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Anthony Vitale
Site Vice President

NL-17-144

December 11, 2017

U.S. Nuclear Regulatory Commission
ATTN: Document Control Desk
Washington, DC 20555-0001

Subject: **Indian Point Nuclear Generating Unit No. 2**
Proposed License Amendment Regarding Spent Fuel Storage
Docket No. 50-247
License No. DPR-26

Dear Sir or Madam:

Pursuant to 10 CFR 50.90, Entergy Nuclear Operations, Inc. (Entergy) hereby requests an amendment to the Technical Specifications (TS) for Indian Point Unit No. 2 (IP2). This request proposes to:

- Revise TS LCO 3.7.13 Spent Fuel Pit Storage
- Revise TS Design Features 4.3 Fuel Storage

The proposed changes resolve a non-conservative TS associated with LCO 3.7.13, negate the need for the associated compensatory measures, and take no credit for the installed Boraflex panels.

Entergy has evaluated the proposed changes in accordance with 10 CFR 50.91(a)(1) using the criteria of 10 CFR 50.92(c) and has determined that these proposed changes involve no significant hazards considerations (NSHC). The NSHC determination and the supporting technical evaluation are provided in Attachment 1. The proposed IP2 TS and TS Bases are provided in Attachments 2 and 3, respectively. The TS Bases markups are provided for information only. The proposed changes are based on Curtiss-Wright Nuclear Division, NETCO Report NET-28091-003-01 Revision 0. Proprietary and non-proprietary versions of this report are included in Enclosures 1 and 2, respectively. NEI 12-16 provides guidance for performing fuel storage criticality analyses and a compliance checklist. Entergy has completed this checklist and it is provided in Enclosure 3.

Enclosure 1 contains information that Westinghouse and Holtec consider to be proprietary and, therefore, exempt from public disclosure pursuant to 10 CFR 2.390. In accordance with 10 CFR 2.390, and in support of this request for withholding, affidavits executed by the respective parties are provided in Enclosure 4.

In accordance with 10 CFR 50.91, a copy of this application, with attachments and enclosures is being provided to the designated New York State official.

A001
NRR

Due to the significant amount of spent fuel casking activities and the reconfiguration of the spent fuel assemblies to support the license amendment, we request a license amendment issue date of September 15, 2019. Entergy requests that the proposed license amendment be effective immediately upon issuance, with implementation in 90 days.

There are no new regulatory commitments being made in this submittal. If you have any questions or require additional information, please contact Mr. Robert Walpole, Licensing Manager at 914-734-6710.

I declare under penalty of perjury that the foregoing is true and correct to the best of my knowledge. Executed on 12-11-17.

Sincerely,

AV/mm

Attachments and Enclosures:

Attachments:
1. Analysis of proposed technical specification changes
2. Proposed IP2 technical specification changes (marked-up)
3. IP2 technical specification bases changes (marked-up) (for information only)

Enclosures:
1. Curtiss-Wright Nuclear Division, NETCO report NET-28091-003-01, Revision 0 (proprietary)
2. Curtiss-Wright Nuclear Division, NETCO report NET-28091-003-01, Revision 0 (non-proprietary)
3. NEI 12-16 draft revision 2c checklist
4. Affidavits in support of request to withhold information

cc:

Mr. David lew, Acting Regional Administrator, NRC Region 1
Mr. Richard V. Guzman, Senior Project Manager, NRR/DORL, NRC
Ms. Alicia Burton, President and CEO, NYSERDA (w/o proprietary information)
Ms. Bridget Frymire, New York State Dept. of Public Service (w/o proprietary information)
NRC Resident Inspector's Office

ENCLOSURE 4 TO NL-17-144

Affidavits in Support of Request to Withhold Information

Entergy Nuclear Operations, Inc.
Indian Point Unit 2
Docket No. 50-247

HOLTEC
INTERNATIONAL

Krishna P. Singh Technology Campus, 1 Holtec Blvd., Camden, NJ 08104
Telephone (856) 797-0900
Fax (856) 797-0909

October 3, 2017

Mr. Giancarlo Delfini
Reactor Engineering Supervisor
Indian Point Energy Center
450 Broadway
GSB Fourth Floor Reactor Engineering
Buchanan, NY 10511-0249

Document ID: 1775062

Subject: Affidavit Related to "Criticality Safety Analysis for the Indian Point Unit 2 Spent Fuel Pool with No Absorber Panel Credit"

Dear Mr. Delfini:

Holtec hereby authorizes the release of Holtec proprietary information in Attachment 1 of this letter to the United States Nuclear Regulatory Commission (USNRC). Attachment 1 contains only pages of the identified criticality safety analysis report with Holtec proprietary information. Holtec proprietary information in the tables in Attachment 1 are shaded for identification purposes.

Attachment 1 – NET-28091-0003-01, Rev. 0 "Criticality Safety Analysis for the Indian Point Unit 2 Spent Fuel Pool with No Absorber Panel Credit" (Proprietary)

Attachment 2 – Affidavit Pursuant to 10 CFR 2.390

We require that you include this letter along with the affidavit in Attachment 2 when submitting Attachment 1 to the USNRC.

If you have any questions, please contact me at (856)-797-0900, Ext. 3844.

Sincerely,

Royston Ngwayah
Licensing Engineer
Holtec International

AFFIDAVIT PURSUANT TO 10 CFR 2.390

I, Kimberly Manzione, being duly sworn, depose and state as follows:

(1) I have reviewed the information described in paragraph (2) which is sought to be withheld, and am authorized to apply for its withholding.

(2) The information sought to be withheld is information provided in Attachment 1 of Holtec Letter 1775062. This document contains Holtec Proprietary information.

(3) In making this application for withholding of proprietary information of which it is the owner, Holtec International relies upon the exemption from disclosure set forth in the Freedom of Information Act ("FOIA"), 5 USC Sec. 552(b)(4) and the Trade Secrets Act, 18 USC Sec. 1905, and NRC regulations 10CFR Part 9.17(a)(4), 2.390(a)(4), and 2.390(b)(1) for "trade secrets and commercial or financial information obtained from a person and privileged or confidential" (Exemption 4). The material for which exemption from disclosure is here sought is all "confidential commercial information", and some portions also qualify under the narrower definition of "trade secret", within the meanings assigned to those terms for purposes of FOIA Exemption 4 in, respectively, Critical Mass Energy Project v. Nuclear Regulatory Commission, 975F2d871 (DC Cir. 1992), and Public Citizen Health Research Group v. FDA, 704F2d1280 (DC Cir. 1983).

(4) Some examples of categories of information which fit into the definition of proprietary information are:

a. Information that discloses a process, method, or apparatus, including supporting data and analyses, where prevention of its use by Holtec's competitors without license from Holtec International constitutes a competitive economic advantage over other companies;

b. Information which, if used by a competitor, would reduce his expenditure of resources or improve his competitive position in the design, manufacture, shipment, installation, assurance of quality, or licensing of a similar product.

c. Information which reveals cost or price information, production, capacities, budget levels, or commercial strategies of Holtec International, its customers, or its suppliers;

d. Information which reveals aspects of past, present, or future Holtec International customer-funded development plans and programs of potential commercial value to Holtec International;

e. Information which discloses patentable subject matter for which it may be desirable to obtain patent protection.

The information sought to be withheld is considered to be proprietary for the reasons set forth in paragraphs 4.a, 4.b and 4.e above.

(5) The information sought to be withheld is being submitted to the NRC in confidence. The information (including that compiled from many sources) is of a sort customarily held in confidence by Holtec International, and is in fact so held. The information sought to be withheld has, to the best of my knowledge and belief, consistently been held in confidence by Holtec International. No public disclosure has been made, and it is not available in public sources. All disclosures to third parties, including any required transmittals to the NRC, have been made, or must be made, pursuant to regulatory provisions or proprietary agreements which provide for

maintenance of the information in confidence. Its initial designation as proprietary information, and the subsequent steps taken to prevent its unauthorized disclosure, are as set forth in paragraphs (6) and (7) following.

(6) Initial approval of proprietary treatment of a document is made by the manager of the originating component, the person most likely to be acquainted with the value and sensitivity of the information in relation to industry knowledge. Access to such documents within Holtec International is limited on a "need to know" basis.

(7) The procedure for approval of external release of such a document typically requires review by the staff manager, project manager, principal scientist or other equivalent authority, by the manager of the cognizant marketing function (or his designee), and by the Legal Operation, for technical content, competitive effect, and determination of the accuracy of the proprietary designation. Disclosures outside Holtec International are limited to regulatory bodies, customers, and potential customers, and their agents, suppliers, and licensees, and others with a legitimate need for the information, and then only in accordance with appropriate regulatory provisions or proprietary agreements.

(8) The information classified as proprietary was developed and compiled by Holtec International at a significant cost to Holtec International. This information is classified as proprietary because it contains detailed descriptions of analytical approaches and methodologies not available elsewhere. This information would provide other parties, including competitors, with information from Holtec International's technical database and the results of evaluations performed by Holtec International. A substantial effort has been expended by Holtec International to develop this information. Release of this information would improve a competitor's position because it would enable Holtec's competitor to copy our technology and offer it for sale in competition with our company, causing us financial injury.

(9) Public disclosure of the information sought to be withheld is likely to cause substantial harm to Holtec International's competitive position and foreclose or reduce the availability of profit-making opportunities. The information is part of Holtec International's comprehensive spent fuel storage technology base, and its commercial value extends beyond the original development cost. The value of the technology base goes beyond the extensive physical database and analytical methodology, and includes development of the expertise to determine and apply the appropriate evaluation process.

The research, development, engineering, and analytical costs comprise a substantial investment of time and money by Holtec International.

The precise value of the expertise to devise an evaluation process and apply the correct analytical methodology is difficult to quantify, but it clearly is substantial.

Holtec International's competitive advantage will be lost if its competitors are able to use the results of the Holtec International experience to normalize or verify their own process or if they are able to claim an equivalent understanding by demonstrating that they can arrive at the same or similar conclusions.

The value of this information to Holtec International would be lost if the information were disclosed to the public. Making such information available to competitors without their having been required to undertake a similar expenditure of resources would unfairly provide competitors with a windfall, and deprive Holtec International of the opportunity to exercise its competitive advantage to seek an adequate return on its large investment in developing these very valuable analytical tools.

AFFIDAVIT PURSUANT TO 10 CFR 2.390

STATE OF NEW JERSEY)
) ss:
COUNTY OF CAMDEN)

Kimberly Manzione, being duly sworn, deposes and says:

That she has read the foregoing affidavit and the matters stated therein are true and correct to the best of her knowledge, information, and belief.

Executed at Camden, New Jersey, this 3rd day of October, 2017.

Kimberly Manzione
Licensing Manager
Holtec International

Subscribed and sworn before me this 3rd day of October, 2017.

Maria C. Massi

MARIA C. MASSI
NOTARY PUBLIC OF NEW JERSEY
My Commission Expires April 25, 2020

Westinghouse

Westinghouse Electric Company
1000 Westinghouse Drive
Cranberry Township, Pennsylvania 16066
USA

U.S. Nuclear Regulatory Commission
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CAW-17-4646

October 3, 2017

APPLICATION FOR WITHHOLDING PROPRIETARY INFORMATION FROM PUBLIC DISCLOSURE

Subject: NETCO Report NET-28091-0003-01, Revision 0, "Criticality Safety Analysis for the Indian Point Unit 2 Spent Fuel Pool with No Absorber Panel Credit"

The Application for Withholding Proprietary Information from Public Disclosure is submitted by Westinghouse Electric Company LLC ("Westinghouse"), pursuant to the provisions of paragraph (b)(1) of Section 2.390 of the Nuclear Regulatory Commission's ("Commission's") regulations. It contains commercial strategic information proprietary to Westinghouse and customarily held in confidence.

The proprietary information for which withholding is being requested in the above-referenced report is prepared by Curtiss-Wright Nuclear Division, NETCO, 44 Shelter Rock Rd., Danbury, CT 06810 on behalf of Entergy Nuclear Operations – Indian Point Energy Center under Contract No.10502876. It is further identified in Affidavit CAW-17-4646 signed by the owner of the proprietary information, Westinghouse. The Affidavit, which accompanies this letter, sets forth the basis on which the information may be withheld from public disclosure by the Commission and addresses with specificity the considerations listed in paragraph (b)(4) of 10 CFR Section 2.390 of the Commission's regulations.

Accordingly, this letter authorizes the utilization of the accompanying Affidavit by Entergy Nuclear Operations, Inc.

Correspondence with respect to the proprietary aspects of the Application for Withholding or the Westinghouse Affidavit should reference CAW-17-4646, and should be addressed to James A. Gresham, Manager, Regulatory Compliance, Westinghouse Electric Company, 1000 Westinghouse Drive, Building 3 Suite 310, Cranberry Township, Pennsylvania 16066.

James A. Gresham, Manager
Regulatory Compliance

AFFIDAVIT

COMMONWEALTH OF PENNSYLVANIA:

ss

COUNTY OF BUTLER:

I, James A. Gresham, am authorized to execute this Affidavit on behalf of Westinghouse Electric Company LLC ("Westinghouse") and declare that the averments of fact set forth in this Affidavit are true and correct to the best of my knowledge, information, and belief.

Executed on: 10/5/17

James A. Gresham, Manager
Regulatory Compliance

(1) I am Manager, Regulatory Compliance, Westinghouse Electric Company LLC ("Westinghouse"), and as such, I have been specifically delegated the function of reviewing the proprietary information sought to be withheld from public disclosure in connection with nuclear power plant licensing and rule making proceedings, and am authorized to apply for its withholding on behalf of Westinghouse.

(2) I am making this Affidavit in conformance with the provisions of 10 CFR Section 2.390 of the Nuclear Regulatory Commission's ("Commission's") regulations and in conjunction with the Westinghouse Application for Withholding Proprietary Information from Public Disclosure accompanying this Affidavit.

(3) I have personal knowledge of the criteria and procedures utilized by Westinghouse in designating information as a trade secret, privileged or as confidential commercial or financial information.

(4) Pursuant to the provisions of paragraph (b)(4) of Section 2.390 of the Commission's regulations, the following is furnished for consideration by the Commission in determining whether the information sought to be withheld from public disclosure should be withheld.

(i) The information sought to be withheld from public disclosure is owned and has been held in confidence by Westinghouse.

(ii) The information is of a type customarily held in confidence by Westinghouse and not customarily disclosed to the public. Westinghouse has a rational basis for determining the types of information customarily held in confidence by it and, in that connection, utilizes a system to determine when and whether to hold certain types of information in confidence. The application of that system and the substance of that system constitute Westinghouse policy and provide the rational basis required.

Under that system, information is held in confidence if it falls in one or more of several types, the release of which might result in the loss of an existing or potential competitive advantage, as follows:

(a) The information reveals the distinguishing aspects of a process (or component, structure, tool, method, etc.) where prevention of its use by any of

Westinghouse's competitors without license from Westinghouse constitutes a competitive economic advantage over other companies.

(b) It consists of supporting data, including test data, relative to a process (or component, structure, tool, method, etc.), the application of which data secures a competitive economic advantage (e.g., by optimization or improved marketability).

(c) Its use by a competitor would reduce his expenditure of resources or improve his competitive position in the design, manufacture, shipment, installation, assurance of quality, or licensing a similar product.

(d) It reveals cost or price information, production capacities, budget levels, or commercial strategies of Westinghouse, its customers or suppliers.

(e) It reveals aspects of past, present, or future Westinghouse or customer funded development plans and programs of potential commercial value to Westinghouse.

(f) It contains patentable ideas, for which patent protection may be desirable.

(iii) There are sound policy reasons behind the Westinghouse system which include the following:

(a) The use of such information by Westinghouse gives Westinghouse a competitive advantage over its competitors. It is, therefore, withheld from disclosure to protect the Westinghouse competitive position.

(b) It is information that is marketable in many ways. The extent to which such information is available to competitors diminishes the Westinghouse ability to sell products and services involving the use of the information.

(c) Use by our competitor would put Westinghouse at a competitive disadvantage by reducing his expenditure of resources at our expense.

(d) Each component of proprietary information pertinent to a particular competitive advantage is potentially as valuable as the total competitive advantage. If competitors acquire components of proprietary information, any one component may be the key to the entire puzzle, thereby depriving Westinghouse of a competitive advantage.

(e) Unrestricted disclosure would jeopardize the position of prominence of Westinghouse in the world market, and thereby give a market advantage to the competition of those countries.

(f) The Westinghouse capacity to invest corporate assets in research and development depends upon the success in obtaining and maintaining a competitive advantage.

(iv) The information is being transmitted to the Commission in confidence and, under the provisions of 10 CFR Section 2.390, is to be received in confidence by the Commission.

(v) The information sought to be protected is not available in public sources or available information has not been previously employed in the same original manner or method to the best of our knowledge and belief.

(vi) The proprietary information sought to be withheld in this submittal is that which is appropriately marked in NETCO Report NET-28091-0003-01, Revision 0, pages 14, 25, 26, 59, 155, 156, and 157 (Proprietary), for submittal to the Commission, being transmitted by Entergy Nuclear Operations, Inc. letter. The proprietary information as submitted by Westinghouse is that associated with the inter-unit transfer of spent nuclear fuel between Indian Point Units 2 and 3, and may be used only for that purpose.

(a) This information is part of that which will enable Westinghouse to:

(i) Assist customers in obtaining licensing changes.

(ii) Assist customers in analyzing the spent fuel pool and absorber panels to ensure criticality does not occur.

(b) Further, this information has substantial commercial value as follows:

(i) Westinghouse plans to sell the use of similar information to its customers for the purpose of assisting in obtaining licensing changes.

(ii) Westinghouse can sell support and defense of spent fuel pool criticality analyses.

(iii) The information requested to be withheld reveals the distinguishing aspects of a methodology which was developed by Westinghouse.

Public disclosure of this proprietary information is likely to cause substantial harm to the competitive position of Westinghouse because it would enhance the ability of competitors to provide similar technical evaluation justifications and licensing defense services for commercial power reactors without commensurate expenses. Also, public disclosure of the information would enable others to use the information to meet NRC requirements for licensing documentation without purchasing the right to use the information.

The development of the technology described in part by the information is the result of applying the results of many years of experience in an intensive Westinghouse effort and the expenditure of a considerable sum of money.

In order for competitors of Westinghouse to duplicate this information, similar technical programs would have to be performed and a significant manpower effort, having the requisite talent and experience, would have to be expended.

Further the deponent sayeth not.

PROPRIETARY INFORMATION NOTICE

Transmitted herewith are proprietary and non-proprietary versions of a document, furnished to the NRC associated with the inter-unit transfer of spent nuclear fuel between Indian Point Units 2 and 3, and may be used only for that purpose.

In order to conform to the requirements of 10 CFR 2.390 of the Commission's regulations concerning the protection of proprietary information so submitted to the NRC, the information which is proprietary in the proprietary versions is contained within brackets, and where the proprietary information has been deleted in the non-proprietary versions, only the brackets remain (the information that was contained within the brackets in the proprietary versions having been deleted). The justification for claiming the information so designated as proprietary is indicated in both versions by means of lower case letters (a) through (f) located as a superscript immediately following the brackets enclosing each item of information being identified as proprietary or in the margin opposite such information. These lower case letters refer to the types of information Westinghouse customarily holds in confidence identified in Sections (4)(ii)(a) through (4)(ii)(f) of the Affidavit accompanying this transmittal pursuant to 10 CFR 2.390(b)(1).

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ATTACHMENT 1 TO NL-17-144

ANALYSIS OF PROPOSED TECHNICAL SPECIFICATION CHANGES

Entergy Nuclear Operations, Inc.
Indian Point Unit 2
Docket No. 50-247

1.0 DESCRIPTION

Entergy Nuclear Operations, Inc. (Entergy) hereby requests an amendment to the Operating License No. DPR-26 for Indian Point Unit 2 (IP2). The proposed changes revise Technical Specification (TS) LCO 3.7.13 Spent Fuel Pit Storage and TS Design Features 4.3.

The Spent Fuel Pit (SFP) contains Boraflex panels which are currently credited as a neutron absorber in the criticality analysis of record. The proposed TS take no credit for the Boraflex panels and instead credit empty cells, Rod Cluster Control Assemblies (RCCAs), and neutron leakage along the outer two storage rows of the pool.

The proposed TS ensure that IP2 and Indian Point Unit No. 3 (IP3) fuel assemblies stored in the SFP will continue to meet the requirements of 10 CFR 50.68.

