UNITED STATES
NUCLEAR REGULATORY COMMISSION
REGION III
801 WARRENVILLE ROAD
LISLE, ILLINOIS 60532-4351

June 7, 2000

MEMORANDUM TO: J. A. Grobe, Chairman
Manual Chapter 0350 Panel For D. C. Cook

FROM: J. E. Dyer, Regional Administrator

SUBJECT: RESOLUTION OF DEGRADED CEQ FAN ROOM WALL

The D. C. Cook MC 0350 Oversight Panel is currently reviewing the closeout activities for restart of Unit 2. One issue remaining open is Restart Action Matrix Item R.2.13.3, "Operability of Degraded Unit 2 CEQ Fan Room Concrete Wall." This item was the topic of a public meeting in NRC headquarters on June 1, 2000, and at the public MC 0350 meeting on June 5, 2000, the staff tentatively agreed with the licensee that the wall was degraded, but operable under Generic Letter 91-18. In your final closeout review I request that you specifically address the following concerns that I have received about this item:

1. Nonconservatisms in the licensee's analysis:

- There was either no and/or inadequate QC/QA on this containment as evidenced by the construction discrepancies that have been identified. These discrepancies have resulted in the following uncertainties:
  - Depth of cover of the reinforcing steel
  - Spacing of the reinforcing steel
  - Undocumented cutting of the reinforcing steel
  - Quality of the grout
  - Quality of the concrete
  - The thickness differences identified on various pours
- These uncertainties have resulted in a reduction in conservatism which results in no margin left on the CEQ wall. The licensee calculations, minus our questions on the concrete strength and dynamic load factors, have resulted in a 1.047 margin.
- In addition, in view of the undocumented findings on these walls, we do not know the extent of the condition of the balance of the containment. What confidence do we have that the other concrete structures are built as designed and meet their intent?
- Westinghouse, in a April 27, 2000 letter to AEP, recommended at least s 40% margin on pressure walls since the pressure inputs were not exact. This a long way from 4.7% that we have.

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2. G.L. 91-18 allows a licensee to resume operation provided the necessary equipment is operable within some reasonable assurance of safety with the following guidelines:

   - Availability of redundant or backup equipment -- we have none.
   - Compensatory measures -- the licensee has stated that we would over pressurize the upper containment and possibly release radioactivity.
   - Conservatism and margains -- already explained above.
   - G.L. 91-18 refers to impact on core damage frequency. The containment is not needed for core damage frequency, but it is needed for the large early release frequency (LERF).
   - G.L. 91-18 refers to timeliness. The licensee first identified problems with this wall on February 11, 1998. They did not start working on it in earnest until over two years later. G.L. 91-18 allows the licensee to declare operability providing they implement corrective action at the first available opportunity, not to exceed the next fueling outage (usually 18 months). We are considerably past that time limit. Currently, the licensee has no plans to do any more on these walls then we have seen (calculations), as told to us during the June 1st meeting.

No formal response to this memo is necessary. This memo and your response should be documented in the internal meeting minutes.

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

June 12, 200

MEMORANDUM TO: John A. Grobe, Chairman
Manual Chapter 0350 Panel for D.C. Cook

FROM: S. Singh Bajwa, Director
Project Directorate III
Division of Licensing Project Management
Office of Nuclear Reactor Regulation

SUBJECT: RESOLUTION OF DEGRADED CEQ FAN ROOM WALL

A memorandum dated June 7, 2000, to you from J. E. Dyer directed the Manual Chapter 0350 Restart Panel to address several points as part of its reviews of the closeout activities for restart of Donald C. Cook (D.C. Cook), Unit 2. The points were related to the Restart Action Matrix (RAM), Item R.2.13.3, "Operability of Degraded Unit 2 CEQ Fan Room Concrete Wall." Because of the technical and policy nature of the questions posed, the restart panel agreed that the Office of Nuclear Reactor Regulation (NRR) would be in the best position to prepare the response to Mr. Dyer's memorandum. Our views on the points raised in the memorandum are discussed below.

Analysis of Issues Raised in J. E. Dyer June 7, 2000, Memorandum

"1. Nonconservatisms in the licensee's analysis:

- There was either no and/or inadequate QC/QA on this containment as evidenced by the construction discrepancies that have been identified. These discrepancies have resulted in the following uncertainties:
  - Depth of cover of the reinforcing steel
  - Spacing of the reinforcing steel
  - Undocumented cutting of the reinforcing steel
  - Quality of the grout
  - Quality of the concrete
  - The thickness differences identified on various pours."

Staff Response:

The first five of these issues were discussed in detail during the public meeting held on June 1, 2000, between the licensee, NRR staff, and Region III staff. The extent of the discussions during the June 1, 2000, meeting regarding "quality of the grout" and "quality of the concrete"

CONTACT: J. Stang, NRR
(301) 415-1345

A/4

JUN 15 2000

were focused on the strength of those materials. The staff is not aware of other concerns regarding grout and concrete "quality." The issue concerning "the thickness differences identified on various pours" was not discussed. The staff is unaware of any deviations between in-situ wall thicknesses and designed wall thicknesses. A copy of the publicly available minutes of the June 1, 2000, meeting, including the licensee's presentation materials, is attached with this memorandum (Attachment 1).

The licensee's Expanded System Readiness Review of the containment structure and follow-up corrective actions, identified that a combination of construction problems affected two subcompartment walls below the ice condenser floor. The deficiencies were caused by problems in the control of activities while the plant was being constructed or by a failure to reconcile design documents with the as-built condition of the two subcompartment walls. The defiencies were not identified through the licensee's construction quality programs.

- "These uncertainties have resulted in a reduction in conservatism which results in no margin left on the CEQ wall. The licensee calculations, minus our questions on the concrete strength and dynamic load factors, have resulted in a 1.047 margin."

Staff Response:

The analytical design margin for the CEQ wall following a main steamline break has been reduced when the current, as-left condition of the wall is compared to the wall as it was shown on original design documentation and in the Updated Final Safety Analysis Report (UFSAR). In the June 1, 2000, meeting, the licensee presented the results of their analyses which concluded that the limiting design margin was 1.21. The NRR and Region III staffs challenged several of the licensee's assumptions that reduced the analyzed design margin of 1.21 somewhat. The final design margin was above 1.0.

The combination of the analyses of pressure response and containment subcompartment integrity has demonstrated that all design requirements have not been satisfied (i.e, not all load factors in the UFSAR are satisfied for all load combinations for the CEQ wall). The licensee stated that they will either perform additional analyses (for the pressure response and wall integrity) and submit those analyses to the NRC for information to demonstrate that all design requirements are satisfied, or modify the walls as necessary to restore full design margin. In the interim, the licensee's evaluation has adequately shown that the wall, although considered degraded based on the current pressure response analyses, is capable of fulfilling its safety function and is considered operable consistent with the provisions of Part 9900, "Technical Guidance" of the NRC Inspection Manual and Generic Letter (GL) 91-18, Revision 1. A comprehensive safety assessment of these walls was documented in a memorandum dated June 9, 2000, from S. Black to J. Grobe (Attachment 2).

- "In addition, in view of the undocumented findings on these walls, we do not know the extent of the condition of the balance of containment. What confidence do we have that the other concrete structures are built as designed and meet their intent."

Staff Response:

At the meeting on June 1, 2000, the licensee described their reviews of construction records, and photographs of initial construction showing the placement of concrete reinforcement bars. In addition, the licensee described the examination of as-built structures that were performed to assess whether the problems identified on the CEQ wall exist in other structures. The NRC staff questioned this ascertion and ultimately agreed that the circumstances that resulted in the condition of the CEQ wall were unique and that the licensee's evaluation provided a much clearer understanding of other walls. The licensee provided data and construction information regarding other walls to support their position.

- "Westinghouse, in an April 27, 2000, letter to AEP, recommended at least a 40 percent margin on pressure walls since the pressure inputs were not exact. This is a long way from 4.7 percent that we have."

Staff Response:

In resolving various containment issues and reconstituting the design and licensing bases for the containment, the licensee contracted Westinghouse to analyze the pressure response of the containment subcompartments following high energy line breaks. The basis for Westinghouse's recommendation to maintain a 40 percent margin was described in the letter dated April 27, 2000, from Westinghouse to the licensee. The basis for the recommendation was to allow for possible differences between the analytical assumptions and the as-built condition of the containment structures. The licensee stated that they verified, in accordance with their Appendix B program, that the as-built-condition of the structures was used in the pressure calculation and the 40 percent allowance was not needed. NRC Standard Review Plan Section 6.2.1 allows the 40 percent margin requirement to be eliminated as long as as-built data is used in the calculations. The licensee has confirmed that as-built data was used to support the assumptions in the calculations. Based on that confirmation, on June 1, 2000, Westinghouse agreed in a letter to the licensee that the appropriate margin could be reduced from 1.40 to 1.00.

"2. GL 91-18 allows a licensee to resume operation provided the necessary equipment is operable within some reasonable assurance of safety with the following guidelines:

- Availability of redundant of backup equipment - we have none.
- Compensatory measures - the licensee has stated that we would over pressurize the upper containment and possibly release radioactivity.
- Conservatisms and margains [sic]- already explained above."

Staff Response:

GL 91-18 and NRC Inspection Manual Part 9900 provide guidance on assessing the operability of equipment that is in nonconformance with its design basis or is "degraded." A variety of factors are considered in evaluating degraded structures, systems, or components. In the case

of structural components, NRC Inspection Manual, Part 9900, Section 6.16, establishes the expectation that structural elements be evaluated against applicable standards to determine operability.

The staff reviewed the limiting load design combination from the UFSAR for the affected structural elements. The staff has reasonable assurance that the stresses in concrete and steel structures meet that limiting load combination with a load factor greater than 1.0 for the main steam line break pressure loading considered. Since the affected structures are operable, that is the load factor is above 1.0, the consideration of other factors (e.g., redundant equipment or compensatory actions) is not necessary.

- "GL 91-18 refers to impact on core damage frequency. The containment is not needed for core damage frequency, but is needed for the large early release frequency (LERF)."

Staff Response:

While the containment structures have been determined to be degraded, the containment remains operable resulting in no substantive change in the probability of a large early release.

- "GL 91-18 refers to timeliness. The licensee first identified problems with this wall on February 11, 1998. They did not start working on it in earnest until over two years later. GL 91-18 allows the licensee to declare operability providing they implement corrective action at the first available opportunity, not to exceed the next fueling outage (usually 18 months). We are considerably past that time limit. Currently, the licensee has no plans to do any more on these walls than we have seen (calculations), as told to us during the June 1, 2000, meeting."

Staff Response:

Early during the current shutdown, the licensee identified surface deficiencies at various locations in the containment and considered them to be a minor problem. The licensee prioritized and scheduled repair of the walls during the outage. The containment was not required to be operable throughout that time period.

During the fall of 1999, the licensee began attempts to repair the walls and identified material deficiencies in the walls. The licensee evaluated the condition of the walls and determined that the walls did not meet specified design margins.

Through the spring of 2000, the licensee evaluated the as-built configuration of the walls, analyzed available design margins, and implemented limited modifications to the walls to establish operability of the walls. During a June 1, 2000, meeting, the licensee provided their post restart corrective action plans. NRC staff and management acknowledged those corrective action plans.

