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

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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"

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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 of 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.

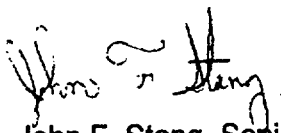
Your staff concluded the presentation by describing the corrective actions to be performed on the subject walls prior to entering MODE 4 for Unit 2 and also the long-term corrective actions. Your staff stated that the final resolution and schedule for both Unit 1 and Unit 2 containment wall issues would 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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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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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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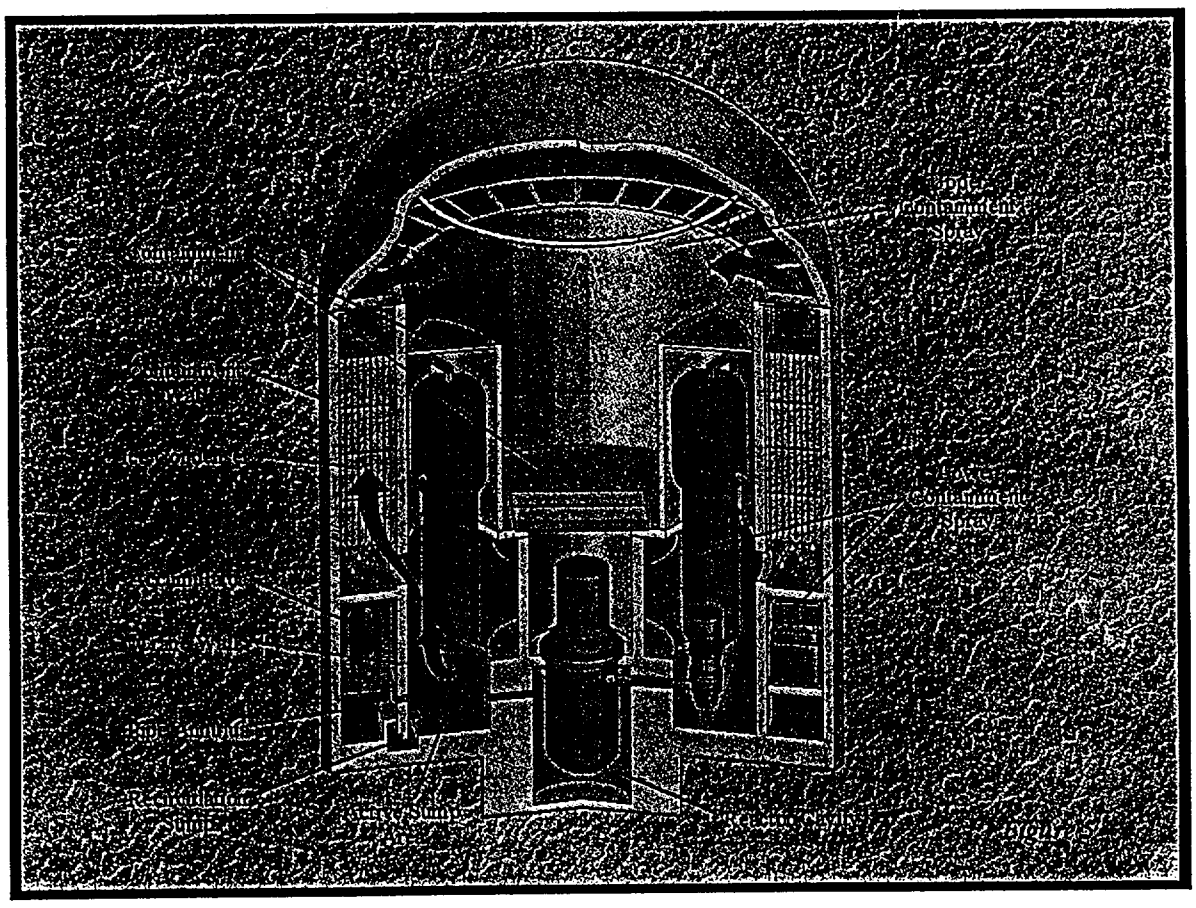
Background: Diagram of Containment Subcompartment Walls

