

REPORT  
PROBABLE MAXIMUM HURRICANE FLOOD ANALYSIS  
OYSTER CREEK NUCLEAR UNIT NO.1  
OYSTER CREEK, NEW JERSEY  
FOR  
JERSEY CENTRAL POWER & LIGHT COMPANY

INTRODUCTION

This report presents the results of our flood analysis for the Oyster Creek Nuclear Unit No.1 , Oyster Creek, New Jersey. The Oyster Creek Plant is located at approximately Latitude  $39^{\circ}49'$  on the eastern coastline of New Jersey 1.5 nautical miles inland from the western shoreline of Barnegat Bay as shown on Plate 1.

All elevations unless otherwise indicated are in feet and refer to Mean Sea Level Datum as Zero.

PURPOSE

The purpose of our study was to perform flood analyses to establish design criteria for suitable flood protection of Class 1 structures. The Oyster Creek Nuclear Unit No.1 plant layout is shown on Plate 2.

SCOPE

The scope of our analysis included an evaluation of the following:

- 1.. Wind-generated waves.
2. Flood levels.
3. Wave forces.

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Work pertinent to this analysis conducted prior to this report included:

1. Hurricane storm surge analyses resulting in a probable maximum hurricane (PMH) stillwater level of +22 feet Mean Sea Level (MSL) at the western side of Barnegat Bay fronting the Oyster Creek Unit No. 1 during a high astronomical tide condition.\* (Reference 1)
2. Procedure for routing the open coast surge into Barnegat Bay.\*\* (Reference 2)

#### BASIC DATA AND ASSUMPTIONS

Basic data and assumptions for our analysis included:

1. The PMH stillwater level at the western side of Barnegat Bay was taken at +22 feet MSL as requested by the AEC.
2. A surge hydrograph giving maximum stillwater levels at the western side of Barnegat Bay was developed by using the Barnegat Bay surge hydrograph of Reference 2.
3. A wind field for the PMH parameters was developed for use in calculating wind-generated waves.
4. The calculation methods for wave generation of Coastal Engineering Research Center (CERC), "Shore Protection, Planning, and Design," Technical Report No. 4, 1966, were used.

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\* D. J. Skovolt, AEC letter to R. H. Sims dated 12-29-71.

\*\* Theodore E. Hacussner, Report-Determination of M.P.H. Flood Height for Oyster Creek, Units 1 and 2, Copy No. 1, December 21, 1968.

PROBABLE MAXIMUM STILLWATER LEVELS AT THE PLANT SITE

The open coast surge was calculated in References 1 and 2. Its effects were routed into Barnegat Bay to determine the probable maximum stillwater levels at the plant site. The PMH parameters used by the AEC (Reference 1) in calculating the open coast surge were:

1. A central pressure index of 27.10 inches of mercury.
2. An asymptotic pressure of 30.70 inches of mercury.
3. A radius of maximum winds of 39 nautical miles.
4. A maximum gradient wind speed of 133.0 miles per hour.
5. A forward translational speed of 12 knots and 23 knots.
6. A bottom friction factor of 0.008.
7. An initial rise in water level of 1.1 feet.
8. An astronomical high spring tide of 4.2 feet above Mean Low Water (MLW).

In evaluating the stillwater levels at the plant site on the western shore of Barnegat Bay, the following were considered:

1. The amount and duration of tidal overflow of Island Beach (the beach island).
2. The amount and duration of tidal inflow through Barnegat Inlet and through the eroded sections of the beach island.
3. The extent of wind setup across Barnegat Bay.
4. Local wave setup.

These four items were analyzed in Reference 2 for an open coast PMH stillwater elevation of 16.75 feet MSL. The result was a maximum stillwater elevation of 19.5 feet MSL at the plant site that occurred one hour after the maximum open coast stillwater elevation.

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The approximate stillwater hydrograph was developed at the plant site as shown on Plate 3 by considering the following:

1. The open coast surge hydrographs of the AEC (Reference 1) and of Reference 2.
2. The surge hydrograph for Barnegat Bay of Reference 2.
3. The inflow-overflow curves of Reference 2.
4. The hurricane wind field developed using the PMH parameters of the AEC.