NRC Inspection Manual Chapter 9900 and GL 91-18, Revision 1, and 10 CFR Part 50, Appendix B, Criterion 16, describe expectations that completion of corrective actions for

degraded systems be accomplished on a time frame consistent with their importance to safety when these systems are required to be operable. During the June 1, 2000, meeting, NRC management emphasized expected time frames for completion of corrective actions pursuant to 10 CFR Part 50, Appendix B, and NRC policy.

Overall Conclusion from Review of J. E. Dyer Memorandum dated June 7, 2000

Regarding the restart of Unit 2, the decision of the restart panel is to determine whether or not the corrective actions taken to date by the licensee provide reasonable assurance that the subcompartment walls are able to fulfill their safety function supporting operability of the containment and the unit can be operated safely. It is our position that the licensee's repairs and reanalyses of containment reflecting the current, as-left condition of the walls provide the necessary level of confidence to consider the walls to be operable. There is no additional information in the memorandum from J. E. Dyer that alters our conclusions. (See memorandum from S. Black to J. Grobe dated June 9, 2000, (Attachment 2).)

Docket Nos. 50-315 and 50-316

Attachments: 1. Summary of June 1, 2000 meeting,
dated June 9, 2000
2. Memorandum from S. Black to J. Grobe,
dated June 9, 2000

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

June 12, 2000

Mr. Robert P. Powers, Senior Vice President
Indiana Michigan Power Company
Nuclear Generation Group
500 Circle Drive
Buchanan, MI 49107

SUBJECT: DONALD C. COOK - SUMMARY OF JUNE 1, 2000, PUBLIC MEETING REGARDING CONTAINMENT SUBCOMPARTMENT WALLS

Dear Mr. Powers:

This letter summarizes the meeting held on June 1, 2000, between members of your staff and the Nuclear Regulatory Commission (NRC) related to subcompartment walls in the Unit 2 containment at the Donald C. Cook (D. C. Cook) nuclear plant. The meeting was held at the NRC headquarters in Rockville, Maryland. This meeting was open for public observation. Enclosure 1 provides a list of meeting attendees.

Your staff presented information related to the design and licensing basis for the subject walls, the current configuration of the walls including walls which were degraded, along with a justification to operate while the walls were considered to be in a degraded or nonconforming condition. A copy of the handouts used by your staff is provided in Enclosure 2. Prior to the meeting, the NRC staff issued questions to be addressed during the meeting. The questions were formulated by members of the NRR Mechanical Engineering Branch and NRC Region III staff. The questions, provided by facsimile to your staff on May 31, 2000, are provided as Enclosure 3.

Your staff presented background information regarding the design and licensing basis and current as-built configuration of the subcompartment walls. In particular, your staff discussed grout and concrete strength in the walls, open pockets in the walls, inappropriate cutting of reinforcing rods, and the location of reinforcing rods in the walls. The staff raised a number of questions during this section of the presentation.

The next portion of the presentation related to the analysis used to demonstrate the operability of the walls. Your staff presented a summary of the inputs used in the analysis, including grout strength, concrete strength, reinforcing bar location, and pressure loading on the walls. The staff raised specific questions concerning the concrete strength and dynamic loading. The results of the operability analysis were also presented. Your staff discussed the criteria used for declaring the walls operable and showed that the analysis demonstrated that the walls in question meet operability criteria established with more than 20 percent margin. The staff questioned portions of operability determination and also questioned the amount of margin determined in the analysis.

In the next portion of the presentation, your staff presented the reviews and inspections used to determine the extent of the condition of other walls in the containment. Your staff presented construction photographs showing the location of reinforcing bars in the containment and the

results from radar mapping of the subject walls to located reinforcing bars in the walls. Your staff also described the results of inspections of the as-built containment for other similar configurations. The staff asked several questions about the extent of the condition of the containment and concluded that there was reasonable basis to conclude no other similar deficiencies existed.

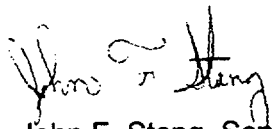
Your staff concluded the presentation by describing the corrective actions to be performed on the subject walls prior to entering MODE 4 for Unit 2 and also the long-term corrective actions. Your staff stated that the final resolution and schedule for both Unit 1 and Unit 2 containment wall issues would be completed prior to restart of D. C. Cook Unit 1. The NRC staff reinforced expectations, as stated in Generic Letter 91-18, "Information to Licensees Regarding NRC Inspection Manual Section on Resolution of Degraded and Nonconforming Conditions," that the corrective actions to remedy the deficiencies in the walls be undertaken as soon as practical commensurate with the safety significance of the deficiency, but not later than the next refueling outage for Unit 2.

Following completion of your staff's presentation, discussion of the six questions contained in Enclosure 3 took place. The NRC staff asked several followup questions. While the NRC staff did not fully agree in the total amount of margin each wall demonstrated, the NRC staff did agree that the analysis performed by your staff demonstrated that each wall in question was operable with some amount of margin.

In accordance with 10 CFR 2.790 of the NRC's "Rules of Practice," a copy of this letter and the enclosures will be available for public inspection at the Commission's Public Document Room, the Gelman Building, 2120 L Street, NW., Washington, DC, and accessible electronically through the ADAMS Public Electronic Reading Room link at the NRC Web site (http://www.nrc.gov).

If you have any questions regarding this matter, please contact me at 301-415-1345.

Sincerely,



John F. Stang, Senior Project Manager, Section 1
Project Directorate III
Division of Licensing Project Management
Office of Nuclear Reactor Regulation

Docket Nos. 50-315 and 50-316

Enclosures: 1. Attendee List
2. Licensee's Slide Presentation
3. NRC Questions

cc w/encls: See next page

cc:

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Robert P. Powers, Senior Vice President
Indiana Michigan Power Company
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ATTENDANCE LIST FOR JUNE 1, 2000, MEETING

NAME	ORGANIZATION
John Stang	NRC
Jack Grobe	NRC
Suzanne Black	NRC
Gene Imbro	NRC
B.P. Jain	NRC
R.B. Landsman	NRC
Tony Vegel	NRC
Bill Reckley	NRC
Hans Asher	NRC
Claudia Craig	NRC
John Zwolinski	NRC
Rich Lobel	NRC
Kamal Lobel	NRC
Robert Godley	AEP
B.G. Kavarik	AEP
S.A. Greenlee	AEP
Paul Leonard	AEP
Mike Rencheck	AEP
Jerry Burford	AEP
Bob Temple	Hopkins & Sutter
A.K. Singh	Sargent & Lundry
Jenny Weil	McGraw Hill
John Stevenson	S&A

Enclosure 1

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Every step of the way.
COOK NUCLEAR PLANT

American Electric Power

Meeting with

Nuclear Regulatory Commission

Discussion of Containment Subcompartment Walls

Restarting D. C. Cook
June 1, 2000

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Enclosure 2

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Agenda

■ Introduction/Agenda	Mike Rencheck
■ Background	Scot Greenlee
■ Description of the Issues, Analysis, Extent of Condition, Corrective Actions	Scot Greenlee & Brenda Kovarik
■ Conclusion	Mike Rencheck

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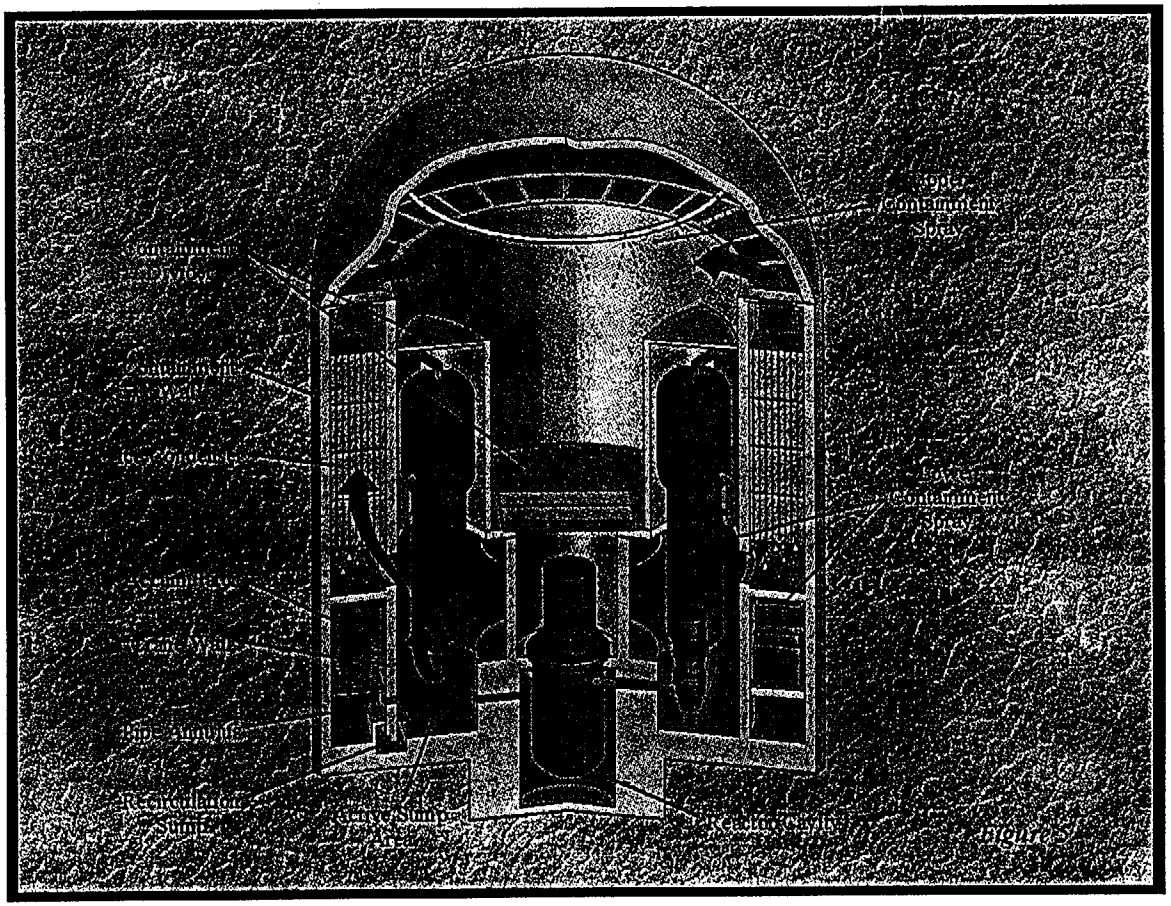
Background: Diagram of Containment Subcompartment Walls

