**From:** William Beckner
**To:** GHM, JWR - A Marcus, J Roe
**Date:** 6/14/96 12:48pm
**Subject:** ANO Fuel Casks

ANO indicates that they expect to meet the terms of the CAL by next week and start moving fuel by July 8.

**CC:** gxk



F18

JUNE 26, 1996

# CRGR MEETING ON URGENT BULLETIN TITLED: "CHEMICAL, GALVANIC AND OTHER REACTION IN SPENT FUEL AND TRANSPORTATION CASKS"

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E/9

# PART A

A. Primary Focus:

(1) Expedited Review Request

(2) Proposed Bulletin (Attachment 1)

(3) Response to CRGR Charter Questions (Attachment 2)

UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D.C. 20555-0001

MEMORANDUM TO: Edward L. Jordan, Chairman
Committee to Review Generic Requirements

FROM: Frank J. Miraglia, Deputy Director
Office of Nuclear Reactor Regulation

John T. Greeves, Acting Deputy Director
Office of Nuclear Material Safety
and Safeguards

SUBJECT: REQUEST EXPEDITED REVIEW AND ENDORSEMENT OF THE PROPOSED URGENT BULLETIN TITLED, "CHEMICAL, GALVANIC AND OTHER REACTIONS IN SPENT FUEL STORAGE AND TRANSPORTATION CASKS"

The Office of Nuclear Reactor Regulation (NRR) and the Office of Nuclear Material Safety and Safeguards (NMSS) request that the Committee to Review Generic Requirements(CRGR) review and endorse the subject proposed bulletin. Following endorsement, the bulletin will be issued. Due to the urgent nature of the bulletin, there will be no public comment period. Shortly after issuance, the bulletin will be published in the Federal Register.

Attachment 1 is the bulletin proposed by the staff. The bulletin addresses the issue of potential chemical, galvanic or other reactions between the materials in spent fuel storage and transportation casks, the contents of the casks, and the environments the casks may encounter during use. This issue stems from a recent event at Point Beach Nuclear Plant in which hydrogen was generated and ignited during operation of a VSC-24 spent fuel storage cask. The bulletin requests licensees, certificate holders, and cask vendors to review their cask materials, including coatings and lubricants, to determine if any reactions can occur, and to evaluate the effect of any identi 'ed reactions. The bulletin requests a review of current cask operations to determine if adequate controls are in place to minimize the hazardous conditions that may be created by any identified reactions. The bulletin requests that casks currently loaded with spent fuel be reviewed to determine if any reactions have occurred, and to evaluate the effect of any identified reactions on the cask's ability to store spent fuel throughout its license. The bulletin also specifically requests the vendor and users of the VSC-24 cask to evaluate the effect of the reaction between Carbo Zinc 11 and water on long-term cask performance and on the unloading procedures. The staff considers this bulletin to be Category 1.

Attachment 2 gives responses to the questions contained in Section IV.B of the CRGR Charter.

The Office of the General Counsel (OGC) reviewed this package and has no legal objections to it. OGC also determined that the proposed bulletin is not a "rule" under the provisions of the Small Business Regulatory Enforcement and Fairness Act (5 U.S.C., Chapter 8, enacted on March 20, 1996).

The bulletin is sponsored by William Travers, Director, Spent Fuel Project Office, Office of Nuclear Material Safety and Safeguards.

Attachments: As stated

UNITED STATES
NUCLEAR REGULATORY COMMISSION
OFFICE OF NUCLEAR REACTOR REGULATION
WASHINGTON, D.C. 20555

**July XX, 1996**

NRC BULLETIN 96-XX: CHEMICAL, GALVANIC, OR OTHER REACTIONS IN SPENT FUEL STORAGE AND TRANSPORTATION CASKS

Addressees

This bulletin is being sent to:

All holders of operating licenses or construction permits for nuclear power reactors

All holders of and applicants for certificates of compliance for light water reactor spent fuel transportation casks

All holders of and applicants for certificates of compliance for light water reactor spent fuel storage casks

All vendors of light water reactor spent fuel storage and transportation casks

All registered users of light water reactor spent fuel transportation casks

It is expected that all recipients will review the information for applicability to their facilities and consider actions as appropriate to avoid problems similar to those discussed here. However, action is only requested from those addressees who are licensees with independent spent fuel storage installations, vendors of spent fuel storage or transportation casks, and holders of certificates of compliance for spent fuel storage or transportation casks ("action addressees").

Purpose

The U.S. Nuclear Regulatory Commission (NRC) is issuing this bulletin to: (1) notify addressees about the potential for chemical, galvanic, or other reactions among the materials of a spent fuel storage or transportation cask, its contents, and the environments the cask may encounter during use, that may produce adverse operating conditions or degrade the integrity and performance of the cask; (2) request that all action addressees implement the actions described herein; and (3) require that all action addressees provide, to NRC, written responses to this bulletin, relating to implementation of the

requested actions. This bulletin also requires that certain information on the subject matter of this bulletin be submitted to NRC.

Background

On May 31, 1996, NRC Information Notice 96-34 was issued as advance notification of a hydrogen gas ignition event that occurred during the welding of the shield lid on a spent fuel storage cask at the Point Beach Nuclear Plant.

Description of Circumstances

On May 28, 1996, a hydrogen gas ignition occurred during the welding of the shield lid on a ventilated storage cask (VSC-24) multi-assembly sealed basket (MSB). The gas ignition displaced the shield lid (weighing about 2898 kilograms [6390 pounds]), leaving it in place but tipped at a slight angle, with one edge about 7.6 centimeters [3 inches] higher than normal.

The loaded VSC-24 multi-assembly transfer cask (MTC), a shielded lifting device used to transfer the MSB loaded with spent fuel to the ventilated concrete cask, had been placed in the cask decontamination work area in the auxiliary building. Approximately 114 liters [30 gallons] of borated spent fuel pool water had been drained from the MSB to facilitate welding of the shield lid, creating an air space below the lid. The hydrogen gas ignition occurred during the initiation of the shield lid welding, approximately 11 hours after the loaded MTC had been removed from the spent fuel storage pool.

After the event, gas and water samples collected from the MSB internals showed detectable levels of hydrogen both in the air space beneath the shield lid and dissolved in the MSB water. The licensee then continuously purged the air space beneath the lid with nitrogen to prevent the accumulation of combustible gases and returned the shield lid to its original position.

The MSB was then fully flooded to eliminate the air space under the shield lid and returned to the spent fuel storage pool. On removal of the shield lid, the licensee observed a white, foam-like substance under the shield lid. Most of the precipitate floated to the top of the pool; however, some remained below the surface of the water. Samples of this substance were taken to Argonne National Laboratory for analysis.

The licensee unloaded the spent fuel assemblies and placed them in the spent fuel pool storage racks. A visual examination of the MSB, the MTC, and the spent fuel assemblies showed no evidence of damage as a result of the combustible gas ignition.

