February 8, 1989

Docket Nos.: 50-361 and 50-362

FACILITY: San Onofre Nuclear Generating Station, Unit Nos. 2 and 3

LICENSEE: Southern California Edison Company (SCE)

SUBJECT: SUMMARY OF MEETING HELD ON DECEMBER 7, 1988

RE: SPENT FUEL POOL RERACKING

On December 7, 1988, Southern California Edison Company (SCE) and representatives of their subcontractors, Westinghouse Electric Corporation (WEC) and Bechtel Power Corporation (BPC), met with NRR staff to discuss their plans to rerack the spent fuel pools of San Onofre Units 2 and 3. The list of attendees is provided in Enclosure 1.

The meeting consisted of a presentation by SCE and their subcontractors with questions, comments and discussion by the staff. Enclosure 2 provides the briefing slides prepared by SCE.

A list of issues to be addressed in the amendment request is provided as Enclosure 3.

original signed by

Donald E. Hickman, Project Manager
Project Directorate V
Division of Reactor Projects - III,
IV, V and Special Projects

Enclosures:
As stated

DISTRIBUTION
Docket File
NRC & Local PDRs
PD #5 Reading
JLee
DHickman
OGC (f/info only)
EJordan
BGrimes
ACRS (10)
MRJohnson (Region V)
NRC Participants

DRSP/PD5
DHickmand:rw
2/7/89

for DRSP/D:PD5
GKnighton
2/8/89

DFOl
1/1

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

February 8, 1989

Docket Nos.: 50-361 and 50-362

FACILITY: San Onofre Nuclear Generating Station, Unit Nos. 2 and 3

LICENSEE: Southern California Edison Company (SCE)

SUBJECT: SUMMARY OF MEETING HELD ON DECEMBER 7, 1988

RE: SPENT FUEL POOL RERACKING

On December 7, 1988, Southern California Edison Company (SCE) and representatives of their subcontractors, Westinghouse Electric Corporation (WEC) and Bechtel Power Corporation (BPC), met with NRR staff to discuss their plans to rerack the spent fuel pools of San Onofre Units 2 and 3. The list of attendees is provided in Enclosure 1.

The meeting consisted of a presentation by SCE and their subcontractors with questions, comments and discussion by the staff. Enclosure 2 provides the briefing slides prepared by SCE.

A list of issues to be addressed in the amendment request is provided as Enclosure 3.

Donald E. Hickman, Project Manager
Project Directorate V
Division of Reactor Projects - III, IV, V and Special Projects

Enclosures:
As stated

cc:

Mr. Gary D. Cotton
Senior Vice President
Engineering and Operations
San Diego Gas & Electric Company
101 Ash Street
Post Office Box 1831
San Diego, California 92112

Charles R. Kocher, Esq.
James A. Beoletto, Esq.
Southern California Edison Company
2244 Walnut Grove Avenue
P. O. Box 800
Rosemead, California 91770

Orrick, Herrington & Sutcliffe
ATTN: David R. Pigott, Esq.
600 Montgomery Street
San Francisco, California 94111

Alan R. Watts, Esq.
Rourke & Woodruff
701 S. Parker St. No. 7000
Orange, California 92668-4702

Mr. S. McClusky
Bechtel Power Corporation
P. O. Box 60860, Terminal Annex
Los Angeles, California 90060

Mr. C. B. Brinkman
Combustion Engineering, Inc.
7910 Woodmont Avenue, Suite 1310
Bethesda, Maryland 20814

Mr. Dennis F. Kirsh
U.S. Nuclear Regulatory Commission
Region V
1450 Maria Lane, Suite 210
Walnut Creek, California 94596

Mr. Sherwin Harris
Resource Project Manager
Public Utilities Department
City of Riverside
City Hall
3900 Main Street
Riverside, California 92522

Mr. Hans Kaspar, Executive Director
Marine Review Committee, Inc.
531 Encinitas Boulevard, Suite 105
Encinitas, California 92024

Mr. Mark Medford
Southern California Edison Company
2244 Walnut Grove Avenue
P. O. Box 800
Rosemead, California 91770

Mr. Robert G. Lacy
Manager, Nuclear Department
San Diego Gas & Electric Company
P. O. Box 1831
San Diego, California 92112

Richard J. Wharton, Esq.
University of San Diego School of Law
Environmental Law Clinic
San Diego, California 92110

Charles E. McClung, Jr., Esq.
Attorney at Law
24012 Calle de la Plaza/Suite 330
Laguna Hills, California 92653

Regional Administrator, Region V
U.S. Nuclear Regulatory Commission
1450 Maria Lane/Suite 210
Walnut Creek, California 94596

Resident Inspector, San Onofre NPS
c/o U. S. Nuclear Regulatory Commission
Post Office Box 4329
San Clemente, California 92672

ENCLOSURE 1

SPENT FUEL POOL RERACKING MEETING

SAN ONOFRE UNITS 2 AND 3

DECEMBER 7, 1988

LIST OF ATTENDEES

NAME	AFFILIATION	FUNCTION
Fred Nandy	SCE	Licensing
Jack Rainsberry	SCE	Licensing
Derrick Mercurio	SCE	Licensing
Raymond Baker	SCE	Project Engineering
Richard Blaschke	SCE	Civil Engineering
Richard Miller	SCE	Civil Enginerring
Dennis Ostrom	SCE	Civil Engineering
Tom Watson	WEC	Engineering Analysis
Keith Matthews	WEC	Licensing
Harry Flanders	WEC	NCD Analysis
Don Green	WEC	NCD Analysis
William Guerin	WEC	Nuclear Safety
Richard Day	BPC	Structural Engineering
Selcuk Atalik	BPC	Task Engineering
Don Hickman	NRR	Project Manager
Charles Trammell	NRR	Project Manager
Jerry Wermiel	NRR	Plant Systems
Norman Wagner	NRR	Plant Systems
Neil Thompson	NRR	Structural Engineering
Hans Asher	NRR	Structural Engineering
David Jeng	NRR	Structural Engineering
Herman Graves	NRC	Research
Giuliano DeGrassi	NRC	Brookhaven National Lab

ENCLOSURE 2

SPENT FUEL POOL RERACKING

HEAVY LOADS EVALUATION

SAN ONOFRE UNITS 2 AND 3

DECEMBER 7, 1988

AGENDA

I. INTRODUCTION (SCE)
DERRICK MERCURIO

II. HEAVY LOADS (BECHTEL)
RICHARD DAY

I. INTRODUCTION

A. SCOPE

1. INCREASE SPENT FUEL STORAGE CAPACITY

   A. INCREASE FROM 800 TO APPROXIMATELY 1572 ASSEMBLIES PER UNIT

   B. STORAGE CAPACITY TO YEAR 2002 WITH CORE OFF-LOAD

I. INTRODUCTION

B. PROJECT SCHEDULE AND MILESTONES

6/3/88 - INITIAL MEETING WITH NRC

12/7/88 - MEETING WITH NRC

2/1/89 - SUBMITTAL OF PROPOSED LICENSE AMENDMENT

3/30/89 - BEGIN RACK FABRICATION FOR UNIT 2

8/1/89 - LICENSE AMENDMENT ISSUED BY NRC

10/2/89 - RACK DELIVERY FOR UNIT 2

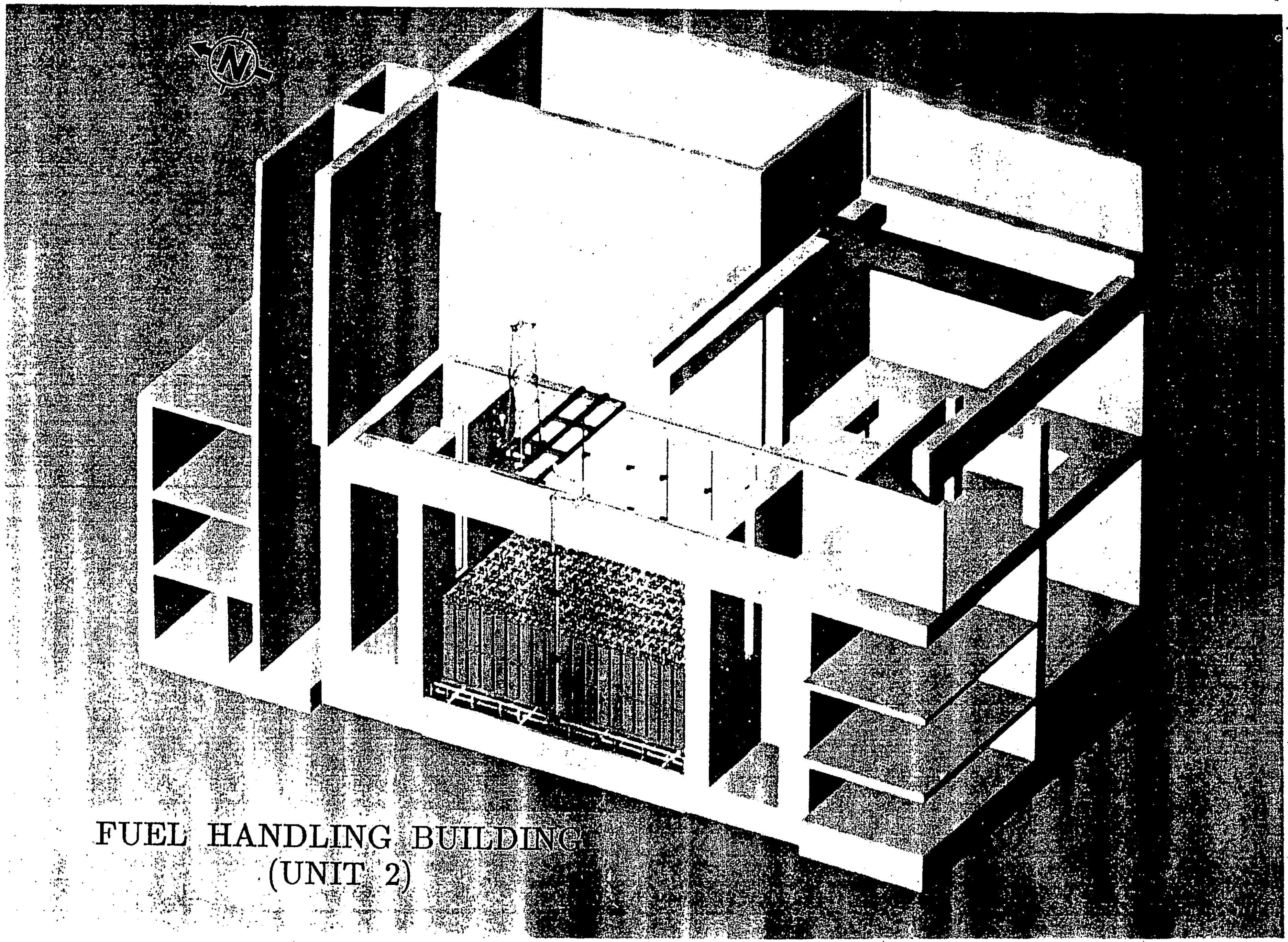
10/89 - BEGIN RACK INSTALLATION IN UNIT 2 (COMPLETE RACK INSTALLATION DURING CYCLE 5 OPERATION)

C. HEAVY LOADS CONSIDERATIONS

- CONSTRUCTION SEQUENCING
  - TEMPORARY SPENT FUEL STORAGE IN CASK POOL
- TEMPORARY CRANE - JANUARY 15, 1989 AWARD
- NUREG-0612 EVALUATION

AGENDA

1. RACK REMOVAL/INSTALLATION SEQUENCING
2. SAFE LOAD PATHS
3. TEMPORARY CONSTRUCTION CRANE
4. CONTROL OF HEAVY LOADS (NUREG 0612)
5. POSTULATED CONSTRUCTION LOAD DROP
6. CASK POOL COVER DESIGN FUNCTIONS



FUEL HANDLING BUILDING
(UNIT 2)

RACK REMOVAL/INSTALLATION SEQUENCING

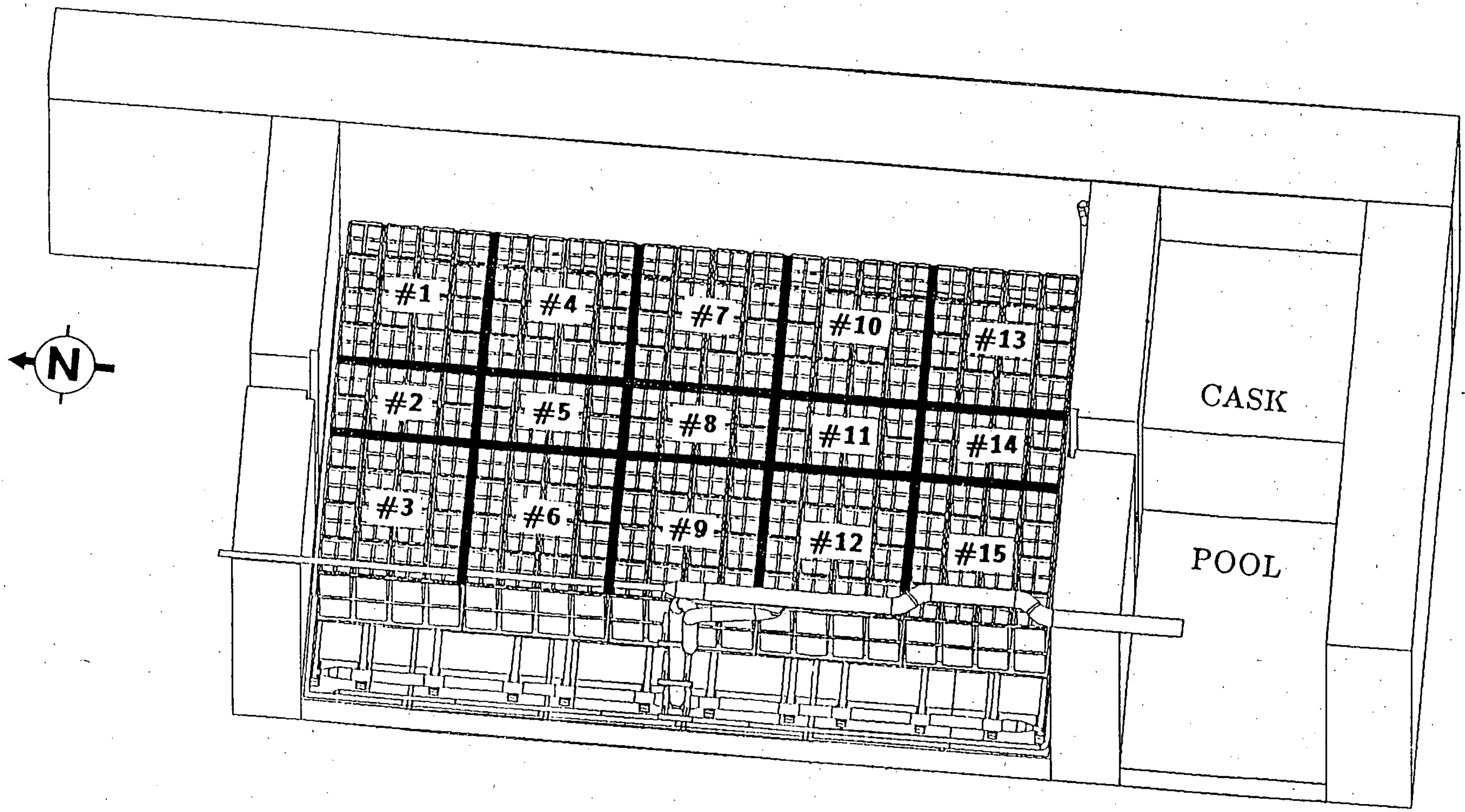
APPROACH

- SPENT FUEL STORED IN CASK POOL (DURING RERACKING)

SIGNIFICANT CRITERIA

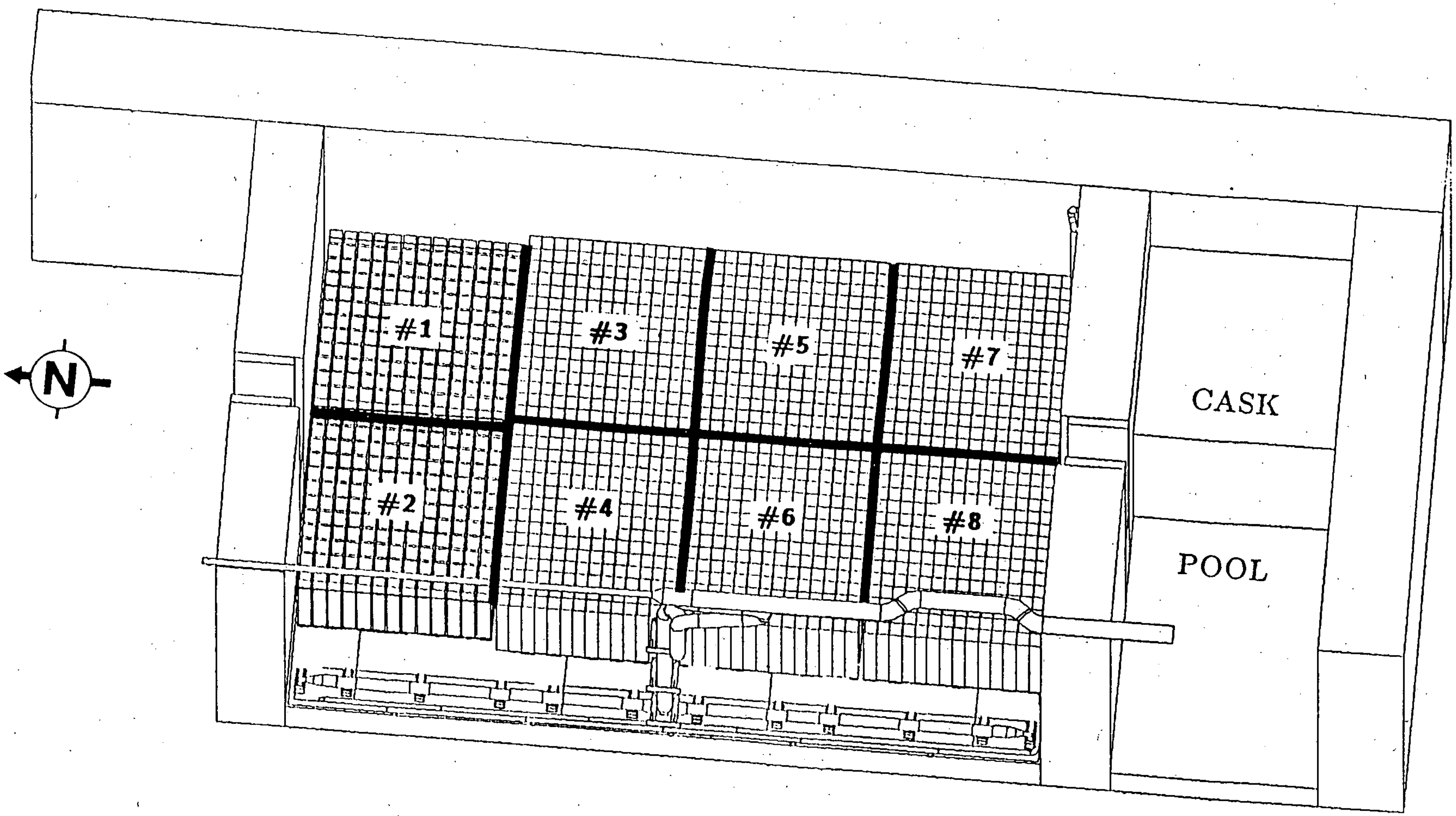
- MAINTAIN SAFE LOAD PATH
- PROVIDE MINIMUM 3 EMPTY ROWS OF CELLS (NO SPENT FUEL) ADJACENT TO WORK AREA
- PROVIDE FLEXIBILITY IN SPENT FUEL LOCATIONS
- MINIMIZE REQUIRED FUEL SHUFFLING

SPENT FUEL POOL
(UNIT 2)