■ Containment



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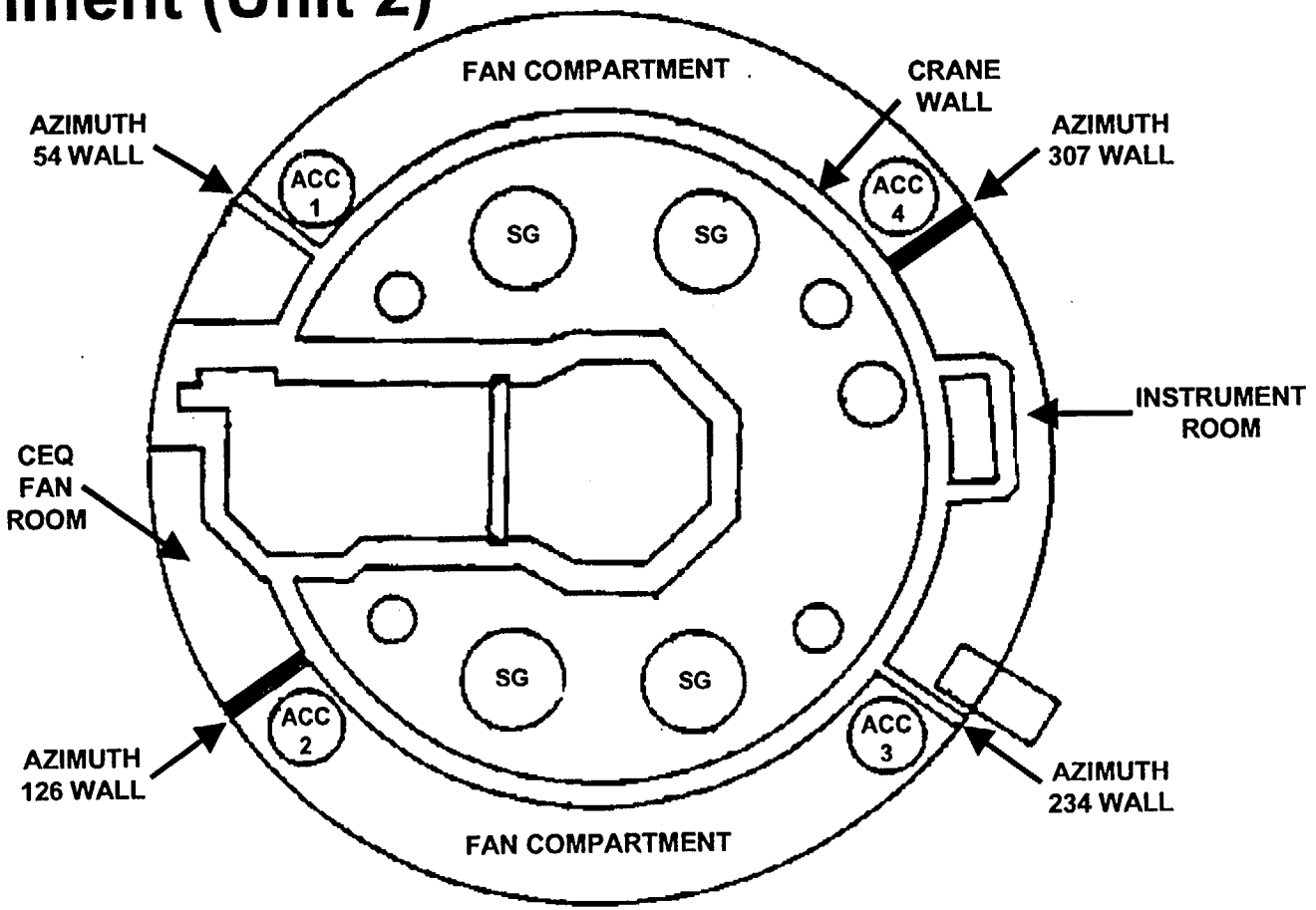
Background: Diagram of Containment Subcompartment Walls

■ Containment (Unit 2)



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Background: Description of Subcompartment Walls

- Four Walls in Each Unit
- Focus on Unit 2:
  - Two end walls of CEQ Fan Room (Upper Compartment)
  - Two end walls of Instrument Room (Lower Compartment)
  - All walls restrained at three sides

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Summary of the Issues: As-found Unit 2 Subcompartment Walls

	54°	126°	234°	307°
■ Grout Strength		x		x
■ Open Pockets		x		
■ Cut Rebar		x		
■ Asbestos		x		
■ Rebar Location	x	x	x	x
■ Rebar Cover	x	x	x	x

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Description of the Issues: Grout Strength

- Spalling Discovered During System Readiness Reviews
  - Grout discovered during repair
- Top of 126° and 307° Walls Grouted
  - 126° wall due to ice condenser structure interference
  - 307° wall due to construction sequence - installed after ice condenser slab poured
- Grout Strength
  - Estimated as 1000 psi in 126° wall
  - Tested in 307° wall: 1,280, 1,770, and 4,380 psi

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Description of the Issues: Open Pockets

- Pockets at Top of 126° Wall for Bolting
- Design Required Pockets to be Grouted
- Pockets Left Open From Original Construction

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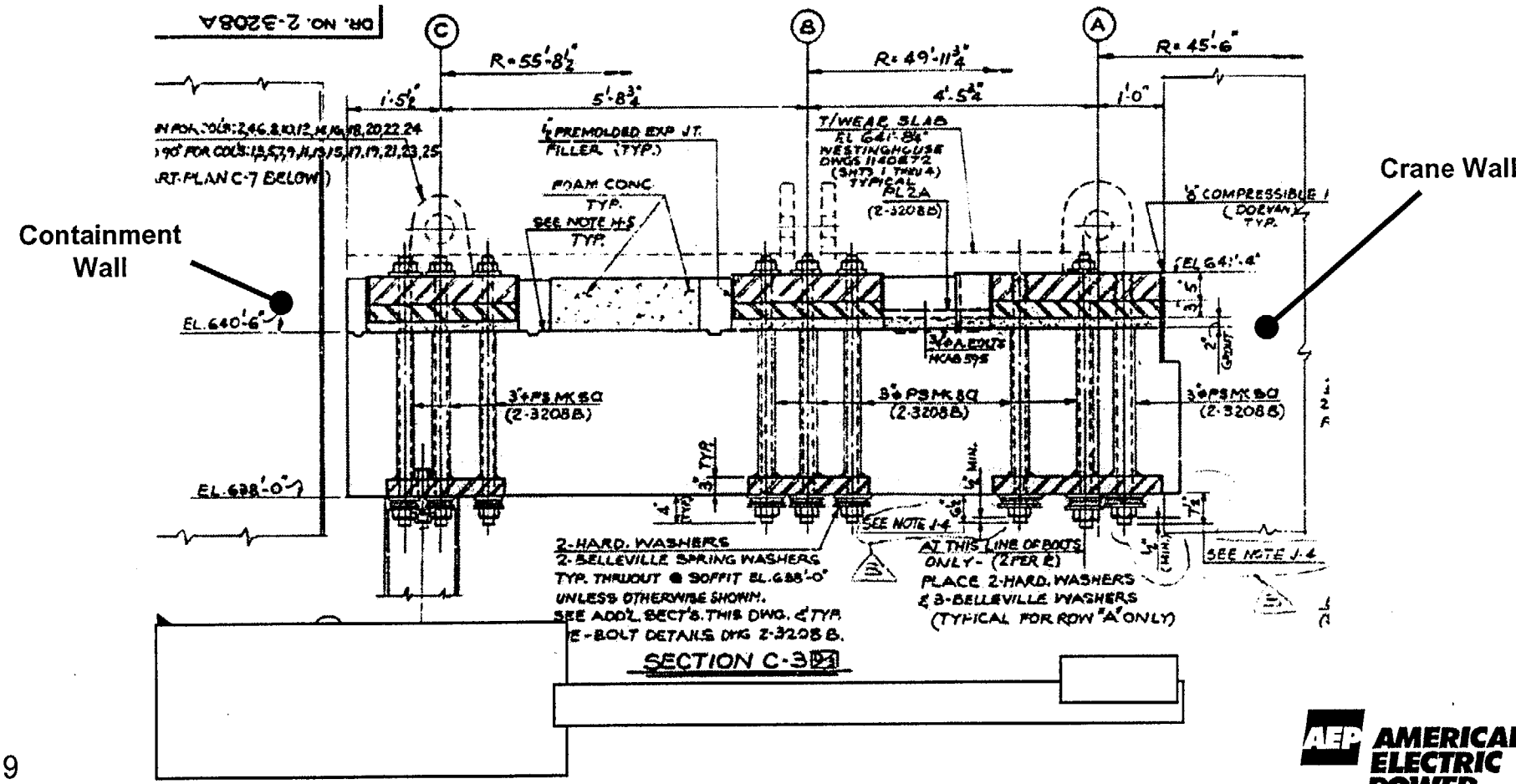
Description of the Issues: Open Pockets - Configuration of Unit 2 Ice Condenser Column Anchorage

■ Typical Slab/Column Connection (Unit 2 Only)



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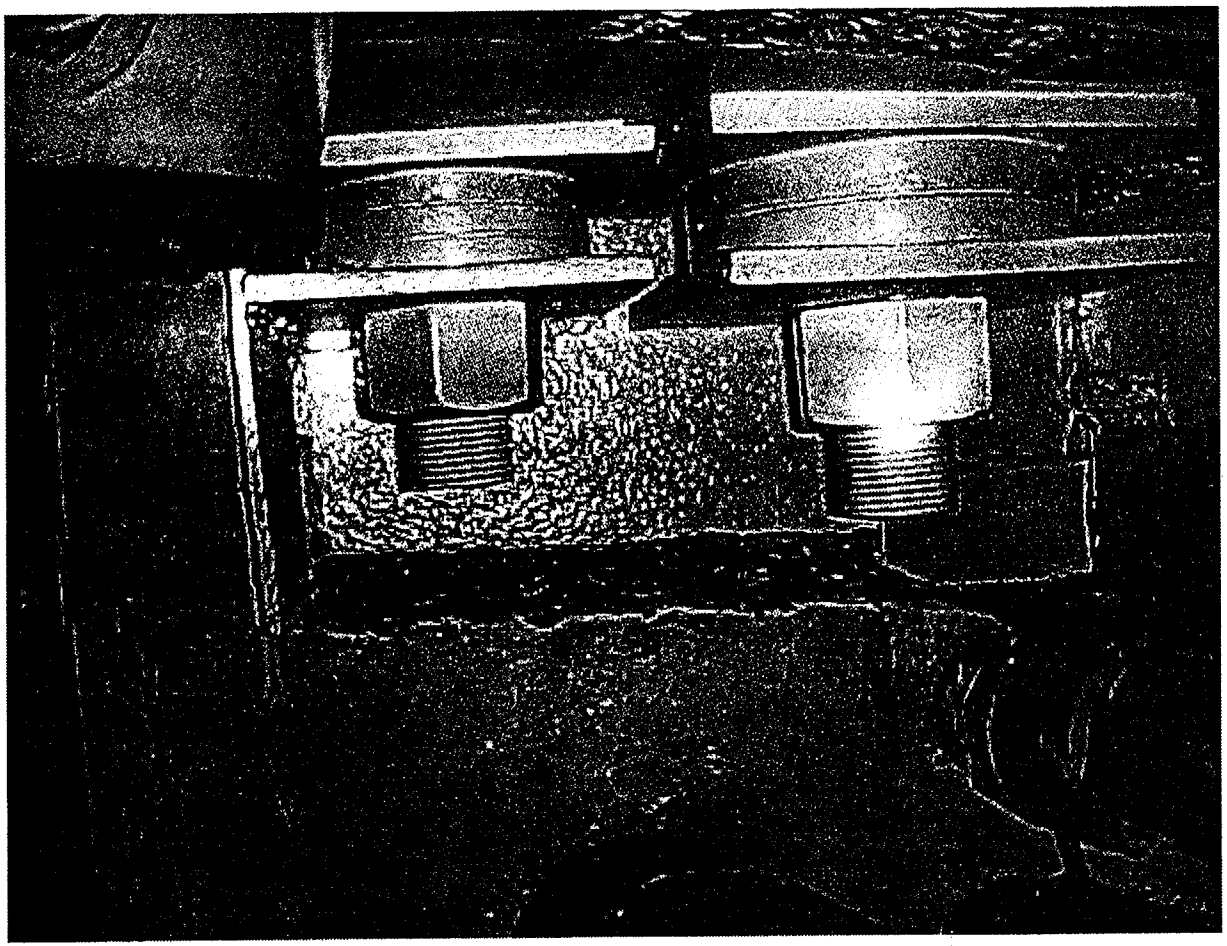
Description of the Issues: Open Pockets - Configuration of Unit 2 Ice Condenser Column Anchorage