The unloaded MTC/MSB was subsequently moved back to the decontamination work area for further inspection as part of the licensee's investigation of the combustible gas ignition. At the decontamination work area, the MSB remained filled with borated spent fuel pool water for several days. Hydrogen

continued to be generated during that time, as evidenced by the effervescence off the MSB shell and fuel grid.

The licensee's investigation determined that the source of hydrogen was oxidation of zinc in the Carbo Zinc 11 coating (used as a coating to prevent corrosion) of the MSB when in contact with the borated water in the spent fuel pool. The zinc reacted chemically with the acidic borated water from the spent fuel storage pool to produce hydrogen, and zinc oxide and hydroxide. The foam-like substance was determined to be a mixture of a precipitate formed by the reaction, residual soap used during decontamination of the MSB, and air.

Discussion

An NRC Augmented Inspection Team (AIT) was formed and sent to the site on May 29, 1996, to examine the circumstances surrounding the event. The AIT Charter consisted of evaluations of the licensee's response to the event, including the radiation protection consequences of the event to both the plant staff and the general public, the effectiveness of the licensee's root-cause investigation, and determination of any potential generic implications of the event. The findings of the AIT are summarized below. Details of the AIT findings are documented in Report Nos. 50-266/96005 and 50-301/96005.

- The AIT agrees with the licensee that the hydrogen was formed by a chemical reaction among the Carbo Zinc 11 coating and the borated pool water.

- The licensee believes that the design, design review, design specifications, and the independent review of the design of the VSC-24 cask did not result in the recognition that the chemical reaction of the Carbo Zinc 11 coating with borated water would result in the production of hydrogen.

- The licensee had several opportunities to identify the generation of gas inside the MSB during previous cask loading operations, because of several noted abnormalities. However, the abnormalities were not documented and were not viewed collectively. This is of particular concern because in at least one case the licensee had indications that the gas being produced may have been combustible.

- The generic implications of the event extend beyond the use of the VSC-24 system. The AIT recommends that the adequacy of the chemical compatibility studies conducted during design reviews for all dry cask storage designs and facility environments should be reviewed. In addition, the suitability of Carbo Zinc 11 and other similar coatings used in nuclear applications, where there is the potential for exposure to boric acid, should be reviewed.

The gas ignition caused no injuries, no radiological releases, and no apparent damage to the spent fuel, or to the storage cask. However, the event has raised some generic issues pertaining to spent fuel storage and transportation casks. These generic issues also extend to spent fuel transportation casks because transportation casks have designs similar to storage casks. Also, the current trend in the industry is to pursue licensing of dual-purpose, storage/transport cask designs.

The event at Point Beach suggests that the VSC-24 vendor and licensees did not adequately consider material reactions, and material compatibility with possible environments, in the design and design review of the VSC-24 cask. NRC also failed to fully consider material reactions and material compatibility in its licensing review of the VSC-24 cask. The concern is that this oversight may extend to other existing storage and transportation cask designs, although provisions for material suitability exist in both 10 CFR Part 71 and Part 72.

Another concern is that, in the short-term, these reactions may create hazardous operating conditions, i.e., generation of combustible gases. This issue is short-term because the reactions, which form combustible gases and precipitate, would not continue after the loaded casks are drained, evacuated, and back-filled with inert helium gas.

A long-term concern is that these reactions may degrade the structural integrity and adversely impact the retrievability of the stored spent fuel. Degradation of the fuel's structural integrity is not expected to present an immediate health or safety concern. However, the overall requirements specified in 10 CFR 72.122 for spent fuel storage casks include protection of the fuel cladding from degradation and ready retrieval of the spent fuel. The staff, based on available information, does not anticipate any impact on the continued safe confinement of spent nuclear fuel in existing dry storage installations.

Requested Actions

NRC is concerned that the fabrication, loading, unloading, or use of spent fuel storage and transportation casks be performed safely and in compliance with the conditions and requirements specified under Title 10 of the *Code of Federal Regulations*. Accordingly, action addressees are requested to take the following actions:

1. Address the following items relating to the susceptibility of the spent fuel storage or transportation cask design to chemical, galvanic, or other reactions:

   (a) Review the cask materials, including coatings and lubricants, to determine whether chemical, galvanic, or other reactions among the materials, contents, and environment can occur during any phase of loading, unloading, handling, storage, and transportation.

Consideration should be given to all environments that may be encountered under normal, off-normal, or accident conditions.

(b) Evaluate the effects of any identified reactions to determine if any adverse conditions could result. Consideration should be given, but not limited, to:

(i) generation of flammable or explosive quantities of hydrogen or other combustible gases; and

(ii) increased neutron multiplication in the fuel in a cask because of boron precipitation from a chemical reaction among the borated water and cask materials.

(c) Evaluate the effects of any identified reactions to determine if their reaction products could reduce the overall integrity of the cask or its contents. Determine if the reaction products could adversely affect the cask's ability to maintain the structural integrity and retrievability of the spent fuel throughout the term of the license or to transport fuel safely. Consideration should be given, but not limited, to:

(i) changes in cask and fuel cladding thermal properties, such as emissivity;

(ii) binding of mechanical surfaces, especially fuel-to-basket clearances; and

(iii) degradation of any safety components, either caused directly by the effects of the reactions, or by the effects of the reactions combined with the effects of long-term exposure of the materials to neutron and gamma radiation, high temperatures, or other possible conditions.

(d) Review current cask operating procedures to determine if adequate controls and procedures are in place to minimize hazardous conditions that may be created by any identified reactions.

2. For storage casks currently loaded with spent fuel, determine the extent, if any, of the chemical, galvanic, or other reactions that have occurred, and the effect of these reactions on the cask's ability to maintain the structural integrity and retrievability of the spent fuel throughout the term of the license.

In addition to the items above, the vendor and users of the VSC-24 spent fuel storage cask (Sierra Nuclear Corporation, Arkansas Nuclear One, Palisades Nuclear Generating Plant, and Point Beach Nuclear Plant) are requested to take the following actions:

1. Evaluate the effects of the reaction among Carbo Zinc 11 and water. Show that the ability of the cask to maintain the structural integrity and retrievability of the spent fuel over a 20-year period has not been adversely affected by the formation of precipitate, or by any other effects of the reaction. Justify the continued use of VSC-24 storage casks already loaded with spent fuel. In this evaluation, consideration should be given, but not limited, to:

   (a) the effect of the precipitate on fuel cladding integrity;

   (b) the effect of the precipitate on the heat transfer characteristics of the cask; and

   (c) behavior of the precipitate under long term exposure to neutron and gamma radiation, high temperatures, and other possible conditions.

2. Evaluate the procedures for unloading the cask to consider the likely presence of hydrogen gas or precipitate inside the MSB and the possible adverse effects of the hydrogen gas or precipitate on cask handling and performance. Inform the NRC of any changes made to the unloading procedures.

