DPC

NRC FORM 464 Part I (6-1998)

U.S. NUCLEAR REGULATORY COMMISSION

RESPONSE TO FREEDOM OF INFORMATION ACT (FOIA) / PRIVACY ACT (PA) REQUEST

FOIA/PA: 2000-0096

RESPONSE NUMBER: 1

RESPONSE TYPE: ☐ FINAL ☑ PARTIAL

REQUESTER: Mr. Jim Warren

DATE: FEB 09 2000

PART I. -- INFORMATION RELEASED

☐ No additional agency records subject to the request have been located.

☐ Requested records are available through another public distribution program. See Comments section.

☑ APPENDICES A — Agency records subject to the request that are identified in the listed appendices are already available for public inspection and copying at the NRC Public Document Room.

☑ APPENDICES B — Agency records subject to the request that are identified in the listed appendices are being made available for public inspection and copying at the NRC Public Document Room.

☑ Enclosed is information on how you may obtain access to and the charges for copying records located at the NRC Public Document Room, 2120 L Street, NW, Washington, DC.

☑ APPENDICES B&C — Agency records subject to the request are enclosed.

☐ Records subject to the request that contain information originated by or of interest to another Federal agency have been referred to that agency (see comments section) for a disclosure determination and direct response to you.

☑ We are continuing to process your request.

☐ See Comments.

PART I.A -- FEES

AMOUNT * $

* See comments for details

☐ You will be billed by NRC for the amount listed.

☐ You will receive a refund for the amount listed.

☐ None. Minimum fee threshold not met.

☐ Fees waived.

PART I.B -- INFORMATION NOT LOCATED OR WITHHELD FROM DISCLOSURE

☐ No agency records subject to the request have been located.

☑ Certain information in the requested records is being withheld from disclosure pursuant to the exemptions described in and for the reasons stated in Part II.

☑ This determination may be appealed within 30 days by writing to the FOIA/PA Officer, U.S. Nuclear Regulatory Commission, Washington, DC 20555-0001. Clearly state on the envelope and in the letter that it is a "FOIA/PA Appeal."

PART I.C COMMENTS (Use attached Comments continuation page if required)

SIGNATURE - FREEDOM OF INFORMATION ACT AND PRIVACY ACT OFFICER

Carol Ann Reed *Carol Ann Reed*

NRC FORM 464 Part II (6-1998) U.S. NUCLEAR REGULATORY COMMISSION

RESPONSE TO FREEDOM OF INFORMATION ACT (FOIA) / PRIVACY ACT (PA) REQUEST

FOIA/PA 2000-0096

DATE FEB 09 2000

PART II.A -- APPLICABLE EXEMPTIONS

APPENDICES C&D

Records subject to the request that are described in the enclosed Appendices are being withheld in their entirety or in part under the Exemption No.(s) of the PA and/or the FOIA as indicated below (5 U.S.C. 552a and/or 5 U.S.C. 552(b)).

☐ Exemption 1: The withheld information is properly classified pursuant to Executive Order 12958.

☐ Exemption 2: The withheld information relates solely to the internal personnel rules and procedures of NRC.

☐ Exemption 3: The withheld information is specifically exempted from public disclosure by statute indicated.

- ☐ Sections 141-145 of the Atomic Energy Act, which prohibits the disclosure of Restricted Data or Formerly Restricted Data (42 U.S.C. 2161-2165).
- ☐ Section 147 of the Atomic Energy Act, which prohibits the disclosure of Unclassified Safeguards Information (42 U.S.C. 2167).
- ☐ 41 U.S.C., Section 253(b), subsection (m)(1), prohibits the disclosure of contractor proposals in the possession and control of an executive agency to any person under section 552 of Title 5, U.S.C. (the FOIA), except when incorporated into the contract between the agency and the submitter of the proposal.

☑ Exemption 4: The withheld information is a trade secret or commercial or financial information that is being withheld for the reason(s) indicated.

- ☑ The information is considered to be confidential business (proprietary) information.
- ☐ The information is considered to be proprietary because it concerns a licensee's or applicant's physical protection or material control and accounting program for special nuclear material pursuant to 10 CFR 2.790(d)(1).
- ☐ The information was submitted by a foreign source and received in confidence pursuant to 10 CFR 2.790(d)(2).

☑ Exemption 5: The withheld information consists of interagency or intraagency records that are not available through discovery during litigation. Applicable privileges:

- ☑ Deliberative process: Disclosure of predecisional information would tend to inhibit the open and frank exchange of ideas essential to the deliberative process. Where records are withheld in their entirety, the facts are inextricably intertwined with the predecisional information. There also are no reasonably segregable factual portions because the release of the facts would permit an indirect inquiry into the predecisional process of the agency.
- ☐ Attorney work-product privilege. (Documents prepared by an attorney in contemplation of litigation)
- ☐ Attorney-client privilege. (Confidential communications between an attorney and his/her client)

☐ Exemption 6: The withheld information is exempted from public disclosure because its disclosure would result in a clearly unwarranted invasion of personal privacy.

☐ Exemption 7: The withheld information consists of records compiled for law enforcement purposes and is being withheld for the reason(s) indicated.

- ☐ (A) Disclosure could reasonably be expected to interfere with an enforcement proceeding (e.g., it would reveal the scope, direction, and focus of enforcement efforts, and thus could possibly allow recipients to take action to shield potential wrongdoing or a violation of NRC requirements from investigators).
- ☐ (C) Disclosure would constitute an unwarranted invasion of personal privacy.
- ☐ (D) The information consists of names of individuals and other information the disclosure of which could reasonably be expected to reveal identities of confidential sources.
- ☐ (E) Disclosure would reveal techniques and procedures for law enforcement investigations or prosecutions, or guidelines that could reasonably be expected to risk circumvention of the law.
- ☐ (F) Disclosure could reasonably be expected to endanger the life or physical safety of an individual.

☐ OTHER (Specify)

PART II.B -- DENYING OFFICIALS

Pursuant to 10 CFR 9.25(g), 9.25(h), and/or 9.65(b) of the U.S. Nuclear Regulatory Commission regulations, it has been determined that the information withheld is exempt from production or disclosure, and that its production or disclosure is contrary to the public interest. The person responsible for the denial are those officials identified below as denying officials and the FOIA/PA Officer for any denials that may be appealed to the Executive Director for Operations (EDO).

DENYING OFFICIAL	TITLE/OFFICE	RECORDS DENIED	APPELLATE OFFICIAL EDO	SECY	IG
Samuel J. Collins	Director, NRR	App. C&D	✓		

Appeal must be made in writing within 30 days of receipt of this response. Appeals should be mailed to the FOIA/Privacy Act Officer, U.S. Nuclear Regulatory Commission, Washington, DC 20555-0001, for action by the appropriate appellate official(s). You should clearly state on the envelope and letter that it is a "FOIA/PA Appeal."

Re: FOIA-2000-0096

APPENDIX A
RECORDS ALREADY AVAILABLE IN THE PDR

NO.	DATE	ACCESSION NUMBER	DESCRIPTION/(PAGE COUNT)
1.	11/14/94	9411210100	FSAR Amendment 45 includes pg. 5.4.7-10i. - ***FOIA ITEM #2, (Ref. 25)***.
2.	10/16/99	9910120292	Meeting Notice for 11/4/99 Meeting to Discuss Harris Plans for SG Replacement and Power Uprate, - ***FOIA ITEMS #4, 46, 51, & 68.***
3.	12/4/97	9712090256, 9712090288 9712110050	FSAR Amendment 48; CP&L 1997 Annual Operating Report, - ***FOIA ITEMS #33, 34,35, & 36.***
4.	3/24/99	9903260263	NRC RAI, - ***FOIA ITEM #70.***
5.	4/30/99	9905050200	CP&L Response, - ***FOIA ITEM #70.***
6.	4/29/99	9905040318	NRC RAI, - ***FOIA ITEM #70.***
7.	6/14/99	9906210117	CP&L Response, - ***FOIA ITEM #70.***
8.	6/16/99	9906210180	NRC RAI, - ***FOIA ITEM #70.***
9.	8/5/99	9908110003	NRC RAI, - ***FOIA ITEM #70 (also identified this record under FOIA 99-367).***
10.	9/3/99	9909100158	CP&L Response - ***FOIA ITEM #70 (also identified this record under FOIA 99-367).***
11.	10/15/99	9910270013	CP&L Submittal, - ***FOIA ITEM #70.***
12.	9/20/99	9909230097	NRC RAI, - ***FOIA ITEM #70.***
13.	8/19/99	9908240174	NRC Response to CP&L Regarding Withholding Information from Public Disclosure.

Re: FOIA-2000-0096

APPENDIX B

RECORDS BEING PLACED AT THE PDR

NUMBER	DATE	DESCRIPTION/PAGES
1.	7/16/98	Attendance List for NRC Meeting with CP&L on 7/16/98, noted as Encl. 1 to Meeting Notice dated 7/29/98, (2 pgs.) - (this enclosure should have been attached to an already Publicly Available Record,) ***Acc. No. 9808040277, - FOIA ITEMS #31 & 32.***
2.	11/4/99	Summary of November 2, 1999, Meeting on Steam Generator Replacement and Power Uprate, (19 pgs.) - ***FOIA ITEMS #4, 46, 51, & 68.***
3.	10/29/99	CP&L's Response to NRC RAI dated 9/20/99, (52 pgs.) - ***FOIA ITEM #70.***
4.	1/20/00	Staff Comments on FOIA-2000-0096, (6 pgs.).

Re: FOIA-2000-0096

APPENDIX C

DOCUMENTS BEING RELEASED IN PART

NUMBER	DATE	DESCRIPTION/EXEMPTION
1.	7/23/99	Letter to NRC from D. Alexander, "Response to NRC Request for Additional Information Regarding Amendment Request to Increase Fuel Storage Capacity by Placing Spent Pools 'C'and 'D' in Service, ***PDR ACCESSION #9907270169, RELEASED,*** Enclosure 3-D Single Rack Analysis of Fuel Racks, ***(111 pgs.) WITHHELD IN ENTIRETY, EX. 4.***

Re: FOIA-2000-0096

APPENDIX D

DOCUMENTS BEING WITHHELD IN THEIR ENTIRETY

NUMBER	DATE	DESCRIPTION/EXEMPTION/PAGES
1.	11/24/99	Memo from Yi-hsiung Hsii to George Hubbard, subject: Safety Evaluation Input on Operation of Harris Spent Fuel Pools 'C' and 'D', (2 pgs.) - ***WITHHELD IN ENTIRETY - EX. 5.***

ATTENDANCE LIST
NRC MEETING WITH CAROLINA POWER & LIGHT COMPANY
July 16, 1998

	NAME	ORGANIZATION
1	Scott Flanders	NRC/NRR/PDII-1
2	Kevin Shaw	CP&L
3	Debbie Doyle	CP&L
4	Bruce Altman	CP&L
5	Steven Edwards	CP&L
6	Christopher Mallner	CP&L
7	Jeff. Lane	CP&L
8	David Lochbaum	Union of Concerned Scientists
9	Gordon Edison	NRC
10	Claudia Craig	NRR/PGEB
11	Tony Attard	NRR/DSSA/SRXB
12	Michelle Hart	NRR/DSSA/SPLB
13	Y. Kim	NRR/DE/ECGB
14	R Rothman	NRR/DE/ECGB
15	G. Hubbard	NRR/DSSA/SPLB
16	John Wagner	Holtec
17	Scott Pellet	HOLTEC
18	Diane Jackson	NRR/DSSA/SPLB
19	Vonna Ordaz	NRR/DSSA/SPLB

Enclosure 1

B/1

ATTENDANCE LIST
NRC MEETING WITH CAROLINA POWER & LIGHT COMPANY
July 16, 1998

NAME	ORGANIZATION
20. Robert Hermann	EMCB
21. Larry L Campbell	NRR/HQMB
22. Ken Heck	NRR/DRCH/HQMB
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UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D.C. 20555-0001

November 4, 1999

LICENSEE: Carolina Power & Light Company

FACILITIES: Shearon Harris Nuclear Power Plant, Unit 1

SUBJECT: SUMMARY OF NOVEMBER 2, 1999 MEETING ON STEAM GENERATOR REPLACEMENT AND POWER UPRATE

On November 2, 1999, the NRC staff met with representatives of Carolina Power & Light Company (CP&L) in Rockville, Maryland. The purpose of the meeting was to discuss CP&L's plans for steam generator (SG) replacement and power uprate at the Shearon Harris Nuclear Power Plant (HNP). A list of the meeting participants is included as Enclosure 1. A copy of the licensee's meeting handout is included as Enclosure 2.

CP&L requested this meeting with the staff to outline their plans and schedule for submitting license amendment requests for a 4.5% power uprate and for SG replacement at HNP. CP&L plans to submit two separate requests to the NRC in September 2000 and to request that the staff complete its review by September 2001. CP&L plans to implement both the power uprate and SG replacement during HNP's fall 2001 refueling outage.

CP&L outlined the schedule for completing the various engineering reviews being conducted to support the amendment requests. CP&L stated that they are reviewing similar requests made by other licensees for both power uprate and SG replacement. They will be incorporating applicable information from the other submittals, NRC requests for additional information and the licensee's responses, and from NRC safety evaluations into their submittals. CP&L expressed their desire to maintain open communications with the NRC staff while they complete their submittals and to meet again either just before or soon after the submittals are made.

Richard J. Laufer

Richard J. Laufer, Project Manager, Section 2
Project Directorate II
Division of Licensing Project management
Office of Nuclear Reactor Regulation

Docket No. 50-400

Enclosures: As stated

cc w/encl: See next page

B/2

cc:

Mr. William D. Johnson
Vice President and Corporate Secretary
Carolina Power & Light Company
Post Office Box 1551
Raleigh, North Carolina 27602

Resident Inspector/Harris NPS
c/o U.S. Nuclear Regulatory Commission
5421 Shearon Harris Road
New Hill, North Carolina 27562-9998

Ms. Karen E. Long
Assistant Attorney General
State of North Carolina
Post Office Box 629
Raleigh, North Carolina 27602

Public Service Commission
State of South Carolina
Post Office Drawer
Columbia, South Carolina 29211

Mr. John H. O'Neill, Jr.
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Washington, DC 20037-1128

Mr. Mel Fry, Director
Division of Radiation Protection
N.C. Department of Environment
and Natural Resources
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Manager
Performance Evaluation and
Regulatory Affairs CPB 7
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Mr. Bo Clark
Plant General Manager - Harris Plant
Carolina Power & Light Company
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Mr. Chris L. Burton
Director of Site Operations
Carolina Power & Light Company
Shearon Harris Nuclear Power Plant
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Mr. Robert P. Gruber
Executive Director
Public Staff NCUC
Post Office Box 29520
Raleigh, North Carolina 27626

Chairman of the North Carolina
Utilities Commission
Post Office Box 29510
Raleigh, North Carolina 27626-0510

Mr. James Scarola
Vice President-Harris Plant
Carolina Power & Light
Post Office Box 165, MC:Zone 1
New Hill, NC 27562-0165

Mr. Vernon Malone, Chairman
Board of County Commissioners
of Wake County
P. O. Box 550
Raleigh, North Carolina 27602

Mr. Richard H. Givens, Chairman
Board of County Commissioners
of Chatham County
P. O. Box 87
Pittsboro, North Carolina 27312

Ms. Donna B. Alexander, Manager
Regulatory Affairs
Carolina Power & Light Company
Shearon Harris Nuclear Power Plant
P.O. Box 165, Mail Zone 1
New Hill, NC 27562-0165

Mr. Johnny H. Eads, Supervisor
Licensing/Regulatory Programs
Carolina Power & Light Company
Shearon Harris Nuclear Power Plant
P. O. Box 165, Mail Zone 1
New Hill, NC 27562-0165

ATTENDANCE LIST
NRC MEETING WITH CAROLINA POWER & LIGHT COMPANY
NOVEMBER 2, 1999

NAME	ORGANIZATION
Richard Laufer	NRC
David Shum	NRC
Meena Khanna	NRC
Andrea Keim	NRC
John Tsao	NRC
George Hubbard	NRC
Brian Thomas	NRC
Raj Goel	NRC
Chu Liang	NRC
Bruce Altman	CP&L
Alan Redpath	CP&L
Tony Groblewski	CP&L
Kevin Shaw	CP&L
Bill Peavyhouse	CP&L
Johnny Eads	CP&L
Bill Flanagan	CP&L
Wayne Barber	McGraw-Hill

Enclosure 1

Harris Nuclear Plant Steam Generator Replacement and Power Uprate

November 2, 1999

CP&L

Enclosure 2

Purpose of the Meeting

Identify CP&L Plans For S/G Replacement And Power Uprate License Change

Agenda / Speakers

• Introduction	Bruce Altman
• Project Overview	Bill Flanagan
• RSG Design	Alan Redpath
• SGR Engineering	Tony Groblewski
• Power Uprate Engineering	Bill Peavyhouse
• Licensing Plan	Kevin Shaw

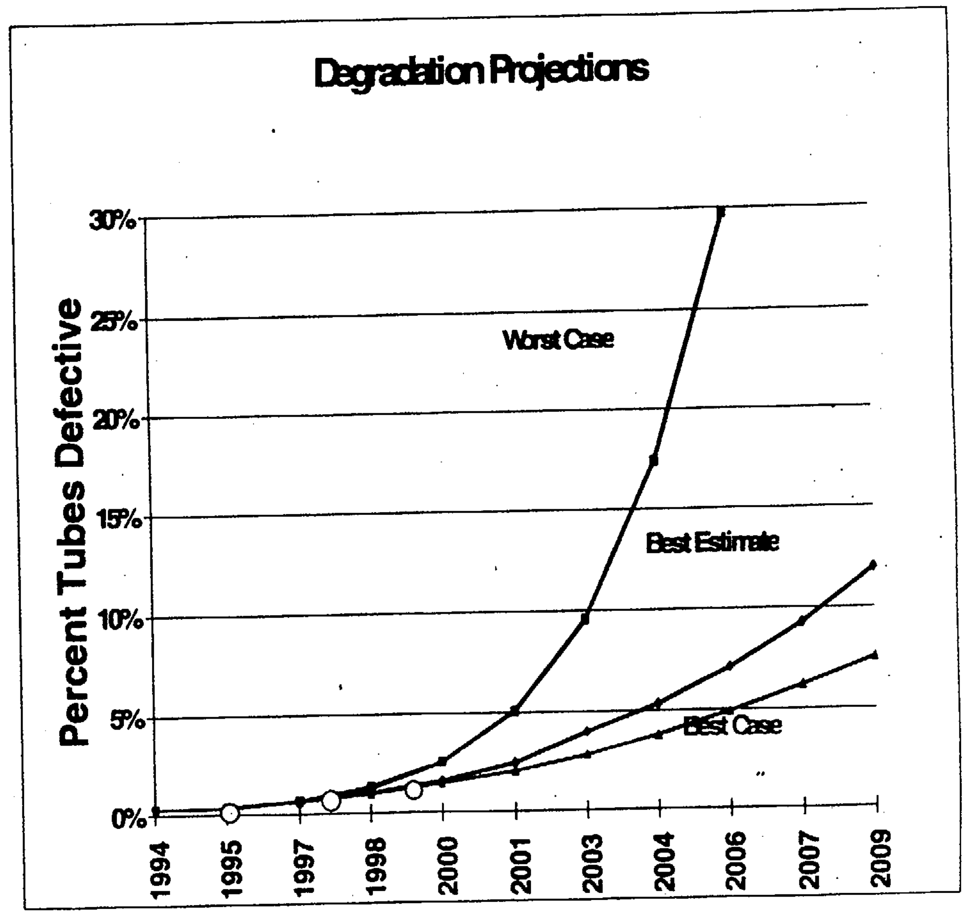
CP&L

Project Overview

- Existing S/G Performance
- SG Replacement Overview
- Power Uprate Overview
- Project Schedule
- Design Control

Existing S/G Performance

- 164 Tubes Have Been Plugged (72 In RFO8)
- Rate Is Consistent With Predictions And Industry Experience
- Testing 100% Of All Hot Leg Tubes (Top Of Tube Sheet)



CP&L

Project Overview

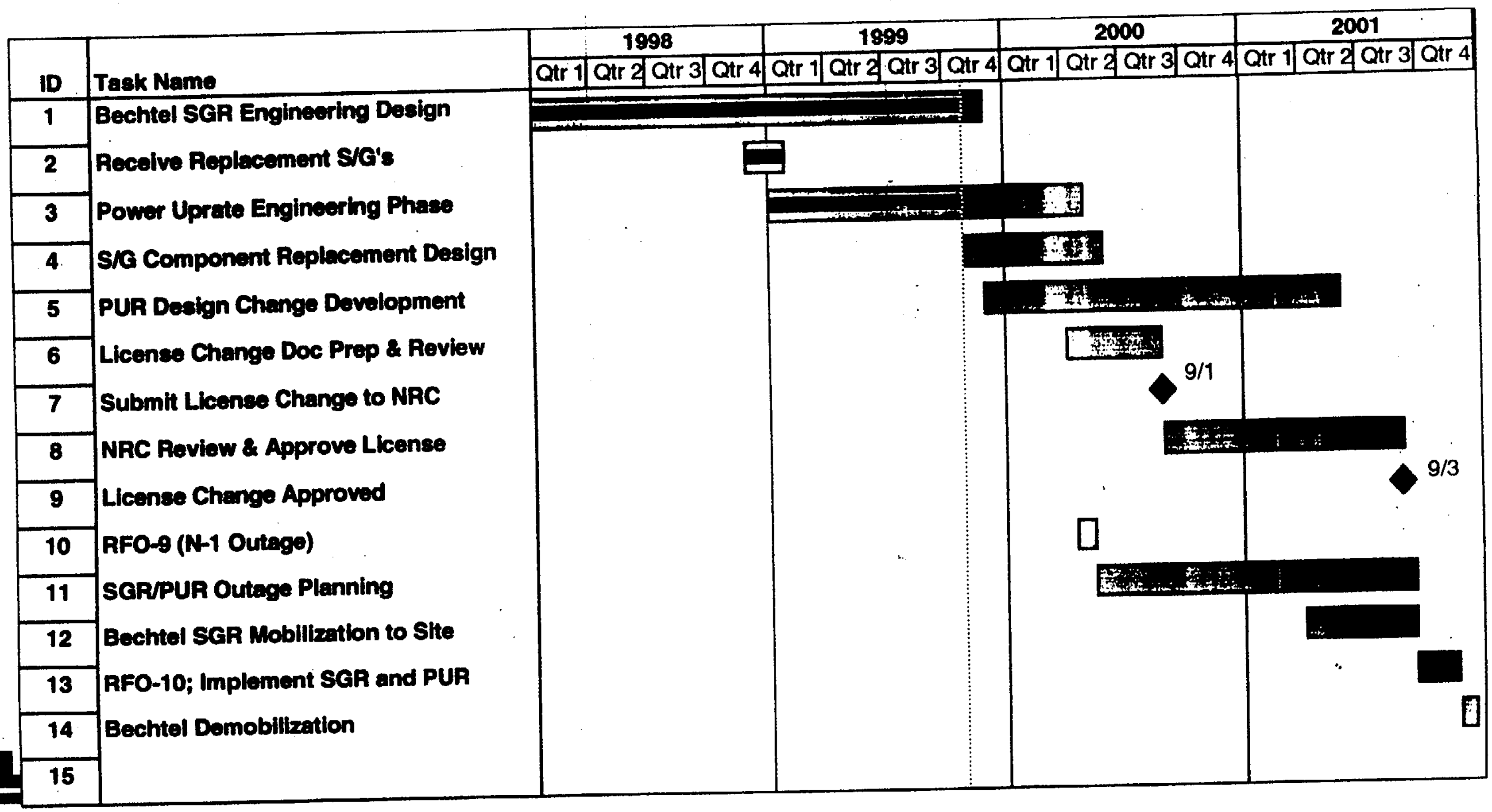
- Standard Bechtel S/G Replacement And A Standard 4.5% Power Uprate
- One Piece, Two Cut, Through The Hatch
- Temporary Lift Device On Polar Crane
- Cut And Weld Equipment Hatch Ring

CP&L

Project Overview

- Replacement S/G's On Site In Level D Storage Under Dry Nitrogen Blanket
- Uprate Is Predominately An Analytical Effort With Minor Hardware Changes
- 75 Days Breaker-to-Breaker

S/G Replacement & Power Uprate Schedule



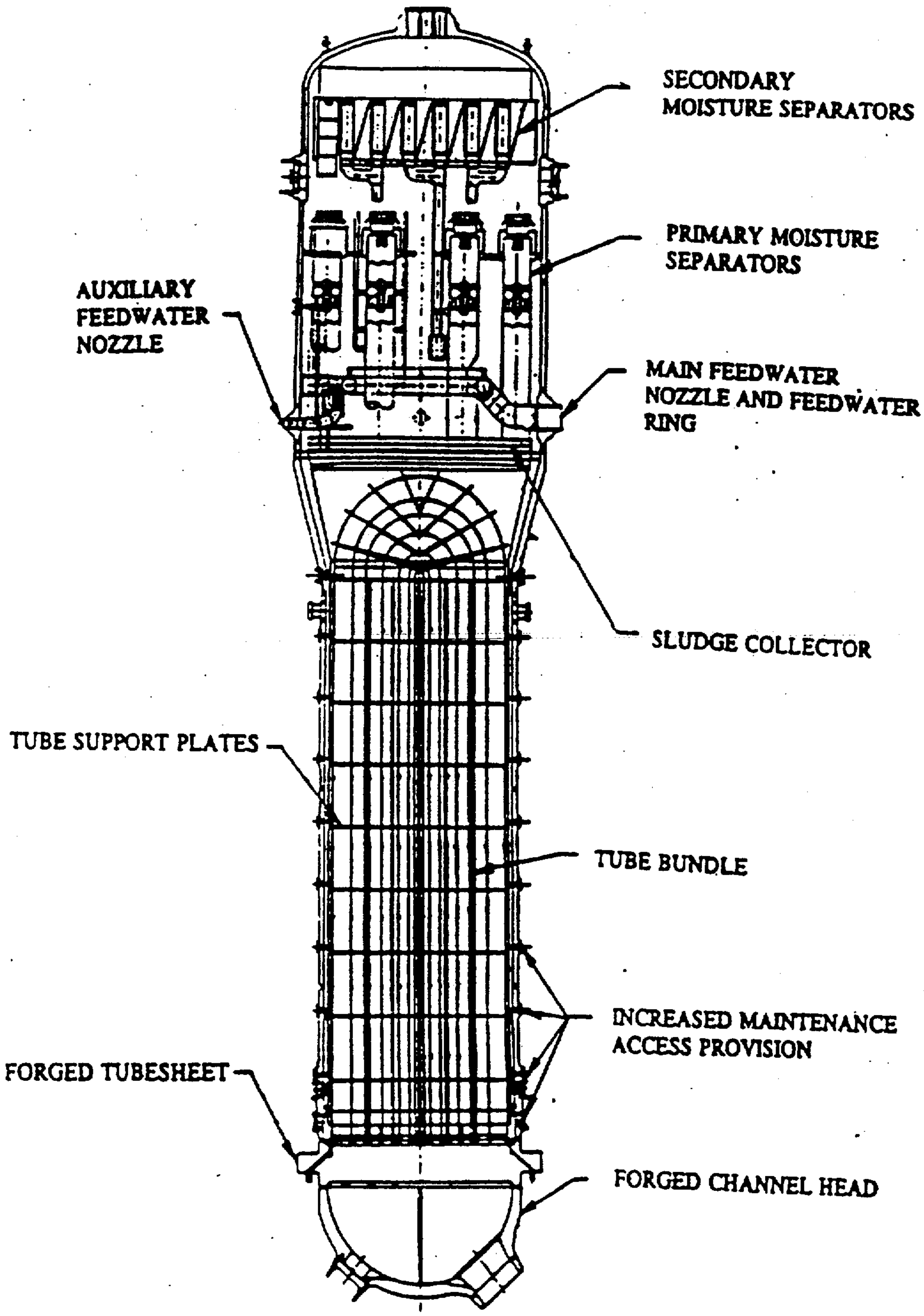
CP&L

Design Control

- Experienced Project Engineers
- 30% - 70% - 100% Product Reviews
- Owners Review
- Safety Reviews
- Design Review Panel

RSG Design

- HNP Will Install Westinghouse Model Delta 75 Replacement Steam Generators
- The Delta 75's Include The Following Upgrade Features:
  - Alloy 690 Thermally Treated Tubing
  - 405 SS Tube Support Plates
  - 405 SS Anti-Vibration Bars
  - Upper Shell Feedwater Distribution System
  - Sludge Collection System



DELTA 75 Feedring Steam Generator

SGR Engineering

- Engineered Products
  - Bechtel SGR Support Modifications
  - CP&L Generator Replacement Evaluation
  - CP&L Testing Plan Attribute Identification
  - Other CP&L Engineered Products

CP&L

SGR Engineering (cont'd)

- **Polar Crane Plan**
  - Six "Planned Engineered Lifts"
  - Install A Jacking Trolley Rated At 450 Tons (Temporary Lifting Device)
- **Equipment Hatch Plan**
  - Removed By Cutting The Equipment Hatch Body Ring
  - Non-Destructive Examination Performed After Re-installation, Hatch Integrity Verified

Power Uprate Engineering Overview

- Currently Performing Engineering And Analysis
  - Power Increase from 2775 To 2900 MWth
  - Electrical Output Increase By 40.3 MWe
  - S/G Replacement And Uprate Engineering Performed Together
  - To Complete 5/00

CP&L

Power Uprate Engineering Overview (Cont'd)

- Engineering Change Packages To Come Next
  - Incorporation Of New Analyses
  - Setpoints
  - Physical Mods Expected To Be Minimal
    - Main Feedwater Pump Impellers
    - Turbine Gland Steam Piping
  - To Start 12/99 And Complete 5/01

CP&L

Licensing Plan

- S/G Replacement And Power Uprate
  - Concurrent Implementation
- S/G Replacement - Tech Spec Changes
- Power Uprate - O/L And Tech Spec Changes
- Precedent Licensing Actions
- Independent Submittals
- Schedule

CP&L

CP&L

Carolina Power & Light Company
Harris Nuclear Plant
PO Box 165
New Hill NC 27562
OCT 29 1999

SERIAL: HNP-99-172

United States Nuclear Regulatory Commission
ATTENTION: Document Control Desk
Washington, DC 20555

SHEARON HARRIS NUCLEAR POWER PLANT
DOCKET NO. 50-400/LICENSE NO. NPF-63
RESPONSE TO NRC REQUEST FOR ADDITIONAL INFORMATION REGARDING THE ALTERNATIVE PLAN FOR SPENT FUEL POOLS C & D COOLING AND CLEANUP SYSTEM PIPING

Dear Sir or Madam:

By letter HNP-98-188, dated December 23, 1998, Carolina Power & Light Company (CP&L) submitted a license amendment request to increase fuel storage capacity at the Harris Nuclear Plant (HNP) by placing spent fuel pools C & D in service. The U. S. Nuclear Regulatory Commission (NRC) issued letters dated March 24, 1999, April 29, 1999, June 16, 1999, and August 5, 1999 requesting additional information regarding our license amendment application. HNP letters HNP-99-069, dated April 30, 1999, HNP-99-094, dated June 14, 1999, HNP-99-112, dated July 23, 1999, and HNP-99-129, dated September 3, 1999 provided our respective responses.

By letter dated September 20, 1999, the NRC issued a fifth request for additional information (RAI) regarding our license amendment application to place spent fuel pools C & D in service. The September 20, 1999 NRC RAI specifically requests additional information on the proposed alternative plan to demonstrate compliance with ASME Code requirements for the cooling and cleanup system piping in accordance with 10 CFR 50.55a(a)(3)(i). The Enclosures to this letter provide the HNP response to the NRC staff's September 20, 1999 RAI.

The enclosed information is provided as supplement to our December 23, 1998 amendment request and does not change our initial determination that the proposed license amendment represents a no significant hazards consideration.

B/3

Please refer any questions regarding the enclosed information to Mr. Steven Edwards at (919) 362-2498.

