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Docket No.: 50-508

MEMORANDUM FOR: George W. Knighton, Chief, Licensing Branch No. 3, DL  
 FROM: V. Nerses, Project Manager, Licensing Branch No. 3, DL

SUBJECT: WNP-3 MEETING

DATE & TIME: Tuesday, July 10, 1984  
 9:00 am - 12:00 pm

LOCATION: P-110  
 Phillips Building  
 Bethesda, Maryland

PURPOSE: The applicant will present to the staff the details of their position with respect to deconvolution.

AGENDA: See enclosed

PARTICIPANTS: WPPSS  
 D. Coleman, et al  
NRC  
 V. Nerses, B. K. Singh, P. T. Kuo

Victor Nerses, Project Manager  
 Licensing Branch No. 3, DL

Enclosure: Agenda

cc: See next page

Meetings between NRC technical staff and applicants for licenses are open for interested members of the public, petitioners, intervenors, or other parties to attend as observers pursuant to "Open Meeting Statement of NRC Staff Policy", 43 Federal Register 28058, 6/28/78. Those interested in attending this meeting should make their intentions known to the Project Manager, Victor Nerses at (301) 492-7238, by no later than July 5, 1984.

344626495A

OFFICE	DL:LB#3	DL:LB#3	DL:LB#3			
IRNAME	BKSingh/ch	VNerses	GWKnighton			
DATE	6/14/84	6/14/84	6/14/84			

WNP 3

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STRUCTURAL ENGINEERING  
BRANCH MEETING

- I. INTRODUCTION
- II. WNP-3 SITUATION & STATUS
- III. STRUCTURAL AUDIT & FINDINGS
- IV. DECONVOLUTION FINDING (AF #1)
- V. HISTORICAL PERSPECTIVE OF WNP-3  
WITH RESPECT TO DECONVOLUTION
- VI. SUPPLY SYSTEM RESPONSE TO AF #1
  - A. INTRODUCTION
  - B. PURPOSE AND SCOPE
  - C. ANALYSIS
  - D. COMPARISON OF ANALYSIS RESULTS
  - E. CONCLUSIONS
- VII. NRC QUESTIONS AND COMMENTS ON SUPPLY SYSTEM  
RESPONSE TO AF #1
- VIII. NRC QUESTIONS OR COMMENTS ON OTHER SUPPLY  
SYSTEM RESPONSES
- IX. NRC CONCLUSIONS

MEETING NOTICE DISTRIBUTION:

Docket No(s): 50-500  
 NRC PDR  
 Local PDR  
 TIC  
 NSIC  
 PRC System  
 LBB Reading  
 H. Denton/E. Case  
 D. Eisenhower/F. Purdie  
 T. Novak  
 J. Youngblood  
 A. Schwencer  
 E. Adensam  
 F. Miraglia  
 E. Butcher  
 D. Crutchfield  
 C. Grimes, Acting  
 G. Holahan  
 C. Thomas  
 G. Laines  
 S. Varga  
 E. Vassallo  
 J. Miller  
 J. Stolz  
 R. Voliner  
 W. Johnston  
 J. P. Knight  
 R. Mattson  
 L. Rubenstein  
 W. Houston  
 D. Muller  
 T. Speis  
 F. Schroeder  
 F. Rowsome  
 H. Thompson  
 T. W. Russell  
 ACRS (16)  
 Attorney, OELD  
 D. L. Jordan  
 N. Grace  
 F. Ingram, PA  
 Receptionist (Only if meeting is held in Bethesda)  
 Project Manager VNurses  
 J. Lee