Required Response

Pursuant to 10 CFR 2.204, 10 CFR 71.39, and 10 CFR 72.44(b)(3), in order to determine whether any license or certificate should be modified, suspended, or revoked, or other action taken, action addressees are required to submit the following written response to this bulletin:

1. Within 30 days of the date of this bulletin, a written response indicating whether the addressee will implement the actions requested above. If the addressee intends to implement the requested actions, provide a schedule for completing implementation. If an addressee chooses not to take the requested actions, provide a description of any proposed alternative course of action, the schedule for completing the alternative course of action (if applicable), and the safety basis for determining the acceptability of the planned alternative course of action.

2. Within 30 days of completion of the requested actions, a report confirming completion and detailing the actions taken.

Address the required written report(s) to the U.S. Nuclear Regulatory Commission, ATTN.: Document Control Desk, Washington, D.C. 20555, under oath or affirmation under the provisions of 10 CFR 2.204, 10 CFR 71.39, and 10 CFR 72.44(b)(3). In addition, submit a copy to the appropriate regional administrator.

Related Generic Communications

IN 95-29, "Oversight of Design and Fabrication Activities for Metal Components Used in Spent Fuel Dry Storage Systems."

IN 96-34, "Hydrogen Gas Ignition during Closure Welding of a VSC-24 Multi-Assembly Sealed Basket"

Backfit Discussion

This bulletin is an information request made pursuant to 10 CFR 2.204, 10 CFR 71.39, and 10 CFR 72.44(b)(3). The objective of the actions requested in this bulletin is to verify that licensees are in compliance with existing NRC rules and regulations pertaining to the appropriateness and adequacy of the design of spent fuel storage and transportation casks including, and without limitation, 10 CFR 71.43(d), 72.122(h), 72.122(l), 72.236(c), 72.236(f), 72.236(g), 72.40(a)(5), 72.212(b)(9), 72.236(h), 72.234(b), and 72.146(b).

Paperwork Reduction Act Statement

This generic letter contains information collections that are subject to the Paperwork Reduction Act of 1995 (44 U.S.C. 3501, et seq.). These information collections were approved by the Office of Management and Budget (OMB), approval number 3150-0012, which expires June 30, 1997.

The public reporting burden for this collection of information is estimated to average 600 hours per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. The U.S. Nuclear Regulatory Commission is seeking public comment on the potential impact of the collection of information contained in the generic letter and on the following issues:

1. Is the proposed collection of information necessary for the proper performance of the functions of NRC, including whether the information will have practical utility?

2. Is the estimate of burden accurate?

3. Is there a way to enhance the quality, utility, and clarity of the information to be collected?

4. How can the burden of the collection of information be minimized, including the use of automated collection techniques?

Send comments on any aspect of this collection of information, including suggestions for reducing this burden, to the Information and Records Management Branch, T-6 F33, U.S. Nuclear Regulatory Commission, Washington, DC 20555-0001, and to the Desk Officer, Office of Information and Regulatory

Affairs, NEOB-10202 (3150-0012), Office of Management and Budget, Washington, DC 20503.

NRC may not conduct or sponsor, and a person is not required to respond to, a collection of information unless it displays a currently valid OMB control number.

Nuclear power reactor licensees with questions regarding this matter should contact the appropriate Office of Nuclear Reactor Regulation (NRR) project manager. All other addressees with questions regarding this matter should contact the technical contact listed below or the appropriate Office of Nuclear Material Safety and Safeguards (NMSS) project manager.

Brian K. Grimes, Acting Director
Division of Reactor Program Management
Office of Nuclear Reactor Regulation

William D. Travers, Director
Spent Fuel Project Office
Office of Nuclear Material Safety and Safeguards

Technical Contact: Marissa Bailey, NMSS
(301) 415-8531
Internet:mgb@nrc.gov

Lead Project Manager: William Reckley, NRR
(301) 415-1314
Internet:wdr@nrc.gov

Attachment: List of Recently Issued NRC Bulletins

ATTACHMENT 2

CRGR REVIEW PACKAGE

PROPOSED BULLETIN

CHEMICAL, GALVANIC, OR OTHER REACTIONS IN SPENT FUEL STORAGE

AND TRANSPORTATION CASKS

**PROPOSED ACTION:** Issue a bulletin on the potential for a chemical, galvanic, or other reactions between the materials of a spent fuel storage or transportation cask, its contents, and the environments it may encounter during fabrication, loading, handling or operation. There will be no public comment period. Shortly after issuance, the bulletin will be published in the Federal Register.

RESPONSE TO REQUIREMENTS FOR CONTENT OF PACKAGE SUBMITTED FOR CRGR REVIEW

(i) The proposed generic requirement or staff position as it is proposed to be sent out to licensees.

* The staff position is:

The proposed bulletin will be sent to all power reactor licensees, holders of certificates of compliance for spent fuel transportation casks, holders of certificates of compliance for spent fuel storage casks, vendors of spent fuel storage and transportation casks, and registered users of spent fuel transportation casks. However, action is only requested from licensees with independent spent fuel storage installations, vendors of spent fuel storage or transportation casks, and holders of certificates of compliance for spent fuel storage or transportation casks. Each affected licensee and vendor is requested to (1) evaluate the susceptibility of spent fuel storage or transportation casks to chemical, galvanic or other reactions; (2) determine the implications of such reactions to casks already loaded with spent fuel; and (3) review current cask operations to determine if adequate controls and procedures are in place to minimize hazardous conditions that may be created by such reactions. In addition to the items above, the designer and users of the VSC-24 Spent Fuel Storage Cask (Sierra Nuclear Corporation, Arkansas Nuclear One, Palisades Nuclear Generating Plant, and Point Beach Nuclear Plant) are requested to address specific questions regarding the use of Carbo Zinc 11 coating.

(ii) Draft staff papers or other underlying staff documents supporting the requirements or staff positions.

* NRC Information Notice 95-29

  This NRC Information Notice alerts all power reactor licensees and independent spent fuel storage installation designers and fabricators to observed shortcomings in oversight of design and fabrication activities for metal components used in spent fuel dry storage systems.

* NRC Information Notice 96-34

  This NRC Information Notice alerts all power reactor licensees and independent spent fuel storage installation designers and fabricators to a hydrogen gas ignition event that occurred during the welding of the shield lid on a spent fuel storage cask at the Point Beach Nuclear Plant.

(iii) Each proposed requirement or staff position shall contain the sponsoring office's position as to whether the proposal would increase requirements or staff positions, implement existing requirements or staff positions, or would relax or reduce existing requirements or staff positions.

* The proposed bulletin would implement existing requirements by requesting information needed to assure that the design and utilization of spent fuel storage or transportation casks do not create hazardous operating conditions or lead to long term degradation of safety components.

(iv) The proposed method of implementation with the concurrence (and any comments) of OGC on the method proposed. The concurrence of affected program offices or an explanation of any nonconcurrences.