Sincerely,

Donna B. Alexander
Manager, Regulatory Affairs
Harris Nuclear Plant

KWS/kws

Enclosures:

1. HNP Responses to NRC Request For Additional Information (RAI)
2. Technical Report: HNP - Material Identification of Chips from Carbon Steel Welds Associated with the Spent Fuel Pool Activation Project (1 page total)
3. Chemistry Sample Data Sheets (2 sheets total)
4. QCI-19.1, Revision 1, entitled "Preparation & Submittal of Weld Data Report, Repair Weld Data Report, Tank Fabrication Weld Record & Seismic I Weld Data Report" (25 pages total)

c: Mr. J. B. Brady, NRC Senior Resident Inspector (w/ Enclosure 1)
Mr. Mel Fry, N.C. DEHNR (w/ Enclosure 1)
Mr. R. J. Laufer, NRC Project Manager (w/ all Enclosures)
Mr. L. A. Reyes, NRC Regional Administrator - Region II (w/ Enclosure 1)

bc: (all w/ Enclosure 1)

Mr. K. B. Altman
Mr. G. E. Attarian
Mr. R. H. Bazemore
Mr. C. L. Burton
Mr. S. R. Carr
Mr. J. R. Caves
Mr. H. K. Chernoff (RNP)
Mr. B. H. Clark
Mr. W. F. Conway
Mr. G. W. Davis
Mr. W. J. Dorman (BNP)
Mr. R. S. Edwards
Mr. R. J. Field
Mr. K. N. Harris
Ms. L. N. Hartz
Mr. W J. Hindman
Mr. C. S. Hinnant
Mr. W. D. Johnson
Mr. G. J. Kline
Mr. B. A. Kruse
Ms. T. A. Head (PE&RAS File)
Mr. R. D. Martin
Mr. T. C. Morton
Mr. J. H. O'Neill, Jr.
Mr. J. S. Scarola
Mr. J. M. Taylor
Nuclear Records
Harris Licensing File
Files: H-X-0511
H-X-0642

SHEARON HARRIS NUCLEAR POWER PLANT
DOCKET NO. 50-400/LICENSE NO. NPF-63
RESPONSE TO NRC REQUEST FOR ADDITIONAL INFORMATION
REGARDING THE ALTERNATIVE PLAN FOR SPENT FUEL POOL
COOLING AND CLEANUP SYSTEM PIPING

Requested Information Item 1:

Explain how the Metorex X-Met 880 Alloy Analyzer discriminates between the different standards that you used in your analysis described in Enclosure 3, "Metallurgy Unit Report for Spent Fuel Pool Weld Metal Composition analysis," of your April 30, 1999, RAI response. What are the chemical element ranges associated with the different standards that you used? What determines a match on a particular standard? What chemical elements are not included in the "Match" determination and how are these elements reconciled?

Response 1:

Background:

The primary objective of the field alloy analysis was to confirm with reasonable assurance that the as-deposited weld material for the spent fuel pool piping field welds is an austenitic stainless steel material compatible with Type 304 stainless steel piping material. The chemical composition of the stainless steel filler materials are specified in ASME Section II, Part C, SFA-5.4 / 5.9. The elements controlled under this specification for stainless steel filler materials are: carbon, chromium, nickel, molybdenum, columbium plus tantalum, manganese, silicon, phosphorus, sulfur, nitrogen, and copper.

The Alloy Analyzer was used in a comparison / identification mode. In the comparison / identification mode, the unknown is compared to reference materials which are input by a specific measurement technique and stored in a memory location of the instrument. This method of analysis was selected to provide reasonable assurance that the chemical compositions of analyzed field welds are consistent with an austenitic stainless steel having a chromium content in the range of 18 to 24 weight percent and a nickel content in the range of 8 to 14 weight percent.

Explain how the Metorex X-Met 880 Alloy Analyzer discriminates between the different standards that you used in your analysis described in Enclosure 4, "Metallurgy Unit Report for Spent Fuel Pool Weld Metal Composition Analysis," of your April 30, 1999, RAI response.

The Metorex X-Met 880 Alloy Analyzer utilizes a Cadmium-109 isotopic source to excite the analyzed material and measure the secondary radiation produced by the source excitation. This instrument can detect elements that range between and include chromium and molybdenum on the periodic chart of the elements. (The elements between and including terbium and uranium are also detected by this instrument with a cadmium source.)

The instrument was configured to detect six specific elements using the following pure element standards: (1) chromium, (2) manganese, (3) iron, (4) nickel, (5) copper, and (6) molybdenum. Iron was selected because austenitic stainless steels are considered to be iron-based alloys; chromium, nickel, and molybdenum were selected because they are primary alloying elements; manganese was selected because it is a secondary alloying element; and copper was selected because it is a potential "tramp" (i.e., unwanted) element in this material that is detectable by this instrument. A backscatter standard was used to determine the background spectrum. The pure element standards and the backscatter standard were supplied with the instrument by the manufacturer. A series of comparison standards were loaded into the instrument for this analysis. These standards included: (1) Type 304 stainless steel, (2) Type 309 stainless steel, (3) Type 310 stainless steel, (4) Type 316 stainless steel, and (5) NIST SRM 1154a. These four secondary standards and one National Institute of Standards and Technology (NIST) Standard Reference Material (SRM) were used because: (1) the instrument was used in a comparison mode, and (2) none of the SRMs available from NIST have compositions consistent with either Type 304, Type 308, or Type 309 stainless steels. NIST SRM 1155 (Type 316 stainless steel) and NIST SRM C1287 (Type 310 stainless steel - modified) were used also, as independent reference checks of the instrument during the field analysis.

In the comparison / identification mode, the unknown is compared to reference materials which are input by a specific measurement technique and stored in a memory location of the instrument. The alloy analyzer has a multi-channel analyzer (MCA) having 256 micro channels. These micro channels represent a specific X-ray energy range (e.g., Channel 1 - 1 to 2 eV, Channel 2 - 2 to 3 eV, etc.). Each element has an average value for its excitation X-ray energy and, in practice, the actual response has a Gaussian distribution. Each pure element has a range, or window, consisting of several micro channels based on the full width at half maximum value of the Gaussian distribution. Therefore, counts detected in an element window are due to a detectable and measurable concentration of this element. The pure element standards and the austenitic stainless steel standards have different compositions. The response of the instrument varies with the concentration of a given element in a standard. The counts obtained for a standard by this instrument are proportional to the elemental concentration(s). Each standard will have a unique pattern (or "fingerprint") of counts in the selected element windows based on its chemical composition. The instrument discriminates between standards and unknowns based on the similarity of the instrument response (or counts detected) to the element windows for the stored standards.

What are the chemical element ranges associated with the different standards that you used?

The chemical element ranges for the standards used are shown below in Table 1. The NIST SRM (1154a) that was used to set-up the Alloy Analyzer has a chemical composition that is not within the chemical composition range for any standard UNS stainless steel alloy. However, the nickel and chromium contents of the NIST 1154a standard are similar to the nickel content of the Type 309 comparison standard and the chromium content of the Type 304 comparison standard, respectively. The remaining detectable elements in these three comparison standards are comparable and cannot be used to accurately differentiate between the various unknowns.

TABLE 1

Chemical Element Ranges for Standards Used to Set-up the Metorex Alloy Analyzer						
Standard	Composition, Weight Percent					
	Chromium	Manganese	Iron	Nickel	Copper	Molybdenum
Type 304	**18.28**	1.48	bal.	8.13	0.19	0.17
Type 309	22.60	1.63	bal.	**13.81**	--	--
Type 310	24.87	1.94	bal.	19.72	0.11	0.16
Type 316	16.74	1.44	bal.	10.07	0.11	2.06
NIST 1154a	**19.31**	1.44	bal.	**13.08**	0.44	0.068
Chemical Element Ranges for Standards Used to Check the Alloy Analyzer						
NIST C1287	23.98	1.66	bal.	21.16	0.58	0.46
NIST 1155	18.45	1.63	bal.	12.18	0.169	2.38

The tolerances for the chemical element ranges for the secondary standards (nominal Type 304, Type 309, Type 310, and Type 316 stainless steels) are not known. These secondary standards were provided with mill test reports for their chemical compositions, but the precise accuracy of these standards is not known because they are not certified as traceable to primary reference standards. However, the applicable ASTM standards for these alloys permit a major alloying element range of between 1 and 2.5 weight percent (e.g., carbon content - 0.08 weight percent maximum; silicon content - 1.00 weight percent maximum; nickel content - 8.00 to 10.50 weight percent maximum; etc.) without the applicable product analysis tolerances that depend upon the specific element and its relative concentration.

What determines a match on a particular standard?

During a test, the Alloy Analyzer detects, measures, and compares the counts obtained for the specified elements in the unknown to those for the standards that have been loaded into the instrument (the specified elements are those that were loaded as pure element standards during the instrument set-up). The X-ray energy detection range for each of the specified elements is pre-set in the instrument and is based on physical constants related to the energy difference between electron shells in atomic structures. The number of counts in each pure element range is measured and compared to the counts for these elements in the known comparison standards. The difference in counts between the unknown and the comparison standards is measured. The instrument is configured with three thresholds (or limits) for the difference in counts between the closest standard and the unknown. The least amount of difference between a comparison standard and the unknown is indicated by "GOOD MATCH." If there are differences between the unknown and standard that do not meet the "GOOD MATCH" criteria, but the unknown is similar to one or more standards, the alloy analyzer will indicate "POSSIBLE MATCH." If the difference in counts is too large, the instrument will indicate "NO GOOD MATCH."

What chemical elements are not included in the "Match" determination and how are these elements reconciled?

The primary objective of the field alloy analysis was to confirm with reasonable assurance that the as-deposited weld material was an austenitic stainless steel material compatible with the Type 304 stainless steel piping material. The chemical compositions of stainless steel filler materials are specified in ASME Section II, Part C, SFA-5.4 / 5.9. The elements controlled under this specification for stainless steel filler materials are: carbon, chromium, nickel, molybdenum, columbium plus tantalum, manganese, silicon, phosphorous, sulfur, nitrogen, and copper.

The alloy analyzer was set up to detect the primary alloying elements: chromium, nickel, and molybdenum. In addition, the alloy analyzer was also set up to detect the secondary alloying element manganese, the tramp element copper, and the alloy base iron. The remaining elements addressed in the specification, but not detected by the alloy analyzer, are: carbon, columbium plus tantalum, silicon, phosphorous, sulfur, and nitrogen. None of these elements are capable of being detected with the Metorex Alloy Analyzer using a Cadmium-109 source either due to their relative concentration or their X-ray excitation energy. These secondary alloying elements, while important to the weldability characteristics of the filler material, are not as important to the performance of the weld in service with regard to strength and corrosion resistance.

Samples of three spent fuel pool cooling piping field welds were obtained by plant personnel and submitted to an external commercial laboratory for chemical analysis. The elements that were not determined by field analysis and those that were used in the identification mode of the field welds were measured by this laboratory and are shown in Table 2. Laboratory analysis of this representative sample substantiates the results of the field analysis and provides additional assurance that the chemical compositions of spent fuel pool field welds are satisfactory.

TABLE 2

NSL Chemical Analysis Results			
Identification	**2-SF-36-FW-450**	**2-SF-38-FW-451**	**2-SF-71-FW-329**
Alloy Analyzer Results	304 SS Possible	NIST 1154a Possible	NIST 1154a Possible
NSL Chemical Analysis Results			
Carbon	0.13	0.10	0.064
Niobium	< 0.05	< 0.05	< 0.05
Chromium	20.08	20.11	19.06
Copper	0.054	0.10	0.093
Manganese	1.46	1.39	0.79
Molybdenum	0.12	0.10	0.085
Nickel	9.30	9.24	9.63
Phosphorus	0.021	0.021	0.026
Sulfur	0.007	0.005	0.013
Silicon	0.37	0.39	0.25
Titanium	< 0.01	0.011	< 0.01

In summary, the alloy analyzer was set up to confirm with reasonable assurance that the as-deposited weld material for the spent fuel pool piping field welds is an austenitic stainless steel material compatible with the reported Type 304 stainless steel piping material and the chemical composition requirements specified in ASME Section II, Part C, SFA-5.4 / 5.9. The programmatic and procedural controls which existed at the time of construction, augmented by the testing and analysis effort described above, provide reasonable assurance that the weld material for the spent fuel pool piping field welds is the proper weld material and will perform satisfactorily in service.

Requested Information Item 2:

Provide assurance that the ferrite numbers are acceptable for A-No. 8 weld wire (ND-2433) used in welds with missing weld wire documentation.

Response 2:

Ferrite numbers have been measured for 18 of the 19 accessible field welds remaining in the scope of the Alternative Plan (one field weld is located underneath a grating which could not be removed at the time the measurements were taken). The results of this work show mean ferrite numbers ranging from approximately 4 to 9 FN. SFA 5.9, Section A4.12 states that the ferrite potential for 308, 308L, and 347 is approximately 10 FN, but notes that the ferrite content may vary by +/- 7 FN or more around these midpoints and still be within the limits of the chemical specification. Furthermore, Section A4.13 also states that the ferrite potential of a filler metal is usually modified downward in the deposit due to changes in the chemical composition caused by the welding process and technique used.

Ferrite is know to be beneficial in reducing the tendency for cracking or fissuring in weld metals; however, it is not critical, particularly under the mild service conditions associated with the spent fuel pool cooling system. Assurance that the ferrite numbers are acceptable is demonstrated by the following: (1) the measured ferrite numbers are reasonably consistent with those expected for the type of filler material used, (2) all of the exposed field welds in the scope of the Alternative Plan have successfully completed a liquid penetrant examination which noted no evidence of cracks or fissures, (3) a strict materials control program governed issuance and control of weld materials, and (4) there is no evidence that incorrect or uncontrolled filler material might have been used.

Requested Information Item 3:

Explain the chemical analysis in the Table associated with PQR 6(c), dated 11/15/84, page 2 of 2, laboratory test No. 9-2-149 described in Enclosure 6, "Lab Test Reports," of your April 30, 1999, RAI response. What row(s) are associated with the base material, weld, and standard(s)? What criteria was used to determine acceptability?

Response 3:

Welding Procedure Specification (WPS) 8B2, Revision 16 is supported by four Procedure Qualification Records (PQRs). The original procedure qualification test, as documented on PQR 6, was performed in 1976. The procedure qualification test coupon for this test was prepared from 10 inch schedule 40 pipe, which has a wall thickness of 0.365 inches. This test coupon thickness supports a qualified base metal thickness range of 3/16 (0.1875) inches to 0.730 inches. In 1981, an additional procedure qualification test, as documented in PQR 6(A), was performed to support the extended thickness range of 3/16 inches to 8 inches. This new qualified range was achieved by welding a 1.5 inch thick weld test coupon. In 1982, another procedure qualification test was performed, as documented in PQR 6(B), to expand the thickness range qualified to include a base material thickness as thin as 0.049 inches. This extended range was achieved by welding a 0.049 inch wall thickness test coupon. In 1984, the final procedure qualification test, as documented in PQR 6(C), was performed to extend the qualified thickness range to include materials as thin as 0.031 inches. This new thickness range was achieved by welding a weld test coupon with a thickness of 0.031 inches.

The portion of WPS 8B2, Revision 16 that was used to fabricate the fuel pool piping, based on base metal thickness range, is supported by PQR 6 and PQR 6(A). The fuel pool piping has a nominal wall thickness of 3/8 (0.375) inches, which is within the qualified base metal thickness range of 3/16 (0.1875) inches to 0.730 inches for PQR 6 and 3/16 (0.1875) inches to 8 inches for PQR 6(A).

Relative to the chemical analysis in the Table associated with PQR 6(c), dated 11/15/84, page 2 of 2, laboratory test No. 9-2-149, referenced WPS 8B2 addresses welding of a SA240 TP 304 test coupon with a thickness of 0.031 inch. The documented mechanical test results reference two test specimens having a thickness of 0.031 inch (E&E Laboratory Test Number 9-2-149, specimen numbers 699 and 700). PQR 6(c) references an Arcos welding filler material, which according to the Certified Material Test Reports (CMTRs) attached to PQR 6(c) is Type 316 stainless steel filler material.

A definitive explanation for all of the entries on the data sheet in question, page 2 of 2 of the chemical analysis results, can not be provided due to insufficient documentation. However, based on the documentation supporting the procedure qualification test for PQR 6 (C), Metallurgy Unit test records and anecdotal information, it appears that Harris Welding Engineering personnel requested the E&E Laboratories to perform mechanical testing and chemical analyses for a completed welding procedure qualification coupon performed using 0.031 inch thick Type 316 stainless steel base material. It is believed that the chemical analysis requested was to be performed on a sample of the material taken from the item that was to be welded in production and which provided the impetus to perform the additional weld procedure qualification. This is supported by the fact that chips of the supplied material were provided to the Analytical Chemistry Laboratory on November 12, 1984 (sampled on November 9, 1984) while the PQR is dated November 15, 1984. This indicates that the chemical analysis was performed prior to the welding of the procedure qualification test coupon and should not be considered a part of the procedure qualification test.

Requested Information Item 4:

For the piping and welds examined internally, provide a discussion of the examination results. What inspection criteria is used for evaluating the piping and welds for corrosion and fouling? Describe the corrosion and fouling inspection procedure and inspection personnel qualification process. For the embedded welds not examined internally, describe what is preventing their examination. Discuss why the decision not to inspect all of the embedded welds will result in an acceptable level of quality and safety.

Response 4:

An initial visual inspection of the embedded piping and welds was completed using a pneumatically-powered crawler carrying a high resolution camera. This crawler employed two sets of pneumatic cylinders which expanded and contracted in coordination with a single cylinder between them to produce an "inch worm" effect. Inspections of four of the eight embedded spent fuel pool cooling lines were performed using this crawler, including six embedded field welds. Camera resolution was excellent and the visual inspection of the lines was thorough. This arrangement proved unsuitable, however, for longer lines having multiple elbows, and a decision was made to investigate other possible methods of inspecting the balance of embedded piping. An arrangement was eventually selected which used flexible fiberglass rods to manually drive a camera on rollers through the pipe. A second inspection effort, only recently completed, used this crawler to successfully inspect all 9 of the remaining embedded field welds and associated piping.

The remainder of this response will focus on the initial inspection of four SFP cooling lines and six embedded welds. The results of the inspection of the remaining lines and nine embedded welds is still in the review process. Our preliminary evaluation is that the results of the second visual inspection are consistent with those of the first inspection and demonstrate that the piping and welds have not measurably degraded and are acceptable for their intended purpose.

The pneumatically-powered crawler provided a stable base from which to successfully complete a visual examination of the piping and welds which could be reached using this equipment. Each inspection was preceded by a resolution check wherein the camera was required to discern a 1.0 mil wire at the appropriate focal length, and the level of detail provided of the internal pipe surfaces was excellent. These inspections were conducted in accordance with Special Plant Procedure SPP-0312T, which provided specific acceptance criteria, as well as qualification requirements for the equipment and inspectors. The inspection included welds on four of the eight embedded cooling lines connected to Spent Fuel Pools C & D. All of the lines inspected were 12 inch, schedule 40 stainless steel (304) piping.

The initial inspection included the following field welds:

Field Weld Number	Piping Function
2-SF-8-FW-65	C SFP Cooling Supply
2-SF-8-FW-66	C SFP Cooling Supply
2-SF-143-FW-512	D SFP Cooling Supply
2-SF-144-FW-515	D SFP Cooling Supply
2-SF-144-FW-516	D SFP Cooling Supply
2-SF-159-FW-408	D SFP Cooling Supply

In accordance with the acceptance criteria in Special Plant Procedure SPP-0312T, welds which can be accepted without further evaluation must be completely free of the following defects:

- no Cracks
- no Lack of Fusion
- no Lack of Penetration
- no Oxidation
- no Undercut greater than 1/32"
- no Reinforcement ("Push Through") greater than 1/16"
- no Concavity (Suck Back") greater than 1/32"
- no Porosity greater than 1/16"
- no Inclusions

In addition, any indications not included in the above list of weld attributes but potentially pertinent to the condition of the piping and welds were required by the inspection procedure to be reviewed and formally evaluated by Harris Nuclear Plant Engineering staff. Such indications would include arc strikes, foreign material, evidence of mishandling, pipe mismatch, pitting, and evidence of corrosion.

The inspection procedure requires that personnel performing visual examinations be CP&L Visual Weld Examiners, certified in accordance with the Corporate NDE Manual. In addition, they are required to have successfully completed the CP&L training course on remote camera equipment and/or have demonstrated their capability to utilize the equipment to the satisfaction of the NDE VT Level III. Vendor personnel operating the closed circuit television system were not required to be certified visual weld examiners, but were required to be familiar with their equipment and proficient in its use.

Generally, the inspection results were good. It is noted that the welds in question were not subject to volumetric examination, and were sufficiently far from the open end of the pipe at the time of welding that an internal visual examination would not have been performed at the time of welding. Relative to the inspection criteria pertaining to weld attributes provided above, five of the six field welds were accepted based on the qualified examiner's review of the camera inspection video. A single weld, 2-SF-144-FW-516, was identified as having areas where portions of a consumable insert could be discerned. This weld, which exists in the horizontal piping on the supply line to SFP D, had several locations where a consumable insert had been utilized but was not fully consumed. Generally, these locations were limited to several very small areas where a small portion of the insert could be discerned, but included one area about 1.5 inches long where a continuous portion of the insert could be seen.

The presence of a small amount of unconsumed insert is not considered to be an indication of an unqualified welder, inadequate procedures, or inappropriate materials. The small amount of unconsumed insert is a relatively insignificant imperfection which is not unusual on field welds such as 2-SF-144-FW-516, which was only subject to surface examination and does not lend itself to internal visual examination. ASME Section III, Subsection ND design rules recognize the potential for imperfections of this nature in welds not subject to volumetric examination, and require that a reduction in joint efficiency be assumed for butt welds which are subject to surface examination only (ref. ND-3552.2).

The root pass associated with the indication of unconsumed insert is backed up by multiple weld passes, any one of which would be adequate to establish a leak tight pressure boundary under these conditions. Hydrostatic test records show that field weld 2-SF-FW-144-516 successfully completed hydrostatic testing at 32 psi during construction prior to the line being embedded, and that this test was witnessed by both QC and the ANI. Procedures and processes at the time required that both these field welds were subject to multiple inspections and documentation reviews during construction. Given this, and considering that this weld was subject to multiple inspections at the time of construction, it is highly unlikely that the indications noted on field weld 2-SF-144-FW-516 extend into the root pass, let alone the multiple passes that followed it.

Since field weld 2-SF-144-FW-516 is on a line which connects directly to atmospheric spent fuel pools, hydraulic pressure at the welds is limited to static head and a small amount of friction losses. (The effect of velocity head would be sufficiently small as to be negligible, but would actually tend to reduce the effective pressure.) At the location of field weld 2-SF-144-FW-516, static head due to the elevation difference is approximately 286 - 277.5 = 8.5 feet. Piping friction losses per 100 ft for 12 inch steel piping is only about 3 feet at 4000 gpm, so even considering the effect of elbows in the line, the 55 foot length of piping between this field weld and SFP C would only contribute another few feet for a total head of about 10 feet (i.e., less than 5 psi).

Operation of the SFP cooling and cleanup system for the C & D pools will be at a relatively low temperature and very low pressure. Accordingly, the minimum wall thickness needed to retain this pressure over a localized area of reduced wall is only a very small percentage of the 0.375 inch wall thickness in this piping. The piping in the vicinity of field weld 2-SF-FW-516 is completely embedded in concrete, located approximately at the center of a six foot thick, seismically-designed wall. As such, this piping is not subject to externally induced movement or stresses. Since the SFP cooling and cleanup system operates at a relatively low temperature with little variation, thermally induced stresses and thermal cycling are not of appreciable concern. Given the lack of externally induced stresses or thermal cycling, the small pieces of unconsumed insert will not initiate a crack or otherwise propagate a piping failure.

Based on all of the above considerations, the indications of an unconsumed insert identified on field weld 2-SF-144-FW-516 are acceptable, and no rework or repair to the weld is required.

Videotapes of the first six embedded field welds and associated piping to be visually inspected have been reviewed by CP&L engineering and metallurgical personnel. Aside from localized occurrences of loosely adhering surface film (principally boron deposits from boric acid added to the water), the videotape provides clear evidence that the piping was free from fouling or foreign materials. Where necessary, deposits were removed with pressurized water before the visual inspection. It is the consensus of the reviewers that the condition of the piping and welds is very good. Several inconsequential stains and small pits were noted, indicating that a small amount of minor corrosion may have occurred at some time in the past. Videotapes of all 15 embedded field welds and associated piping have been forwarded to corrosion experts both within CP&L and in the industry.

Requested Information Item 5:

What are the chemical analyses for steel welds 2-CC-3-FW-207, 2-CC-3-FW-208, and 2-CC-3-FW-209?

Response 5:

Chemical analyses for the carbon steel chips have been completed and are provided as Enclosure 2 to this RAI response. The results of these analyses substantiate that the filler material used for these welds is generally consistent with chemical composition requirements found in SFA 5.1 for ER70S-6 and SFA 5.18 for E7018.

Requested Information Item 6:

Describe the paper trail that identifies a specific weld material to a specific weld on the isometric drawings, i.e., show that the weld material being verified with the Metorex X-Met 880 was specified for that location. Identify missing documentation that breaks the paper trial, if any.

Response 6:

The weld metal to be used on a given weld was prescribed by the Weld Procedure Specification. The Weld Data Report (WDR) documented the Weld Procedure Specification to be used, as well as the AWS Classification of filler material. For the field welds for which WDRs are no longer available, it is not possible to directly document the Weld Procedure Specification and filler metal that was used. However, since the vendor data sheets are available on the pipe spools, a review has been done of the Weld Procedure Specifications available at that time and which would have been applicable for this type piping, material, and end prep. These Weld Procedure Specifications were provided to the NRC as Enclosure 6 to HNP-99-069, dated April 30, 1999, the HNP response to the March 24, 1999 NRC RAI on the Alternative Plan.

The pipe spools utilized in the HNP spent fuel pool cooling system are Type 304 stainless steel, a P-8 material. The Weld Procedure Specifications for P-8 to P-8 piping welds such as these in the spent fuel pool cooling system would have used filler metals conforming to SFA No. 5.4 / 5.9, including ER308, ER308L, ER316, ER316L and ER347. For Type 304 to Type 304 piping, ER308 would have typically been specified on the WDR. Given that some chemical changes in composition will be caused by the welding process and that blending of the base metal and filler metal would occur, the Metorex X-Met 880 testing is not intended to confirm the that chemical composition conforms to chemical composition requirements for each element, but rather to assure that weldments are sound by substantiating that the filler metal used was compatible with the piping material and generally consistent with composition requirements of the Weld Procedure Specification. Additional details on the use of the Alloy Analyzer to evaluate filler metal is provided in the HNP response to Requested Information Item 1 above.

Requested Information Item 7:

Discuss the chemical analysis and any other analysis performed on the water in the fuel pool cooling and cleanup system (FPCCS) and component cooling water system (CCWS) for spent fuel pools (SFPs) C and D. Where did the water come from? Discuss any differences between the chemical analysis and the original water source. Provide the staff with a representative analysis of the water.

Response 7:

A review of plant documentation substantiates that the embedded lines connected to SFPs C & D had water in them on two separate occasions during the construction process. Water samples were collected from seven of the eight lines associated with the embedded piping. * Analysis results of those water samples substantiate that the water in these lines originated from the spent fuel pools. Specifically, chloride and fluoride concentrations were very low, and generally consistent with specifications for spent fuel pool chemistry. Sulfate levels and conductivity, while not typically analyzed for spent fuel pool chemistry, were also very low and consistent with high purity water. The water samples also showed low levels of tritium, at a concentration similar to that of the spent fuel pools. Enclosure 3 to this RAI response provides a representative analysis of water samples taken from both the C and D SFP piping.

Initially, these lines were filled with water for hydrostatic testing prior to pouring concrete. Potential sources of hydrotest water included potable water and lake water, although procedures did require that the piping be drained and vented subsequent to test completion. Since these lines could not be isolated from their respective fuel pool liners, they would have been filled again in support of pool liner leak testing. The procedure for liner leak testing required test water to have a chloride content of no more than 100 ppm, which effectively precluded the use of either potable water or lake water for this evolution. Furthermore, procedures required the pools to be drained after testing, then rinsed with distilled or demineralized water. Subsequent to liner leak testing, there was no reason to introduce water into the pools again until they were filled and put into service (1989 - 1990 time frame). Several of these lines were drained one additional time in 1995 - 1996, when drain valves were added to the exposed portions of several of the embedded lines. Since that time, these lines refilled with water from the spent fuel pools. The water samples that were collected and analyzed, as discussed above, were samples of water that leaked past "plumbers plugs" in the pool nozzles since this last evolution.

* One of the eight lines has no drain line with an isolation valve for taking water samples, and was not represented in the initial set of water samples.

Requested Information Item 8:

In Enclosure 8, "Hydrotest Records for Embedded Spent Fuel Pool Cooling Piping and Field Welds," of your April 30, 1999, RAI response, you provided signed hydrostatic test reports for 13 embedded welds. Starting with the signed hydrostatic test report, back track through procedures and program requirements to the point where the missing document(s) were verified as being complete. In other words, identify the specific procedural and program controls requiring verification of completion of the missing documentation (manufacturing/fabrication records, weld data records, updated isometric drawings, and inspections) starting backward from the hydrostatic test report.

Response 8:

Construction procedure WP-115, "Pressure Testing of Pressure Piping (Nuclear Safety Related)," governed the hydrostatic testing of the embedded lines connected to HNP SFPs C and D. This procedure specifically required, prior to hydrotesting, the Mechanical QA Specialist verify that:

1) all required piping documentation is complete, and
2) all required weld documentation is complete.

Reference to piping and weld documentation is found in WP-102, "Installation of Piping." Specific requirements found in this document include:

1) that each weld joint for Code piping receive a WDR, and that these WDRs receive a QA and ANI inspection.
2) that weld procedures utilized be qualified in accordance with MP-01, "Qualification of Weld Procedures."
3) that welders and welding operators be qualified in accordance with MP-02, "Procedure for Qualifying Welders and Weld Operators."
4) that welds be stamped in accordance with MP-05, "Stamping of Weldments."
5) that weld material be controlled in accordance with MP-03, "Welding Material Control."

Generally, items 2 - 5 above ensure that Code welds were performed to appropriate procedures in the plant's Section IX weld program. Relative to item 1, WP-102 provided reference to CQC-19, "Weld Control" which again required that all Code welds received a WDR, and referenced procedure CQI-19.1, "Preparation & Submittal of Weld Data Report & Repair Weld Data Report," for detailed instructions on the use of WDRs. As prescribed by this procedure, the WDR included essentially all of the required attributes and documentation for welds within Code boundaries. Enclosure 4 provides a copy of CQI 19.1 at a revision level existing at or about the time most of the welds in question were made. Similarly, WP-102 contained requirements for layout and dimensional tolerances, as well as references to appropriate procedures for other piping installation processes, such as performance of cold pulls and torqueing of flanged connections. Therefore, in order to satisfy the prerequisites of procedure WP-115, the Mechanical QA Specialist would be required to verify that all the WDRs and RWDRs were complete and approved, dimensional and tolerance inspections had been completed, and all other piping installation processes had been completed and appropriately documented.

Requested Information Item 9:

Identify the concrete pouring procedure that requires checking for the welder symbol and a successful hydrostatic test before pouring.

Response 9:

Since embedding a line in concrete represented a point at which piping was no longer accessible for inspections, rework, etc., procedural controls were established to ensure that all required work activities had been completed and that documentation was in order prior to authorizing concrete placement. Procedure WP-05, "Concrete Placement", included a pre-placement requirement for a craft superintendent sign-off on the concrete placement report to signify completion of the craft's installation and superintendent inspection thereof. This procedure required that this sign-off be made by all craft superintendents, as a safeguard against omissions, whether or not they had material in a particular placement. Subsequently, procedure WP-05 required that the Construction Inspection Unit (QC) be notified when the installation was complete and ready for pre-placement inspection.

Procedure TP-24, "Mechanical Pipe Installation Inspection" provided requirements for the Construction Inspection Unit relative to inspection of piping, and included separate sections on embedded piping inspection. This procedure specifically required the CI inspector to inspect the installation and documentation prior to concrete placement. The CI inspector was required to verify the specific installation attributes:

1) that piping installation was performed in accordance with design drawings and documents, notably including verification of pipe spool identification
2) that piping was free from physical damage, and had no missing parts, and
3) that all piping leak tests were complete and documented.