NRC PARTICIPANTS

VNurses

~~BKSingh~~

PTKuo

RSavio

bcc: Applicant &amp; Service List

Attendance List

<u>Name</u>	<u>Organization</u>	<u>Title</u>
B. K. Singh	NRC/NRR/DL	Project Manager
G. Knighton	NRC/NRR/DL	Chief, LB#3
J. Porrovecchio	EBASCO	Lic. Supervisor
Jeff Kimball	NRC/GSB/DE	Seismologist
Eugen Rosolie	Coalition for Safe Power (CFSP)	Intervenor
D. W. Coleman	Wash. Public Power Supply Supply (WPPSS)	Licensing Manager
A. D. Kohler	WPPSS	Program Director
D. M. Bosi	WPPSS	
R. H. Wang	EBASCO Services, Inc.	Super. Civil Engr.
M. C. Hsieh	EBASCO Services, Inc.	Princ. Civil Engr.
K. D. Chiu	EBASCO Services, Inc.	Assc. Consult. Engr.
Owen Rothberg	NRR/DE	Engineer/Exreviewer
H. Worchel	EBASCO	Project Engineer
Lyman Heller	NRC/NRR/DE	Geotechnical Engrg. Ldr.
C. P. Tan	NRC/NRR/DE	Structural Engineer
S. P. Chan	NRC/NRR/DE	Structural Engineer

- 0 PROJECT IS 76% COMPLETE
- 0 FULL CONSTRUCTION ACTIVITIES STOPPED DUE TO LACK OF FINANCING
- 0 CONSTRUCTION RESTART DATE TO BE DETERMINED BY BONNEVILLE POWER ADMINISTRATION IN NEXT FEW MONTHS
  - PROJECT PLANNING PRESENTLY BASED ON A JULY 1985 RESTART DATE AND A JUNE 1989 FUEL LOAD
  - PUBLIC PROCESS IN WHICH ALL PROJECT COMPLETION ALTERNATIVES WILL BE EVALUATED
- 0 DESIGN IS APPROXIMATELY 95% COMPLETE
- 0 PRESERVATION PROGRAM IMPLEMENTED
- 0 ESSENTIAL DESIGN & LICENSING ACTIVITIES CONTINUING
- 0 PREPARATIONS FOR OPERATIONS CONTINUING
- 0 400 FULL TIME EQUIVALENT PEOPLE WORKING ON THE PROJECT
- 0 RESPONSES TO NRC QUESTIONS CONTINUING
  - 496 QUESTIONS RECEIVED
  - 397 RESPONSES COMPLETE
  - 21 PARTIAL RESPONSES PROVIDED
  - MORE RESPONSES WILL BE PROVIDED IN JULY/AUGUST
  - REMAINDER TO BE PROVIDED FOLLOWING CONSTRUCTION RESTART.
- 0 SUPPLY SYSTEM INVOLVEMENT IN CESSAR-F ACTIVITIES MAINTAINED
- 0 DRAFT SAFETY EVALUATION REPORT (DSER) EXPECTED FROM NRC LATER THIS YEAR
- 0 EXPECT TO RECEIVE MORE NRC QUESTIONS.

WNP-3 STRUCTURAL REVIEW SUMMARY

0 STRUCTURAL REVIEW QUESTIONS

- 37 COMPLETE RESPONSES
- 1 PARTIAL RESPONSE

0 25 FINDINGS FROM STRUCTURAL AUDIT AT EBASCO

- 8 FINDINGS CLOSED PRIOR TO ISSUANCE OF NRC'S 11/02/84 REPORT
- 16 RESPONSES COMPLETED VIA 06/2<sup>1</sup>7/84 LETTER TO NRC
- 1 RESPONSE PLANNED FOR LATER IN 1984