- Detail Showing Pocket for Anchorage Through Bolts



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Description of the Issues: Cut Rebar

- Vertical Rebar Cut at Top of 126° Wall
- Cuts Required for Installation of Ice Condenser Anchorage
- Excavation Determined Extent of Condition on 126° Wall
- Issue Limited to 126° Wall

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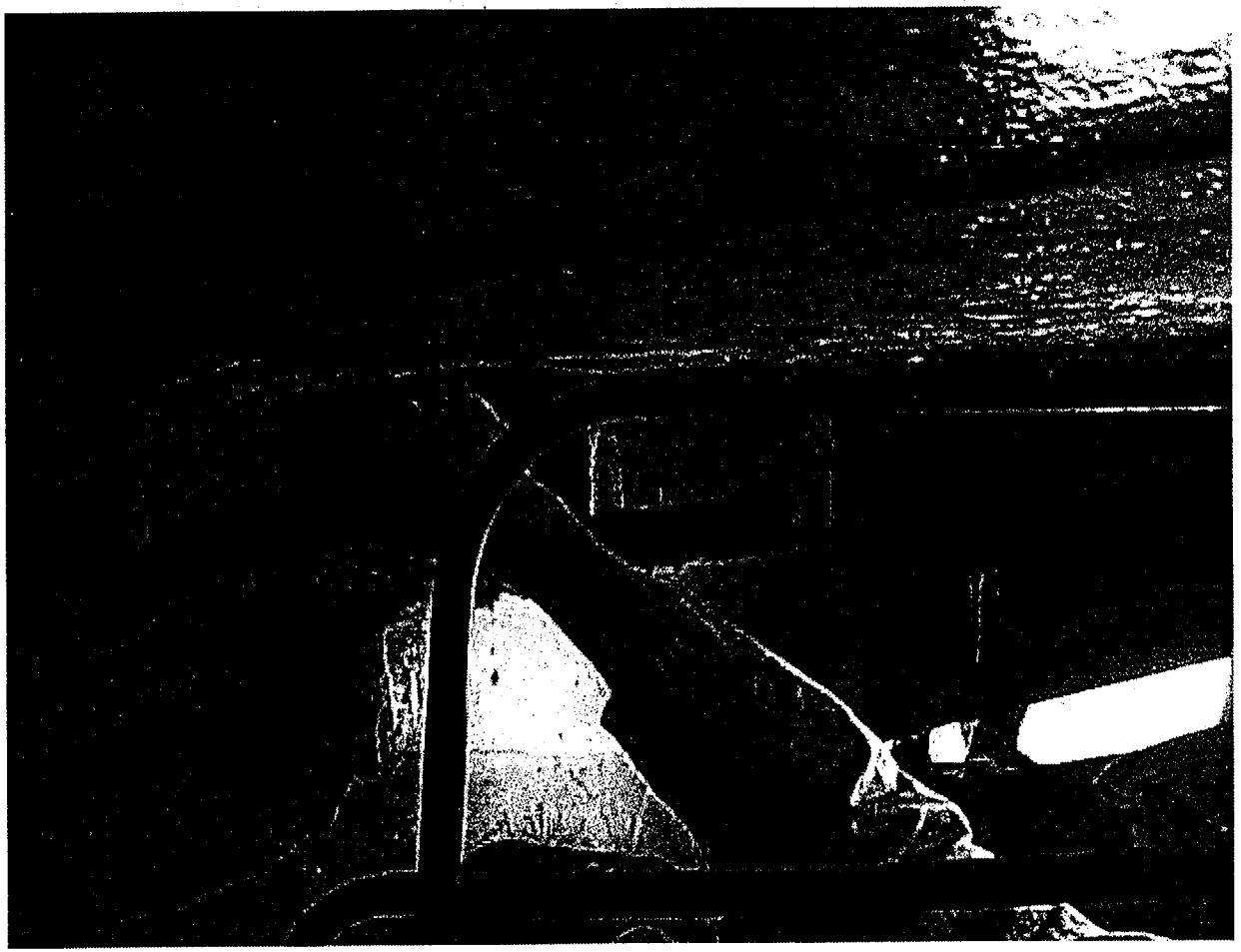
Description of the Issues: Cut Rebar

- Detail Showing Chipped Grout



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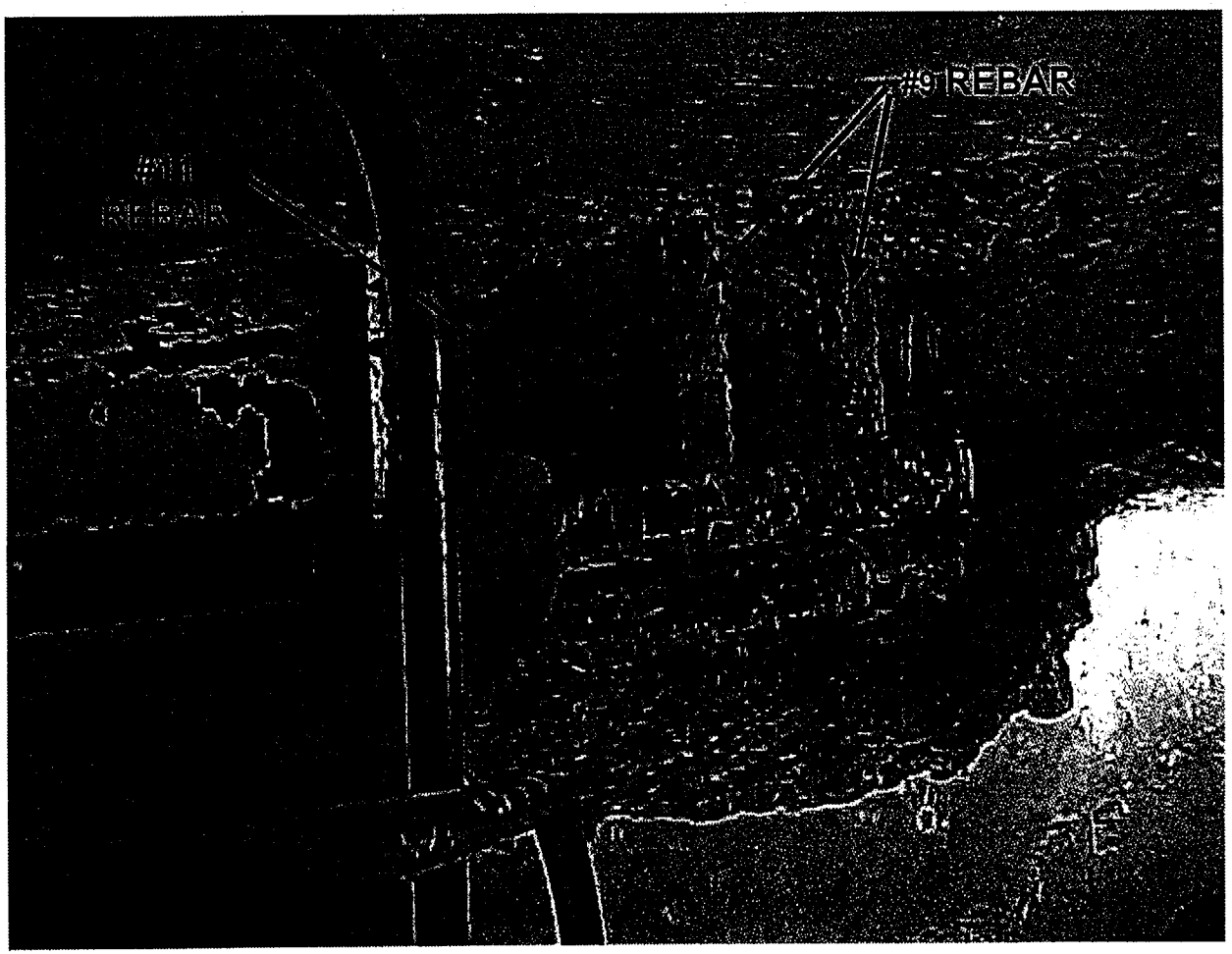
Description of the Issues: Cut Rebar

- Detail Showing Excavation and Rebar



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Description of the Issues: Asbestos

- Asbestos Blanket Found at Top of 126° Wall During Excavation
- Likely Used for Cutting of Embedments - Then Left Behind
- Embedment Cutting Limited to 126° Wall
- No Asbestos Found in 307° Wall

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Evaluation: Mapping and Excavation

- 126° Wall Grout Excavated - Accessible Areas at Top on CEQ Fan Room Side
- 307° Wall Grout Excavated - Four Locations to Verify Bar Penetration Into Ice Condenser Slab
- Radar Mapping - All Four Walls
  - Critical accessible areas
  - Both sides of each wall