■ Containment



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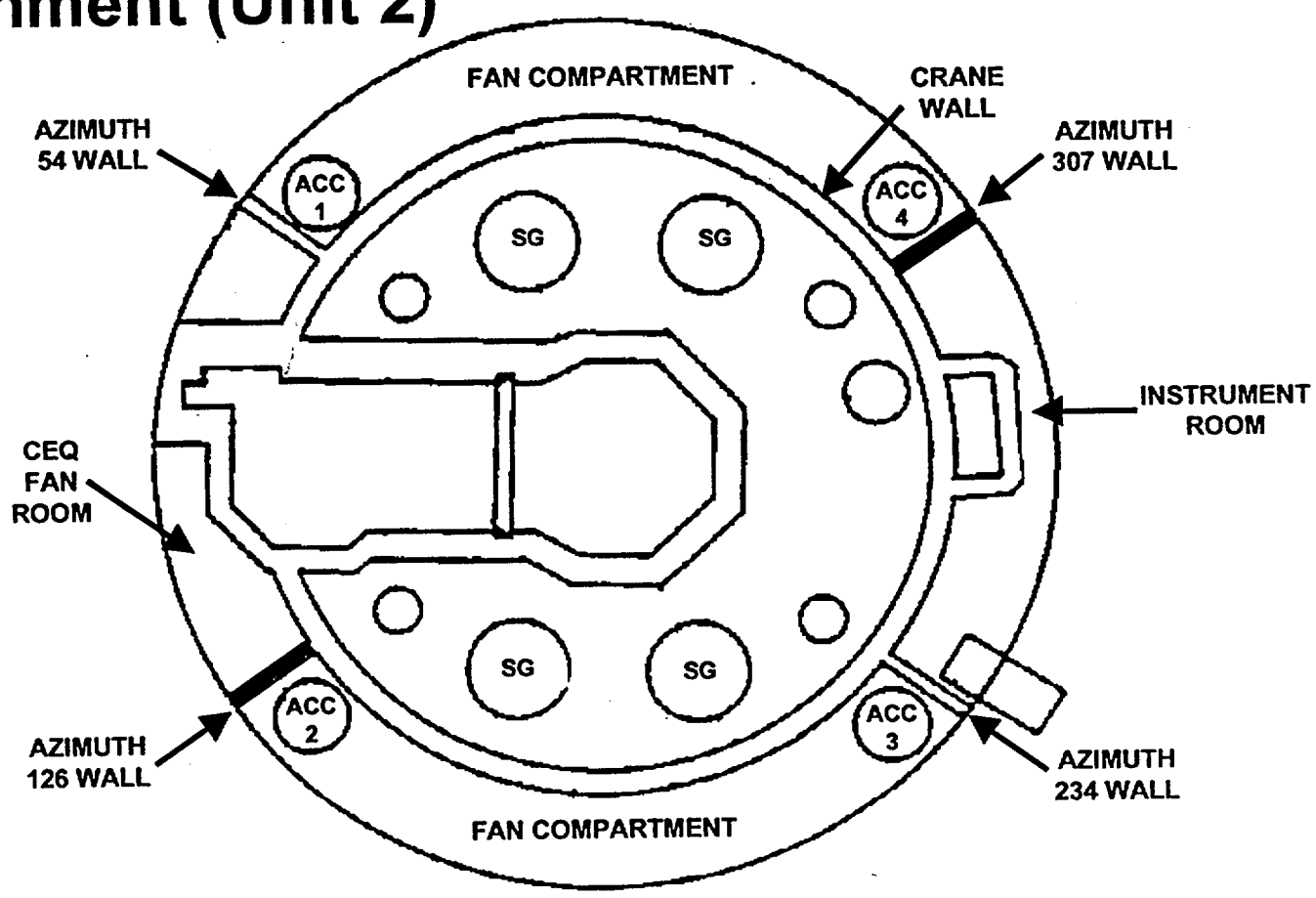
Background: Diagram of Containment Subcompartment Walls