2.0 PROPOSED CHANGES

Marked-up TS pages showing the proposed changes are provided in Attachment 2. The changes are summarized below.

2.1 Technical Specification Changes

The following changes are proposed to the IP2 TS:

LCO 3.7.13

Replace:

> IP2 fuel assemblies stored in the Spent Fuel Pit shall be classified in accordance with Figure 3.7.13-1, Figure 3.7.13-2, Figure 3.7.13-3, and Figure 3.7.13-4, based on initial enrichment, burnup, cooling time and number of Integral Fuel Burnable Absorbers (IFBA) rods; and,
>
> Fuel assembly storage location within the Spent Fuel Pit shall be restricted to Regions identified in Figure 3.7.13-5 as follows:
>
> Fuel assemblies that satisfy requirements of Figure 3.7.13-1 may be stored in any location in Region 2-1, Region 2-2, Region 1-2 or Region 1-1;
>
> Fuel assemblies that satisfy requirements of Figure 3.7.13-2 may be stored in any location in Region 2-2, Region 1-2 or Region 1-1;
>
> Fuel assemblies that satisfy requirements of Figure 3.7.13-3 may be stored in any location in Region 1-2, Region 1-1, or in locations designated as “peripheral” cells in Region 2-2; and
>
> Fuel assemblies that satisfy requirements of Figure 3.7.13-4 may be stored:

In any location in Region 1-2, or

In a checkerboard loading configuration (1 out of every two cells with every other cell vacant) in Region 1-1; or

In locations designated as "peripheral" cells in Region 2-2.

IP3 fuel assemblies shall be stored in Region 1-2 of the Spent Fuel Pit. Only assemblies with initial enrichment ≥ 3.2 and ≤ 4.4 w/o U^{235} and discharged prior to IP3 Cycle 12 shall be stored in the Spent Fuel Pit.

By:

IP2 fuel assemblies stored in the Spent Fuel Pit shall be categorized in accordance with Table 3.7.13-1 or, if pre-categorized, Table 3.7.13-2.

IP3 fuel assemblies stored in the Spent Fuel Pit shall be categorized in accordance with Table 3.7.13-1 or, if pre-categorized, Table 3.7.13-3.

IP2 and IP3 fuel assembly storage locations within the Spent Fuel Pit shall be restricted to locations allowed by Figure 3.7.13-1 and its associated notes.

---Note---
Regarding Category 5 fuel assemblies that are required by Figure 3.7.13-1 to contain a full length RCCA - The RCCA must not be placed in or removed while the assembly is in an RCCA required location unless all 8 adjacent cells are empty.

<u>Surveillance Requirement 3.7.13.1</u>

Replace:

Verify by administrative means that the IP2 fuel assembly has been classified in accordance with Figure 3.7.13-1, Figure 3.7.13-2, Figure 3.7.13-3, or Figure 3.7.13-4 and meets the requirements for the intended storage location.

<u>OR</u>

Verify by administrative means that the IP3 fuel assembly meets the requirements for the intended storage location.

By:

Verify by administrative means that the IP2 fuel assembly has been categorized in accordance with Table 3.7.13-1 or, if pre-categorized, Table 3.7.13-2 and meets the requirements for the intended storage location.

OR

Verify by administrative means that the IP3 fuel assembly has been categorized in accordance with Table 3.7.13-1 or, if pre-categorized, Table 3.7.13-3 and meets the requirements for the intended storage location.

Figures 3.7.13-1 through Figure 3.7.13-5

Replace:

Figures 3.7.13-1 through Figure 3.7.13-5

By:

Figures 3.7.13-1 and 3.7.13-2 and Tables 3.7.13-1 through Table 3.7.13-3 as shown in Attachment 2

4.3.1 Criticality 4.3.1.1 a.

Replace:

Fuel assemblies having a maximum U-235 enrichment of 5.0 weight percent,

By:

Fuel assemblies having a maximum U-235 enrichment of 5.0 weight percent, and poisons, if necessary, to meet the limit for k_{eff},

4.3.1 Criticality 4.3.1.1 c.

Replace:

Each fuel assembly classified based on initial enrichment, burnup, cooling time, and number of Integral Fuel Burnable Absorbers (IFBA) rods with individual fuel assembly storage location within the spent fuel storage rack restricted as required by Technical Specification 3.7.13.

By:

Each fuel assembly categorized based on initial enrichment, burnup, cooling time, averaged assembly peaking factor, and number of Integral Fuel Burnable Absorbers (IFBA) rods with individual fuel assembly storage location within the spent fuel storage rack restricted as required by Technical Specification 3.7.13.

The Bases for TS 3.7.12 and TS 3.7.13 are also being changed (Attachment 3). The TS Bases markups are provided for information only. Changes to the TS Bases are controlled in accordance with the TS Bases Control Program.

2.2 Need for Proposed Changes

The current TS are based on the SFP criticality safety analysis (CSA) of record (AOR) [Ref .1]. The criticality safety analysis of record (CAOR) analysis takes credit for the neutron absorber material Boraflex installed in each SFP storage rack location. In response to a non-conservative TS and observed Boraflex degradation in the IP2 SFP racks, Entergy has undertaken various corrective actions including; declaring TS LCO 3.7.13 non-conservative in Region 2-2, implementing compensatory measures, performing a CSA with credit for neutron absorber panels [Ref. 2], and performing this proposed CSA with no credit for neutron absorber panels (Enclosure 1). The proposed changes to the TS are based on the proposed CSA and would resolve both the non-conservative TS and the Boraflex degradation issue.

3.0 BACKGROUND

In 1990, SFP storage capacity was increased from 980 fuel assemblies to 1374 fuel assemblies by the installation of high-density racks that reduced the distance between adjacent fuel assemblies. In order to maintain $k_{95/95}$ of the SFP within the limits of 10 CFR 50.68(b) the following were required:

1) installation of Boraflex absorber panels between spent fuel rack cells; and,

2) restrictions placed on fuel assembly storage location within the SFP based on initial enrichment and burnup.

In 2001, Entergy submitted a license amendment request supported by the CAOR [Ref. 1] to address the observance of unexpected Boraflex thinning and gaps. The CAOR took varying amounts of credit for Boraflex for reactivity hold-down and a Boraflex monitoring program was initiated to ensure that the amounts of Boraflex credit taken in the CAOR remain valid.

The CAOR paralleled analyses performed by the industry at that time in accordance with an NRC approved methodology. This analysis formed the basis for TS amendment 227 [Ref. 3], issued in 2002, and is the basis for the IP2 fuel portion of LCO 3.7.13 SFP. This analysis demonstrated compliance with 10 CFR 50.68 and TS 4.3.1.1.

In 2009, Indian Point submitted a license amendment request [Ref. 4] to allow the transfer of spent fuel from IP3 to IP2. The NRC approved the license amendment request in 2012 [Ref. 5]. During review of the license amendment request the NRC concluded that IP3 fuel could only be stored in Region 1-2 of the IP2 SFP. This restriction is reflected in LCO 3.7.13 SFP. The NRC also noted that LCO 3.7.13 was non-conservative. The NRC found that the methodology used in the CAOR could not be used to support a current license amendment request and that IN 2011-03 [Ref. 6] had not been addressed. In response, Entergy evaluated the CAOR and determined that LCO 3.7.13 was non-conservative in SFP Region 2-2 and implemented the necessary compensatory measures to ensure continued compliance with 10 CFR 50.68.

Continued compliance of 10 CFR 50.68 is also dependent on the results of the Boraflex monitoring program. This program determined that the Boraflex in the SFP degrades with time. This determination is consistent with the NRC documented observance of Boraflex degradation [Refs. 7 and 8]

In order to address the non-conservative TS and Boraflex degradation, Entergy submitted a CSA in 2015 that credited yet to be installed metal-matrix-composite neutron absorber inserts [Ref. 2]. The intent was to install these inserts concurrent with NRC review and approval of a planned future license amendment request that would have credited the CSA. During review, the NRC requested additional information in June 2015 [Ref. 9] and Entergy issued a response in August 2015 [Ref. 10]. In November 2015, the NRC issued a staff review of the CSA, concluding that "The NRC staff finds that the CSA methodology is acceptable for use at IP2" [Ref. 11]. However, due to the prolonged schedule for the installation of the inserts, Entergy determined that a new approach, that did not credit inserts, was needed.

The new approach, as documented in the proposed CSA (Enclosure 1), does not credit inserts, but instead credits empty cells, RCCAs, and neutron leakage along the outer two storage rows of the pool for criticality control. This new approach for the resolution of the non-conservative TS and Boraflex degradation was the subject of an NRC pre-application public meeting held on July 26, 2017 [Ref. 12]. As noted at the public meeting, this approach is based on the previously submitted CSA methodology [Ref. 2] which was accepted by the NRC, with several improvements including a depletion analysis with peaking factor and axial blanket credit, validation updates regarding RCCAs and temperature dependence, the inclusion of grid growth and creep biases, eccentric placement bias, and full pool calculations.

The proposed CSA (Enclosure 1) is not compatible with the number of empty cells currently in the SFP. Compatibility will be achieved by transferring the necessary number of fuel assemblies to dry cask storage prior to implementation of the proposed TS (Attachment 2).

The proposed CSA addresses storage of both IP2 and IP3 fuel assemblies in the IP2 SFP. Transfer and storage of spent IP3 fuel in the IP2 SFP was approved by the NRC [Ref. 5] via Amendments 268 and 246 for IP2 and IP3, respectively. In this submittal, there are no proposed changes to the IP3 Technical Specifications nor the IP2 and IP3 Appendix C Technical Specifications that control the inter-unit transfer of fuel.

The proposed CSA follows the guidance of DSS-ISG-2010-1, "Staff Guidance Regarding the Nuclear Criticality Safety Analysis for Spent Fuel Pools" [Ref. 13] and NEI 12-16, Rev. 2 draft c, "Guidance for Performing Criticality Analyses of Fuel Storage at Light-Water Reactor Power Plants", August 2017 [Ref. 14]. Compliance checklists are provided in Enclosure 3 (NEI 12-16) and Section 10.1 of Enclosure 1 (DSS-ISG-2010-01). These checklists demonstrate that the guidance provided in these documents has been followed in the proposed CSA.

4.0 **TECHNICAL ANALYSIS**

4.1 Introduction

The proposed CSA (Enclosure 1) provides full details of the technical analysis that supports this license amendment request. In this section, all references to the CSA are references to Enclosure 1 unless otherwise stated. Likewise, all references to the TS are references to the proposed TS in Attachment 2, unless otherwise stated.

NEI 12-16 [Ref. 14] provides guidance for performing fuel storage criticality analyses and Entergy has used this guidance to ensure that the proper considerations are made in the CSA and that all appropriate controls are implemented. The following provides a summary of NEI 12-16 considerations applicable to this amendment request.

4.2 Acceptance Criteria

NEI 12-16, Section 2.1 summarizes the 10 CFR 50.68 acceptance criteria for criticality analyses.

Section 1.3 of the CSA reflects the requirements of 10CFR50.68(b)(4) which states in part:

> *"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), at a 95 percent probability, 95 percent confidence level, if flooded with unborated water."*

The CSA takes credit for soluble boron. In addition to meeting the above criteria, an engineering safety margin is provided in the CSA to cover unanticipated issues. The engineering safety margin used is 1%, so that the $k_{95/95}$ target value is 0.99 for no soluble boron and 0.94 with soluble boron.

Unless otherwise specified, all of the k_{eff} values reported below are raw calculated k_{eff} values with no adjustment for bias and uncertainty. The final values to be compared to the criticality criteria are the calculated values plus the total bias and uncertainty (notated as "$k_{95/95}$").

4.3 Computer Codes

NEI 12-16, Sections 3.1 and 3.2 describe the types and uses of depletion and criticality computer codes, and their validation that may be used in criticality analyses.

Section 2.1 of the CSA identifies the computer codes used in the analysis. The CSA uses the t5-depl TRITON module of SCALE 6.1.2 for the depletion analysis and the CSAS5 module for the criticality analysis. All of the analyses are performed using the 238 group ENDF/B-VII.0 library.

The validation of the SCALE 6.1.2, TRITON (t5-depl) and CSAS5 models is discussed in Section 4, and Appendix A of the CSA.

4.4 Reactivity Effects of Depletion

NEI 12-16, Section 4.2 describes considerations for calculating reactivity effects of fuel depletion. The significant parameters identified in NEI 12-16 which could affect the reactivity of discharged fuel are considered in the identified Sections of the CSA as follows:

Depletion Analysis

The depletion analysis treats historic fuel and current and future fuel differently. Historic fuel is defined as fuel assemblies with identifications (IDs) A through X for IP2 and A through AA for IP3. Current and future fuel is defined as fuel assemblies with IDs after X for IP2 and after AA for IP3. As the fuel designs and operating condition of historic fuel are known, the historic fuel can be pre-categorized. This pre-categorization is included in TS Tables 3.7.13-2 and 3.7.13-3.

a. Power, moderator temperature and fuel temperature during depletion

   Section 5.1 of the CSA determines the highest average moderator and fuel temperatures during depletion to maximize fuel assembly reactivity after depletion. As a result of radial power peaking, some assemblies are burned at a higher relative power than the core average; thus, the moderator and fuel temperatures are higher. The CSA uses the averaged assembly radial peaking factor in the determination of the highest average moderator and fuel temperatures.

b. Soluble boron during depletion

   Section 5.3 of the CSA describes the reactivity dependence on soluble boron during depletion. Soluble boron hardens the neutron spectrum, making the fuel more reactive for a given burnup. The depletion calculations are performed at the burnup averaged soluble boron concentration. Tables 3.5 and 3.6 of the CSA show the cycle average soluble boron concentration for each cycle. Since nearly every assembly is burned at least two cycles, the soluble boron to use for the depletion analysis is the multi-cycle burnup averaged soluble boron for each assembly.

c. Presence of burnable absorbers

   Section 5.2 of the CSA determines the maximum absorber burnup for the various combinations of absorbers used at IP2 and IP3 (Pyrex, Wet Annular Burnable Absorbers, and IFBA) which harden the neutron spectrum and maximize the reactivity of burned fuel.

d. Rodded operation

   Section 5.5 of the CSA evaluates the reactivity impact of control rods inserted during power operation. The reference depletion analyses for historic fuel are modeled with no control rods inserted. Control bank D is the only control bank

that may be inserted above 70% of rated power. All historic assemblies under D-Bank were identified and the burnup requirement for storage was increased by an appropriate burnup penalty, if necessary. For current and future fuel it is not known which assemblies will be under D-bank. To cover power operation with some control rods inserted, the top node for D-bank assemblies is depleted for 1 GWd/T with a control rod and lower nodes are depleted for 2 GWd/T with a control rod. This approach eliminates the need to check future assemblies for rodded operation under D-bank.

e. Cooling time

Section 5.9 of the CSA determines the isotopic inventory with cooling time. Cooling time credit is limited to 25 years. This restriction is included in the notes to TS Table 3.7.13-1.

f. Operation at reduced power at end of core life

Section 5.8 of the CSA determines the reactivity effect of operation at reduced power at the end of core life. To account for this effect, the amount of Pm-149 is reduced which results in a reactivity penalty of about 100 pcm in all criticality calculations. This covers coast downs to 50% power and covers all past operating experience and anticipated future operation at IP2 and IP3.

g. Early shutdown

If a cycle is shut down very early, it is possible that the limiting soluble boron used in the depletion analysis (950 ppm) would not be met. The cycle would have to be shut down extremely early since the 950 ppm would be violated only if the cycle were shut down more than two months early. To cover this unlikely possibility, a special depletion was done at a soluble boron concentration of 1200 ppm throughout the depletion (this value exceeds the highest cycle average ppm at any burnup). If the burnup averaged ppm for any assembly exceeds 950 ppm, burnup penalties of 0.2, 0.3, 0.6, and 0.9 GWd/T would have to be applied to the burnup requirement for Category 2, 3, 4, and 5, respectively. These adjustments are included in the notes to TS Table 3.7.13-1.

h. Flux suppression inserts

Section 8.9 of the CSA determines the reactivity effect of hafnium inserts that were used only at IP3. The burnup requirements are adjusted for any IP3 assembly that contained a hafnium insert. This adjustment is included in the notes to TS Figure 3.7.13-1.

<u>Fuel assembly physical changes with depletion</u>

Section 6.3 of the CSA evaluates the reactivity effect of clad creep and grid growth and conservative models were developed.

Depletion bias and uncertainty

Section 5.6 of the CSA demonstrates that the utilization of the 5% uncertainty allowed by DSS-ISG-2010-01 is appropriate.

4.5 Fuel Assembly and Storage Rack Modeling

NEI 12-16, Section 5 describes methods for fuel assembly and spent fuel rack modeling. The significant parameters identified in NEI 12-16 which could affect the reactivity of discharged fuel are considered in the identified Sections of the CSA as follows:

a. Fuel assembly modeling considerations

   Sections 3.2 and 3.3 of the CSA provide details of the fuel assembly and insert designs used at IP2 and IP3. In all cases nominal dimensions are provided with tolerances, if required. The CSA uses several fuel designs to bound groups of fuel assemblies. All presently stored and anticipated IP2 and IP3 fuel assemblies are covered by a group.

b. Design basis fuel assembly

   Sections 3.2 and 3.3 of the CSA provide a review of fuel and insert designs for both IP2 and IP3. The review was conducted to ensure that the analysis bounds all of the fuel and insert designs.

c. Axial burnup distribution

   Section 6.2 of the CSA specifies the axial power shape over the life of the assembly as the axial burnup profile used in the depletion calculation. The DOE axial burnup profiles are used with a limited number of exceptions. The exceptions use the actual assembly axial burnup profile.

   Section 6.2 of the CSA optimizes the number and size of the nodes in the axial burnup distribution used in the criticality calculations.

d. Reactor record burnup uncertainty

   Section 7.2 of the CSA addresses the reactor record burnup uncertainty. The burnup uncertainty from the reactor records is assumed to be 5% of the burnup.

e. Assembly inserts and integral absorber credit

   Section 6.6 of the CSA credits RCCAs inserted in assemblies at specific SFP locations. In addition, RCCAs may be used to reduce the reactivity of assemblies that would otherwise fail the loading requirements. No credit is taken for any other inserts in the criticality calculations. The depletion calculations are performed with inserts in order to harden the neutron spectrum and maximize the reactivity of burned fuel.

The RCCA atom densities are reduced by 10% to cover potential depletion. The CSA concludes that any depletion of the control rods is insignificant.

CSA Figure 10.1 and TS Figure 3.7.13-1 show the SFP cell locations where RCCA credit is taken.

For current and future fuel the CSA takes credit for IFBA in unburned fuel. To provide flexibility in fuel design, the number of IFBA for fresh fuel can be reduced for lower enrichments. The number of minimum IFBA for enrichments less than or equal to 3.0, 3.5, 4.0, 4.5, and 5.0 w/o is 0, 16, 32, 48, and 64, respectively. TS Table 3.7.13-1 shows this IFBA credit.

Storage rack modeling

a. Spent fuel pool racks

Section 3.1 of the CSA describes the spent fuel racks. The Region 1 fuel racks (flux trap design) contain Boraflex in sheaths and Region 2 is an egg-crate design where square storage tubes are joined at the corners via spacer rods creating "resultant" cells between the tubes. Boraflex sheaths are in place in all cells in Regions 1 and 2. The Boraflex is not credited in the CSA. In the CSA, nominal dimensions are provided with tolerances, if required.

Section 8.1 of the CSA determines the SFP temperature at which maximum reactivity occurs in Regions 1 and 2. The temperature producing the maximum reactivity is used when comparing $k_{95/95}$ against the acceptance criteria.

Section 7.3 of the CSA evaluates the eccentricity bias associated with the random placement of a fuel assembly within a storage cell. The reference calculation is the 8x8 model with centered assemblies. The eccentricity bias is applied to the centrally located 2x2 results.

4.6 Configuration Modeling

NEI 12-16, Section 6 defines configuration modeling as any unique combination of requirements for fuel, inserts (either fixed neutron absorbers or reactivity hold-down devices) and/or empty cells for a rack design.

Configuration modeling

a. Fuel assembly categorization

Sections 1.2 and 8 of the CSA define five fuel assembly reactivity categories based on minimum required burnup. The minimum required burnups are chosen to optimize the storage of fresh and once burnt fuel assemblies in Region 1 (Categories 1, 2, and 3), and to optimize the storage of permanently discharged assemblies in Region 2 (Categories 4 and 5).