* The requirements of this bulletin would be implemented by supplying the requested information with respect to storage and transportation cask material compatibility with environments during loading, unloading, handling, storage, or transportation. OGC has no legal objection to this proposal and their comments were incorporated.

(v) Regulatory analyses conforming to the directives and guidance of NUREG/BR-0058 and NUREG/CR-3568. (This does not apply for backfits that ensure compliance or ensure, define, or redefine adequate protection. In these cases a documented evaluation is required as discussed in IV.B.(ix).)

* A formal regulatory analysis is not required because the actions proposed by the bulletin would ensure licensee and vendor compliance with 10 CFR 71 43(d), 72.146, 72.234, and 72.236(h). Backfitting requirements for the storage casks are governed by 10 CFR 72.62.

(vi) Identification of the category of reactor plants to which the generic requirement or staff position is to apply.

* Action is requested from power reactor licensees with independent spent fuel storage installations, vendors of spent fuel storage or transportation casks, and holders of certificates of compliance for spent fuel storage or transportation casks.

(vii) For backfits other than compliance or adequate protection backfits, a backfit analysis as defined in 10 CFR 50.109. The backfit analysis shall include, for each category of reactor plants, an evaluation which demonstrates how the action should be prioritized and scheduled in light of other ongoing regulatory activities. The backfit analysis shall document for consideration information available concerning any of the following factors as may be appropriate and any other information relevant and material to the proposed action:

(a) Statement of the specific objectives that the proposed action is designed to achieve;

(b) General description of the activity that would be required by the licensee or applicant in order to complete the action;

(c) Potential change in the risk to the public from the accidental release of radioactive material;

(d) Potential impact on radiological exposure of facility employees and other onsite workers;

(e) Installation and continuing costs associated with the action, including the cost of facility downtime or the cost of construction delay;

(f) The potential safety impact of changes in plant or operational complexity, including the relationship of proposed and existing regulatory requirements and staff positions;

(g) The estimated resource burden on the NRC associated with the proposed action and the availability of resources;

(h) The potential impact of differences in facility type, design, or age on the relevancy and practicality of the proposed action;

(i) Whether the proposed action is interim or final, and if interim, the justification for imposing the proposed action on an interim basis;

(j) How the action should be prioritized and scheduled in light of other ongoing regulatory activities.

* Not applicable because any action potentially considered a backfit pursuant to 10 CFR 72.64 for storage casks is required in order to demonstrate compliance with various sections of Part 72. Likewise actions required for transportation casks are considered necessary to demonstrate compliance with 10 CFR 71.43(d).

(viii) For each backfit analyzed pursuant to 10 CFR 50.109(a)(2) (i.e., not adequate protection backfits and not compliance backfits), the proposing Office Director's determination, together with the rational for the determination based on the consideration of paragraph (i) and (vii) above, that:

(a) There is a substantial increase in the overall protection of public health and safety or the common defense and security to be derived from the proposal; and

(b) The direct and indirect costs of implementation, for the facilities affected, are justified in view of this increased protection.

* Not applicable because any action potentially considered a backfit pursuant to 10 CFR 72.64 for storage casks is required in order to demonstrate compliance with various sections of Part 72. Likewise actions required for transportation casks are considered necessary to demonstrate compliance with 10 CFR 71.43(d).

(ix) For adequate protection or compliance backfits evaluated pursuant to 10 CFR 50.109(a)(4)

(a) a documented evaluation consisting of:
(1) the objectives of the modification
(2) the reasons for the modification
(3) the basis for invoking the compliance or adequate protection exemption.

(b) in addition, for actions that were immediately effective (and therefore issued without prior CRGR review as discussed in III.C) the evaluation shall document the safety significance and appropriateness of the action taken and (if applicable) consideration of how costs contributed to selecting the solution among various acceptable alternatives.

* The bulletin does not propose any specific backfit related to the design or procedures related to storage or transportation casks. Evaluations to be performed in order to meet the information request related to material interactions are required pursuant to various sections of Parts 71 and 72 of Title 10 of the Code of Federal Regulations. The actions required in this bulletin are therefore seen as merely information requests. In addition, action addressees for this bulletin will be responding in their role as Part 71 or Part 72 licensees or vendors.

(x) For each evaluation conducted for proposed relaxations or decreases in current requirements or staff positions, the proposing Office Director's determination, together with the rationale for the determination based on the considerations or paragraphs (i) through (vii) above, that:

(a) The public health and safety and the common defense and security would be adequately protected if the proposed reduction in requirements or positions were implemented, and

(b) The cost savings attributed to the action would be substantial enough to justify taking the action.

* The bulletin does not contain any relaxations.

(xi) For each request for information under 10 CFR 50.54(f) (which is not subject to exception as discussed in III.A) an evaluation that includes at least the following elements:

(a) A problem statement that describes the need for the information in terms of potential safety benefit.

(b) The licensee actions required and the cost to develop a response to the information request.

(c) An anticipated schedule for NRC use of the information.

(d) A statement affirming that the request does not impose new requirements on the licensee, other than for the requested information.

* Response to this item is not necessary because information requested by the proposed bulletin under 10 CFR 71.39 and 72.44 will be used to ensure adequate protection to occupational safety and compliance with various other regulations in Parts 71 and 72.

(xii) An assessment of how the proposed action relates to the Commission's Safety Goal Policy Statement.

* This assessment is not applicable since the proposed actions are information requests to ensure compliance with existing regulations contained in Parts 71 and 72 of Title 10 of the Code of Federal Regulations.

# PART B

B. Meeting Supplements:

(1) Meeting Presentation Slides

(2) Redline/Strikeout Version of Previously Forwarded Proposed Bulletin (Attachment 1)

**URGENT BULLETIN 96-XX: CHEMICAL, GALVANIC, OR OTHER REACTIONS IN SPENT FUEL STORAGE AND TRANSPORTATION CASKS.**

- **Point Beach VSC-24 Storage Cask Event - May 28, 1996**

- **Initial Regulatory Actions**
  - Issued IN 96-34 on May 31, 1996
  - CALs Issued June 3, 1996 to Affected Licensees (Pt. Beach, Palisades, ANO)
  - AIT Investigation/Vendor Inspection

- **Future Regulatory Actions**
  - Supplement to original CALs
  - Generic Communication: Urgent Bulletin
  - Modify SRP for Storage Casks

**URGENT BULLETIN 96-XX: CHEMICAL, GALVANIC, OR OTHER REACTIONS IN SPENT FUEL STORAGE AND TRANSPORTATION CASKS.**

- **Scope**
  - Part 50 licensees, Part 71 & 72 CofC Holders/Applicants/Users
- **Requested Actions**
  - All Action Addresses
  - VSC-24 Vendor and Users
- **Required Response**
  - 30 Day Response
  - Report Confirming Completion of Actions Taken
- **Backfit Discussion**
  - Part 71
  - Part 72