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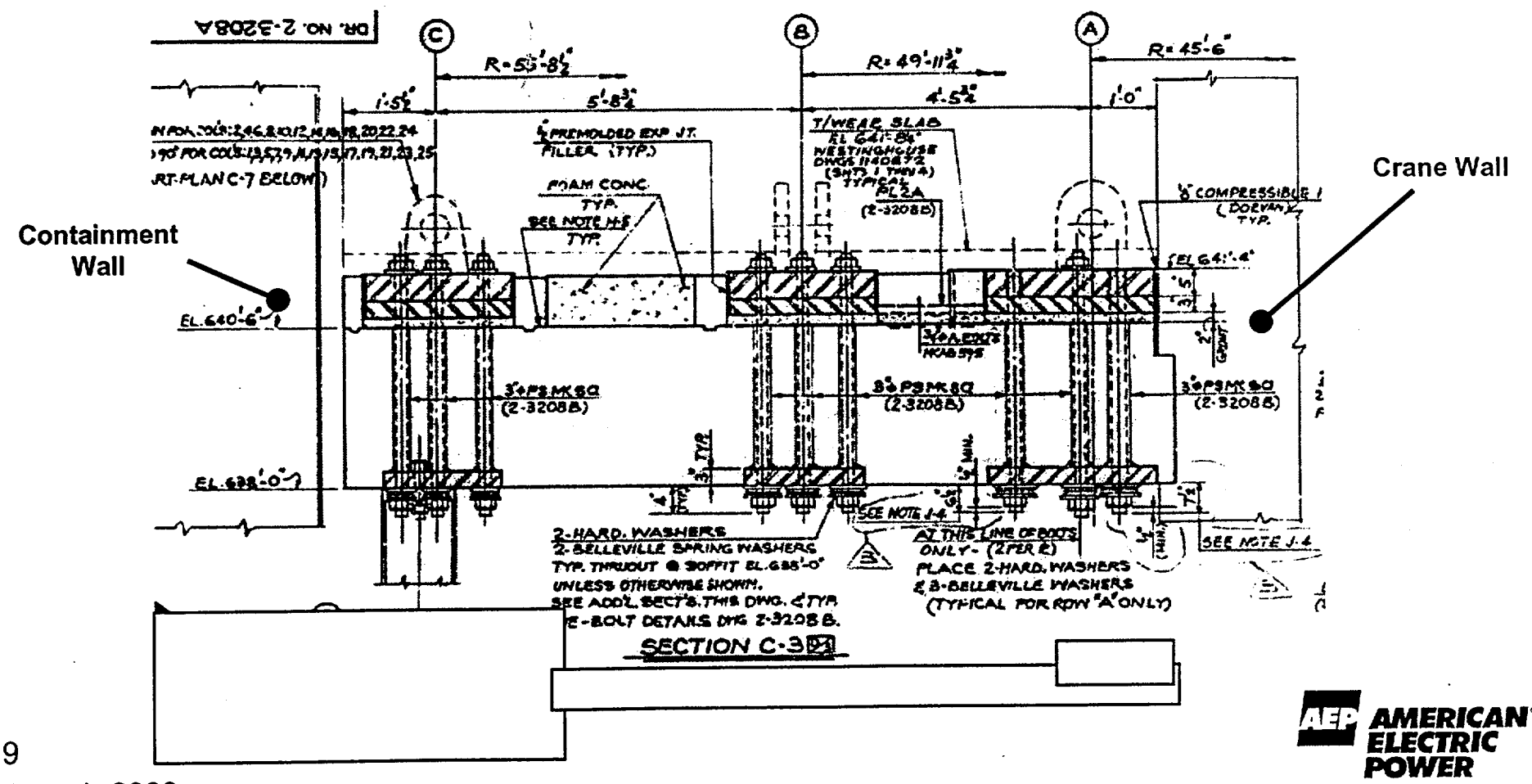
Description of the Issues: Open Pockets -
Configuration of Unit 2 Ice Condenser Column Anchorage

■ Typical Slab/Column Connection (Unit 2 Only)