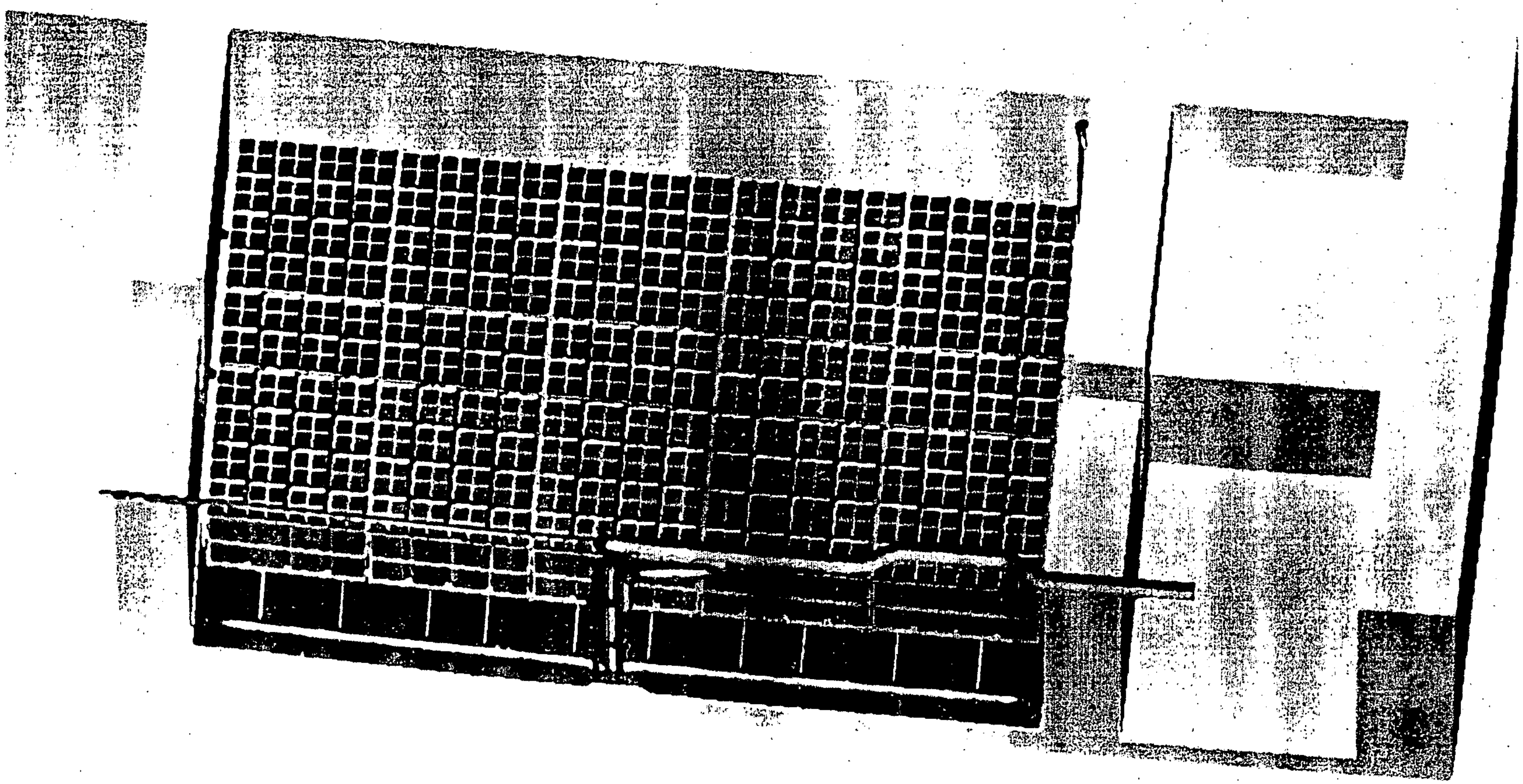
ORIGINAL CONDITION

SPENT FUEL POOL
(UNIT 2)



FINAL CONFIGURATION

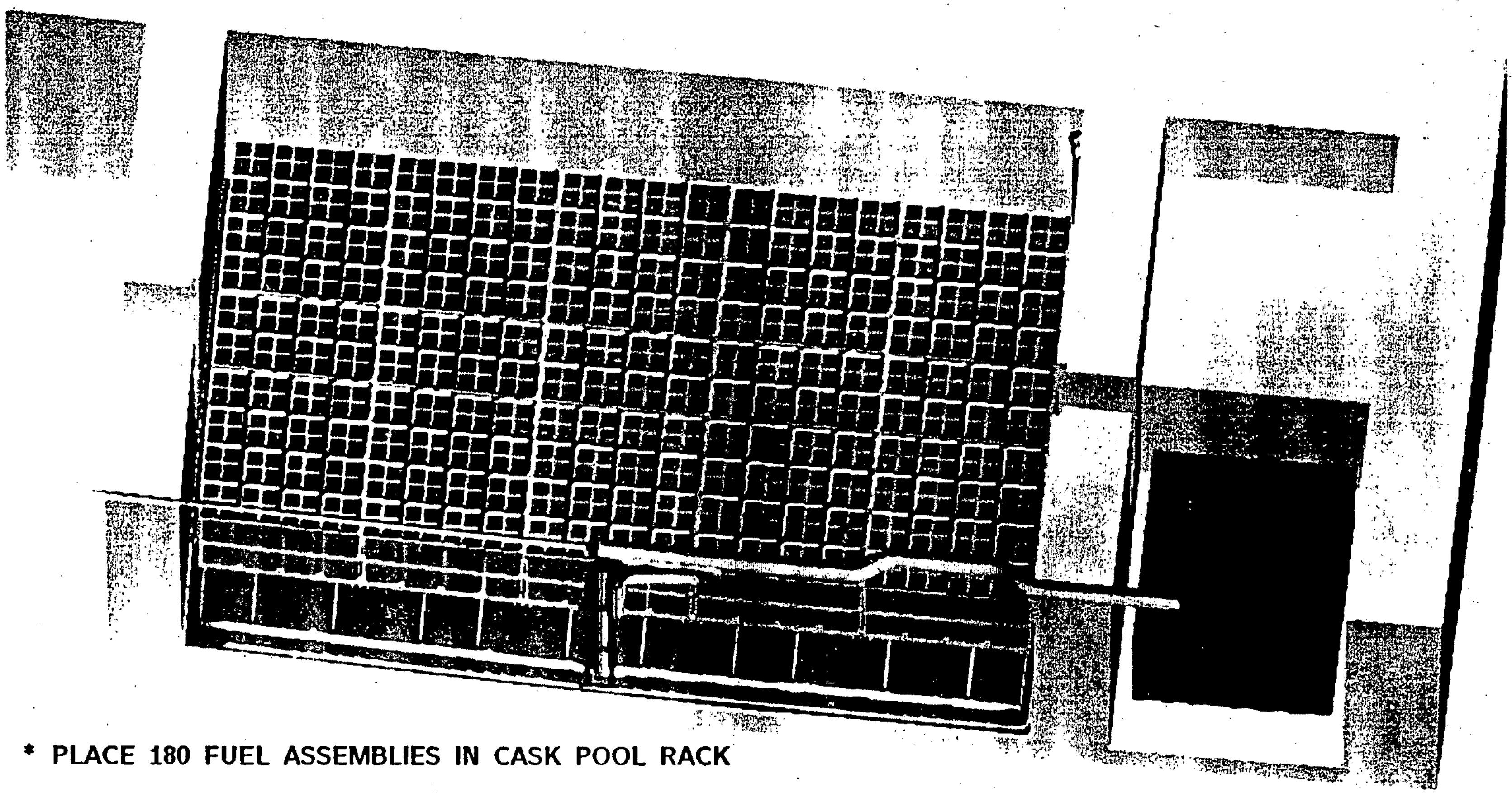
RERACK SEQUENCING
SPENT FUEL POOL (UNIT 2)



* 800 FUEL STORAGE LOCATIONS IN EXISTING RACKS
* 480 FUEL ASSEMBLIES STORED IN POOL (POST CYCLE 5 REFUELING)
* 320 EMPTY FUEL STORAGE LOCATIONS

ORIGINAL CONDITION

PROPOSED RERACK SEQUENCING



* PLACE 180 FUEL ASSEMBLIES IN CASK POOL RACK

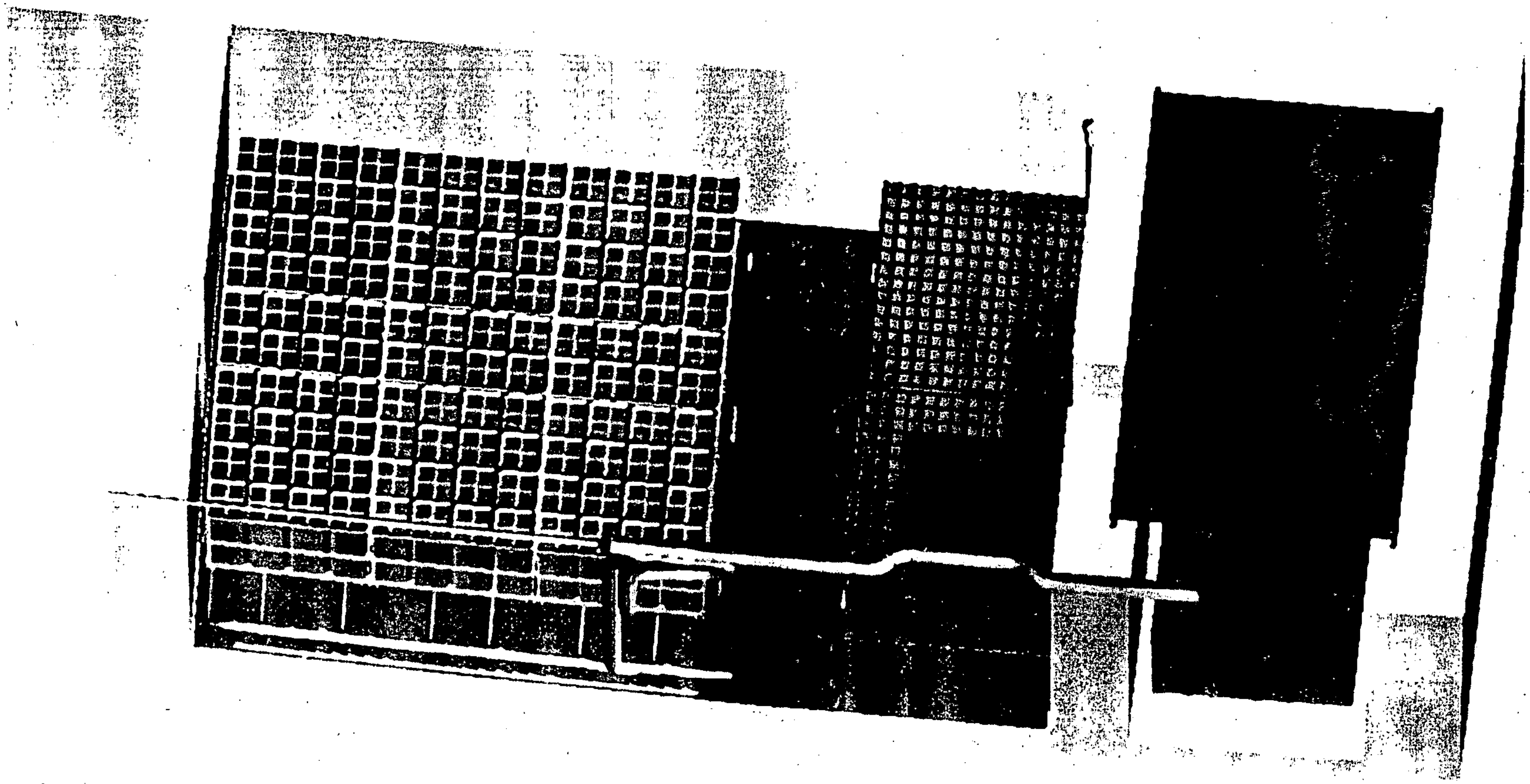
* PLACE PROTECTIVE COVER OVER CASK HANDLING POOL

* LOCATE REMAINING 300 FUEL ASSEMBLIES AT NORTH END
* REMOVE NES RACKS #10-15

* REMOVE PIPING AND SUPPORTS FROM VACATED AREA

STEP 1

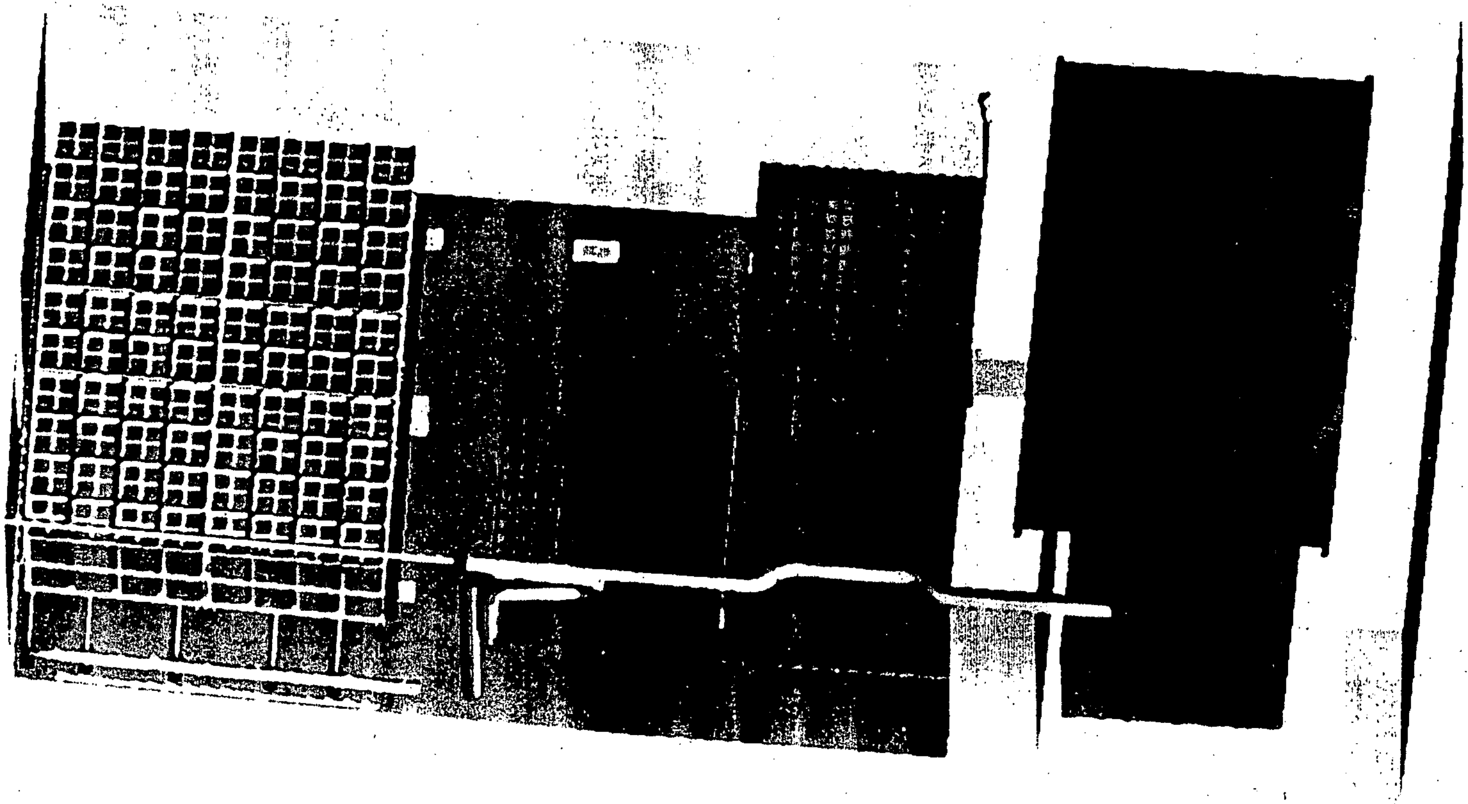
PROPOSED RERACK SEQUENCING



* INSTALL W RACKS #7 & 8
* SHIFT 132 FUEL ASSEMBLIES INTO W RACK #8
* REMOVE NES RACKS #7-9
* REMOVE PIPING AND SUPPORTS FROM VACATED AREA

STEP 2

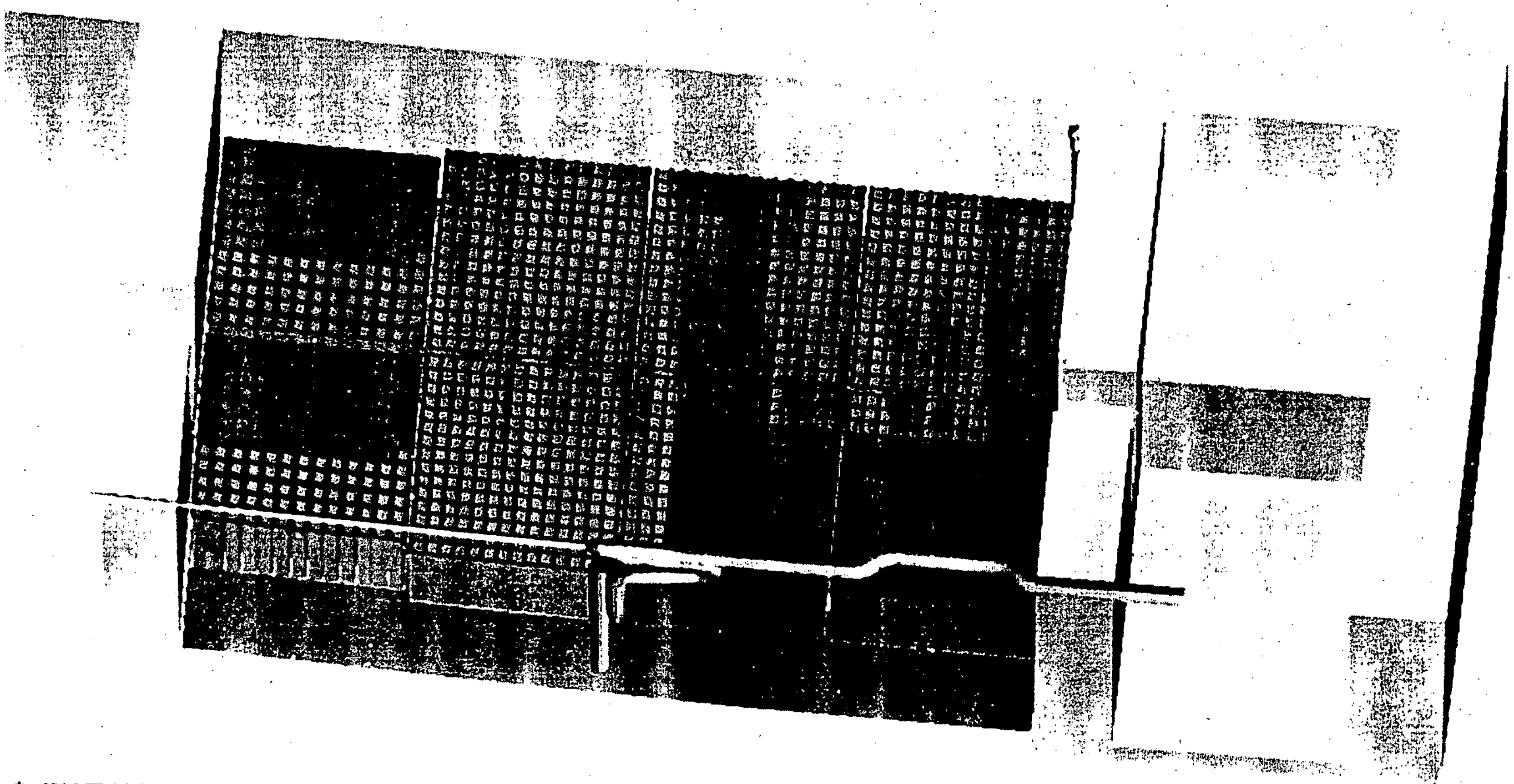
PROPOSED RERACK SEQUENCING



* INSTALL W RACK #6
* PLACE ALL FUEL ASSEMBLIES IN W RACKS #6 & 8
* REMOVE NES RACKS #1-6
* REMOVE REMAINING PIPING AND SUPPORTS