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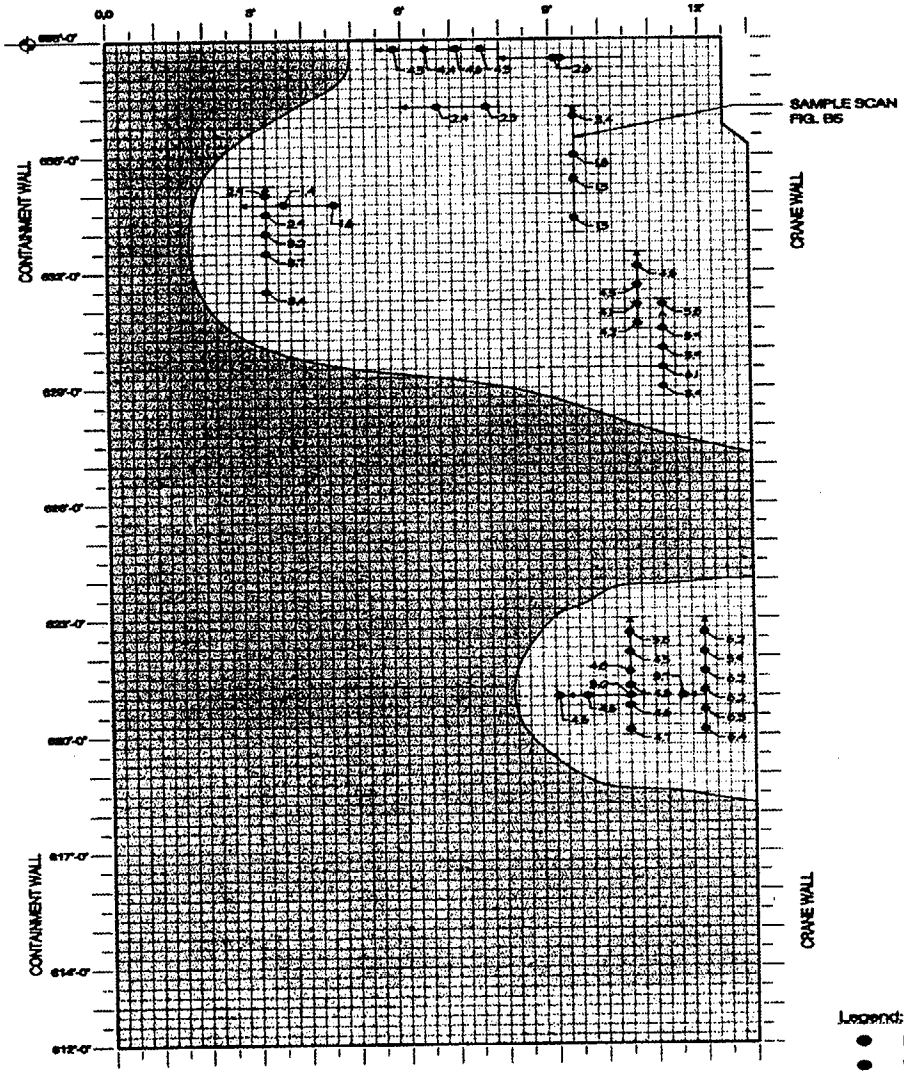
Description of the Issues: Wall Radar Mapping



Wall at 126° Accumulator Side

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Description of the Issues: Rebar Location

- **Design**
  - #9 rebars at 12 inch centers (vertical)
  - #11 rebars at 6 inch centers (horizontal - accumulator side)
  - #11 rebars at 12 inch centers (horizontal - instrument/CEQ fan room side)

- **Excavation and Radar Mapping - Average Spacing:**
  - Horizontal bars per design
  - Vertical bars
    - » Most areas per design
    - » Up to 15 inch spacing in limited areas

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Description of the Issues: Rebar Cover

- **Design**
  - Horizontal bars - 2¾ inch cover
  - Vertical bars - behind horizontal (4⅛ inch cover)

- **Excavation and Radar Mapping:**
  - Minimum ACI cover requirements met
  - Average maximum depth developed for horizontal bars and vertical bars

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Wall Analysis: Overview

- **Given Issues, All Walls Analyzed to Ensure Operability**
- **In-situ Parameters Used**
  - Grout strength
  - Concrete strength
  - Rebar location
  - Rebar cover
- **All Walls Operable With Margin**

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COOK NUCLEAR PLANT

Wall Analysis: Design Inputs

- **Grout Strength**
  - 307° wall - 1,000 psi
  - 126° wall
    - » Filled pockets and excavation with new grout
    - » 2,500 psi new grout (conservative)
    - » No credit for old grout
- **Concrete Strength**
  - 5,300 psi design strength concrete based on cylinder test data
- **Rebar Locations From Mapping and Excavation Data**
- **New Transient Mass Distribution (Pressure) Loads**

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Wall Analysis: Acceptance Criteria

- **Limiting Design Load Combination**
  - **UFSAR Eq. (i): C = 1.5 P1 + DL + T + TL**
    - » **C = Wall capacity**
    - » **P1 = Pressure load due MSLB**
    - » **DL = Dead load**
    - » **T = Operating thermal gradient load**
    - » **TL = Liner temperature load (not applicable to walls)**
  - **DL and T loads are negligible**
- **Operability Criteria: C > 1.0 P1**

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Analysis: Results

- Conservative Analysis
- All Four Walls Operable
- Margin Available (C > 1.0 P1)

Wall	Simplified	Yield Line
54°	1.36	1.48
126°	1.21	1.34
234°	1.25	1.54
307°	1.29	2.83

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Extent of Condition: Other Unit 2 Structures

- Ice Condenser Support Interference and Asbestos Limited to 126° Wall
- Grout Deficiencies Limited to the 307° Instrument Room and 126° CEQ Fan Room Walls
- Other Construction Openings Evaluated
  - Containment
  - Crane Wall

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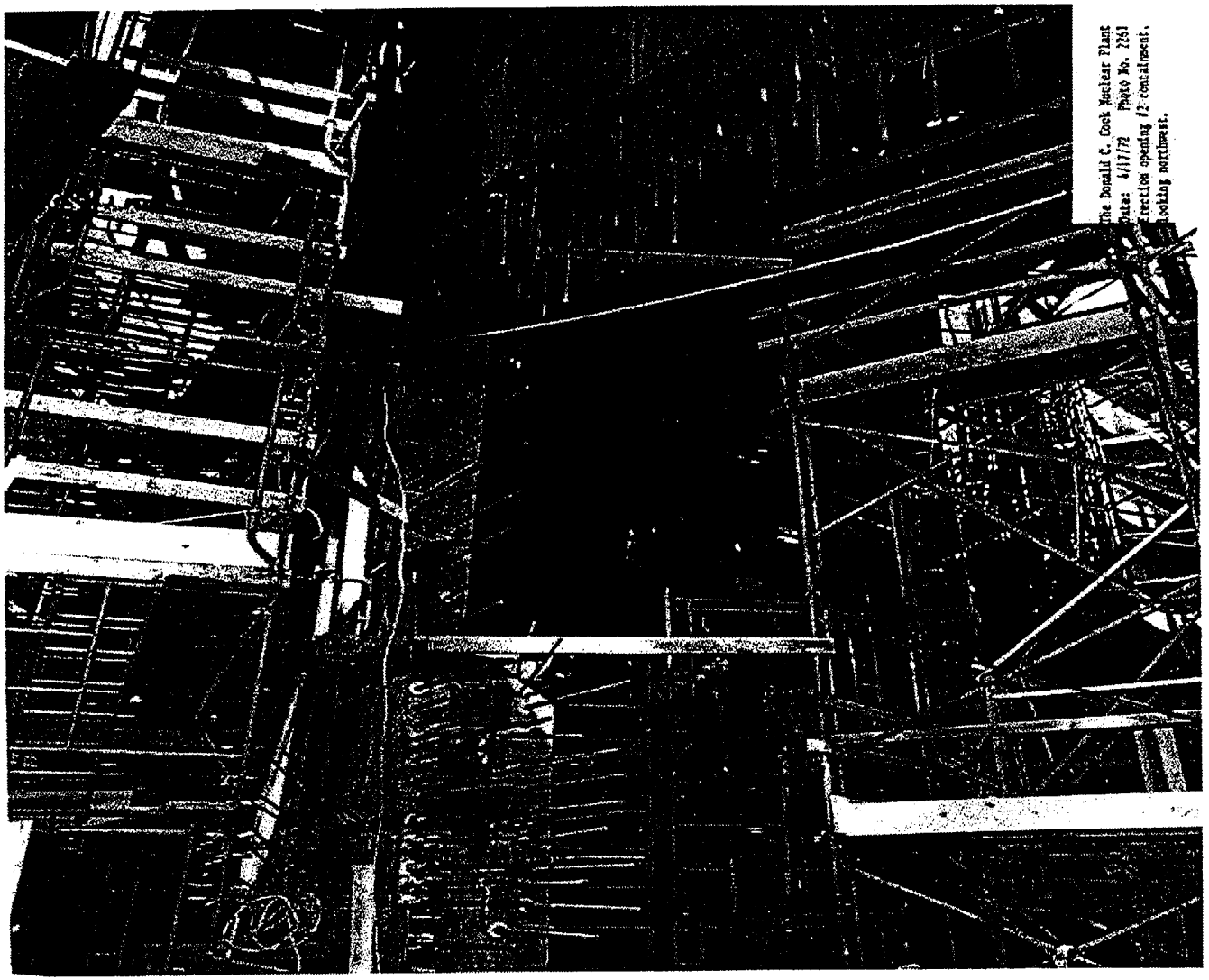
Extent of Condition: Crane Wall Construction Opening



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Extent of Condition: Other Unit 2 Structures

- **Rebar Placement**
  - Structural elements similar to accumulator walls
    - » Steam Generator Enclosure
    - » Pressurizer Enclosure
    - » Primary Shield Wall
    - » Crane Wall
  - Similar structural elements significantly thicker (less limiting)
  - Variations offset by conservatism in design
    - » Confirmed by Steam Generator and wall evaluations
  - No generic issues from review of construction records

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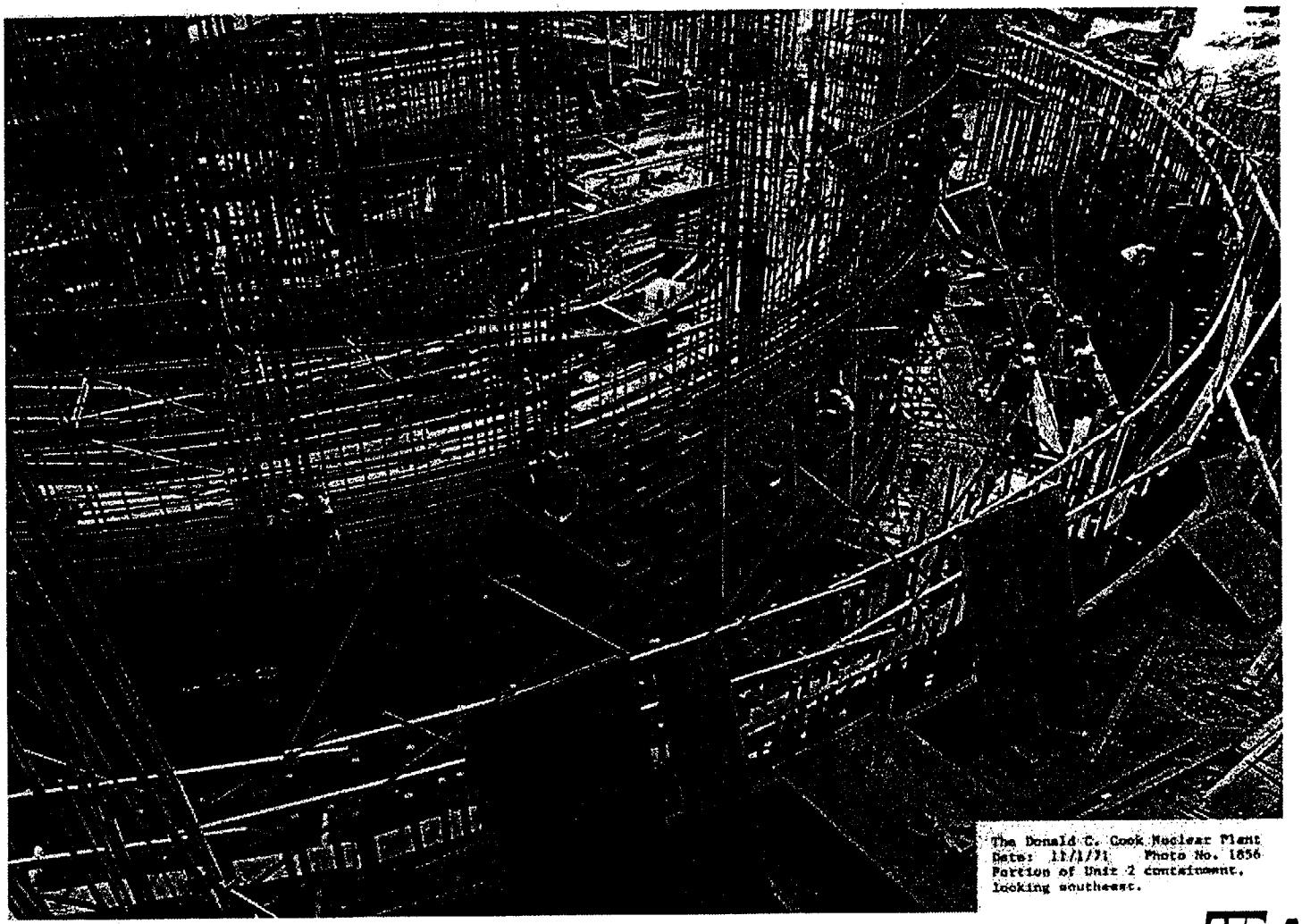
Unit 2 Containment Under Construction