The fuel categories are numbered from the most reactive fuel (Category 1) to the least reactive fuel (Category 5). The assembly's enrichment, burnup, cooling

time, and averaged assembly peaking factor are used to determine the reactivity category. The reactivity categories are shown in order of decreasing reactivity in the following table.

Reactivity Category	Minimum Required Burnup (MRB) (GWd/T)
1	0
2	21
3	28.5
4	MRB = Curve fit
5	MRB for Category 4 plus 11

Section 10.2 of the CSA and TS Table 3.7.13-1 provide the curve fit equation, adjustments to, and the limits of applicability of the above table.

As identified in Table 10.2 and the notes to TS Figure 3.7.13-1, Category 1 fuel assemblies that contain an RCCA are Category 4. Likewise, Category 2, 3, or 4 fuel assemblies containing an RCCA are Category 5.

b. Categorization of historic fuel assemblies (fuel assemblies with IDs A through X)

Section 5 of the CSA describes the depletion calculations. For historic fuel assemblies, these calculations utilize actual fuel assembly depletion conditions instead of bounding conditions that would penalize most assemblies for which the depletion conditions are known. This data includes use of inserts, burnup achieved while the insert was in the assembly, use of control rods, soluble boron level, averaged assembly peaking factor, and use of axial blankets. The fuel categorization of historic fuel is accomplished by use of batch groupings with similar characteristics. The depletion analysis is performed for each batch grouping using bounding depletion parameters. For some historic fuel assemblies the bounding parameters are overly conservative. For such assemblies, the actual depletion parameters are used. Historic fuel assemblies have been pre-categorized as shown in Appendix B to the CSA and TS Tables 3.7.13-2 and 3.7.13-3.

c. Categorization of current and future fuel assemblies (fuel assemblies with IDs A through AA)

For current and future fuel assemblies bounding depletion assumptions are used. Table 10.2 of the CSA and TS Table 3.7.13-1 provide the minimum required burnup for each reactivity category for these fuel assemblies.

Controls which ensure future fuel designs satisfy the assumptions of the analysis are discussed in the Licensee Controls section 4.9 below.

d. SFP storage location by fuel assembly category

The CSA uses a cell dependent reactivity. That reactivity by position is defined in Figure 10.1 and TS Figure 3.7.13-1 by use of cell categories, required control rods, and two types of water holes. Each cell in the IP2 SFP has a predetermined minimum fuel category. However, there are a few alternative configurations of the cell categories in the SFP. The criteria for forming the alternative configurations are provided in the notes to TS Figure 10.7.13-1.

Section 8 of the CSA determines acceptable storage locations for each fuel assembly reactivity category. Figure 10.1 is the base case configuration and Figures 10.2, 10.3 and 10.4 are examples of allowable configurations. These figures are included in the TS as Figures 3.7.13-1 and 3.7.13-2. Note that the base case arrangement only shows four reactivity categories since it is the most limiting reactivity arrangement.

NEI 12-16, Section 6 also describes acceptable methods for modeling normal conditions, interfaces and abnormal and accident conditions.

<u>Normal conditions</u>

a. SFP conditions

The SFP is required by TS 3.7.12 to contain at least 2000 ppm of soluble boron. The water temperature during normal operation ranges from above freezing to 180°F.

Section 10 of the CSA addresses normal loading configurations. Figure 10.1 of the CSA and TS Figure 3.7.13-1 show the base case normal configuration. This is the most limiting reactivity arrangement and, as such, is the configuration used in the accident analyses. As shown in the notes to TS Figure 3.7.13-1 fuel assemblies of any higher numbered Category can be stored in any cell location that allows for a lower numbered Category. For example, a Category 5 fuel assembly can be stored in Category 1, 2, 3, 4, and 5 cells. Any cell may be empty.

Figure 10.1 of the CSA and TS Figure 3.7.13-1 show SFP cell locations where RCCAs are credited. These RCCAs that are required in the fuel layout may not be credited to raise the category of that fuel assembly (for example, a Category 2 assembly with an inserted RCCA may not be placed in a location that requires an RCCA).

Figure 10.1 of the CSA and TS Figure 3.7.13-1 show SFP cell locations where Water Holes and 50% Water Holes are credited. Water Holes and 50% Water Holes are defined in the notes to TS Figure 3.7.13-1.

Figure 10.1 of the CSA and TS Figure 3.7.13-1 show two blocked cells. One of these cells is at the Region 1 and 2 interface and is not credited. The other is located at the edge of the pool above the cask loading area. This cell blocker is

credited and allows for storage of a Category 4 fuel assembly on both sides of the cell blocker.

Section 10.3 of the CSA and the notes to TS Figure 3.7.13-1 allow for the formation of areas of Category 1 fuel in both Regions 1 and 2. Region 1 examples are provided in TS Figure 3.7.13-2.

Section 8.4 of the CSA determines that the $k_{95/95}$ for the Figure 10.1 Region 1 and 2 configurations are 0.9881 and 0.9897, respectively, and therefore meet the acceptance criteria.

b. Movement of fuel

Section 9.1 of the CSA addresses movement of fuel assemblies in and around the pool, fuel inspection and fuel reconstitution. An assembly is isolated if there is 20 cm of water between assemblies. There are two locations where it would be possible to place two assemblies within 20 cm of each other outside of the rack: when a fuel assembly is in the fuel elevator and another fuel assembly is vertical in the upender. However, procedures will not permit moving an assembly within 25 cm of either of those locations when another assembly is in either the fuel elevator or upender.

Section 8.4 of the CSA addresses the Category 5 fuel assemblies in Figure 10.1 that are required to contain a full length RCCA. There is a restriction on the movement of such fuel, namely, that the RCCA must not be placed in or removed while the assembly is in the RCCA credited location unless all the eight adjacent cells are empty. This restriction is included in TS 3.7.13 LCO.

c. Normal storage of miscellaneous material

Section 8 of the CSA addresses the use of the failed fuel containers, the fuel rod storage basket, assemblies with missing fuel rods, and the storage of non-fuel materials.

Failed fuel containers

The southeast corner of the spent fuel pool contains two 16" circular pipes that are used as failed fuel containers. The CSA permits 16 fuel rods in each of these failed fuel containers. The maximum of 16 fuel rods in each of the failed fuel containers will be controlled by procedure.

Fuel rod storage basket

There is a movable fuel rod storage basket that can be used to store fuel rods. This basket can fit in a storage cell and has 52 holes for storing fuel rods. The fuel rod storage basket is classified as reactivity Category 4 and this categorization is included in TS Table 3.7.13-2.

Assemblies with missing fuel rods

Reconstituted fuel assemblies may be stored in the SFP provided a 4GWd/T burnup penalty is added to the MRB for those assemblies that did not have stainless steel rods installed. This requirement is included in the notes to TS Table 3.7.13-1.

Storage of non-fuel material

Water Holes and 50% Water Holes may be used to store miscellaneous materials with certain restrictions. These restrictions are included in the notes to TS Figure 3.7.13-1.

In summary, the CSA concludes that under normal operations with no soluble boron credit, $k_{95/95}$ is maintained below the acceptance criterion of 1.00. The target value of 0.99 is also met.

Interfaces

Section 6.6 of the CSA describes the full pool model that was developed to take advantage of leakage at the boundaries of the pool and for use in checking interfaces between category cells.

Figure 10.1 of the CSA and TS Figure 3.7.13-1 show the SFP rack layout, the Region 1/2 interface, and the interfaces between cell categories.

Accident Analyses

The CSA assumes that the accident occurs when the pool is configured in the most reactive state allowed by normal operations. This configuration is shown on Fig 10.1 of the CSA.

The CSA has analyzed the following postulated accident conditions assuming a SFP soluble boron concentration of 2000 ppm.

a. Temperatures beyond normal operating range

   Section 9.4 of the CSA assumes that the pool water is boiling including a 20% void fraction and determines a nominal k_{eff} of 0.7464 for this accident. This case has a large margin to the 0.94 target, so calculation of a bias and uncertainty for this specific case is not necessary.

b. Dropped and mislocated assembly

   Section 9.3 of the CSA assumes that a fresh fuel assembly at maximum enrichment is dropped into an empty cell in Region 2 and determines a nominal k_{eff} of 0.8700 for the dropped assembly accident.

   Section 9.2 of the CSA assumes that a fresh fuel assembly at maximum enrichment is placed in the pool next to the rack in the most reactive location and

determines a nominal k_{eff} of 0.7864 for the worst case mislocated/misplaced assembly accident.

In these cases there is a large margin to the 0.94 target and 0.95 acceptance criterion, so calculation of a bias and uncertainty is not necessary.

An assembly dropped horizontally on top of other assemblies is not specifically analyzed because the assemblies are decoupled as a result of the structure above the active fuel.

c. Assembly misload

Section 9 of the CSA states that a single misloaded assembly is bounded by a fresh fuel assembly at maximum enrichment dropped into an empty cell and therefore is not specifically evaluated.

d. Multiple assembly misload

Section 9.5 of the CSA determines a worst case $k_{95/95}$ of 0.9375 for this accident. The worst case occurs in Region 2, with the assumption that all cells that are permitted to contain fuel are modeled as misloaded with once burned 5.0 w/o fuel with a burnup of 24 GWd/T. The water hole and 50% water hole locations remained empty.

e. Seismic

Section 9.7 of the CSA determines that k_{eff} is not sensitive to a seismic event. Any absorber plates that could be affected by a seismic event are not credited and the space between the rack modules is not credited.

In summary, the CSA concludes that the limiting accident is a multiple misload accident. It is concluded that a SFP TS minimum soluble boron concentration of 2000 ppm will maintain $k_{95/95}$ below the acceptance criterion of 0.95 including all uncertainties and biases for this postulated scenario. The target value of 0.94 is also met. Thus, compliance with 10 CFR 50.68 is maintained.

4.7 Soluble Boron Credit

NEI 12-16, Section 7 describes conditions for soluble boron credit under normal and accident conditions including a boron dilution accident. The IP2 pool is required to contain at least 2000 ppm of soluble boron whenever any fuel assembly is stored in the SFP (TS LCO 3.7.12 “Spent Fuel Pit Boron Concentration”).

a. Normal Conditions

Section 8 of CSA determines that the Region 1 and Region 2 racks have a $k_{95/95}$ of less than 1.0 with the racks loaded with a certain bounding initial enrichment, number of IFBAs, and designated storage cells void of fuel, and the racks flood with unborated water at a temperature corresponding to the highest reactivity.

b. Accident Conditions

Section 9 of CSA evaluates the accident condition at the minimum soluble boron concentration allowed by the Technical Specifications and demonstrates that at this concentration $k_{95/95}$ is maintained below the acceptance criterion of 0.95 including all uncertainties and biases.

c. Boron Dilution Accident

Section 9.6 of CSA assumes a minimum soluble boron concentration of 700 ppm in the boron dilution accident. This is less than the 786 ppm determined in the boron dilution analysis of record (NET-173-02) that was submitted in support of the CAOR [Ref. 1]. The CAOR concluded that sufficient time is available to detect the dilution of the pool, and to mitigate the dilution, prior to the pool boron concentration decreasing from the Technical Specification minimum of 2000 ppm to 786 ppm - the value necessary in the CAOR to ensure subcriticality under non-accident conditions.

NET-173-02 evaluated postulated unplanned SFP boron dilution scenarios. The evaluation considered various scenarios by which the SFP boron concentration may be diluted and the time available before the minimum boron concentration necessary to ensure subcriticality for the non-accident condition (i.e. in accordance with the double-contingency principle it was not assumed that an accident occurs concurrent with the spent fuel pit dilution event). NET-173-02 determined that an unplanned or inadvertent event that could dilute the SFP boron concentration from 2000 ppm to 786 ppm is not a credible event because of the low frequency of postulated initiating events and because the event would be readily detected and mitigated by plant personnel through alarms, flooding, security and operator rounds through the SFP area. Entergy has confirmed that the assumptions made in the boron dilution CAOR regarding accident detection and mitigation remain valid.

The CSA conservatively credits 700 ppm (versus an already not credible 786 ppm in the CAOR) of soluble boron. It is concluded that a SFP TS minimum soluble boron concentration of 700 ppm will maintain $k_{95/95}$ below the acceptance criterion of 0.95 for this postulated scenario. The target value of 0.94 was also met. Thus, compliance with 10 CFR 50.68 is maintained.

4.8 Calculation of Maximum k_{eff}

NEI 12-16, Section 8 describes an acceptable methodology for determining the maximum k_{eff}. The maximum k_{eff} ($k_{95/95}$) is determined by adding to the nominal k_{eff} any biases that exist in the methodology and the statistical combination of uncertainties.

Section 7.0 of the CSA describes sensitivity studies that were conducted to determine the uncertainties and biases associated with manufacturing tolerances, burnup, validation, eccentric placement of fuel, and the Monte Carlo statistical methodology.

4.9 Licensee Controls

NEI 12-16, Section 9 describes controls that help to ensure that the conditions evaluated in the nuclear criticality safety analysis are and remain bounding to the current plant operating parameters.

Appropriate licensee controls include plant procedures and programs that control storage configurations, and burnup/enrichment loading curves, that ensure that the storage of fuel is bounded by the criticality analyses.

Procedural Controls

Entergy will administratively control the categorization of fuel assemblies and their storage in the SFP in accordance with the following.

1. Procedural controls will be developed to ensure that fresh and burnt fuel will be stored in accordance with TS 3.7.13. This will require revisions to procedures for preparing, reviewing, and performing fuel moves.

   The current process for moving fuel assemblies is controlled by system operating procedure SOP 2-SOP-17.12, "Spent Fuel Handling Machine and Spent Fuel Pit Operations". This procedure provides the detailed steps associated with the equipment controls on the fuel handling machines, as well as the required communications necessary between the SFP bridge operator, the spotter, and the fuel handling supervisor (FHS).

   Fuel movement plans are developed by experienced and qualified personnel. 0-NF-203, "Internal Transfer of Fuel Assemblies and Inserts," is the governing document for preparation of fuel move sheets. Both fresh and spent fuel is moved in and out of the SFP, and within the SFP in accordance with Fuel Transfer Forms. The forms are generated using the Shuffleworks computer code and in accordance with the procedural controls of 0-NF-203.The procedure requires an independent review by another qualified person and ensures that both the preparer and reviewer verify that the fuel move sheet would result in approved storage patterns per TS 3.7.13.

   The following human performance tools are used during fuel handling activities;

   a. Three-way communications between the fuel handling machine operator and the FHC is used during verification of "from" and "to" locations, and during verification of fuel handling machine mast orientation. All fuel handling communications will be in accordance with procedure EN-FAP-OU-108, which includes FHS/SRO permission prior to latch/unlatch.

   b. Place-keeping on the fuel moves sheets is required for each fuel move step.

   c. The performance of fuel move evolutions is preceded with formal pre-job briefs.

2. Current procedures require all fuel movement plans be prepared and independently reviewed by Reactor Engineers.

   These requirements will not change, but the training for obtaining these qualifications will be updated to reflect the revised TS and associated procedure changes. Training will be provided to all currently qualified personnel in these positions related to the changes. It is recognized that with the implementation of the proposed TS there will be a significant difference in how the SFP will be arranged. Therefore, training will be provided to ensure that the individuals that prepare the fuel move sheets and the fuel handlers will be able to clearly understand, and easily identify, which patterns are acceptable in accordance with the TS. This training will be required to maintain fuel move sheet development qualifications and the fuel handler qualification.

   There are several tools that are already in place that will be revised to aid in the development of the fuel move sheets. Categorizing a fuel assembly is procedurally controlled and will continue to provide a straightforward means to identifying the correct category for each assembly. Then, to identify where it is acceptable to place those fuel categories in the SFP, the Shuffleworks computer code has the ability to identify graphically and in color the locations acceptable for storage of each fuel category. This minimizes the possibility of an error in designing the move sheets.

The above controls and qualification requirements are considered appropriate to minimize the probability of the occurrence of a fuel misload event.

Future Fuel Types

Entergy will establish controls which will ensure that future fuel designs will meet the CSA requirements. Table 10.3 of the CSA provides the fuel design requirements for future fuel designs. These parameters will be verified during the core reload design process.

Pre and Post Irradiation Characterization

Entergy will establish controls which will ensure that the future fuel assembly operating requirements will meet the CSA requirements. Table 10.4 of the CSA provides the fuel assembly operating requirements for current and future fuel designs. These parameters will be verified following fuel depletion. Should an assembly not meet any of the fuel assembly operating requirements of Table 10.4 of the CSA, then the fuel must be categorized as Category 1 (or Category 4 if a full length RCCA is inserted). This categorization will be controlled by procedure.

Entergy will evaluate any future design changes to SFP racks, fuel assemblies, RCCAs, inserts, cell blockers, the fuel rod storage basket, failed fuel containers, etc. in accordance with existing procedures and processes for changes to the facility. These evaluations would employ the requirements for documentation and implementation under the provisions of 10CFR50.59.

5.0 REGULATORY ANALYSIS

5.1 No Significant Hazards Considerations

Entergy has evaluated whether or not a significant hazards consideration is involved with the proposed amendment by focusing on the three standards set forth in 10 CFR 50.92, "Issuance of Amendment," as discussed below:

1. Does the proposed amendment involve a significant increase in the probability or consequences of an accident previously evaluated?

   Response: No.

   The proposed amendment was evaluated for impact on the following previously evaluated events and accidents:

   - Multiple Misloads
   - Misplaced Assembly
   - Dropped Assembly
   - Misloaded Assembly
   - Over Temperature
   - Seismic
   - Boron Dilution
   - Fuel Handling Accident
   - Loss of Spent Fuel Pool Cooling

   Multiple misloads, misplaced assembly, dropped assembly, misloaded accidents

   Operation in accordance with the proposed Technical Specifications will not significantly increase the probability of multiple misloads, misplaced assembly, dropped assembly and misloaded assembly accidents because:

   a. There are no changes to the equipment for fuel handling or how fuel assemblies are handled, including how fuel assemblies are inserted into and removed from SFP storage locations. There are no changes to how RCCAs will be handled, including how RCCAs are inserted into, or removed from, a fuel assembly.

   b. The processes and procedures that are currently in place are sufficiently robust. The proposed Technical Specifications utilize the same basic fuel assembly classification and storage location concepts as those currently in place. However, they do represent a minimal increase in complexity:

      - The current TS for fuel storage are complex because the Boraflex neutron absorber built into the SFP racks has degraded. To address this degradation the SFP is divided into four irregularly shaped Regions (Region 1-1, Region 1-2, Region 2-1, and Region 2- 2). In addition to the four regions there are six special locations known as peripheral locations in Region 2-2 which are treated as suitable for storage of fuel otherwise designated for Region 1-1 or 1-2. These regions are graphically depicted in the current TS Figure 3.7.13-5.

Each one of these regions has its own rules for fuel placement which are identified in the TS.

- The current Technical Specifications determine a minimum required burnup for each fuel assembly based on initial enrichment, burnup, and cooling time with individual fuel assembly storage location within the SFP restricted based on this minimum required burnup. The minimum required burnup is determined for each of the four regions (1-1, 1-2, 2-1, and 2-2) that utilize a total of ten curves. The proposed assembly categorization is slightly more complex due to the following:

  - the minimum required burnup is dependent on the averaged assembly peaking factor in addition to the initial enrichment, burnup, and cooling time.

  - the minimum required burnup is used to determine the reactivity category of each fuel assembly.

  - the minimum required burnup is adjusted, as necessary, to account for hafnium inserts, a reconstituted fuel assembly with missing stainless steel replacement rods, and a maximum burnup average boron concentration in excess of 950 ppm.

- The current Technical Specifications restrict acceptable SFP storage locations to Regions 1-1, 1-2, 2-1 and 2-2 based on minimum required burnup. The proposed Technical Specifications are minimally more complex due to the following:

  - acceptable storage locations are defined by fuel assembly category and a base configuration is specified. There are five reactivity categories. Certain cell locations in Region 2 require that Category 5 fuel assemblies contain a full length RCCA.

  - the base configurations in Region 1 and Region 2 may be changed in accordance with certain well-defined criteria. An example of a change to a base configuration is that a checkerboard area may be formed in Region 2 where all four sides of the checkerboard are rows of empty cells.

The minimal increase in complexity of current and future fuel categorization and SFP storage restrictions is offset by the significant number of fuel assemblies that have been pre-categorized in TS Tables 3.7.13-2 and Table 3.7.13-3. The minimal increase is also offset by the use of two curves to determine the minimum required burnup (instead of the 10 currently used).