STEP 3

PROPOSED RERACK SEQUENCING

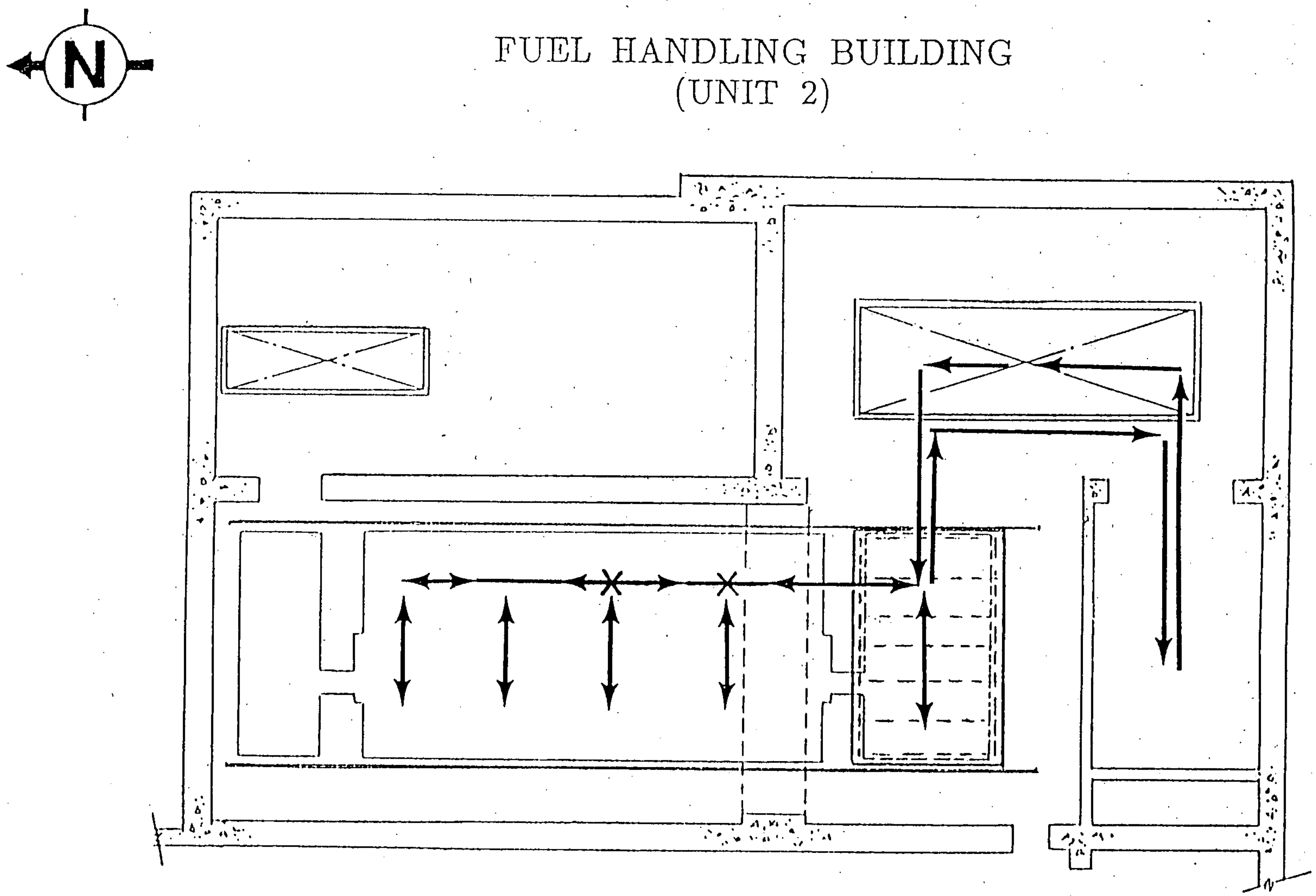


* INSTALL W RACKS #1-4
* REMOVE PROTECTIVE COVER FROM CASK HANDLING POOL
* SHIFT 180 FUEL ASSEMBLIES FROM CASK POOL TO SPENT FUEL POOL
* PLACE W RACK #7 IN SPENT FUEL POOL

STEP 4

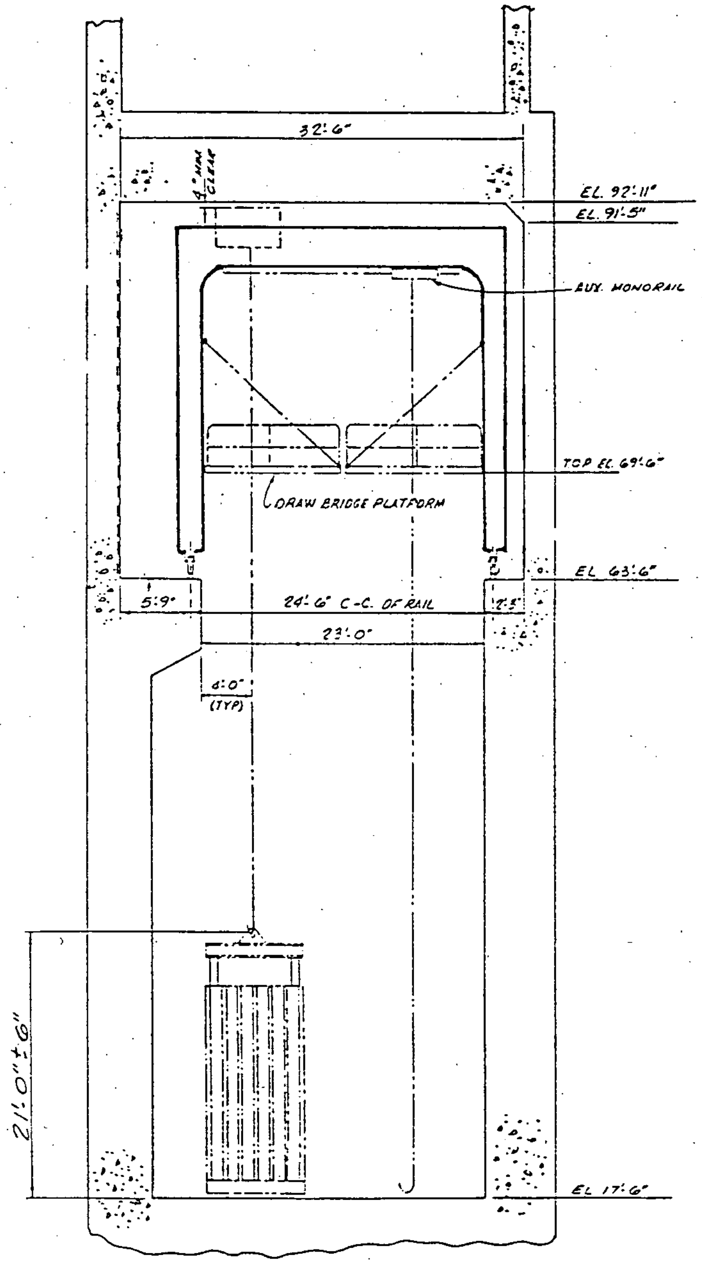
SAFE LOAD PATHS

FUEL HANDLING BUILDING
(UNIT 2)



PARTIAL PLAN AT ELEV. 63'-6"
POOL DECK

TEMPORARY CONSTRUCTION GANTRY CRANE



SECTION - SPENT FUEL POOL
(UNIT 2)

TEMPORARY GANTRY CRANE

- 35 TON UPGRADED COMMERCIAL CLASS C
- MEET CMAA-70 AND CHAPTER 2-1 OF ANSI B30.2 REQUIREMENTS
- FACTOR OF SAFETY FOR LOAD BEARING MEMBERS
  - 3 AGAINST MINIMUM TENSILE YIELD STRENGTH
  - 5 AGAINST AVERAGE ULTIMATE STRENGTH
- MEET SRP LOAD COMBINATIONS (INCLUDES DBE)
- DUAL HOLDING BRAKES ON HOISTS (MAIN AND AUXILIARY) RATED AT 150% OF MOTOR TORQUE
- GANTRY AND TROLLEY BRAKES RATED AT 150% MOTOR TORQUE
- HOOKS TESTED AT TWICE RATED CAPACITY

NUREG 0612

CONTROL OF HEAVY LOADS AT NUCLEAR POWER PLANTS

SECTION	TITLE
5	GUIDELINES FOR CONTROL OF HEAVY LOADS
5.1.1	GENERAL (GUIDELINES)
5.1.2	SPENT FUEL POOL AREA - PWR

NUREG 0612

SECTION 5.1.1 GENERAL (GUIDELINES)

REQUIREMENTS	EXTENT OF COMPLIANCE
2. PROCEDURES	COMPLY
3. CRANE OPERATORS	COMPLY
4. SPECIAL LIFTING DEVICES	COMPLY
5. LIFTING DEVICES THAT ARE NOT SPECIALLY DESIGNED (SLINGS)	COMPLY
7. CRANE DESIGN	COMPLY

NUREG 0612

SECTION 5.1.2 (GUIDELINES FOR) SPENT FUEL POOL AREA - PWR

REQUIREMENTS	EXTENT OF COMPLIANCE
(3) (a) "HOT" SPENT FUEL AT ONE LOCATION WITH MAXIMUM SEPARATION FROM LOAD PATH	COMPLY (NO "HOT" FUEL)
(b) PREVENT LOAD BLOCK MOVEMENT WITHIN 25' (HORIZ) OF "HOT" FUEL	COMPLY (NO "HOT" FUEL)

NUREG 0612

SECTION 5.1.2 (GUIDELINES FOR) SPENT FUEL POOL AREA - PWR

REQUIREMENTS	EXTENT OF COMPLIANCE
(3) (c) MECHANICAL STOP/ELECTRICAL INTERLOCK TO PREVENT TRAVEL WHERE DROP COULD DAMAGE EQUIPMENT (SAFE SHUTDOWN)	COMPLY (NOT APPLICABLE)
- ANALYZE DROPS IN UNRESTRICTED TRAVEL AREAS TO ENSURE NOT CAUSE OF CRITICALITY, LEAKAGE UNCOVERING FUEL, OR LOSS OF SAFE SHUTDOWN EQUIPMENT	COMPLY

NUREG 0612

SECTION 5.1.1 GENERAL (GUIDELINES)

REQUIREMENTS	EXTENT OF COMPLIANCE
1. SAFE LOAD PATHS	**COMPLY -** EXCEPT MARKINGS OF FLOOR
6. CRANES - INSPECTION, TESTING, AND MAINTENANCE PER CHAPTER 2-2 OF ANSI B30.2-1976	**COMPLY -** EXCEPT LOAD TESTS (2-2.2.2) PERFORMED AT SHOP AND SITE PRIOR TO INSTALLATION

TEMPORARY GANTRY CRANE TESTING

PER ANSI B30.2-1976

- OPERATIONAL TESTS (SECTION 2-2.2.1)

  AT FACTORY PRIOR TO SHIPMENT

  AT SITE PRIOR TO FINAL INSTALLATION

  IN PLACE (OVER POOLS) PRIOR TO INITIAL USE

- RATED LOAD TEST (SECTION 2-2.2.2)

  AT FACTORY PRIOR TO SHIPMENT (1.25 X 35 TON)

  AT SITE PRIOR TO FINAL INSTALLATION (1.25 X 35 TON)

- MODIFIED LOAD TEST (HOIST & TROLLEY ONLY)

  IN PLACE (OVER CASK POOL ONLY) PRIOR TO INITIAL USE
  (1.25 X MAX. ANTICIPATED LOAD)

NUREG 0612

SECTION 5.1.2 (GUIDELINES FOR) SPENT FUEL POOL AREA - PWR

REQUIREMENTS	EXTENT OF COMPLIANCE
(3) (b) LOAD BLOCK MOVEMENT WITHIN 25' (HORIZ) OF FUEL	
- SUFFICIENT FUEL DECAY	COMPLY
- APPROVAL OF SHIFT SUPERVISOR	MEET INTENT BY PROCEDURE APPLICATION AND SCHEDULED WORK ACTIVITIES
MECHANICAL STOP/ELECTRICAL INTERLOCK IN PLACE PRIOR TO PLACING "HOT" FUEL IN POOL	COMPLY

NUREG 0612

SECTION 5.1.2 (GUIDELINES FOR)
SPENT FUEL POOL AREA - PWR

REQUIREMENTS	EXTENT OF COMPLIANCE
(3) (b) LOAD BLOCK MOVEMENT WITHIN 25' (HORIZ) OF FUEL	
- SUFFICIENT FUEL DECAY	COMPLY
- APPROVAL OF SHIFT SUPERVISOR	MEET INTENT BY PROCEDURE APPLICATION AND SCHEDULED WORK ACTIVITIES
MECHANICAL STOP/ELECTRICAL INTERLOCK IN PLACE PRIOR TO PLACING "HOT" FUEL IN POOL	COMPLY (NOT APPLICABLE)

NUREG 0612

SECTION 5.1.2 (GUIDELINES FOR) SPENT FUEL POOL AREA - PWR

REQUIREMENTS	EXTENT OF COMPLIANCE
(3) (d) CARRY LOAD (CASK) MAXIMUM 6 INCHES, OR LESS, ABOVE FLOOR	MAXIMUM 24 INCHES IN POOL (RACK WEIGHT << CASK) EXCEPT WHEN ENTERING/ LEAVING ALL OTHER AREAS 12 INCH MAXIMUM
(3) (e) ANALYZE POSTULATED LOAD DROPS PER NUREG APPENDIX A	COMPLY - APPLYING DROP ANALYSES TO NORMAL TRAVEL PATHS

POSTULATED CONSTRUCTION LOAD DROP

SPENT FUEL POOL

RESULTS:

1) LINER (3/16" THICK) AND RELINER (1/8" THICK) PENETRATED

2) CONCRETE BASEMAT PENETRATED ABOUT 5 3/4 INCHES (7% OF THICKNESS)

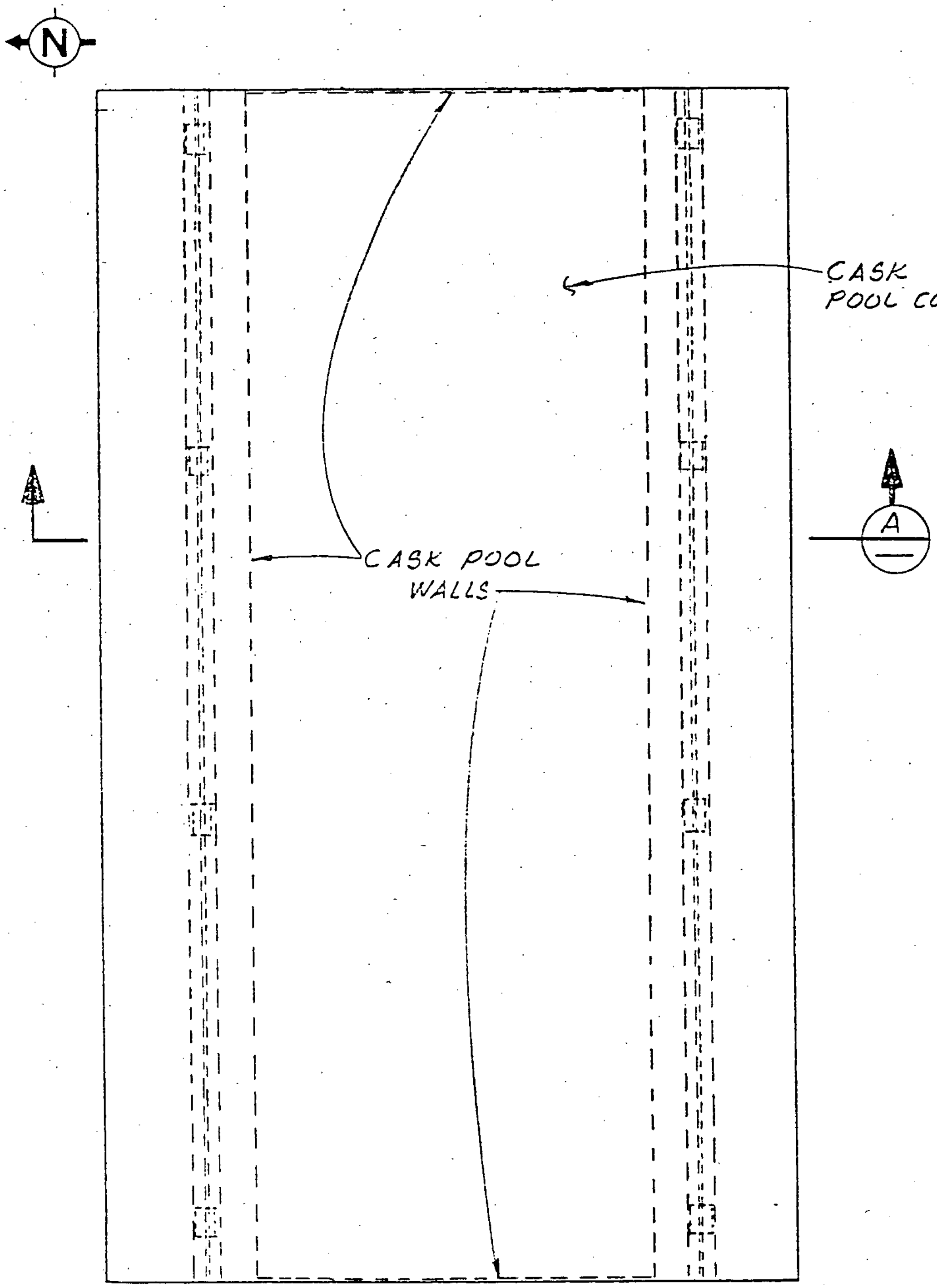
3) LEAKAGE CONFINED TO LEAK CHASE SYSTEM (MAXIMUM FLOW RATE $<$ 60 GPM)

4) MAKEUP WATER SUPPLY (150 GPM)

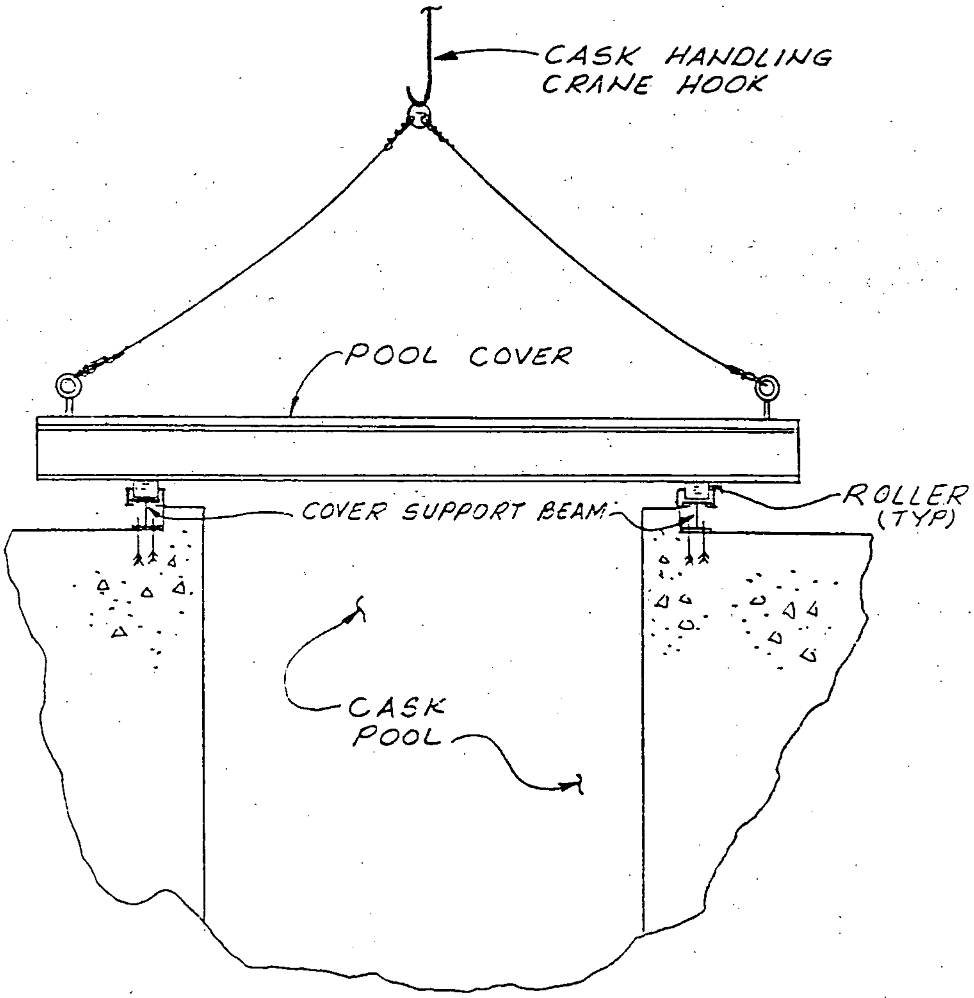
5) TECHNICAL SPECIFICATION WATER LEVEL MAINTAINED

CASK POOL COVER
DESIGN FUNCTIONS

- PRECLUDE COVER DROP IN CASK POOL DURING INSTALLATION/REMOVAL
- WITHSTAND POSTULATED CONSTRUCTION LOAD DROPS (COMPLY WITH NUREG 0612 APPENDIX A)
- ANCHOR COVER TO POOL DECK
- PROVIDE UNIFORM WORKING SURFACE (LAYDOWN AREA)