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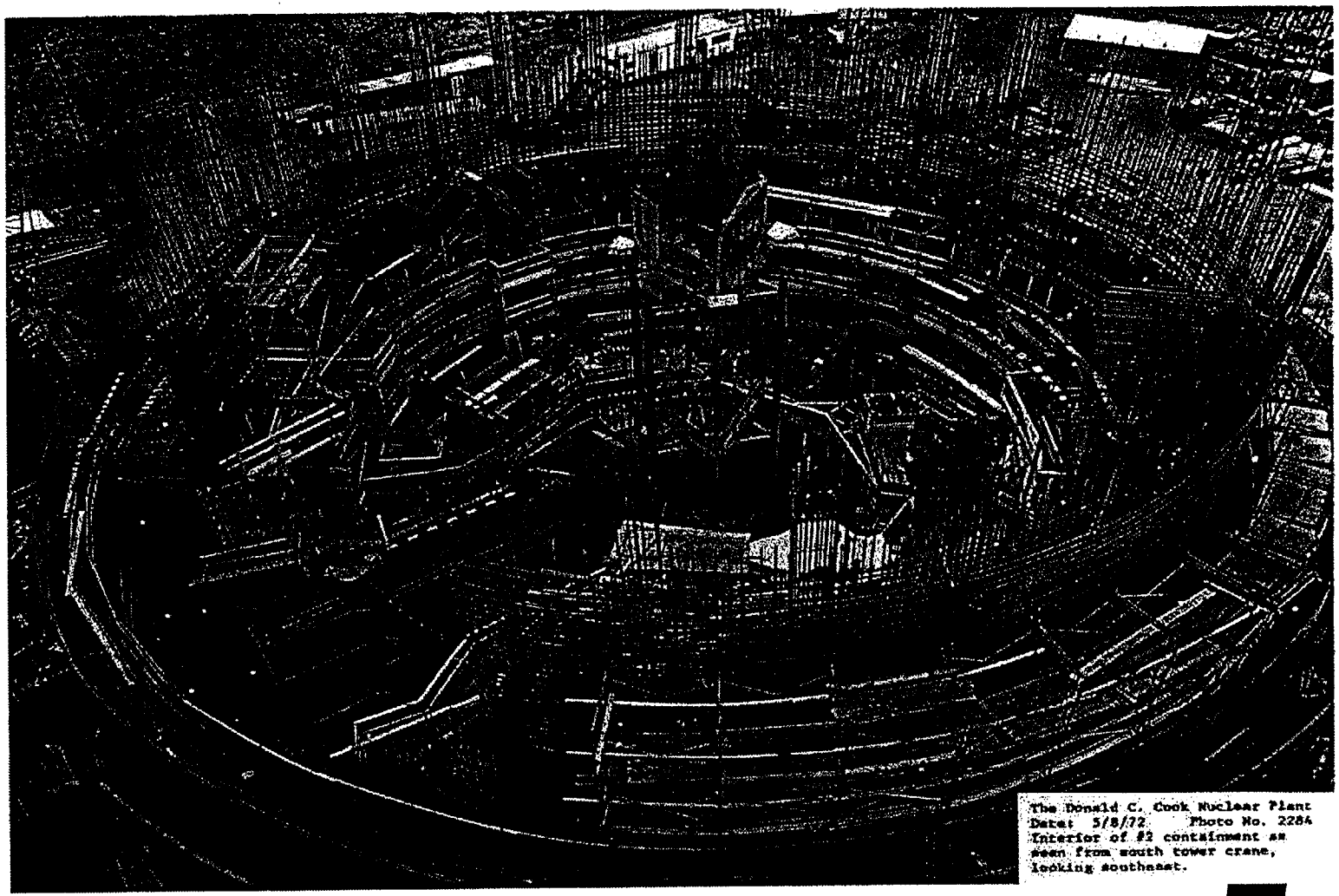
Unit 2 Containment Under Construction



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Corrective Actions - Completed

- Performed Field Investigation and Confirmation of Rebar Depth and Location
- Tested Cores of Existing Grout (Unit 2 Wall at 307°)
- Excavated/Missing Grout Replaced with High Strength Grout
- Verified Concrete Strength from Construction Records
- Determined Wall Structural Capabilities
- Assessed Extent of Condition

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Corrective Actions - Post Restart

- Develop Schedule for Permanent Resolution during Unit 1 Restart Preparations
  - Review with NRC prior to restart of Unit 1
- Achieve Agreement on Final Course and Schedule by Unit 1 Restart

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Conclusion: Unit 2 Walls

- Walls Safe for Restart
- Reasonable Assurance that Other Structures Not Impacted

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NRC STAFF QUESTIONS CONCERNING OPERABILITY OF

SUBCOMPARTMENT WALLS - D. C. COOK UNIT 2

1. Provide the frequency calculation of the missile shield cover. Also provide the differential pressure time histories constructed based on Figures 1 and 2, reported in the letter from Westinghouse to the licensee (AEP-00-139, dated April 27, 2000) to demonstrate the adequacy of using a dynamic load factor (DLF) of 1.0.

2. In response to question No. 1 in Westinghouse's letter AEP-00-139, confirm that the input data to the TMD pressure calculations are verified to be the as built data.

3. For Unit 2, based on 4800 psi from cylinder break tests and FSAR compressive strength of 3500 psi, provide the basis for using a concrete strength of 5300 psi in concrete design calculations.

4. When the dynamic load factor used for calculating the effective pressure loads on the concrete members is close to unity, we conclude that the load is not dynamic in nature. In that case, dynamic increase factor per Appendix C-ACI349 may not be applicable. Please explain this discrepancy.

5. Justify the use of the 3 vertical bars in determining shear capacity at the top of wall 126.

6. Provide the long term plan for wall 126 with regard to its conformance with design basis requirements.

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

June 9, 2000

MEMORANDUM TO: John A. Grobe, Director
Division of Reactor Safety
Region III

FROM: Suzanne C. Black, Deputy Director
Division of Licensing Project Management
Office of Nuclear Reactor Regulation

SUBJECT: DONALD C. COOK NUCLEAR PLANT, UNIT 2 - CLOSEOUT OF RESTART ACTION MATRIX ISSUES DEALING WITH GENERIC LETTER 91-18 OPERABILITY EVALUATIONS

The Office of Nuclear Reactor Regulation (NRR) staff has reviewed your verbal request for technical assistance pertaining to auditing Indiana Michigan Power Company's (the licensee's) operability evaluations pursuant to Generic Letter 91-18. These issues are being tracked in the Restart Action Matrix (RAM) as R.3.8, R.3.12, R.3.13, R.3.14, R.3.15, R.3.16, and R.3.17.

RAM ISSUE R.3.8: Post-LOCA Control Room Dose, Noncompliance with GDC 19 Acceptance Criteria (see Attachment 1).

RAM ISSUE R.3.12: Tornado Missile - Related issue on Unit 2: Missile issue for the HVAC intake hoods located on the roof of the Electrical Switchgear Room and Spent Fuel Building (see Attachment 2). Unit 2 is currently in Mode 4. The licensee intends to address Mode 5 and 6 compensatory measures under the same severe weather procedures as Modes 1-4.

RAM ISSUE R.3.13: HELB - Licensing Basis Change Request for 10D on Plume and SRP, MEB 3-1 exclusion areas (see Attachment 3).

RAM ISSUE R.3.14: Methodology Changes to SGTR Analysis: Original 30 minute operator action time to isolate the affected Steam Generator to prevent overfill was not supported by analysis (see Attachment 4).

RAM ISSUE R.3.15: Loss of AC and Feedwater Analyses Revision: Input changes on positive MTC used to meet acceptance criteria, resulting in a reduction in safety margin for Unit 2 (see Attachment 5).

CONTACT: J. Stang, NRR
(301) 415-1345

Attachment 2

RAM ISSUE R.3.16: Auxiliary Building Engineered Safety Feature Ventilation System Filtration System Bypass Damper Redundancy: The previous charcoal filter bypass dampers were installed in series; because of excess leakage rates they were replaced, however, the replacement dampers were installed in parallel and are subject to single failure issues (see Attachment 6).

RAM ISSUE R.3.17: Changes in Input Assumptions and the UFSAR for Transient Mass Distribution (TMD) Analysis: Reconstitution of Sub-Compartment Blowdown Analysis and Assumptions Resulted in Differential Pressures Higher than in the UFSAR (see Attachment 7).

As discussed in the attachments, the NRR staff finds that the licensee's modifications, compensatory measures, and calculations provide reasonable assurance that the degraded or nonconforming conditions will not prevent the systems in question from performing their intended functions. Therefore, NRR recommends to the MC 0350 Restart Panel closure of the above RAM issues based on the attached documentation.

This concludes our efforts under TAC Nos. MA8958, MA9020, MA8968, MA8969, MA9022, MA9023, and MA8977.

Docket No. 50-316

Attachments:
1. RAM ISSUE R.3.8
2. RAM ISSUE R.3.12
3. RAM ISSUE R.3.13
4. RAM ISSUE R.3.14
5. RAM ISSUE R.3.15
6. RAM ISSUE R.3.16
7. RAM ISSUE R.3.17

RAM ISSUE R.3.8: CONTROL ROOM HABITABILITY

BACKGROUND: By letter dated October 28, 1998, the NRC documented the status of the current review of the D. C. Cook control room habitability evaluation. The letter documented an August 5, 1998, phone conversation where the licensee stated that the current control room ventilation dose calculations being evaluated by the NRC were determined to require technical and administrative upgrades. However, the licensee stated that the changes in the analysis did not affect the ability of the control room ventilation system to meet the requirements of GDC 19 or raise questions regarding the operability of these systems.