Operation in accordance with the proposed TS will not significantly increase the consequences of multiple misloads, misplaced assembly, dropped assembly and misloaded assembly criticality accidents because the proposed CSA demonstrates that the acceptance criteria continue to be met for each of these accidents.

Over temperature accident

Operation in accordance with the proposed TS will not significantly increase the probability of an over temperature accident because the proposed change does not alter the manner in which the IP2 spent fuel cooling loop is designed, operated, or maintained.

Operation in accordance with the proposed TS will not significantly increase the consequences of an over temperature accident because the proposed CSA demonstrates that the acceptance criteria continue to be met for this accident.

Seismic event

Operation in accordance with the proposed TS will not significantly increase the probability of a seismic event because there are no elements of the proposed changes that influence the occurrence of any natural event.

Operation in accordance with the proposed TS will not significantly increase the consequences of a seismic event because the proposed changes do not significantly alter the physical arrangement of the spent fuel racks and do not increase the allowable number of fuel assemblies to be stored in the pool. The proposed TS changes require two cell blockers to be in place. These cell blockers have been evaluated and they have a negligible effect on the seismic response of the SFP racks. In addition, the proposed TS changes allow for the placement of miscellaneous non-actinide materials, for example, empty or full trash baskets in fuel positions of any category, in Water Holes and in 50% Water Holes. The placement of miscellaneous materials in the identified locations has been evaluated and has a negligible effect on the seismic response of the SFP racks.

Boron dilution accident

Operation in accordance with the proposed TS will not significantly increase the probability of a boron dilution event because the proposed change does not alter the manner in which the IP2 spent fuel cooling system or any other plant system is designed, operated, or maintained, or otherwise increase the likelihood of adding significant quantities of unborated water into the spent fuel pit.

Operation in accordance with the proposed TS will not significantly increase the consequences of a boron dilution event because the TS minimum soluble boron concentration remains unchanged at 2000 ppm and the boron concentration required to ensure k_{eff} less than or equal to 0.95 has been evaluated at 700 ppm. The proposed CSA demonstrates that the acceptance criteria continue to be met for this accident.

Fuel handling accident

Operation in accordance with the proposed TS will not significantly increase the probability of a FHA because the individual fuel assemblies will be moved using the

same equipment, procedures, and other administrative controls (i.e. fuel move sheets) that are currently used.

Operation in accordance with the proposed TS will not significantly increase the consequences of a FHA because the radiological source term of a single fuel assembly will remain the same.

<u>Loss of spent fuel pool cooling</u>

Operation in accordance with the proposed TS will not significantly increase the probability of a loss of spent fuel pit cooling because the proposed change does not alter the manner in which the IP2 spent fuel cooling loop is designed, operated, or maintained.

Operation in accordance with the proposed TS will not significantly increase the consequences of a loss of spent fuel pit cooling because the proposed change credits empty cells whereas the thermal design basis for the spent fuel pit cooling loop provides for all fuel pit rack locations to be filled at the end of a full core discharge. The proposed TS changes require two cell blockers to be in place. These cell blockers have been evaluated and they have a negligible effect on the thermal response to a loss of spent fuel pool cooling. In addition, the proposed TS changes allow for the placement of miscellaneous non-actinide materials, for example, empty or full trash baskets in fuel positions of any category, in Water Holes and in 50% Water Holes. The placement of miscellaneous materials in the identified locations has been evaluated and has a negligible effect on the thermal response to a loss of spent fuel pool cooling.

Therefore, the proposed change does not involve a significant increase in the probability or consequences of an accident previously evaluated.

2. Does the proposed amendment create the possibility of a new or different kind of accident from any accident previously evaluated?

   Response: No.

   Operation in accordance with the proposed TS do not create the possibility of a new or different kind of accident from any accident previously evaluated. No new modes of operation are introduced by the proposed changes. The proposed changes will not create any failure mode not bounded by previously evaluated accidents.

   Therefore, the proposed changes do not create the possibility of a new or different kind of accident, from any accident previously evaluated.

3. Does the proposed amendment involve a significant reduction in a margin of safety?

   Response: No.

   Operation in accordance with the proposed TS does not involve a significant reduction in a margin of safety.

The margin of safety required by 10 CFR 50.68(b)(4) remains unchanged. The evaluations in the CSA confirm that operation in accordance with the proposed amendment continues to meet the required subcriticality margins for both normal operations and accident conditions. In addition, the SFP seismic and thermal margins are essentially unchanged.

Therefore, the proposed change does not involve a significant reduction in a margin of safety.

Based on the above, Entergy concludes that the proposed amendment to the IP2 Technical Specifications presents no significant hazards consideration under the standards set forth in 10 CFR 50.92(c), and, accordingly, a finding of "no significant hazards consideration" is justified.

5.2 Applicable Regulatory Requirements/Criteria

Criterion 2 of 10 CFR 50.36(c)(2)(ii), "A technical specification limiting condition for operation of a nuclear reactor must be established for each item meeting one or more of the following criteria: A process variable, design feature, or operating restriction that is an initial condition of a design basis accident or transient analysis that either assumes the failure of or presents a challenge to the integrity of a fission product barrier."

GDC 61 - Fuel Storage and Handling and Radioactivity Control, "The fuel storage and handling, radioactive waste, and other systems which may contain radioactivity shall be designed to assure adequate safety under normal and postulated accident conditions. These systems shall be designed (1) with a capability to permit appropriate periodic inspection and testing of components important to safety, (2) with suitable shielding for radiation protection, (3) with appropriate containment, confinement, and filtering systems, (4) with a residual heat removal capability having reliability and testability that reflects the importance to safety of decay heat and other residual heat removal, and (5) to prevent significant reduction in fuel storage coolant inventory under accident conditions."

GDC 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."

NUREG-0800, Standard Review Plan 9.1.2, "Spent Fuel Storage": "Nuclear reactor plants include storage facilities for the wet storage of spent fuel assemblies. The safety function of the spent fuel pool and storage racks is to maintain the spent fuel assemblies in a safe and subcritical array during all credible storage conditions and to provide a safe means of loading the assemblies into shipping casks."

10 CFR 50.68 (b)(4):"If no credit for soluble boron is taken, 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 unborated water. 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), at a 95 percent probability, 95 percent confidence level, if flooded with unborated water."

The proposed changes consider the types of fuel used for past, current and planned future operating conditions for IP2 and IP3. Storage of this fuel in the spent fuel storage pools does not change the compliance with the above general design criteria and are also consistent with the above Standard Review Plan and 10 CFR 50.68 (b)(4).

5.3 Environmental Considerations

Entergy has concluded that the proposed changes and determined that the changes do not involve (1) a significant hazards consideration (2) a significant change in the types or significant increase in the amounts of any effluents that may be released off-site, or (3) a significant increase in individual or cumulative occupational radiation exposure. Accordingly, the proposed changes meet the eligibility criteria for categorical exclusion set forth in 10 CFR 51.22(c) (9). Therefore, pursuant to 10 CFR 51.22(b), no environmental impact statement or environmental assessment need be prepared in connection with the proposed amendment.

6.0 REFERENCES

1. Entergy letter NL-01-110, 09/20/01, "License Amendment Request (LAR 01-010) for Spent Fuel Storage Pit Rack Criticality Analysis with Soluble Boron Credit".

2. Entergy letter NL-14-083, 11/13/14, "Submittal of NETCO Report NET-300067-01, "Criticality Safety Analysis of the Indian Point Unit 2 Spent Fuel Pool with Credit for Inserted Neutron Absorber Panels," for NRC Review and Approval".

3. NRC letter, 05/29/2002, "Indian Point Nuclear Generating Unit No. 2 – Amendment Re: Credit for Soluble Boron and Burnup in Spent Fuel Pit (TAC No. MB2989)".

4. Entergy letter NL-09-076, 07/08/2009, "Indian Point Nuclear Power Plant Units 2 and 3 - Application for Unit 2 Operating License Condition Change and Units 2 and 3 Technical Specification Changes to Add Inter-Unit Spent Fuel Transfer Requirements".

5. NRC letter, 07/13/2012, "Indian Point Nuclear Generating Unit Nos. 2 and 3 – Issuance of Amendments Re: Inter-Unit Spent Fuel Transfer (TAC Nos. ME1671, ME1672, and L24299".

6. NRC Information Notice, 2011-03, "Nonconservative Criticality Safety Analysis for Fuel Storage", dated February 16, 2011.

7. NRC Generic Letter 96-04, "Boraflex Degradation in Spent Fuel Pool Storage Racks".

8. NRC Generic Letter 2016-01, "Monitoring of Neutron-Absorbing Materials in Spent Fuel Pools", April 7, 2016.

9. NRC RAI, “Request for Additional Information Regarding the Indian Point Nuclear Generating Unit No. 2 – Spent Fuel Pool Criticality Analysis (TAC No. MF5282)”, dated June 29, 2015.

10. Entergy letter NL-15-089, 08/14/2015, “Response to Request for Additional Information Regarding the Indian Point Nuclear Generating Unit No. 2 – Spent Fuel Pool Criticality Analysis (TAC No. MF5282)”.

11. NRC letter, “Indian Point Nuclear Generating Unit No. 2 – Staff Review of NETCO Report NET-300067-01, “Criticality Safety Analysis of the Indian Point Unit 2 Spent Fuel Pool with Credit for Inserted Neutron Absorber Panels,”” US NRC, Washington, DC, November 23, 2015.

12. NRC, “Category 1 Public Meeting, Indian Point Nuclear Generating Unit No. 2, Pre-Application Meeting Summary, July 26, 2017”.

13. DSS-ISG-2010-1, "Staff Guidance Regarding the Nuclear Criticality Safety Analysis for Spent Fuel Pools".

14. NEI 12-16, Rev. 2 Draft C, "Guidance for Performing Criticality Analyses of Fuel Storage at Light-Water Reactor Power Plants", August 2017.

ATTACHMENT 2 TO NL-17-144

Indian Point Unit 2

Proposed Technical Specification Changes (Marked-Up)

Affected Appendix A Tech Spec Page:	3.7.13-1
	3.7.13-2
	3.7.13-3
	3.7.13-4
	3.7.13-5
	3.7.13-6
	3.7.13-7
	4.0-1
	4.0-2

Entergy Nuclear Operations, Inc.
Indian Point Unit 2
Docket No. 50-247

Replace by revised LCO
(Insert 1)

3.7 PLANT SYSTEMS

3.7.13 Spent Fuel Pit Storage

LCO 3.7.13 IP2 fuel assemblies stored in the Spent Fuel Pit shall be classified in accordance with Figure 3.7.13-1, Figure 3.7.13-2, Figure 3.7.13-3, and Figure 3.7.13-4, based on initial enrichment, burnup, cooling time and number of Integral Fuel Burnable Absorbers (IFBA) rods; and,

Fuel assembly storage location within the Spent Fuel Pit shall be restricted to Regions identified in Figure 3.7.13-5 as follows:

a. Fuel assemblies that satisfy requirements of Figure 3.7.13-1 may be stored in any location in Region 2-1, Region 2-2, Region 1-2 or Region 1-1;

b. Fuel assemblies that satisfy requirements of Figure 3.7.13-2 may be stored in any location in Region 2-2, Region 1-2 or Region 1-1;

c. Fuel assemblies that satisfy requirements of Figure 3.7.13-3 may be stored in any location in Region 1-2, Region 1-1, or in locations designated as "peripheral" cells in Region 2-2; and

d. Fuel assemblies that satisfy requirements of Figure 3.7.13-4 may be stored:

1) In any location in Region 1-2, or

2) In a checkerboard loading configuration (1 out of every two cells with every other cell vacant) in Region 1-1; or

3) In locations designated as "peripheral" cells in Region 2-2.

IP3 fuel assemblies shall be stored in Region 1-2 of the Spent Fuel Pit. Only assemblies with initial enrichment ≥ 3.2 and ≤ 4.4 w/o U^{235} and discharged prior to IP3 Cycle 12 shall be stored in the Spent Fuel Pit.

APPLICABILITY: Whenever any fuel assembly is stored in the Spent Fuel Pit.

ACTIONS

CONDITION	REQUIRED ACTION	COMPLETION TIME
A. Requirements of the LCO not met.	A.1 ------------------------------------ **- NOTE -** LCO 3.0.3 is not applicable. ------------------------------------ Initiate action to move the noncomplying fuel assembly to an acceptable location.	Immediately

Replace by revised Surveillance Requirements (Insert 2)

SURVEILLANCE REQUIREMENTS

SURVEILLANCE		FREQUENCY
SR 3.7.13.1	Verify by administrative means that the IP2 fuel assembly has been classified in accordance with Figure 3.7.13-1, Figure 3.7.13-2, Figure 3.7.13-3, or Figure 3.7.13-4 and meets the requirements for the intended storage location.	Prior to storing the fuel assembly in the Spent Fuel Pit.
	<u>OR</u>	
	Verify by administrative means that the IP3 fuel assembly meets the requirements for the intended storage location.	Prior to storing the fuel assembly in the Spent Fuel Pit.

Replace by new Figure 3.7.13-1
(Insert 3)

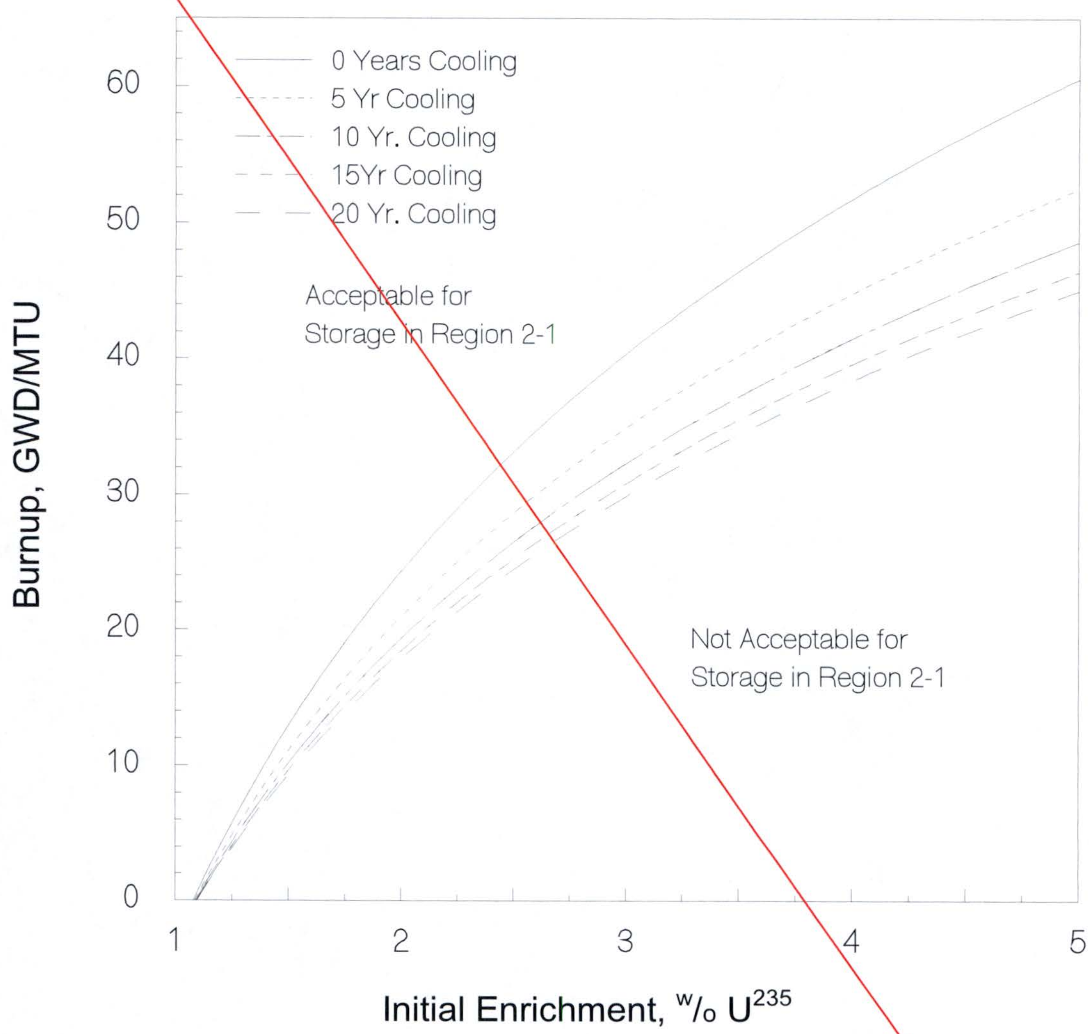

Figure 3.7.13-1
IP2 Fuel Assembly Limiting Burnup and Cooling Time versus Initial Enrichment:
Acceptable for Storage in Any Location in
Region 2-1, Region 2-2, Region 1-2 or Region 1-1

Replace by new Figure 3.7.13-2 (Insert 4) and new Tables 3.7.13-1, 3.7.13-2, and 3.7.13-3 (Insert 5)

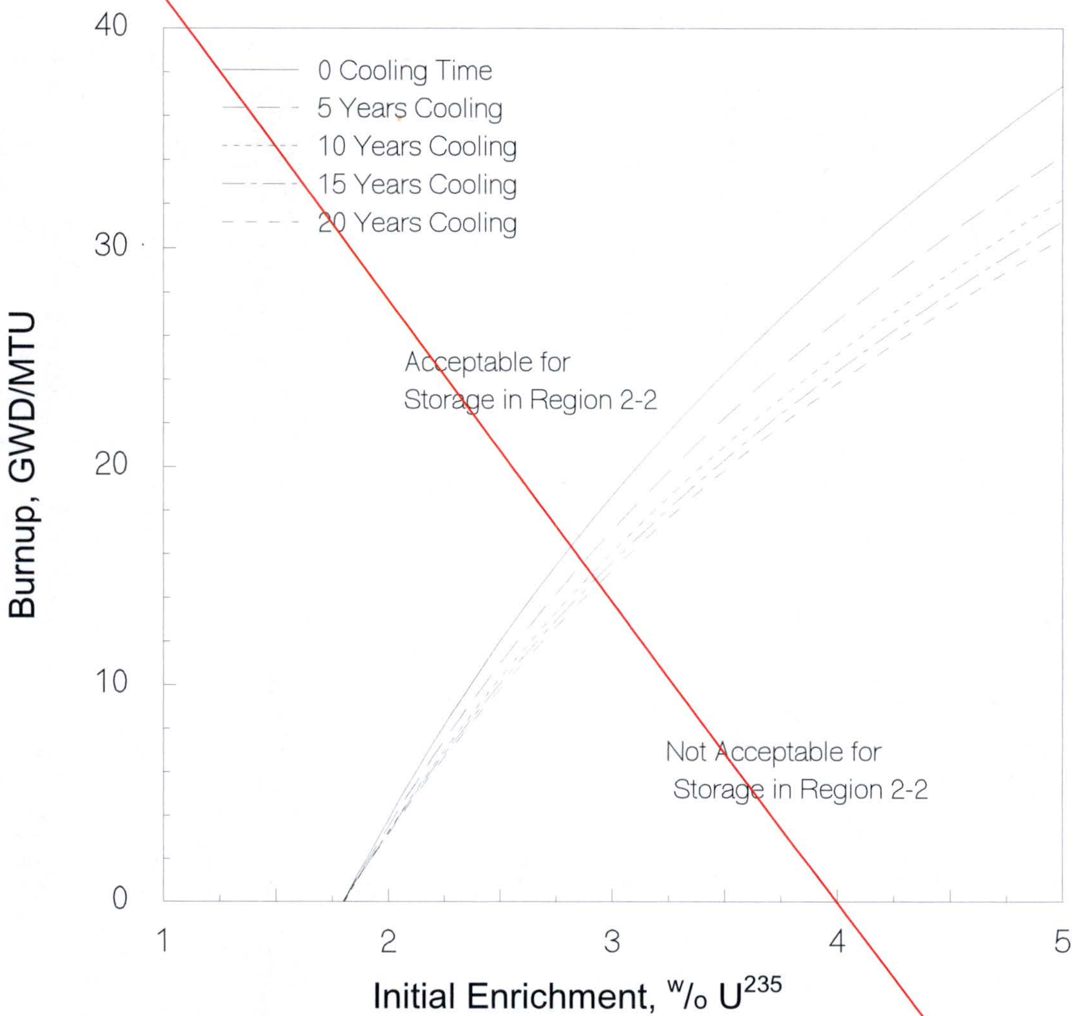

Figure 3.7.13-2
IP2 Fuel Assembly Limiting Burnup and Cooling Time versus Initial Enrichment: Acceptable for Storage in Any Location in Region 2-2, Region 1-2 or Region 1-1