WHIP-3 LICENSING DOCUMENTS TRACKING SYSTEM HISTORY  
 RESPONSES TO NRC QUESTIONS  
 AS OF 5 JUL 1984

QUESTION NUMBER	SCN #	ESAR SECTION	AMEND. #	NRC LTR DATE	RESPONSE DATE	SIS	ITEM #
220 001	0223	05 04 02	02	19820020	19821022	C	82-223
220 002	0104	05 07 01 01	02	19820820	19821022	C	82-184
220 003	N/A	03 07 02 06	NA	19820820	19821022	C	82-239
220 004	0216	03 07 04	02	19820820	19821022	C	82-216
220 004	0216	07 06	02	19820820	19821022	C	82-216A
220 005	0201	03 08 03 05	01	19820820	19821022	C	82-201
220 006	N/A	05 08 03	NA	19820020	19821022	C	82-260
220 007	0101	01 08 04 01 03	02	19820820	19821022	C	82-103
220 008	N/A	03 08 04 01 02	NA	19820820	19821022	00	82-261
220 008	N/A	03 08 04 01 02	NA	19820820	19830117	C	83-079
220 009	0229	01 08 05 01	02	19820820	19821022	C	82-225
220 010	N/A	01 03 02	NA	19830503	19830902	C	83-417
220 011	N/A	03 04	NA	19830503	19830902	C	83-419
220 012	N/A	03 05 03	NA	19830503	19830502	C	83-422
220 013	N/A	03 07 01	NA	19830503	19840406	C	84-010
220 014	N/A	03 07	NA	19830503	19830708	C	83-423
220 014	N/A	03 08	NA	19830503	19830908	C	83-424
220 015	N/A	03 07 02	NA	19830503	19840405	C	84-011
220 016	N/A	03 07 01	NA	19830503	19840406	C	84-012
220 017	N/A	03 07 02 06	NA	19830503	19830902	C	83-425
220 018	N/A	01 07 02 03	NA	19830503	19840117	C	84-156
220 019	N/A	07 04	NA	19830503	19830902	PC	83-428
220 020	N/A	03 07 02 01	NA	19830503	19830902	C	83-429
220 021	0560	01 07 03 02	04	19830503	19830902	C	83-330
220 022	N/A	01 07	NA	19830503	19840406	00	84-161
220 022	0660	01 08 01	06	19830503	19840427	C	84-254
220 022	0660	01 08 01(3, 7, 2)	06	19830503	19840427	C	84-255
220 023	N/A	03 07 03 15	NA	19830503	19830902	C	83-430
220 024	0595	03 07 03 02	04	19830503	19830902	C	83-352
220 025	N/A	03 08 02	NA	19830503	19840117	C*	83-431
220 025	N/A	03 08	NA	19830503	19840117	C	83-432
220 027	N/A	03 08 02	NA	19830503	19830902	C	83-434
220 028	N/A	03 08 02	NA	19830503	19830902	C	83-435
220 029	N/A	03 08 03	NA	19830503	19830902	C	83-436
220 030	N/A	01 08 03	NA	19830503	19840117	C	84-163
220 031	N/A	03 08 03	NA	19830503	19830902	C	83-439
220 032	N/A	03 08 04	NA	19830503	19830902	C	83-440
220 033	N/A	03 08	NA	19830503	19830715	C	83-441
220 034	N/A	03 08 04	NA	19830503	19830902	C	83-442
220 035	N/A	03 08	NA	19830503	19830902	C	83-443
220 036	N/A	03 08	NA	19830503	19830902	C	83-444
220 037	0617	09 01 02 02	05	19830503	19840117	C	84-141
220 037	0619	03 09 01	05	19830503	19840117	C	84-142
220 039	N/A	01 09 01	NA	19830503	19830902	C	83-446
AF01	N/A	N/A	NA	19831102	19840627	C	84-252
AF02	N/A	N/A	NA	19831102	19831102	C	83-447
AF03	N/A	N/A	NA	19831102	19831102	C	83-448



APP-3 LICENSING DOCUMENTS TRACKING SYSTEM HISTORY  
 RESPONSES TO NRC QUESTIONS  
 AS OF 3 JUL 1984

QUESTION NUMBER	SCH #	FSAR SECTION	AMEND #	NRC LTR DATE	RESPONSE DATE	SIS	ITEM ID
AF05	N/A	N/A	NA	19831102	19840627	C	04-071
AF06	N/A	N/A	NA	19831102	19831102	C	03-449
AF07	N/A	N/A	NA	19831102	19831102	C*	03-450
AF08	N/A	N/A	NA	19831102	19831102	PC	03-431
AF09	N/A	N/A	NA	19831102	19840627	C	04-269
AF09	N/A	N/A	NA	19831102	19831102	C	03-452
AF10	N/A	N/A	NA	19831102	19831102	C	03-453
AF11	N/A	N/A	NA	19831102	19840627	C	04-233
AF12	N/A	N/A	NA	19831102	19810627	C	04-073
AF13	N/A	N/A	NA	19831102	19831102	C	03-454
AF14	N/A	N/A	NA	19831102	19840627	C	04-074
AF15	N/A	N/A	NA	19831102	19840627	C	04-075
AF16	N/A	N/A	NA	19831102	19831102	C	03-455
AF17	N/A	N/A	NA	19831102	19840627	C	04-076
AF18	N/A	N/A	NA	19831102	19840627	C*	04-077
AF19	N/A	N/A	NA	19831102	19840627	C*	04-078
AF20	N/A	N/A	NA	19831102	19840627	C	04-079
AF21	N/A	N/A	NA	19831102	19840627	C	04-080
AF22	N/A	N/A	NA	19831102	19840627	C	04-081
AF23	N/A	N/A	NA	19831102	19840627	C	04-082
AF24	N/A	N/A	NA	19831102	19840627	C	04-083
AF25	N/A	N/A	NA	19831102	19840627	C	04-083