PLAN (CASK POOL COVER)


CASK HANDLING
CRANE HOOK
POOL COVER
COVER SUPPORT BEAM
ROLLER
(TYP)
CASK
POOL

SECTION (A)

SAN ONOFRE NUCLEAR GENERATING STATION

UNITS 2 AND 3

SPENT FUEL POOL RERACK

PRESENTATION

DECEMBER 7, 1988

AGENDA

I. INTRODUCTION (SCE)
DERRICK MERCURIO

II. SEISMIC ANALYSES OF SPENT FUEL RACKS (WESTINGHOUSE)
HARRY FLANDERS

I. INTRODUCTION

A. <u>SCOPE</u>

1. INCREASE SPENT FUEL STORAGE CAPACITY

   A. INCREASE FROM 800 TO APPROXIMATELY 1572 ASSEMBLIES PER UNIT

   B. STORAGE CAPACITY TO YEAR 2002 WITH CORE OFF-LOAD

I. INTRODUCTION

B. <u>RACK DESIGN PARAMETERS</u>

1. FREE STANDING RACKS

2. FIXED BORAFLEX POISON

3. 2 REGION DESIGN

   A. 312 LOCATIONS (APPROXIMATE) - NEW AND RECENTLY IRRADIATED FUEL

   B. 1260 LOCATIONS (APPROXIMATE) - IRRADIATED FUEL

4. LICENSE FOR 4.1% ENRICHED FUEL (5.1% DESIGN)

5. STORE UNITS 1, 2 AND 3 FUEL

I. INTRODUCTION

C. PROJECT SCHEDULE AND MILESTONES

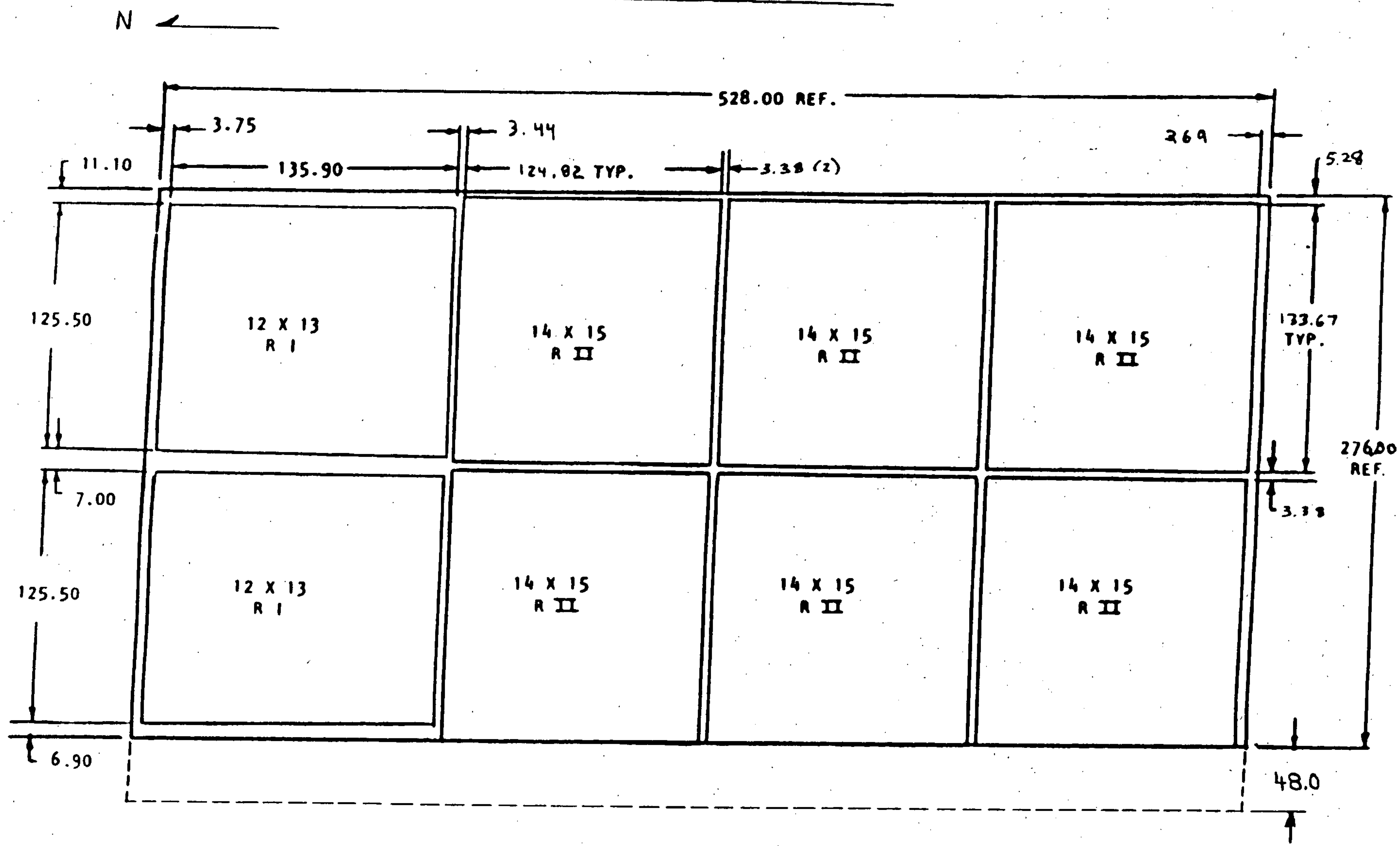
6/3/88	-	INITIAL MEETING WITH NRC
12/7/88	-	MEETING WITH NRC
2/1/89	-	SUBMITTAL OF PROPOSED LICENSE AMENDMENT
3/30/89	-	BEGIN RACK FABRICATION FOR UNIT 2
8/1/89	-	LICENSE AMENDMENT ISSUED BY NRC
10/2/89	-	RACK DELIVERY FOR UNIT 2
10/89	-	BEGIN RACK INSTALLATION IN UNIT 2 (COMPLETE RACK INSTALLATION DURING CYCLE 5 OPERATION)

SAN ONOFRE UNITS 2 & 3 FUEL RACKS SEISMIC ANALYSIS

- o Pool Layout
- o Background Information
- o Fuel Rack Structural Model
- o Single Rack Seismic Models
  - Full Fuel Loading
  - Partial Fuel Loading (Quadrant)
  - Partial Fuel Loading (4 Rows)
  - Partial Fuel Loading (1 Row)
  - Empty Rack
  - Displacement Results
- o Multiple Rack Seismic Models
  - Full/Full
  - Full/Empty
- o Displacement Results
  - Rack Absolute Displacements
  - Rack Relative Displacements
  - Displacement Characteristics
- o Conservatisms

AEA-88-304

SAN ONOFRE UNIT 2 OR UNIT 3
SPENT FUEL POOL LAYOUT



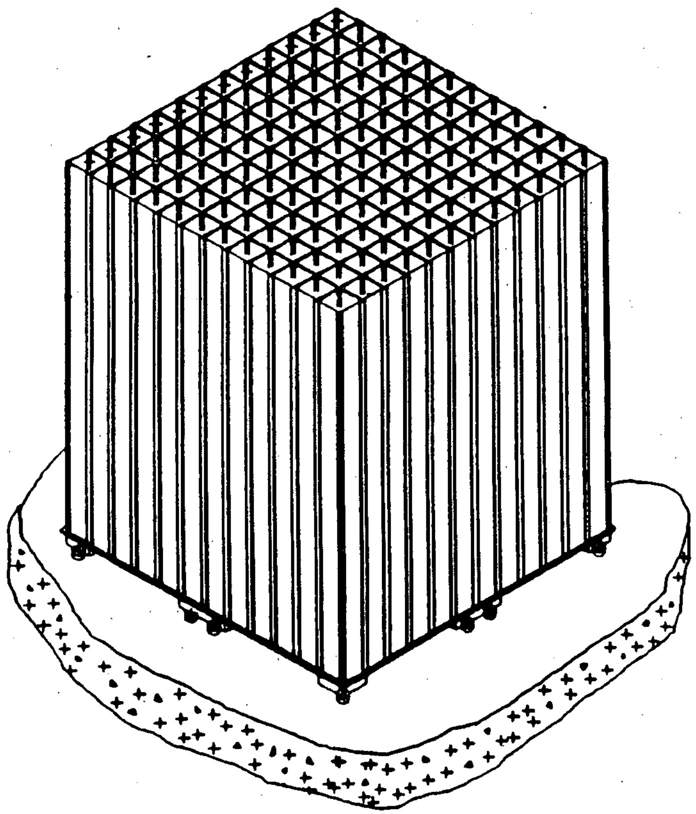
BACKGROUND INFORMATION

BACKGROUND INFORMATION

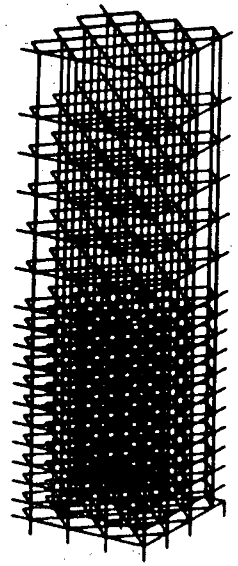
Friction	-	.8 Maximum/.2 Minimum
	-	Reference: Rabinowicz, E., Friction Coefficients of Water - Lubricated Stainless Steels for a Spent Fuel Rack Facility, Report Q 23.1.3 to Boston Edison Co., November 1976
Finite Element Code	-	WECAN, Westinghouse Electric Computer Analysis. Configuration control under strict QA standards. Generic review by NRC and reviewed 2 times by Franklin Institute for fuel rack application.
Hydrodynamic Mass	-	Potential flow theory
	-	Reference: Fritz, R. J., The Effects of Liquids on the Dynamic Motions of Immersed Solids, Transactions of the ASME, February 1972
Time History	-	Developed by Bechtel
	-	Three statistically independent components
	-	80 seconds duration
Standard Fuel Characteristics	-	Dynamic properties supplied by fuel vendor