Delete Figure 3.7.13-3

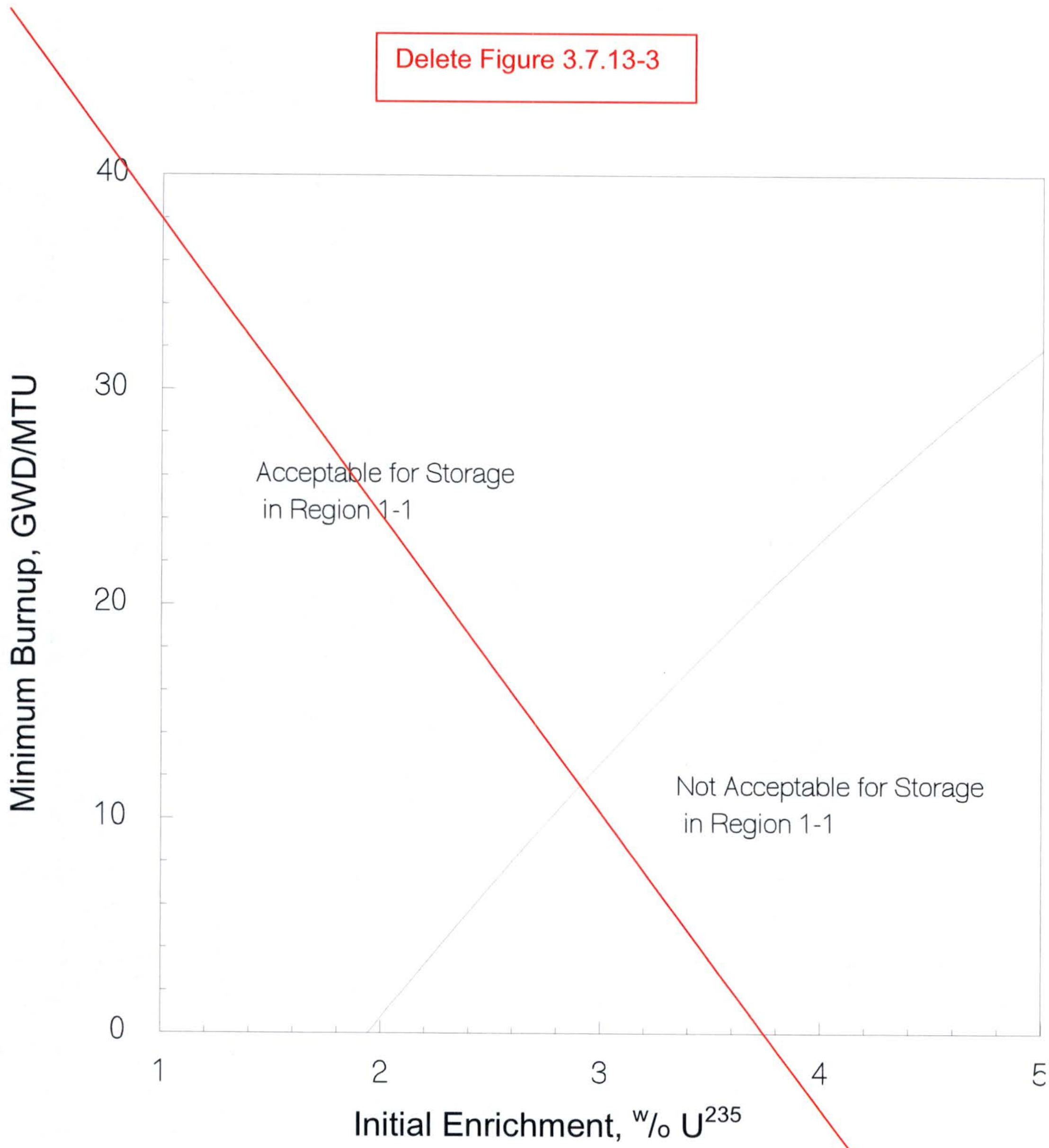

Figure 3.7.13-3
IP2 Fuel Assembly Limiting Burnup versus Initial Enrichment:
Acceptable for Storage in Any Location in Region 1-2, Region 1-1,
or in locations designated as "peripheral" cells in Region 2-2.

Delete Figure 3.7.13-4

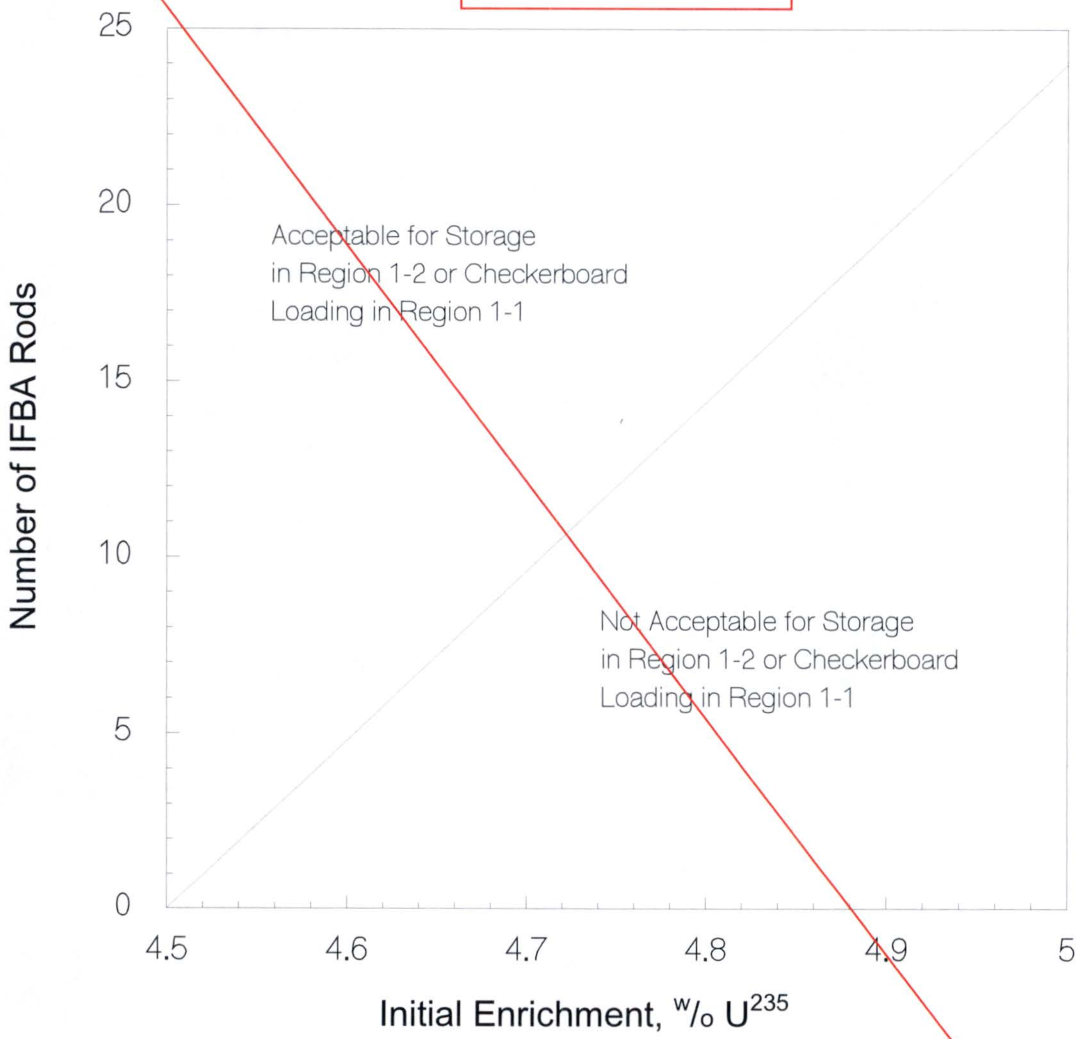

Figure 3.7.13-4
IP2 Fuel Assembly Minimum number of IFBA rods versus Initial Enrichment:

1) Acceptable for Storage in Any Location in Region 1-2, or
2) Acceptable for Storage in a checkerboard loading configuration in Region 1-1, or
3) Acceptable for Storage in locations designated as "peripheral" cells in Region 2-2.

Delete Figure 3.7.13-5

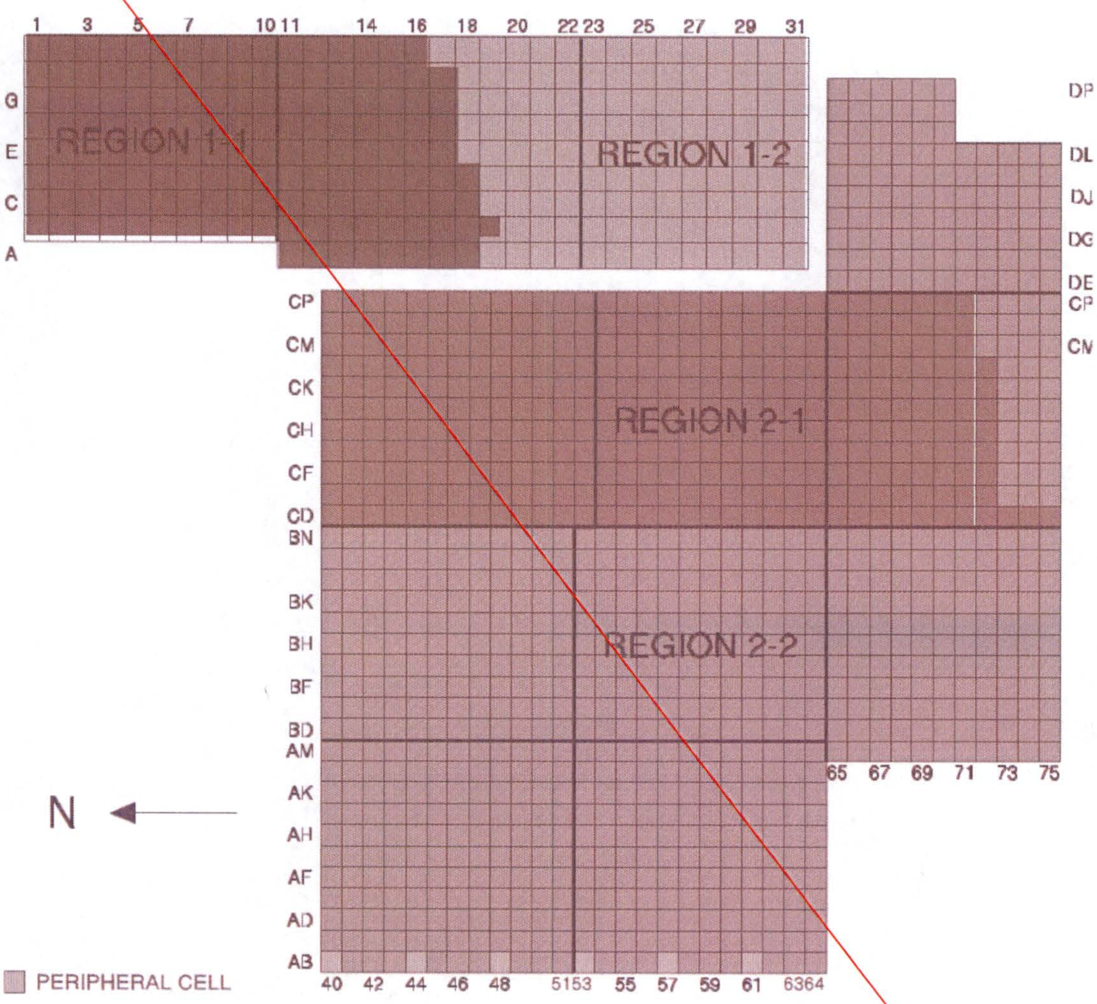

Figure 3.7.13-5
Spent Fuel Pit Rack Layout

INSERT 1

LCO 3.7.13

IP2 fuel assemblies stored in the Spent Fuel Pit shall be categorized in accordance with Table 3.7.13-1 or, if pre-categorized, Table 3.7.13-2.

IP3 fuel assemblies stored in the Spent Fuel Pit shall be categorized in accordance with Table 3.7.13-1 or, if pre-categorized, Table 3.7.13-3.

IP2 and IP3 fuel assembly storage locations within the Spent Fuel Pit shall be restricted to locations allowed by Figure 3.7.13-1 and its associated notes.

--Note--

Regarding Category 5 fuel assemblies that are required by Figure 3.7.13-1 to contain a full length RCCA - The RCCA must not be placed in or removed while the assembly is in an RCCA required location unless all 8 adjacent cells are empty.

INSERT 2

SURVEILLANCE REQUIREMENTS

SURVEILLANCE		FREQUENCY
SR 3.7.13.1	Verify by administrative means that the IP2 fuel assembly has been categorized in accordance with Table 3.7.13-1 or, if pre-categorized, Table 3.7.13-2 and meets the requirements for the intended storage location.	Prior to storing the fuel assembly in the Spent Fuel Pit.
	OR	
	Verify by administrative means that the IP3 fuel assembly has been categorized in accordance with Table 3.7.13-1 or, if pre-categorized, Table 3.7.13-3 and meets the requirements for the intended storage location.	Prior to storing the fuel assembly in the Spent Fuel Pit.

INSERT 3

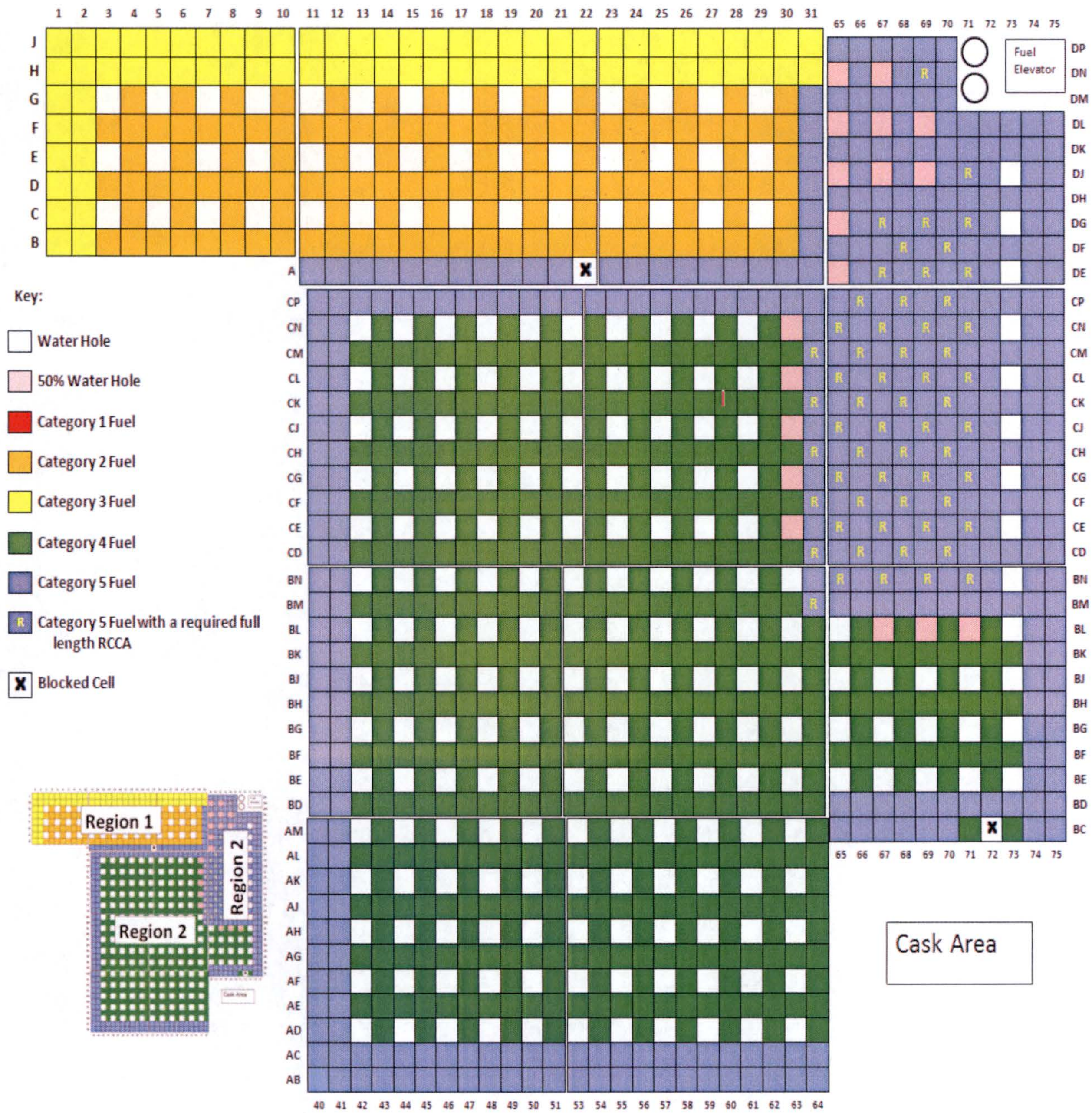

Figure 3.7.13-1 (page 1 of 2)
Allowable Spent Fuel Pit Storage Locations for Category 1 through Category 5 Fuel Assemblies in Regions 1 and 2

INSERT 3 (Continued)

-Notes-

1. Fuel assembly Categories are ranked in order of relative reactivity, from Category 1 to 5. Category 1 fuel assemblies have the highest reactivity, and Category 5 fuel assemblies have the lowest.

2. Fuel assembly categorization for assembly IDs after X for IP2 and after AA for IP3 must be performed in accordance with Table 3.7.13-1.

3. Fuel assembly Categories for IP2 assembly IDs A through X are located in Table 3.7.13-2.

4. Fuel assembly Categories for IP3 assembly IDs A through AA are located in Table 3.7.13-3.

5. Fuel assemblies of any higher numbered Category can be stored in any cell location that allows for a lower numbered Category. For example, a Category 5 fuel assembly can be stored in Category 1, 2, 3, 4, and 5 cells. Any cell may be empty.

6. Category 1 fuel assemblies that contain a full length RCCA may be stored in any Category 4, 3, 2, or 1 cell.

7. Category 2, 3 or 4 fuel assemblies that contain a full length RCCA may be stored in any Category 5 cell that does not require an inserted RCCA or in any Category 4, 3, 2, or 1 cell.

8. A Water Hole may contain up to 50% of absorber material by volume in the active fuel area. Stainless steel and Inconel meet the definition of absorber material. There is no restriction for non-actinide material outside of the active fuel area.

9. A 50% Water Hole may contain up to 50% of any non-actinide material by volume in the active fuel area. Zirconium meets the definition of non-actinide material. There is no restriction for non-actinide material outside of the active fuel area.

10. A Blocked Cell has the same requirements as a Water Hole.

11. A checkerboard area consists of every other cell being a Water Hole.

12. An area of Category 1 fuel assemblies may be formed in Region 1. The Category 1 area must be formed by replacing the Region 1 arrangement shown in this figure with an area of Category 1 fuel assemblies in accordance with the following criteria (see examples in Figure 3.7.13-2):

    a) Category 1 fuel assemblies must be face adjacent to at least three Water Holes.

    b) Category 2 fuel assemblies must not be face adjacent to more than one Category 1 fuel assembly.

13. A checkerboard area of Category 1 fuel assemblies may be formed in Region 2. All four sides of the checkerboard area must be rows of Water Holes.