UNITED STATES
NUCLEAR REGULATORY COMMISSION
OFFICE OF NUCLEAR REACTOR REGULATION
WASHINGTON, D.C. 20555

July XX, 1996

NRC BULLETIN 96-XX: CHEMICAL, GALVANIC, OR OTHER REACTIONS IN SPENT FUEL STORAGE AND TRANSPORTATION CASKS

Addressees

This bulletin is being sent to:

All holders of operating licenses or construction permits for nuclear power reactors

All holders of and applicants for certificates of compliance for light water reactor spent fuel transportation casks

All holders of and applicants for certificates of compliance for light water reactor spent fuel storage casks

All vendors of light water reactor spent fuel storage and transportation casks

All Registered users of light water reactor spent fuel transportation casks

It is expected that all recipients will review the information for applicability to their facilities and consider actions as appropriate to avoid ~~similar~~ problems similar to those discussed here. However, action is only requested from those addressees who are licensees with independent spent fuel storage installations, vendors of spent fuel storage or transportation casks, and holders of certificates of compliance for spent fuel storage or transportation casks ("action addressees").

Purpose

The U.S. Nuclear Regulatory Commission (NRC) is issuing this bulletin to: (1) notify addressees about the potential for chemical, galvanic, or other reactions ~~between~~among the materials of a spent fuel storage or transportation cask, its contents, and the environments the cask may encounter during use, that may produce adverse operating conditions or degrade the integrity and performance of the cask; (2) request that all action addressees implement the actions described herein; and (3) require that all action addressees provide, to NRC, written responses to this bulletin, relating to implementation of the

requested actions. This bulletin also requires that certain information on the subject matter of this bulletin be submitted to NRC.

Background

On May 31, 1996, NRC Information Notice 96-34 was issued as advance notification of a hydrogen gas ignition event that occurred during the welding of the shield lid on a spent fuel storage cask at the Point Beach Nuclear Plant.

Description of Circumstances

On May 28, 1996, a hydrogen gas ignition occurred during the welding of the shield lid on a ventilated storage cask (VSC-24) multi-assembly sealed basket (MSB). The gas ignition displaced the shield lid (weighing about 2898 kilograms [6390 pounds]), leaving it in place but tipped at a slight angle, with one edge about 7.6 centimeters [3 inches] higher than normal.

The loaded VSC-24 multi-assembly transfer cask (MTC), a shielded lifting device used to transfer the MSB loaded with spent fuel to the ventilated concrete cask, had been placed in the cask decontamination work area in the auxiliary building. Approximately 114 liters [30 gallons] of borated spent fuel pool water had been drained from the MSB to facilitate welding of the shield lid, creating an air space below the lid. The hydrogen gas ignition occurred during the initiation of the shield lid welding, approximately 11 hours after the loaded MTC had been removed from the spent fuel storage pool.

After the event, gas and water samples collected from the MSB internals showed detectable levels of hydrogen both in the air space beneath the shield lid and dissolved in the MSB water. The licensee then continuously purged the air space beneath the lid with nitrogen to prevent the accumulation of combustible gases and returned the shield lid to its original position.

The MSB was then fully flooded to eliminate the air space under the shield lid and returned to the spent fuel storage pool. On removal of the shield lid, the licensee observed a white, foam-like substance under the shield lid. Most of the precipitate floated to the top of the pool; however, some remained below the surface of the water. Samples of this substance were taken to Argonne National Laboratory for analysis.

The licensee unloaded the spent fuel assemblies and placed them in the spent fuel pool storage racks. A visual examination of the MSB, the MTC, and the spent fuel assemblies showed no evidence of damage as a result of the combustible gas ignition.

The unloaded MTC/MSB was subsequently moved back to the decontamination work area for further inspection as part of the licensee's investigation of the combustible gas ignition. At the decontamination work area, the MSB remained filled with borated spent fuel pool water for several days. Hydrogen

continued to be generated during that time, as evidenced by the effervescence off the MSB shell and fuel grid.

The licensee's investigation determined that the source of hydrogen was ~~corrosion~~ **oxidation** of zinc in the Carbo Zinc 11 coating (used **as a coating** to prevent corrosion) of the MSB when in contact with the borated water in the spent fuel pool. The zinc reacted chemically with the acidic borated water from the spent fuel storage pool to produce hydrogen, **and zinc oxide and hydroxide**. The foam-like substance was determined to be a mixture of a precipitate formed by the reaction, residual soap used during decontamination of the MSB, and air. ~~The precipitate consisted of approximately 4 percent boron, 15 percent zi , and other constituents.~~

Discussion

An NRC Augmented Inspection Team (AIT) was formed and sent to the site on May 29, 1996, to examine the circumstances surrounding the event. The AIT Charter consisted of evaluations of the licensee's response to the event, including the radiation protection consequences of the event to both the plant staff and the general public, the effectiveness of the licensee's root-cause investigation, and determination of any potential generic implications of the event. The findings of the AIT are summarized below. Details of the AIT findings are documented in Report Nos. 50-266/96005 and 50-301/96005.

- ~~The AIT found no basis to disagree with the licensee's conclusion~~**The AIT agrees with the licensee** that the hydrogen was formed by a chemical reaction ~~between~~**among** the Carbo Zinc 11 **coating** and the borated pool water.

- The licensee believes that ~~one or more barriers broke down during~~ the design, design review, design specifications, and the independent review of the design of the VSC-24 cask ~~which resulted in not recognizing~~ **did not result in the recognition** that the chemical reaction of the **Carbo Zinc 11** coating with borated water would result in the production of hydrogen.

- The licensee had several opportunities to identify the generation of gas inside the MSB during previous cask loading operations, because of several noted abnormalities. However, the abnormalities were not documented and were not viewed collectively. This is of particular concern because in at least one case the licensee had indications that the gas being produced may have been combustible.

- The generic implications of the event extend beyond the use of the VSC-24 system. The AIT recommends that the adequacy of the chemical compatibility studies conducted during design reviews for all dry cask storage designs and facility environments should be reviewed. In addition, the suitability of Carbo Zinc 11 and other

similar coatings used in nuclear applications, where there is the potential for exposure to boric acid, should be reviewed.

The gas ignition caused no injuries, no radiological releases, and no apparent damage to the spent fuel, or to the storage cask. However, the event has raised ~~concerns about the potential for chemical, galvanic, or other reactions between the materials in spent fuel storage casks, the contents of the casks, and environments the casks may encounter during operations~~ some generic issues pertaining to spent fuel storage and transportation casks. These generic issues also extend to spent fuel transportation casks because transportation casks have designs similar to storage casks~~; therefore, the generic implications of the event also extend to spent fuel transportation casks~~. Also, the current trend in the industry is to pursue licensing of dual-purpose, storage/transport casks designs.