FUEL RACK STRUCTURAL MODEL

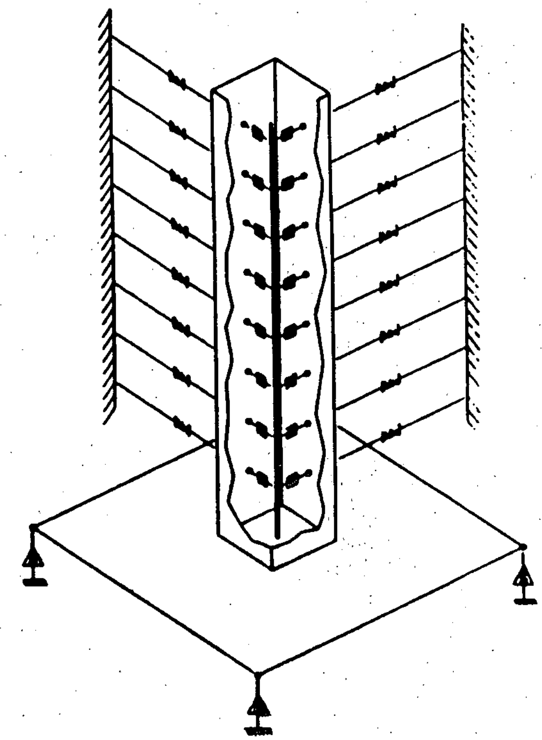
SEISMIC MODEL DEVELOPMENT



FUEL RACK MODULE

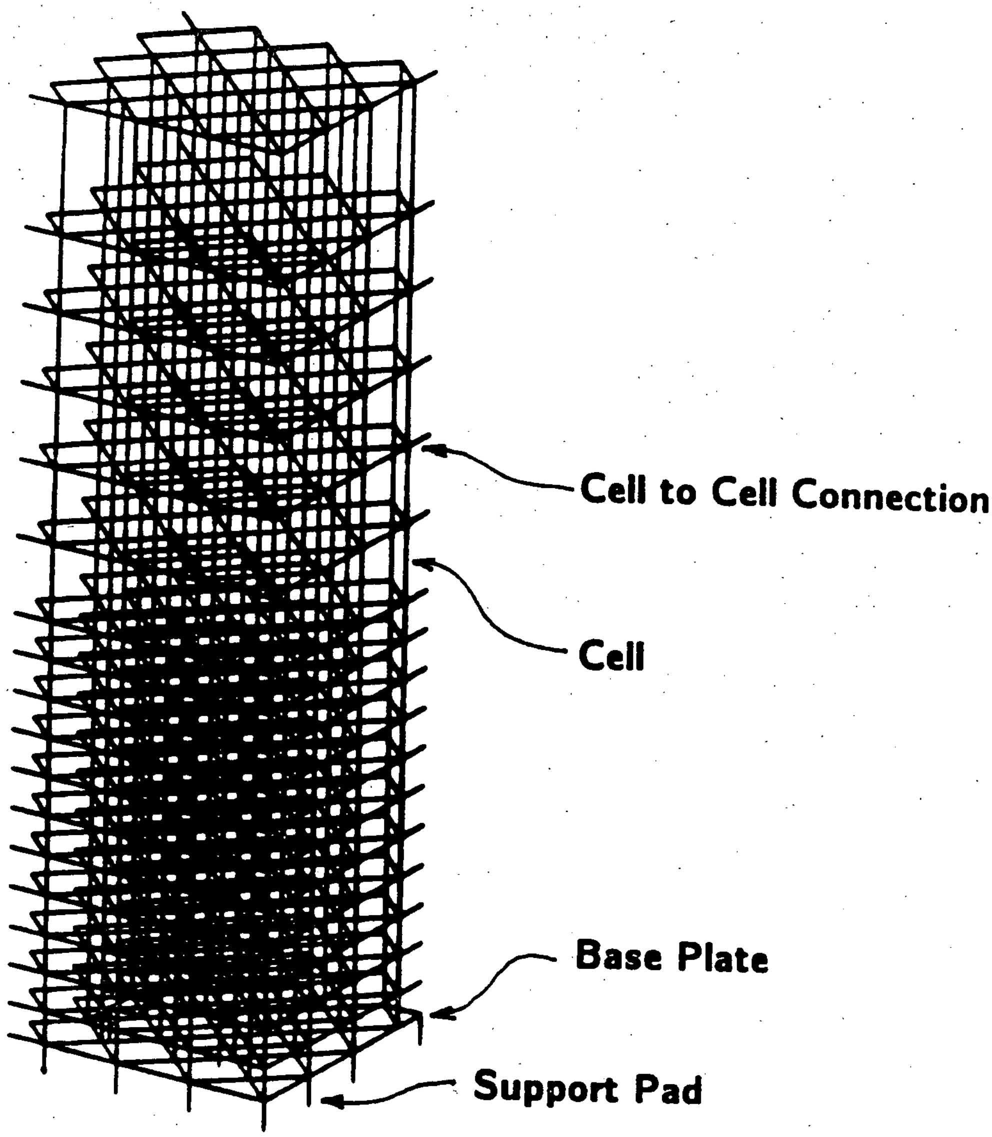


STRUCTURAL MODEL

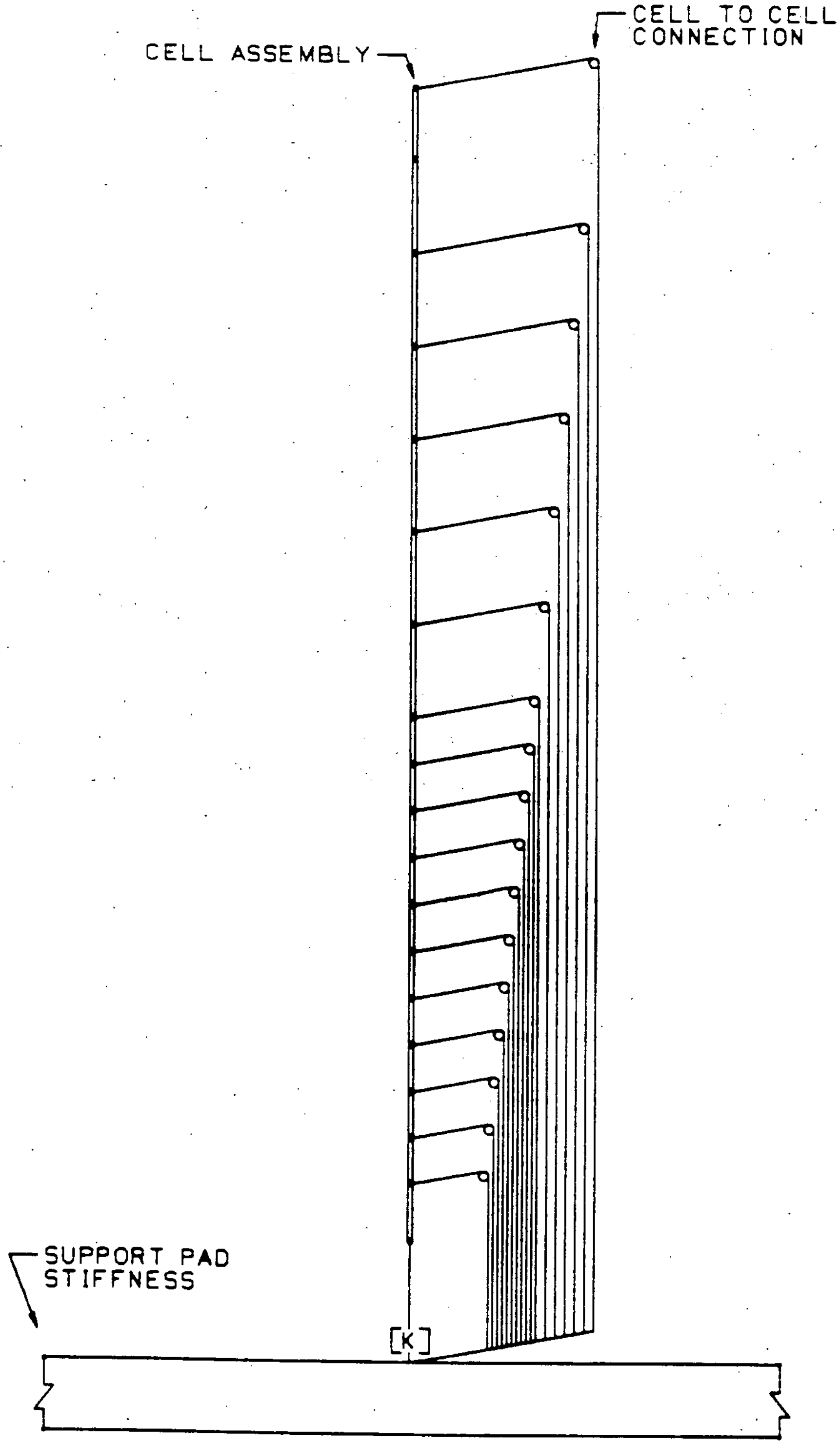


SEISMIC MODEL

FUEL RACK STRUCTURAL MODEL
REGION II

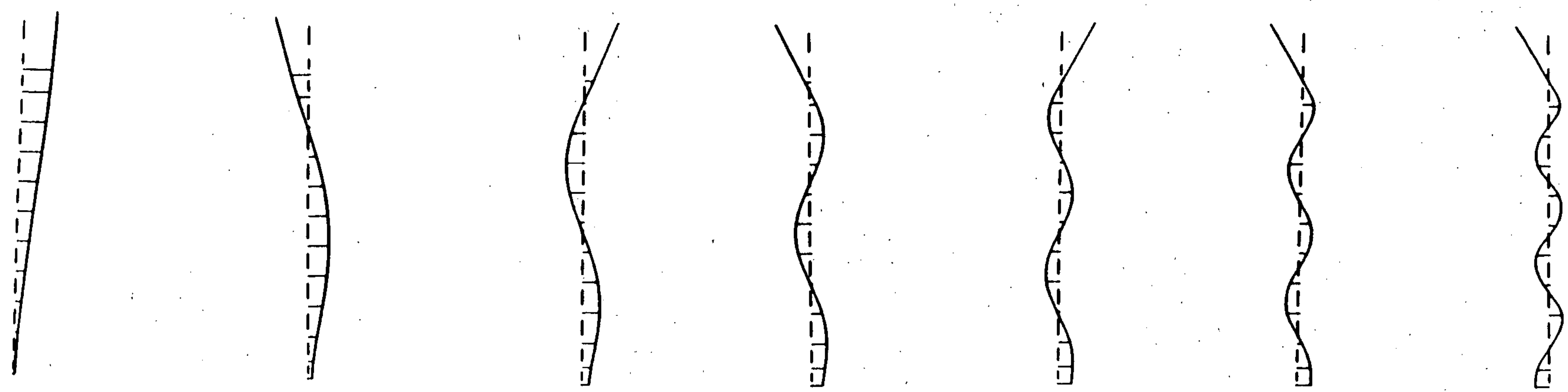


EFFECTIVE STRUCTURAL PROPERTIES



EQUIVALENT STRUCTURAL MODEL

MODE SHAPES

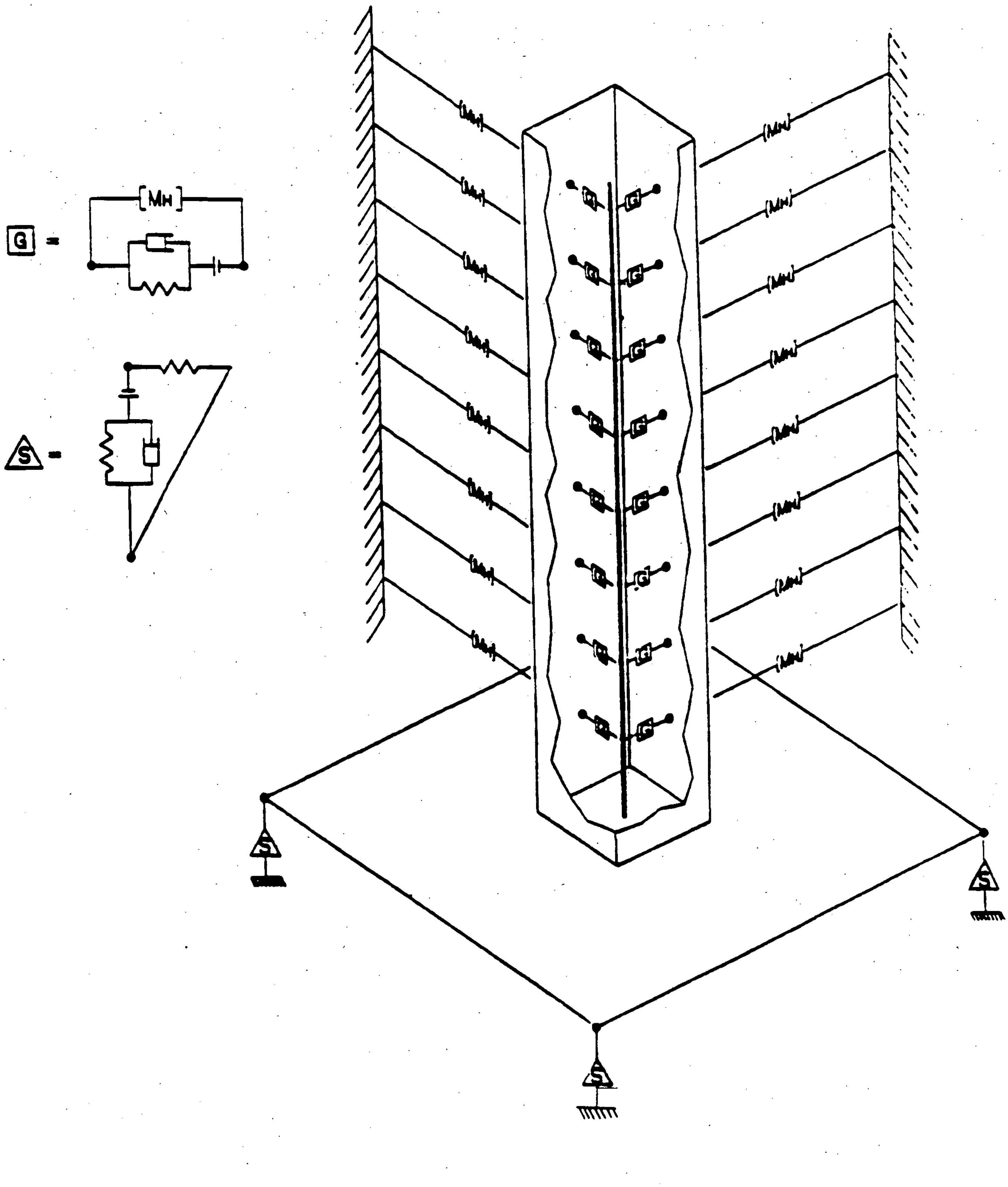


1ST MODE	2ND MODE	3RD MODE	4TH MODE	5TH MODE	6TH MODE	7TH MODE
12.7 H_Z	40.4 H_Z	74.5 H_Z	116.3 H_Z	165.8 H_Z	226.8 H_Z	304.2 H_Z

SINGLE RACK SEISMIC MODELS

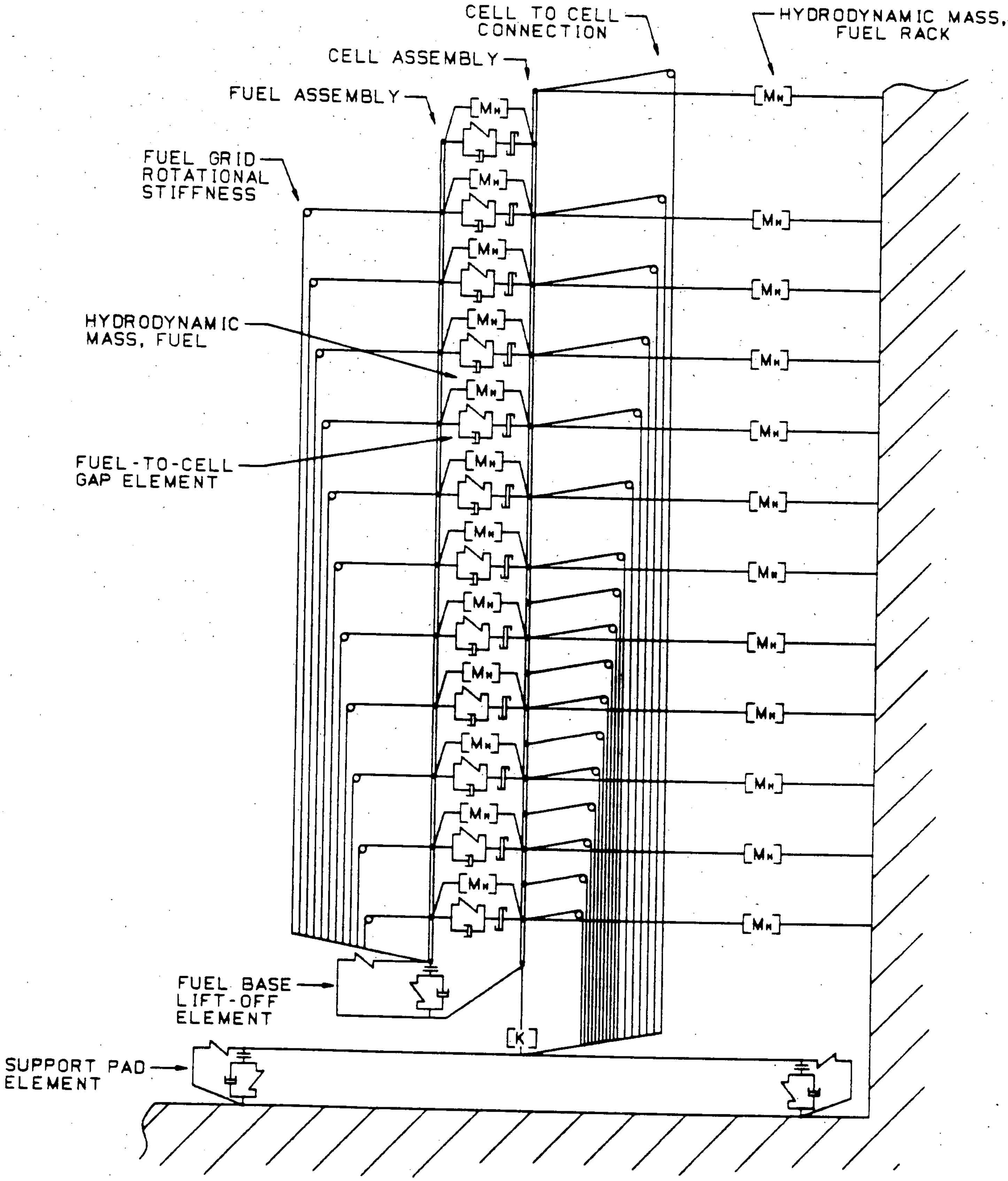
- FULL FUEL LOADING
- PARTIAL FUEL LOADING (QUADRANT)
- PARTIAL FUEL LOADING (4 ROWS)
- PARTIAL FUEL LOADING (1 ROW)
- EMPTY RACK
- DISPLACEMENT RESULTS

THREE DIMENS-[illegible]L NONLINEAR SEISMIC MODEL

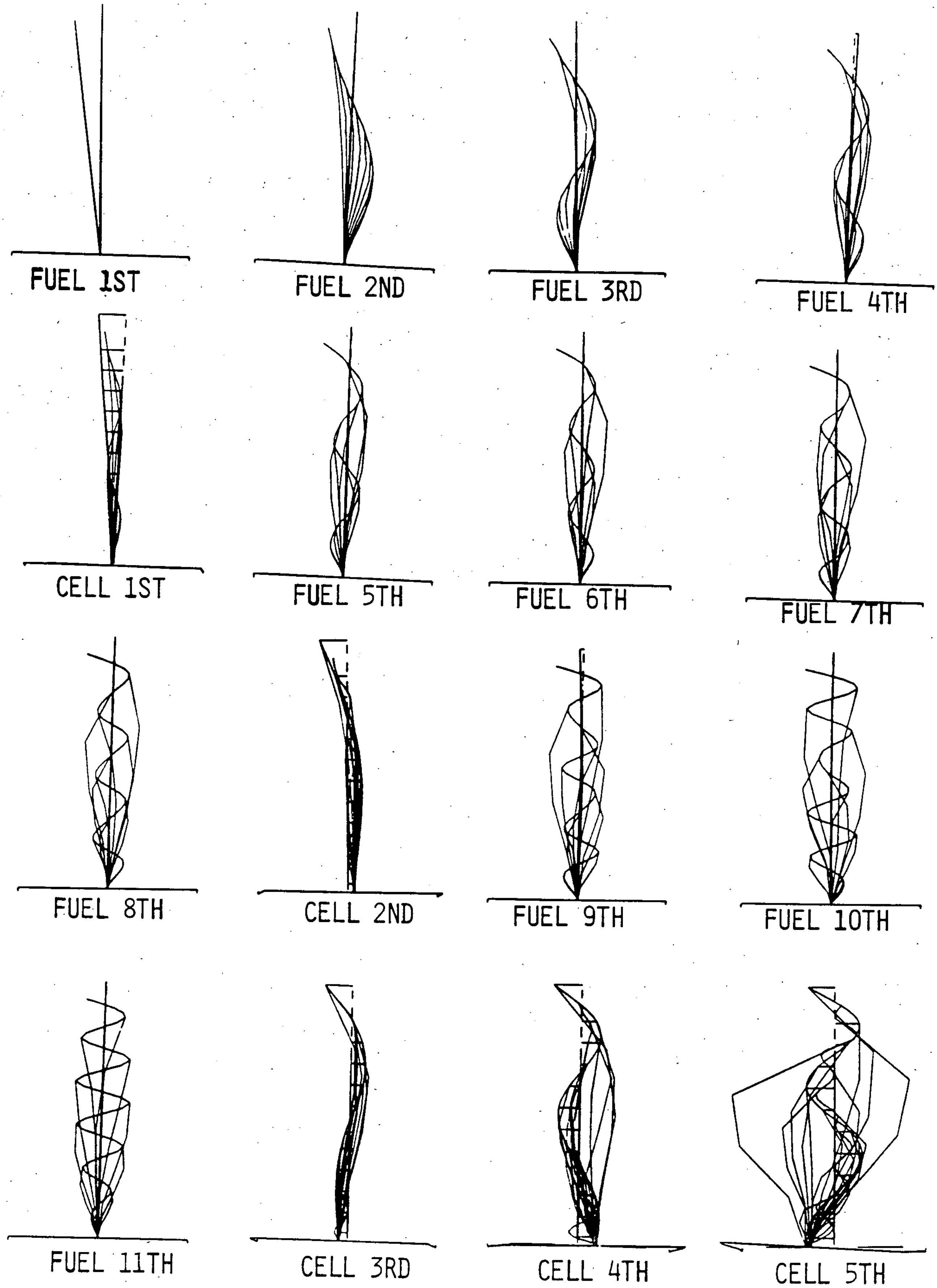


N LINEAR SEISMIC MODEL, SINGLE RACK

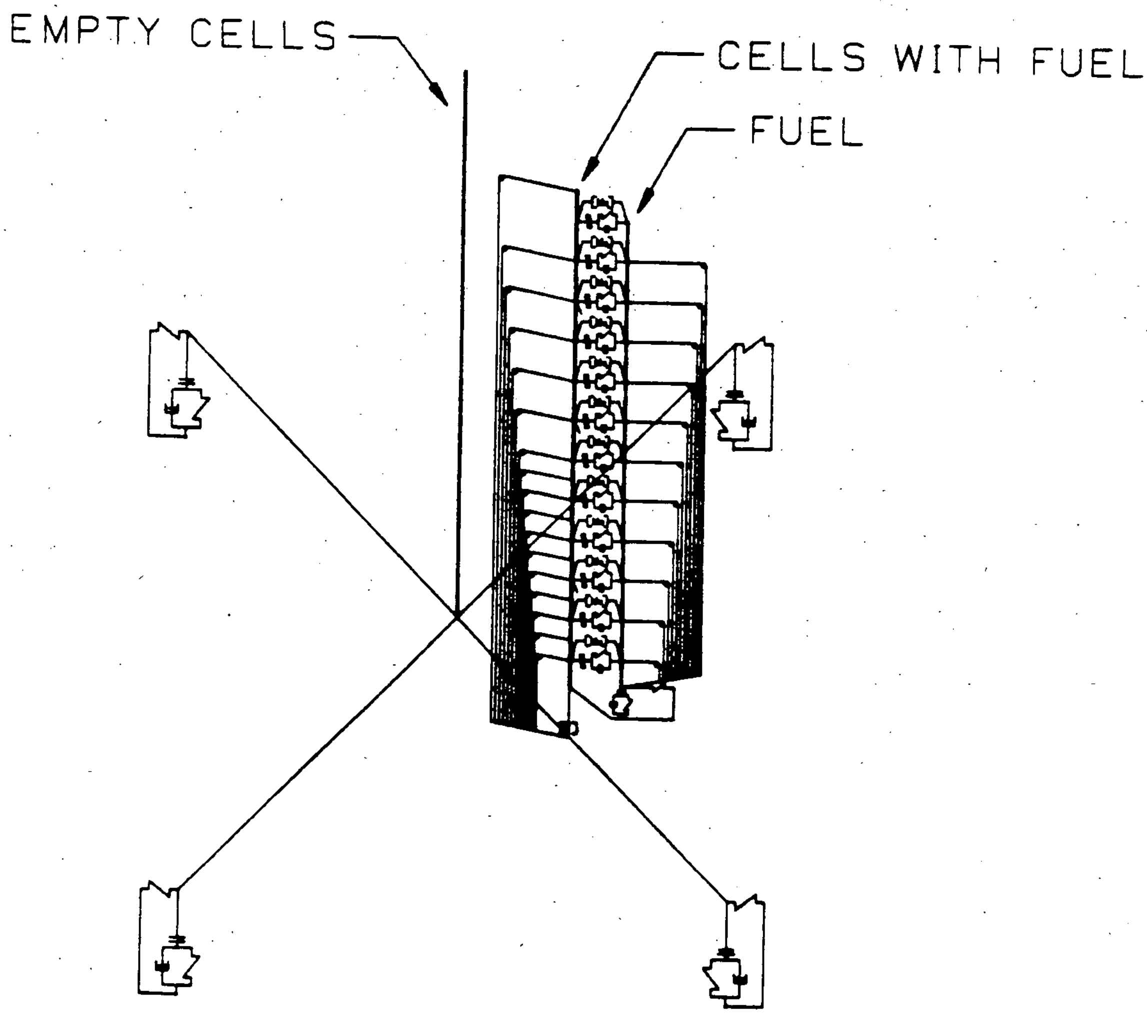
(2-D VIEW OF 3-D M



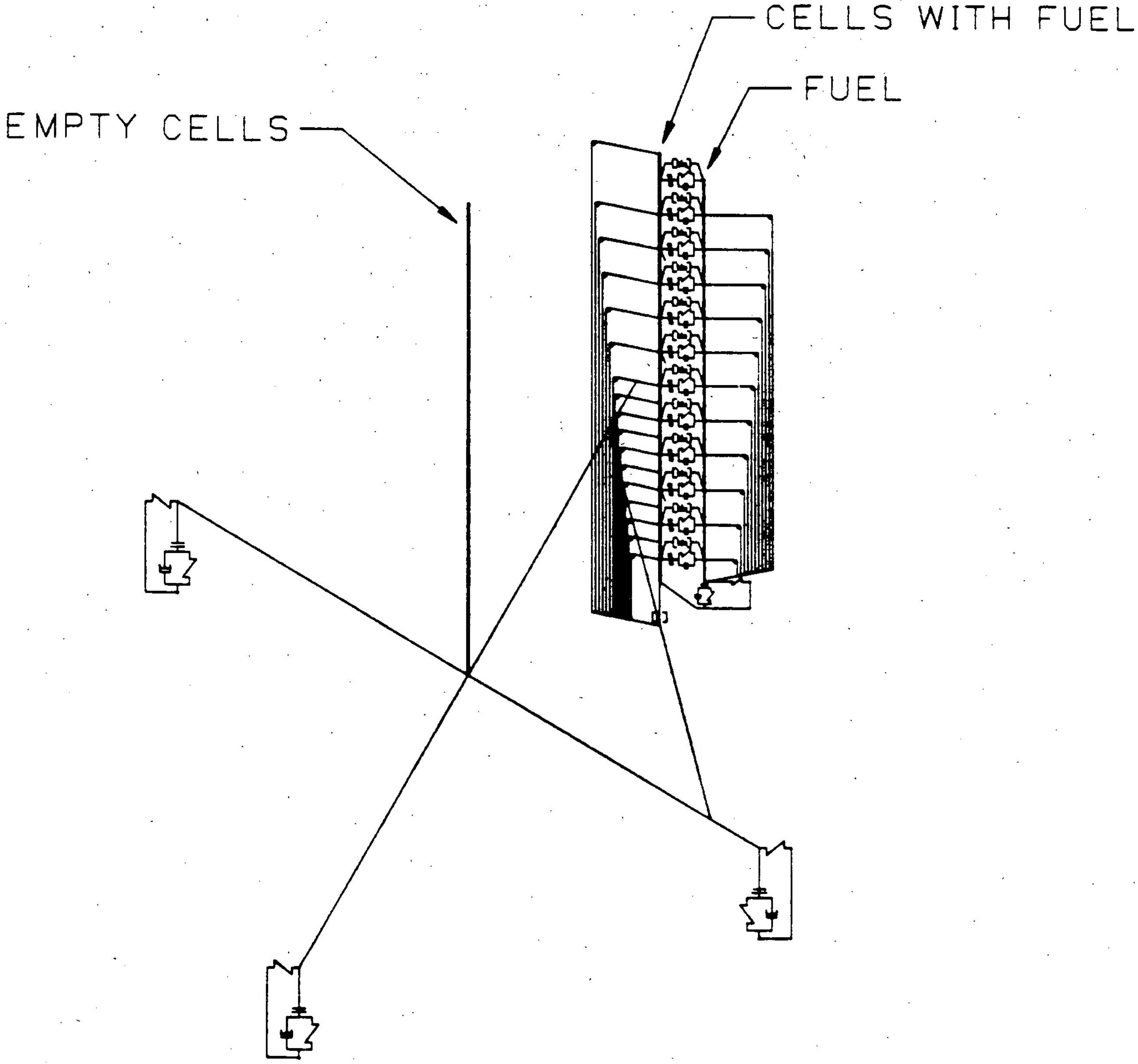
FUEL AND CELL MODE SHAPES
REGION 2 STANDARD FUEL



PARTIAL FUEL LOADING MODEL
(QUADRANT LOADING)