It can be seen that procedures associated with concrete placement did provide assurance that piping embedded in concrete was the correct piping and was correctly installed. Furthermore, since the hydro-test was generally the final milestone for completion of a pipe segment, verification that all piping leak tests were complete and documented provided assurance that all test and inspection requirements were met. Procedures WP-05 and TP-24 do not specifically require a verification of the welder symbol. Rather, this assurance is provided by the review of weld documentation prior to hydro-testing, as well as the programmatic controls in CQC-19 and related procedures discussed above.

Requested Information Item 10:

Describe how the liner leak tests support weld integrity for welds 2-SF-8-FW-65 and 2-SF-8-FW-66 (Enclosure 3 of your response to NRCs RAI). For these two welds, back track through procedures and program requirements to the point where the missing documents were verified as being completed.

Response 10:

Leak testing of the liner was accomplished under procedure TP-057, "Hydrostatic Testing of Fuel Pool Liners." This procedure provided specific steps to be completed prior to performance of the liner leak test. The procedure required that Engineering prepare the test package, including identification of all boundaries and all isolation points to be utilized. For the north spent fuel pool liner hydrostatic test, the documented test boundaries included the piping runs containing 2-SF-8-FW-65 and 2-SF-8-FW-66.

Subsequent to preparation of the test package, QC was required to complete the "Prerequisites" section of the test form. Similar to the discussion of piping hydro-test procedures provided in the response to Requested Information Item 8 above, these prerequisites included a line item for the QC Inspector to verify "all weld documentation complete." Although the test procedure was specifically concerned with inspection of the liners, this verification would have necessarily extended to the entire pressurized boundary to ensure that no external leakage occurred, that partially completed welds were not overstressed, etc.

Although hydrostatic test packages have not been located at this time for welds 2-SF-8-FW-65 and 2-SF-8-FW-66, plant documentation does support that this hydrostatic test was done. For example, QA Deficiency and Disposition Report (DDR) 794 was initiated to assess hydrostatic test requirements for the plate rings reinforcing the piping to pool nozzle connections.. The resolution to this DDR acknowledged that the pipe spools adjacent to these welds had been subject to hydrostatic testing, even going so far as to include the dates of test performance. Four of the ten spools listed are included in the scope of the SFP C and D embedded piping, and two of these spools are in the line in which welds 2-SF-8-FW-65 and 2-SF-8-FW-66 are located. The other two spools referenced are on isometric drawing 2-SF-159, and are specifically included in a hydrostatic test package for which records have been located (provided previously to the NRC as Enclosure 7 to HNP-99-069, dated April 30, 1999). Comparison of the dates listed on DDR 794 against those associated with piping on isometric drawing 2-SF-159 verify that the test dates on these documents are in agreement.

Therefore, even though hydrostatic test records specifically listing welds 2-SF-8-FW-65 and 2-SF-8-FW-66 as inspection items have not been located, it can be established with a high level of confidence that these welds were hydro-statically tested, and that documentation associated with these welds was reviewed and verified as being complete.

Requested Information Item 11:

Describe precautions that were taken to protect system components (e.g., pumps, valves, heat exchangers, piping) from deleterious environmental effects during layup. Describe the layed up condition of the partially completed piping system and how this was determined. How would these layup conditions be different if it was known that SFPs C and D would be put in service later?

Response 11:

The location of system components (e.g., pumps, valves, heat exchangers, piping), the 236' elevation area of the Fuel Handling Building, is fully enclosed and serviced by a safety related HVAC system. This area is also the location of the operating Unit 1 spent fuel pool cooling pumps and heat exchangers, and is completely suitable for the long term storage of piping and equipment. It was anticipated that at some time it would be necessary to place C and D pools into service, and consideration was given to specific requirements for equipment protection. The spent fuel pool cooling pump motors were removed and placed in controlled storage conditions with heaters energized and shafts periodically rotated. The spent fuel pool heat exchangers were capped to preclude introduction of foreign material, and provided with a nitrogen blanket on the shell (CCW) side to prevent moisture and other contaminants from inducing corrosion. Spent Fuel Pool Cooling piping not connected to the spent fuel pools, which had never been wetted and was not connected to any active water systems, also received Foreign Material Exclusion (FME) type covers. Notably, the spent fuel pool cooling pumps and strainers were protected by FME covers on adjacent piping.

Through conversations with cognizant personnel, it is known that when it became necessary to fill the C and D spent fuel pools, the exposed ends of the connected spent fuel pool piping were fitted with leak tight covers and flooded as well. At some point, "plumber's plugs" were fitted in the C and D spent fuel pool cooling nozzles, although it is not clear whether these plugs were installed before or after the lines were flooded by the spent fuel pools. The primary purpose of these plugs was not for equipment protection but instead for ALARA considerations, i.e., to preclude collection of radioactive material in the piping.

Requested Information Item 12:

Why was visual inspection rather than ultrasonic inspection chosen to examine the integrity of the embedded welds?

Response 12:

Examination requirements for the embedded spent fuel pool cooling piping at the time of construction consisted of a surface visual and liquid penetrant examination of the piping OD, consistent with design rules and NDE requirements in ASME Section III, Subsection ND. Numerous programmatic and documentation assurances exist to confirm that these required inspections were indeed completed. In reviewing options for inspection of embedded piping and associated welds under the Alternative Plan, the objective was to implement an inspection program which: (1) provided yet another measure of assurance of construction quality, (2) provided a means to inspect as much of the overall scope as possible, (3) allowed for inspection of not only discrete areas of interest (ie., field welds), but also for qualitative assessment of overall piping condition, including corrosion and fouling, and (4) had a high level of probability to produce meaningful results with existing, proven technology. These criteria are individually discussed as follows:

1) Provides additional measure of assurance of construction quality

A detailed inspection of the interior of the piping with a high resolution camera provides a means to discern and assess numerous attributes pertaining to construction quality, including fit-up and alignment, adequacy of purge, and fusion of the root pass. These attributes, while readily examined with the use of a remote camera, do not lend themselves to detection and evaluation through ultrasonic examination.

2) Provides a means to inspect as much of the overall scope as possible

Camera inspection provides a means to see as much of the overall inspection scope (piping interior surfaces) as possible, as well as focus on specific areas of interest. A number of vendors offer inspection services of piping using remote cameras and a variety of propulsion methods, providing the best probability of inspecting as much of the piping as possible. Using real time feedback, direct camera operators can move relatively quickly over long runs of piping which can be readily observed as clean and in good condition; however, considerable time is spent in adjusting focus, lighting and other parameters to provide a detailed examination of specific areas of interest. Although ultrasonic techniques are commonly used to detect wall thinning in steam piping, this process requires that the entire surface to be examined be mapped, with each grid location receiving an ultrasonic examination. Clearly, the lack of access in the embedded piping precludes the use of a similar technique to assess the overall condition of the embedded piping.

3) Allows for inspection of overall piping condition, but also macroscopic examination for fouling, corrosion, etc.

Camera inspection is the only viable means to identify and assess numerous attributes which pertain to the suitability of piping for service, including surface corrosion, fouling, foreign objects in the line, etc. Visual inspection with a high resolution camera can also detect visual evidence of corrosion (stains, discoloration) even when no loss of material or other degradation is obvious.

(4) Provide a high level of probability of producing meaningful results with existing, proven technology

While not deemed appropriate to evaluate macroscopic examination of piping quality for the reasons discussed above, CP&L has investigated the feasibility of using ultrasonic examination to disposition discrete, localized indications. The obstacles associated with remotely performing ultrasonic examinations of these 12 inch embedded lines are considerable, and include:

- Piping runs approaching 100 feet long
- Piping runs including 4 or more elbows
- Both horizontal and vertical runs
- Since pools are full, inspections must be done from the exposed piping end, meaning that all vertical runs are upward
- The weld joints themselves are irregular to the extent a direct beam method could not be used. In addition, these butt welds utilized consumable inserts with an end prep having a counterbore approximately ¾ inch from the weld joint. This configuration complicates the use of angle beam ultrasonic methods
- The piping surface must be clean and smooth, such that boron crystals or any other film or material which are in the area to be inspected must be removed.
- A means must be devised to inject couplant in the area to be inspected
- The technique must provide a means to precisely locate and control the detector transducers, which would invariably require the use of a remote camera

The device would need to be capable of propelling a camera, UT transducers, and all attendant cabling through long pipe sections with numerous elbows and risers to the location of interest, identify and focus on the indication to be examined, clean it as necessary, inject couplant on the area where the transducer will be placed, then precisely locate the transducer at that point, adjusting it as necessary to provide a good signal. Even then, since the back (outside) surface of the weld joints is irregular, it is not certain that the results will allow an accurate interpretation of the condition of the piping. In summary, while several vendors have expressed an interest in working on a cost and materials basis to provide the propulsion, robotics, and equipment necessary to perform ultrasonic examination of the embedded piping, none have been identified with the proven experience necessary to provide repeatable, reliable results under similar conditions.

Requested Information Item 13:

Describe the post modification testing to be performed to ensure that the system(s) will satisfy all design requirements. Include description of hydro-tests to verify the integrity of the system pressure boundaries, flushing to ensure unobstructed flow through the system components, and pre-operational functional testing under design flow/heat loads.

Response 13:

Post modification testing will include the following:

1) System Hydrostatic testing conforming to Section III requirements will be performed on the completed system. With the exception of embedded piping, components inside Code boundaries will be included in this test effort, including pumps, heat exchangers and strainers. In a previous HNP response to the NRC RAI on the Alternative Plan (ref. HNP-99-069, dated April 30, 1999), CP&L stated that Code Case N-240 would be used to exempt formal requirements for hydro-testing of the embedded piping connected to the atmospheric spent fuel pools. CP&L is continuing to investigate methods to provide additional assurance of the quality of embedded piping and field welds, including consideration of pressure testing. The final disposition of hydrostatic testing of embedded spent fuel pool piping will be provided to the NRC as part of the follow-up report on embedded piping and welds as discussed in the response to Requested Information Item 4 above.

2) A flush procedure will be developed which ensures that piping and components inside Code boundaries are free from fouling and debris which might affect system performance, reliability or spent fuel integrity.

3) Pre-operational testing will include a flow balance and verification which ensures that design flow requirements are met for the Spent Fuel Pool Cooling and Component Cooling Water systems, as well as those heat loads which rely on CCW (such as RHR) and heat sinks downstream of CCW (ESW, UHS). Given the lack of a heat load which would facilitate the performance of a meaningful heat duty test of the Spent Fuel Pool Cooling System, no such test will be performed. Moreover, at the 1.0 Mbtu / hr maximum heat load associated with this license amendment request, performance of such a test would not be viable even at the proposed licensed limit. Although the C and D spent fuel pool cooling heat exchangers were installed in the Fuel Handling Building nearly 20 years ago, they have never been placed into service and, from a design perspective, are still new. Moreover, these heat exchangers were layed up with a nitrogen blanket on the shell side, protecting it from moisture and corrosion. A pre-service inspection of the tubesheets and tubes has been performed on these heat exchangers to ensure that no foreign material or corrosion exists which might obstruct flow or otherwise reduce performance.

ENCLOSURE 2 to SERIAL: HNP-99-172

SHEARON HARRIS NUCLEAR POWER PLANT
DOCKET NO. 50-400/LICENSE NO. NPF-63
RESPONSE TO NRC REQUEST FOR ADDITIONAL INFORMATION REGARDING THE ALTERNATIVE PLAN FOR SPENT FUEL POOLS C & D COOLING AND CLEANUP SYSTEM PIPING

Carolina Power & Light Company
Material Services Section
Metallurgy Services
Technical Report

Subject: HNP - Material Identification of Chips from Carbon Steel Welds Associated with the Spent Fuel Pool Activation Project

(1 page total)

CAROLINA POWER & LIGHT COMPANY
MATERIAL SERVICES SECTION
METALLURGY SERVICES

TECHNICAL REPORT

To: Mr. Jeff Lane

Project Number: 99-134
Date: August 25, 1999

Investigators:
Robert Jordan
Danny Brinkley

Reviewed by: J. W. Wood

Distribution:
File/Metallurgy Services

Approved by: R. J. Bloch
Supervisor, Metallurgy Services

SUBJECT: HNP- Material Identification of Chips from Carbon Steel Welds Associated with the Spent Fuel Pool Activation Project.

On July 8, 1999 three samples of chips were received from HNP personnel for chemical analysis. The chips were removed from Welds 2CC-FW-207, 208, and 209 on ASME Section III, Class 3 Piping used on the Component Cooling Water (CCW) System. Metallurgy Services personnel were asked to perform chemical analysis on the three samples.

On July 27, 1999 the three samples of chips were sent to NSL Analytical Services, Inc., in Cleveland, Ohio for analysis. A report of the analyses was received from NSL on August 16, 1999. The results of the analysis for each sample are listed in the table below and a copy of the results from NSL is attached.

ELEMENT	SAMPLE 2CC-FW-207 (WEIGHT PERCENT)	SAMPLE 2CC-FW-208 (WEIGHT PERCENT)	SAMPLE 2CC-FW-209 (WEIGHT PERCENT)
Carbon	0.13	0.11	0.11
Chromium	0.028	0.031	0.027
Copper	0.035	0.018	0.018
Manganese	1.29	1.20	1.15
Molybdenum	0.014	0.004	0.003
Nickel	0.028	0.016	0.014
Phosphorus	0.021	0.014	0.013
Sulfur	0.011	0.012	0.013
Silicon	0.29	0.29	0.41
Vanadium	0.018	0.026	0.026

ENCLOSURE 3 to SERIAL: HNP-99-172

SHEARON HARRIS NUCLEAR POWER PLANT
DOCKET NO. 50-400/LICENSE NO. NPF-63
RESPONSE TO NRC REQUEST FOR ADDITIONAL INFORMATION REGARDING THE ALTERNATIVE PLAN FOR SPENT FUEL POOLS C & D COOLING AND CLEANUP SYSTEM PIPING

Chemistry Sample Data Sheets from HNP Procedure CRC-001

(2 sheets total)

CHEMISTRY SAMPLE DATA SHEET

SAMPLE PT SPENT FUEL POOL 'C' -2SF-213		
SAMPLE COLLECTOR JERRY BOLEY	OP MODE I	DATE 4-27-99

SAMPLE TIME	PARAMETER	LIMITS	RESULTS	ANALYST
0930	F		13.1 ppb	LLB/MSJ
↓	Cl		28.2 ppb	↓
	SO4		424 ppb	
	pH		5.33	
	KTOT		25.4	

Comments

Reviewed By: Terry Thompson Date 4-29-99

CHEMISTRY SAMPLE DATA SHEET

SAMPLE PT SPENT FUEL POOL D 2SF-212		
SAMPLE COLLECTOR JERRY BOLEY	OP MODE I	DATE 4-27-99

SAMPLE TIME	PARAMETER	LIMITS	RESULTS	ANALYST
0900	F		120 ppb	MSJ/LCB
↓	Cl		70.5 ppb	↓
	SO4		676 ppb	
	pH		6.74	
	KTOT		92.3	

Comments

Reviewed By: Terry Thompson Date 4-29-99

ENCLOSURE 4 to SERIAL: HNP-99-172

SHEARON HARRIS NUCLEAR POWER PLANT
DOCKET NO. 50-400/LICENSE NO. NPF-63
RESPONSE TO NRC REQUEST FOR ADDITIONAL INFORMATION REGARDING THE ALTERNATIVE PLAN FOR SPENT FUEL POOLS C & D COOLING AND CLEANUP SYSTEM PIPING

Carolina Power & Light Company
Corporate Quality Assurance Department
Engineering and Construction Quality Assurance/Quality Control Section

QCI-19.1, Revision 1

Title: Preparation & Submittal of Weld Data Report, Repair Weld Data Report, Tank Fabrication Weld Record & Seismic I Weld Data Report

Initial Issue Date: March 16, 1981

(25 pages total)

CONTROLLED DOCUMENT

CAROLINA POWER & LIGHT COMPANY

CORPORATE QUALITY ASSURANCE DEPARTMENT

ENGINEERING AND CONSTRUCTION QUALITY ASSURANCE/QUALITY CONTROL SECTION

PREPARATION & SUBMITTAL OF WELD DATA REPORT, REPAIR WELD DATA REPORT, TANK FABRICATION WELD RECORD & SEISMIC I WELD DATA REPORT

FOR INFORMATION ONLY

NUMBER:		INITIAL ISSUE DATE:
QCI-19.1	Q A RECORDS RECEIVED NOV 6 1981 SHNPP CONSTR. Q A UNIT	March 16, 1981
RECOMMENDED FOR APPROVAL BY: *(signature)* Q 'ECIALIST		APPROVED BY: *(signature)* DIRECTOR - QA/QC

2-4

QAI-1
Exhibit 1-C
Rev. 1

CONTROLLED DOCUMENT

CAROLINA POWER & LIGHT COMPANY
CORPORATE QUALITY ASSURANCE DEPARTMENT
ENGINEERING & CONSTRUCTION QUALITY ASSURANCE/
QUALITY CONTROL SECTION

NUMBER	REVISION
QCI-19.1	1

TITLE: PREPARATION & SUBMITTAL OF WELD DATA REPORT, REPAIR WELD DATA REPORT, TANK FABRICATION WELD RECORD & SEISMIC I WELD DATA REPORT

REVISION RECORD

Changes and additions are indicated by a vertical bar in the right-hand margin of the revised page(s). Manual holder is to replace affected pages only. This record is to be retained behind the title page of the instruction.

Rev.	Description	Signatures	Date
1	Major rewrite of complete procedure including title change. (See list of effective pages)	Prepared By: [signature]	11/2/81
		Approved By: [signature]	11/2/81
		Prepared By:	
		Approved By:	
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		Approved By:	
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		Approved By:	

CONTROLLED DOCUMENT

CAROLINA POWER & LIGHT COMPANY
CORPORATE QUALITY ASSURANCE DEPARTMENT
ENGINEERING & CONSTRUCTION QUALITY ASSURANCE/
QUALITY CONTROL SECTION

NUMBER	REVISION
QCI-19.1	1

TITLE: PREPARATION & SUBMITTAL OF WELD DATA REPORT, REPAIR WELD DATA REPORT, TANK FABRICATION WELD RECORD & SEISMIC WELD DATA REPORT

LIST OF EFFECTIVE PAGES

Page	Rev. No.
1	1
2	1
3	1
4	1
5	1
6	1
7	1
8	1
9	1
10	1
11	1
12	1
13	1
14	1
15	1
16	1
17	1
18	1
Exhibit 1	1
Exhibit 2	1
Exhibit 3	1
Exhibit 4	1

CAROLINA POWER & LIGHT COMPANY
CORPORATE QUALITY ASSURANCE DEPARTMENT
ENGINEERING & CONSTRUCTION QUALITY ASSURANCE/
QUALITY CONTROL SECTION

NUMBER	REVISION
QCI-19.1	1

TITLE: PREPARATION & SUBMITTAL OF WELD DATA REPORT, REPAIR WELD DATA REPORT, TANK FABRICATION WELD RECORD & SEISMIC I WELD DATA REPORT

1.0 PURPOSE

The purpose of this instruction is to provide guidelines for preparing Weld Data Reports, Repair Weld Data Reports, Seismic I Weld Data Report and Tank Fabrication Weld Data Records required for documentation of weld joint control.

2.0 SCOPE

This instruction is applicable to weld data records required for ASME Code Class 1, 2, 3 and MC welds; Seismic Category I welds; and welds in the site fabrication of nuclear safety related and ASME Code Class storage tanks.

3.0 REFERENCES

1. CQC-19, Weld Control
2. MP-06, General Welding Procedure for Carbon Steel
3. MP-07, General Welding Procedure for Stainless Steel
4. MP-10, Repair of Base Material and Weldouts
5. NDEP-601, Visual Inspection
6. AWS D1.1, Structural Welding Code
7. MP-08, General Welding Procedure for Structural Steel and Hangers
8. WP-18, Miscellaneous Steel Fabrication
9. MP-19, Field Erected Stainless Steel Storage Tanks
10. AS-7, Seismic Class I & Non-Seismic Class I Structural Steel

4.0 GENERAL

4.1 Weld Data Report

ASME Code Class 1, 2, 3 and MC welding data shall be documented on a WDR (QA-28 form).

4.2 Repair Weld Data Report

4.2.1 A repair WDR (QA-30 form) is required for the following conditions:

a) Rejectable defect is found by NDE at a specified holdpoint or completed weld.

b) Damage to base material requiring deposition of filler metal.

4.2.1 (cont.)

4.2.2 A repair WDR is not required for the following conditions:

a) Weld defects which occur during the in-process welding and which can be removed and reworked within the Weld Procedure Specification (WPS) specified on the original WDR (this includes slag; porosity; burn-through in the root pass or backing ring; or root weld defect in the pipe I.D. or O.D.).

b) Rework required to correct in-process defects found by NDE performed "for information".

c) Where complete removal of the weld joint is the repair method used (a new WDR will be issued in this case).

4.3 Seismic I Weld Data Report (SWDR)

4.3.1 Seismic I structural welding with the exception of stud welding shall be documented on a SWDR (QA-34).

4.3.2 Repairs to Seismic I structural welds will be documented on the SWDR when the following conditions exist:

a) A rejectable defect is found by visual inspection or other NDE at a specified holdpoint or completed weld.

b) Damage to base material requiring deposition of filler metal.

4.3.3 Entries on the SWDR are not required for the following conditions:

a) Weld defects which occur during the in-process welding and which can be removed and reworked within the Weld Procedure Specification (WPS) specified on the SWDR (this includes slag, porosity, burn-through in the root pass or backing strip or root weld defect in the structural item).

b) Rework required to correct in-process defects found by NDE performed for "information only".

4.3.3 (cont.)

c) Where complete removal of the weld joint is the repair method used (a new SWDR will be issued in this case).

4.4 Tank Fabrication Weld Record (TFWR)

4.4.1 The TFWR (QA-32 form) will be used to document weld joint data for the field fabrication of nuclear safety related and ASME Code Class storage tanks.

4.4.2 Repairs to tank fabrication welds will be documented on the TFWR when the following conditions exist:

a) A rejectable indication is found by visual inspection or other NDE at a specified holdpoint or after completion of the weld.

b) Damage to base material requiring deposition of weld filler metal.

4.4.3 Documentation of repairs to tank fabrication welds is not required for the following conditions:

a) Weld defects which occur during the in-process welding and which can be removed and reworked within the Weld Procedure Specification (WPS) specified on the TFWR (this includes slag, porosity, burn through in the root pass or backing strip or root weld defect in the item).

b) Rework required to correct in-process defects found by NDE performed for "information only".

c) Where complete removal of the weld joint is the repair method used. A new entry for that joint number will be made on the TFWR in this case.

5.0 PROCEDURE

5.1 Weld Data Report (WDR)

The WDR (Exhibit 1) is initiated by Welding Engineering. The Welding Engineer, or his designee, fills out pertinent information and designates the required holdpoints.

5.1 (cont.)

The white and yellow copies of the WDR, along with the work package, are forwarded to the Welding QA/QC Specialist. The Welding QA/QC Specialist, or his designee, reviews the WDR for essential information and mandatory holdpoints and inserts additional holdpoints, if required. The ANI will assign additional holdpoints, if he desires, sign and date the WDR, if he concurs with the data given, and return it to the Welding QA/QC Specialist. QA shall keep the yellow copy of the WDR and send the white copy along with the work package to the Mechanical Engineering Group for transmittal to the field. The areas of responsibility in filling out the WDR are outlined below: (Numbers correspond with Exhibit 1)

	Title	Data	Responsibility
1.	Turnover No.	No. assigned by Startup Group	Weld Eng.
2.	Weld Joint Record No.	Zone, ~~Isometric~~, Field Weld No., Obtained from Isometric	Weld Eng.
3.	System	System Name or designation Obtained from Isometric	Weld Eng.
4.	Category	System Category (ASME Class 1,2,3, Seismic I) Obtained from Isometric	Weld Eng.
5.	Eng. Dwg. No.	Drawing No. Obtained from Isometric	Weld Eng.
6.	Fill Metal Type	Type of Filler Metal (E 7018, 309, 308, 316, etc.)	Weld Eng.
7.	Design Line No.	Design Line No. Identification from Isometric/Drawing	Weld Eng.
8.	Base Metal Spec.	ASME Spec. and Grade of base material being joined. Obtained from Isometric or Line Lists	Weld Eng.

5.1 (cont.)

	Title	Data	Responsibility
9.	Joint Type - CI, BR, F, OB, SKT, and Other	Circle the appropriate joint type. CI = Consumable Insert BR = Backing Ring F = Fillet OB = Open Butt SKT = Socket Obtained from drawing while meeting requirements of WPS and Ebasco Spec. M-30	Weld Eng.
10.	Pipe-Component Size	Size, in inches, of pipe and/or component. Obtained from Isometric	Weld Eng.
11.	PC no. to PC no.	Piece No. to Piece No. of items being joined. Obtained from Isometric	Weld Eng.
12.	Welding Procedure	Appropriate Welding Procedure and Revision No.	Weld Eng.
13.	Material Thickness	Thickness of materials being joined. Obtained from drawing or Line List.	Weld Eng.
14.	Ht. No. to Ht. No.	Heat No. to Heat No. of items being joined. Obtained from Pipe Marking and/or from Pipe Spool Fabrication Drawing. Exception: When welded valves are joined to a piping system the valve serial number will be used in lieu of the Heat No. In the event the valve serial number cannot be determined, the valve National Board Registration number may be used.	QA/QC Inspector
15.	PWHT Procedure & Rev. No.	Appropriate Post-Weld Heat Treatment Procedure & Revision No.	Weld Eng.

5.1 (cont.)

	Title	Data	Responsibility
16.	Inservice Inspection	Inservice Insp. if required for the field weld is assigned by Welding Engineering.	Weld Eng.
17.	Welding Eng. Verification Date	Signature of Welding Engineer (or his designee) indicating concurrence with holdpoints.	Weld Eng.
18.	ANI Review	Signature of Authorized Nuclear Inspector (or his designee) indicating concurrence with holdpoints.	ANI
19.	Release for QA and Date	Signature of Welding QA/QC Specialist (or his designee) indicating concurrence with holdpoints and releasing WDR to construction. (Date Signed)	QA/QC Welding
20.	Welder(s) Symbol	Symbol(s) of Welder(s) assigned to perform welding. (QC Inspector verifies welder qualification at this point).	QA/QC Inspector
21.	Items	QC Inspection holdpoints checked (✓) that are required by Code, Specification, Procedures, Drawings, or Isometric	Weld Eng.
		QC Inspection holdpoints checked (✓) that are desgnated by QA in addition to holdpoints checked (✓) by Welding Engineer. (Holdpoints that do not apply shall be marked N/A.)	Welding QA/QC Specialist
		ANI Inspection holdpoints checked (✓) to be witnessed by ANI	ANI

5.1 (cont.)

	Title	Data	Responsibility
22.	Backing Type CI BR	Circle Type of Backing CI = Consumable Insert BR = Backing Ring	Weld Eng.
	Metal Spec. Heat No.	ASME Metal Specification Heat No. of the Backing Material. Obtained from Weld Material Requisition (WMR)	Weld Eng. QA/QC Inspector

Note: Size and Type of CI shall be specified by Welding

	Title	Data	Responsibility
23.	Bare Filler Metal Spec.	ASME Filler Metal Spec.	Weld Eng.
	Size	Size of Filler Metal	QA/QC Inspector
	Ht No.	Heat No. of Bare Filler Metal. Obtained from WMR.	QA/QC Inspector
24.	Coated Filler Metal Spec.	ASME Filler Metal Spec.	Weld Eng.
	Size	Size of Filler Metal	QA/QC Inspector
	Ht/Lot No.	Heat No. of filler metal and/ or lot no. assigned to filler metal. Obtained from WMR.	QA/QC Inspector
25.	No. of Repairs Comments	Number of repairs made to the weld and pertinent comments. Enter Repair WDR numbers.	QA/QC Inspector
26.	PWHT Chart No/Date	Post-Weld Heat Treatment Chart No. and Date performed	QA/QC Inspector

5.1 (cont.)

	Title	Data	Responsibility
27.	QA/QC Inspector	QA/QC Inspector's signature indicating acceptance of weld and date.	QA/QC Inspector
28.	QA Final Acceptance	Signature of Welding QA/QC Specialist (or his designee) indicating final acceptance of weld. Date signed.	QA/QC Welding
29.	Verified by ANI/Date	Signature of ANI indicating WDR was reviewed and accepted. Date signed.	ANI

(Items listed individually)

Part II - Erection Traveler Process Check Points

1. Verify spools being joined - Verify that the numbers of the spool pieces being joined coincide with the WDR and the appropriate isometrics.

2. Pre fit-up inspection - Inspection performed in accordance with the requirements of NDEP-601

3. Fit-up inspection - Inspection performed in accordance with the requirements of NDEP-601.

4. Check purge gas - Check for compliance with the appropriate welding procedure.

5. Check preheat temperature - Check for compliance with the appropriate welding procedure.

6. Root Pass NDE UT-RT-MT-PT-VT - If required, NDE is performed in accordance with the applicable procedure. (NDEP-402, NDEP-101, NDEP-301, NDEP-201 and NDEP-601). (Insert procedure and revision number.)

7. Check interpass temperature - Check for compliance with the applicable welding procedure.

8. Intermediate NDE UT-RT-MT-PT-VT - If required, NDE is performed in accordance with the applicable procedure. (NDEP-402,

5.1 (cont.)

NDEP-101, NDEP-301, NDEP-201 and NDEP-601). (Insert procedure and revision number).

9. Visually inspect Final Weld ID & OD - Perform inspection in accordance with NDEP-601. (Insert procedure and revision number.)

10. Record Ferrite - Two (2) locations checked in accordance with applicable site procedure when required.

11. Inspect for joint identification - Verify that the field weld is marked in accordance with MP-05.

12. Check final cleanliness - Checked in accordance with NDEP-601.

13. Final NDE RT-MT-PT-UT - NDE is performed in accordance with the applicable procedure. (NDEP-101, NDEP-301, NDEP-201, NDEP-601). (Insert procedure and revision number.)

14. Release for PWHT - If required, verify that all required NDE has been completed.

15. PWHT NDE RT-MT-PT-UT-VT - If required, perform required NDE after PWHT according to the applicable procedure. (NDEP-101, NDEP-301, NDEP-201, NDEP-401, NDEP-601). (Insert procedure and revision number.)

5.1.1 Each item under Title No. 21 shall be initialed, dated and checked (✓) in the appropriate block, indicating acceptance or rejection in accordance with the applicable MP procedures and/or NDEP-601 (Visual Welding Inspection). If the item is initially rejected, later acceptance will be noted in the "Remarks" section when rework has been completed.

5.2 Repair Weld Data Report

5.2.1 The Repair Weld Data Report (Exhibit 2) is initiated by the Welding Engineering Unit.

5.2.2 The white and yellow copies of the Repair WDR are forwarded to QA and the ANI for approval and the insertion of additional holdpoints.

5.2.3 The yellow copy is maintained by Welding QA/QC and the white copy is forwarded to the field.

5.2.4 Data shall be entered on the Repair WDR as follows: (Numbers correspond with Exhibit 2)

	Title	Data	Responsibility
1.	Repair WDR No.	Number of repairs made to the weld.	Weld Eng.
2.	Unit	Unit No. obtained from "Line No. on WDR.	Weld Eng.
3.	System	System name or designation obtained from Isometric	Weld Eng.
4.	Category	System Category (ASME Class 1, 2, 3, Seismic I). Obtained from Isometric	Weld Eng.
5.	Drawing	Iso No./Engineering Drawing No. obtained from Isometric	Weld Eng.
6.	Field Weld ID	Assigned weld identification from Isometric/Drawing	Weld End.
7.	Base Metal and Grade	ASME Spec. and Grade of Base materials being joined. Obtained from Isometric or Line Lists.	Weld Eng.
8.	Pipe/ Component Size	Size in inches of Pipe and/or component and thickness of material. Obtained from Isometric or WDR.	Weld Eng.
9.	Welding Procedure and Revision No.	Appropriate Welding Procedure and Revision No..	Weld Eng.
10.	Pc No. to Pc No. Ht No. to Ht.No.	Piece No. to Piece No. Heat No. to Heat No. Obtained from Pipe Marking and/or from Pipe Spool Fabrication Dwg. Exception: When welded valves are joined to a piping system, the valve serial number will be used in lieu of Ht. No..	Weld Eng/ QA/QC Inspector

5.2.4 (cont.)