By using the AEC open coast surge hydrograph in conjunction with the open coast surge hydrograph and inflow-overflow curves of Reference 2, an approximate time history of additional inflow-overflow was determined for use in adjusting the Barnegat Bay surge hydrograph of Reference 2 upward to a peak value of +22 feet MSL. This stillwater hydrograph also includes the effects of wind and wave setup, and is, therefore, used as the plant site stillwater hydrograph. The hurricane wind field developed using the PMH parameters was adjusted for nearshore land effects and was then propagated across Barnegat Bay. Component wind velocities were calculated along the storm traverse as shown on Plate 4 in order to consider wind setup and wind-generated waves. The time history of these component winds is shown on Plate 5. This wind profile and the stillwater hydrograph, shown on Plate 3, including the effects of wind and wave setup, at the plant site, were used in the following analyses.

#### WIND-GENERATED WAVES

##### GENERAL

Wave characteristics are dependent upon wind speed, wind duration, water depth and fetch length. Generated waves were calculated coincidental with the maximum surge hydrograph to determine the maximum flood elevation.

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### FETCH

Deepwater fetches were not considered because the larger deep-water-generated waves would break on reaching Island Beach. The elevation of the island, ranging from 0 to +40 feet, as shown on Plate 4, would be reduced by approximately five feet along its lower elevations by wave erosion. Most of the erosion would occur primarily during the surge recession when wave direction would be offshore rather than onshore. Therefore, the critical wave conditions would be the shallow water waves generated within Barnegat Bay. The fetch distance would be approximately five nautical miles (along the hurricane traverse) across Barnegat Bay from Island Beach to the Oyster Creek Plant Unit No.1 as shown on Plate 6.

### WIND

As hurricanes move towards the coast, wind speeds and directions are dependent upon location and time. In order to prepare a wind distribution for the purpose of wave forecasting, the wind vectors along the storm traverse were calculated using the hurricane wind field. A component wind profile was then plotted as shown on Plate 5 using the time history of average wind vectors over the fetch length.

### WAVE CHARACTERISTICS

Shallow water waves were generated by using Fig.1-32 of CERC, T.R. No.4\*. These significant shallow water wave heights and periods, based on the fetch length, component wind profile and average water depth are plotted on Plate 7. The generated wave height and period profiles have a phase shift in time of +0.5 hour over the wind profile to allow for the generation and travel of waves to the site. The maximum significant wave height and period is 8.7

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\*U.S.Army Coastal Engineering Research Center (1966). Shore Protection Planning and Design, Technical Report No.4, 3rd Edition.

feet and 6.3 seconds, respectively. This significant wave occurs during stillwater level of +21.3 feet Mean Sea Level as shown on Plate 7 at the site location.

The significant wave height was obtained from statistical analysis of synoptic weather charts. Approximate relationships of the significant wave height to other parameters of the normal wave spectra were defined. The maximum wave height curve\*, as shown on Plate 7 is based on the significant wave height curve. The maximum wave height is 14.5 feet but will not occur at the site because of insufficient water depth.

#### DESIGN WAVES

Selection of design waves depends on the offshore waves at the site, the structures being considered, and the available water depths fronting the structures. Generated wave conditions during the PMH occurrence were propagated shoreward to the plant structures. Topographic data indicate that the elevation of Highway 9 to the east of the plant site is about 18 to 19 feet MSL. As shown on Plate 8 the top of fill elevation surrounding the plant site will be at least +23 feet MSL, and this fill will be graded towards Highway 9, east of the plant. Therefore, as land elevations rise abruptly to the west, waves would break progressively westward and would not reach the plant site area. The only wave action that could reach the plant site would result from possible waves traveling up the 100 to 140 feet wide intake and discharge channels. This wave action would be small because of channel friction, trees, vegetation, and other obstructions adjacent to the channels, the two bridges in the intake and discharge channels, the 90 degree curvature of the channels in the plant area, and the fact that the intake and discharge structures are located on the westward side of the power plant. Therefore the largest wave

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\*Considered as the one percent wave in this analysis as requested by the AEC.

that could possibly reach the intake and discharge structures is on the order of one foot.

