing administrative controls

In LBP-00-26, the Licensing Board found that "there is no basis in law or language for differentiating between one type of administrative control and another." *Id.*, slip op. at 43. However, GDC 62 does not call for a distinction between "one kind of administrative control and another," but between "physical systems and processes" and other non-physical systems and processes. As demonstrated in CCAM/CAM's Summary, there is a

[26] Indeed, one member of the Licensing Board panel remarked during oral argument, when referring to Webster's Third New International Dictionary definition of "process," "I don't necessarily endorse that dictionary. I prefer the second edition . . . " (Transcript of Oral Argument, July 19, 2000, page 521)

basic difference between the nature of physical systems and processes, on the one hand, and administrative controls, on the other hand. While it is also true that any physical measure has some administrative component, and any administrative measure has a physical component, the slight overlap does not negate the fundamental distinction between physical and administrative measures for criticality prevention.[27] For example, if a subcritical margin of reactivity is to be maintained in a fuel pool solely by use of a geometrically safe configuration, then administrative controls will be needed to ensure that the fuel racks provide the required configuration. That configuration must be maintained during normal operation and after specified insults, such as an earthquake or the drop of an object onto a rack. The necessary administrative controls may be stringent, but they will be applied on a one-time basis. After the fuel racks are designed, fabricated and installed, ongoing administrative controls will not be required.

Similarly, if a subcritical margin of reactivity is to be maintained in a pool partly by exploiting the neutron-absorbing properties of the fuel racks, then one-time administrative controls will be needed to ensure that those properties are provided. For example, if Boral panels are attached to the racks, then one-time administrative controls will be needed to ensure that the Boral panels are properly designed, fabricated and installed. Periodic inspections may be needed to ensure that the Boral panels or other neutron-absorbing materials retain their needed properties, but these inspections will be comparatively straightforward.

[27] Although not addressed by the Board, a potentially useful definition of "physical" appears in Webster's New International Dictionary (Second Edition) as follows: "Of or pertaining to physics; characterized or produced by the forces and operations of physics." "Physics" is further defined as "the physical composition and properties of a substance; as, the physics of soils; physical processes and phenomena, collectively, as of an organism."

By contrast, prevention of criticality by ongoing administrative controls will require continuing actions by human beings to carry out these measures, such as inputting information into a computer system, and operating and maintaining equipment. These measures must be carried out throughout the period when criticality is possible. For example, if the presence of soluble boron is to be exploited as a means of criticality suppression in a fuel pool, then administrative controls must ensure that the concentration of soluble boron in the pool water never falls below a specified level. These administrative controls must be implemented on a continuous, ongoing basis, with complete reliability. The controls must apply to an entire pool, and to canals or other pools that are interconnected with that pool.

Similarly, if restrictions on fuel burnup or decay time are to be exploited as means of criticality suppression in a rack in a fuel pool, then ongoing administrative controls must ensure that a fuel assembly is never placed in the rack unless its burnup or decay time is within a specified range. Ongoing administrative controls on fuel burnup or decay time can be specified for an entire pool, for a particular rack, or for particular spaces within a rack. At a number of nuclear plants, a "checkerboard" pattern of fuel placement has been specified, wherein particular spaces in the repeating checkerboard pattern have particular restrictions on fuel burnup/enrichment. These administrative controls must be effective on each occasion when a fuel assembly could be placed in the pool.

Ongoing administrative controls are inherently less reliable than physical systems and processes, because they involve the repetition of tasks numerous times, thus providing

multiple and cumulative opportunities for error. They must also be implemented by human beings, and thus are prey to human error.[28]

Thus, while physical systems and processes entail some administrative controls, these are one-time controls that generally are completed before the system or process is put to use. By contrast, the use of restrictions on fuel burnup or decay time, or reliance on the presence of soluble boron, as means of criticality suppression will require ongoing administrative controls. This requirement can never be relaxed, and the controls must be implemented on a completely reliable basis. Over time, ongoing administrative controls of this kind will have a much higher cumulative probability of failure than one-time controls.