The event at Point Beach suggests that the VSC-24 vendor and licensees did not adequately consider material reactions, and material compatibility with possible environments, in the design and design review of the VSC-24 cask. NRC also failed to fully consider material reactions and material compatibility in its licensing review of the VSC-24 cask. The concern is that this oversight may extend to other existing storage and transportation cask designs, although provisions for material suitability exist in both 10 CFR Part 71 and Part 72.

~~The basic~~ Another concern is that, in the short-term, these reactions may create hazardous operating conditions, i.e., generation of combustible gases. This issue is short-term because the reactions, which form combustible gases and precipitate, would not continue after the loaded casks are drained, evacuated, and back-filled with inert helium gas.

~~and~~A long-term concern is that these reactions may degrade the structural integrity and adversely impact the retrievability of the stored spent fuel.~~the cask's safety components to the extent that its ability to store or transport fuel safely is compromised.~~ Degradation of the fuel's structural integrity is not expected to present an immediate health or safety concern. However, the overall requirements, specified in 10 CFR 72.122, for spent fuel storage casks include protection of the fuel cladding from degradation and ready retrieval of the spent fuel. The staff, based on available information, does not anticipate any impact on the continued safe confinement of spent nuclear fuel in existing dry storage installations.~~There is also the concern that licensees, certificate holders, and designers are not adequately evaluating the suitability of materials in their material selection process.~~

Requested Actions

~~To ensure~~NRC is concerned that the fabrication, loading, unloading, or ~~operations~~use of spent fuel storage and transportation casks ~~are~~be performed safely and in compliance with~~in~~ the conditions and requirements specified under Title 10 of the *Code of Federal Regulations*. Accordingly, action

addressees are requested to take the following actions:

1. Address the following items relating to the susceptibility of the spent fuel storage or transportation cask design to chemical, galvanic, or other reactions:

   ~~(a) Identify and fully describe the materials, including coatings, used for all components of the storage or transportation cask design.~~

   (a) Review the ~~specified~~ cask materials, **including coatings and lubricants,** to determine whether chemical, galvanic, or other reactions ~~between~~**among** the materials, contents, and environment can occur during any phase of ~~fabrication,~~ loading, **unloading,** handling, **storage, and transportation.** ~~or operation~~. Consideration should be given to all environments ~~likely to~~**that may** be encountered **under normal, off-normal, or accident conditions**.

   (b) ~~Show that such reactions will not cause unsafe conditions during cask operations~~. Evaluate the effects of any identified reactions **to determine if any adverse conditions could result.** Considerations should be given, but not limited, to:

      (i) generation of flammable or explosive quantities of hydrogen or other combustible gases; and

      (ii) increased **neutron multiplication in the fuel in a** cask ~~neutron multiplication~~ because of boron precipitation from a chemical reaction ~~between~~**among** the borated water and cask materials.

   (c) ~~Show that such reactions will not~~ **Evaluate the effects of any identified reactions to determine if their reaction products could** reduce the overall integrity of the cask ~~and~~**or its contents. Determine if the reaction products could adversely affect the cask's** ~~its~~ ability to ~~store~~**maintain the structural integrity and retrievability of the** spent fuel **throughout the term of the license** or **to** transport fuel safely. Consideration should be given, but not limited, to:

      (i) changes in cask and fuel cladding thermal properties, such as emissivity;

      (ii) binding of mechanical surfaces, especially fuel-to-basket clearances; and

      (iii) degradation of any safety components, either caused directly by the effects of the reactions, or by the effects of the

reactions combined with the effects of long-term exposure of the materials to neutron and gamma radiation, high temperatures, or other possible conditions.

~~(e) If items (c) and (d) cannot be satisfactorily demonstrated, implement design changes to the cask to use only materials that are compatible with each other, the contents, and the environments encountered during cask operations. As an alternative, implement appropriate controls and procedures to prevent any chemical, galvanic, or other reactions or to minimize their adverse effects (see item 3, below). If items (c) and (d) cannot be satisfactorily demonstrated, justify the use of casks that have already been fabricated.~~

(d) Review current cask operating procedures to determine if adequate controls and procedures are in place to minimize hazardous conditions that may be created by any identified reactions.

2. For storage casks currently loaded with spent fuel, determine the extent, if any, of the chemical, galvanic, or other reactions that ~~may~~ have occurred, and the effect of these reactions on the cask's ability to ~~store~~maintain the structural integrity and retrievability of the spent fuel throughout the term of the license. ~~safely. If any effects exist that could compromise the cask's ability to store or transport fuel safely, then justify continued use of the cask.~~

~~3. Review current cask operations to determine if adequate controls and procedures are in place to minimize hazardous conditions that may be created by reactions between the cask materials, contents, and environments, such as the generation and ignition of explosive gases. If not, develop and implement appropriate compensatory measures. In developing compensatory measures, site specific operational characteristics should be considered, as well as the effect of the worst case credible accident.~~

~~4. Submit a report describing any problems, abnormalities, or unexpected occurrences experienced with previous cask operations and the actions taken to resolve them. Specify any such incidents that remain unresolved, the steps expected to achieve resolution for each incident, and the date by which full resolution will be achieved.~~

In addition to the items above, the ~~designer~~ vendor and users of the VSC-24 Spent Fuel Storage Cask (Sierra Nuclear Corporation, Arkansas Nuclear One, Palisades Nuclear Generating Plant, and Point Beach Nuclear Plant) are requested to take the following actions:

1. Evaluate the effects of the reaction ~~between~~among Carbo Zinc 11 and water. Show that the ability of the cask to ~~safely store~~maintain the structural integrity and retrievability of the spent fuel over a 20-year

period has not been adversely affected by the formation of precipitate, or by any other effects of the reaction. Justify the continued use of VSC-24 storage casks already loaded with spent fuel. In this evaluation, consideration should be given, but not limited, to:

(a) the effect of the precipitate on fuel cladding integrity;

(b) the effect of the precipitate on the heat transfer characteristics of the cask; and

(c) behavior of the precipitate under long term exposure to neutron and gamma radiation, high temperatures, and other possible conditions.

2. Evaluate the procedures for unloading the cask to consider the likely presence of **hydrogen gas or** precipitate inside the MSB and the possible adverse effects of the **hydrogen gas or** precipitate on cask handling and performance. ~~Revise the cask unloading procedures as necessary and appropriate.~~ **Inform the NRC of any changes made to the unloading procedures.**

Required Response

Pursuant to 10 CFR 2.204, 10 CFR 71.39, and 10 CFR 72.44(b)(3), **in order to determine whether any license or certificate should be modified, suspended, or revoked, or other action taken,** action addressees are required to submit the following written response to this bulletin:

1. Within ~~60~~ **30** days of the date of this bulletin, a written response indicating whether the addressee will implement the actions requested above. If the addressee intends to implement the requested actions, provide a schedule for completing implementation. If an addressee chooses not to take the requested actions, provide a description of any proposed alternative course of action, the schedule for completing the alternative course of action (if applicable), and the safety basis for determining the acceptability of the planned alternative course of action.