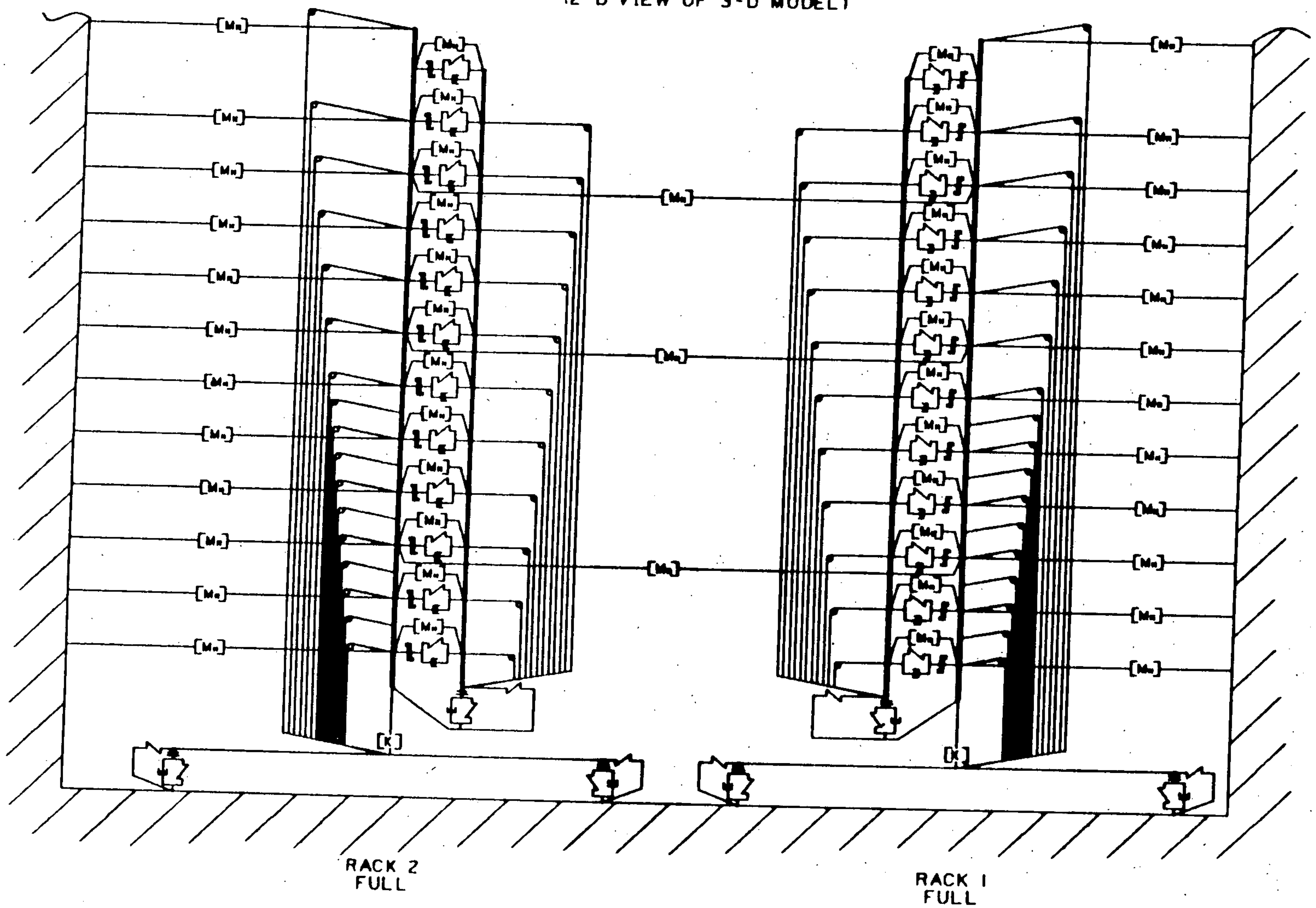
PARTIAL FUEL LOADING MODEL
(4 ROW LOADING)



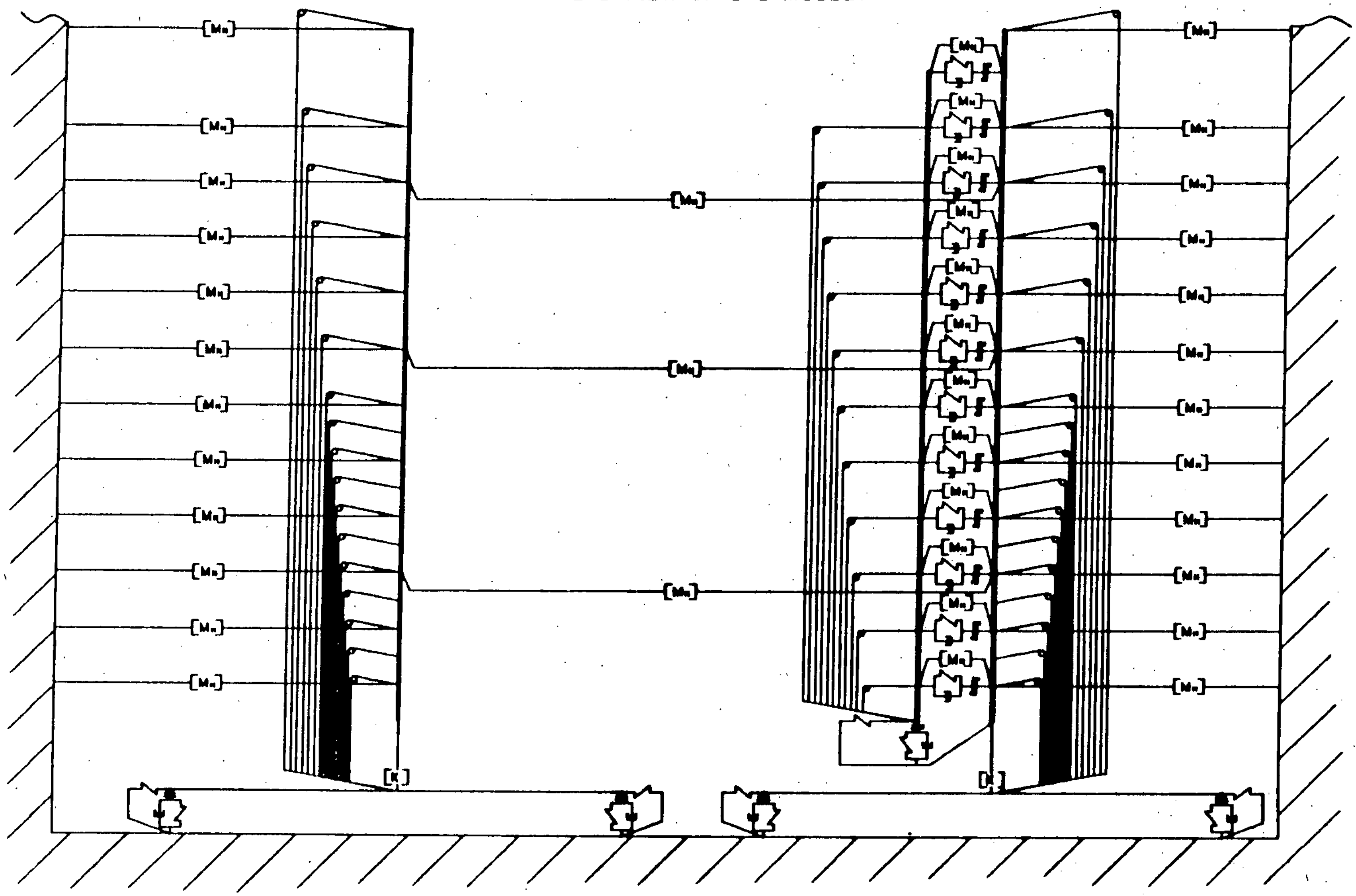
MULTIPLE RACK SEISMIC MODELS

- FULL/FULL
- FULL/EMPTY

MULTIPLE RACK POOL MODEL, FULL/FULL
(2-D VIEW OF 3-D MODEL)



MULTIPLE RACK POOL MODEL, EMPTY/FULL
(2-D VIEW OF 3-D MODEL)

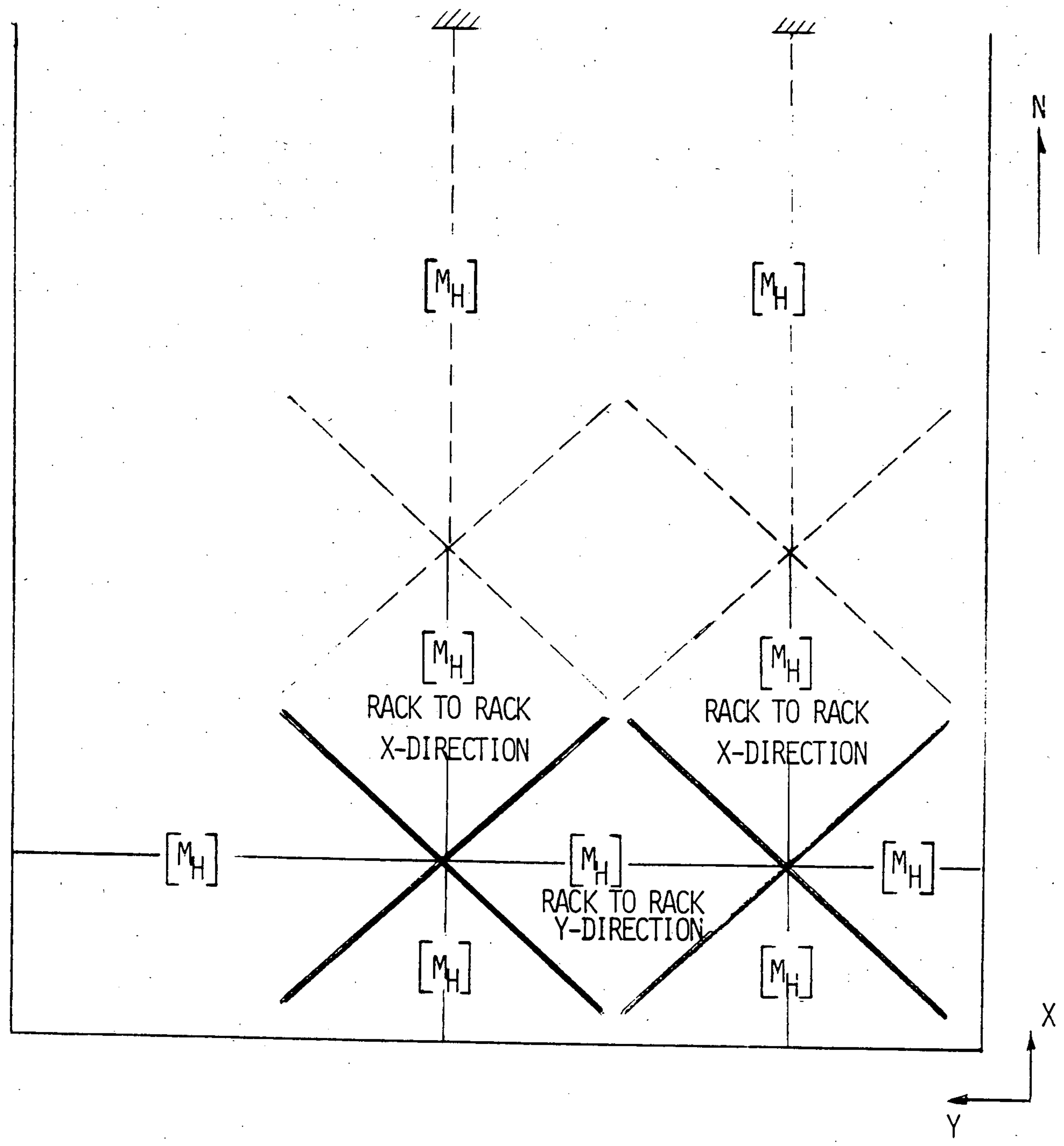


RACK 2
EMPTY

RACK 1
FULL

MULTIPLE RACK POOL MODEL

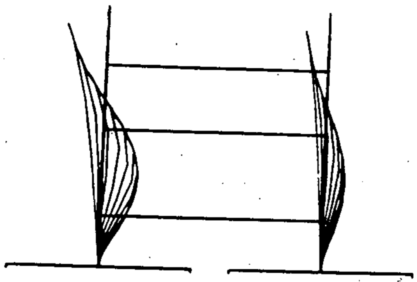
(PLAN VIEW)



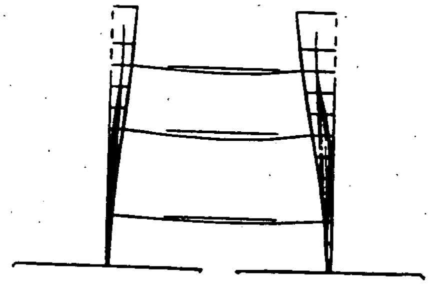
MULTIPLE RACK MODULE MODE SHAPES

REGION 2 STANDARD FUEL

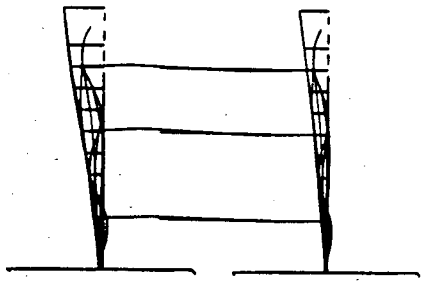
FULL/FULL CONDITION



FUEL 2ND MODE
4.6 H_Z

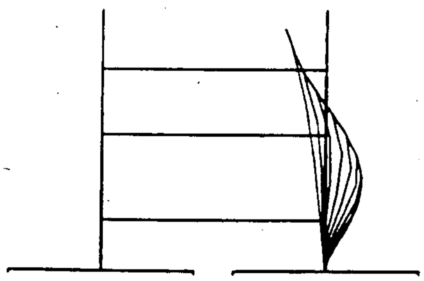


CELLS OUT-OF-PHASE
8.3 H_Z

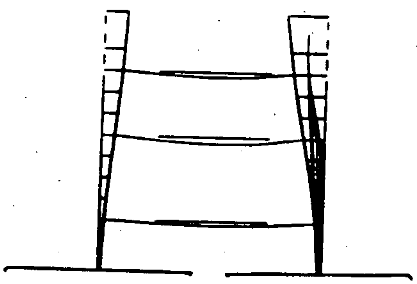


CELLS IN-PHASE
14.5 H_Z

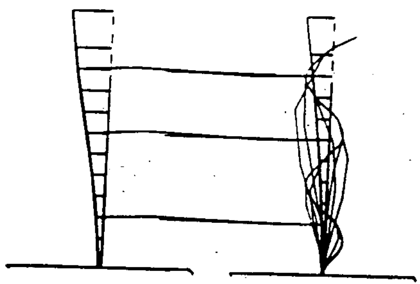
EMPTY/FULL CONDITION



FUEL 2ND MODE
4.6 H_Z



CELLS OUT-OF-PHASE
8.4 H_Z



CELLS IN-PHASE
15.2 H_Z

DISPLACEMENT RESULTS

- RACK ABSOLUTE DISPLACEMENTS
- RACK RELATIVE DISPLACEMENTS
- DISPLACEMENT CHARACTERISTICS

SAN ONOFRE RACK DISPLACEMENT SUMMARY

MODEL TYPE*	Mu	Max Disp (in) NS	Max Disp (in) EW	Rel Disp (in) NS	Rel Disp (in) EW	LOCATION	Frequency (Hz) NS	Frequency (Hz) EW
Reg. 1, Std, Full	.2	1.50	1.80	.33	.41	Top/Top	14.1	17.0
Reg. 1, Std, Full	.8	1.49	1.37	.84	.44	Top/Top	14.1	17.0
Reg. 1, Std, E/F	.2	1.30	1.51	1.39	.96	Top/Top	14.7	18.6
Reg. 1, Std, E/F	.8	1.42	1.60	.99	.90	Top/Top	14.7	18.6
Reg. 1, Std, Quad	.2	.39	.43	**	**	Top/Top	15.1	17.1
Reg. 1, Std, Quad	.8	.67	.33	**	**	Top/Top	15.1	17.1
Reg. 1, Std, Rows	.2	.33	.60	**	**	Top/Top	15.1	17.2
Reg. 1, Std, Rows	.8	.35	.64	**	**	Top/Top	15.1	17.2
Reg. 2, Std, Full	.2	1.00	1.39	.26	.59	Top/Top	13.8	14.1
Reg. 2, Std, Full	.8	1.44	1.36	.68	.76	Top/Top	13.8	14.1
Reg. 2, Std, E/F	.2	1.09	1.05	.99	.83	Top/Bot	14.2	15.2
Reg. 2, Std, E/F	.8	1.39	1.33	1.17	.96	Top/Top	14.2	15.2
Reg. 2, 2xStd, Full	.2	2.28	2.38	.44	.38	Bot/Top	11.7	12.0
Reg. 2, 2xStd, Full	.8	1.33	1.34	.87	.83	Top/Top	11.7	12.0
Reg. 2, 2xStd, E/F	.2	1.29	1.37	1.27	1.22	Bot/Bot	13.1	14.5
Reg. 2, 2xStd, E/F	.8	1.40	1.14	.98	.79	Top/Top	13.1	14.5

* Loading Conditions

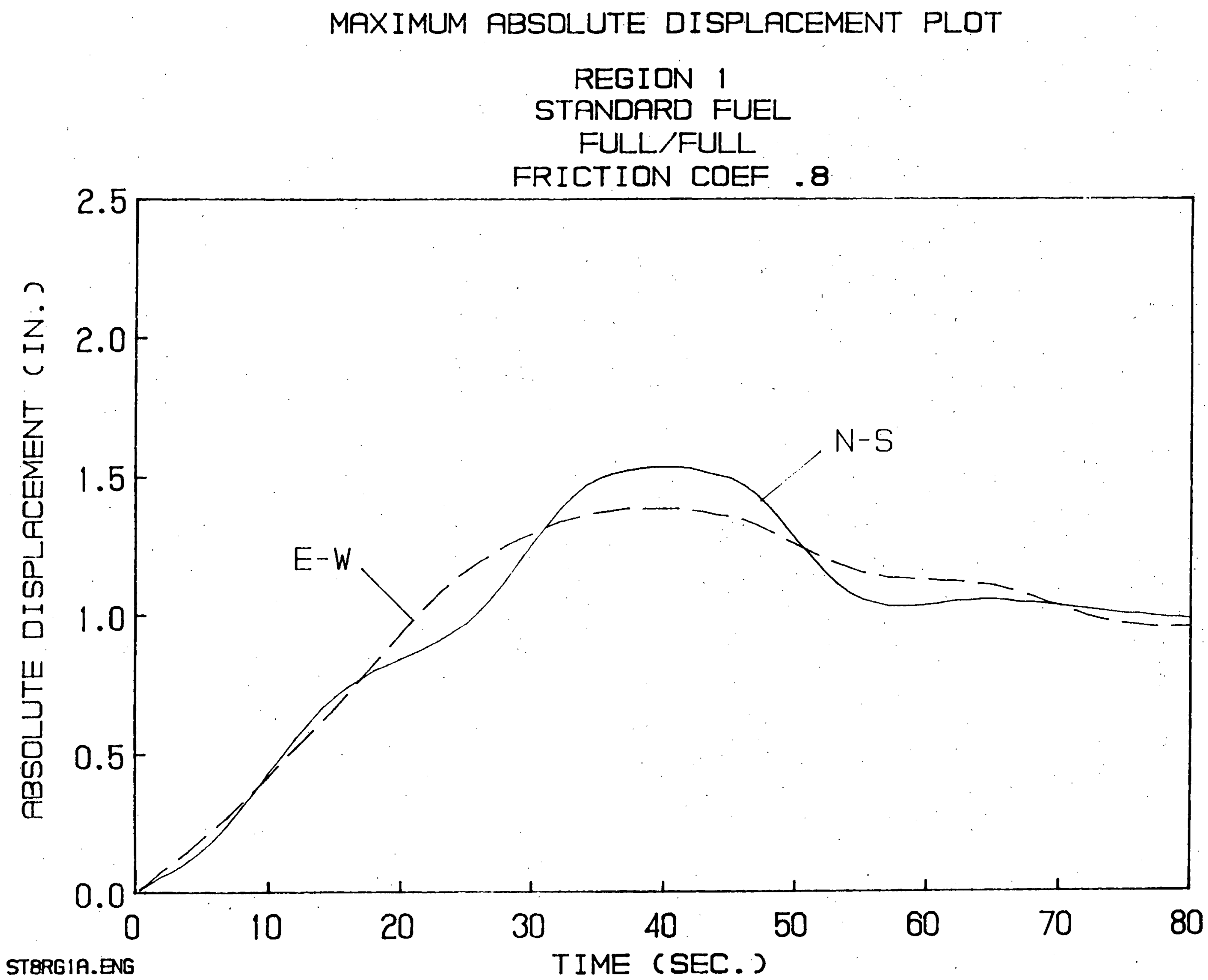
Four terms are used to define the different loading conditions. They are defined as follows. Full is used to describe the fully loaded situation. E/F describes a case where one rack is full and another is empty. Quad represents a single rack case where one quadrant only is loaded. Rows describes a case where only four rack rows are loaded. Finally, 2xStd represents a fuel assembly with double mass, increased beam stiffness, and increased hydrodynamic mass.