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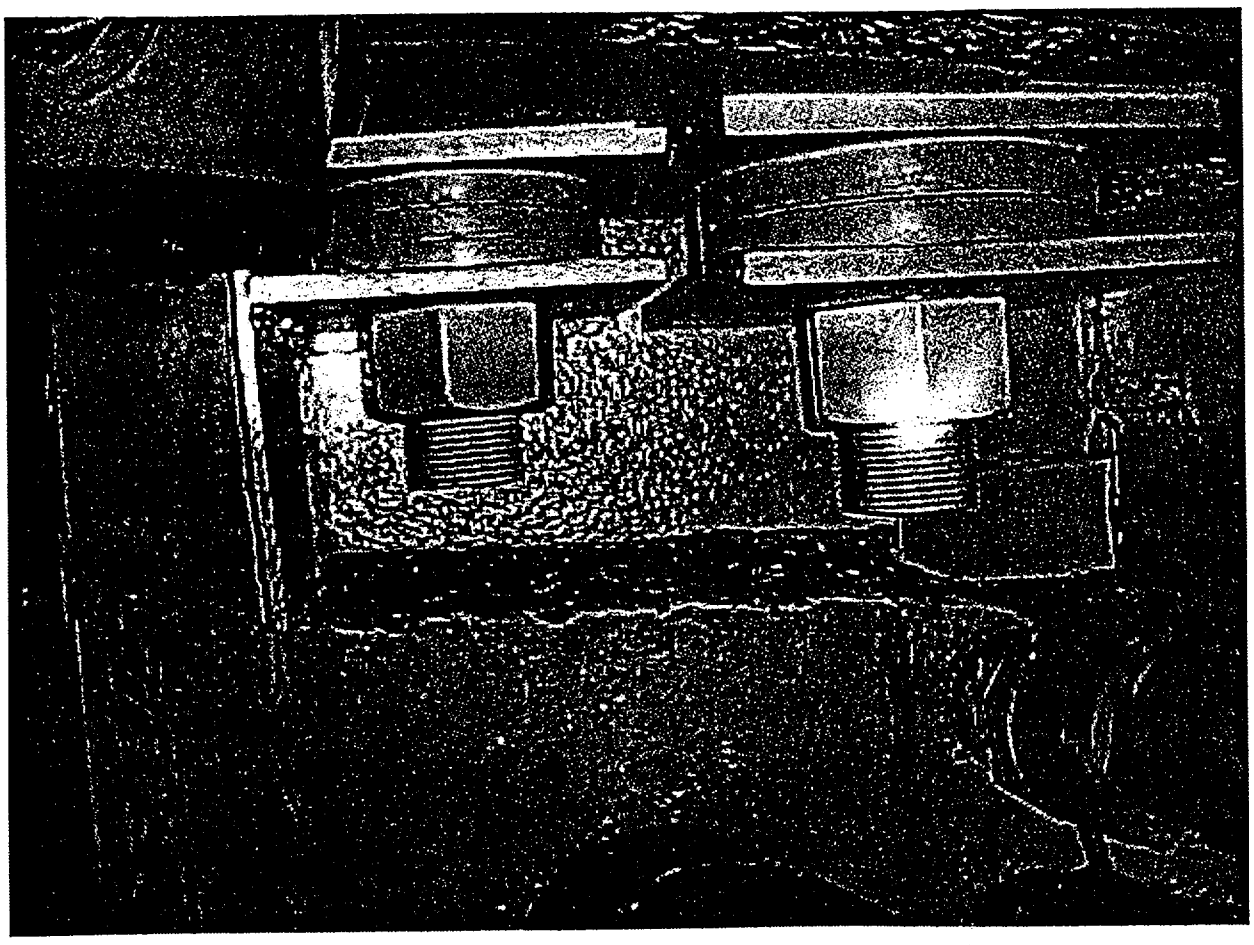
Description of the Issues: Open Pockets - Configuration of Unit 2 Ice Condenser Column Anchorage