14. The edge of the spent fuel rack can be considered as a row of Water Holes.

Figure 3.7.13-1 (page 2 of 2)

INSERT 4

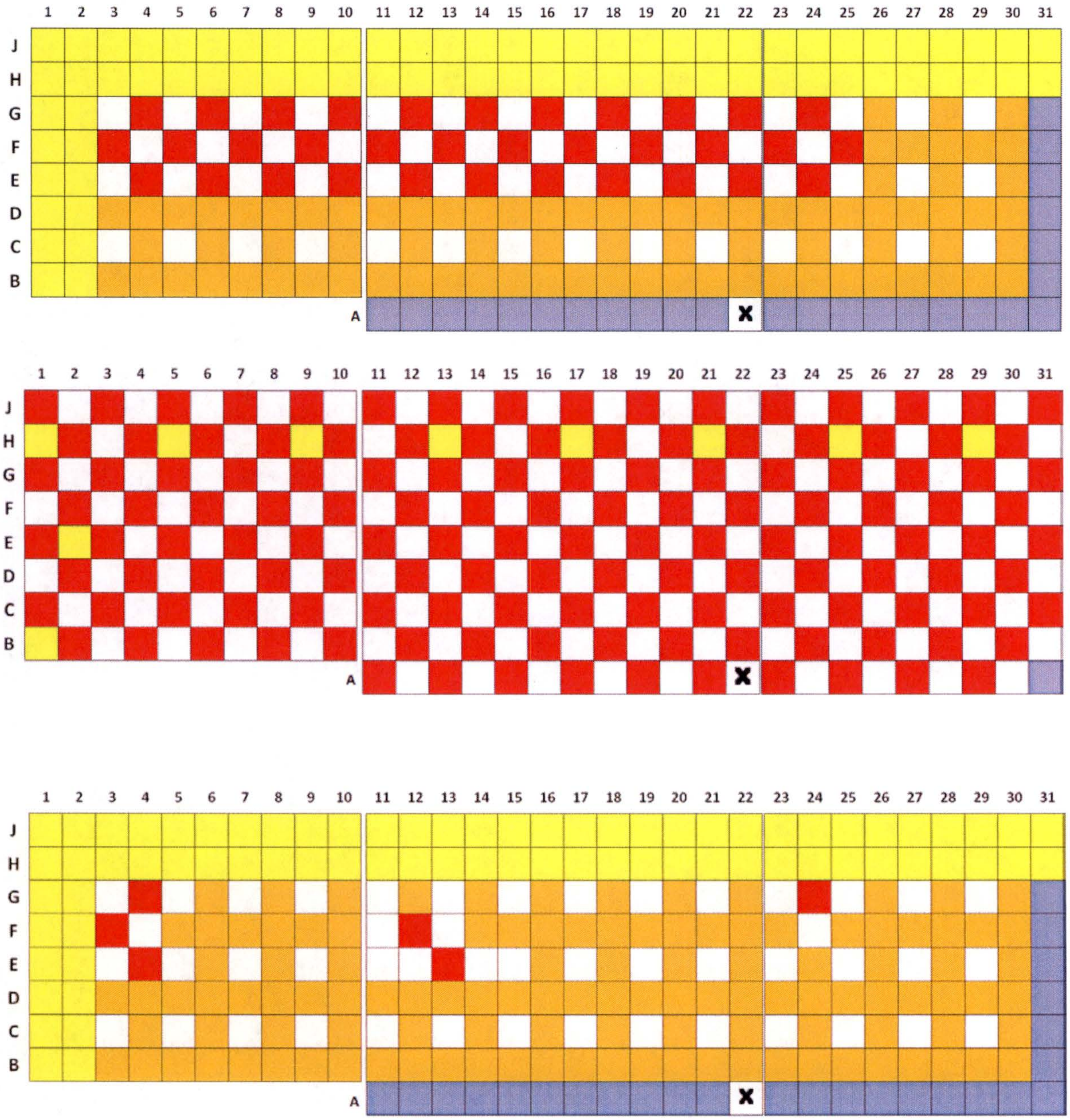

Figure 3.7.13-2
Examples of Allowable Spent Fuel Pit Storage Locations for Category 1 Fuel Assemblies in Region 1

INSERT 5

Table 3.7.13-1
Fuel Assembly Reactivity Categorization for Assembly IDs after X for IP2 and after AA for IP3

Reactivity Category	Minimum Required Burnup (MRB) (GWd/T)[(a)(b)(c)]
1	0[(d)]
2	21
3	28.5
4	$B_{1.2} = (a1 + a2*E + a3*E^2) \times \exp[-(a4 + a5*E + a6*E^2) \times CT] + a7 + a8*E + a9*E^2$ $B_{0.8} = (b1 + b2*E + b3*E^2) \times \exp[-(b4 + b5*E + b6*E^2) \times CT] + b7 + b8*E + b9*E^2$ $MRB = B_{0.8} + (B_{1.2} - B_{0.8}) \times (PF - 0.8)/ 0.4$
5	MRB for Category 4 plus 11

Where:

E is enrichment in wt% U-235[(e)],

CT is cooling time in years[(f)], and

PF is the average peaking factor defined by the fuel assembly burnup divided by the sum of the cycle burnups for the cycles the fuel assembly was in the core.

and:

Coefficient	Value	Coefficient	Value
a1	-6.26824	b1	15.1405
a2	5.29367	b2	-4.81133
a3	-0.37154	b3	0.753855
a4	0.129582	b4	0.121252
a5	-0.0204918	b5	-0.0150991
a6	0.00205596	b6	0.00127009
a7	-0.13331	b7	-16.2293
a8	6.9037	b8	14.0159
a9	0.122068	b9	-0.687054

(a) 2 GWd/T must be added to the MRB for any fuel assembly that had a Hafnium insert.

(b) 4 GWd/T must be added to the MRB for any fuel assembly that was reconstituted without replacing removed fuel rods with stainless steel rods.

(c) 0.2, 0.3, 0.6, and 0.9 GWd/T must be added to the MRB for Categories 2, 3, 4, and 5, respectively if the maximum burnup averaged soluble boron of 950 ppm for the cycle is exceeded.

(d) With 64 IFBA rods or more. Assemblies with enrichments less than or equal to 4.5, 4.0, 3.5, and 3.0 require only 48, 32, 16, and 0 IFBA rods, respectively.

INSERT 5 (Continued)

(e) Fuel assemblies at enrichments less than 4.2 wt% U-235 must use 4.2 wt% U-235 in the Category 4 equation.

(f) Fuel assemblies with cooling times of more than 25 years must use 25 years in the Category 4 equation.

INSERT 5 (Continued)

Table 3.7.13-2 (page 1 of 3)
Fuel Assembly Reactivity Categorization for Assembly IDs A through X for IP2

Indian Point Unit 2 Fuel					
Assembly ID	Category	Assembly ID	Category	Assembly ID	Category
A01-A65	4	E43-E55	4	K01-K13	4
		E56	3	K14-K15	5
B01-B07	4	E57-E60	4	K16-K57	4
B08-B13	5			K58	5
B14-B23	4	F01	3	K59-K68	4
B24-B26	5	F02-F20	4		
B27-B64	4	F21	3	L01-L07	4
		F22-F30	4	L08-L10	5
C01-C04	4	F31-F34	5	L11-L63	4
C05-C06	5	F35	4	L64	3
C07-C12	4	F36	3	L65-L68	4
C13	5	F37-F39	4		
C14	4	F40	3	M01-M04	4
C15-C18	5	F41-F49	4	M05	5
C19-C28	4	F50	3	M06-M08	4
C29	5	F51-F60	4	M09	5
C30-C64	4	F61	3	M10-M12	4
		F62-F64	4	M13-M14	5
D01-D25	4	F65	3	M15-M20	4
D26	5	F66	4	M21	5
D27-D60	4	F67-F68	5	M22-M23	4
D61-D68	5			M24	5
D69-D72	4	G01-G05	4	M25-M27	4
		G06	5	M28	5
E01-E14	4	G07-G37	4	M29-M30	4
E15	3	G38	5	M31	5
E16-E19	5	G39-G72	4	M32-M34	4
E20	4			M35	5
E21-E24	5	H01-H38	4	M36-M37	4
E25-E27	4	H39-H51	5	M38-M44	5
E28-E31	5	H52-H54	4	M45	3
E32-E33	4	H55	5	M46	4
E34-E35	5	H56	4	M47-M48	5
E36-E40	4			M49-M50	4
E41-E42	5	J01-J68	4	M51-M52	5

INSERT 5 (Continued)

Table 3.7.13-2 (page 2 of 3)
Fuel Assembly Reactivity Categorization for Assembly IDs A through X for IP2

Indian Point Unit 2 Fuel					
Assembly ID	Category	Assembly ID	Category	Assembly ID	Category
M53-M54	4	Q71-Q73	4	T42-T43	4
M55-M56	5	Q74-Q76	5	T44-T46	5
M57	4	Q77	4	T47	4
M58-M59	5	Q78	5	T48	5
M60	4	Q79-Q80	4	T49-T51	4
M61	3			T52-T53	5
M62-M63	4	R01-R07	5	T54	4
M64	3	R08	4	T55	5
M65	4	R09-R38	5	T56-T72	4
M66	5	R39	4	T73-T80	5
M67	3	R40-R43	5		
M68	5	R44-R50	4		
M69-M71	4	R51-R69	5	U01-U04	5
M72	5	R70	4	U05	4
		R71-R72	5	U06-U13	5
N01-N08	4	R73-R74	4	U14	4
N09-N12	5	R75-R79	5	U15-U16	5
N13-N14	4	R80-R81	4	U17-U21	4
N15-N16	5	R82	5	U22	5
N17-N23	4	R83-R85	4	U23	4
N24-N32	5			U24-U49	5
N33-N47	4	S01-S44	5	U50	4
N48	5	S45	4	U51	5
N49-N80	4	S46-S47	5	U52	4
		S48	4	U53-U61	5
P01-P02	4	S49-S61	5	U62-U64	4
P03	3	S62	4	U65	5
P04-P47	4	S63-S65	5	U66-U68	4
P48	5	S66	4	U69-U73	5
P49-P60	4	S67-S77	5		
P61-P72	5			V01-V16	5
				V17-V29	4
Q01-Q65	5	T01-T32	5	V30-V35	5
Q66	4	T33-T34	4	V36	4
Q67-Q68	5	T35-T36	5	V37-V38	5
Q69	4	T37	3	V39	4
Q70	5	T38-T41	5	V40-V41	5

INSERT 5 (Continued)

Table 3.7.13-2 (page 3 of 3)
Fuel Assembly Reactivity Categorization for Assembly IDs A through X for IP2

Indian Point Unit 2 Fuel					
Assembly ID	Category	Assembly ID	Category	Assembly ID	Category
V42-V43	4	W21	5	X01-X02	3
V44-V49	5	W22	4	X03-X04	5
V50	4	W23	5	X05-X37	4
V51-V54	5	W24	4	X38	5
V55-V57	4	W25	5	X39-X49	4
V58-V61	5	W26	4	X50-X51	5
V62	4	W27	5	X52-X53	4
V63	5	W28-W34	4	X54-X55	5
V64-V65	4	W35	5	X56-X58	4
V66-V67	5	W36-W38	4	X59-X60	5
V68	4	W39	5	X61-X62	4
V69-V77	5	W40	4	X63	5
V78-V79	4	W41-W43	5	X64-X65	4
V80-V81	5	W44-W45	4	X66	5
V82	4	W46	5	X67	4
V83	5	W47	4	X68-X69	5
V84	4	W48-W49	5	X70-X73	4
V85	5	W50	4	X74	5
V86	4	W51	5	X75	4
V87-V88	5	W52-W55	4	X76	5
V89	4	W56-W58	5	X77	4
V90-V91	5	W59-W60	4	X78	5
V92	4	W61	5	X79	4
		W62	4	X80-X93	5
W01-W10	4	W63-W67	5	X94-X95	4
W11	5	W68	4	X96	5
W12-W15	4	W69-W71	5		
W16	5	W72	4	FRSB[1]	4
W17	4	W73-W83	5		
W18-W19	5	W84	4		
W20	4	W85-W93	5		

1 FRSB is the Fuel Rod Storage Basket

INSERT 5 (Continued)

Table 3.7.13-3

Fuel Assembly Reactivity Categorization for Fuel Assembly IDs A through AA for IP3

Indian Point Unit 3 Fuel					
Assembly ID	Category	Assembly ID	Category	Assembly ID	Category
V43	3	V48	3		
All other Fuel Assembly IDs A through AA are Category 4					

4.0 DESIGN FEATURES

4.1 Site Location

Indian Point 2 is located on the East bank of the Hudson River at Indian Point, Village of Buchanan, in upper Westchester County, New York. The site is approximately 24 miles north of the New York City boundary line. The nearest city is Peekskill which is 2.5 miles northeast of Indian Point.

The minimum distance from the reactor center line to the boundary of the site exclusion area and the outer boundary of the low population zone, as defined in 10 CFR 100.3, is 520 meters and 1100 meters, respectively. For the purpose of satisfying 10 CFR Part 20, the "Restricted Area" is the same as the "Exclusion Area" shown in UFSAR, Figure 2.2-2.

4.2 Reactor Core

4.2.1 Fuel Assemblies

The reactor shall contain 193 fuel assemblies. Each assembly shall consist of a matrix of Zircalloy-4 or ZIRLO fuel rods. Fuel shall have a U-235 enrichment of ≤ 5.0 weight percent. Limited substitutions of Zircalloy-4, ZIRLO or stainless steel filler rods for fuel rods, in accordance with approved applications of fuel rod configurations, may be used. Fuel assemblies shall be limited to those fuel designs that have been analyzed with applicable NRC staff approved codes and methods and shown by tests or analyses to comply with all fuel safety design bases. A limited number of lead test assemblies that have not completed representative testing may be placed in nonlimiting core regions.

4.2.2 Control Rod Assemblies

The reactor core shall contain 53 control rod assemblies. The control rod material shall be silver indium cadmium, clad with stainless steel, as approved by the NRC.

4.3 Fuel Storage

4.3.1 Criticality

4.3.1.1 The spent fuel storage racks are designed and shall be maintained with:

a. Fuel assemblies having a maximum U-235 enrichment of 5.0 weight percent,

and poisons, if necessary, to meet the limit for k_{eff},

categorized

4.0 DESIGN FEATURES

4.3 Fuel Storage (continued)

b. $k_{eff} < 1.0$ if fully flooded with unborated water, and

c. Each fuel assembly ~~classified~~ based on initial enrichment, burnup, cooling time, and number of Integral Fuel Burnable Absorbers (IFBA) ~~rods~~ with individual fuel assembly storage location within the spent fuel storage rack restricted as required by Technical Specification 3.7.13.

, averaged assembly peaking factor,

4.3.1.2 The new fuel storage racks are designed and shall be maintained with:

a. Fuel assemblies having a maximum U-235 enrichment of 5.0 weight percent, and poisons, if necessary, to meet the limit for k_{eff},

b. $k_{eff} \leq 0.95$ if fully flooded with unborated water, and

c. A 20.5 inch center to center distance between fuel assemblies placed in the storage racks to meet the limit for k_{eff}.

4.3.2 Drainage

The spent fuel pit is designed and shall be maintained to prevent inadvertent draining of the pit below a nominal elevation of 88 feet, 6 inches.

4.3.3 Capacity

The spent fuel pit is designed and shall be maintained with a storage capacity limited to no more than 269 fuel assemblies in Region I and 1105 fuel assemblies in Region II.

ATTACHMENT 3 TO NL-17-144

Indian Point Unit 2

Technical Specification Bases Changes (Marked-Up)

(For Information Only)

Affected Appendix A Tech Spec Bases Pages:	B 3.7.12-1 B 3.7.12-2 B 3.7.12-3 B 3.7.12-4
	B 3.7.13-1 B 3.7.13-2 B 3.7.13-3 B 3.7.13-4 B 3.7.13-5 B 3.7.13-6 B 3.7.13-7 B 3.7.13-8 B 3.7.13-9 B 3.7.13-10 B 3.7.13-11

Entergy Nuclear Operations, Inc.
Indian Point Unit 2
Docket No. 50-247

B 3.7 PLANT SYSTEMS

B 3.7.12 Spent Fuel Pit Boron Concentration

BASES

BACKGROUND

The Spent Fuel Pit (SFP) is used to store spent fuel removed from the reactor and new fuel ready for insertion into the reactor. The SFP has been evaluated to meet the requirements of option (b) of 10 CFR 50.68, "Criticality Accident Requirements" (Ref. 1). IP2 compliance with 10 CFR 50.68(b)(4) was confirmed by an analysis ~~documented in Northeast Technology Corporation report NET-173-01, "Criticality Analysis for Soluble Boron and Burnup Credit in the Con Edison Indian Point Unit No. 2 Spent Fuel Storage Racks"~~ (Ref. 2). This analysis demonstrated that 10 CFR 50.68(b)(4) will be met during normal SFP operation and all credible accident scenarios ~~(including the affects of boraflex degradation)~~ if the following requirements are met:

INSERT 1

a) Spent Fuel Pit boron concentration is maintained within the limits of LCO 3.7.12, "Spent Fuel Pit Boron Concentration," whenever fuel is stored in the SFP; and,

b) Fuel assembly storage location within the Spent Fuel Pit is restricted in accordance with LCO 3.7.13, "Spent Fuel Pit Storage," ~~based on the fuel assembly's initial enrichment, burnup, decay of Plutonium-241 (i.e., cooling time), and number of Integral Fuel Burnable Absorbers (IFBA) rods.~~

A detailed description of how this combination of minimum boron concentration and restrictions on fuel assembly storage location is presented in the Bases for LCO 3.7.13.

APPLICABLE SAFETY ANALYSES

INSERT 2

NET-173-01, "Criticality Analysis for Soluble Boron and Burnup Credit in the Con Edison Indian Point Unit No. 2 Spent Fuel Storage Racks" (Ref. 2) evaluated non-accident conditions in the SFP including the affects of the projected boraflex degradation through the year 2006. Based upon BADGER testing in calendar years 2003, 2006 and 2010 and RACKLIFE code projections, the validity of the criticality and boron dilution analysis documented in References 2, 3, 5 and 6 can be extended through the end of the current license (September 28, 2013). Reference 7 allowed BADGER testing to be performed in 2013, to confirm the progression of localized Boraflex dissolution. The continued validity of the criticality and boron dilution analysis will be verified based on the boron monitoring program as defined in the License Renewal Application. Reference 2 determined that if storage location requirements in this LCO are met then the

BASES

APPLICABLE SAFETY ANALYSES (continued)

SFP will have a keff of ≤ 0.95 if filled with a soluble boron concentration of ≥ 786 ppm and will have a keff of < 1.0 if filled with unborated water.

Reference 2 also evaluated credible abnormal occurrences in accordance with ANSI/ANS-57.2-1983. This evaluation considered the effects of the following: a) a dropped fuel assembly or an assembly placed alongside a rack; b) a misloaded fuel assembly; and, c) abnormal heat loads. Reference 2 determined that the SFP will maintain a keff of ≤ 0.95 under the worst-case accident scenario if the SFP is filled with a soluble boron concentration of ≥ 1495 ppm.

NET-173-02, "Indian Point Unit 2 Spent Fuel Pool (SFP) Boron Dilution Analysis" (Ref. 3) evaluated postulated unplanned SFP boron dilution scenarios assuming an initial SFP boron concentration within the limits of LCO 3.7.12. The evaluation considered various scenarios by which the SFP boron concentration may be diluted and the time available before the minimum boron concentration necessary to ensure subcriticality for the non-accident condition (i.e. it is not assumed an assembly is misloaded concurrent with the Spent Fuel Pit dilution event). Reference 3 determined that an unplanned or inadvertent event that could dilute the SFP boron concentration from 2000 ppm to 786 ppm is not a credible event because of the low frequency of postulated initiating events and because the event would be readily detected and mitigated by plant personnel through alarms, flooding, and operator rounds through the SFP area.

References 2 and 3 are based on conservative projections of amount of Boraflex absorber panel degradation assumed in each sub-region. These projections are valid through the end of the year 2006. Based upon BADGER testing in calendar years 2003, 2006 and 2010 and RACKLIFE code projections, the validity of the criticality and boron dilution analysis documented in References 2, 3, 5 and 6 can be extended through the end of the current license (September 28, 2013). Reference 7 allowed BADGER testing to be performed in 2013, to confirm the progression of localized Boraflex dissolution. The continued validity of the criticality and boron dilution analysis will be verified based on the boron monitoring program as defined in the License Renewal Application. These compensatory measures for boraflex degradation in the SFP were evaluated by the NRC in Reference 4.

The concentration of dissolved boron in the spent fuel pit satisfies Criterion 2 of 10 CFR 50.36 (c)(2)(ii).

BASES

LCO

The Spent Fuel Pit boron concentration is required to be ≥ 2000 ppm. The specified concentration of dissolved boron in the Spent Fuel Pit preserves the assumptions used in the analyses of the potential critical accident scenarios as described in Reference 2. This concentration of dissolved boron is the minimum required concentration for fuel assembly storage and movement within the Spent Fuel Pit.

APPLICABILITY

This LCO applies whenever fuel assemblies are stored in the Spent Fuel Pit.

ACTIONS

A.1 and A.2

The Required Actions are modified by a Note indicating that LCO 3.0.3 does not apply.