** These are single rack cases. Relative Displacements do not apply.

MAXIMUM ABSOLUTE DISPLACEMENTS
UNITS (IN.)

Friction Coefficient	Region 1		Region 2			
	Standard Fuel		Standard Fuel		2xStandard Fuel	
	Full-Full		Full-Full		Full-Full	
	N-S	E-W	N-S	E-W	N-S	E-W
.2	1.50	1.80	1.09*	1.39	2.28	2.38
.8	1.49	1.60*	1.44	1.36	1.33	1.34

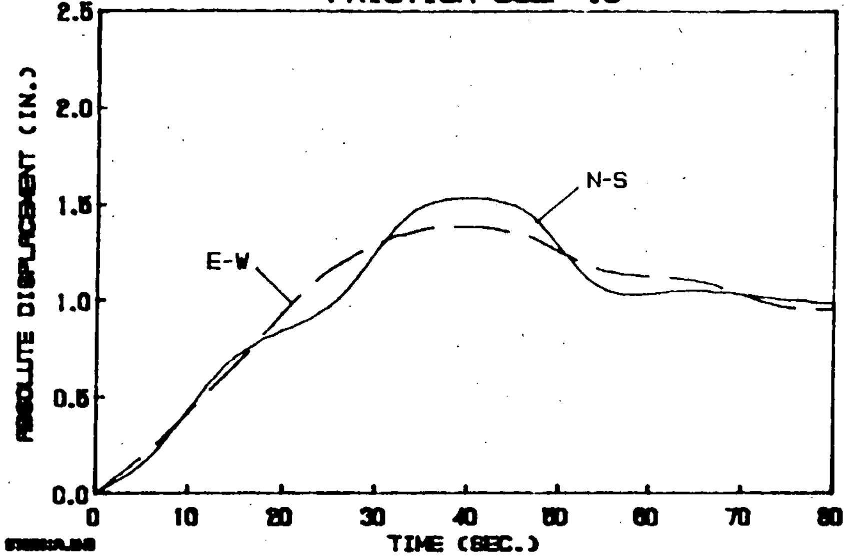
* Empty-Full Condition



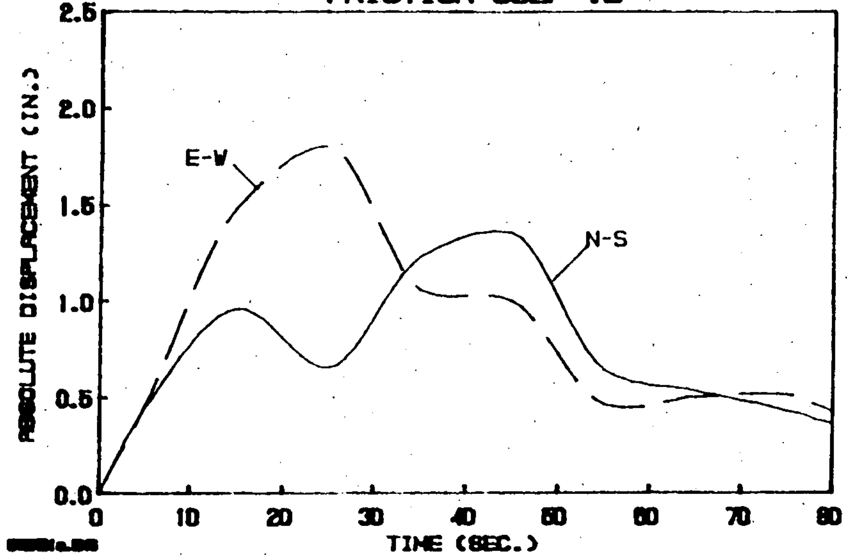
MAXIMUM ABSOLUTE DISPLACEMENT PLOT
REGION 1
STANDARD FUEL
FULL/FULL
FRICTION COEF .8
ABSOLUTE DISPLACEMENT (IN.)
2.5
2.0
1.5
1.0
0.5
0.0
N-S
E-W
0
10
20
30
40
50
60
70
80
TIME (SEC.)
ST8RG1A.ENG

MAXIMUM ABSOLUTE DISPLACEMENT PLOTS

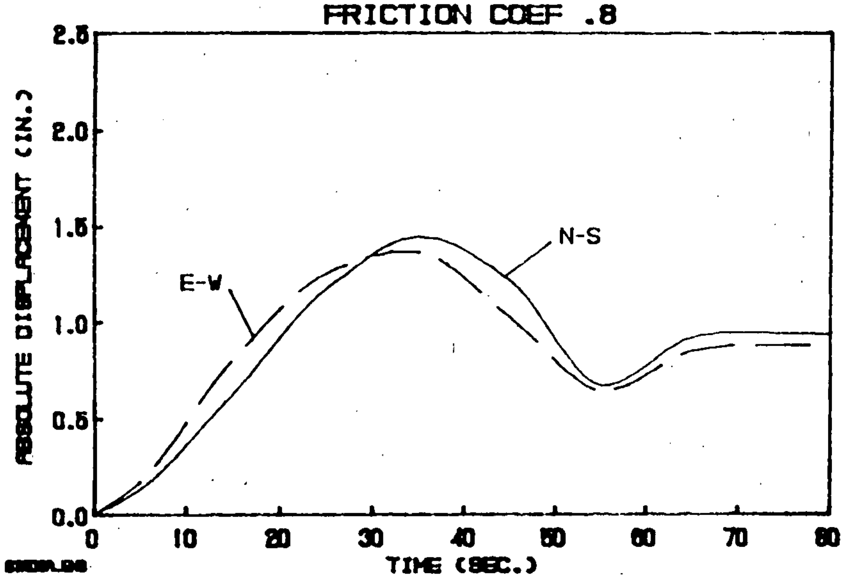
REGION 1
STANDARD FUEL
FULL/FULL
FRICTION COEF .8



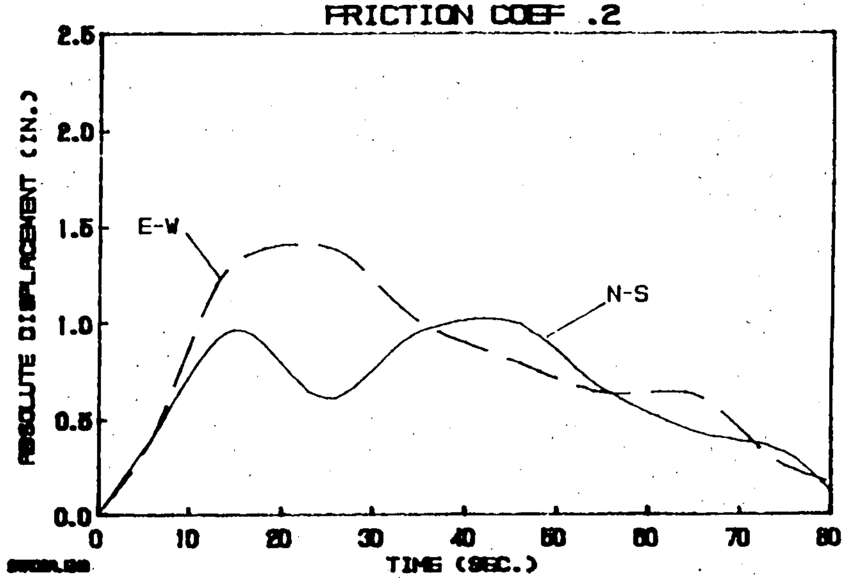
REGION 1
STANDARD FUEL
FULL/FULL
FRICTION COEF .2



REGION 2
STANDARD FUEL
FULL/FULL
FRICTION COEF .8



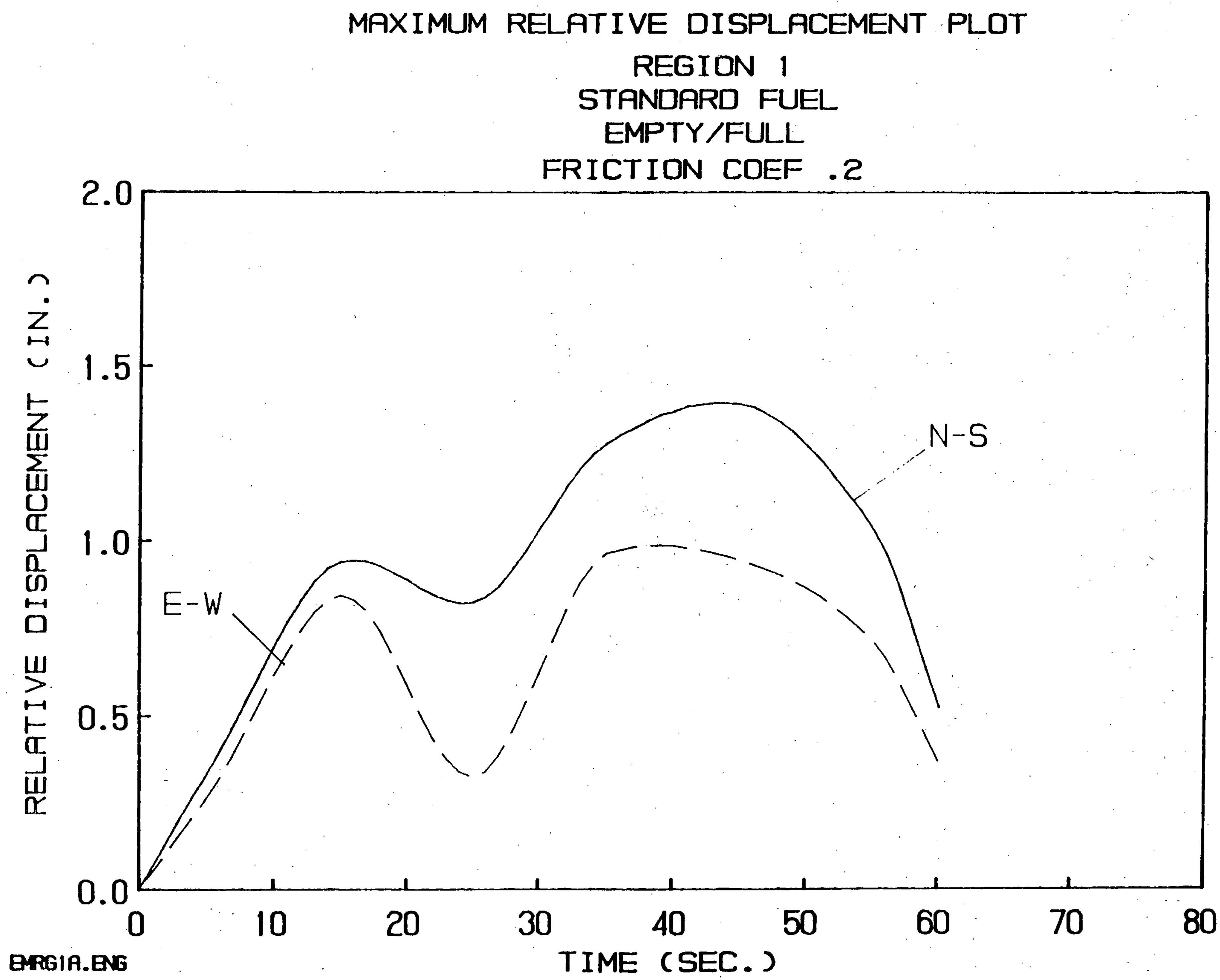
REGION 2
STANDARD FUEL
FULL/FULL
FRICTION COEF .2



MAXIMUM RELATIVE DISPLACEMENTS
UNITS (IN.)

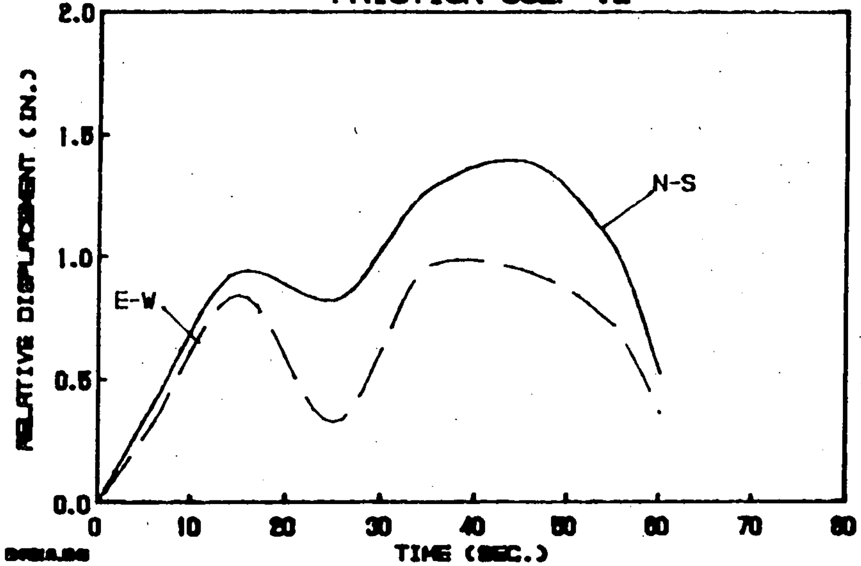
Friction Coefficient	Region 1		Region 2			
	Standard Fuel		Standard Fuel		2xStandard Fuel	
	Empty-Full		Empty-Full		Empty-Full	
	N-S	E-W	N-S	E-W	N-S	E-W
.2	1.39	.96	.99	.83	1.27	1.22
.8	.99	.90	1.17	.96	.98	.83*

* Full-Full Condition

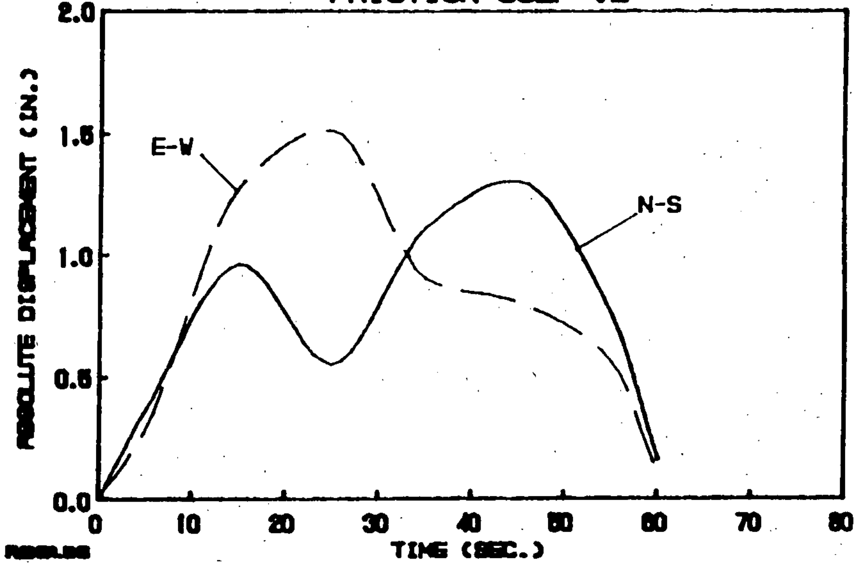

MAXIMUM RELATIVE DISPLACEMENT PLOT
REGION 1
STANDARD FUEL
EMPTY/FULL
FRICTION COEF .2
RELATIVE DISPLACEMENT (IN.)
2.0
1.5
1.0
0.5
0.0
N-S
E-W
0
10
20
30
40
50
60
70
80
TIME (SEC.)
EMRG1A.ENG