■ 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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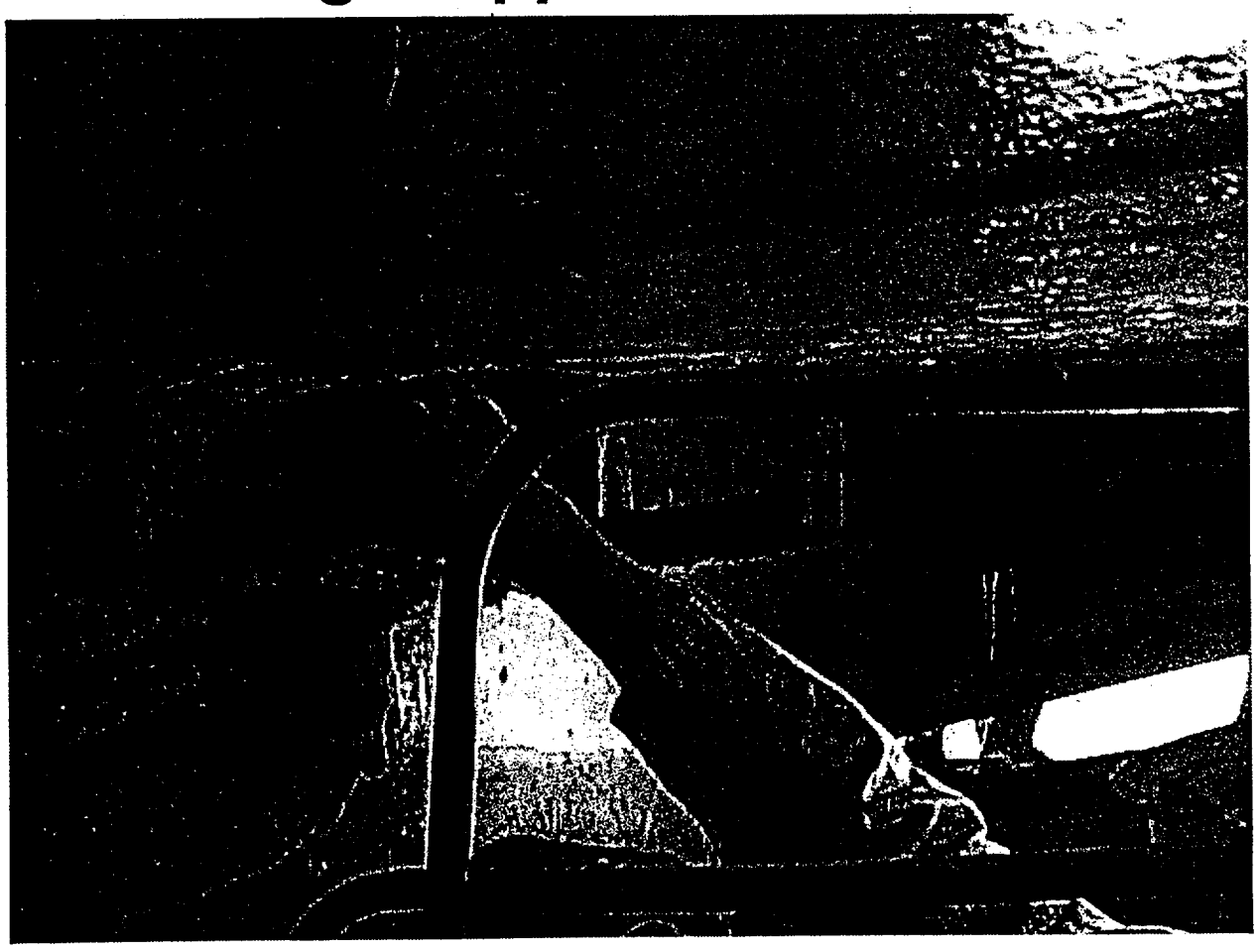
Description of the Issues: Cut Rebar

■ 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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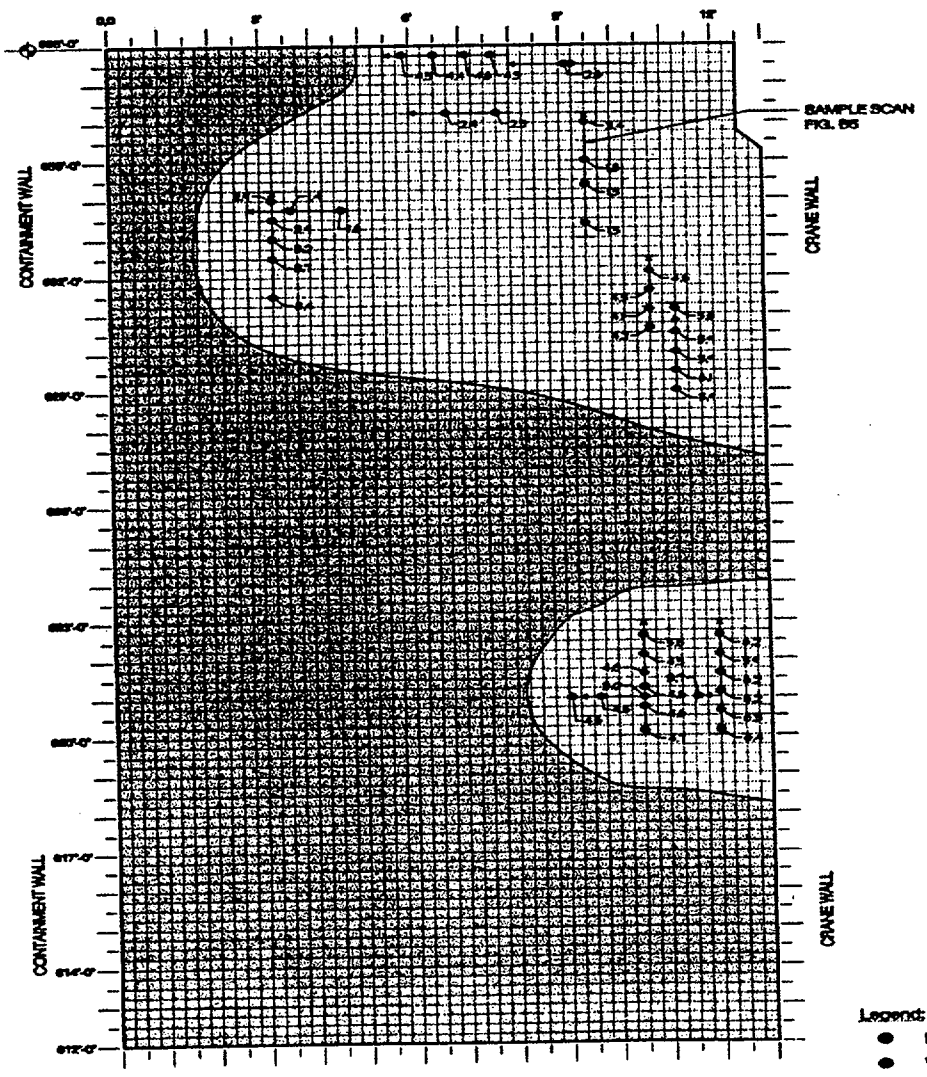
Description of the Issues: Wall Radar Mapping