TOTAL COUNT = 69

## SUMMARY OF STRUCTURAL AUDIT

### FINDING NUMBER

### ISSUE

### RESPONSE

1	DECONVOLUTION/FINITE ELEMENT METHODOLOGY	ELASTIC HALF SPACE RESPONSE SPECTRA GENERATED AND COMPARED TO FINITE ELEMENT RESULTS.
2*	PEAK BROADENING OF RESPONSE SPECTRA BY EBASCO	BROADENING PERFORMED BY USERS.
3*	DIFFERENCES IN RESPONSE SPECTRA IN FSAR SECTIONS	R.G. 1.60 VS ACTUAL EXPECTED SPECTRA - CONSERVATIVE SPECTRA USED.
4	CONTAINMENT BUCKLING	TO BE PROVIDED.
5	EARTHQUAKE TIME HISTORY TRUN- CATION IN HORIZONTAL DIRECTION.	SPECTRA ENVELOPING VERIFIED.
6*	INPUT OF MODEL TO COMPUTER	CORRECT INPUT DEMONSTRATED BY MODE SHAPE OUTPUT DATA.

SUMMARY OF STRUCTURAL AUDIT (CONT'D)

<u>FINDING NUMBER</u>	<u>ISSUE</u>	<u>RESPONSE</u>
7*	POISSON'S RATIO FOR MAT AND WALLS	CORRECT VALUES USED
8	FINITE ELEMENT MODEL SENSITIVITY ANALYSIS	PROVIDED
9*	PROPERTIES OF FRESH AND WEATHERED SANDSTONE	VALUES USED ARE WITHIN THE MEASURED RANGES
10*	CONTAINMENT INTERNAL STEEL STRUCTURES MODELED AS PIN-ENDED	MODEL CONSISTENT WITH INDUSTRY DESIGN PRACTICES.
11	PEAK BROADENING PER R.G. 1.122	BROADENING PERFORMED BY USERS. REFER TO RESPONSE TO 220.22 FOR CONFORMANCE TO R.G. 1.122
12	VALUE OF POISSON'S RATIO FOR SOIL STRUCTURE INTERACTION	CORRECTNESS OF VALUE DEMONSTRATED.
13*	THERMAL EXPANSION COEFFICIENT	APPROPRIATE METHOD USED

SUMMARY OF STRUCTURAL AUDIT (CONT'D)

<u>FINDING NUMBER</u>	<u>ISSUE</u>	<u>RESPONSE</u>
14	ROCKING OMITTED FOR INTERFACE NODES BETWEEN ROCK AND STRUCTURE	EFFECT OF OMISSION ON DYNAMIC RESPONSE NEGLIGIBLE
15	VALUES OF SOIL/ <sup>SITE</sup> SPRING MODULI	CORRECTNESS OF VALUES DEMONSTRATED
16*	SRSS PROCEDURE FOR MAT	RESPONSE MADE TO QUESTION 220.17 - METHOD DOES NOT APPLY TO MAT
17	EFFECTS OF ASYMMETRICAL COMPONENTS OF ACCELERATION	EFFECTS DEMONSTRATED TO BE NEGLIGIBLE
18	USE OF SOME ACCELERATIONS IN SHIELD BUILDING ANALYSIS	JUSTIFICATION OF PROCEDURE PROVIDED
19	VERIFICATION THAT RESPONSE SPECTRA WERE PROPERLY BROADENED BY USERS	EQUIPMENT QUALIFICATIONS VERIFIED
20	SHIELD BUILDING STATIC ANALYSIS INPUTS	INPUT DATA VERIFIED
21	LOAD COMBINATIONS FOR SHIELD BUILDING	LOAD COMBINATIONS ARE CONSERVATIVE