2. Within 30 days of completion of the requested actions, a report confirming completion and ~~summarizing~~ **detailing** the actions taken.

Address the required written report(s) to the U.S. Nuclear Regulatory Commission, ATTN.: Document Control Desk, Washington, D.C. 20555, under oath or affirmation under the provisions of 10 CFR 2.204, 10 CFR 71.39, and 10 CFR 72.44(b)(3). In addition, submit a copy to the appropriate regional administrator.

Related Generic Communications

IN 95-29, "Oversight of Design and Fabrication Activities for Metal Components Used in Spent Fuel Dry Storage Systems."

IN 96-34, "Hydrogen Gas Ignition during Closure Welding of a VSC-24 Multi-Assembly Sealed Basket"

Backfit Discussion

This bulletin is an information request made pursuant to 10 CFR 2.204, 10 CFR 71.39, and 10 CFR 72.44(b)(3). The objective of the actions requested in this bulletin is to verify that licensees are in compliance with existing NRC rules and regulations pertaining to the appropriateness and adequacy of the design of spent fuel storage and transportation casks including, and without limitation, 10 CFR 71.43(d), 72.122(h), 72.122(l), 72.236(c), 72.236(f), 72.236(g), 72.40(a)(5), 72.212(b)(9), 72.236(h), 72.234(b), and 72.146(b). ~~72.234, and 72.236(h).~~

Paperwork Reduction Act Statement

This generic letter contains information collections that are subject to the Paperwork Reduction Act of 1995 (44 U.S.C. 3501, et seq.). These information collections were approved by the Office of Management and Budget (OMB), approval number 3150-0012, which expires June 30, 1997.

The public reporting burden for this collection of information is estimated to average 600 hours per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. The U.S. Nuclear Regulatory Commission is seeking public comment on the potential impact of the collection of information contained in the generic letter and on the following issues:

1. Is the proposed collection of information necessary for the proper performance of the functions of NRC, including whether the information will have practical utility?

2. Is the estimate of burden accurate?

3. Is there a way to enhance the quality, utility, and clarity of the information to be collected?

4. How can the burden of the collection of information be minimized, including the use of automated collection techniques?

Send comments on any aspect of this collection of information, including suggestions for reducing this burden, to the Information and Records Management Branch, T-6 F33, U.S. Nuclear Regulatory Commission, Washington, DC 20555-0001, and to the Desk Officer, Office of Information and Regulatory Affairs, NEOB-10202 (3150-0012), Office of Management and Budget,

Washington, DC 20503.

NRC may not conduct or sponsor, and a person is not required to respond to, a collection of information unless it displays a currently valid OMB control number.

~~If you have any questions about this matter, please~~ **Nuclear power reactor licensees with questions regarding this matter should** contact ~~the technical contact listed below or~~ the appropriate Office of Nuclear Reactor Regulation (NRR) project manager. **All other addressees with questions regarding this matter should contact the technical contact listed below or the appropriate Office of Nuclear Material Safety and Safeguards (NMSS) project manager.**

Brian K. Grimes, Acting Director
Division of Reactor Program Management
Office of Nuclear Reactor Regulation

William D. Travers, Director
Spent Fuel Project Office
Office of Nuclear Material
Safety and Safeguards

Technical Contact: Marissa Bailey, NMSS
(301) 415-8531
Internet:mgb@nrc.gov

Lead Project Manager: William Reckley, NRR
(301) 415-1314
Internet:wdr@nrc.gov

Attachment: List of Recently Issued NRC Bulletins

CHRONOLOGY OF RELEVANT DRY CASK OPERATIONS

TIME AND DATE OF EVENT

| EVENT | LOAD #1 | LOAD #2 | LOAD #3 |
|---|---|---|---|
| Serial # | (MSB-01) | (MSB-03) | (MSB-02) |
| | | | |
| Start MSB fill | 0911 : 12/11/95 | 1800e : 5/20/96 | 2145 : 5/26/96 |
| MSB into SFP | 1030 | 2215 | 2300e |
| Load fuel | 1235-0030 : 12/12 | 0100-1330 : 5/21 | 0100e-1142 : 5/27 |
| Shield lid in place | 0415 | 1645 | 1450 |
| MSB breaks SFP surface | 0820 | 2035 | 1610 |
| 30 gal. Pump down | 0830e | 2041 | 1620e |
| MSB out of SFP | 0900 | 2100 | 1645 |
| Tack welds begin | 2145 | 0700e : 5/22 | 0245 : 5/28 |
| Shield weld complete | 0330 : 12/13 | 1230 | * |
| Weld structural lid | 0900-1530 | 2300-1100e : 5/23 | * |
| Structural lid seal weld | 1640-1715 | 0405e1 : 5/25 | * |
| Drain MSB | 2145-2230 | 1600e-1641 : 5/23 | * |

e - Time of event not recorded; estimate based on adjacent recorded events.
* - Not performed
MSB - Multi-Assembly Sealed Basket
1 - Drained down prior to completing structural lid seal weld
SFP - Spent Fuel Pool

E11

CHRONOLOGY OF RELEVANT DRY CASK OPERATIONS

ELAPSED TIME (HRS:MINS)

| EVENT | LOAD #1 | LOAD #2 | LOAD #3 |
|---|---|---|---|
| Serial # | (MSB-01) | (MSB-03) | (MSB-02) |
| | | | |
| Start MSB fill | 0 | 0 | 0 |
| MSB into SFP | 1:19 | 4:15 | 1:15 |
| Load fuel | 15:19 12 hr | 19:30 12.5 hr | 13:57 10.7 hr |
| Shield lid in place | 19:04 | 22:45 | 17:05 |
| MSB breaks SFP surface | 23:09 | 26:35 | 18:25 |
| 30 gal. Pump down | 23:19 | 26:41 | 18:35 |
| MSB out of SFP | 23:49 | 27:00 | 19:00 |
| Tack welds begin | 36:34 | 37:00 | 29:00 |
| Shield weld complete | 42:19 | 42:30 | * |
| Weld structural lid | 54:19 6.5 hr | 65:00 12 hr | * |
| Structural lid seal weld | 56:04 | 106:001 | * |
| Drain MSB | 61:19 | 70:00 | * |

* - Not performed
MSB - Multi-Assembly Sealed Basket
SFP - Spent Fuel Pool
1 - Drained down prior to completing structural lid seal weld

| PLANT | CASK DESIGN | COATING |
|---|---|---|
| Point Beach | VSC-24 | Carbo Zinc 11 |
| Palisades | VSC-24 | Carbo Zinc 11 |
| Prairie Island | TN-40 | Carbo Zinc 11 *<br>Zinc-Aluminum Inner Lining (welded) |
| Surry | MC-10 | Flame Sprayed Aluminum |
| | Castor V/21 X/33 | Galvanically Applied Nickel Plating |
| | NAC-ST-I28 | NONE |
| Oconee | NUHOMS-24P | Flame Sprayed Aluminum |
| Calvert Cliffs | NUHOMS-24P | Flame Sprayed Aluminum |
| David Besse | NUHOMS-24P | Flame Sprayed Aluminum |
| H.B. Robinson | NUHOMS-7P | NONE |
| Fort St. Vrain | MVDS | Flame Sprayed Aluminum |

* Used on top of drain line; 1.5" stripe used as a warning marker for fuel handlers.