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 (4 1/8 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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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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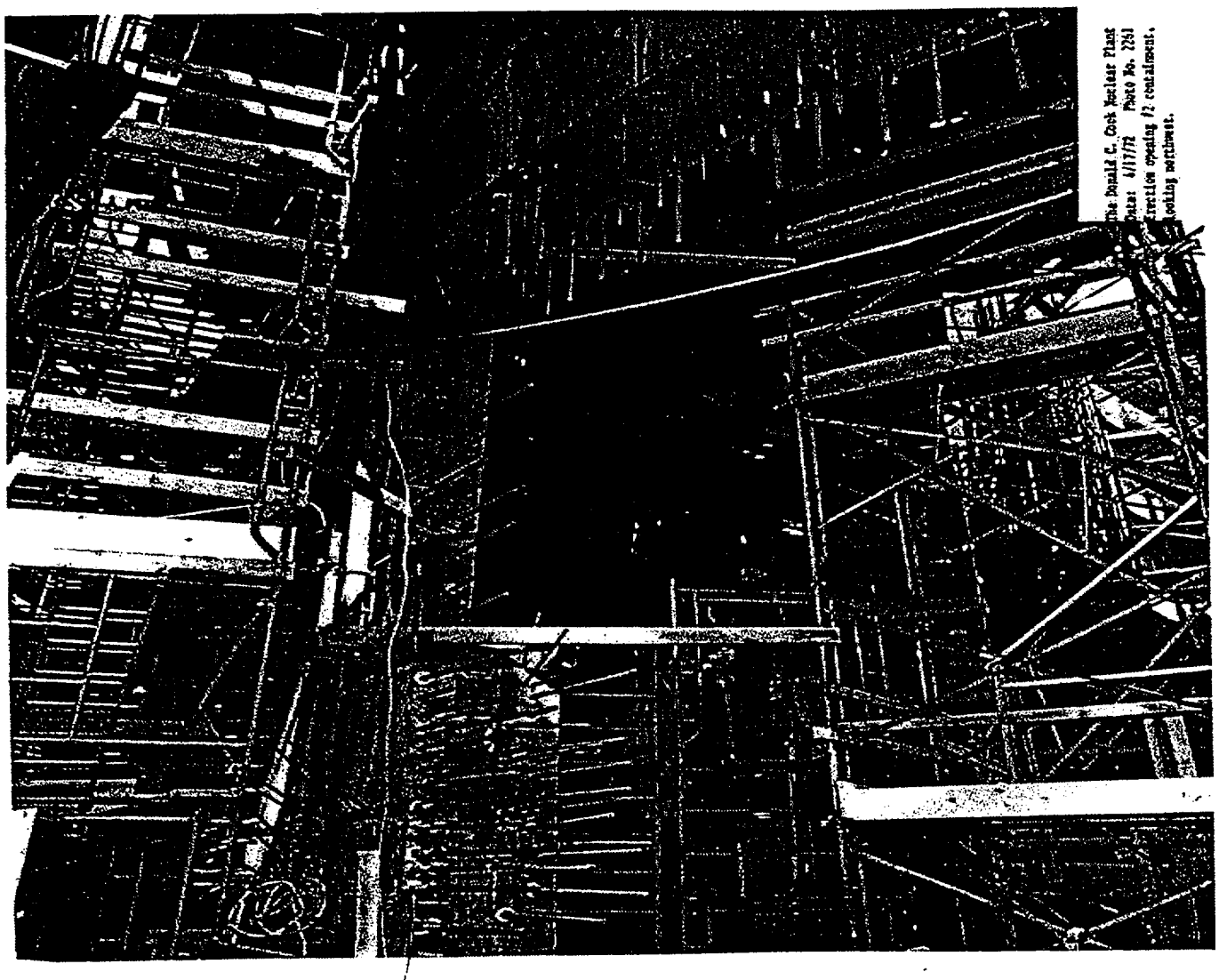
Extent of Condition: Crane Wall Construction Opening