Following issuance of the letter, deficiencies in the Control Room Ventilation System (CRVS) were identified during the ESRR discovery process. The issues included single-failure problems related to control room isolation and pressurization and other deficiencies with control room dose assumptions, such as unfiltered in-leakage and atmospheric dispersion factors. In addition, a tracer gas test was conducted on the Unit 1 and Unit 2 control rooms, which resulted in higher than previously measured unfiltered in-leakage.

LICENSEE'S CORRECTIVE ACTIONS: As a result of the discovery of the nonconforming condition of the control room, the licensee followed the guidance contained in GL 91-18, Revision 1, and developed compensatory actions for the nonconforming condition. The licensee performed post-accident Control Room dose analysis, with the currently licensed TID-14844 source term, and determined that interim compliance with GDC 19 is achieved by operating with a more restrictive Reactor Coolant System (RCS) activity limit than the current Technical Specification (TS) limit of 1.0 micro-curies/gram dose equivalent I-131. The licensee is also using administrative controls to lower the allowable limits for total containment leakage and lower the allowable limits for total ECCS leakage. The licensee will also use KI for the operators as an additional compensatory measure. The licensee has performed a safety screening of the compensatory measures and concluded that the compensatory measures do not introduce a USQ.

For long-term resolution of the issue, the licensee has decided not to restore the plant to the original licensing basis as described the UFSAR. The licensee has elected to revise the control room analysis with new analysis assumptions, methodology, and acceptance criteria for the 10 C.F.R. § 50.67 Alternative Source Term. This submittal will also contain new Technical Specifications for recent plant upgrades and the implementation of Generic Letter 99-02 requirements. The licensee has performed a safety screening of the final resolution of the issue and determined that it constitutes a USQ and a license amendment will have to be submitted and approved by the NRC prior to making the changes to the UFSAR. The licensee is scheduled to submit the license amendment prior to the restart of Unit 2.

NRC REVIEW: The NRR technical staff provided an overview of the licensee's GL 91-18 evaluation of the nonconforming condition. The staff is aware of the following compensatory measures:

1. Maintain RCS activity less than 0.35 micro-curies/gm dose equivalent I-131;

2. Maintain total containment leak rate less than 0.125 weight %/day; and

3. Maintain total ECCS leak rate less than 0.2 gpm.

The staff considers that the implementation of such compensatory measures is a reasonable approach to limit the post-accident control room dose to within the limits specified by GDC 19 for Unit 2. The staff also notes that the licensee considers the availability of KI for control room operators a defense-in-depth measure in the event radiological conditions within the control room exceed the guidelines of the licensee's established procedures. The performance of the NRR overview will be mentioned in NRC Inspection Report (IR)200016.

RECOMMENDATIONS/ACTIONS: It is recommended to the MC 0350 Panel that RAM ISSUE R.3.8 be closed. No further inspection on this issue is necessary, based on the corrective actions taken by the licensee. In addition, the NRR staff finds that the timeliness of the licensee's corrective actions (prior to restart of Unit 2) for final resolution of the issue is commensurate with the safety significance of the issue.

RAM ISSUE R.3.12: Tornado Missile - Related Issue on Unit 2

The issue deals with tornado missile vulnerabilities associated with the heating, ventilation, and air conditioning (HVAC) intake hoods located on the roof of the electrical switchgear room (I&M Condition Report P-99-13576), and tornado missile vulnerabilities associated with the fuel handling building (I&M Condition Report P-99-27193).

Consistent with the guidance contained in Generic Letter 91-18, equipment listed in the Technical Specifications is considered to be operable if it is able to perform its specified functions as defined in the current licensing basis for the facility. Therefore, in order to be operable, Technical Specification equipment that includes this as a design requirement must be protected from tornado missiles whenever a valid tornado threat exists (i.e., during tornado season). The staff's position with regard to the operability evaluations that were completed by the licensee is as follows:

- The NRR staff agrees with the licensee's operability evaluation relative to the HVAC intake hoods for Modes 1-4. The staff also agrees that compensatory measures can be taken to restore equipment operability consistent with the guidance contained in GL 91-18. The staff has reviewed the licensee's compensatory measures and find them reasonable, but recommends the resident inspector staff inspect the adequacy of the compensatory measures since they are in a better position to make an assessment.

- The licensee's evaluation did not assess whether the affected equipment that is required to be operable in Modes 5 and 6 can perform their specified functions in the event of a tornado missile strike. This would be applicable to the affected Technical Specification equipment that includes tornado missile protection as a design requirement. Although the licensee's evaluation is weak in its lack of addressing any Mode 5 and 6 vulnerabilities, the staff considers this issue to be of very low safety significance.

- The staff agrees with the licensee's operability evaluation relative to the fuel handling building. While the Technical Specification requirement associated with spent fuel pool water level could be impacted by a tornado missile, the licensee has determined that there is reasonable assurance that the spent fuel pool will continue to perform its intended safety function and therefore, should be considered operable but degraded. This is consistent with the guidance that is contained in GL 91-18, and this approach is acceptable.

RAM ISSUE R.3.13: High Energy Line Break

The staff has completed its assessment of the licensee's operability evaluation regarding High Energy Line Break (HELB) exclusion zones in the Chemical and Volume Control System (CVCS) letdown piping and Steam Generator Blowdown (SGBD) piping. The piping of concern is located outside the containment structure, between the containment penetration and the outboard isolation valve, and near the normal blowdown flash tanks.

In accordance with the Current Licensing Basis (CLB) for D. C. Cook, Units 1 and 2, for high energy lines, breaks must be postulated at terminal ends, and at locations where the break stress threshold is exceeded. Likewise, a single critical crack must be postulated at the most adverse location near safety related equipment, which can be anywhere along the line. For the above listed systems, the licensee determined that they were in a degraded and nonconforming condition with the CLB. In lieu of bringing these systems into conformance with the CLB, the licensee elected to establish their operability by evaluating postulated break and crack exclusion zones in the affected piping. The licensee requested to amend the licensing basis requirements using the same operability criteria as discussed below.

To justify operability in the degraded condition, the licensee performed analyses to determine the stresses at break postulation locations. The pipe stresses were calculated based on ANSI B31.1.0, 1967, subject to stress-based break postulation threshold criteria stated in Appendix B of Standard Review Plan (SRP) Branch Technical Position (BTP) ASB 3-1 (letters of December 1972 and January 1973, from A. Giambusso, NRC, to licensees). The results of these calculations indicate that the pipe stresses at the terminal ends and other locations are below the threshold break postulation criterion; therefore, there is a low likelihood of breaks occurring in the affected piping.

To avoid postulating a single critical crack at the most adverse location near safety related equipment, as required under the CLB, the licensee proposed the postulation of cracks based on one half of the break stress criterion. Although this is outside the CLB, the staff finds it acceptable to show operability. To mitigate the effects of potential jet impingement effects on adjacent safety-related equipment, the licensee proposed an exclusion criterion based on the results of NUREG/CR-2913 (no jet impingement effects for equipment located at a distance greater than 10 pipe diameters). This criterion has been accepted by the staff at other plants. The licensee stated that no safety related equipment was located closer than 10 pipe diameters from the affected piping. The staff finds this acceptable.

To eliminate the postulation of a crack in a portion of the SGBD system located in the normal flash tank room, the licensee replaced a segment of existing piping with heavy wall piping and introduced piping support modifications. This lowered the pipe stresses below the crack stress threshold. The staff finds this acceptable for demonstrating the operability of this piping.

The staff has reviewed the results of the licensee's calculations, and concludes that, although the piping is nonconforming with the CLB, the licensee's operability evaluation is acceptable and provides reasonable assurance for operation in Mode 1.

RAM ISSUE R.3.14: Methodology Changes to SGTR Analysis

The staff has completed its assessment of the licensee's operability evaluation concerning the methodology used in its steam generator tube rupture (SGTR) analysis. The current SGTR analysis assumes that break flow through the ruptured steam generator tube will be stopped in 30 minutes following the event. This assumption was not supported by a thermal hydraulic analysis considering proper operator actions for accident mitigation.

To address the above described non-conservativeness in its SGTR analysis, the licensee has modified its Emergency Operating Procedures (EOPs) and used a staff-approved methodology (WCAP - 10698-P-A) to analyze a design basis SGTR event which incorporated the operator actions specified by plant EOPs at D. C. Cook. The operator action times considered in this analysis has been verified at plant simulator by different operating crews. However, a limiting single failure is not assumed in this new analysis. The licensee considers that this approach is consistent with its current licensing basis. The results of the licensee's new analysis confirms that there will be no steam generator overfill following a SGTR event, break flow will be stopped in 51 minutes, and the radiological consequence will be bounded by the current analysis.

The staff concludes that the licensee's operability evaluation for this issue is acceptable since the results of its new analysis provide reasonable assurance that it is unlikely that a SGTR event could cause steam generator overfill at D. C. Cook.

RAM ISSUE R.3.15: Loss of AC and Feedwater Analyses Revision Due to Input changes to positive MTC used to meet acceptance criteria

The staff has reviewed the licensee's approach to reanalyzing the loss of normal feedwater (LONF) and loss of AC power (LOAC) transients based on the Westinghouse Nuclear Safety Advisory Letter, NSAL-98-007. This letter notified the licensee that incorporation of the pressurizer heater (which was not previously modeled) and a corrected pressurizer spray model resulted in increased pressurizer in-surge for these transients for D.C. Cook Unit 2 when the most positive moderator temperature coefficient (MTC) allowed by plant technical specifications (TS) was used. The current D.C. Cook TS limit the MTC to $+0.5 \times 10^{-4}$ $\Delta k/k/°F$ for power levels up to 70%, and ramp linearly to 0×10^{-4} $\Delta k/k/°F$ at 100% power. In order to achieve acceptable results for Unit 2, Westinghouse used the full power TS limit of 0×10^{-4} $\Delta k/k/°F$ instead of the part power limit of $+0.5 \times 10^{-4}$ $\Delta k/k/°F$ used previously in these analyses. The results confirmed that all acceptance criteria for these events continue to be met and, in particular, the pressurizer does not become water solid.

Although the revised MTC assumption is in compliance with the D.C. Cook Unit 2 TS at full power, the reduction in MTC for the full power transients represents a change in a design input value used in the current UFSAR analyses and represents a reduction in margin of safety, thereby constituting an unresolved safety question (USQ). However, the staff concludes that since this revised analysis complies with the TS limits for MTC under the assumed worst case initiating conditions for these transients, Unit 2 is considered operable but nonconforming until such time that a license amendment incorporating the revised methodology and revised UFSAR pages is reviewed and approved.

RAM ISSUE R.3.16: Auxiliary Building Engineered Safety Feature Ventilation System Filtration System Bypass Damper Redundancy

The staff reviewed the licensee's operability determination regarding the replacement of two ESF ventilation system charcoal filter bypass dampers in series with two bypass dampers in parallel. The bypass dampers are normally open and the charcoal filters are bypassed to maximize the time between charcoal replacements. On receipt of a Phase B Containment Isolation signal, the charcoal filter bypass dampers close and airflow is directed through the charcoal filters. Charcoal filter mode of operation is required in order to remove radioactive gases from the auxiliary building exhaust that may be present under accident conditions.