#### FLOOD LEVELS

The generated waves coming from the east, break far eastward of the site because the minimum top of levee elevation at the plant is +23. Maximum waves that might break in the area of Highway 9 will depend on the available water depth. Time histories of the maximum wave heights without breaking ( $H_b$ ) that might reach and runup on the graded plant fill are shown on Plate 7. Using these data, the maximum design wave height was computed as 3.1 feet during a stillwater elevation of +22 feet MSL. Runup would be less than one foot; therefore, there will be no wave overtopping of the +23 feet MSL top of plant fill.

The top of both the intake and discharge structures is at elevation 15 feet MSL. Because these structures are located on the western side of the plant, they will not experience as high a stillwater level as the eastern side of the plant which is directly exposed to the wave and wind setup. Maximum stillwater levels against the intake and discharge structures would be less than +20 feet MSL. However, during maximum stillwater levels, a one-foot wave could pass across the intake and discharge structures and runup on the 2;1 backfilled slope in front of the turbine building. Maximum runup would be about 2.2 feet for a smooth slope and about one foot for a rough slope such as rip-rap, resulting in a maximum flood elevation of 22.2 feet MSL. Therefore, the +23 feet top of backfill elevation in front of the turbine building would not be overtopped.

The maximum flood level for plant structures would be caused by the maximum stillwater level, or +22 feet MSL. Plate 10 illustrates the boundaries

of flooded land in the vicinity of the Oyster Creek Nuclear Unit No.1 during a stillwater level of +22 feet MSL.

#### WAVE FORCES

There will be no wave forces against plant structures except for the intake and discharge structures because the plant grade elevation of 23 feet MSL protects plant structures from wave action. As wave action is small at the intake and discharge structures, the maximum wave forces against these structures will essentially be the hydrostatic pressures resulting from a stillwater elevation of +22 feet MSL. The generated waves will break to the east of the plant site against the graded fill during the higher water levels. For design purposes the maximum significant wave height that may break against this graded fill is 3.1 feet.

#### CONCLUSIONS

Based on the above discussions and analyses the following is concluded:

1. The maximum stillwater elevation at the site, as determined by the AEC, is +22 feet MSL.
2. With the surrounding top of the plant site fill to at least Elevation +23 feet MSL, plant structures are protected against wave runup.
3. The maximum flood elevation for plant structures is +22 feet MSL.
4. Plant structures are protected against wave forces.

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The following Plates are attached and complete this Report:

|          |   |   |
|----------|---|---|
| Plate 1  | - | Site Location   |
| Plate 2  | - | Plot Plan   |
| Plate 3  | - | PMH Stillwater Level at Oyster Creek<br>Nuclear Unit No.1           |
| Plate 4  | - | Storm Traverse  |
| Plate 5  | - | Component Wind Profile  |
| Plate 6  | - | Storm Traverse Depth Profile  |
| Plate 7  | - | Wave Characteristics and Stillwater Levels<br>versus Time.          |
| Plate 8  | - | Site Plan   |
| Plate 9  | - | Intake & Turbine Area Excavation and<br>Backfill Plan and Sections. |
| Plate 10 | - | Boundaries of Flooded Land during the<br>PMH Occurrence.            |

Respectfully submitted,

DAMES & MOORE



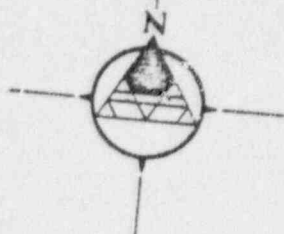
Philip Sherlock

PS-UK-bak  
(5 copies submitted)

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POOR ORIGINAL



SITE

AMBROSE TO BARNEGAT

SITE LOCATION

REFERENCE:

C & G S 1108  
(Approaches to New York)  
SOUNDINGS IN FATHOMS - SCALE 1:400,000

Published at Washington, D. C.  
U. S. DEPARTMENT OF COMMERCE  
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION  
NATIONAL OCEAN SURVEY