MAXIMUM RELATIVE/ABSOLUTE DISPLACEMENT PLOTS

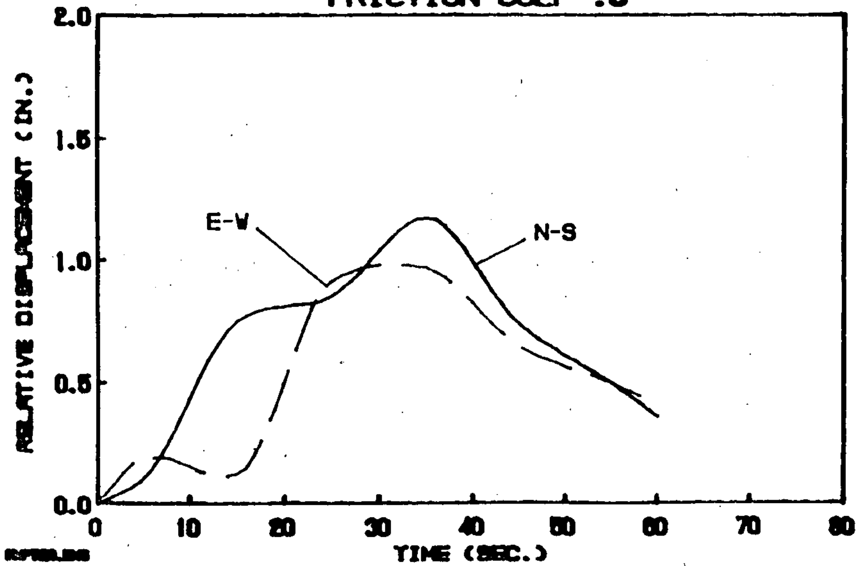
REGION 1
STANDARD FUEL
EMPTY/FULL
FRICTION COEF .2



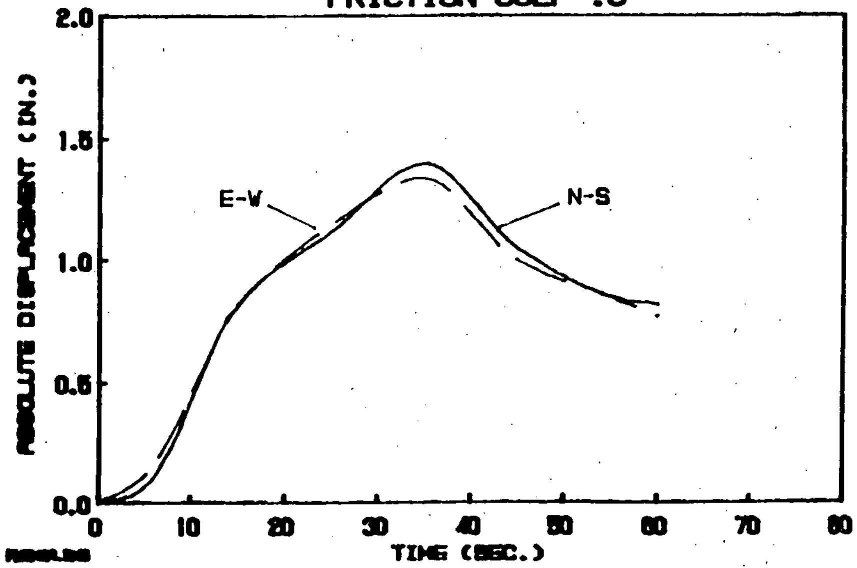
REGION 1
STANDARD FUEL
EMPTY/FULL
FRICTION COEF .2



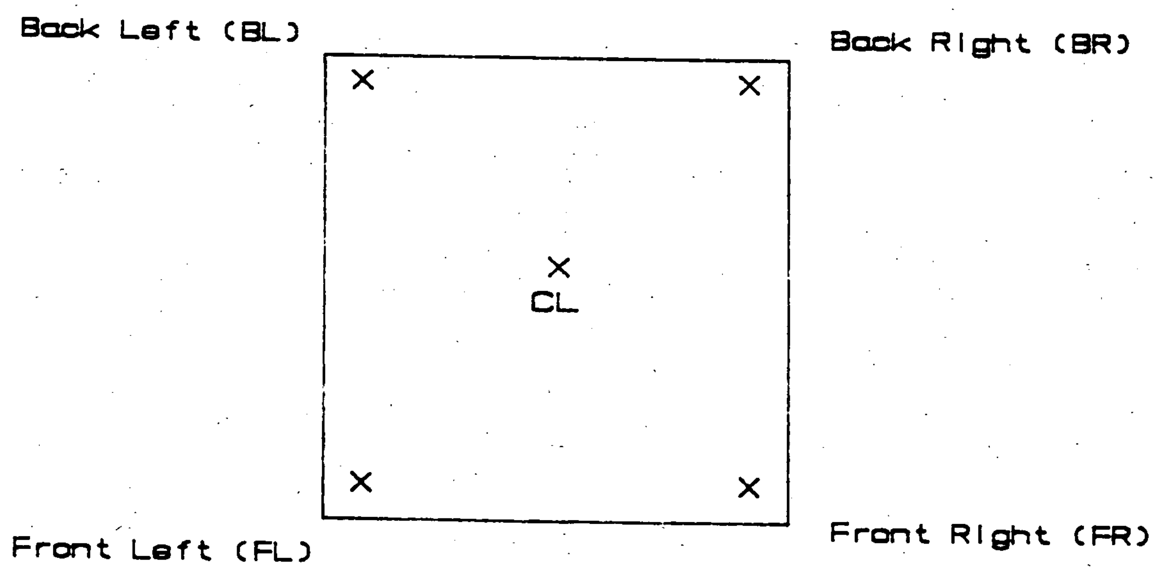
REGION 2
STANDARD FUEL
EMPTY/FULL
FRICTION COEF .8



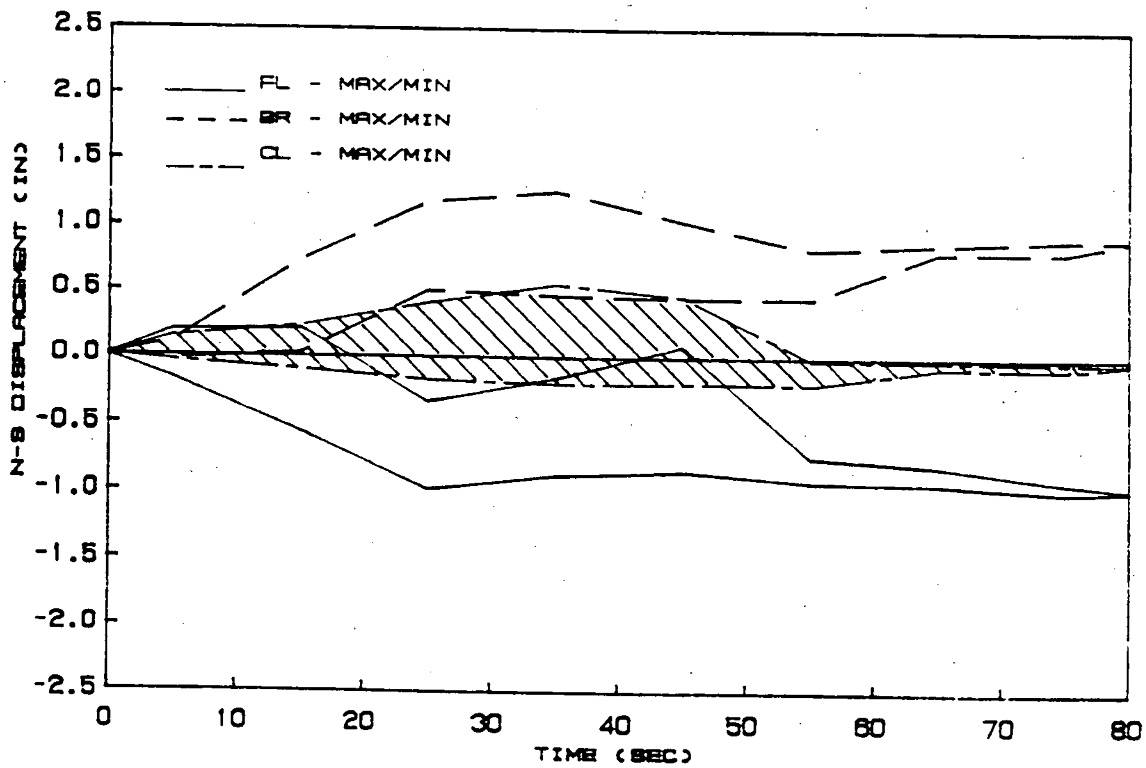
REGION 2
STANDARD FUEL
EMPTY/FULL
FRICTION COEF .8



TORSIONAL VS SLIDING MOTION

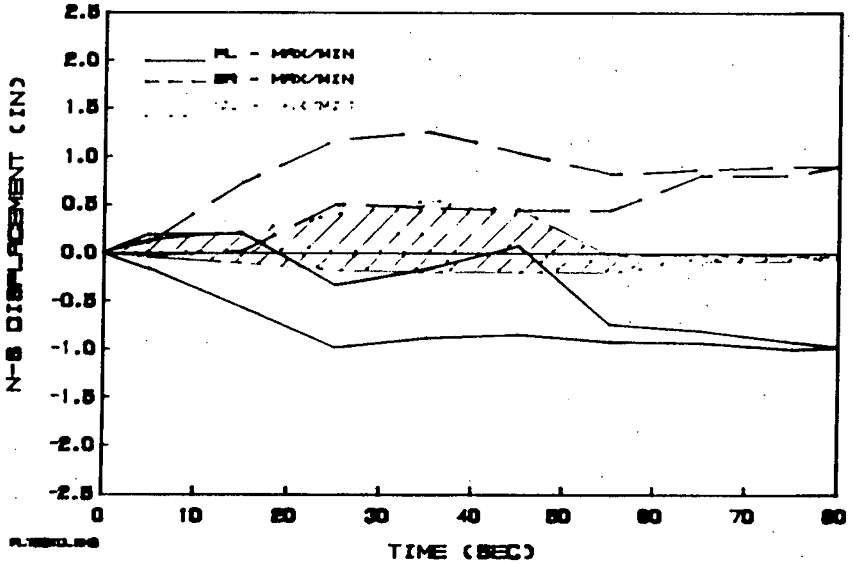


RACK 1
STANDARD FUEL
FULL/FULL. FRICTION COEF. = 0.8

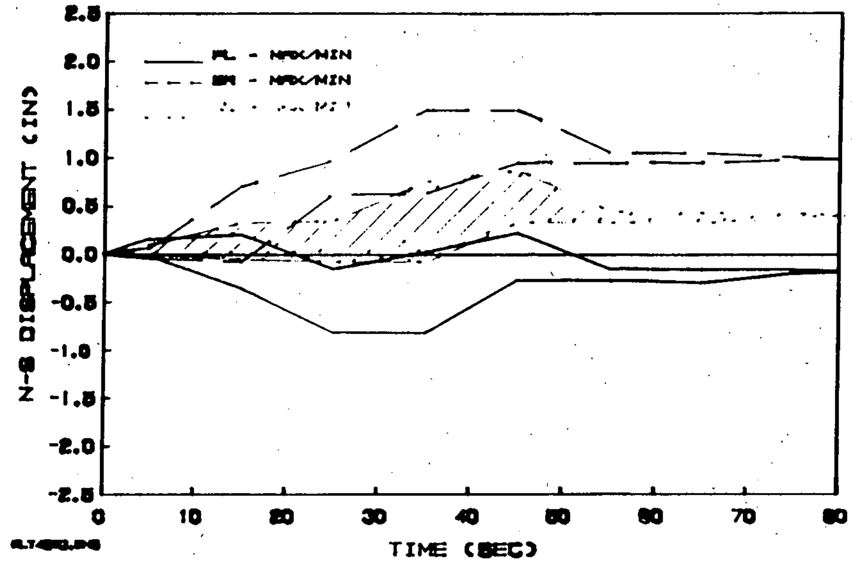


SLIDING/TORSION DISPLACEMENT CHARACTERISTICS

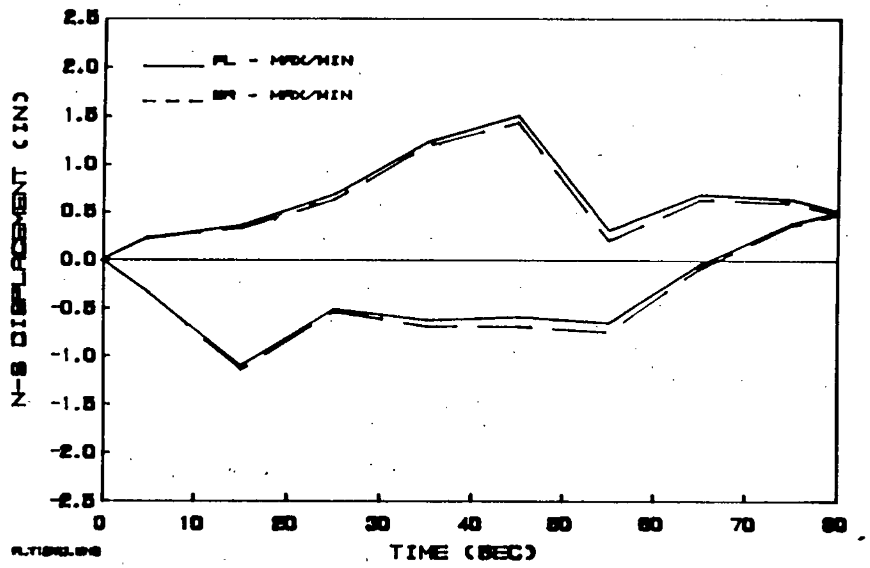
RACK 1
STANDARD FUEL
FULL/FULL, FRICTION COEF. - 0.8



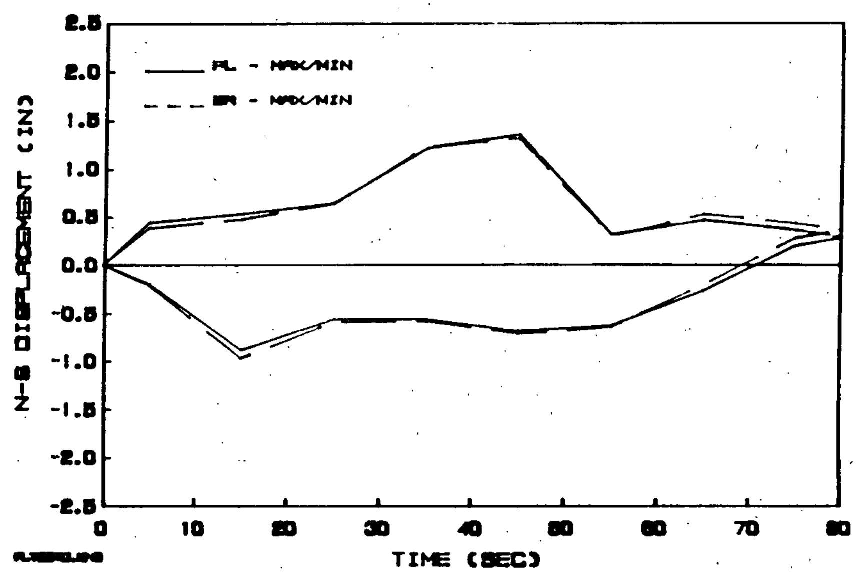
RACK 2
STANDARD FUEL
FULL/FULL, FRICTION COEF. - 0.8



RACK 1
STANDARD FUEL
FULL/FULL, FRICTION COEF. - 0.2



RACK 2
STANDARD FUEL
FULL/FULL, FRICTION COEF. - 0.2



CONSERVATISMS

CONSERVATISMS

1. ALL FUEL ASSEMBLIES RESPOND IN PHASE.

2. FRICTION COEFFICIENTS OF 0.8 MAXIMUM AND 0.2 MINIMUM.

3. FUEL ASSEMBLY GRID IMPACT DAMPING OF 4.4%.

4. HYDRODYNAMIC MASS BASED UPON CONSTANT GAPS. AS GAP DECREASES THE HYDRODYNAMIC MASS RESTORING FORCE INCREASES, BUT SINCE THE ANALYSIS IS BASED UPON CONSTANT GAPS, THE DISPLACEMENTS WHICH CLOSE THE GAPS ARE CONSERVATIVE.

5. THE SEISMIC MODEL, WHICH USES 4 EFFECTIVE SUPPORT PADS TO REPRESENT THE 26 TO 33 ACTUAL SUPPORT PADS, ROCKED ONTO ONE SUPPORT PAD AND PRODUCED ROTATIONAL MOTION. SINCE THE ACTUAL RACK MODULE HAS MULTIPLE INTERIOR SUPPORT POINTS AND WILL NOT LIFT OFF ONTO ONE SUPPORT POINT, THE SUPPORT PADS IN CONTACT WILL RESIST THE ROTATIONAL MOTION.

6. NO FRICTION USED IN SUPPORT PAD BALL JOINT TO RESIST ROTATION WHEN RACK ROCKS ONTO ONE PAD.

7. GAPS BETWEEN FUEL AND CELL WERE MAXIMIZED AND PRODUCE THE MAXIMUM IMPACT FORCES.

8. MARGIN OF SAFETY AGAINST RACK IMPACT BASED UPON THE MINIMUM GAP DURING SEISMIC EVENT.

SUMMARY/CONCLUSIONS

- SOPHISTICATED AND REALISTIC DYNAMIC MODEL USED IN ANALYSIS
- EVALUATED MANY CASES AND DETERMINED BOUNDING CASES
- DESIGN BASIS IS FROM MULTIPLE RACK MODEL
- RACK TO RACK AND RACK TO WALL IMPACT DOES NOT OCCUR
- REMAINING SEPARATION RESULTS IN COMFORTABLE MARGIN OF SAFETY

IV. SUMMARY

(SCE)

DERRICK MERCURIO

NRC SEISMIC DESIGN INFORMATION REQUESTS
FROM THE JUNE 3, 1988 NRC MEETING
SAN ONOFRE UNITS 2 AND 3

1. PROVIDE A STRENGTH EVALUATION FOR THE GROUND MOTION DBE TIME HISTORY.
2. DESCRIBE THE CHANGES IN RACK FREQUENCY WITH WELD SIZE AND CLIPS, AND INCLUDE DESCRIPTIONS OF THE SIZES AND NUMBERS OF WELDS AND CLIPS.
3. PROVIDE ASSURANCE THAT RACK-TO-RACK SPACING IS MAINTAINED.
4. COMPLETELY ADDRESS RACK-TO-RACK AND RACK-TO-WALL INTERACTIONS.
5. EXPLAIN ANY EFFECT OF THE RACK LEVELING PAD ON ROCKING OR LIFTING FROM SEISMIC INPUTS.
6. JUSTIFY SRSS COMBINATIONS OF ADJACENT RACK DISPLACEMENTS.
7. INCLUDE ROTATION ABOUT ONE RACK SUPPORT FOOT AS A POTENTIAL WORST CASE DISPLACEMENT.
8. EXPLAIN HOW HIGH FREQUENCY IMPACT LOADS ARE CALCULATED WITH THE PROPOSED RACK MODEL.
   A. DESCRIBE IN DETAIL HOW THE RACK CELL WALLS ARE DESIGNED INCLUDING THE FUEL ELEMENT/CELL WALL IMPACT MODEL.
   B. IN MODELING THE FUEL ASSEMBLY-RACK CELL GAP WIDTH, THE GAP SHOULD BE MAXIMIZED BY INCLUDING TOLERANCES.
   C. DEMONSTRATE THAT THE ANALYSES ENVELOPE DIFFERENT HYDRODYNAMIC MASS AND GAP SIZE CONDITIONS.
9. ADDRESS ANALYSES UNCERTAINTIES TO VERIFY THE RACK MODEL DYNAMIC CHARACTERISTICS.
10. IF VERTICAL ACCELERATION EXCEEDS 1G, INCLUDE THE IMPACT EFFECTS IN THE FUEL CELL ANALYSES.
11. INCLUDE AN ADEQUATE RANGE OF FUEL ASSEMBLY STIFFNESS (INCLUDING IMPACT STIFFNESS) TO ENCOMPASS CURRENT AND FUTURE FUEL.

0564n

IV. SUMMARY

- O 2/1/89 - SUBMITTAL OF PROPOSED LICENSE AMENDMENT
  - PROVIDE COMPLETE RERACKING ANALYSES AND LICENSE AMENDMENT REQUEST
- O 3/30/89 - BEGIN RACK FABRICATION
- O 8/1/89 - NRC ISSUE LICENSE AMENDMENT

ENCLOSURE 3

SPENT FUEL POOL RERACKING
SAN ONOFRE UNITS 2 AND 3
December 7, 1988
Issues to be Addressed in the License Amendment Request

1. Structural and Effective Structural Properties.

   A. Analysis method and calculation to determine the structural properties of the cell-to-cell weld shear connection for the structural model.

   B. Analysis method and calculation to determine the effective rotational stiffness properties of the cell-to-cell connections for the effective structural model.

   C. Analysis method and calculation to determine the effective rotational stiffness properties of the fuel rack base for the effective structural model.

   D. The basis for the use of rigid beams in the base of the nonlinear model. "Rigid base plate"

2. Hydrodynamic Mass.

   A. Details of the hydrodynamic mass calculation.

   B. Justification of the hydrodynamic mass simulation in the N-S direction (4 rack configuration).

3. Maximum support pad lift-off and margin against overturn.

4. Uncertainties and conservatisms.

5. WECAN Code.

   A. Information on method and verification solutions on the nonlinear model superposition method. Justify its validity in case of multiple non-linearities.

   B. List of licensees where WECAN was reviewed by NRC.

6. Engineering explanation of the relationship between the values of rack relative displacements for the N-S and E-W directions. Why does N-S exceed E-W?

7. Reference test data which may be used to substantiate rack parameters.

8. Stresses in rack components.

9. Interface loads and effects on pool.

10. Confirm earthquake time history inputs are compatible with FSAR.

11. Rack-to-rack and rack-to-wall gap adequacy, including installation tolerances

12. Walkdown requirements after a seismic event.

TDM:0633n