	Title	Data	Responsibility
11.	Joint Type, CI, BR, OB, SKT, other	Circle the appropriate joint type. CI = Consumable Insert BR = Backing Ring F = Fillet OB = Open Butt SKT = Socket Obtained from Drawing while meeting requirements of WPS & Ebasco Spec. M-30	Weld Eng.
12.	Heat Treat Procedure & Rev. No.	Appropriate Post-Weld Heat Treatment Procedure & Rev. No.	Weld Eng.
13.	Welding Engineer & Date	Signature and date of Welding Engineer (or his designee) initiating Weld Data Report	Weld Eng.
14.	ANI Review & Date	Signature & date of ANI agreeing to holdpoints.	ANI
15.	QA Review & Date	Signature & date of QA/QC Welding agreeing to holdpoints and releasing WDR to construction.	QA/QC Welding
16.	Backing Type	Circle type of backing, if not applicable, mark N/A.	Weld Eng.
17.	Bare Metal	Size of Filler Metal	QA/QC Inspector
	Size		
	Ht	Heat No. of Bare Filler Metal	QA/QC Inspector
18.	Coated Filler Metal Spec.	ASME Filler Metal Spec. (If not applicable, mark N/A)	Weld Eng.
	Size		

5.2.4 (cont.)

	Title	Data	Responsibility
19.	Ht/Lot No.	Heat No. of Filler Metal and/or Lot No. assigned to Filler Metal	QA/QC Inspector
20.	Welder's Symbol Root	Symbol assigned to Welder entered at time of welding.	QA/QC Inspector
21.	Welder' Symbol Intermediate	Symbol assigned to Welder entered at time of welding	QA/QC Inspector
22.	Welder's Symbol Final	Symbol assigned to Welder, entered at time of welding.	QA/QC Inspector
23.	Repair Instructions	The instructions for repairing the weld as assigned by Welding Engineer.	Weld Eng.
24.	Item	Holdpoints Engineer checked (✓) that are required by QA in addition to holdpoints checked (✓) by Welding Engineer. Hold-points that do not apply shall be marked N/A.	QA/QC Welding
		ANI holdpoints checked (✓) to be witnessed by ANI. Hold-points that do not apply shall be marked N/A.	ANI
25.	QA/QC Specialist	Signature of Welding QA/QC Specialist (or his designee) indicating final acceptance of weld repair. Date signed.	Welding QA/QC Specialist
26.	ANI (Code Weld)	Signature and date of ANI indicating RWDR was reviewed and accepted. Date signed.	ANI

5.2.5 QA accepted signature signifies that the item has been repaired and accepted in accordance with the applicable MP specification and NDEP specification.

5.3 Seismic I WDR (SWDR)

5.3.1 The SWDR (QA-34 form) is initiated by the discipline engineer in the case of pipe hangers and structural items. It is initiated by the craft foreman for cable tray, conduit and HVAC supports. The appropriate individual fills out pertinent information and forwards the SWDR to the welding engineer if holdpoints are required.

5.3.2 The white and yellow copies of the SWDR, along with the work package are forwarded to the Welding QA/QC Specialist or his designee.

5.3.3 The Welding QA/QC Specialist or his designee, reviews the SWDR for essential information and mandatory holdpoints and inserts additional holdpoints if required.

5.3.4 The Welding QA/QC Specialist, or his designee, will initial and date the SWDR and send the white copy to the applicable Engineering discipline or craft.

5.3.5 The areas of responsibility fpr filling out the SWDR are outlined below: (numbers correspond with numbered blocks on Exhibit 1)

5.3.5.1 Pipe Hangers & Structural

A. Discipline Engineer (or his designee)

1. Completes blocks 1 through 6
2. Identifies joints involving 1-1/2" and thicker base material and assigns preheat holdpoints (and fitup holdpoints, if applicable).
3. Signs and dates: Retains pink copy and forwards white copy and yellow copy to Welding Engineer.

B. Welding Engineer (or his designee)

1. Completes blocks 7, 8 and 9.
2. Identifies joint type and assigns mandatory holdpoints.

5.3.5.1 (cont.)

3. Identifies joints which require PWHT.
4. Sign and dates; forwards yellow and white copies to Welding QA/QC.

C. Welding QA/QC Specialist (or his designee)

1. Reviews entries made by Engineers against applicable drawings and specifications.
2. Designates additional holdpoints as needed.
3. Initials and dates; retains yellow copy and forwards white copy to discipline engineer.

D. Discipline Engineer

1. Forwards white copy with work package to the craft foreman.

E. Craft Foreman

1. Completes weldout of joints not requiring preheat or fitup inspection.
2. Notifies Welding QA/QC when ready for preheat and/or fitup inspection.
3. Notifies Welding QA/QC when ready for full penetration root pass holdpoints.
4. Signs and dates Section II of white copy when all welds are complete.

F. Welding QA/QC Inspector

1. Completes items 1 through 3 in Section III.
2. Performs preheat and fitup inspection as designated. (Releases for weldout/root pass when acceptable.)
3. Performs root pass visual inspection of full penetration joints.
   a. Performs specified NDE, or
   b. initiates NDE Request to the NDE subunit.
   c. Releases for weldout when acceptable.
4. Performs final visual inspection of all joints and records welder(s) symbol(s).
5. Performs specified Final NDE or:
   a. Initiates NDE Request to the NDE subunit.

5.3.5.1 (cont.)

b. Initiates request for vacuum box testing, if specified.

6. Monitors PWHT in accordance with CQC-20, if specified.
7. Acceptable welds having the same inspection and NDE requirements may be tested collectively. Quantities as shown on applicable drawings, will be indicated (i.e. (8) fillet welds or (4) flare bevel welds). Unacceptable joints will be listed and identified separately (i.e. 5/16" fillet Pc. 5 to Pc. 8 top). Reinspection and acceptance will be indicated by listing the joint again in the same section of the QA-34 form.

5.3.5.2 Cable Tray, Conduit and HVAC Supports

A. Craft Foreman

1. Completes blocks 1 through 6 (obtains help from Area Engineer as needed).
2. Enters data in blocks 7 and 8 for joints covered by WP-203 and WP-400 (electrical cable tray and conduit supports; and HVAC supports).
3. Completes weldout of joints not involving full penetration welds or attachments to engineered embedded plates. (Signs and dates Section I if no full penetration welds or attachments to engineered embedded plates are involved.)
4. Informs Discipline Engineer of full penetration welds or joints involving engineered embedded plates (forwards SWDR to the Discipline Engineer).

B. Discipline Engineer

1. Identifies full penetration welds and assigns fitup holdpoints.
2. Identifies joints involving 1-1/2" and thicker base material and assigns preheat holdpoints.
3. Identifies joints requiring PWHT and assigns PWHT holdpoints.

5.3.5.2 (cont.)

4. Signs and dates: Retains pink copy and forward white and yellow copies to the Welding Engineer.

C. Welding Engineer (or his designee)

1. Enter data in blocks 7 and 8 for full penetration welds and joints involving 1-1/2" thick base material. Other pertinent welding information will be entered in block 9.
2. Signs and dates; forwards white and yellow copies to Welding QA/QC.

D. Welding QA/QC Specialist (or his designee)

1. Review entries made by engineers against applicable drawings and documents.
2. Designates additional holdpoints as needed.
3. Initials and dates; retains yellow copy and forwards white copy to the craft foreman.

E. Craft Foreman

1. Notifies QA/QC when ready for preheat and/or fitup holdpoints.
2. Notifies QA/QC when ready for full penetration joint root pass holdpoints.
3. Signs and dates Section II of white copy and yellow copy when all welds are completed.

F. Welding QA/QC Inspector

1. Completes items 1 through 3 in Section III.
2. Performs preheat and fitup inspection as designated. (Releases for weldout/root pass when acceptable.)
3. Performs root pass visual inspection of full penetration joints.
   a. Performs specified NDE, or
   b. initiates NDE Request to the NDE subunit.
   c. Releases for weldout when acceptable.
4. Performs final visual inspection of all joints and records welder(s) symbol(s).

5.3.5.2 (cont.)

5. Performs specified Final NDE or:
   a. Initiates NDE Request to the NDE subunit.
   b. Initiates request for vacuum box testing, if specified.
6. Monitors PWHT in accordance with CQC-20, if specified.
7. Acceptable welds having the same inspection and NDE requirements may be tested collectively. Quantities as shown on applicable drawings, will be indicated (i.e. (8) fillet welds or (4) flare bevel welds). Unacceptable joints will be listed and identified separately (i.e. 5/16" fillet Pc. 5 to Pc. 8 top). Reinspection and acceptance will be indicated by listing the joint again in the same section of the QA-34 form.

5.4 Tank Fabrication Weld Record (TFWR)

5.4.1 The TFWR (QA-32 form) is initiated by the Welding Engineer (or his designee) who will fill in the tank design and identification data; joint identification, the material thickness, joint type, specified holdpoints and weld procedures for each weld joint. The TFWR is forwarded to Welding QA/QC.

5.4.2 The Welding QA/QC Specialist (or his designee) reviews the TFWR for essential requirements and mandatory holdpoints; designates additional holdpoints, as needed; and submits it to the ANI (Code Class tanks only) for review and designation of his holdpoints.

	Title	Data	Responsibility
1.	Unit No.	Assigned to Unit which tank belongs.	Weld Eng.
2.	Tank I.D. Number	Obtained from tank drawing.	Weld Eng.
3.	ASME Code Class	ASME Code Class 1, 2 or 3.	Weld Eng.
4.	Drawing Number	Obtained from drawing.	Weld Eng.

5.4.2 (cont.)

	Title	Data	Responsibility
5.	Weld Engr.	Signature of Weld Engr. (or his designee) initiating the Tank Fabrication Weld Record and date.	Weld Eng.
6.	Weld Number	I.D. No. of weld from drawing.	Weld Eng.
7.	Material Thickness	Obtained from drawing.	Weld Eng.
8.	Joint Type	Obtained from drawing.	Weld Eng.
9.	Weld Proc. and NDE Requirements	Assigned by Weld Engr.	Weld Eng.
10.	Required Holdpoints	Assigned by Weld Engr.	Weld Eng.
11.	Weld Symbol	From assigned welder(s).	Foreman
12.	Material Heat	From WMR.	Foreman
13.	QA/QC Inspector	Signature and date of QA/QC Inspector verifying holdpoints.	QA/QC Inspector
14.	ANI	Signature and date of ANI verifying and/or adding holdpoints.	ANI
15.	QA/QC Specialist	Signature and date of QA/QC Specialist or his designee after completion of TFWR.	QA/QC Spec.

6.0 EXHIBITS

Exhibit 1, Weld Data Report (WDR)
Exhibit 2, Repair Weld Data Report (Repair WDR)
Exhibit 3, Tank Fabrication Weld Record (TFWR)
Exhibit 4, Seismic I Weld Data Report (SWDR)

PROJECT ____________

PG&E
QA-28

WELD DATA REPORT
(PROCESS CONTROL CHECKLIST)
(PROCEDURE CQC-19)

UNIT NO. | TURNOVER NO. (1)

WELD JOINT RECORD NO. (2)

REV. 4 2/81

SYSTEM (3)	CAT. (4)	ENG. DWG. NO. (5)	FILL METAL TYPE (6)	DESIGN LINE NO. (7)

BASE METAL SPEC. & GRADE (8) TO (8)

JOINT TYPE - CI, BR, F, OB, SKT, OTHER (9)

PIPE/COMP. SIZE NOM. (10)

WELDING PROCEDURE & REV. NO. (12)

MATERIAL NOM. THICKNESS (13)

PC NO. (11) TO PC NO. (11)

PWHT PROCEDURE & REV. NO. (15)

INSERVICE INSPECTION REQ'D ☐ NA ☐ (16)

HT NO. (14) TO HT NO. (14)

WELDING ENG. VERIFICATION DATE (17)	ANI REVIEW FOR HOLDPOINTS DATE (18)	RELEASED FOR WELDING QA/QC DATE (19)

PART II - ERECTION TRAVELER PROCESS CHECK POINTS

A-ACCEPTED

R-REJECTED

H- ✓ IN H COLUMN MEANS HOLD FOR QA/QC OR ANI AS APPLICABLE

INSERT N/A WHERE AN OPERATION DOES NOT APPLY

USE BLANK LINES FOR ADDITIONAL CHECKS OR REINSPECTIONS

WELDER(S) SYMBOL (20)

TACK

ROOT

INTERMEDIATE

FINAL

	ITEMS (21)	QA/QC INSPECTOR H	A	R	DATE	INSP.	ANI H	A	R	DATE	ANI
1	VERIFY SPOOLS BEING JOINED										
2	PRE FIT-UP INSPECTION										
3	FIT-UP INSPECTION										
4	CHECK PURGE GAS										
5	CHECK PREHEAT TEMPERATURE										
6	ROOT PASS NDE UT-RT-MT-PT										
	NDEP REV.										
7	CHECK INTERPASS TEMPERATURE										
8	VISUALLY INSPECT FINAL WELD										
	ID & OD - NDEP REV.										
9	PURGE DAM REMOVAL										
10	INSPECT FOR JOINT IDENTIFICATION										
11	CHECK FINAL CLEANLINESS										
12	FINAL NDE RT-MT-PT-UT-VT										
	NDEP. REV.										
13	INSPECT PWHT										
14	INSPECTION OF THERMOCOUPLE REMOVAL NDEP REV.										
15	PWHT NDE RT-MT-PT-UT-VT										
	NDEP REV.										

SAMPLE

BACKING TYPE CI BR
METAL SPEC. (22)
HEAT/CODE

BARE FILL METAL SPEC.
SIZE (23) HT NO.

COATED FILLER METAL SPEC.
SIZE (24) HT/LOT NO.

NO. OF REPAIRS - COMMENTS (REPAIR WDR NUMBERS) (25)

REMARKS:

PWHT CHART NO. (26) DATE

QA/QC INSPECTOR (27) DATE

QA/QC FINAL ACCEPTANCE (28)

VERIFIED BY ANI (29) DATE

SIGNATURE

30
3/81
v. 2

REPAIR WELD DATA REPORT

(PROCEDURE CQC-19)

REPAIR WOR NO. (1)

UNIT	SYSTEM	CAT.	DRAWING / ISOMETRIC	FIELD WELD I.D.
(2)	(3)	(4)	(5)	(6)

BASE METAL SPEC. & GRADE (7) TO ______

PIPE/COMPONENT SIZE ______
MATERIAL THICKNESS (8) ______

WELDING PROCEDURE & REV. NO. (9)

PC NO. ______ TO PC NO. ______
HT NO. (10) TO HT NO. ______

JOINT TYPE - CI, BR, OB, SKT
OTHER (11)

HEAT TREAT. PROC. & REV. NO. (12)

WELDING ENGINEER & DATE	ANI REVIEW & DATE	QA/QC REVIEW & DATE
(13)	(14)	(15)

BACKING TYPE CI BR (15)
METAL SPEC. ______
HEAT NO. ______

BARE FILLER METAL SPEC. ______
SIZE (17) HT NO. ______

COATED FILLER METAL SPEC. ______
SIZE (18) HT/LOT NO. (19)

WELDER'S SYMBOL - ROOT	WELDER'S SYMBOL - INTERMEDIATE	WELDER'S SYMBOL - FINAL
(20)	(21)	(22)

SAMPLE

REPAIR INSTRUCTIONS: (23)

ITEM	HOLD PT. QA/QC	HOLD PT. ANI	ANI ACCEPTED	DATE	QA/QC ACCEPTED	DATE
(24)						

REMARKS:

ACCEPTED BY

QA/QC SPECIALIST (25) ______ DATE

VERIFIED BY

ANI (CODE WELD ONLY) (26) ______ DATE

QA-32 Exhibit 3
QCI-19.1
Rev. 0

CAROLINA POWER & LIGHT COMPANY
CORPORATE QUALITY ASSURANCE DEPARTMENT
TANK FABRICATION WELD RECORD

SHNPP

WELD NUMBER (6)					
MATERIAL THICKNESS (7)					
JOINT TYPE (8)					
WELD PROCEDURE CODE(S)					
WELDER SYMBOL: TACK					
WELDER SYMBOL: ROOT (11)					
WELDER SYMBOL: INTERMEDIATE					
WELDER SYMBOL: FINAL					
MATERIAL HEAT / LOT: GTAW WIRE					
MATERIAL HEAT / LOT: SMAW ELECTRODE					
MATERIAL HEAT / LOT: INSERT (12)					
MATERIAL HEAT / LOT: BACKING RING					
MATERIAL HEAT / LOT: OTHER					

	REQUIRED	PROCEDURE CODE	Q A HOLDPOINT	A N I HOLDPOINT	INSPECTOR'S INITIALS	DATE
IN PROCESS INSPECTIONS & NDE: VERIFY PREHEAT						
FIT-UP : QA						
ANI						
ROOT : VT						
ANI						
MT/PT						
ANI						
RT						
ANI						
VER. INT PASS TEMP.			(10)			
FINAL : VT						
ANI						
MT/PT						
ANI						
RT/UT						
ANI						
POST FABRICATION OPERATIONS: PWHT : QA						
ANI						
VACUUM BOX : QA						
ANI						
CLEANING : QA						
ANI						
HYDRO : QA						
ANI						
OTHER :						
POST HYDRO NDE						

(The REQUIRED / PROCEDURE CODE / Q A HOLDPOINT / A N I HOLDPOINT / INSPECTOR'S INITIALS / DATE column group is repeated for each of five weld numbers.)

SAMPLE

PROCESS & NDE PROCEDURES / INSPECTION PROCEDURES

CODE	PROCEDURE NUMBER	REV.	CODE	PROCEDURE NUMBER	REV.
A			M		
B			N		
C			O		
D			P		
E			R		
F	(9)		S	(9)	
G			T		
H			V		
I			W		
J			X		
K			Y		
L			Z		

UNIT No. (1)	TANK IDENTIFICATION No. / NAME (2)	ASME CODE CLASS (3)	EDITION	ADDENDA

DRAWING & REVISION NUMBERS (4)

WELDING ENGINEER (5)	DATE	QA/QC INSPECTOR (13)	DATE
AUTHORIZED NUCLEAR INSPECTOR (14)	DATE	QA/QC SPECIALIST (15)	DATE

REMARKS

Rev. 0

(PROCEDURE CQC-19)

I	1. UN	2. BUILDING	3. ELEV.	4. LOCA.	5. COMPONENT/HANGER I.D.	DRAWINGS, REV. & SHT. #	7. WELD PROC.	9. WELD INSTRUC IS
	DISCIPLINE ENG.		DATE	WELDING ENG./FOREMAN	DATE		8. WELD ML. TY.	

II

1. NOTIFY DISCIPLINE ENGINEER FOR ADDITIONAL INSTRUCTIONS FOR FULL PENETRATION
2. NOTIFY DISCIPLINE ENGINEER FOR ADDITIONAL INSTRUCTIONS ON JOINTS INVOLVING ENGINEERED PLATES
3. COMPLETE WELDOUT OF JOINTS NOT REQUIRING ADDITIONAL INSTRUCTIONS
4. INFORM QA/QC FOR HOLD POINTS (H) & FINAL WELD INSPECTION

FOREMAN: DATE:

III

1. WELD TYPE & CONFIGURATION CHECKED WITH DWG(S) & COMPONENT/HANGER CONFIGURATION CHECKED WITH DWG(S) A ☐ R ☐ DATE

2 WELDER(S) QUALIFICATION A ☐ R ☐ | 3. MAT'L STATUS A ☐ R ☐ | NCR/DDR* | QA/QC INSPECTION | DATE:

IV

* JOINT I.D. OR DESCRIP. QTY. OF WELDS	WELDER SYMBOL(S)	PREHEAT		FITUP			ROOT NDE						FINAL NDE															PWHT			INSP. INITIALS	DATE	DESCRIPTION OF DEFICIENCY, REPAIR OR REWORK NCR/DDR, ETC.
							VT			MT/PT			VT			MT/PT			RT			UT			VAC BOX								
		H	TEMP.	H	A	R	H	A	R	H	A	R	H	A	R	H	A	R	H	A	R	H	A	R	H	A	R	H	A	R			

LEGEND: H = HOLDPOINT
A = ACCEPT
R = REJECT
T = TEMP. GREATER THAN LISTED

QA/QC INSPECTION & NDE HOLDPOINT ASSIGNED AND/OR VERIFIED BY ________ INITIALS ________ DATE

________ QA/QC SPECIALIST / DESIGNEE ________ DATE

REMARKS:

* USE QA-34A TO LIST ADDITIONAL WELDS

FOIA 2000-0096 January 20, 2000

1. The staff does not have all of the attachments to SF-0040 that are being requested. See Note 1.

2. Of the 35 references requested, the staff only has information supporting the following three:

   (1) Ref. (12), the staff provided FSAR table 9.2.2-3, Amendment 49, in response to FOIA 99-367.
   (2) Ref. (25), FSAR page 5.4.7-10i, Amendment No. 45, was submitted by licensee on 11/14/94 (accession #9411210100).
   (3) Ref. (31), the staff provided FSAR Table 9.2.1-7, Amendment No. 15, in response to FOIA 99-367.

3. CP&L discusses its proposed 1.0 MBtu/hr heat load limit for spent fuel pools C and D in its 12/23/98 amendment request; accession # 9812290056, which was provided in response to FOIA 99-367.

   The staff discusses the 1.0 MBtu/hr limit in a November 24, 1999, internal memo from Reactor Systems Branch to Plant Systems Branch. This is a predecisional memo that is exempt from disclosure under Exemption 5.

4. The only documents relating to steam generator replacement and power uprate at Harris, are a meeting notice and meeting summary associated with a November 4, 1999, public meeting that CP&L had with the staff to discuss its future plans in this area.

   The meeting notice is accession #9910120292, dated 10/6/99
   The meeting summary dated 11/4/99 is attached.

   Information for other 3-loop Westinghouse plants will have to be provided by the respective Project Managers.

5. No additional information to that provided in response to FOIA 99-367.

6. Referred to Technical Branches for response.

7. Referred to Technical Branches for response.

8. Referred to Technical Branches for response.

9. See Note 1

10. See Note 1

11. See Note 1

12. See Note 1

B/4
~~12/11~~

13. See Note 1

14. See Note 1

15. See Note 1

16. See Note 1; characteristics of the SFP cooling system are located in FSAR Section 9.1.3 which was provided in response to FOIA 99-367.

17. See Note 1

18. See Note 1

19. See Note 1

20. See Note 1

21. The staff has no information responsive to this request.

22. See Note 2

23. See Note 2

24. See Note 2

25. See Note 2

26. See Note 2

27. See Note 2

28. See Note 2

29. Meeting Summaries from the March 3 (accession # 9803200255), and July 16 (accession #9808040277),1998, meetings were provided in response to FOIA 99-367.

30. Names for 3/3/98 meeting were included as Enclosure 1 to Meeting Summary (accession #9803200255) provided in response to FOIA 99-367.

31. Names from 7/16/98 meeting are provided. (Enclosure 1 of Meeting Summary did not show up in NUDOCS).

32. Lists from items 30 and 31 contain all meeting attendees.

33. The current SFP heat load analysis is as described in FSAR Section 9.1.3 which was provided in FOIA 99-367.

33. See Note 5

34. See Note 5

35. See Note 5

36. See Note 5. The original design of the SFP is described in NUREG 1038, "Safety Evaluation Report related to the Operation of Shearon Harris Nuclear Power Plant, Units 1 and 2," dated November 1983.

37. See Note 3

38. See Note 3

39. See Note 3

40. See Note 3

41. See Note 3

42. See Note 3

43. See Note 3

44. See Note 3

45. The staff has no information responsive to this request. The current amendment application under review only addresses adding a 1 MBtu/hr heat load to SFPs C and D.

46. See Note 3. The only documents relating to steam generator replacement and power uprate at Harris, are a meeting notice and meeting summary associated with a November 4, 1999, public meeting that CP&L had with the staff to discuss its future plans in this area.

    The meeting notice is accession #9910120292, dated 10/6/99
    The meeting summary dated 11/4/99 is attached.

47. The referenced slide from item E/11 of FOIA 99-367 summarizes the design of the spent fuel pool cooling system which is discussed in NUREG 1038, "Safety Evaluation Report related to the Operation of Shearon Harris Nuclear Power Plant, Units 1 and 2," dated November 1983.

48. The referenced slide from item E/11 of FOIA 99-367 summarizes the design of the spent fuel pool cooling system which is discussed in NUREG 1038, "Safety Evaluation Report related to the Operation of Shearon Harris Nuclear Power Plant, Units 1 and 2," dated November 1983.

49. See Note 4.

50. See Note 4.

51. See Note 4. The only documents specifically relating to steam generator replacement and power uprate at Harris, are a meeting notice and meeting summary associated with a November 4, 1999, public meeting that CP&L had with the staff to discuss its future plans in this area.
    The meeting notice is accession #9910120292, dated 10/6/99
    The meeting summary dated 11/4/99 is attached.

52. See Note 4. Also, transshipment schedules are safeguards information that are not releasable to the public.

53. See Note 4.

54. See Note 4.

55. See Note 4.

56. See Note 4.

57. See Note 4.

58. See Note 4.

59. See Note 4.

60. See Note 4.

61. See Note 4.

62. See Note 4.

63. See Note 4.

64. See Note 4.

65. See Note 4.

66. See Note 4.

67. See Note 4.

68. See Note 4. The only documents specifically relating to steam generator replacement and power uprate at Harris, are a meeting notice and meeting summary associated with a November 4, 1999, public meeting that CP&L had with the staff to discuss its future plans in this area.
    The meeting notice is accession #9910120292, dated 10/6/99
    The meeting summary dated 11/4/99 is attached.

69. See Note 4.

70. Listed below are the accession #'s and dates for all of the NRC RAIs and CP&L responses to the RAIs. Those marked with an asterisk were provided in response to FOIA 99-367:

NRC RAI	CP&L Response
3/24/99 (9903260263)	4/30/99 (9905050200)
4/29/99 (9905040318)	6/14/99 (9906210117)
6/16/99 (9906210180)	7/23/99 (9907270169)
8/5/99 (9908110003)*	9/3/99 (9909100158)*
n/a	10/15/99 (9910270013)
9/20/99 (9909230097)	10/29/99 (copy provided)

The 7/23/99 CP&L response contained proprietary information. The staff made a proprietary determination on 8/19/99 (990824017).

71. The staff has no other information responsive to this item. The SFP heat exchangers are described in FSAR Section 9.1.3 which was provided in response to FOIA 99-367.

72. Referred to Technical Staff (Instrumentation and Control Branch (HICB))

73. Referred to Allegations Branch (Greg Cwalina)

74. See Note 1. The staff's review of the licensee's amendment application, including any portion of SF-0400, is not yet completed.

75. The staff has no additional information than that provided in FOIA 99-367 that is responsive to this request.

Note 1: The only portions of SF-0040 that the staff has were provided under FOIA 99-367:

(1) CP&L response to petition to intervene; accession #9905100006 dated 5/5/99.
(2) CP&L response to NRC RAI dated 8/5/99; accession#9909100158 dated 9/3/99.

Note 2: Item E/6 from FOIA 99-367 is an internal NRC slide presentation prepared for NRC Projects Management following the July 16, 1998, public meeting with CP&L to discuss its plans for submitting the SFP expansion amendment. The slide show (item E/6) is a summary of the status of CP&L's plans based on the public meeting on March 3, and July 16, 1998. Any additional information explaining the items in the slide show is contained in the Meeting Summaries from the March 3 (accession # 9803200255), and July 16 (accession #9808040277),1998; meetings and in the licensee's December 23, 1998 amendment application (accession #9812290056) which were all provided in response to FOIA 99-367, or in any request for additional information (RAI) responses (listed in response to item 70 of this FOIA request).

Note 3: The staff has no further information on this slide other than the Meeting Summary dated March 11, 1998 (accession #9803200255) provided in response to FOIA 99-367.

Note 4: Any additional information explaining this item would be contained in the Meeting Summary from July 16, 1998 (accession #9808040277) meeting or in the licensee's December 23, 1998 amendment application (accession #9812290056) which were all provided in response to FOIA 99-367, or in any request for additional information (RAI) responses (listed in response to item 70 of this FOIA request).

Note 5: The commitments discussed in CP&L's 8/8/96 letter (item E/9 from FOIA 99-367) were incorporated by CP&L in FSAR Revision 48 dated 12/4/97 (accession #9712090256 / # 9712090288). A summary of the 10 CFR 50.59 evaluation performed by the licensee to make these changes is contained in CP&L's Annual Operating Report dated 12/4/97 (accession #9712110050), SE # 97-084. FSAR Section 9.1.3 which was provided in response to FOIA 99-367 provides the current description of the SFPs. The staff does not maintain previous (superceded) revisions to the FSAR.

CATEGORY 1

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SHEARON HARRIS NUCLEAR POWER PLANT
DOCKET NO. 50-400/LICENSE NO. NPF-63
RESPONSE TO NRC REQUEST FOR ADDITIONAL INFORMATION
REGARDING AMENDMENT REQUEST TO INCREASE FUEL STORAGE
CAPACITY BY PLACING SPENT POOLS 'C' & 'D' IN SERVICE

Dear Sir or Madam:

By letter HNP-98-188, dated December 23, 1998, Carolina Power & Light Company (CP&L) submitted a license amendment request to increase fuel storage capacity at the Harris Nuclear Plant (HNP) by placing spent fuel pools C & D in service. NRC letters dated March 24, 1999 and April 29, 1999 each requested additional information regarding our license amendment application. HNP letters HNP-99-069, dated April 30, 1999 and HNP-99-094, dated June 14, 1999 provided our respective responses.

By letter dated June 16, 1999, the NRC issued a third request for additional information (RAI) regarding our license amendment request to place spent fuel pools C & D in service. Enclosure 1 to this letter provides the HNP responses to each of the questions included within the June 16, 1999 RAI. Enclosures 2 and 3 provide information in support of our responses to the Staff RAI. Please note that Enclosure 3, in its entirety, contains information considered proprietary to Holtec International pursuant to 10 CFR 2.790. In this regard, CP&L requests Enclosure 3 be withheld from public viewing.

The enclosed information is provided as an additional supplement to our December 23, 1998 amendment request and does not change our initial determination that the proposed license amendment represents a no significant hazards consideration.

Please refer any questions regarding the enclosed information to Mr. Steven Edwards at (919) 362-2498.

Sincerely,

Donna B. Alexander

Donna B. Alexander
Manager, Regulatory Affairs
Harris Nuclear Plant

KWS/kws

Enclosures

c:

Mr. J. B. Brady, NRC Senior Resident Inspector (w/Enclosure 1)
Mr. Mel Fry, N.C. DEHNR (w/Enclosure 1)
Mr. R. J. Laufer, NRC Project Manager (w/all Enclosures)
Mr. L. A. Reyes, NRC Regional Administrator - Region II (w/Enclosure 1)

bc: (all w/Enclosure 1)

Mr. K. B. Altman
Mr. G. E. Attarian
Mr. R. H. Bazemore
Mr. C. L. Burton
Mr. S. R. Carr
Mr. J. R. Caves
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Mr. B. A. Kruse
Ms. W. C. Langston (PE&RAS File)
Mr. R. D. Martin
Mr. T. C. Morton
Mr. J. H. O'Neill, Jr.
Mr. J. S. Scarola
Mr. J. M. Taylor
Nuclear Records
Harris Licensing File
Files: H-X-0511
H-X-0642

SHEARON HARRIS NUCLEAR POWER PLANT
DOCKET NO. 50-400/LICENSE NO. NPF-63
RESPONSE TO NRC REQUEST FOR ADDITIONAL INFORMATION REGARDING THE LICENSE AMENDMENT REQUEST TO INCREASE FUEL STORAGE CAPACITY BY PLACING SPENT POOLS 'C' & 'D' IN SERVICE

Question 1

With respect to the dynamic fluid-structure interaction analysis using the computer code, DYNARACK, in the Reference, provide the following:

a) Explain how the simple stick model used in the dynamic analyses can represent accurately and realistically the actual highly-complicated nonlinear hydrodynamic fluid-rack structure interactions and behavior of the fuel assemblies and the box-type rack structures. Discuss whether or not a finite element (FE) model with 3-D plate, beam and fluid elements together with appropriate constitutive relationships would be a more realistic, accurate approach to analyze the fluid-structure interactions in contrast to the stick model.

b) Provide the results of any prototype or experimental study that verifies the correct or adequate simulation of the fluid coupling utilized in the numerical analyses for the fuel assemblies, racks and walls. If there is no such experimental study available, provide justification that the current level of the DYNARACK code verification is adequate for engineering application without further experimental verification work

Response to Question 1(a)

As explained in Sections 6.2 and 6.5 of Holtec International Report HI-971760 (Enclosure 6 of the December 23, 1998 submittal), the Whole Pool Multi-Rack (WPMR) model used to predict the dynamic behavior of the storage racks contains elements specifically designed to represent the attributes necessary to simulate rack motions during earthquakes. These elements include non-linear springs to develop the interaction between racks, between racks and walls, and between fuel assemblies and rack internal cell walls. Linear springs having the necessary characteristics to capture the lowest natural frequencies of the ensemble of fuel cells acting as an elastic beam-like structure in extension/compression, two-plane bending, and twisting are used to simulate rack structural elastic action. Hydrodynamic effects within these interstitial spaces are accounted for using Fritz's classical method which relates the fluid kinetic energy in the annulus due to relative motion to an equivalent hydrodynamic mass. Presented below is a historical overview of the fluid coupling effect as applied to the modeling of spent fuel racks in a seismic environment.