**URGENT BULLETIN 96-XX: CHEMICAL, GALVANIC, OR OTHER REACTIONS IN SPENT FUEL STORAGE AND TRANSPORTATION CASKS.**

- **Point Beach VSC-24 Storage Cask Event - May 28, 1996**

- **Initial Regulatory Actions**
  - Issued IN 96-34 on May 31, 1996
  - CALs Issued June 3, 1996 to Affected Licensees (Pt. Beach, Palisades, ANO)
  - AIT Investigation/Vendor Inspection

- **Supplemental Regulatory Actions**
  - Supplement to original CALs issued June 27, 1996
  - Generic Communication: Urgent Bulletin issued July 5, 1996

- **Future Regulatory Actions**
  - Modify SRP for Storage Casks
  - Explore need for Rulemaking

E/3

URGENT BULLETIN 96-XX: CHEMICAL, GALVANIC, OR OTHER REACTIONS IN SPENT FUEL STORAGE AND TRANSPORTATION CASKS.

- **Scope**
  - Part 50 licensees, Part 71 & 72 CofC Holders/Applicants/Users

- **Requested Actions**
  - All Action Addresses
  - VSC-24 Vendor and Users

- **Required Response**
  - 30 Day Response
  - Report Confirming Completion of Actions Taken

- **Backfit Discussion**
  - Part 71
  - Part 72

# SUMMARY OF NRC BULLETIN 96-04

Requested Actions (short and long term)

Required Responses

Schedule for Actions/Responses

E/H

# SUMMARY OF NRC BULLETIN 96-04

Requested Actions

Short Term

- Review cask materials and components for susceptibility
- Evaluate effect of identified reactions on loading and unloading
- Review cask loading and unloading procedures for adequacy

Long Term

- Review effects on overall integrity of cask (clad integrity, structural, thermal, mechanical binding)
- Evaluate effects on loaded casks

SN & VSC-24 users

- Evaluate Carbo-Zinc effects on 20 year cask life (precipitate interaction with clad integrity, heat transfer, radiation)
- Re-evaluate unloading procedures

## REQUIRED RESPONSE

- Notify NRC of intent to implement within 45 days of issuance (8/19/96)

  YES: Confirm completion of short term requested actions and schedule for long term actions.

  Notify NRC within in 30 days of completion of long term actions

  NO: Provide description of alternate plans, including safety basis.

**PROPOSED RESPONSE TO F. SHILLINGLAW 6/20/96 LETTER TO CHAIRMAN**

6. As you indicated in Question 6, calculations using licensing basis assumptions would indicate maximum fuel clad temperatures above 800° F when the MSB is in the MTC. Based on Sierra Nuclear Corporation (SNC) calculations submitted as part of the VSC-24 application review, this could be expected to occur only in the four fuel assemblies in the middle of the MSB. Only those portions of those guide sleeve tubes surrounding the hottest part of those assemblies would be expected to have a temperature close to the fuel clad temperatures. SNC's calculations also show that fuel clad and basket temperatures are lower than 800° F away from the center of the MSB. At temperatures above 800° F, in the dry, helium-filled MSB, hydrogen off-gassing from the Carbozinc 11 coating would not be expected. Reactions of concern, at these high temperatures, could be oxidation or melting of the coating materials. From discussions with WEPCO and SNC, we expect that these questions, relating to the temperatures experienced by the Carbozinc 11 coating in the cask and potential effects of exceeding the manufactures recommended temperature for non-continuous use, will be addressed in their responses to the bulletin.

   You also alluded to hot steam heating the shield lid to 900° F and expressed your concern about possible offgasssing of hydrogen from the RX-277 neutron shield material in the lid. SNC calculations show that shield lid temperatures are a factor of 4 to 5 lower than the maximum fuel clad temperatures. Steam generated in the unloading process would be below the 350° F temperature at which the RX-277 material is baked and, therefore, additional off-gassing is not expected from the encased RX-277.

G:\STUBZ\CARBTEMP.FC5

F15

Attached is draft information related to literature research on radiolysis and conservative preliminary staff estimates on $H_2$ generation rates prepared after the Point Beach event.

F/6

The literature suggests that a yield of $H_2$ in borated water may be considerably less than the value of 0.42 moles/100eV used in this analysis. The values used in this analysis represent the gross production rates or yields of $H_2$, however, Allen and Schwarz mention net production rates (G-values accounting for the recombination events of the $H_2$) of less than half of those used in the present analysis. Using a value of $G_{gross}$ = 0.2 moles/100eV yields significantly less $H_2$ values of 1.1 and 0.38 moles (compared to 2.29 and 0.81 moles with $G_{gross}$ = 0.42 moles/100eV), respectively for design basis and real time scenarios.

It is my opinion that even with the production rates of 2.29 moles and 0.81 moles, for design and real scenarios, respectively, radiolytic decomposition of water is not the cause of the Point Beach incident. Although it is a contributor to the problem, I do not believe it is the cause. Chemical analysis found about 3.8 moles of $H_2$ dissolved in the water within the MSB. An additional amount of about 0.25 moles was detected in the air volume above the water in the MSB after about 12 hours following the incident. The amount of $H_2$ consumed during the burn is unclear, however, it is likely to have been a considerable amount considering the force required to move the shield plug. Neglecting the $H_2$ consumed in the burn, more than 4 moles $H_2$ was found in the MSB after 12 hours. These calculations show that radiolysis produced less than one mole (0.81 moles) of $H_2$ and even in the design case could only have produced 2.29 moles (conservative) of the greater than 4 moles detected.

In summary, it is my belief that radiolytic decomposition of water did not cause the $H_2$ burn at Point Beach. Although radiolysis is capable of producing the necessary $H_2$ concentrations (about 0.25 moles) to cause combustion, I assert that without a stirring or bubbling mechanism by which $H_2$ can escape the liquid phase more readily, much of this $H_2$ would remain in the liquid phase (consider the 3.8 moles dissolved $H_2$ detected in the water). Further, it is my recommendation that a simple test be conducted to determine the actual amount of $H_2$ gas being release from the liquid

phase, as the mechanisms by which water decomposes in the presence of radiation is extremely complex due to the large number of radicals produced. Further, the addition of impurities and boron makes the radiation chemistry even more complex due to scavenging and secondary radiation effects.