## SUMMARY OF STRUCTURAL AUDIT (CONT'D)

### FINDING NUMBER

### ISSUE

### RESPONSE

22	NEGATIVE PRINCIPAL STRESSES FOR SHIELD BUILDING	CONSERVATISM OF DESIGN DEMONSTRATED FOR COMPRESSION AND BENDING CASE
23	COMPATIBILITY OF STATIC AND DYNAMIC ANALYSIS OF DRY COOLING TOWER	VERIFICATION PROVIDED
24	ADJUSTMENT FOR FOUNDATION UPLIFT IN FOUNDATION STABILITY ANALYSIS	FOUNDATION UPLIFT DEMONSTRATED TO HAVE NEGLIGIBLE EFFECT
25	DEMONSTRATION THAT ALL APPLICABLE LOADS AND LOAD COMBINATIONS WERE CONSIDERED	DOCUMENTATION PROVIDED DEMONSTRATING ALL APPLICABLE LOADS AND LOAD COMBINATIONS WERE PROPERLY CONSIDERED.

\* SUPPLY SYSTEM RESPONSE WAS ACCEPTED BY NRC IN THE AUDIT REPORT ISSUED NOVEMBER 2, 1983.

WASHINGTON PUBLIC POWER SUPPLY SYSTEM

WASHINGTON NUCLEAR PROJECT NO 3

SEISMIC DYNAMIC ANALYSIS

COMPARISON

OF

FINITE ELEMENT/BOUNDARIES APPROACH

AND

ELASTIC HALF-SPACE APPROACH

JUNE 1984

## PRESENTATION OVERVIEW

- 0 FOCUS ON RESPONSE TO AUDIT FINDING NO. 1 - - ACCEPT-  
ABILITY OF THE WNP-3 FINITE ELEMENT SEISMIC MODEL  
AND DECONVOLUTION ANALYSIS TECHNIQUE
  
- 0 REVIEW FINITE ELEMENT MODEL SELECTION BASIS
  
- 0 PRESENT ELASTIC HALF SPACE STUDIES AS VERIFICATION  
OF THE DESIGN BASIS FINITE ELEMENT MODEL
  - HALF SPACE ANALYSIS TECHNIQUES
  
  - MAJOR ASSUMPTIONS
  
  - SEISMIC FOUNDATION AND BUILDING MODELS
  
  - COMPARISON - - FEM VS HALF SPACE  
RESULTS
  
  - IMPACT - - ENGINEERING EVALUATIONS
  
- 0 CONCLUSIONS

## RESPONSE TO FINDING #1

AN ELASTIC HALF-SPACE APPROACH FOR SEISMIC DYNAMIC ANALYSIS OF CATEGORY I STRUCTURES HAS BEEN PERFORMED IN RESPONSE TO THE STAFF'S REQUEST. THE ANALYSIS RESULTS CONFIRM THE ACCEPTABILITY OF THE FINITE ELEMENT/BOUNDARIES APPROACH EMPLOYED FOR THE WNP-3 SEISMIC DESIGN.

SUFFICIENT ANALYSIS HAS BEEN PERFORMED TO DEMONSTRATE THE ACCEPTABILITY OF THE PRESENT DESIGN BASIS FOR WNP-3 (I.E., A FINITE ELEMENT APPROACH).

THE DETAILS OF THE ELASTIC HALF-SPACE ANALYSIS AND COMPARISON OF THE ANALYSIS RESULTS OF THE WNP-3 DESIGN BASIS ARE PRESENTED BELOW.



## SELECTION BASIS FOR FINITE ELEMENT SEISMIC ANALYSIS

- 0 FINITE ELEMENT/BOUNDARIES APPROACH WAS CHOSEN SINCE IT IS GENERALLY ACCEPTED AS THE BEST ANALYSIS METHOD FOR A DEEPLY EMBEDDED STRUCTURE.
  