The phenomenon of fluid coupling between rectangular planform structures was sparsely investigated until the 1980s. Fritz's classical paper (ca. 1972) was used in the *earliest* version of DYNARACK to model rack-to-surrounding fluid effects in the so-called single rack 3-D simulation. Enrico Fermi Unit 2 (ca. 1980) and Quad Cities Units 1 and 2 (ca. 1982) were licensed using the Fritz fluid coupling terms embedded in DYNARACK. The Fermi 2 and Quad Cities 1 and 2 submittals were the *first* rerack applications wherein a rack module was analyzed using the 3-D time-history technique. The adoption of a nonlinear time-history approach helped quantify the motion of a rack under a 3-D earthquake event and as a byproduct, also served to demonstrate that solutions using the Response Spectrum Method (which, by definition, presumes a linear structure) can be non-conservative. Practically all rerack licensing submittals since 1980 have utilized the 3-D time-history method. While the nonlinear 3-D time-history method was an improvement over the Response Spectrum (by definition, linear) approach, it nevertheless was limited inasmuch as only one rack could be modeled in any simulation. The analyst had to *assume* the behavior of the adjacent racks. Models, which postulated the behavior of the contiguous racks in the vicinity of the subject rack (rack being analyzed), were developed and deployed in safety analyses. Two most commonly used models were the so-called "opposed phase" model and the "in-phase" model, the former used almost exclusively to predict inter-rack impacts until 1985. Holtec Position Paper WS-115 (proprietary), included in Enclosure 3, provides a summary description of these early single rack 3-D models.

The inadequacy of the single rack models (albeit nonlinear) to predict the response of a grouping of submerged racks arrayed in close proximity became an object of prolonged intervenors' contention in the reracking of PG&E's Diablo Canyon units in 1986-87. Holtec, with assistance from the USNRC, developed a 2-D multi-rack model for the Diablo Canyon racks; this model helped answer intervention issues, permitting PG&E to rerack. USNRC experts testified in support of the veracity of the 2-D multi-rack dynamic models at the ASLB hearings in Pismo Beach, California in June 1987.

The Diablo Canyon intervention prompted Holtec to develop what later came to be known as the 3-D Whole Pool Multi-Rack (WPMR) analysis. A key ingredient in the WPMR analysis is quantification of the hydrodynamic coupling effect that couples the motion of *every* rack with *every* other rack in the pool. In 1987, Dr. Burton Paul (Professor Emeritus, University of Pennsylvania) developed a fluid mechanics formulation using Kelvin's recirculation theorem that provided the fluid coupling matrix (2n x 2n for a pool containing n racks).

As an example, refer to Figure RAI 1.1 (Enclosure 2), where an array of N (N = 16) two-dimensional bodies (each with two degrees of freedom) is illustrated. The dynamic equilibrium equation for the i-th mass in the x-direction can be written as:

$$[m_i + M_{ii}]\ddot{x}_i + \sum_{j=1}^{N}[M_{ij}\ddot{x}_j + N_{ij}\ddot{y}] = Q_{x_i}(t)$$

In the above equation, m_i is the mass of body i (i = 1,2...N), and $\ddot{x}_i$ is the x-direction acceleration vector of body i. M_{ij} and N_{ij} denote the "virtual" mass effects of body j on body i in the two directions of motion. The second derivative of y with respect to time represents the acceleration in the y-direction.

The terms M_{ij} are functions of the shape and size of the bodies (and the container boundary) and, most important, the size of the inter-body gaps. M_{ij} are *analytically* derived coefficients. Q_{xi} represents the so-called Generalized force that may be an amalgam of all externally applied loads on the mass i in the x-direction. The above equilibrium equation for mass i in x-direction translational motions can be written for all degrees of freedom and for all masses. The resulting second order matrix differential equation contains a fully populated mass matrix (in contrast, dynamic equations *without* multi-body fluid coupling will have only diagonal non-zero terms).

The above exposition explains the inclusion of fluid coupling in a multi-body fluid coupled problem using a simplified planar motion case. This explanation provides the building blocks to explain the more complicated formulation needed to simulate freestanding racks. Dr. Paul's formulation is documented in a series of four (Holtec proprietary) reports written for PG&E in 1987, and are included in Enclosure 3. The Paul multi-body fluid coupling theory conservatively assumes the flow of water to be irrotational (inviscid) and assumes that no energy losses (due to form drag, turbulence, etc.) occur. The USNRC personnel reviewed this formulation in the course of their audit of the Diablo Canyon rerack (ca. 1987) and subsequently testified in the ASLB hearings on this matter, as stated above.

While the ASLB, USNRC, and Commission consultants (Brookhaven National Laboratory and Franklin Research Center) all endorsed the Paul multi-body coupling model as an appropriate and conservative construct, the theory was still just a theory. Recognizing this perceptual weakness, Holtec and Northeast Utilities undertook an experimental program in 1988 to benchmark the theory. The experiment consisted of subjecting a scale model of racks (from one to four at one time in the tank) to a two-dimensional excitation on a shake table at a QA qualified laboratory in Waltham, Massachusetts.

The Paul multi-body coupling formulation, coded in QA validated preprocessors to DYNARACK, was compared against the test data (over 100 separate tests were run). The results, documented in Holtec Report HI-88243, were previously provided to the Commission. The experimental benchmark work validated Paul's fluid mechanics model and showed that the theoretical model (which neglects viscosity effects) is consistently bounded by the test data. This experimentally verified multi-body fluid coupling is the central underpinning of the DYNARACK WPMR solution that has been employed in every license application since Chinshan (1989). The DYNARACK 3-D WPMR solution has been found to predict much greater rack displacements and rotations than the previously used 3-D single rack results.

In general, the advance from linearized analyses (response spectrum) in the late 1970s to the single rack 3-D analyses until the mid-1980s and, finally, to the 3-D WPMR analysis in the past eleven years has, at each technology evolution stage, led to some *increase* in the computed rack response. The stresses and displacements computed by the DYNARACK 3-D WPMR analysis for the Shearon Harris racks, in other words, may be larger (and therefore more conservative) than the docketed work on similar instances from 15 years ago. The conservatisms built into the WPMR solution arises from several simplifying assumptions explicitly intended to establish an upper bound on the results, namely:

i. In contrast to the single rack 3-D models, the fluid forces on every rack in the pool consist of the aggregate of fluid coupling effects from *all other* racks located in the pool. No empirical assumptions on the motion of racks need to be made; the motion of each rack in the pool is a result of the analysis.

ii. The fluid coupling terms are premised on classical fluid mechanics; they are not derived from empirical reasoning. Further, fluid drag and viscosity effects, collectively referred to as "fluid damping," are neglected. In short, while the transfer of fluid kinetic energy to the racks helps accentuate their motion, there is *no* subtraction of energy through damping or other means.

iii. In the Shearon Harris rack simulations, the dynamic model for the fuel assemblies in a rack assumes that *all* fuel assemblies within a rack move in unison. Work in quantifying the effect of discordant rattling of fuel assemblies within a rack in other licensing applications by Holtec has shown that the "unified motion" assumption exaggerates the rack response by 25% to 60%, depending on the rack geometry details and earthquake harmonics.

iv. The rack-to-rack and rack-to-wall gaps are taken as the *initial* nominal values. During the earthquake, these gaps will in fact change through the time-history duration. Strictly speaking, the fluid coupling matrix should be recomputed at each time-step with the concomitant gap distribution. The inversion of the mass matrix at each time-step (there are over four million time-steps in a typical WPMR run) would, even today, mandate use of a supercomputer. Fortunately, neglect of this so-called nonlinear fluid coupling effect is a conservative assumption. This fact is rigorously proven in a peer reviewed paper by Drs. Soler and Singh entitled "Dynamic Coupling in a Closely Spaced Two-Body System Vibrating in a Liquid Medium: The Case of Fuel Racks," published in 1982. The only docket where recourse to the nonlinear fluid coupling was deemed essential was Vogtle Unit 2 (in 1988) where the margin inherent in the nonlinear fluid effect, published in the above mentioned paper, was reaffirmed.

Nonlinear fluid coupling effects due to the use of current gaps at each time instant are not employed in this present application which imputes over 15% margin (in Holtec's analysts' estimate) in the computed rack response.

In summary, the WPMR analysis utilizes a fluid coupling formulation that is theoretically derived (without empiricism) and experimentally validated. The assumptions built in the DYNARACK formulation are aimed to demonstrably exaggerate the response of all racks in the pool simulated in one comprehensive model.

A further elaboration of the details of the structural model used for the spent fuel racks and a mathematical explanation of the manner in which fluid coupling is considered in the solution is provided below.

DYNARACK, developed in the late 1970s and continuously updated since that time to incorporate technology advances such as multi-body fluid coupling, is a Code based on the Component Element Method (CEM). The chief merit of the CEM is its ability to simulate friction, impact, and other nonlinear dynamic events with accuracy. The high-density racks designed by Holtec International are ideally tailored for the CEM-based Code because of their honeycomb construction (HCC). Through the interconnection of the boxes, the HCC rack essentially simulates a multi-flange beam. The beam characteristics of the rack (including shear, flexure, and torsion effects) are appropriately modeled in DYNARACK using the classical CEM "beam spring." However, the rack is not rendered into a "stick" model, as implied by the staff's RAI. Rather, each rack is modeled as a prismatic 3-D structure with support pedestal locations and the fuel assembly aggregate locations set to coincide with their respective center of gravity axes. The rattling between the fuel and storage cells is simulated in exactly the same manner as it would be experienced in nature; namely, impact at any of the four facing walls followed by rebound and impact at the opposite wall. Similarly, the rack pedestals can lift off or slide as the instantaneous dynamic equilibrium would dictate throughout the seismic event. The rack structure can undergo overturning, bending, twist, and other dynamic motion modes as determined by the interaction between the seismic (inertia) impact, friction, and fluid coupling forces. Hydrodynamic loads, which can be quite significant, are included in a comprehensive manner, as we explain in more detail below.

As explained above, the fluid coupling effect renders the mass matrix into a fully populated matrix. Modeling the fuel rack as a multi-degree of freedom structure, the following key considerations are significant:

i. Over 70% of the mass of the loaded rack consist of fuel assemblies, which are unattached to the rack, and resemble a loose bundle of slender thin-walled tubes (high mass, low frequency).

ii. In honeycomb construction (HCC) racks, as shown in a 1984 ASME paper, the rack behaves like a stiff elongated box beam (End Connected Construction racks, built 20 years ago and now obsolescent, behave as a beam and bar assemblage).

Since the Shearon Harris racks under inertial loading have overall structural characteristics of a multi-flange beam, it is computationally impractical to model such a structure as a plate assemblage. The DYNARACK dynamic model preserves the numerical stability of the physical problem by representing the rack structure by an equivalent flexural and shear resisting "component element" (in the terminology of the Component Element Method).

A detailed discussion of the formation of the fluid mass matrix is presented below.

The problem to be investigated is shown in Figure RAI 1.1 (Enclosure 2), which shows an orthogonal array of sixteen rectangles which represent a unit depth of the sixteen spent fuel racks in the Shearon Harris Spent Fuel Pool. The rectangles are surrounded by narrow fluid filled channels whose width is much smaller than the characteristic length or width of any of the racks. The spent fuel pool walls are shown enclosing the entire array of racks.

The dimensions of the channels are such that an assumption of uni-directional fluid flow in a channel is an engineering assumption consistent with classical fluid mechanics principles.

We consider that each rectangular body (fuel rack) has horizontal velocity components U and V parallel to the x and y axes, and that the channels are parallel to either the x or y axes. The pool walls are also assumed to move.

We conservatively assume that the channels are filled with an inviscid, incompressible fluid. Due to a seismic event, the pool walls and the spent fuel racks are subject to inertia forces that induce motion to the rectangular racks and to the wall. This motion causes the channel widths to depart from their initial nominal values and causes flow to occur in each of the channels. Because all of the channels are connected, the equations of classical fluid mechanics can be used to establish the fluid velocity (and hence, the fluid kinetic energy) in terms of the motion of the spent fuel racks.

For the case in question, there are 40 channels of fluid identified. Figure RAI 1.2 (Enclosure 2) shows a typical rack (box) with four adjacent boxes and fluid and box velocities identified. The condition of vanishing circulation around the box may be expressed as

$$\Gamma = \oint_C v_s ds = 0$$

or

$$\int_{-a/2}^{a/2} (u_B - u_T) d\xi + \int_{-b/2}^{b/2} (v_R - v_L) d\eta = 0$$

where the subscripts (L, R, B, T) refer to the left, right, bottom, and top channels, respectively; ξ, η are local axes parallel to x and y, and u, v are velocities parallel to ξ, η.

Continuity within each channel gives an equation for the fluid velocity as

$$w = w_m - \left(\frac{\dot{h}}{h}\right) s$$

where w represents the velocity along the axis of a channel, w_m represents the mean velocity in the channel, s is either ξ or η, and $\dot{h}$ is the rate of increase of channel width. For example,

$$\dot{h}_R = U_R - U$$

From Figure RAI 1.2 (Enclosure 2), four equations for u_B, u_T, v_R, and v_L, in terms of the respective mean channel velocities, can be developed so that the circulation equation becomes

$$a\,(U_{Bm} - U_{Tm}) + b\,(v_{Rm} - v_{Lm}) = 0$$

One such circulation equation exists for each spent fuel rack rectangle. We see that the velocity in any channel is determined in terms of the adjacent rack velocities if we can determine the mean fluid velocity in each of the 40 channels. Circulation gives 16 equations. The remaining equations are obtained by enforcing continuity at each junction as shown in Figure RAI 1.3 (Enclosure 2). Enforcing continuity at each of the 25 junctions gives 25 equations of the general form

$$\Sigma h \sigma w \frac{1}{2} \Sigma L \dot{h}$$

where w is the mid-length mean velocity in a connecting channel of length L and $\dot{h}$ is the relative normal velocity at which the walls open. The summation covers all channels that meet at the node in question. The sign indicator $\sigma = \pm 1$ is associated with flow from a channel either into or out of a junction.

Therefore, there are a total of 25 + 16 = 41 equations which can be formally written; one circulation equation, however, is not independent of the others and reflect the fact that the sum total of the 25 circulation equations must also equal zero, representing circulation around a path enclosing all racks. Thus, there are exactly 40 independent algebraic equations to determine the 40 unknown mean velocities in this configuration.

Once the velocities are determined in terms of the rack motion, the kinetic energy can be written and the fluid mass matrix identified using the Holtec QA-validated pre-processor program CHANBP6. The fluid mass matrix is subsequently apportioned between the upper and lower portions of the actual rack in a manner consistent with the assumed rack deformation shape as a function of height in each of the two horizontal directions. This operation is performed by the Holtec QA-validated pre-processor code VMCHANGE. Finally, structural mass effects and the hydrodynamic effect from fluid within the narrow annulus in each cell containing a fuel assembly between fuel and cell wall is incorporated using the Holtec QA-validated pre-processor code MULTI122.

The initial inter-rack and rack-to-wall gaps are illustrated in Figure RAI 1.2 (Enclosure 2). These gaps, which directly figure in the computation of fluid mass effects in fluid coupling matrix, are assumed to apply for the entire duration of the earthquake. In reality, the gaps change throughout the seismic event and a rigorous analysis would require that the mass matrix be recomputed at every time-step. Besides being numerically impractical, such refinement in the solution would reduce the conservatism in the computed results, as previously discussed.

The time variations in the inter-rack and rack-to-wall gaps are, however, tracked for the duration of the earthquake. Closure of any gap at any location results in activation of the compression gap spring at that location. The loads registered in the gap spring quantify the collision force at that location. The fuel-to-storage cell rattling forces and rack pedestal-to-pool liner impact forces (in the event of pedestal lift-off) are typical examples of collision forces that are ubiquitous in rack seismic simulations. The nonlinear contact springs in DYNARACK simulate these "varying gap" events during seismic events using an unconditionally convergent algorithm.

In summary, the Whole Pool Multi-Rack (WPMR) analysis is a geometrically nonlinear formulation in all respects (lift-off, sliding, friction, impact, etc.), except in the computation of the fluid coupling matrix, which is based on the nominal (initial) inter-body gaps.

The modeling technique used (i.e. representation of the fuel rack and contained fuel by elastic beams and appropriate lumped masses) was chosen based on the application Codes, Standards and Specifications given in Section IV (2) of the NRC guidance on spent fuel pool modifications entitled, "Review and Acceptance of Spent Fuel Storage and Handling Applications," dated April 14, 1978. This reference states that "Design…may be performed based upon the AISC specification or Subsection NF requirements of Section III of the ASME B&PV Code for Class 3 component supports." The rack modeling technique is consistent with the linear support beam-element type members covered by these codes.

It is recognized that finite element models could also be developed using plate and fluid elements, which may also provide satisfactory simulated behavior for a single rack. However, there is no known commercial finite element code which can treat multi-body fluid interaction correctly and sufficiently so as to account for near and far field fluid effects involving many bodies (racks) in a closed pool. It is for this reason that the global dynamic analysis uses the formulation specifically developed and contained within DYNARACK.

Response to Question 1(b)

Holtec Report HI-88243 by Dr. Burton Paul provides a comparison of DYNARACK fluid coupling formulation with over 100 experiments carried out in an independent laboratory under a 10CFR50 Appendix B program. These tests were performed with the sole purpose of validating the multi-body fluid coupling formulation based on Kelvin's recirculation theorem in classical fluid mechanics. These experiments, to our knowledge, are the only multi-body fluid coupling tests conducted and recorded under a rigorous QA program. The participating bodies used in the tests were carefully scaled to simulate rectangular planform fuel racks. The tests were run on a wide range of seismic frequencies to sort out effects of spurious effects such as sloshing in the tank, and to establish that the fluid coupling matrix is independent of the frequency content of the impressed loading. The University of Akron tests performed some testing under the sponsorship of the predecessor company of U.S. Tool & Die, Inc. However, these tests were performed in the time when racks were still being analyzed using the Response Spectrum Method. We note that a theoretical model developed by Scavuzzo (Scavuzzo, R.J., et al. "Dynamics Fluid Structure Coupling of Rectangular Modules in Rectangular Pools," ASME Publications PVP-39, 1979, pp. 77-87) is *exactly* that used in the Holtec WPMR analysis when the Holtec mass matrix is reduced to a single rectangular solid block surrounded by four rigid (pool) walls. That is, the work by Scavuzzo is a special case of a Holtec WPMR analysis for a spent fuel pool containing a single spent fuel rack.

The Holtec WPMR fluid mass matrix for many racks in the pool is obtained by applying the same classical principles of fluid continuity, momentum balance, and circulation, to a case of many rectangular bodies in the pool with multi-connected narrow fluid channels.

The experimental work performed by Scavuzzo, et al., does not attempt to model a free standing rack since many rack structures of that vintage were not free-standing. The experimental test is equivalent to a single spring-mass-damper subject to a forced harmonic oscillation while submerged. If one accepts the fact that the fluid model used by Scavuzzo is a limiting case of the more general Holtec formulation, then the good agreement of theory with experiment for the single "rack" modeled experimentally serves as additional confirmation that the Holtec theoretical hydrodynamic mass model, which is identical to the Scavuzzo model (for a simple rack) is reproducible by experiment.

We have utilized the data supplied by Scavuzzo to simulate the experiment using the pre-processor CHANBP6 and the solver DYNARACK. The results of this comparison have been incorporated into the Holtec validation manual for DYNARACK (HI-91700) as an additional confirmation of the fluid coupling methodology. This validation manual, along with additional supporting documentation and discussions, was presented to the NRC in April, 1992 under dockets 50-315 and 50-316 for the D.C. Cook station and also was submitted in the licensing for re-racking of the Waterford 3 spent fuel pool. The submittal for Waterford contained the evaluation of the Scavuzzo theory and experiment, and demonstrated that the WPMR general formulation was in agreement with the experimental work presented in ASME Publication PVP-39, 1979, "Dynamics Fluid Structure Coupling of Rectangular Modules in Rectangular Pools."

Question 2

Demonstrate that the artificial seismic time histories used in the analyses satisfy the power spectral density (PSD) requirement of Standard Review Plan (SRP) Section 3.7.1.

Response to Question 2

Holtec Report HI-971702 provides the details of the development of the time histories used for the Shearon Harris spent fuel pool from the design basis Response Spectra. Figures RAI 2.1 through 2.6 (Enclosure 2), reproduced from the aforementioned report, demonstrate the required enveloping of the target PSD over the frequency range important to spent fuel racks (3-7 Hz) by the PSD regenerated from the developed time histories.

Question 3

Provide the physical dimensions of the racks, gaps between the racks, and the gaps between the racks and the walls.

Response to Question 3

The requested dimensional data is included in the Holtec Licensing Report, HI-971760, submitted as Enclosure 6 to the December 23, 1998 license amendment request. Pages 1-9, 1-10, and pages 2-17 through 2-20 from the Holtec report provide this requested information.

Question 4

Your analysis results show that there are rack-to-pool wall and rack-to-rack impacts. Indicate whether you are planning to install a support system to minimize displacement and impact force between the rack-to-pool wall and rack-to-rack.

Response to Question 4

The high-density racks for Shearon Harris are designed for installation as freestanding structures. There are no rack-to-pool wall impacts predicted by any of the WPMR simulations performed for the Shearon Harris spent fuel pool. There are, however, some rack-to-rack impacts that occur during the seismic simulations.

Impact during seismic events is a natural corollary of a freestanding structure. At minimum, during seismic events, the fuel assemblies rattle inside the storage cavity and rack pedestals' compression forces change with time. Pedestal lift-off and impact are also more of a rule than an exception. Rack-to-rack impact is also observed in a significant number of cases. None of these impact forces would lead to an adverse effect on safety if their magnitudes are conservatively quantified and if their consequences to the rack structure are carefully examined. The Shearon Harris racks have been subjected to an exhaustive set of dynamic and stress analyses to ensure that the safety conclusions are accurate. Where rack-to-rack impacts occur, there is no effect on the structure in the region of active fuel; the effects from the impact forces are accounted for in the subsequent dynamic response of the rack. Consequently, the magnitudes of the impact forces suggest that there is no need to add any type of rack support system.

Question 5

With respect to the spent fuel pool (SFP) structural analysis using the STARDYNE computer code presented in the Reference:

a) Provide a plan view of the SFP and physical dimensions of the reinforced concrete slab and walls, liner plate and liner anchorage.

b) Provide the mesh used in the analysis.

c) Describe the boundary conditions used, and indicate them in the mesh.

d) Provide the material properties used in the analysis.

e) Describe the applied loading conditions including the magnitudes, and indicate their locations in the mesh.

f) Explain how the interface between the liner and concrete slab is modeled, and also, how the liner anchors are modeled. Provide the basis for using such modeling with respect to how they accurately represent the real structural behavior.

g) Provide the calculated governing factors of safety in a tabular form for the axial, shear, bending and combined stress conditions.

Response to Question 5(a)

Harris Nuclear Plant (HNP) drawings CAR-2168-G-117, 118, 119, 120, and 122 along with HNP drawings CAR-2167-G-1876, 1877, 1878, and 1879 provide the requested dimensional information for the Spent Fuel Pools (see Enclosure 2).

Response to Question 5(b)

The pre-processing capabilities of the STARDYNE computer code are used to develop the 3-D finite-element model. The STARDYNE finite-element model contains 13353 nodes, 3564 solid type finite-elements, 7991 plate type finite-elements and 24 hydro-dynamic masses. Figure 4 from Holtec Report HI-981868 (see Enclosure 2) depicts an isometric view of the three-dimensional finite element model without the water and concentrated masses (racks, cask, etc.). Figure 5, also taken from Holtec Report HI-981868, shows a 3-D longitudinal section through the finite-element (see Enclosure 2).

The on-grade mat, completely modeled from solid type finite-elements, is shown in Figure 6. The vertical reinforced concrete structure (walls) located parallel to the global X and Y directions of the model are depicted in enclosed Figures 7 and 8. These elements are constructed by employing plate type finite-elements which account for the shear deformation that is an important factor in the structural investigation of thick plates. Figures 6, 7, and 8 are also taken from Holtec Report HI-981868 and included in Enclosure 2.

Response to Question 5(c)

To simulate the interaction between the modeled region and the rest of the Fuel Handling Building a number of boundary restraints were imposed upon the described finite-element model. All nodes located at the ground level elevation 206'-0" (the model Z coordinate -120") are fixed. Additionally, in order to simulate the structural continuity of the overall mat, the nodes located at the periphery of the concrete mat, between elevations 206'-0" and 216'-0", are restrained from moving in all three directions. The nodes located at the contact between the walls and the mat are constrained against rotations.

All nodes located on column line 43 (the model X=-984"), which represents the Fuel Handling Building East-West axis of symmetry, are constrained appropriately to ensure preservation of symmetry.

The nodes associated with the masses used to describe the hydro-dynamic behavior of the water during a seismic event are constrained to move in only one direction (X or Y horizontal direction only).

Response to Question 5(d)

The behavior of the reinforced concrete in the structural elements (walls, slabs and mat) is considered elastic and isotropic. The elastic characteristics of the concrete are independent of the reinforcement contained in each structural element for the case when the un-cracked cross-section is assumed. This assumption is valid for all load cases with the exception of the thermal loads, where for a more realistic description of the reinforced concrete cross-section behavior cracking of the concrete is assumed. The elastic characteristics for the concrete and reinforcement used in this calculation are summarized in Table 2 (see Enclosure 2). To simulate the variation and the degree of cracking patterns, the concrete Young's Modulus was reduced to reflect the scenario where all tension is carried only by the available reinforcement. Table 3 (see Enclosure 2) contains the elastic isotropic material properties and the reduced elastic modulus (E_{crack}) pertinent to each one of the structural elements used in the finite-element model. As shown in Table 3, some locations not subject to exposure to the fuel pool water do not suffer cracking under thermal loads as there is no significant thermal gradient in these regions.

Response to Question 5(e)

For this numerical investigation, only four of the load categories described in NUREG-0800 Standard Review Plan are applicable. They are: dead loads (D), live loads (L), thermal loads (operating - T_o and accident - T_a) and seismically induced loads (OBE - E and SSE – E').

Dead Loads - (D)

The dead loads acting on the Harris Spent Fuel Pools C and D concrete structures consist of the self weight of the concrete structure, fully loaded racks, spent fuel cask, and the existing reinforced concrete upper structure of the Fuel Handling Building resting on the pool walls. All the loads contained in this category are statically applied loads. The magnitude of the loads used in the analysis are summarized below:

* Dead weight of the modeled concrete structure is calculated considering a density of 150 lb/ft^3;

* Dead weight of maximum density rack modules in Pools C and D. The loads are concentrated at the pedestals and cumulatively applied at the nearest corresponding slab nodes as concentrated weights.

* Dead maximum weight of fully loaded cask is estimated to be 250,000 lb. The weight of the cask is also distributed as concentrated weights at its slab tributary nodes. The racks, cask and upper structure loads are summarized in Table 4 (Enclosure 2);

* Dead weight of Fuel Handling Building reinforced concrete upper structure considered at 150 lb/ft^3. The weights are equally distributed as concentrated weights at the nodes located along the corresponding supporting walls;

* Hydro-static water pressures vary linearly along the height of the walls. The considered water density is 62.00 lb/ft^3, a value which corresponds to 100 degrees F, since the operating pool temperature is expected to be in this range with a maximum normal temperature of 140 degrees F. The vertical variation of the hydro-static pressure is shown in Table 5 (see Enclosure 2).

Live Loads - (L)

The only live loads considered in this numerical investigation are the live loads related to the Cask Handling Crane (CHC), the Auxiliary Crane (AC) and the Spent Fuel Handling Machine (SFHM), consider as follows:

* The 2.050E+05 lb weight for the Cask Handling Crane (CHC), considered to be located in a stationary position over the East-West center line of Spent Fuel Pool D having a lifting capacity of 3.000E+05 lb. The crane has four (4) wheels on each truck.

* The 3.500E+04 lb weight for the Spent Fuel Handling Machine (SFHM) which has a lifting capacity of 2.000E+03 lb. The SFHM has four (4) wheels and is considered to be located in stationary position on the East-West center-line of Spent Fuel C.

* The Auxiliary Crane is modeled at the same position as the SFHM with a dead weight of 6.000E+04 lb and a lifting capacity of 2.000E+04 lb. This crane has four (4) wheels.

The loads, calculated from the equipment lifting capacities, are multiplied by an impact factor of 1.25. The live loads used in the analysis are tabulated in Table 6 (see Enclosure 2).

Thermal Load - T_o, T_a

Two thermal loading conditions, normal operating (T_o) and accident (T_a), are evaluated. The maximum normal bulk water temperature for partial discharge operating condition (T_o) in the Spent Fuel Pools C and D is considered to be 140 degrees F. During a loss-of-cooling accident, the pool water temperature (T_a) could reach the boiling point (212 °F). The temperature existing in all other rooms and adjacent areas is considered to be constant at 60 °F. The ambient temperature outside of the analyzed structures is considered to be 0 °F.

The temperatures on each side of the wall or slab are determined using a one-dimensional steady-state heat transfer. The results from the heat transfer analyses are then used as inputs in the numerical analysis of the concrete structure and are reported for both scenarios in Table 7 (see Enclosure 2).

Seismic Induced Loads - (E, E')

Two levels of seismic events were considered in the numerical analysis: the operating basis earthquake (OBE) and the safe shut down earthquake (SSE). The inertial loads generated for OBE and SSE are noted as E and E', respectively.

A. Structural Seismic Loads - (Es, Es')

Inertial loads of the reinforced structure are computed using the Response Spectrum method by considering a simultaneous application of the plant design basis three-dimensional acceleration spectra of the seismic event applied at the ground level.

B. Hydro-dynamic Loads - (Ew, Ew')

The impulsive and convective hydro-dynamic forces, which act on the surfaces of the reinforced concrete walls, develop as the pool water is accelerated by the horizontal components of the ground accelerations during a seismic event. The upper portion of the water mass exhibits sloshing motion during the seismic excitation. These pool water oscillation effects are modeled using a spring-mass system, developed in compliance with the guidelines established in TID 7024. The lower portion of the water acts as if it is a solid mass in rigid contact with the walls. The dynamic model of the water is shown in Figures 9 and 10 (see Enclosure 2). The vertical movement of the water mass, generated by the vertical component of the ground acceleration, also induces time dependent wall and floor pressures. This component of the hydro-dynamic load is conservatively modeled as an equivalent static pressure by multiplying the hydro-static water pressure by the value corresponding with the ZPA vertical spectral acceleration. The ZPA value is used because the vertical frequency of the pool floors is higher then 33.0 Hz.

All forces resulting from the water movement, due to the three-dimensional seismic acceleration are calculated for both OBE (Ew) and SSE (Ew') seismic events.