The Donald C. Cook Nuclear Plant
Date: 4/17/72 Photo No. 2261
Erection opening #2 containment.
Looking northwest.

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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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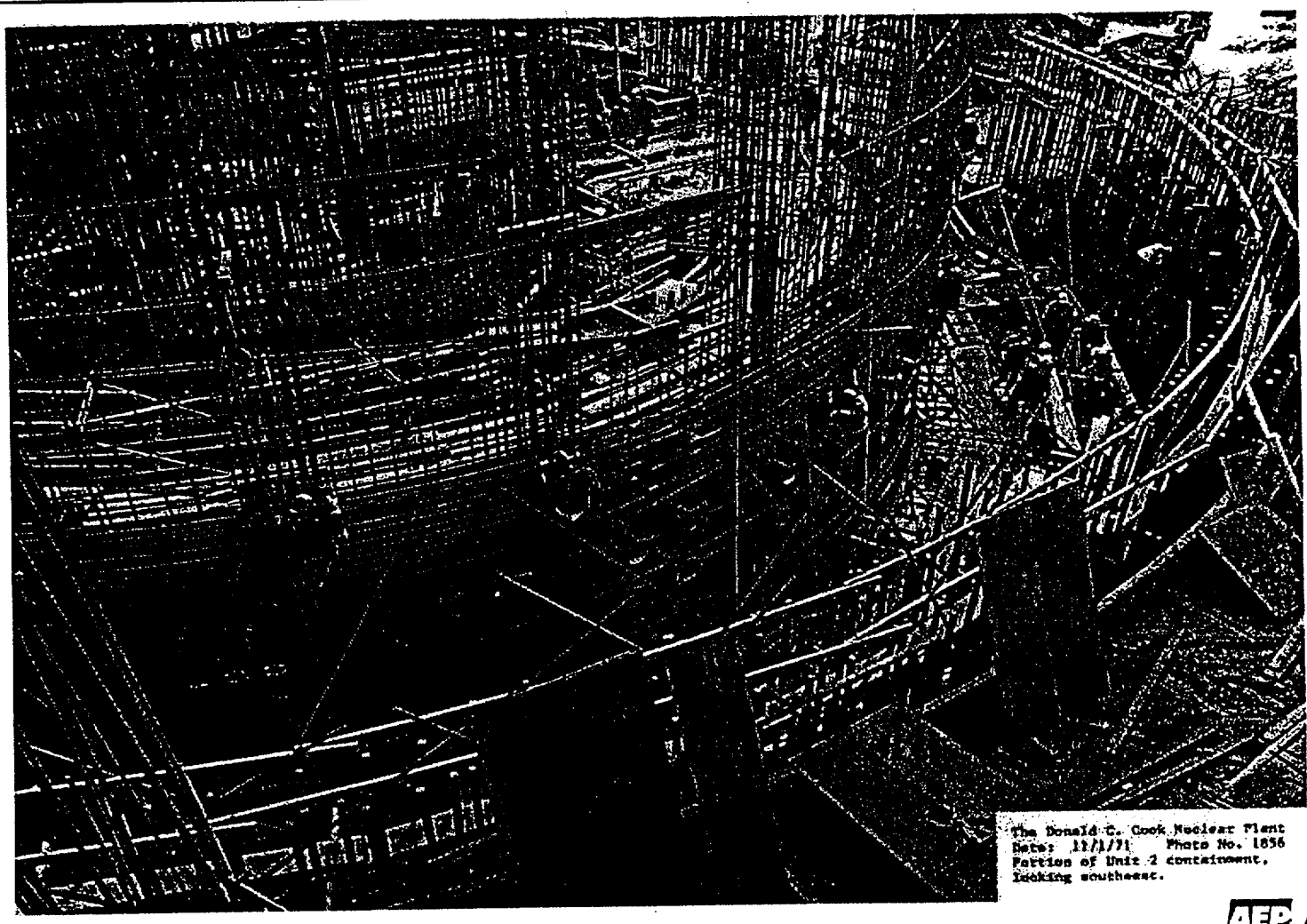
COOK NUCLEAR PLANT

Unit 2 Containment Under Construction



The Donald C. Cook Nuclear Plant
Date: 11/1/71 Photo No. 1856
Portion of Unit 2 containment,
looking southeast.