- 0 USE OF FINITE ELEMENT APPROACH REQUIRED THE USE OF DECONVOLUTION ANALYSIS.
  
- 0 PROCEDURE FOR SEISMIC INPUT FOLLOWED THE GUIDELINES OF NUREG - 75/087 AND WAS ACCEPTED FOR THE CONSTRUCTION PERMIT.

HISTORICAL PERSPECTIVE OF WNP-3

WITH RESPECT TO DECONVOLUTION/FINITE ELEMENT ANALYSIS

ITEM

NUREG - 0800

CP BASIS

(1)

0

CONTROL MOTION APPLIED  
AT FOUNDATION LEVEL

0

CONTROL MOTION APPLIED  
AT PLANT GRADE.

(2)

0

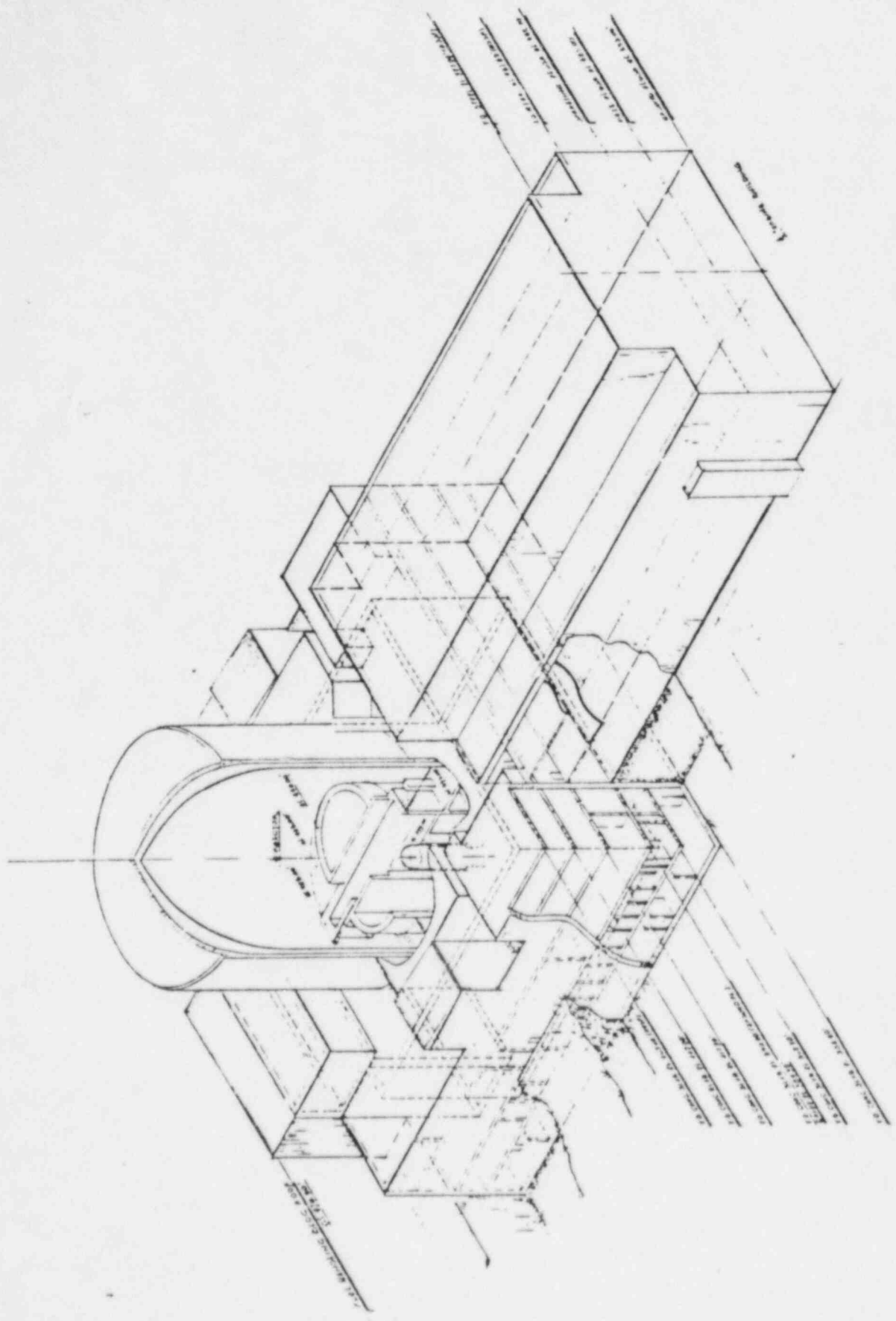
BOTH FINITE BOUNDARIES AND  
HALF-SPACE APPROACHES FOR  
INTERACTION ANALYSIS.