C. Rack Dynamic Load - (Er, Er')

In order to assess the effect of the motion of the submerged, fully loaded racks due to the seismic excitation of the pool concrete structure, the dynamic model that includes the concentrated nodal weights simulating the existence of the array of racks was used to compute the rack reactive forces acting on the pool floor. The fluid coupling maximum pressure acting on the wall surfaces is obtained from the rack dynamic analyses and applied as an uniformly distributed pressure. The rack to wall hydro-dynamic coupling pressures are listed in Table 8 (see Enclosure 2).

Load Combinations

The loads described in the above sections are grouped in thirteen (13) individual load cases and shown in Table 9 (see Enclosure 2). These various individual load cases are combined in accordance with the NUREG-0800 Standard Review Plan requirements with the intent to obtain the most critical stress fields for the investigated reinforced concrete structural elements. This process results in the following thirteen (13) load combinations. The load combination matrix is shown in Table 10 (see Enclosure 2). The load combinations for "Service Load Conditions" and "Factored Load Conditions" are provided in Enclosure 6, Section 8.4.3, of the December 23, 1998 submittal.

Response to Question 5(f)

The liner and the liner slab interface are not part of the global model of the spent fuel pool used for structural analysis. Liner evaluation is carried out in a separate analysis where the frictional loading from the rack pedestals (obtained from the rack dynamic analyses) is used as an input to a model of the liner. The in-plane stresses in the liner, induced by this loading, are computed and evaluated for their fatigue and liner buckling implications. The liner weld seams nearest to the highest loaded portion of the liner plate are evaluated for safety against rupture of the weld.

Response to Question 5(g)

In general, the acceptability of the reinforced concrete cross-section should be judged with reference to two important limit states: the strength ultimate load (usually the most important) and the service load. For both limit states, the reinforced concrete cross-section is well defined when the Axial Force-Bending Moment Interaction Diagram and the Shear Capacity is evaluated. For practical purposes, the diagram may be defined by four points (P_o - compression capacity, P_b and M_b - the balanced point, M_o - pure bending capacity and T_o - pure tension capacity) and a linear variation between them. In the present calculation, only the assessment of the strength ultimate load interaction diagram and shear capacity are determined in accordance with ACI-318-95.

The structural evaluation focused on the eight reinforced concrete walls and two slabs associated with Spent Fuel Pools C and D located in the north end of the Fuel Handling Building. The axial forces, bending moments and shear forces are computed using a 3-D finite-element model and the capabilities of STARDYNE computer code. The reinforced concrete cross-sectional capacities are evaluated and used to obtain the safety margins of the structural elements.

Tables 12 through 21 (Enclosure 2) contain the minimum safety factors obtained from the numerical investigation for each one of the eight walls and two slabs. Table 22 (Enclosure 2) summarizes the calculated safety factors.

Question 6

What is the maximum bulk pool temperature at a full core off-load during a refueling outage? If the temperature exceeds 150 °F, provide the following:

a) ACI Code 349 limits the concrete temperature to 150 °F for normal operation or any other long-term period. Provide technical justifications for exceeding 150 °F.

b) Describe the details of the SFP structural analysis including the material properties (i.e., modulus of elasticity, shear modulus, Poisson's ratio, yield stress and strain, ultimate stress and strain, compressive strength) used in the analysis for the reinforced concrete slab and walls, and liner plate, welds and anchorages in the analysis.

Response to Question 6

The maximum bulk pool temperature resulting from a full core offload during a refueling outage is limited to less than or equal to 137 °F, as stated in HNP FSAR Section 9.1.3.

Question 7

Discuss the quality assurance and inspection programs to preclude installation of any irregular or distorted racks, and to confirm the actual fuel rack gap configurations with respect to the gaps assumed in the DYNARACK analyses after installation of the racks.

Response to Question 7

Following rack construction, all racks cells are drag tested using a free path inspection gage (dummy fuel assembly) to ensure that fuel assemblies can be inserted into and withdrawn from the storage cells without damage. Any cells that do not pass this test are reworked and then re-tested until the cell passes.

Receipt inspection procedures ensure that each rack is in full compliance with the provisions of the December 23, 1998 submittal and Holtec International's 10CFR50 Appendix B program. Upon receipt, racks are first inspected for any damage potentially caused by the shipping or handling processes. The racks are also inspected for any scratches, dents, or signs of environmental exposure.

After the racks are set in the spent fuel pool, the rack gaps are checked at various locations along each side of the rack at the rack top. Long handled measuring tools and an underwater camera are used for this evolution. If the gaps are within the tolerances assumed in the analysis and allowed by the pool layout drawings, then the rack is acceptable. If the gaps are not acceptable, the rack is re-lifted and re-positioned.

Question 8

Describe the plan and procedure for the post operating basis earthquake inspection of fuel rack gaps and configurations.

Response to Question 8

Since the fuel racks are free standing structures, the inter-body spacings (rack gaps) after a seismic event may change from the as-installed values. HNP procedure AOP-021 (*Seismic Disturbances*) prescribes actions to be taken following a seismic event and includes general inspection guidelines for the Fuel Handling Building and facility areas. AOP-021 will be revised to require post-seismic event verification of rack gaps as required to ensure continued compliance with the plant licensing basis. If the gaps are found to be greater than or equal to 75% of the as-installed values, then the revised configuration will be accepted without further modification. If the gaps are found to be less than 75% of the as-installed values, then the racks will either be re-evaluated to determine acceptability of the rack gaps and module layout configuration or the racks will be re-positioned to achieve the pre-seismic event gaps and configuration.

Question 9

Describe how the liner plates are attached to the channels embedded in the concrete slab.

Response to Question 9

As shown on HNP drawing 2168-G-117, Section AH (see Enclosure 2), the liner floor plate is attached to a 1-1/2" x 1-1/2" stainless steel backing bar utilizing a 3/16" full penetration groove weld. The backing bar is attached to the slab through the use of ½" diameter x 1-5/8" anchor studs. Additionally, the liner plate is attached to the edges of embedded plates as detailed on Section CU of enclosed HNP drawing 2168-G-117 also using a 3/16" full penetration groove weld. The only channel that is embedded in the concrete slab are those around the outer wall of the pools. The liner plate does not attach to these channels. The sole purpose of the channels is leak collection.

Question 10

Provide the locations of the leak chase systems with respect to the locations of the racks and pedestals.

Response to Question 10

As shown on HNP drawings 2168-G-118, -119, and -122 (see Enclosure 2), the leak chase system corresponds to the location of the liner seams. Enclosed Holtec rack layout drawings 1994 (for pool C) and 1993 (for pool D) show the leak chases and their location with respect to the rack pedestals. The bearing pad analysis is carried out assuming that a leak chase is located directly under the pedestal transmitting the largest vertical load to the liner. Average bearing pressures in the concrete are demonstrated to be below the allowables set forth in the ACI 318 Code.

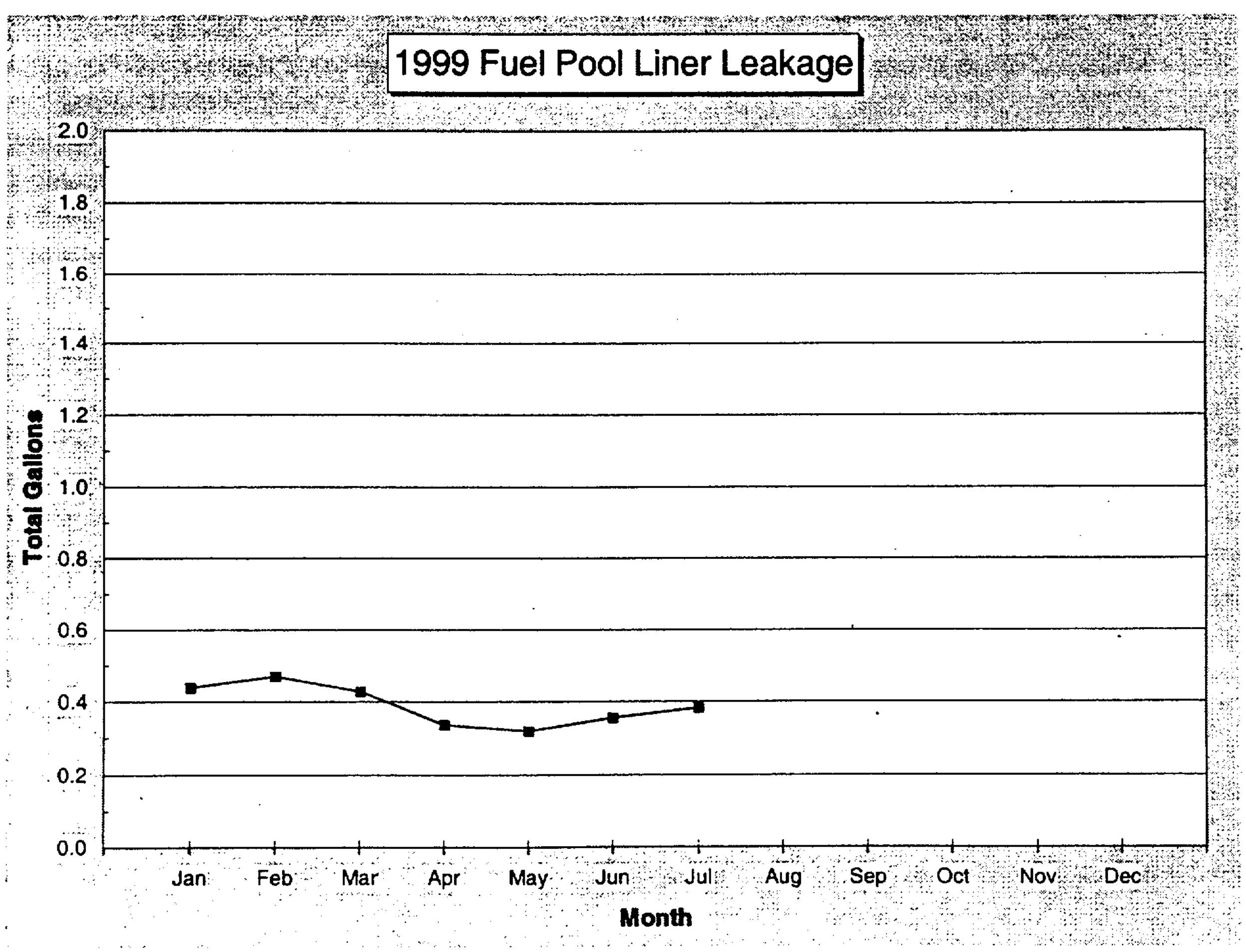
Question 11

Describe the method of leak detection in the fuel pool structure. How are leaks monitored? Is there any existing leakage?

Response to Question 11

As shown on HNP drawing 2168-G-117, Section AK (see enclosure 2), the liner is attached to a backing bar with a full penetration groove weld. On each side of the backing bar, a filler material was poured with and then removed from the concrete to form a 1" x ¾" concrete channel. Also, a filler material was poured with and then removed from the concrete in the area behind the liner plate to form a 1/8" gap. The embedded channels as well as the floor backing bars have been divided into zones by the use of plates. These plates are welded to the embedded bars and channels such that the water would be directed toward a specific zone, and thus a leak in a specific area could be detected. The design of the leak detection is such that if a liner plate or seam began to leak, the water would flow behind the plate within the 1/8" gap. The water would then proceed over to the vertical seam, whereby it would fall down to the embedded channel located at the wall/floor intersection. A potential floor leak would run horizontal and drain into the embedded channel. The channels would then funnel any leakage to drain lines which are located on the 216' elevation of the Fuel Handling Building.

Leaks are monitored under site procedure OMM-016, Operator Logs, which delineates four leak detection zones. Each leak detection zone is checked on a monthly basis. The chart shown below is a graphical month-by-month illustration of fuel pool liner leakage for calendar year 1999 through the 10^{th} of July.



ENCLOSURE 2

TO HNP LETTER SERIAL: HNP-99-112

INFORMATION SUPPORTING HNP RESPONSES TO NRC RAI DATED JUNE 16, 1999

(NON-PROPRIETARY)

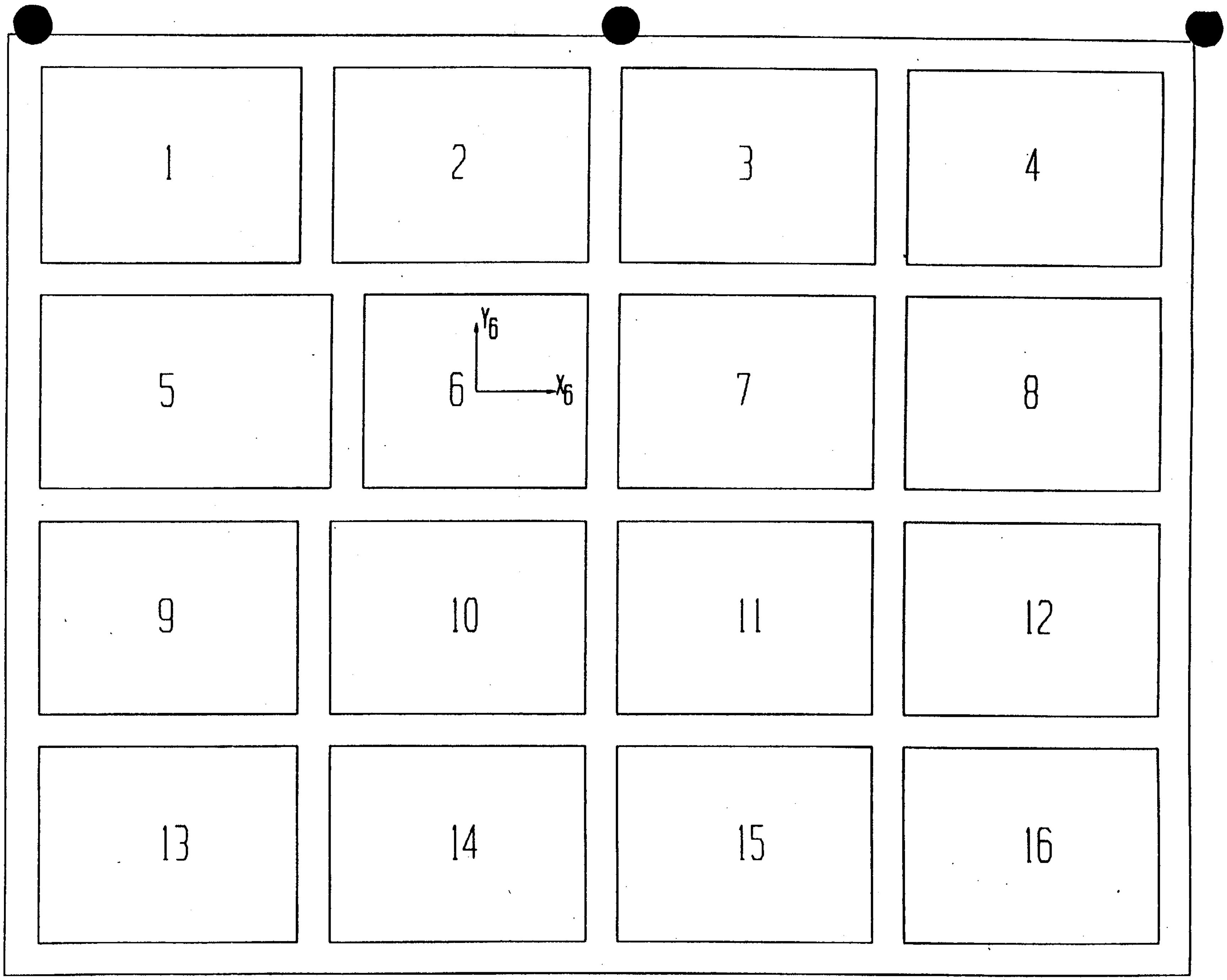


Figure RAI 1.1 PLANAR VIEW OF A 16 RACK ARRAY

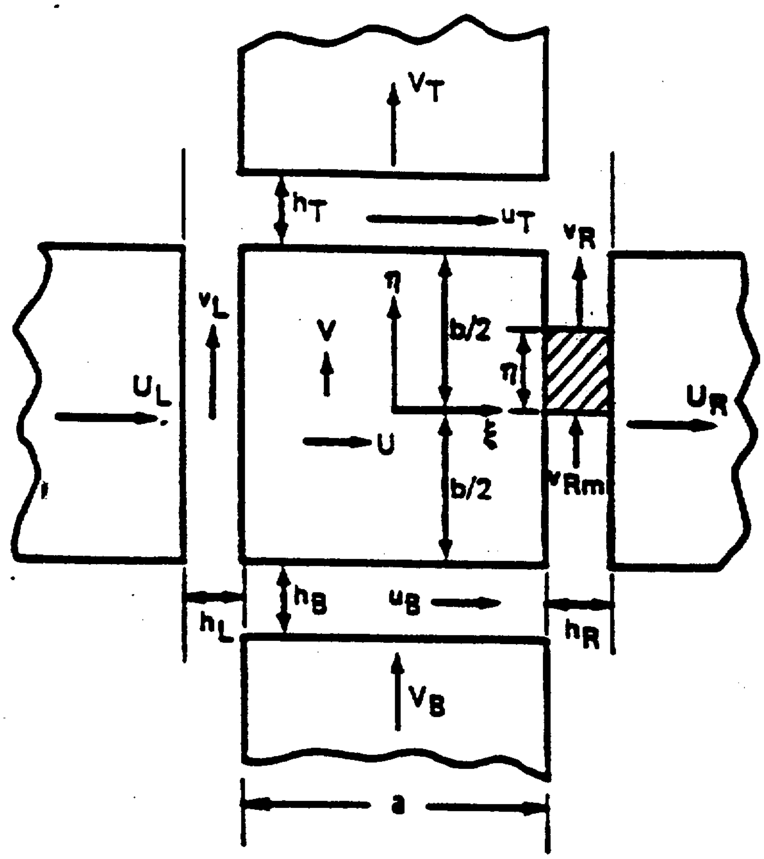


Figure RAI 1.2 FLOWS AROUND A TYPICAL CELL

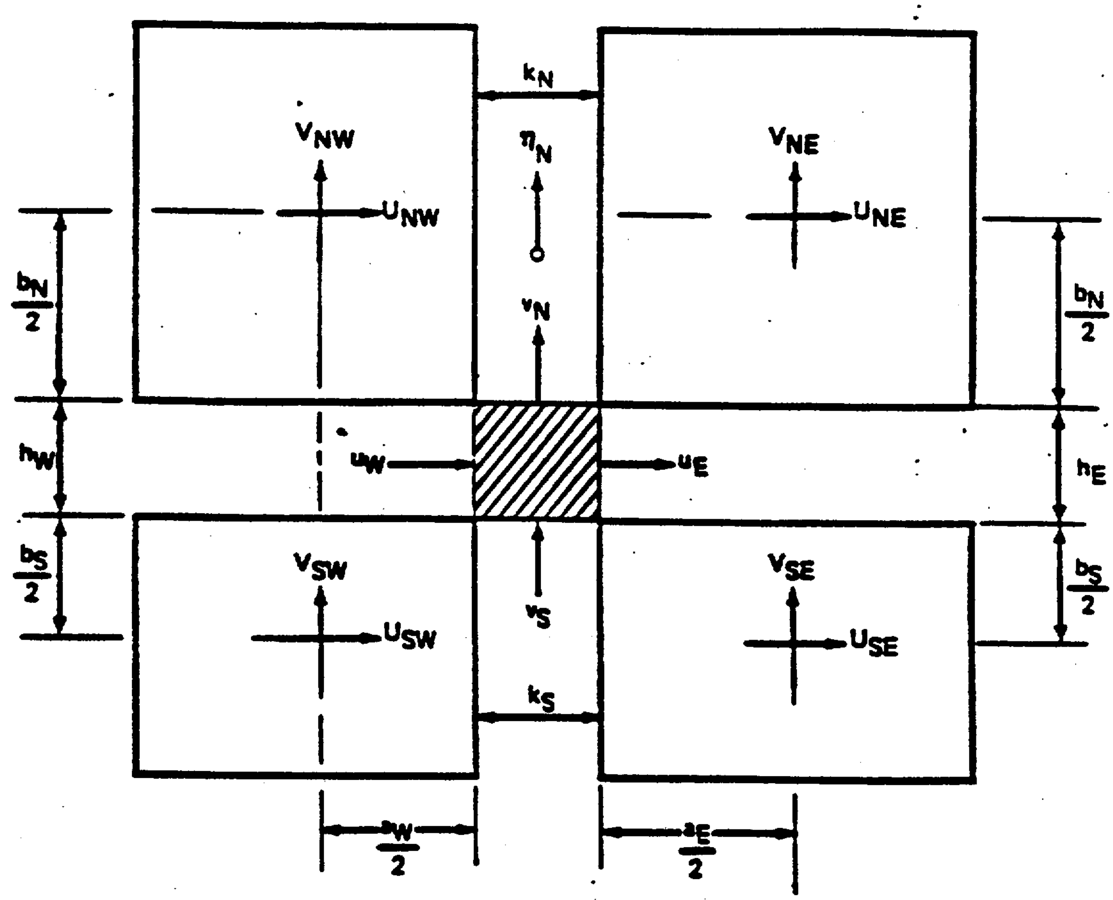


Figure RAI 1.3

FLOWS AT A CHANNEL INTERSECTION

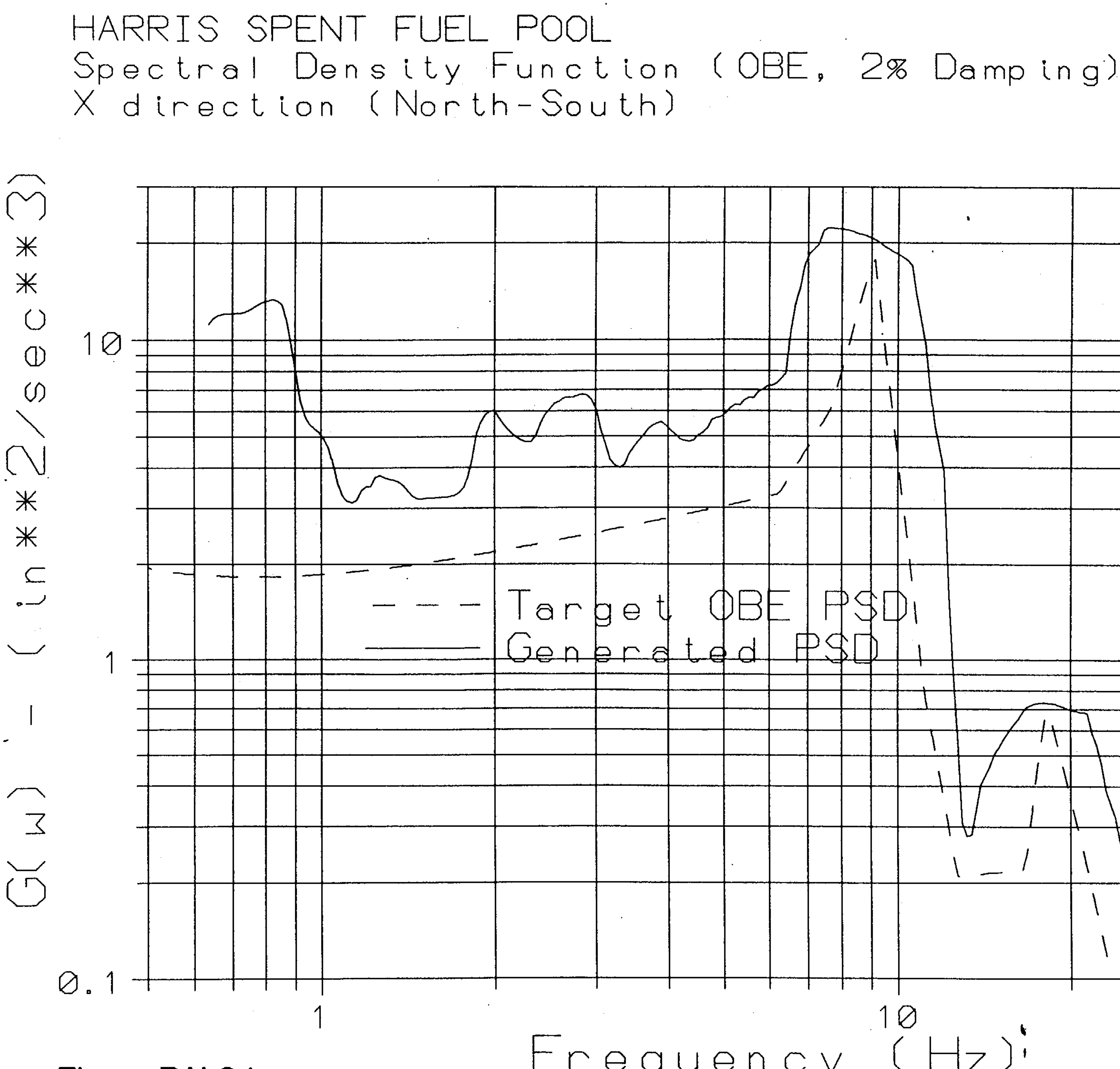


Figure RAI 2.1

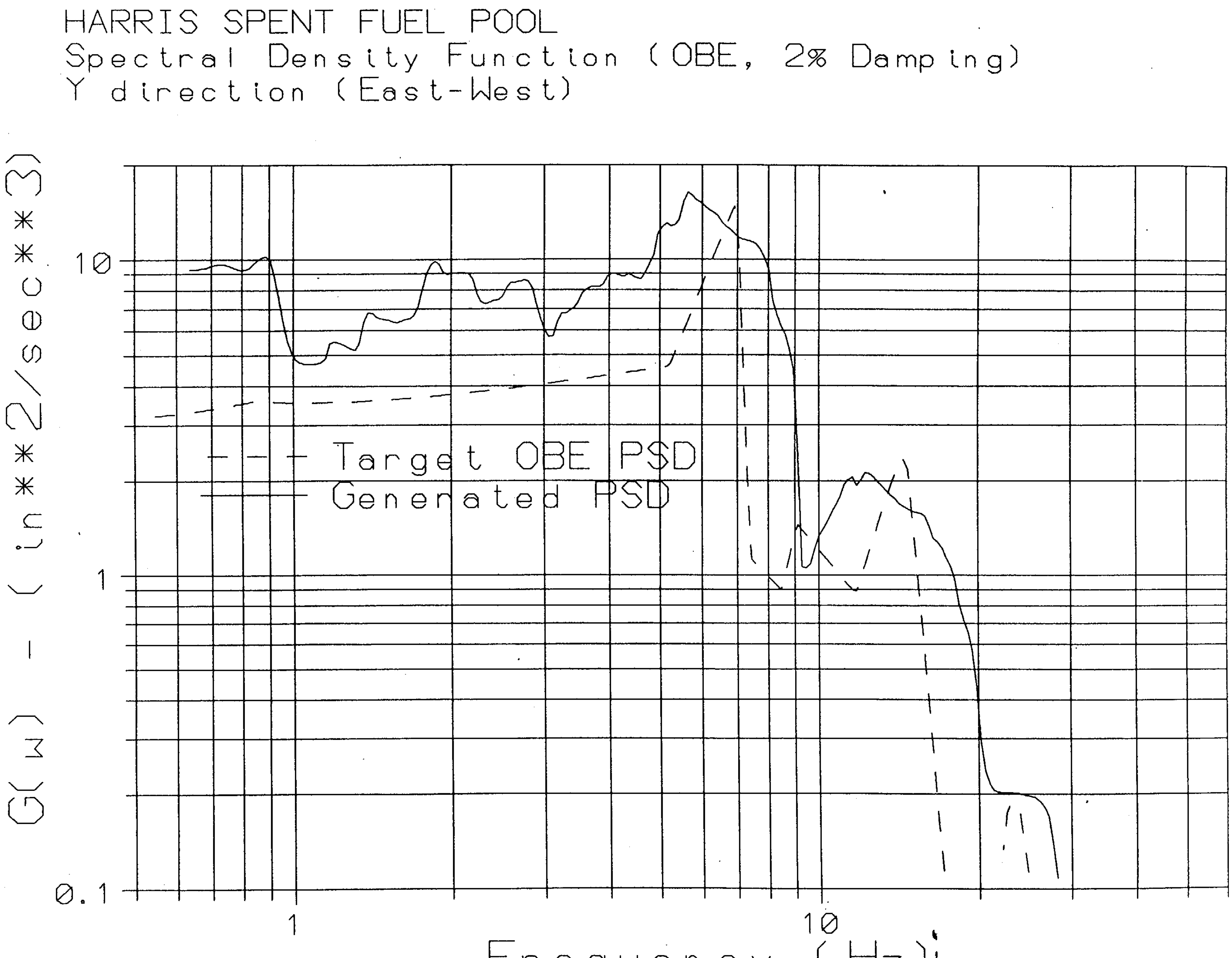


Figure RAI 2.2

HARRIS SPENT FUEL POOL
Spectral Density Function (OBE, 2% Damping)
Z direction (Vertical)