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Every step of the way.
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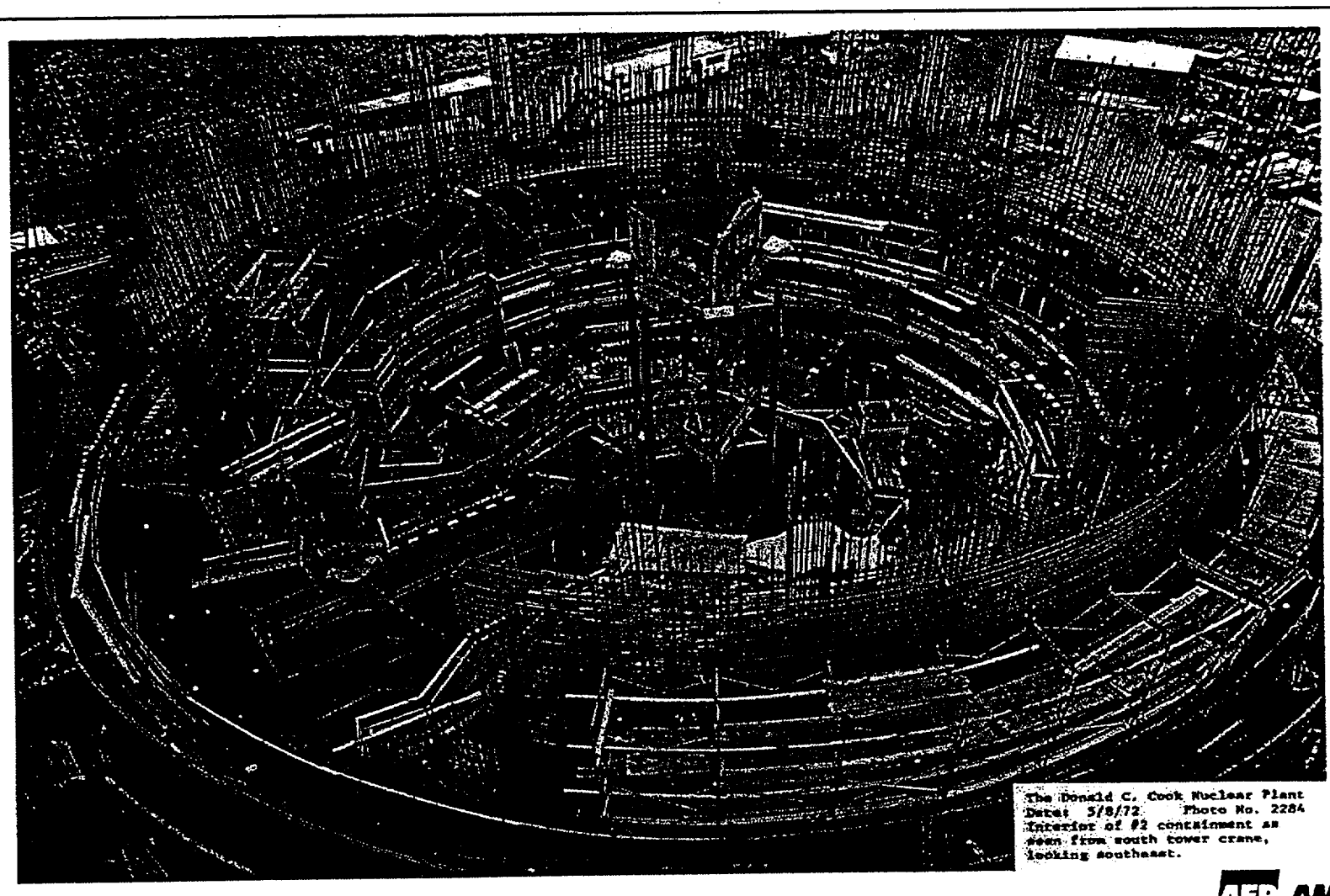

The Donald C. Cook Nuclear Plant
Date: 5/8/72 Photo No. 2284
Interior of #2 containment as seen from south tower crane, looking southeast.

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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.