90000152

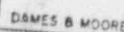
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| 2   | 10-1-66 | J. B. G. |       |      |      |
| 3   | 10-1-66 | J. B. G. |       |      |      |
| 4   | 10-1-66 | J. B. G. |       |      |      |
| 5   | 10-1-66 | J. B. G. |       |      |      |
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| 7   | 10-1-66 | J. B. G. |       |      |      |
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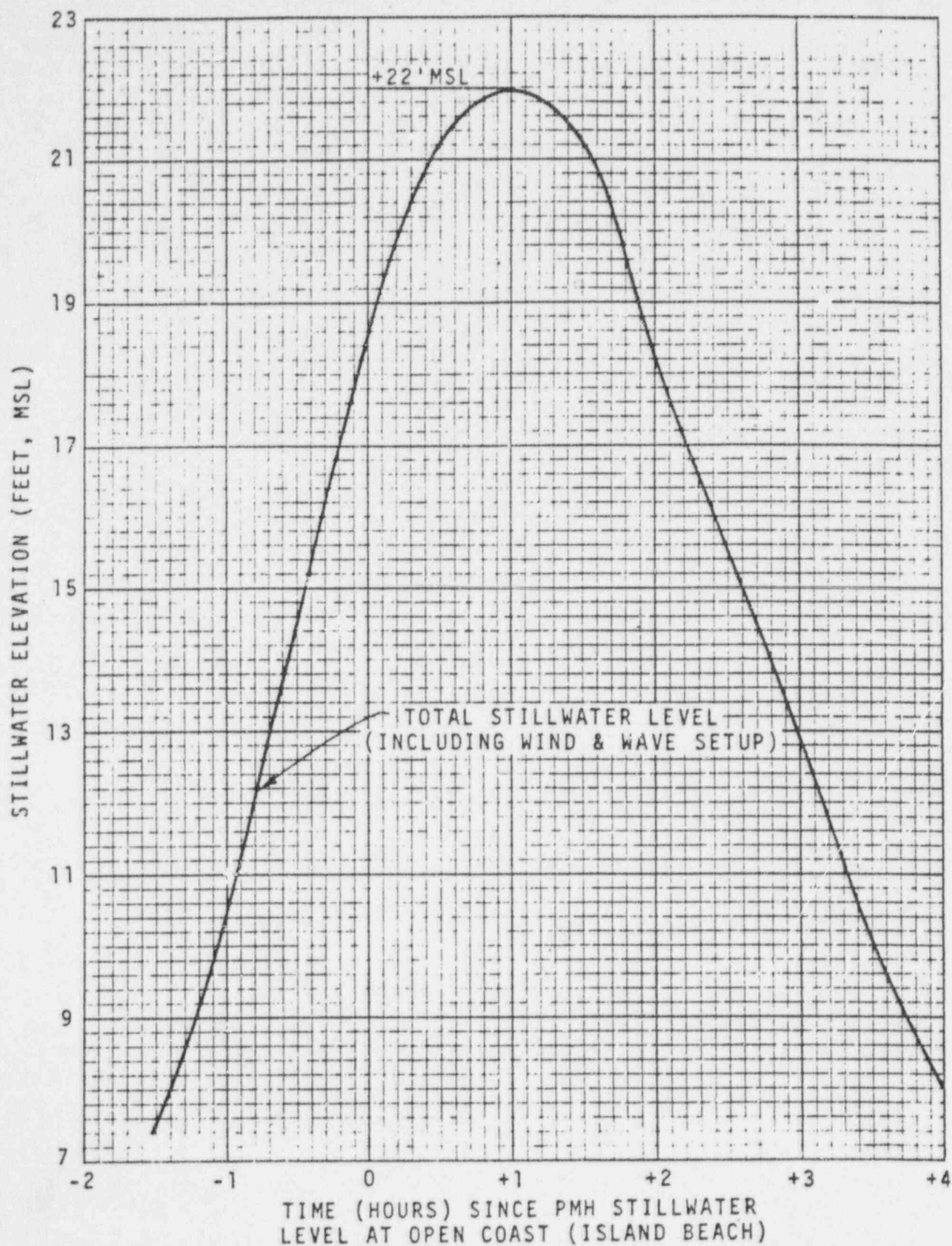
90000153