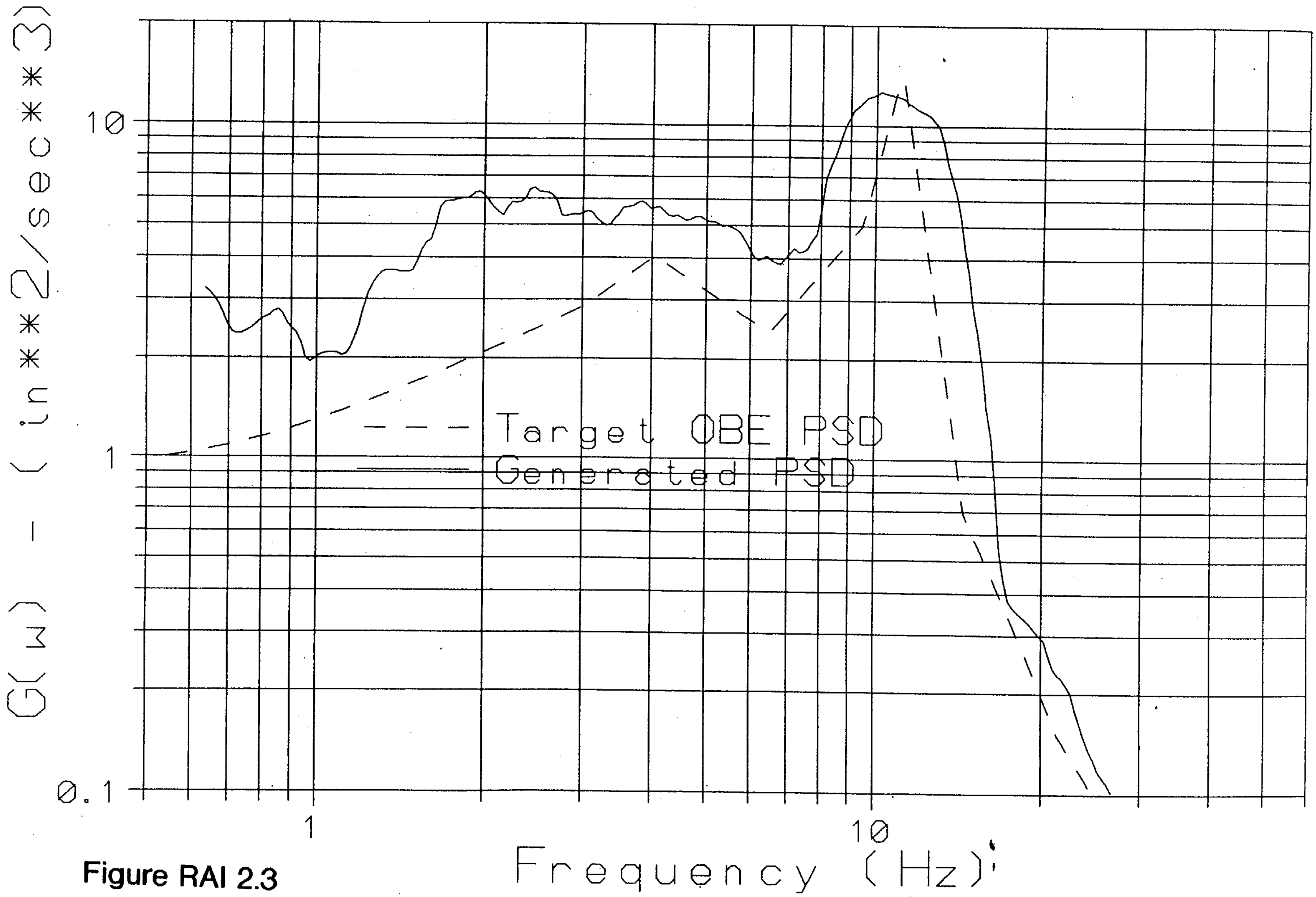


Figure RAI 2.3

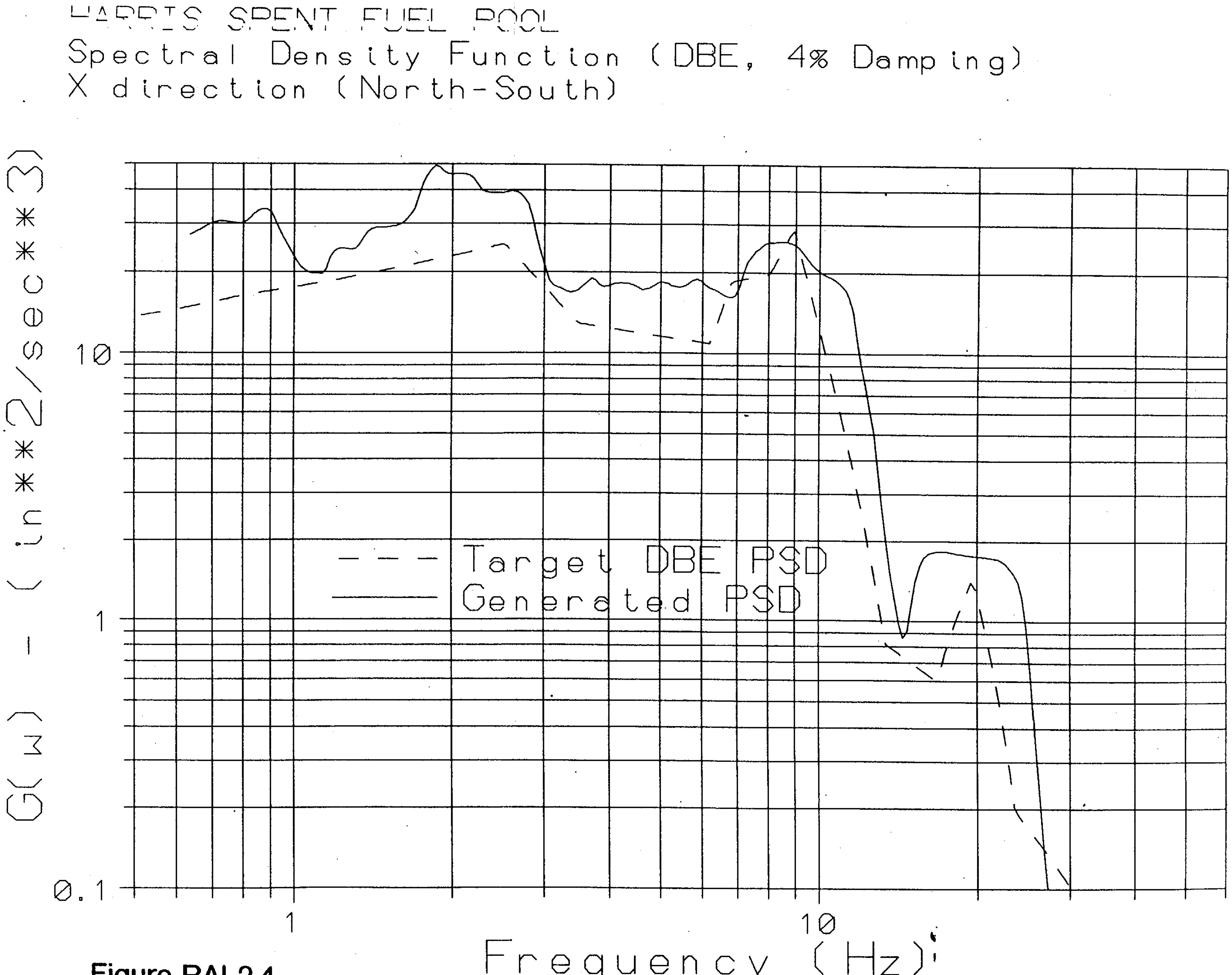


Figure RAI 2.4

HARRIS SPENT FUEL POOL
Spectral Density Function (DBE, 4% Damping)
Y direction (East-West)

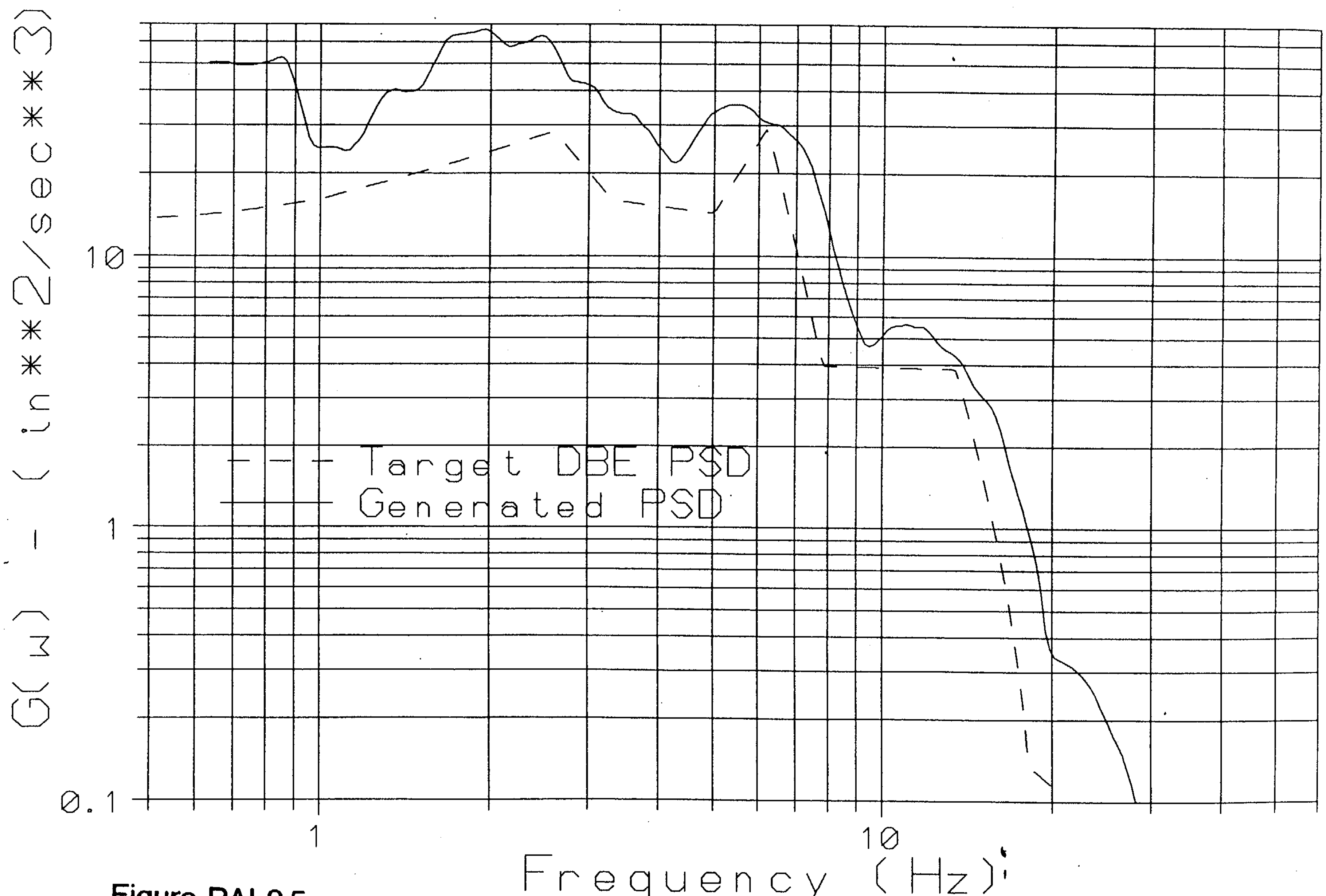


Figure RAI 2.5

HARRIS SPENT FUEL POOL
Spectral Density Function (DBE, 4% Damping)
Z direction (Vertical)

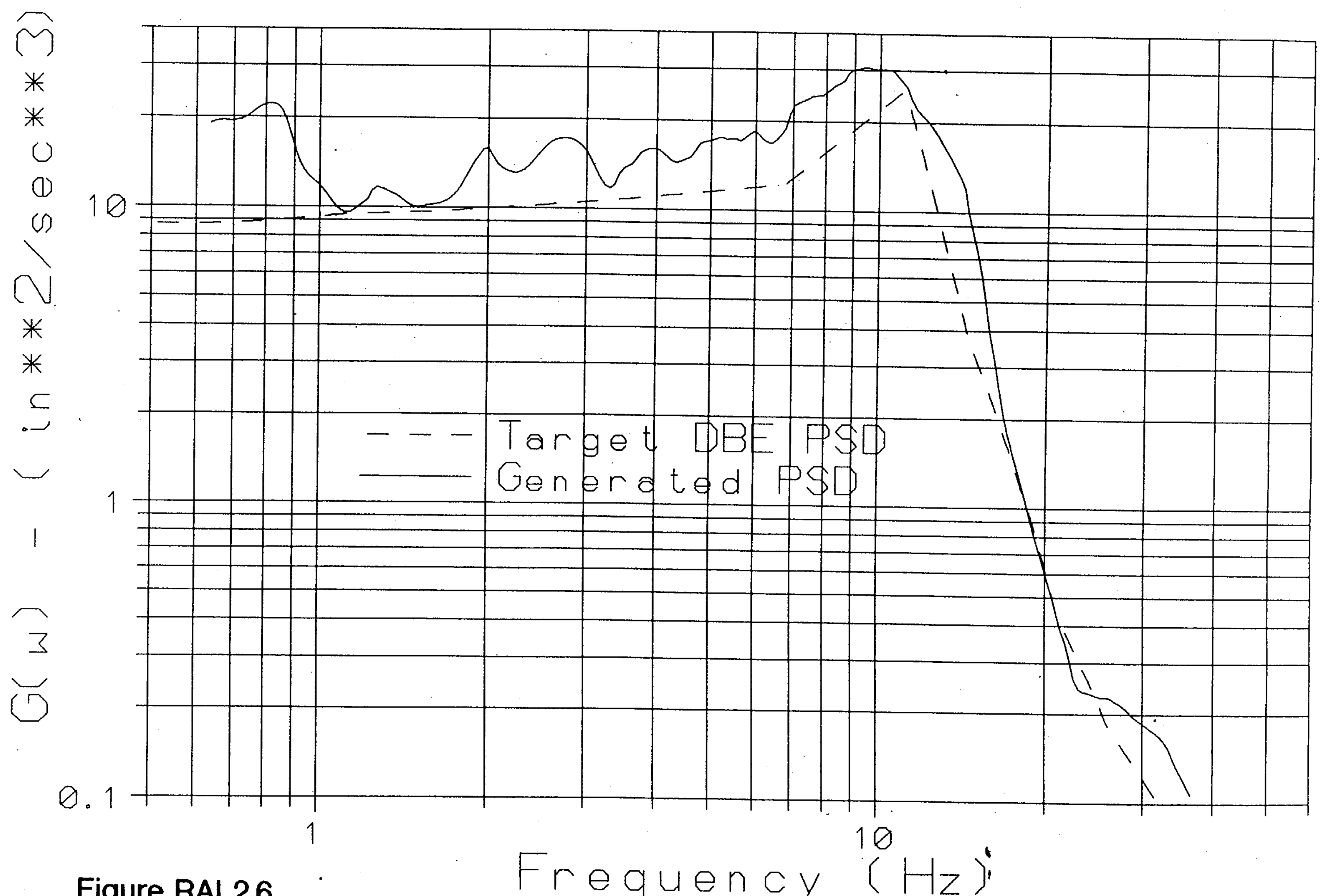


Figure RAI 2.6

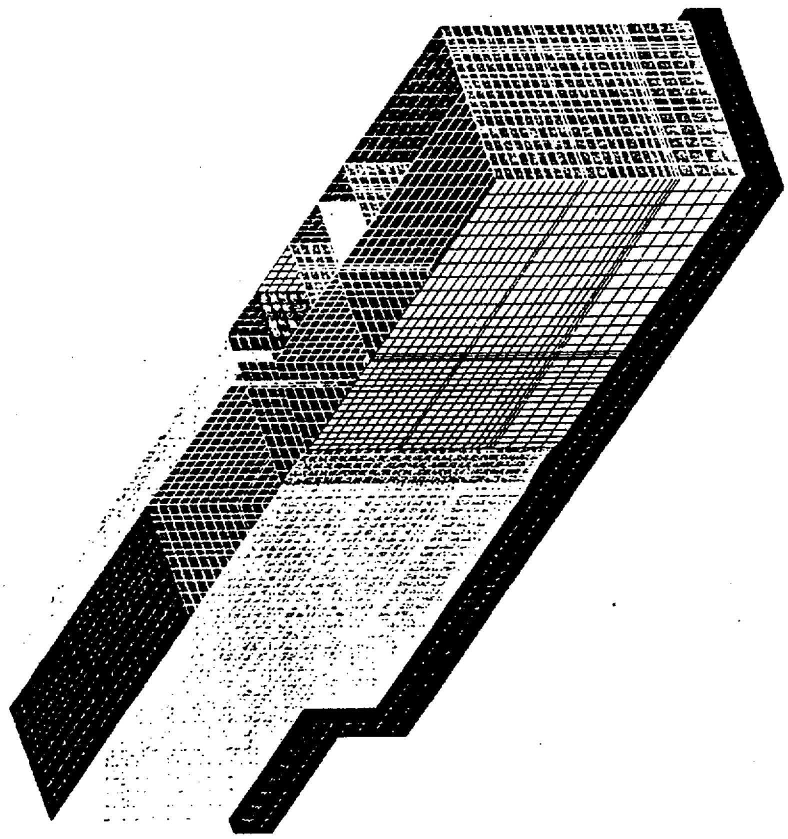


Fig. 4 Finite-Element Model (3-D View)

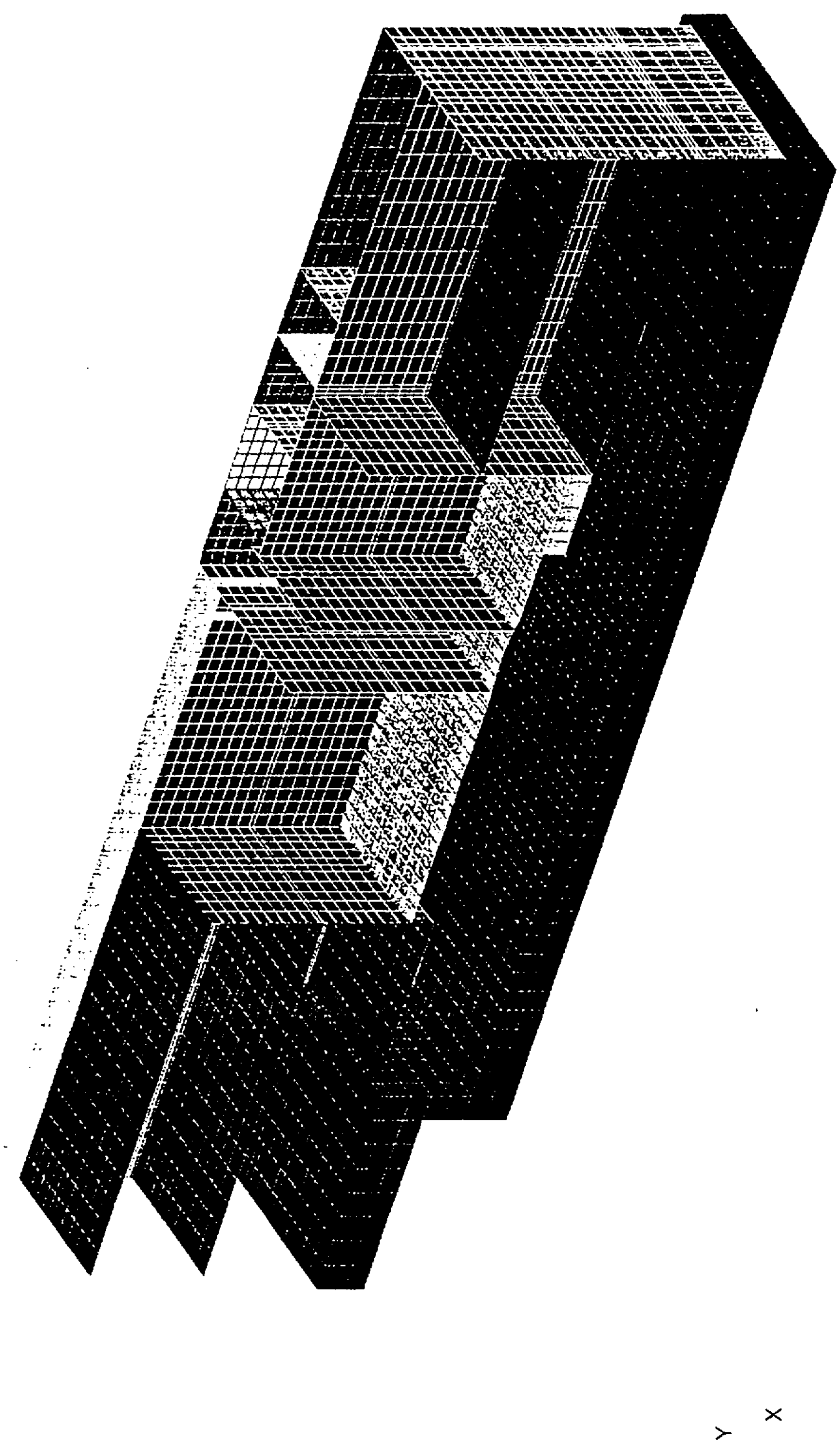


Figure 5 Finite-Element Model SFP's Sectional 3-D View

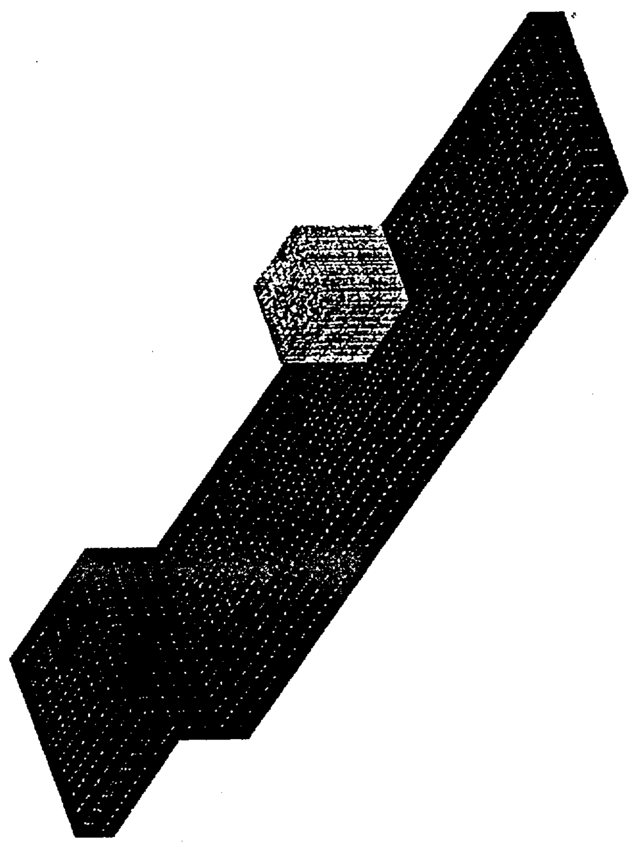


Fig. 6 Finite-Element Model of the Mat (3-D View)

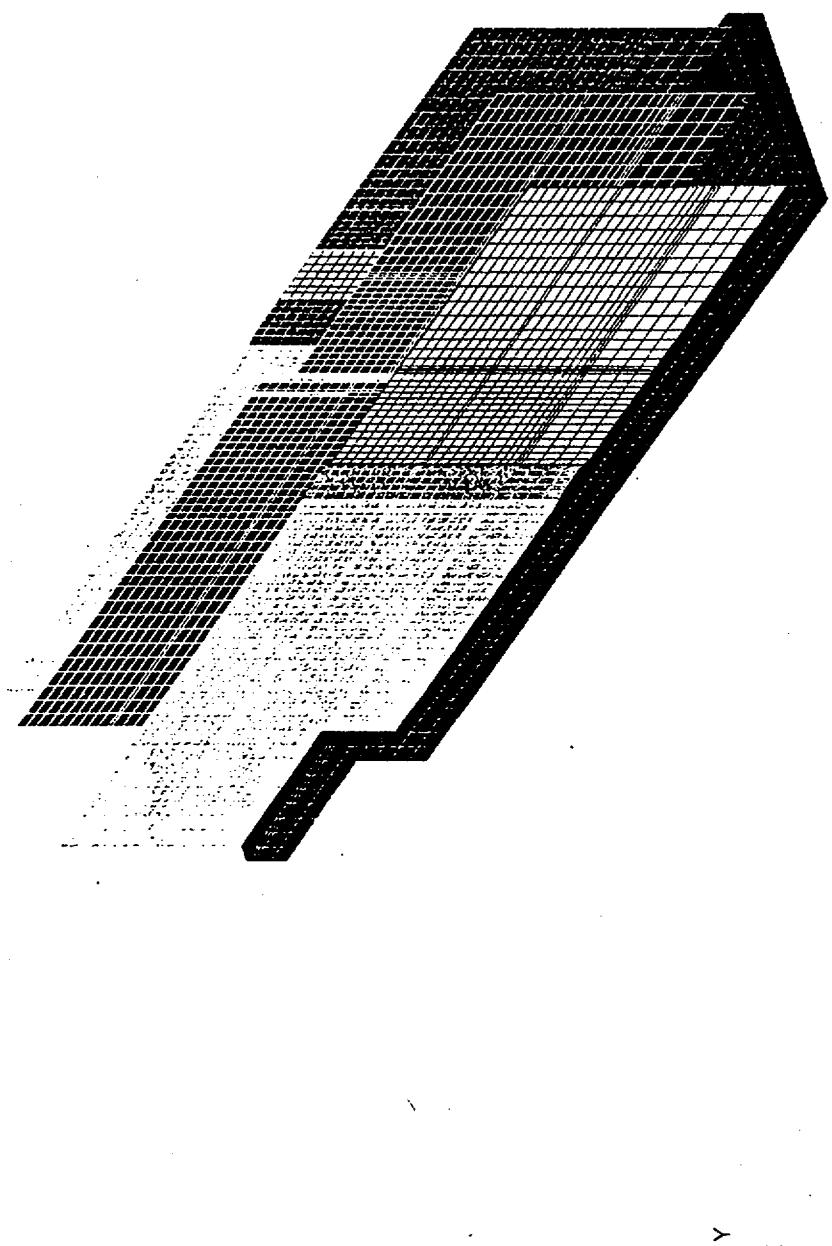


Fig. 7 Finite-Element Model of the Walls Running in X Direction (3-D View)

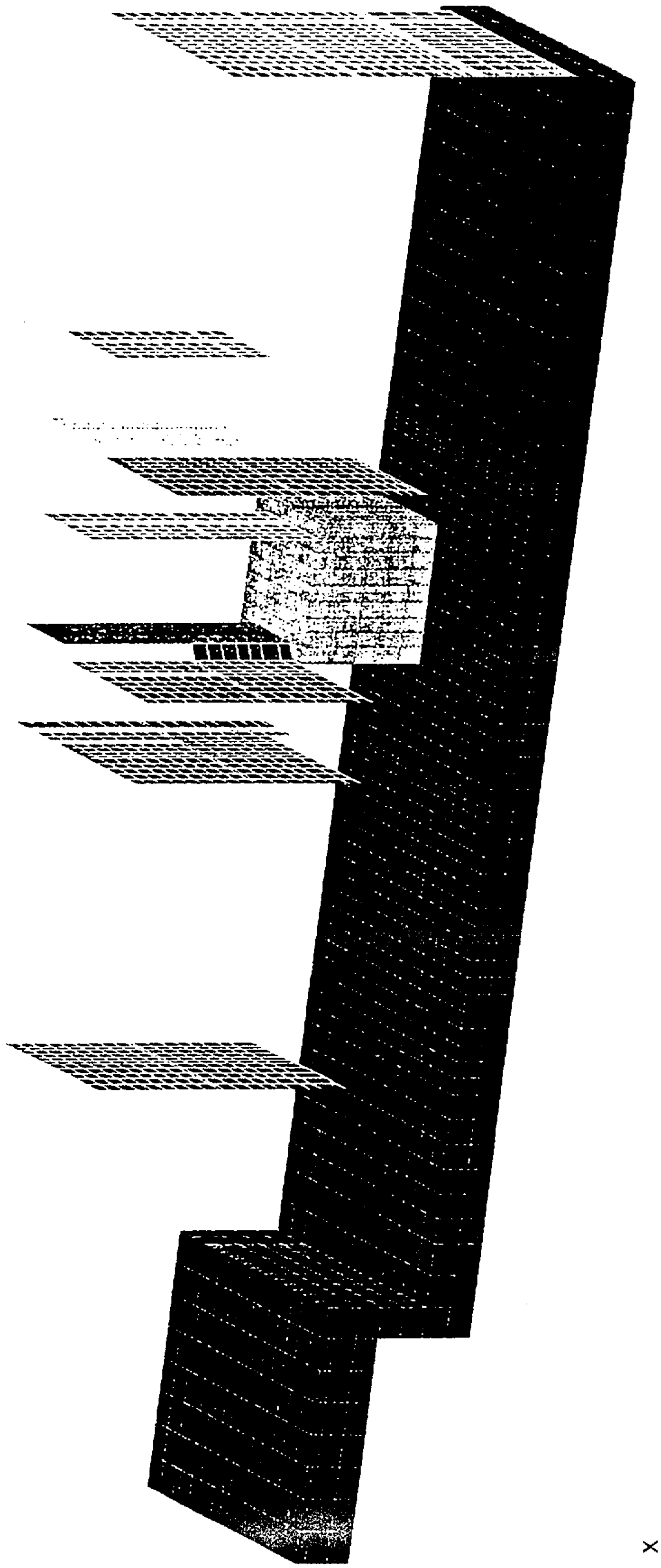


Fig. 8 Finite-Element Model of the Walls Running in Y Direction (3-D View)

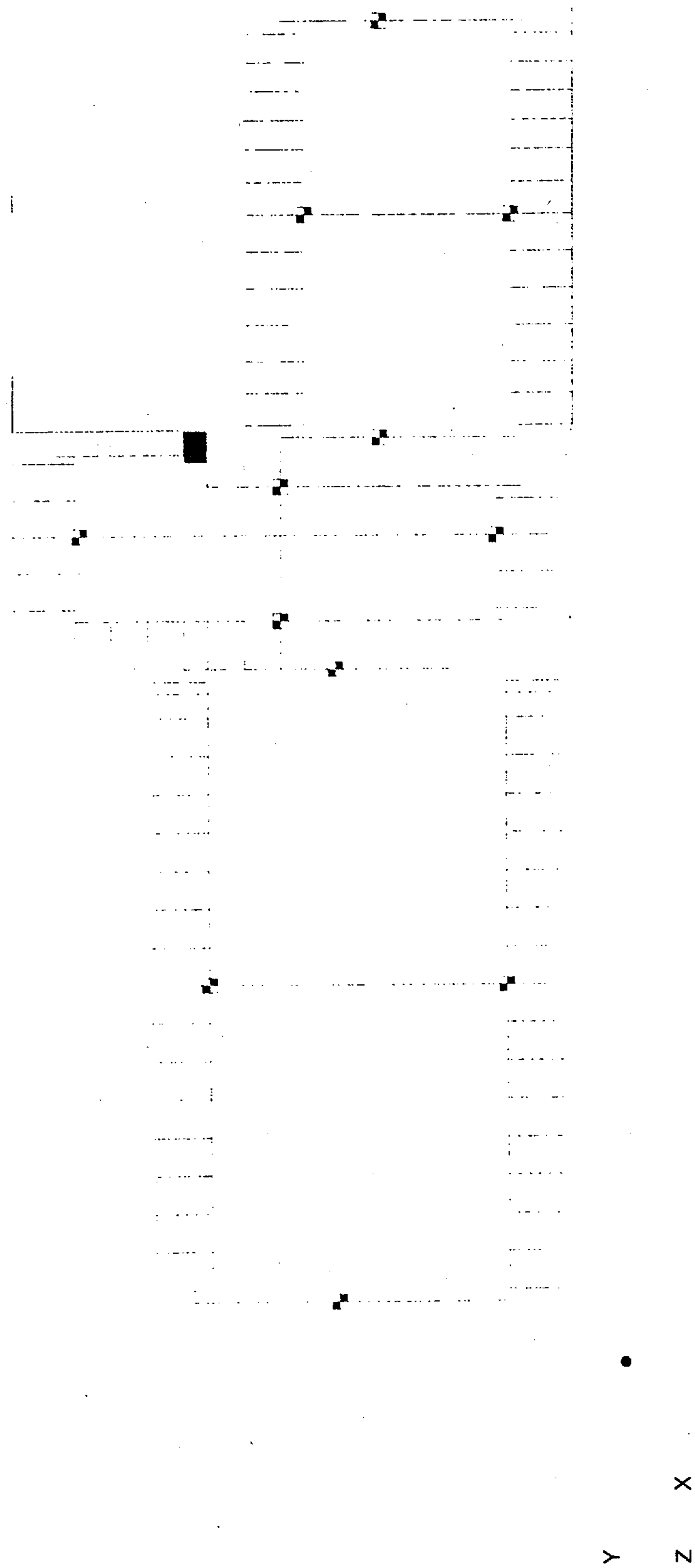


Fig. 9 Finite-Element Model of the Sloshing Water Masses (Plan View)

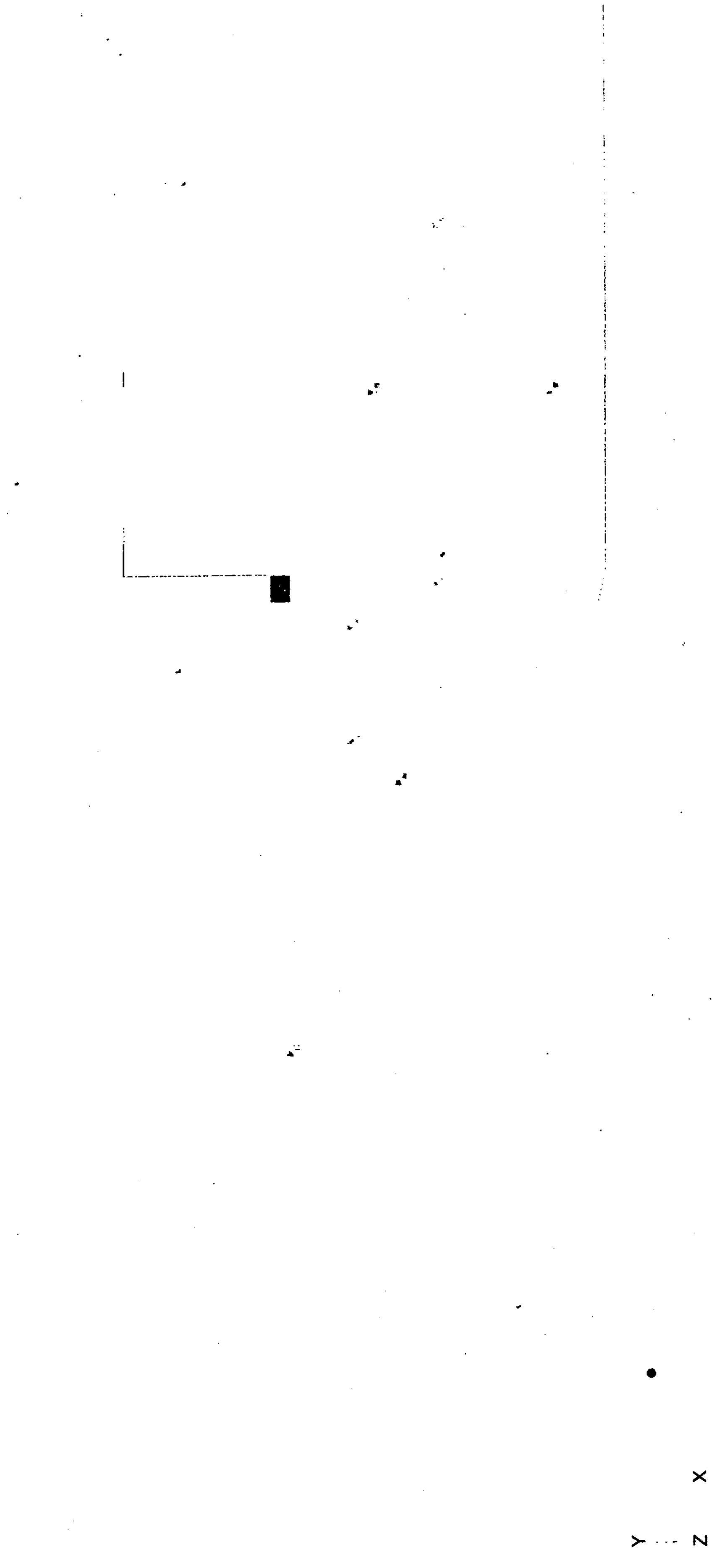


Fig. 10 Finite-Element Model of the Rigid Water Masses (Plan View)