0

EITHER FINITE ELEMENT OR  
HALF-SPACE APPROACHES FOR  
INTERACTION ANALYSIS.

## ELASTIC HALF-SPACE STUDIES - PURPOSE/SCOPE

- 0 THE PURPOSE OF THIS STUDY IS TO DEMONSTRATE THE VALIDITY OF THE ORIGINAL FINITE ELEMENT ANALYSIS USING THE INDEPENDENT ELASTIC HALF SPACE METHOD OF ANALYSIS.
- 0 ANALYSES WERE PERFORMED FOR EACH OF THE THREE ORTHOGONAL DIRECTIONS (N-S, E-W, AND VERTICAL) SEPARATELY FOR ONE-TO-ONE COMPARISON WITH THE FINITE ELEMENT ANALYSIS RESULTS.
- 0 CATEGORY I STRUCTURES INCLUDED IN COMPARISON ARE:
  - A) RAB
  - B) SHIELD BUILDING
  - C) STEEL CONTAINMENT VESSEL
  - D) INTERNAL STRUCTURES INCLUDING RCS COMPONENTS
- 0 ONLY THE SSE IS USED FOR COMPARISON PURPOSES OF MAXIMUM RESPONSES



## ELASTIC HALF-SPACE ANALYSIS TECHNIQUES

- 0 USED THE TIME-HISTORY, MODAL SUPERPOSITION METHOD.
- 0 EMPLOYED NASTRAN COMPUTER CODE - INDUSTRY ACCEPTED.
- 0 ANALYSIS RESULTS GENERATED FOR COMPARISON ARE:
  - A) NATURAL FREQUENCIES AND MODE SHAPES
  - B) MAXIMUM BUILDING ACCELERATIONS
  - C) FLOOR RESPONSE SPECTRA

## ELASTIC HALF-SPACE MAJOR ANALYSIS ASSUMPTIONS

0 ANALYSIS ASSUMPTIONS ARE AS FOLLOWS:

- A) CONTROL MOTIONS ARE APPLIED AT THE FOUNDATION LEVEL OF THE STRUCTURE
- B) HALF SPACE AND EMBEDMENT FOUNDATION PROPERTIES ARE LINEARLY COMBINED
- C) COMPOSITE MODAL DAMPING RATIO IS LIMITED TO 0.20 AS THE UPPER BOUND
- D) TWO-DIMENSIONAL ANALYSIS
- E) MODAL SUPERPOSITION INCLUDED 23 MODES UP TO 33 CPS

## ELASTIC HALF-SPACE ANALYSIS MODEL

0 EQUIVALENT ROCK SPRINGS ACCOUNT FOR TWO MAJOR SOURCES OF INTERACTION

1. ELASTIC HALF-SPACE EFFECTS
2. EMBEDMENT EFFECTS

0 DAMPING OF THE FOUNDATION ROCK CONSISTS OF:

1. RADIATION DAMPING - MAJOR SOURCE - USED FORMULAS FROM ELASTIC HALF SPACE THEORY AND APPLIED A REDUCTION FACTOR FROM R.C. MURRAY, ET AL (REFERENCE 2)
2. MATERIAL DAMPING - MINOR EFFECT - USED THE AVERAGE DAMPING RATIO OF THE ROCK OF 0.025 FOR THE SSE CONDITION

0 DASHPOTS AT THE FOUNDATION MAT INCLUDE BOTH RADIATION AND MATERIAL DAMPING

0 DASHPOTS AT LOCATIONS ABOVE THE MAT CONSIDER ONLY THE MATERIAL DAMPING