The licensee's original design required two dampers in series around each charcoal filter. A single failure of one bypass damper to close in a series configuration would not preclude the other bypass damper from closing and redirecting all of the air flow to the charcoal filters. Due to excessive leakage past the original dampers, the licensee replaced them during modification 12-DCP-049, Rev. 1, with improved dampers; however, the improved dampers were installed in a parallel configuration. In the parallel configuration, the failure of one damper to close would allow a bypass flow path around the charcoal filters and release air to the environment without benefit of charcoal filtration.

The licensee determined that an unreviewed safety question existed since the single failure protection of the bypass damper series configuration was lost. The licensee concluded that either a license amendment or additional modification was necessary to resolve the single failure issue, but that the system was operable, but degraded, in the interim. The operability determination was documented in Condition Report P-00-004984.

The licensee's operability determination was supported by the following:

- The operability of the ESF ventilation system as modified has been successfully established by periodic surveillance test procedures;
- The operability of the bypass dampers is verified on a staggered test basis every 31 days;
- The replacement dampers are of superior design, quality, and reliability to the original dampers;
- There have been no known failures of this type of damper in the industry;
- The failure of a bypass damper represents only a partial loss of filtration, since the roughing filters and high efficiency particulate filters are always in the flow path; and
- While a postulated bypass damper failure increases the release of radioactive fission products, the consequences are bounded by the licensee's accident analysis and are within the current licensing basis limits.

The staff reviewed the licensee's operability determination documented in Condition Report P-00-04984 and concluded that it is reasonable until final resolution of the single failure issue, based upon continued successful periodic surveillance testing, the improved design of the replacement dampers, and meeting the current licensing basis accident consequences in the case of a postulated failure of one of the bypass dampers.

RAM ISSUE R.3.17: Transient Mass Distribution Analysis

BACKGROUND

The Mechanical & Civil Engineering Branch (EMEB) has reviewed the submittals by American Electric Power Company (licensee) regarding its operability determination evaluation (ODE) of the D. C. Cook Unit 2 containment and Ice Condenser structures, containment divider barrier seal assembly, and Fan-Accumulator walls in containment (Refs. 2 and 4). EMEB was requested to review the licensee's ODE to determine if the licensee's approach to the structural issues is reasonable and if its conclusion is acceptable for restart of D. C. Cook Unit 2 until final resolution of these issues is determined. EMEB staff also participated in a meeting with the licensee on June 1, 2000, to discuss the results of its operability determination of affected structures. The Plant Systems Branch was consulted concerning the acceptability of the assumptions used in the calculations of differential pressures provided by Westinghouse Electric Company to the licensee (Ref. 3) for its use in the operability evaluation of designated structures.

Containment and Ice Condenser Structures (CR: P- 99-06123)

EMEB has reviewed the operability determination evaluation for Unit 2 containment and Ice Condenser structures identified in Section 2 of CR: P-99-06123, to determine if the licensee's technical approach is reasonable and if its conclusion is acceptable. The licensee provided a summary of its ODE of the affected structures.

In its operability evaluation, the licensee examined applicable UFSAR load combinations and determined that the combinations containing design basis accident (DBA) pressure loadings are governing. The licensee used as-built plant specific information in its reconstituted new calculations for Transient Mass Distribution (TMD) analysis (Ref. 3). The licensee has demonstrated that for operability evaluation of Unit 2 containment structures a load factor of 1.0 on the pressure loading was exceeded. The staff considers this evaluation reasonable and a load factor of 1.0 an acceptable threshold for operability due to the inherent conservatism in the TMD analysis. The licensee stated that the other concurrent loads (e.g., seismic) are consistent with UFSAR commitments. The licensee also stated that for concrete and steel structures evaluated in CR 99-06123, stresses are within the code-allowable stresses for the abnormal / extreme environment loading combination with a load factor of greater than 1.0 for each of the loads considered in the load combination.

The licensee has used concrete strength of 5300 psi based on extrapolated data from Unit 1 for the steam generator (SG) enclosure structure. The staff currently accepts as-built strength of 4867 psi based on 28-days concrete cylinder strength data at Unit 2. The licensee has not provided an adequate justification for as-built concrete strength greater than 4867 psi for Unit 2 containment structures. However, the current margin in the SG enclosure structure is sufficient based on as-built concrete strength of 4867 psi.

Containment Divider Barrier Seal Assembly (CR: P-00-02184)

In CR: P-00-02184, the licensee provided a summary of its ODE of Unit 2 containment divider barrier seal assembly. The divider barrier seal assembly provides for separation of the lower compartment of containment from the upper compartment at all locations adjacent to the containment wall. The licensing basis design of the divider barrier seal assembly is qualified for

an upward differential pressure of 24 psig, and 1.3 inch of differential movement due to pressure and seismic loading. During the reconstitution of calculations to substantiate the divider barrier seal assembly design, the licensee determined that, portions of the divider barrier seal assembly do not meet the licensing basis design requirements of 24 psig differential pressure and 1.3 inch of lateral movement. The licensee recalculated expected differential pressure of 15.8 psi and maximum lateral movement of 0.96 inch (between the containment and crane wall) for the qualification of divider barrier seal assembly and determined the divider barrier seal assembly to be operable.

The licensee also determined that the existing floor seal assembly was not designed or is capable of resisting a recalculated expected downward differential pressure between the ice condenser lower plenum and the fan accumulator room. However, the licensee stated that the differential pressure exists for a short duration of 200 milliseconds, and any leakage in the downward direction would not constitute a bypass of the ice condenser (Ref. 3).

Fan-Accumulator Walls in Containment (CR: P-00-2506)

a. Limiting Load Combination

In Reference 1, the licensee designates C = 1.5 P1 + DL + T as the limiting load-factored design combination, where C is the capacity; P1 is the pressure due MSLB; DL is the dead load; and T is the thermal loading associated with MSLB. The staff agrees with the licensee's hypothesis that the stresses, strains, and deformations from this loading combination will be larger than those from the other load combinations in the UFSAR. The licensee's operability criterion is C > 1.0 P1, as the effects of DL and T are very small. The operability criterion is controlling compared to LOCA pressures, or the effects of the postulated design-basis earthquake. The licensee does not meet the MSLB design-basis load combination. However, for operability determination, the staff considers the licensee's selection of the operability criterion reasonable and acceptable when taken in context with the inherent conservatism in the TMD analysis.

b. Conditions of Degraded Walls

In the original construction, the top of the walls at azimuths 126° and 307° contained weak grout credited for up to 1000 psi strength. The licensee used sound grout to fill the pockets and excavations created to verify the existence of rebars and to take concrete core samples for verifying the strength of the 126° wall. The licensee asserts that the actual strength of this grout is more than 7000 psi but in the operability calculation it is conservatively assumed as 2500 psi. For the 307° wall, the licensee considered the strength of the weak grout as 1000 psi in the ODE calculations (Ref. 1). For the purpose of the operability calculations, the licensee considered: (1) The top of all walls to be transferring shear, but not any moment, and (2) the number of rebars considered in the shear resistance was limited only to those verified by visual examination for the 126° wall. The staff considers these actions by the licensee to account for the degraded condition of the walls reasonable and conservative.

c. Concrete Strength

The design concrete strength of 3500 psi is specified for the walls (Ref. 1). The 28-days strengths of concrete cylinders taken during the construction computed for 95/05 confidence are 4385 psi and 4867 psi for Unit 1 and Unit 2 respectively. These are the strength statistics based on lab-cured cylinders. The licensee also has four 28-days and 90-days compressive strength data taken from the Unit 1 containment. The average of these four tests at 28 days is

4856 psi, and at 90 days the average is 5920 psi. Based on these four tests, the licensee is establishing the strength gain due to aging of concrete as 1.22. The licensee proposed to use such relation for Unit 2 containment. The staff did not find this acceptable.

The mere fact that there is an 11% difference in the 28-days strengths of Units 1 and 2 indicates that the concrete in the two containments is markedly different; either in the mix proportion, use of admixtures, curing condition, or combination of these factors. This fact would suggest that the statistics of one Unit cannot be applied to the other Unit. Even for Unit 1, to base the strength gain ratio on the average of four tests does not appear reasonable. Also, relatively early strength gain at 28 days for Unit 2 concrete suggests that the later strength gain may not be as large as that for Unit 1.

In order to establish the 90-days concrete strength at Unit 2, the licensee increased the concrete strength at 28 days from 4867 psi to 5300 psi (i.e., 9% increase due to aging). Such a strength gain is not unusual for normal concrete. However, the licensee did not offer substantive basis in support of the proposed increase. Therefore, the staff does not consider the use of 5300 psi concrete reasonable at this time. The staff based its decision on operability of affected walls using 4867 psi concrete as discussed in E below.

d. Treatment of Impulsive Pressure Load

The licensee has used the new TMD analysis (Ref. 3), based on the as-built condition, to develop the time history of the differential pressure resulting from an MSLB, which was applied to the walls as an impulsive load. The licensee developed a generic dynamic load factor (DLF) relationship corresponding to the natural period of vibration (T) of a structure, based on the applied time-history. For all four walls, the licensee has calculated a DLF of 1.09 corresponding to the T of approximately 0.05 seconds. The licensee has also considered the dynamic increase factor (DIF) in strength of materials that could occur as a result of the rapid strain rates associated with a dynamic load, using Appendix C of ACI 349. The staff finds the use of DLF to be consistent with current industry practice. However, considering the almost static response of the structure to the applied differential pressure load, the use of DIF, in this case, was not adequately justified by the licensee and therefore was not accepted by the staff.

e. Staff's Review of the Calculations

Based on the validity of the licensee's calculations, the staff recalculated the impact of the acceptable parameters in items C and D above, for the weakest wall at azimuth 126°. The staff found that the impact of the use of 5300 psi vs. 4867 psi in the operability calculations for the 126° wall is not significant. Eliminating the DIF does not appreciably change the load factor calculated for moment, but the load factor associated with the shear transfer calculations changes to 1.05 from the licensee calculated value of 1.21. However, increasing the grout compressive strength from 2500 psi to 3500 psi (which is reasonable for a grout showing the strength of above 7000 psi), would increase the load factor to 1.18. Thus, overall, the staff finds the licensee's operability calculations reasonable and acceptable.

CONCLUSION

The staff has reasonable assurance that the stresses in concrete and steel structures evaluated in CR: P- 99-06123, CR: P-00-02184, and CR: P-00-02506, are within the code-allowable stresses for the abnormal / extreme environment loading combination with load factor greater than 1.0 for each of the loads considered. Based on its review of the information submitted by the licensee and the response to the staff's request for additional information, the staff

concludes that the licensee's technical basis for determining operability of Unit 2 containment and Ice Condenser structures, containment divider barrier seal assembly, and Fan-Accumulator walls in containment is reasonable. This conclusion is acceptable for restart of Unit 2 of D. C. Cook.

REFERENCES

1. AEP's submittal: Calculation No. SD-000510-003, May 29, 2000.

2. D.C. Cook Condition Report: P-00-02506, May 31, 2000.

3. Letters, Westinghouse Electric Company to AEP, AEP-00-139, dated April 27, 2000, AEP-99-261, dated August 17, 1999, and AEP-00-178, dated June 1, 2000

4. CR: P- 99-06123, and CR: P- 00-02184.