Table No. 2 Concrete and Rebar Properties

Parameter	Notation	Value
Concrete Compressive Strength (psi)	f_c'	4.000E+03
Un-Cracked Concrete Elastic Modulus (psi)	E_{con}	3.605E+06
Concrete Poisson's Ratio	ν	0.167
Concrete Weight Density (lb/ft^3)	ρ_w	150.0
Concrete Thermal Expansion Coefficient	α	5.500E-06
Reinforcement Yield Strength (psi)	F_y	6.000E+04
Reinforcement Elastic Modulus (psi)	E_r	2.900E+07

Table No. 3 Material Properties

Structural Element	Region	E_{con} (psi)	E_{crack} (psi)	ν	ρ_w (lb/ft^3)	α	Material Type
Wall	X=(-984;36)	3.605E+06	3.605E+06	0.167	150	5.5E-06	1
Y=54.00	X=(36;708)	3.605E+06	5.907E+05	0.167	150	5.5E-06	101
Wall	X=(708;888)			0.167	150	5.5E-06	
Y=63.00	Z=(0;228)	3.605E+06	3.605E+06				2
	Z=(228;540)	3.605E+06	3.605E+06				201
	Z=(540; 840)	3.605E+06	3.605E+06				202
Wall	X=(888;1344)			0.167	150	5.5E-06	
Y=48.00	Z=(0;228)	3.605E+06	3.605E+06				3
	Z=(228; 840)	3.605E+06	6.473E+05				301
	X=(1344;2256)			0.167	150	5.5E-06	
	Z=(0;228)	3.605E+06	3.605E+06				4
	Z=(228; 840)	3.605E+06	3.605E+06				401
Wall	X=(888;1344)	3.605E+06	7.967E+05	0.167	150	5.5E-06	6
Y=372.00	X=(1344;2256)	3.605E+06	3.605E+06				601
Wall	X=(-984;36)	3.605E+06	3.605E+06	0.167	150	5.5E-06	5
Y=468.00	X=(36;708)	3.605E+06	7.967E+05	0.167	150	5.5E-06	501
Wall	X=(-984;708)			0.167	150	5.5E-06	
Y=594.00	Z=(0;228)	3.605E+06	3.605E+06				7
	Z=(228;492)	3.605E+06	3.605E+06				701
	Z=(492; 840)	3.605E+06	3.605E+06				702
Wall	X=(708;919.5)			0.167	150	5.5E-06	
Y=603.00	Z=(0;228)	3.605E+06	3.605E+06				8
	Z=(228;540)	3.605E+06	3.605E+06				801
	Z=(540; 840)	3.605E+06	3.605E+06				802
	X=(1162.5;2256)	3.605E+06	3.605E+06	0.167	150	5.5E-06	10

Wall Y=600.00	X=(919.5;1162.5)	3.605E+06	3.605E+06	0.167	150	5.5E-06	9
Wall X=36.00	Y=(54;468)	3.605E+06	7.967E+05	0.167	150	5.5E-06	11
Wall X=708.00	Y=(54,594)	3.605E+06	9.425E+05	0.167	150	5.5E-06	12
Wall X=888.00	Y=(63;372)	3.605E+06	7.967E+05	0.167	150	5.5E-06	13
Wall X=919.50	Y=(372;603)	3.605E+06	3.605E+06	0.167	150	5.5E-06	16
Wall X=1262.50	Y=(372;603)	3.605E+06	3.605E+06	0.167	150	5.5E-06	17
Wall X=1344.00	Y=(48;372)	3.605E+06	7.967E+05	0.167	150	5.5E-06	14
Wall X=1368.00	Y=(372;603)	3.605E+06	3.605E+06	0.167	150	5.5E-06	18
Wall X=1560.00	Y=(372;603)	3.605E+06	3.605E+06	0.167	150	5.5E-06	19
Wall X=2256.00	Y=(48;603)	3.605E+06	3.605E+06	0.167	150	5.5E-06	15
SFP "C" Slab	X=(36;708) Y=(54;468)	3.605E+06	3.825E+05	0.167	159	5.5E-06	22
TC Slab	X=(-984;708) & Y=(468;594)	3.605E+06	3.605E+06	0.167	150	5.5E-06	23
TC Slab	X=(708;919.5) & Y=(54;594) Pit Areas	3.605E+06 3.605E+06	3.605E+06 3.605E+06	0.167	150	5.5E-06	24 2401
SFP "D" Slab	X=(808;1344) & Y=(48;372)	3.605E+06	3.825E+05	0.167	159	5.5E-06	25

Auxiliary Slabs							
Z=228.00	X=(-427;36) & Y=(54;594)	3.605E+06	3.605E+06	0.167	150	5.5E-06	26
	X=(36;708) & Y=(468;594)						
	X=(1344;2256) & Y=(48,372)						
Z=456.00	X=(1162.5;2256)& Y=(372;603)	3.605E+06	3.605E+06	0.167	150	5.5E-06	27
Z=528.00	X=(-984;36) & Y=(54;468)	3.605E+06	3.605E+06	0.167	150	5.5E-06	28
	X=(1344;2256) & Y=(48,372)						
Z=840.00	Y=(1162.5;2256)& Y=(372;603)	3.605E+06	3.605E+06	0.167	150	5.5E-06	29

Foundation Mats							
Z=(-120;0)	X=(-496;2256) & Y=(0;648)	3.605E+06	3.605E+06	0.167	150	5.5E-06	20
Z=(0,240)	X=(-984;-427) & Y=(0;648)	3.605E+06	3.605E+06	0.167	150	5.5E-06	20
Z=(0;288)	X=(888;1194)& Y=(372;648)	3.605E+06	3.605E+06	0.167	150	5.5E-06	21

Table No.4 Racks and Cask Weights

Load Type	Location	Node	Weight (lb)	Load Type	Location	Node	Weight (lb)
RACKS	SFP "C"	5563	4.30e+04			5355	1.20e+05
		5420	7.10e+04			5357	1.20e+05
		5430	7.10e+04			5359	1.20e+05
		5422	7.10e+04			5384	1.20e+05
		5426	7.10e+04			5385	1.20e+05
		5424	7.10e+04			5387	1.20e+05
		5419	7.90e+04			5340	2.80e+04
		5561	3.50e+04			5399	2.80e+04
		5405	8.60e+04			5342	5.60e+04
		5522	1.58e+05			5328	5.60e+04
		5452	1.42e+05			5335	5.60e+04
		5453	1.42e+05			5332	5.60e+04
		5456	1.42e+05			5333	5.60e+04
		5457	1.36e+05			5337	5.60e+04
		5528	1.36e+05		SFP "D"	12428	3.50e+04
		5411	6.80e+04			5975	3.50e+04
		5415	6.80e+04			13036	7.00e+04
		5406	7.90e+04			13053	7.00e+04
		5493	1.36e+05			5918	7.00e+04
		5436	1.36e+05			5915	7.00e+04
		5497	1.36e+05			5861	7.00e+04
		5499	1.36e+05			5859	7.00e+04
		5500	1.30e+05			5796	7.00e+04
		5469	1.30e+05			5961	1.40e+05
		5325	6.00e+04			5962	1.40e+05
		5401	6.00e+04			5941	1.40e+05

RACKS	SFP "D"	5882	1.40e+05
		5892	1.40e+05
		5905	1.40e+05
		5782	4.00e+04
		1043	4.00e+04
		5865	8.30e+04
		5875	8.30e+04
		5868	8.30e+04
CASK		13088	6.94e+03
		13100	6.94e+03
		13066	6.94e+03
		13061	6.94e+03
		13069	1.39e+04
		13098	1.39e+04
		13099	1.39e+04
		13072	1.39e+04
		13059	1.39e+04
		13060	1.39e+04
		13070	2.78e+04
		13073	2.78e+04
		13089	2.78e+04
		13071	2.78e+04
		13070	2.78e+04
		13082	1.39e+04
		13074	1.39e+04

Table No. 5 Hydro-Static Pressure Distribution

Elevation (ft)	Model Z coordinate (in)	Pressure (psi)	Average Pressure (psi)	Elevation (ft)	Model Z coordinate (in)	Pressure (psi)	Average Pressure (psi)
840.00	0.00	0.00		456.00	384.00	13.78	
			1				14
807.00	33.00	1.18		420.00	420.00	15.07	
			2				16
774.00	66.00	2.37		390 .00	450.00	16.15	
			3				17
738.00	102.00	3.66		360.00	480.00	17.22	
			4				
705.00	135.00	4.84					
			5				
672.00	168.00	6.03					
			7				
639.00	201.00	7.21					
			8				
606.00	234.00	8.40					
			9				
573.00	267.00	9.58					
			10				
540.00	300.00	10.76					
			11				
528.00	312.00	11.19					
			12				
492.00	348.00	12.49					
			13				
456.00	384.00	13.78					

Table No. 6 Live Loads (Auxiliary Crane, Cask Crane and Fuel Handling Machine)

Structural Element Location	Node	Load Type			
		Auxiliary Crane (lb)	Cask Crane (lb)	Fuel Machine (lb)	Total (lb)
Wall Y=54.00	1472	21250	-	9375	30625
	1474	21250	-	9375	30625
Wall Y=48.00	2231	-	72500	-	72500
	2232	-	72500	-	72500
	2233	-	72500	-	72500
	2234	-	72500	-	72500
Wall Y=372.00	2854	-	72500	-	72500
	2855	-	72500	-	72500
	2856	-	72500	-	72500
	2857	-	72500	-	72500
Wall Y=468.00	3493	21250	-	9375	30625
	3496	21250	-	9375	30625

Note: All loads include 1.25 impact factor.

Table No.7 Temperature (*)

Structural Element		Temperature Condition			
Location	Region	Normal (T_o) (°F)		Accident (T_a) (°F)	
		N(-)	N(+)	N(-)	N(+)
Wall Y=54.00	X=(-984;36)	60	13	60	13
	X=(36;708)				
	Z=(0;288)	60	13	60	13
	Z=(288;840)	140	24	212	34
Wall Y=63.00	X=(708;888)	60	13	60	13
Wall Y=48.00	X=(888;1344)				
	Z=(0;228)	60	13	60	13
	Z=(228; 840)	140	24	212	34
	X=(1344;2256)	60	13	60	13
Wall Y=372.00	X=(888;1344)	80	140	94	212
	X=(1344;2256)	60	60	60	60
Wall Y=468.00	X=(-984;36)	60	60	60	60
	X=(36;708)	80	140	94	212
Wall Y=594.00	X=(-984;708)	13	60	13	60
Wall Y=603.00	X=(708;919.5)	13	60	13	60
	X=(1162.5;2256)	13	60	13	60
Wall Y=600.00	X=(919.5;1162.5)	13	60	13	60
Wall X=36.00	Y=(54;468)	80	140	94	212
Wall X=708.00	Y=(54,594)				
	Z=(0;228)	60	60	60	60
	Z=(228;840)	140	80	212	94

Wall X=888.00	Y=(63;372) Z=(0;228) Z=(228;840)	 60 80	 60 140	 60 94	 60 212
Wall X=919.50	Y=(372;603)	60	60	60	60
Wall X=1262.50	Y=(372;603)	60	60	60	60
Wall X=1344.00	Y=(48;372) Z=(0;228) Z=(228;840)	 60 80	 60 140	 60 94	 60 212
Wall X=1368.00	Y=(372;603)	60	60	60	60
Wall X=1560.00	Y=(372;603)	60	60	60	60
Wall X=2256.00	Y=(48;603)	60	13	60	13
SFP "C" Slab		73	140	82	212
TC Slab		60	60	60	60
SFP "D" Slab		73	140	82	212
Auxiliary Slabs		60	60	60	60
Foundation		60	60	60	60

Note: (*) the positive normal vectors N(+) are indicated in Figure 3.

Table No. 8 Rack to Wall Hydro-Dynamic Coupling Pressures

Structural Element	Region	Location	Pressure (psi)	
			OBE	SSE
Wall Y=54.00	X=(36;708) & Z=(288;840)	SFP "C"	20	20
Wall Y=468.00	X=(36;708) & Z=(288;840)			
Wall X=36.00	Z=(288;840)			
Wall X=708.00	Z=(288;840)			
Wall Y=48.00	X=(888;1344) & Z=(288;840)	SFP "D"	20	20
Wall Y=372.00	X=(888;1344) & Z=(288;840)			
Wall X=888.00	Z=(288;840)			
Wall X=1344.00	Z=(288;840)			

Table No. 9 Individual Load Case Description

Load No.	Type	Description	STARDYNE Input File
1	D	Structural Concrete Weight Fully Loaded Racks and Cask Fuel Handling Building Upper Structure	STATIC.STK
2	D	Spent Fuel Pools "C" and "D" Hydro-Static Pressure	STATIC.STK
3	L	Auxiliary Crane, Cask Crane and Fuel Handling Machine Load	STATIC.STK
4	E	OBE Fluid Coupling Pressure in X-direction	STATIC.STK
5	E	OBE Fluid Coupling Pressure in Y-direction	STATIC.STK
6	E'	SSE Fluid Coupling Pressure in X-direction	STATIC.STK
7	E'	SSE Fluid Coupling Pressure in Y-direction	STATIC.STK
8	E	OBE Hydro-Dynamic Pressure Z spectrum	STATIC.STK
9	E'	SSE Hydro-Dynamic Pressure Z spectrum	STATIC.STK
10	To	Temperature for Operating Condition	TEMP.STK
11	Ta	Temperature for Accident Condition	TEMP.STK
12	E	OBE Structural Inertia Loads	OBE.D04
13	E'	SSE Structural Inertia Loads	SSE.D04

Table No. 10 Load Combination Matrix

Load Combination	Individual Load												
	1	2	3	4	5	6	7	8	9	10	11	12	13
	D	D	L	E	E	E'	E'	E	E'	To	Ta	E	E'
1	1.4	1.4	1.7										
2	1.4	1.4	1.7	1.9	1.9			1.9				1.9	
3	1.4	1.4	1.7	-1.9	-1.9			-1.9				-1.9	
4	1.05	1.05	1.275	1.425	1.425			1.425		1.275		1.425	
5	1.05	1.05	1.275	-1.425	-1.425			-1.425		1.275		-1.425	
6	1.2	1.2		1.9	1.9			1.9				1.9	
7	1.2	1.2		-1.9	-1.9			-1.9				-1.9	
8	1.0	1.0	1.0			1.0	1.0		1.0	1.0			1.0
9	1.0	1.0	1.0			-1.0	-1.0		-1.0	1.0			-1.0
10	1.0	1.0	1.0	1.25	1.25			1.25			1.0	1.25	
11	1.0	1.0	1.0	-1.25	-1.25			-1.25			1.0	-1.25	
12	1.0	1.0	1.0			1.0	1.0		1.0		1.0		1.0
13	1.0	1.0	1.0			-1.0	-1.0		-1.0		1.0		-1.0

Table No. 12 SFP "C" East Wall (Y=54.00) Safety Factors

Load Case	Reinforcement Disposition							
	X Direction				Y Direction			
	Axial+Bending		Shear		Axial+Bending		Shear	
	Safety Factor	Element Number	Safety Factor	Element Number	Safety Factor	Element Number	Safety Factor	Element Number
1	22.97	10	31.87	10	156.7	304	49.35	304
2	1.19	152	1.15	96	11.12	152	2.02	115
3	1.35	19	1.1	96	4.24	305	1.14	115
4	1.06	114	1.41	134	4.5	134	1.06	134
5	1.41	19	1.26	96	22.58	60	1.12	96
6	1.19	152	1.14	96	4.28	305	1.17	115
7	1.35	19	1.11	96	4.25	305	1.14	115
8	2.48	152	2.73	305	9.32	134	2.79	325
9	4.82	77	3.99	96	13.28	5	1.29	305
10	1.05	132	1.38	305	4.59	134	1.18	134
11	1.53	19	1.29	96	8.75	7	1.14	1.35
12	1.72	148	2.02	305	6.76	314	1.74	305
13	2.88	140	2.95	96	8.61	6	1.36	306
Min.	1.05		1.1		4.24		1.06	

Table No. 13 SFP "C" West Wall (Y=468.00) Safety Factors

Load Case	Reinforcement Disposition							
	X Direction				Y Direction			
	Axial+Bending		Shear		Axial+Bending		Shear	
	Safety Factor	Element Number	Safety Factor	Element Number	Safety Factor	Element Number	Safety Factor	Element Number
1	29.36	206	18.86	206	124.15	353	17.51	19
2	1.72	71	1.35	206	5.64	353	1.16	17
3	2	69	1.49	56	6.23	353	1.22	17
4	2.76	70	1.35	207	7.59	353	1.63	17
5	2.48	69	1.1	207	8.27	335	1.25	19
6	1.73	71	1.36	206	5.67	353	1.15	19
7	1.99	69	1.51	56	6.19	353	1.22	17
8	5.99	207	4.24	207	26.94	353	6.42	35
9	9.39	207	2.65	207	31.57	227	3.28	19
10	3.46	70	1.6	207	8.71	353	1.9	17
11	2.68	69	1.22	207	9.06	245	1.35	19
12	6.22	207	3.76	206	27.77	353	4.67	35
13	7.61	69	2.47	207	24.68	227	2.87	19
Min.	1.72		1.1		5.64		1.15	

Table No. 14 SFP "C" North Wall (X=708.00) Safety Factors

Load Case	Reinforcement Disposition							
	X Direction				Y Direction			
	Axial+Bending		Shear		Axial+Bending		Shear	
	Safety Factor	Element Number	Safety Factor	Element Number	Safety Factor	Element Number	Safety Factor	Element Number
1	79.38	158	9.52	68	110.03	6	13.08	79
2	1.97	87	1.31	68	18.71	101	1.38	79
3	6.81	209	1.8	68	18.24	6	1.75	79
4	2.73	77	1.59	68	19.94	207	1.62	79
5	8.4	209	2.79	68	23.88	6	2.84	7[illegible]
6	1.97	87	1.34	68	18.75	101	1.4	79
7	6.79	209	1.76	68	18.48	207	1.72	79
8	7.27	87	1.76	68	23.6	101	1.79	79
9	7.95	208	3.06	68	27.1	6	3.03	79
10	3.93	77	1.69	68	20.6	66	1.69	79
11	9.12	209	3.63	68	23.26	185	3.16	9[illegible]
12	6.62	87	1.65	68	20.87	66	1.64	79
13	7.48	208	3.47	68	27.97	6	3.03	9[illegible]
Min.	1.97		1.31		18.24		1.38	

Table No. 15 SFP "C" South Wall (X=36.00) Safety Factors

Load Case	Reinforcement Disposition							
	X Direction				Y Direction			
	Axial+Bending		Shear		Axial+Bending		Shear	
	Safety Factor	Element Number	Safety Factor	Element Number	Safety Factor	Element Number	Safety Factor	Element Number
1	54.3	11	41.62	11	135.44	5	38.12	187
2	3.51	177	2.3	177	8.97	77	2.43	77
3	3.89	166	2.39	177	9.92	77	2.2	77
4	5.9	177	3.6	177	12.96	77	3.3	77
5	4.54	177	2.76	177	12.52	77	2.89	77
6	3.52	177	2.31	177	9.02	77	2.41	77
7	3.88	166	2.38	177	9.87	77	2.22	77
8	30.78	177	17.62	177	52.11	187	12.06	72
9	13.32	177	8.27	177	49.37	77	9.57	11
10	8.1	177	4.78	177	15.61	77	3.81	2
11	4.62	177	2.84	177	13.68	77	3.23	77
12	23.79	8	13.12	1	55.5	19	9.42	2
13	9.83	155	6.24	177	33.22	5	6.64	11
Min.	3.51		2.3		8.97		2.2	

Table No. 16 SFP "C" Slab Safety Factors

Load Case	Reinforcement Disposition							
	X Direction				Y Direction			
	Axial+Bending		Shear		Axial+Bending		Shear	
	Safety Factor	Element Number	Safety Factor	Element Number	Safety Factor	Element Number	Safety Factor	Element Number
1	37.98	97	15.5	11	59.34	129	24.29	20[illegible]
2	2.1	18	2.71	18	14.54	207	4.14	20[illegible]
3	3.78	18	3.62	18	12.07	175	3.38	20[illegible]
4	3.53	18	3.53	18	32.56	207	5.33	20[illegible]
5	4.62	18	4.94	176	13.09	175	4.47	20[illegible]
6	2.11	18	2.76	18	14.81	207	4.16	20[illegible]
7	3.75	18	3.53	18	12.35	175	3.45	20[illegible]
8	19.87	14	10.72	18	61.44	100	15.09	16[illegible]
9	18.51	18	13.43	174	28.93	145	12.43	20[illegible]
10	4.5	18	4	18	33.82	19	6.11	20[illegible]
11	4.99	18	5.46	176	13.12	175	5.04	20[illegible]
12	28.53	15	10.81	18	34.15	19	11.9	16[illegible]
13	15.15	18	11.98	28	22.17	145	12.39	20[illegible]
Min.	2.1		2.71		12.07		3.38	

Table No. 17 SFP "D" East Wall (Y=48.00) Safety Factors

Load Case	Reinforcement Disposition							
	X Direction				Y Direction			
	Axial+Bending		Shear		Axial+Bending		Shear	
	Safety Factor	Element Number	Safety Factor	Element Number	Safety Factor	Element Number	Safety Factor	Element Number
1	48.24	7	48.74	7	271.71	133	44.6	9
2	1.06	2	1.6	70	7.34	230	1.06	23
3	1.16	1	1.55	70	7.41	238	1.07	23
4	1.05	85	2.4	70	7.34	112	1.07	23
5	1.19	1	1.87	70	10.2	238	1.3	22
6	1.06	2	1.59	70	7.32	238	1.06	23
7	1.16	1	1.56	70	7.42	238	1.07	23
8	4.03	99	12.01	2	15.15	112	3.38	23
9	6.37	1	6.64	70	25.31	112	4.38	22
10	1.25	1	3.04	2	8.23	230	1.17	23
11	1.29	1	1.98	70	11.63	238	1.39	22
12	3.51	112	16.41	227	13.45	112	2.95	23
13	4.31	1	5.21	70	21.28	112	3.62	22
Min.	1.05		1.55		7.32		1.06	

Table No. 18 SFP "D" West Wall (Y=372.00) Safety Factors

Load Case	Reinforcement Disposition							
	X Direction				Y Direction			
	Axial+Bending		Shear		Axial+Bending		Shear	
	Safety Factor	Element Number	Safety Factor	Element Number	Safety Factor	Element Number	Safety Factor	Element Number
1	72.12	34	38.55	22	212.86	108	30.16	12
2	1.48	36	1.46	23	4.63	224	1.1	27
3	2.24	25	1.45	23	4.66	224	1.07	27
4	2.61	36	1.08	4	7.12	224	1.69	27
5	2.81	25	1.08	4	5.54	224	1.27	27
6	1.48	36	1.46	23	4.64	224	1.1	27
7	2.23	25	1.45	23	4.65	224	1.07	27
8	17.45	25	3.53	22	29.14	278	7.4	9
9	10.83	25	3.91	22	19.8	224	4.39	27
10	3.38	36	1.1	7	8.4	224	2.01	27
11	3.1	25	1.09	10	6.18	224	1.4	27
12	26.42	25	3.12	22	31.74	278	6.84	9
13	9.3	25	4.57	22	17.76	212	3.88	27
Min.	1.48		1.08		4.63		1.07	

Table No. 19 SFP "C" North Wall (X=1344.00) Safety Factors

Load Case	Reinforcement Disposition							
	X Direction				Y Direction			
	Axial+Bending		Shear		Axial+Bending		Shear	
	Safety Factor	Element Number	Safety Factor	Element Number	Safety Factor	Element Number	Safety Factor	Element Number
1	125.98	73	57.58	42	282.18	115	75.54	1[illegible]
2	2.32	122	3.49	58	35.27	106	5.44	15[illegible]
3	2.47	130	3.43	135	37.12	3	5.46	15[illegible]
4	3.06	130	4.65	122	28.15	3	7.21	5[illegible]
5	3.36	129	4.23	136	66.53	153	5.94	[illegible]
6	2.32	122	3.5	134	35.33	106	5.44	15[illegible]
7	2.47	130	3.44	135	37.43	3	5.46	15[illegible]
8	13.68	122	14.98	2	50.99	5	13.67	14[illegible]
9	12.53	129	14.47	1	108.14	7	14.38	[illegible]
10	3.51	130	5.02	131	24.49	4	8.29	5[illegible]
11	3.95	129	4.63	136	48.02	7	5.96	[illegible]
12	12.05	106	9.87	2	31.28	6	8.43	14[illegible]
13	13.93	129	9	1	45.89	6	10.63	[illegible]
Min.	2.32		3.43		24.49		5.44	

Table No. 20 SFP "D" South Wall (X=888.00) Safety Factors

Load Case	Reinforcement Disposition							
	X Direction				Y Direction			
	Axial+Bending		Shear		Axial+Bending		Shear	
	Safety Factor	Element Number	Safety Factor	Element Number	Safety Factor	Element Number	Safety Factor	Element Number
1	57.81	71	27.51	150	361.11	127	35.37	127
2	1.93	147	1.09	134	7.14	150	1.53	134
3	2.18	150	1.08	134	12.76	134	1.49	134
4	2.33	134	1.27	148	13.24	150	2.28	136
5	2.67	150	1.24	148	14.97	134	1.74	134
6	1.86	147	1.09	134	7.15	150	1.53	134
7	2.18	150	1.08	134	12.77	134	1.49	134
8	8.08	150	1.42	150	34.88	66	2.7	149
9	6.89	52	1.22	150	22.57	73	2.22	66
10	1.3	149	1.49	148	17.56	150	1.16	144
11	3.01	150	1.31	134	15.81	134	1.81	134
12	7.89	150	1.61	150	45.18	66	2.78	149
13	5.06	52	1.11	150	19.12	73	1.97	59
Min.	1.3		1.08		7.14		1.16	

Table No. 21 SFP "D" Slab Safety Factors

Load Case	Reinforcement Disposition							
	X Direction				Y Direction			
	Axial+Bending		Shear		Axial+Bending		Shear	
	Safety Factor	Element Number	Safety Factor	Element Number	Safety Factor	Element Number	Safety Factor	Element Number
1	41.78	107	18.58	107	129.73	20	26.57	9
2	2.01	2	2.8	14	9.49	108	1.88	9
3	3.1	5	3.24	100	12.48	108	1.64	9
4	3.12	2	3.32	14	15.78	108	2.59	9
5	4.19	5	4.35	100	14.59	108	2.13	9
6	2.02	2	2.84	14	9.44	108	1.86	9
7	3.1	5	3.3	100	12.56	108	1.66	9
8	15.65	4	9.61	14	98.43	108	16.04	9
9	19.41	6	13.27	100	35.86	15	7.22	9
10	3.9	2	3.59	14	22.8	108	2.98	9
11	4.69	5	4.93	100	14.27	20	2.41	9
12	17.68	4	8.39	14	41.16	24	16.6	9
13	17.61	6	11.99	112	22.2	15	7.11	9
Min.	2.01		2.8		9.44		1.64	

Table No. 22 Summary of Minimum Safety Factors

Pool	Location	Bending		Shear	
		Limiting Safety Margin	Load Combinations	Limiting Safety Margin	Load Combinations
C	North Wall	1.97	2	1.31	2
	South Wall	3.51	2	2.20	3
	East Wall	1.05	10	1.06	4
	West Wall	1.72	2	1.1	5
	Slab	2.1	2	2.71	2
D	North Wall	2.32	2	3.43	3
	South Wall	1.30	10	1.08	3, 7
	East Wall	1.05	4	1.06	2,6
	West Wall	1.48	2, 6	1.07	3, 7
	Slab	2.01	2	1.64	3

ENCLOSURE 3

TO HNP LETTER SERIAL: HNP-99-112

INFORMATION SUPPORTING HNP RESPONSES TO NRC RAI DATED JUNE 16, 1999

(PROPRIETARY)

AFFIDAVIT PURSUANT TO 10CFR2.790

I, Scott H. Pellet, being duly sworn, depose and state as follows:

(1) I am the Project Manager for Holtec International and have been delegated the function of reviewing the information described in paragraph (2) which is sought to be withheld, and have been authorized to apply for its withholding.

(2) The information sought to be withheld is contained in Enclosure 3 to "RAI Response for Harris Nuclear Plant". The following specific documents are considered proprietary in the entirety:

- Holtec Position Paper WS-115, Rev. 1, 3D Single Rack Analysis of Fuel Racks.
- Holtec Report HI-87113, Rev. 0, Evaluation of Fluid Flow for In-Phase and Out-of-Phase Rack Motions.
- Holtec Report HI-87114, Rev. 0, Estimated Effects of Vertical Flow Between Racks and Between Fuel Cell Assemblies
- Holtec Report HI-87102, Rev. 0, Study of Non-Linear Fluid Coupling Effects.
- Holtec Report HI-87112, Rev. 0, Fluid Flow in Narrow Channels Surrounding Moving Rigid Bodies.

(3) In making this application for withholding of proprietary information of which it is the owner, Holtec International relies upon the exemption from disclosure set forth in the Freedom of Information Act ("FOIA"), 5 USC Sec. 552(b)(4) and the Trade Secrets Act, 18 USC Sec. 1905, and NRC regulations 10CFR Part 9.17(a)(4), 2.790(a)(4), and 2.790(b)(1) for "trade secrets and commercial or financial information obtained from a person and privileged or confidential" (Exemption 4). The material for which exemption from disclosure is here sought is all "confidential commercial information", and some portions also qualify under the narrower definition of "trade secret", within the meanings assigned to those terms for purposes of FOIA Exemption 4 in, respectively, Critical Mass Energy Project v. Nuclear Regulatory Commission, 975F2d871 (DC Cir. 1992), and Public Citizen Health Research Group v. FDA, 704F2d1280 (DC Cir. 1983).

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

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

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

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

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

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

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

(5) The information sought to be withheld is being submitted to the NRC in confidence. The information (including that compiled from many sources) is of a sort customarily held in confidence by Holtec International, and is in fact so held. The information sought to be withheld has, to the best of my knowledge and belief, consistently been held in confidence by Holtec International. No public disclosure has been made, and it is not available in public sources. All disclosures to third parties, including any required transmittals to the NRC, have been made, or must be made, pursuant to regulatory provisions or proprietary agreements which provide for maintenance of the information in confidence. Its initial designation as proprietary information, and the subsequent steps taken to prevent its unauthorized disclosure, are as set forth in paragraphs (6) and (7) following.

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

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

(8) The information classified as proprietary was developed and compiled by Holtec International at a significant cost to Holtec International. This information is classified as proprietary because it contains detailed historical data and analytical results not available elsewhere. This information would provide other parties, including competitors, with information from Holtec International's technical database and the results of evaluations performed using codes developed by Holtec International. Release of this information would improve a competitor's position without the competitor having to expend similar resources for the development of the database. A substantial effort has been expended by Holtec International to develop this information.

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

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

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

AFFIDAVIT PURSUANT TO 10CFR2.790

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

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

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

Scott H. Pellet, being duly sworn, deposes and says:

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

Executed at Marlton, New Jersey, this 2nd day of July 1999.

Scott H. Pellet

Scott H. Pellet
Holtec International

Subscribed and sworn before me this 2nd day of July, 1999.

Maria C. Pepe

MARIA C. PEPE
NOTARY PUBLIC OF NEW JERSEY
My Commission Expires April 25, 2000