When the concentration of boron in the Spent Fuel Pit is less than required, immediate action must be taken to preclude the occurrence of an accident or to mitigate the consequences of an accident in progress. This is most efficiently achieved by immediately suspending the movement of fuel assemblies. The concentration of boron is restored simultaneously with suspending movement of fuel assemblies.

If the LCO is not met while moving irradiated fuel assemblies in MODE 5 or 6, LCO 3.0.3 would not be applicable. If moving irradiated fuel assemblies while in MODE 1, 2, 3, or 4, the fuel movement is independent of reactor operation. Therefore, inability to suspend movement of fuel assemblies is not sufficient reason to require a reactor shutdown.

SURVEILLANCE REQUIREMENTS

SR 3.7.12.1

This SR verifies that the concentration of boron in the Spent Fuel Pit is within the required limit. As long as this SR is met, the analyzed accidents are fully addressed. The 7 day Frequency is appropriate because no major replenishment of Spent Fuel Pit water is expected to take place over such a short period of time.

BASES

REFERENCES

INSERT 3

1. 10 CFR 50.68, "Criticality Accident Requirements."

2. Northeast Technology Corporation report NET-173-01, "Criticality Analysis for Soluble Boron and Burnup Credit in the Con Edison Indian Point Unit No. 2 Spent Fuel Storage Racks."

3. Northeast Technology Corporation report NET-173-02, "Indian Point Unit 2 Spent Fuel Pool (SFP) Boron Dilution Analysis."

4. Safety Evaluation by the Office of Nuclear Reactor Regulation Related to Amendment No. 227 to Facility Operating License No. DPR-26, May 29, 2002.

5. NETCO Letter to M. R. Hansler from E. Lindquist, Northeast Technology Corp. dated 12/19/06, Subject – Reference 2 and 3 extension.

6. NETCO Letter to Floyd Gumble from Matt Harris dated 12/22/2009, titled "Indian Point 2 RACKLIFE Projections Through 2010 and 2012 BADGER Tests with RACKLIFE Version 2.1"

7. NETCO Letter to Giancarlo Delfini from Matt Harris dated 12/12/2012, titled "Update of IP2 RACKLIFE Model – (In partial fulfillment of Entergy Contract 10351857, Change Order No. 1, Task 2A)".

INSERT 1

Curtiss-Wright Nuclear Division, NETCO report NET-28091-003-01, Rev. 0 "Criticality Safety Analysis for the Indian Point Unit 2 Spent Fuel Pool with No Absorber Panel Credit."

INSERT 2

Curtiss-Wright Nuclear Division, NETCO report NET-28091-003-01, Rev. 0 "Criticality Safety Analysis for the Indian Point Unit 2 Spent Fuel Pool with No Absorber Panel Credit" (Ref. 2) evaluated non-accident conditions in the SFP. Reference 2 determined that if storage location requirements in this LCO are met then the SFP will have a keff of ≤ 0.95 if filled with a soluble boron concentration of ≥ 700 ppm and will have a keff of < 1.0 if filled with unborated water.

Reference 2 evaluated abnormal occurrences and accidents. This evaluation considered the effects of the following: a) multiple misloads, b) an assembly placed alongside a rack; c) a dropped assembly, d) a misloaded assembly; e) SFP over temperature, f) a seismic event, and, g) a SFP boron dilution accident. Reference 2 determined that the most limiting fuel handling accident is the multiple misload accident and determined keff of ≤ 0.95 if the SFP is filled with a soluble boron concentration of ≥ 2000 ppm.

NET-173-02, "Indian Point Unit 2 Spent Fuel Pool (SFP) Boron Dilution Analysis" (Ref. 3) evaluated postulated unplanned SFP boron dilution scenarios assuming an initial SFP boron concentration within the limits of LCO 3.7.12. The evaluation considered various scenarios by which the SFP boron concentration may be diluted and the time available before the minimum boron concentration necessary to ensure subcriticality for the non-accident condition (i.e. it is not assumed an assembly is misloaded concurrent with the Spent Fuel Pit dilution event). Reference 3 determined that an unplanned or inadvertent event that could dilute the SFP boron concentration from 2000 ppm to 786 ppm is not a credible event because of the low frequency of postulated initiating events and because the event would be readily detected and mitigated by plant personnel through alarms, flooding, and operator and security rounds through the SFP area.

The concentration of dissolved boron in the spent fuel pit satisfies Criterion 2 of 10 CFR 50.36 (c)(2)(ii).

INSERT 3

2. Curtiss-Wright Nuclear Division, NETCO report NET-28091-003-01, Rev. 0 "Criticality Safety Analysis for the Indian Point Unit 2 Spent Fuel Pool with No Absorber Panel Credit."

3. Northeast Technology Corporation report NET-173-02, "Indian Point Unit 2 Spent Fuel Pool (SFP) Boron Dilution Analysis."

B 3.7 Plant Systems

B 3.7.13 Spent Fuel Pit Storage

BASES

BACKGROUND

INSERT 1

An issue has been identified with the degradation of boraflex used in the spent fuel pool to meet the licensing basis. To address this degradation Procedure 0-NF-203R16, Attachment 3, Transfer Form Checklist, discusses the administrative controls used to mitigate the effects of the boraflex degradation.

IP2 Fuel Assemblies

The Spent Fuel Pit (SFP) is used to store spent fuel removed from the reactor and new fuel ready for insertion into the reactor. Spent fuel racks (SFRs) are erected on the SFP floor to hold the fuel assemblies. The SFRs have been evaluated to meet the requirements of option (b) of 10 CFR 50.68, "Criticality Accident Requirements" (Ref. 1) when: a) Spent Fuel Pit boron concentration is maintained within the limits of LCO 3.7.12, "Spent Fuel Pit Boron Concentration," and, b) fuel assembly storage location within the Spent Fuel Pit is restricted in accordance with LCO 3.7.13, "Spent Fuel Pit Storage," based on the fuel assembly's initial enrichment, burnup, decay of Plutonium-241 (i.e., cooling time), and number of Integral Fuel Burnable Absorbers (IFBA) rods.

In 1990, Spent Fuel Pit storage capacity was increased from 980 fuel assemblies to 1376 fuel assemblies by the installation of high-density racks that reduced the distance between adjacent fuel assemblies. This was possible because the k-effective of the SFP was maintained within the limits of 10 CFR 50.68(b) (Ref. 1) by the following: 1) the use of boraflex absorber panels (i.e., neutron absorbers) between SFR cells; and, 2) restrictions on fuel assembly storage location within the SFP based on initial enrichment and burnup. The original design of the high density racks met the requirements of 10 CFR 50.68(b) without crediting soluble boron.

The use of high-density SFRs that depend on boraflex absorber panels between cells requires that IP2 adhere to a long-term inspection program to monitor the performance of the boraflex panels. Requirements for the boraflex inspection program are specified in IP2 Amendment 150 (Ref. 2) and Generic Letter 96-04, "Boraflex Degradation in Spent Fuel Pool Storage Racks" (Ref. 3).

BASES

BACKGROUND (continued)

During an inspection of the SFRs in 2000, it was determined that the assumptions regarding the boraflex panels used in the criticality analysis for the SFP were no longer valid because of thinning and gaps in the boraflex panels. This degradation of the boraflex panels between SFR cells required that IP2 adopt the "use of soluble boron" option in 10 CFR 50.68(b)(4) which specifies that:

> " ... 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), at a 95 percent probability, 95 percent confidence level, if flooded with unborated water."

Based on the results of an inspection and analysis that conservatively projected the condition of the boraflex panels through the end of 2006, IP2 compliance with 10 CFR 50.68(b)(4) was confirmed by an analysis documented in Northeast Technology Corporation report NET-173-01, "Criticality Analysis for Soluble Boron and Burnup Credit in the Con Edison Indian Point Unit No. 2 Spent Fuel Storage Racks" (Ref. 4). Based upon BADGER testing in calendar years 2003, 2006 and 2010 and RACKLIFE code projections, the validity of the criticality and boron dilution analysis documented in References 4, 5, 7 and 10 can be extended through the end of the current license (September 28, 2013). Based on Reference 11, BADGER testing was performed in 2013, to confirm the progression of localized Boraflex dissolution. The continued validity of the criticality and boron dilution analysis will be verified based on the boron monitoring program as defined in the License Renewal Application. This analysis demonstrated that 10 CFR 50.68(b)(4) will be met for all normal and credible accident scenarios if the following requirements are met:

a) Spent Fuel Pit boron concentration is maintained within the limits of LCO 3.7.12, "Spent Fuel Pit Boron Concentration," whenever fuel is stored in the SFP; and,

b) Fuel assembly storage location within the Spent Fuel Pit is restricted in accordance with LCO 3.7.13, "Spent Fuel Pit Storage," based on the fuel assembly's initial enrichment, burnup, decay of Plutonium-241 (i.e., cooling time), and number of Integral Fuel Burnable Absorbers (IFBA) rods.

Fuel assembly storage location within the Spent Fuel Pit is an essential element for the validity of the analysis because the storage racks in the areas designated Region 1 have a different design than the storage racks in the

BASES

BACKGROUND (continued)

areas designated Region 2. These design differences have a significant impact on criticality calculations. Additionally, each of the two regions is sub-divided into two parts based on the extent of the boraflex degradation. Therefore, the SFP is divided into four distinct regions based on rack design and boraflex degradation. Figure 3.7.13-5 identifies the four regions as Region 1-1, Region 1-2, Region 2-1 and Region 2-2. Additionally, selected cells located on the perimeter of Region 2-2 have higher neutron leakage rates than other cells in the Region and are designated as "peripheral" cells.

Each SFP region and sub-region is shown in Figure 3.7.13-5 and is described below beginning with the region that can be used to store only the least reactive fuel and ending with the region that must be used to store the most reactive fuel.

Region 2, consisting of nine racks that use the egg-crate design, can store 1105 fuel assemblies and two failed fuel canisters. Region 2 racks consist of boxes welded into a "checkerboard" array with a storage location in each square. One Boraflex absorber panel is held to one side of each cell wall by picture frame sheathing. Region 2 racks were originally designed to store fuel assemblies that have undergone significant burnup (e.g., ≤ 5.0 weight percent (w/o) U^{235} with a burnup of at least 40,900 megawatt days per metric ton (MWD/MT)) or fuel assemblies with a relatively low initial enrichment and low burnup (i.e., ≤ 1.764 w/o U^{235} at zero burnup).

Region 2 is subdivided into two regions (Region 2-1 and Region 2-2):

> **Region 2-1** is assumed to have sustained a 100% loss of Boraflex (i.e., none of the boraflex in the panels is assumed to be available). Figure 3.7.13-1 shows the fuel assembly criteria that will meet the requirements of 10 CFR 50.68(b)(4) if stored in Region 2-1. As shown on Figure 3.7.13-1, the maximum initial enrichment that can be stored in Region 2-1 with no burnup is 1.06 w/o U^{235}. Figure 3.7.13-1 shows an allowance permitting storage of fuel assemblies with higher initial enrichments based on the reactivity reduction due to the cumulative burnup of the fuel assembly in the core and the decay of Pu^{241} (expressed as cooling time) after a fuel assembly is discharged.
>
> **Region 2-2** is assumed to have sustained only a 30% loss of Boraflex (i.e., 70% of the boraflex in the panels is assumed to be available). Figure 3.7.13-2 shows the fuel assembly criteria that will meet the requirements of 10 CFR 50.68(b)(4) if stored in Region 2-2. As shown on Figure 3.7.13-2, the maximum initial enrichment that can be stored in Region 2-2 with no burnup is 1.80 w/o U^{235}.

BASES

BACKGROUND (continued)

Additionally, Figure 3.7.13-2 shows an allowance permitting storage of fuel assemblies with higher initial enrichments based on the reactivity reduction due to the cumulative burnup of the fuel assembly in the core and the decay (expressed as cooling time) of Pu^{241} after a fuel assembly is discharged.

Region 1, consisting of three racks that use the flux trap design, can store 269 new or irradiated fuel assemblies. The flux trap design used in Region 1 uses spacer plates in the axial direction to separate the cells. Boraflex absorber panels are held in place adjacent to each side of the cell by picture-frame sheathing. The spacer plates between cells form a flux trap between the boraflex absorber panels. Region 1 racks were originally designed to store new fuel with enrichments up to 5.0 $^{w}/_{o}$ U^{235}.

Region 1 is subdivided into two regions (Region 1-1 and Region 1-2):

Region 1-1 is assumed to have sustained a 100% loss of Boraflex (i.e., none of the boraflex in the panels is assumed to be available). Figure 3.7.13-3 shows the fuel assembly criteria that will meet the requirements of 10 CFR 50.68(b)(4) if stored in Region 1-1. As shown on Figure 3.7.13-3, the maximum initial enrichment that can be stored in Region 1-1 with no burnup is 1.95 $^{w}/_{o}$ U^{235}. Additionally, Figure 3.7.13-3 shows an allowance permitting storage of fuel assemblies with higher initial enrichments based on the reactivity reduction due to the cumulative burnup of the fuel assembly in the core. Figure 3.7.13-3 does not provide any allowance from the minimum required fuel assembly burnup based on the decay of Pu^{241}.

(Fuel assemblies that do not meet the criteria in Figure 3.7.13-3 may be stored in Region 1-1 if the following two conditions are met: a) the fuel assemblies are stored in a checkerboard loading configuration (1 out of every two cells with every other cell vacant); and, b) fuel assemblies meet the criteria of Figure 3.7.13-4.)

Region 1-2 is assumed to have sustained a 50% loss of Boraflex (i.e., 50% of the boraflex in the panels is assumed to be available). Region 1-2 can accommodate unirradiated fuel up to 5.0 $^{w}/_{o}$ U^{235} assuming the presence of a minimum number of IFBA rods as specified in Figure 3.7.13-4. As shown on Figure 3.7.13-4, the maximum initial enrichment that can be stored in Region 1-2 when there are no IFBA rods is 4.50 $^{w}/_{o}$ U^{235}. Figure 3.7.13-4 does not Provide any allowance from the minimum required IFBA rods based on the decay of PU^{241}.

BASES

BACKGROUND (continued)

Peripheral" Cells, consisting of six select cells along the SFP west wall in Region 2-2, are shown in Figure 3.7.13-5. These six "peripheral" cells may be used to store fuel that meets the requirements for storage in any other location in the SFP. Cells between and adjacent to the "peripheral" cells may be filled with fuel assemblies that meet the requirements of Figure 3.7.13-2 (i.e., meet the requirements for storage in Region 2-2). The two prematurely discharged fuel assemblies meet the requirements of Figure 3.7.13-4 and qualify for storage in the "peripheral" cells.

IP3 Fuel Assemblies

The SFP is also used to store spent fuel transferred from the IP3 SFP. The IP3 fuel assembly storage location is also restricted in accordance with LCO 3.7.13 that limits IP3 fuel assemblies to Region 1-2 of the IP2 SFP. The NRC has issued Amendment 268 for the inter-unit transfer of spent nuclear fuel (Ref. 8). The Amendment is based on evaluations conducted for each aspect of the inter-unit transfer of fuel as documented in Reference 9.

APPLICABLE SAFETY ANALYSES

INSERT 2

IP2 Fuel Assemblies

As required by 10 CFR 50.68, "Criticality Accident Requirements" (Ref. 1), if the Spent Fuel Pit takes credit for soluble boron, then "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), at a 95 percent probability, 95 percent confidence level, if flooded with unborated water."

NET-173-01, "Criticality Analysis for Soluble Boron and Burnup Credit in the Con Edison Indian Point Unit No. 2 Spent Fuel Storage Racks" (Ref. 4) and NET-173-02, "Indian Point Unit 2 Spent Fuel Pool (SFP) Boron Dilution Analysis," (Ref. 5) determined that 10 CFR 50.68(b)(4) will be met during normal SFP operation and all credible accident scenarios (including the affects of boraflex degradation) if: a) Spent Fuel Pit boron concentration is maintained within the limits of LCO 3.7.12, "Spent Fuel Pit Boron Concentration," and, b) fuel assembly storage location within the Spent Fuel Pit is restricted based on the fuel assembly's initial enrichment, burnup, decay of Pu^{241} (i.e., cooling time) and number of Integral Fuel Burnable Absorbers (IFBA) rods.

BASES

APPLICABLE SAFETY ANALYSES (continued)

Reference 4 evaluated non-accident conditions in the SFP including the affects of the projected boraflex degradation through the year 2006. Based upon BADGER testing in calendar years 2003, 2006 and 2010 and RACKLIFE code projections, the validity of the criticality and boron dilution analysis documented in References 4, 5, 7 and 10 can be extended through the end of the current license (September 28, 2013). Based on Reference 11 BADGER testing was performed in 2013, to confirm the progression of localized Boraflex dissolution. The continued validity of the criticality and boron dilution analysis will be verified based on the boron monitoring program as defined in the License Renewal Application. Reference 4 determined that if storage location requirements in this LCO are met then the SFP will have a keff of ≤ 0.95 if filled with a soluble boron concentration of ≥ 786 ppm and will have a keff of < 1.0 if filled with unborated water.

Reference 4 also evaluated credible abnormal occurrences in accordance with ANSI/ANS-57.2-1983. This evaluation considered the effects of the following: a) a dropped fuel assembly or an assembly placed alongside a rack; b) a misloaded fuel assembly; and, c) abnormal heat loads. Reference 4 determined that the SFP will maintain a keff of ≤ 0.95 under the worst-case accident scenario if the SFP is filled with a soluble boron concentration of ≥ 1495 ppm.

Therefore, reference 4 confirmed that the requirements in 10 CFR 50.68, "Criticality Accident Requirements," (Ref. 1) will be met for both normal SFP operation and credible abnormal occurrences if:

a) Spent Fuel Pit boron concentration is maintained within the limits of LCO 3.7.12, "Spent Fuel Pit Boron Concentration," whenever fuel is stored in the SFP; and,

b) Fuel assembly storage location within the Spent Fuel Pit is restricted in accordance with LCO 3.7.13, "Spent Fuel Pit Storage," based on the fuel assembly's initial enrichment, burnup, decay of Plutonium-241 (i.e., cooling time), and number of Integral Fuel Burnable Absorbers (IFBA) rods.

Reference 5 evaluated postulated unplanned SFP boron dilution scenarios assuming an initial SFP boron concentration within the limits of LCO 3.7.12. The evaluation considered various scenarios by which the SFP boron concentration may be diluted and the time available before the minimum boron concentration necessary to ensure subcriticality for the non-accident condition (i.e. it is not assumed an assembly is misloaded concurrent with the Spent Fuel Pit dilution event). Reference 5 determined that an unplanned or inadvertent event that could dilute the SFP boron concentration from

BASES

APPLICABLE SAFETY ANALYSES (continued)

2000 ppm to 786 ppm is not a credible event because of the low frequency of postulated initiating events and because the event would be readily detected and mitigated by plant personnel through alarms, flooding, and operator rounds through the SFP area.

Reference 4 and 5 are based on conservative projections of amount of Boraflex absorber panel degradation assumed in each sub-region. These projections are valid through the end of the year 2006. These compensatory measures for boraflex degradation in the SFP were evaluated by the NRC in Reference 6. Based upon BADGER testing in calendar years 2003, 2006 and 2010 and RACKLIFE code projections, the validity of the criticality and boron dilution analysis documented in References 4, 5, 7 and 10 can be extended through the end of the current license (September 28, 2013). Based on Reference 11, BADGER testing was performed in 2013, to confirm the progression of localized Boraflex dissolution. The continued validity of the criticality and boron dilution analysis will be verified based on the boron monitoring program as defined in the License Renewal Application.

<u>IP3 Fuel Assemblies</u>

An analysis, documented in Reference 9, evaluated the effect of modeling IP3 integral and discrete burnable absorbers on reactivity in the IP2 spent fuel pool using current methodologies. A reactivity bias was determined. In order to offset this bias, and maintain the validity of the IP2 SFP criticality analysis, it was determined that IP3 fuel assemblies can be stored in the IP2 SFP with the following restrictions:

a. IP3 fuel assemblies shall be stored in Region 1-2 of the IP2 Spent Fuel Pit, and

b. The fuel assembly initial enrichment $\geq$ 3.2 and $\leq$ 4.4 w/o U235, and

c. The fuel assembly discharge Cycle > 1 and $\leq$ 11.

The configuration of fuel assemblies in the Spent Fuel Pit satisfies Criterion 2 of 10 CFR 50.36(c)(2)(ii).