THE CONTRACT





POOR ORIGINAL

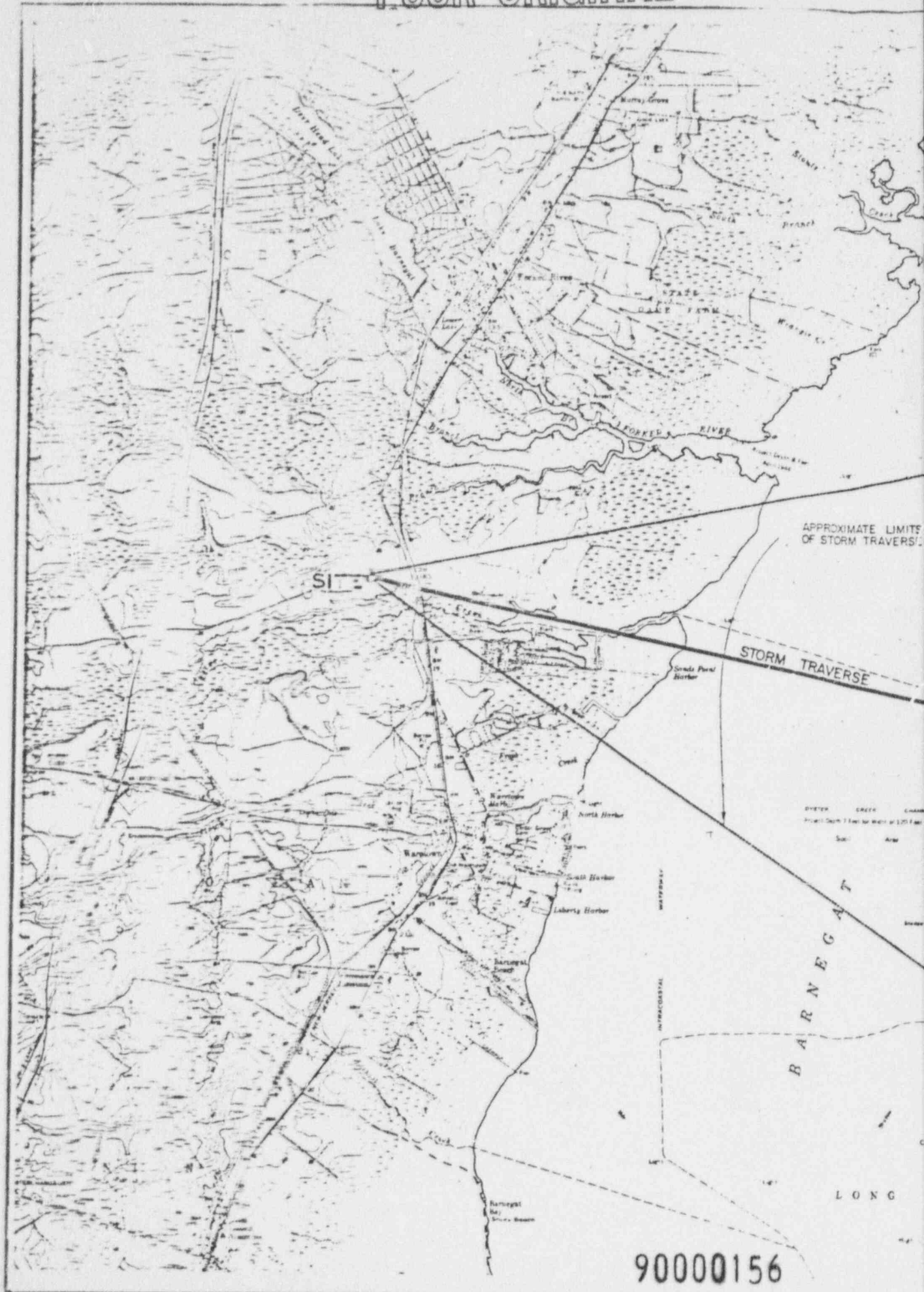


PMH STILLWATER LEVEL 90000155

AT OYSTER CREEK NUCLEAR UNIT 1

DAMES & MOORE