IV. RESPONSE TO COMMISSION'S QUESTION

In CLI-01-03, the Commission directed all parties to address the question "whether GDC 62 permits a licensee to take credit in criticality calculations for fuel enrichment, burn-up, and decay time limits." CCAM/CAM submits that these measures constitute administrative or procedural controls that are not permitted under GDC 62.

The permissibility of taking credit for burnup and enrichment must be viewed together, because burnup limits are expressed as a combination of burnup and initial enrichment. In order to take credit for burnup, it is necessary to (a) calculate burnup levels in individual fuel assemblies, (b) keep track of burnup levels in the spent fuel kept onsite,

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[28] A related factor noted by the NRC Staff in an Information Notice is the potential unfamiliarity of fuel handling personnel with procedures:

> "Refueling activities are safety-significant operations that are not conducted on a routine basis. In addition, fuel handling activities are often performed by contractor personnel under the supervision of licensee personnel. As a result, fuel handling personnel may not be familiar with the fuel handling equipment or may feel that their experience in fuel handling operations permits them to ignore some requirements for procedural use and adherence."

Information Notice 94-13 (February 22, 1994) A copy of this Information Notice is attached to the Summary in Appendix A.

and (c) ensure that placement of the spent fuel in the pools is carried out in such a way that burn-up levels of fuel assemblies are at levels high enough to prevent criticality. All of these measures require ongoing human action to prevent criticality. Thus, the "systems or processes" involved in taking credit for burnup/enrichment are fundamentally procedural or administrative in nature, rather than physical.

The same is true for the process of taking credit for decay time. For each fuel assembly, accurate records must be kept. Fuel placement in the pools must be arranged to ensure that no assembly is placed in a location for which its decay time would be inappropriate. These actions are fundamentally procedural in nature.

GDC 62 precludes reliance on such fundamentally procedural criticality prevention measures. It requires the use of physical systems and processes, such that fuel of any enrichment, burn-up, or decay level could be stored safely in the pools. Criticality must be preventable by physical means, without placing heavy reliance on ongoing human intervention.

V. CONCLUSION

As this brief has demonstrated, the NRC Staff has, over time, without addressing the legality of its conduct, approved applications to increase spent fuel density with the substitution of ongoing administrative controls for the physical systems or processes mandated by GDC 62. GDC 62 has never by its terms been modified, qualified or abridged. GDC 62 has thereby been rendered utterly devoid of meaning. No standards or criteria have been established to define the meaning of "physical systems or processes" permitted by GDC 62 and, as the present application demonstrates, the NRC has simply in their absence permitted substitution of administrative controls. The complexity of the

new administrative controls poses new challenges to those required to carry them out, creating new and impermissible opportunities for mistakes which may be of the utmost consequence.

CCAM/CAM therefore request that the Commissioners sustain their Petition for Review and reverse the Licensing Board's dismissal of Contention 6.

THE INTERVENORS
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AGAINST MILLSTONE
LONG ISLAND COALITION
AGAINST MILLSTONE

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UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION
BEFORE THE COMISSION

In the Matter of:	:	Docket No. 50-423-LA-2
NORTHEAST NUCLEAR ENERGY COMPANY	: :	ASLBP No. 00-771-01-LA
(Millstone Nuclear Power Station, Unit No. 3; Facility Operating License NPF-49)	: : :	February 7, 2001

CERTIFICATE OF SERVICE

I hereby certify that copies of "CONNECTICUT COALITION AGAINST MILLSTONE AND LONG ISLAND COALITION AGAINST MILLSTONE BRIEF ON REVIEW OF LBP-00-26" in the above-captioned proceeding have been served on the following by E-Mail as indicated by asterisk on February 7, 2001 and to all by conforming copy via U.S. Mail, postage pre-paid, on February 8, 2001:

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