BASES

LCO

INSERT 3

IP2 Fuel Assemblies

This LCO establishes restrictions on fuel assembly storage location within the SFP to ensure that the requirements of 10 CFR 50.68 are met. This LCO requires that each fuel assembly stored in the Spent Fuel Pit is classified in accordance with Figure 3.7.13-1, Figure 3.7.13-2, Figure 3.7.13-3, and Figure 3.7.13-4, based on initial enrichment, burnup, cooling time and number of Integral Fuel Burnable Absorbers (IFBA) rods; and, that fuel assembly storage location within the Spent Fuel Pit is restricted to Regions identified in Figure 3.7.13-5 as follows:

a. Fuel assemblies that satisfy requirements of Figure 3.7.13-1 may be stored in any location in Region 2-1, Region 2-2, Region 1-2 or Region 1-1.

   As shown on Figure 3.7.13-1, the maximum initial enrichment that can be stored in Region 2-1 with no burnup is 1.06 $^{w}/_{o}$ U^{235}. Additionally, Figure 3.7.13-1 shows an allowance permitting storage of fuel assemblies with higher initial enrichments based on the reactivity reduction due to the cumulative burnup of the fuel assembly in the core and the decay of Pu^{241} after a fuel assembly is discharged (expressed as cooling time).

b. Fuel assemblies that satisfy requirements of Figure 3.7.13-2 may be stored in any location in Region 2-2, Region 1-2 or Region 1-1.

   As shown on Figure 3.7.13-2, the maximum initial enrichment that can be stored in Region 2-2 with no burnup is 1.80 $^{w}/_{o}$ U^{235}. Additionally, Figure 3.7.13-2 shows an allowance permitting storage of fuel assemblies with higher initial enrichments based on the reactivity reduction due to the cumulative burnup of the fuel assembly in the core and the decay (expressed as cooling time) of Pu^{241} after a fuel assembly is discharged.

c. Fuel assemblies that satisfy requirements of Figure 3.7.13-3 may be stored in any location in Region 1-2 or Region 1-1.

   As shown on Figure 3.7.13-3, the maximum initial enrichment that can be stored in Region 1-1 with no burnup is 1.95 $^{w}/_{o}$ U^{235}. Additionally, Figure 3.7.13-3 shows an allowance permitting storage of fuel assemblies with higher initial enrichments based on the reactivity reduction due to the cumulative burnup of the fuel assembly in the core. Figure 3.7.13-3 does not provide any allowance from the minimum required fuel assembly burnup based on the decay of Pu^{241}.

   (Fuel assemblies that do not meet the criteria in Figure 3.7.13-3 may be stored in Region 1-1 if the fuel assemblies are stored in a checkerboard

BASES

LCO (continued)

loading configuration (1 out of every two cells with every other cell vacant) and fuel assemblies meet the criteria of Figure 3.7.13-4.)

d. Fuel assemblies that satisfy requirements of Figure 3.7.13-4 may be stored as follows: 1) In any location in Region 1-2; or, 2) In a checkerboard loading configuration (1 out of every two cells with every other cell vacant) in Region 1-1; or, 3) In locations designated as "peripheral" cells in Region 2-2 of Figure 3.7.13-5.

   As shown on Figure 3.7.13-4, the maximum initial enrichment that can be stored in Region 1-2 with when there are no IFBA rods is 4.50 $^{w}/_{o}$ U^{235}. Figure 3.7.13-4 does not provide any allowance from the minimum required IFBA rods based on the decay of Pu^{241}.

   The six "peripheral" cells may be used to store fuel that meets the requirements for storage in any location in the SFP (i.e., meets requirements for storage in Region 1-1, 1-2, 2-1 or 2-2). Cells between and adjacent to the "peripheral" cells may be filled with fuel assemblies that meet the requirements of Figure 3.7.13-2 (i.e., meet the requirements for storage in Region 2-2). The two prematurely discharged fuel assemblies meet the requirements of Figure 3.7.13-4 and qualify for storage in canisters that are loaded in Module H in the southeast corner of the SFP. Module H is in the upper right corner of the SFP in Figure 3.7.13-5.

<u>IP3 Fuel Assemblies</u>

This LCO establishes restrictions on fuel assembly storage location within the SFP to ensure that the requirements of 10 CFR 50.68 are met.

APPLICABILITY

This LCO applies whenever any fuel assembly is stored in the Spent Fuel Pit.

ACTIONS

<u>A.1</u>

Required Action A.1 is modified by a Note indicating that LCO 3.0.3 does not apply.

When the configuration of fuel assemblies stored in the Spent Fuel Pit is not in accordance with the rules established by LCO 3.7.13, the immediate action is to initiate action to make the necessary fuel assembly movement(s)

BASES

ACTIONS (continued)

to bring the configuration into compliance with the rules established by LCO 3.7.13.

If unable to move irradiated fuel assemblies while in MODE 5 or 6, LCO 3.0.3 would not be applicable. If unable to move irradiated fuel assemblies while in MODE 1, 2, 3, or 4, the action is independent of reactor operation. Therefore, inability to move fuel assemblies is not sufficient reason to require a reactor shutdown.

SURVEILLANCE REQUIREMENTS

SR 3.7.13.1

INSERT 4

This SR verifies by administrative means that the IP2 fuel assembly has been classified based on initial enrichment, burnup, cooling time and number of Integral Fuel Burnable Absorbers (IFBA) rods in the fuel assembly in accordance with Figure 3.7.13-1, Figure 3.7.13-2, Figure 3.7.13-3, or Figure 3.7.13-4 and that the fuel assembly meets the requirements for the intended storage location defined on Figure 3.7.13-5. This SR also verifies by administrative means that the IP3 fuel assembly meets the requirements for storage in the IP2 SFP. This administrative verification must be completed prior to placing any fuel assembly in the SFP. This SR ensures that this LCO and Specification 4.3.1.1 will be met after the fuel assembly is inserted in the SFP.

REFERENCES

INSERT 5

1. 10 CFR 50.68, "Criticality Accident Requirements."

2. Safety Evaluation by the Office of Nuclear Reactor Regulation Related to Amendment No. 150 to Facility Operating License No. DPR-26, April 19, 1990.

3. Generic Letter 96-04, "Boraflex Degradation in Spent Fuel Pool Storage Racks."

4. Northeast Technology Corporation report NET-173-01, "Criticality Analysis for Soluble Boron and Burnup Credit in the Con Edison Indian Point Unit No. 2 Spent Fuel Storage Racks."

5. Northeast Technology Corporation report NET-173-02, "Indian Point Unit 2 Spent Fuel Pool (SFP) Boron Dilution Analysis."

6. Safety Evaluation by the Office of Nuclear Reactor Regulation Related to Amendment No. 227 to Facility Operating License No. DPR-26, May 29, 2002.

BASES

REFERENCES (continued)

7. NETCO Letter to M. R. Hansler from E. Lindquist, Northeast Technology Corp. dated 12/19/06, Subject – Reference 4 and 5 extension.

8. Safety Evaluation by the Office of Nuclear Reactor Regulation Related to Amendment No. 268 to Facility Operating License No. DPR-26, July 13, 2012.

9. Holtec Report HI-2094289, Licensing Report on the Inter-Unit Transfer of Spent Nuclear Fuel at Indian Point Energy Center, Revision 6.

10. NETCO Letter to Floyd Gumble from Matt Harris dated 12/22/2009, titled "Indian Point 2 RACKLIFE Projections Through 2010 and 2012 BADGER Tests with RACKLIFE Version 2.1".

11. NETCO Letter to Giancarlo Delfini from Matt Harris dated 12/12/2012, titled "Update of IP2 RACKLIFE Model – (In partial fulfillment of Entergy Contract 10351857, Change Order No. 1, Task 2A)".

INSERT 1

The Spent Fuel Pit (SFP) is used to store IP2 spent fuel removed from the reactor and new fuel ready for insertion into the reactor. It is also used to store IP3 fuel that has been transferred from the IP3 SFP prior to it being placed into dry cask storage (Refs 1 and 2). Spent fuel racks (SFRs) are erected on the SFP floor to hold the fuel assemblies. The SFRs have been evaluated to meet the requirements of option (b) of 10 CFR 50.68, "Criticality Accident Requirements" (Ref. 3).

IP2 compliance with 10 CFR 50.68(b)(4) was confirmed by an analysis documented in Curtiss-Wright Nuclear Division, NETCO report NET-28091-003-01, Rev. 0 "Criticality Safety Analysis for the Indian Point Unit 2 Spent Fuel Pool with No Absorber Panel Credit." (Ref. 4) and was approved by the NRC in Amendment TBD (Ref. 5). This analysis demonstrates that 10 CFR 50.68(b)(4) will be met during normal SFP operation and all credible accident scenarios if the following requirements are met:

a) Spent Fuel Pit boron concentration is maintained within the limits of LCO 3.7.12, "Spent Fuel Pit Boron Concentration," whenever fuel is stored in the SFP; and,

b) Fuel assembly storage location within the Spent Fuel Pit is restricted in accordance with LCO 3.7.13, "Spent Fuel Pit Storage," based on the fuel assembly's initial enrichment, burnup, decay of Plutonium-241 (i.e., cooling time), averaged assembly peaking factor, and number of Integral Fuel Burnable Absorbers (IFBA) rods. Note that historic fuel assemblies have been pre-categorized (Tables 3.7.13-2 and 3.7.13-3).

Fuel assembly storage location within the Spent Fuel Pit is an essential element of the criticality analysis. The storage racks in the areas designated Region 1 have a different design than the storage racks in the areas designated Region 2 and this design difference has a significant impact on criticality calculations. Regions 1 and 2 are shown on the insert to Figure 3.7.13-1.

Region 1 consists of three racks that use the flux trap design and has 269 cell locations for the storage of fuel assemblies. The flux trap design used in Region 1 uses spacer plates in the axial direction to separate the cells. Boraflex panels are held in place adjacent to each side of the cell by picture-frame sheathing. In addition, due to a damaged cell, there is one cell blocker in Region 1.

Region 2 consists of nine racks that use an egg-crate design and has 1105 cell locations for the storage of fuel assemblies and two failed fuel canisters. The Region 2 racks consist of boxes welded into a "checkerboard" array with a storage location in each square. One Boraflex absorber panel is held to one side of each cell wall by picture frame sheathing. In addition, there is one cell blocker in Region 2 that is credited in the analysis to allow higher reactive fuel assemblies to be stored in two of its adjacent cells. This cell blocker cannot be moved while fuel is stored in the Spent Fuel Pit.

With two installed cells blockers the total number of cell locations available for the storage of fuel assemblies is 1372. However, the number of fuel assemblies that can actually be stored in Regions 1 and 2 is dependent on the fuel assembly categorization and the SFP locations allowable by Figure 3.7.13-1 and its associated notes.

The criticality analysis defines five fuel assembly reactivity categories based on minimum required burnup and the number of IFBA rods. The minimum required burnups are chosen to optimize the storage of fresh and once burnt fuel assemblies in Region 1 (Categories 1, 2, and 3), and to optimize the storage of permanently discharged assemblies in Region 2 (Categories 4 and 5).

The fuel categories are numbered from most reactive fuel (Category 1) to least reactive fuel (Category 5). The assembly's enrichment, burnup, cooling time, averaged assembly peaking factor, and number of IFBA rods are used to determine the reactivity category. The reactivity categories and their associated burnup requirements are shown in order of decreasing reactivity in Table 3.7.13-1. The averaged assembly peaking factor is the assembly burnup divided by the sum of the cycle burnups for the cycles the assembly was in the core.

The depletion analysis treats historic fuel and current and future fuel differently. Historic fuel is defined as fuel assemblies with identifiers (IDs) A through X for IP2 and A through AA for IP3. Current and future fuel is defined as fuel assemblies with IDs after X for IP2 and after AA for IP3. As the fuel designs and operating condition of historic fuel are known this fuel can be pre-categorized. This pre-categorization in included in Tables 3.7.13-2 and 3.7.13-3.

a. Categorization of historic fuel assemblies

   For historic fuel assemblies, the depletion calculations utilize actual fuel assembly depletion conditions instead of bounding conditions that would penalize most assemblies for which the depletion conditions are known. This data includes use of inserts, burnup achieved while the insert was in the assembly, use of control rods, soluble boron level, averaged assembly peaking factor, and use of axial blankets. The fuel categorization of historic fuel is accomplished by use of batch groupings with similar characteristics. The depletion analysis is performed for each batch grouping using bounding depletion parameters. For some historic fuel assemblies the bounding parameters are overly conservative. For such assemblies, the actual depletion parameters are used. Historic fuel assemblies have been pre-categorized as shown in Appendix B to the CSA and TS Tables 3.7.13-2 and 3.7.13-3.

b. Categorization of current and future fuel assemblies

   For current and future fuel assemblies bounding depletion assumptions are used. Table 3.7.13-1 provides the minimum required burnup for each reactivity category for these fuel assemblies. The notes to Table 3.7.13-1 specify the circumstances under which burnup penalties must be applied to the minimum required burnup.

   Should an assembly not meet any of the fuel assembly operating requirements specified in the analysis, then the fuel must be categorized as Category 1 (or Category 4 if a full length RCCA is inserted).

c. SFP storage location by fuel assembly category

   The analysis determines acceptable storage locations for each fuel assembly reactivity category as shown in Figures 3.7.13-1 and 3.7.13-2.

Figure 3.7.13-1 shows the base case arrangement of the fuel categories. Note that the base case arrangement only shows four reactivity categories since it is the most limiting reactivity arrangement.

d. Storage of non-fuel assemblies

The analysis addresses the use of the failed fuel containers, the fuel rod storage basket, assemblies with missing fuel rods, and the storage of miscellaneous materials.

Failed fuel containers

The southeast corner of the spent fuel pool contains two 16" circular pipes that are used as failed fuel containers. The criticality analysis permits 16 fuel rods in each of these failed fuel containers. The maximum of 16 fuel rods in each of the failed fuel containers will be controlled by procedure.

Fuel rod storage basket

There is a movable fuel rod storage basket that can be used to store fuel rods. This basket can fit in a storage cell and has 52 holes for storing fuel rods. The fuel rod storage basket is classified as reactivity Category 4 and this categorization is included in Table 3.7.13-2.

Assemblies with missing fuel rods

Reconstituted fuel assemblies may be stored in the SFP provided a 4GWd/T burnup penalty is added to the MRB for those assemblies that did not have stainless steel rods installed. This requirement is included in the notes to Table 3.7.13-1.

Storage of miscellaneous materials

Water Holes and 50% Water Holes may be used to store miscellaneous materials with certain restrictions. Miscellaneous non-actinide materials, for example, empty or full trash baskets, can be stored in fuel positions of any category. However, there are some special cases where some of the material may be stored in a water hole or 50% water hole. If the miscellaneous material is any type of steel, Inconel, or absorber material (e.g., absorber coupons, stainless steel coupon trees, control rods, unburned burnable absorbers) it may displace up to 50% of the water volume at the active fuel zone (144 inches) of a water hole or 50% water hole (there are no restrictions on material above or below the active fuel zone). If the miscellaneous material is a very low absorbing material such as a void, zirconium, aluminum, cloth, plastic, concrete, etc., it cannot be placed in a water hole but may be placed in a 50% water hole so long as the 50% water hole still has 50% water volume in the active fuel zone. The restrictions that apply to Water Holes and 50% Water Holes are included in the notes to Figure 3.7.13-1.

INSERT 2

Curtiss-Wright Nuclear Division, NETCO report NET-28091-003-01, Rev. 0 "Criticality Safety Analysis for the Indian Point Unit 2 Spent Fuel Pool with No Absorber Panel Credit" (Ref. 4) evaluated non-accident and accident conditions in the SFP.

Reference 4 determined that if storage location requirements in this LCO are met then then the SFP will have a keff of ≤ 0.95 if filled with a soluble boron concentration of ≥ 700 ppm and will have a keff of < 1.0 if filled with unborated water.

Reference 4 evaluated abnormal occurrences and accidents. This evaluation considered the effects of the following: a) multiple misloads, b) an assembly placed alongside a rack; c) a dropped assembly, d) a misloaded assembly; e) SFP over temperature, f) a seismic event, and, g) a SFP boron dilution accident. Reference 4 determined that the most limiting fuel handling accident is the multiple misload accident and determined keff of ≤ 0.95 if the SFP is filled with a soluble boron concentration of ≥ 2000 ppm.

NET-173-02, "Indian Point Unit 2 Spent Fuel Pool (SFP) Boron Dilution Analysis" (Ref. 6) evaluated postulated unplanned SFP boron dilution scenarios assuming an initial SFP boron concentration within the limits of LCO 3.7.12. The evaluation considered various scenarios by which the SFP boron concentration may be diluted and the time available before the minimum boron concentration necessary to ensure subcriticality for the non-accident condition (i.e. it is not assumed an assembly is misloaded concurrent with the Spent Fuel Pit dilution event). Reference 6 determined that an unplanned or inadvertent event that could dilute the SFP boron concentration from 2000 ppm to 786 ppm is not a credible event because of the low frequency of postulated initiating events and because the event would be readily detected and mitigated by plant personnel through alarms, flooding, and operator rounds through the SFP area. The criticality analysis conservatively credits 700 ppm (versus an already not credible 786 ppm in the AOR) of soluble boron.

The configuration of fuel assemblies in the Spent Fuel Pit satisfies Criterion 2 of 10 CFR 50.36(c)(2)(ii).

INSERT 3

This LCO requires that each IP2 fuel assembly stored in the Spent Fuel Pit is categorized in accordance with Table 3.7.13-1 or, if pre-categorized, Table 3.7.13-2, that each IP3 fuel assembly stored in the Spent Fuel Pit is categorized in accordance with Table 3.7.13-1 or, if pre-categorized, Table 3.7.13-3, and, IP2 and IP3 fuel assembly storage locations within the Spent Fuel Pit shall be restricted to locations allowed by Figure 3.7.13-1 and its associated notes as follows:

a. Categorized fuel assemblies may be stored in any cell location of the same or lower numbered category.

b. Category 1 fuel assemblies may be stored in any cell location in Regions 1 and 2 in accordance with Figure 3.7.13-1 notes 12 and 13, respectively.

c. Category 5 fuel assemblies with an installed full length RCCA take the reactivity credit provided by the presence of the RCCA. This credit may also be taken for Category 1 fuel assemblies that contain a full length RCCA. These assemblies may be stored in any Category 4, 3, 2, or 1 cell. Likewise, Category 2, 3, or 4 fuel assemblies that contain a full length RCCA may be stored any Category 5, 4, 3, 2, or 1 cell.

d. Category 5 fuel assemblies that are required to have a full length RCCA installed are the subject of the LCO note. Because reactivity credit is taken for the installed RCCA it may not be placed in, or removed from, the fuel assembly while the assembly is in the RCCA credited location. Movement of the RCCA in the credited location would be a violation of the criticality analysis.

This LCO establishes restrictions on fuel assembly storage location within the SFP to ensure that the requirements of 10 CFR 50.68 are met.

INSERT 4

This SR verifies by administrative means that the IP2 fuel assembly has been classified based on initial enrichment, burnup, cooling time, averaged assembly peaking factor, and number of IFBA rods in the fuel assembly in accordance with Figure 3.7.13-1, Figure 3.7.13-2, Figure 3.7.13-3, or Figure 3.7.13-4 and that the fuel assembly meets the requirements for the intended storage location defined on Figure 3.7.13-5. This SR also verifies by administrative means that the IP3 fuel assembly meets the requirements for storage in the IP2 SFP. This administrative verification must be completed prior to placing any fuel assembly in the SFP. This SR ensures that this LCO and Specification 4.3.1.1 will be met after the fuel assembly is inserted in the SFP.

INSERT 5

1. Safety Evaluation by the Office of Nuclear Reactor Regulation Related to Amendment No. 268 to Facility Operating License No. DPR-26, July 13, 2012.

2. Holtec Report HI-2094289, Licensing Report on the Inter-Unit Transfer of Spent Nuclear Fuel at Indian Point Energy Center, Revision 6.

3. 10 CFR 50.68, “Criticality Accident Requirements.”

4. Curtiss-Wright Nuclear Division, NETCO report NET-28091-0003-01, Rev. 0 “Criticality Safety Analysis for the Indian Point Unit 2 Spent Fuel Pool with No Absorber Panel Credit.”

5. Safety Evaluation by the Office of Nuclear Reactor Regulation Related to Amendment No. TBD to Facility Operating License No. DPR-26, TBD.

6. Northeast Technology Corporation report NET-173-02, “Indian Point Unit 2 Spent Fuel Pool (SFP) Boron Dilution Analysis.”