POOR ORIGINAL

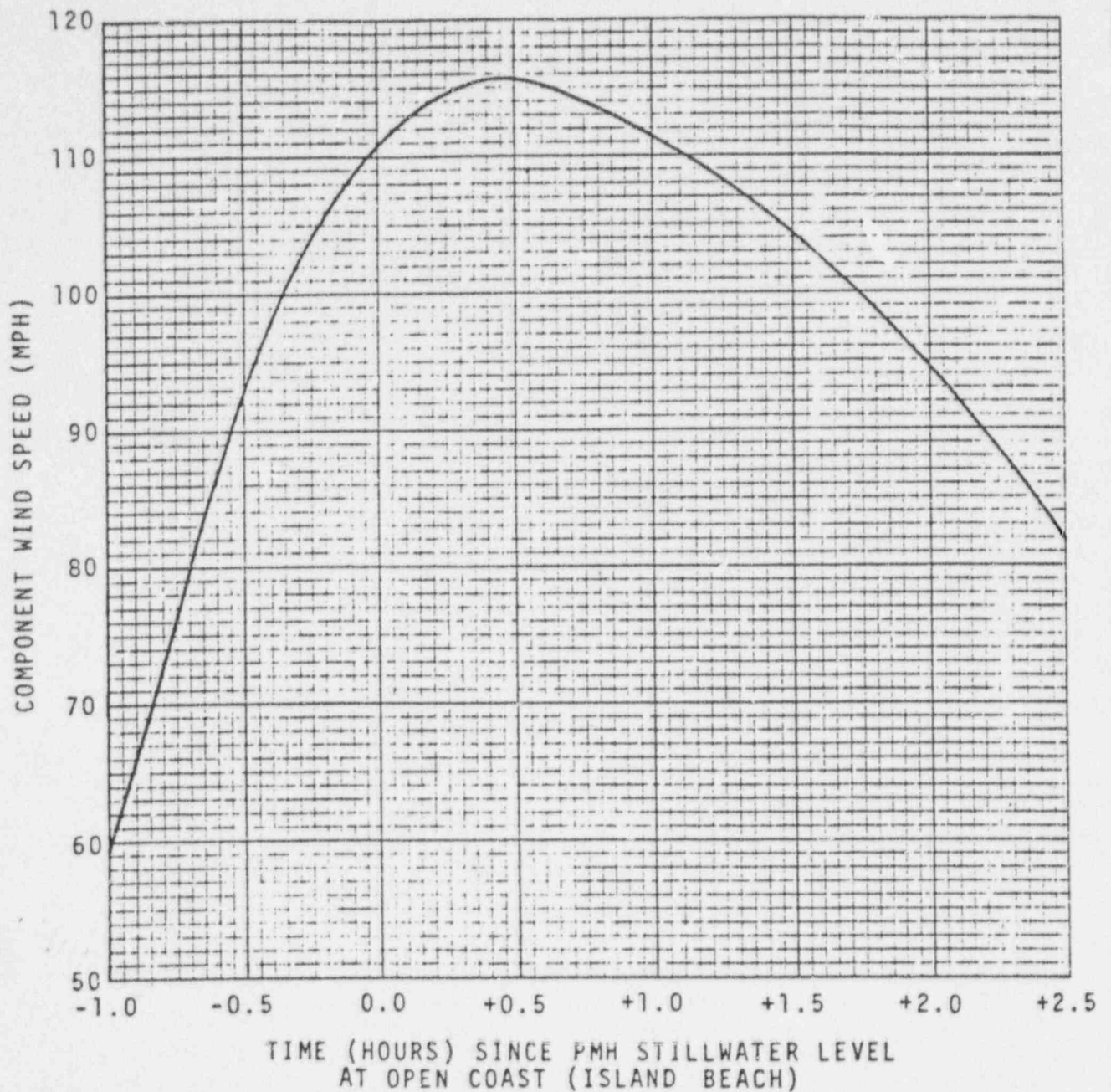


90000156





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## COMPONENT WIND PROFILE

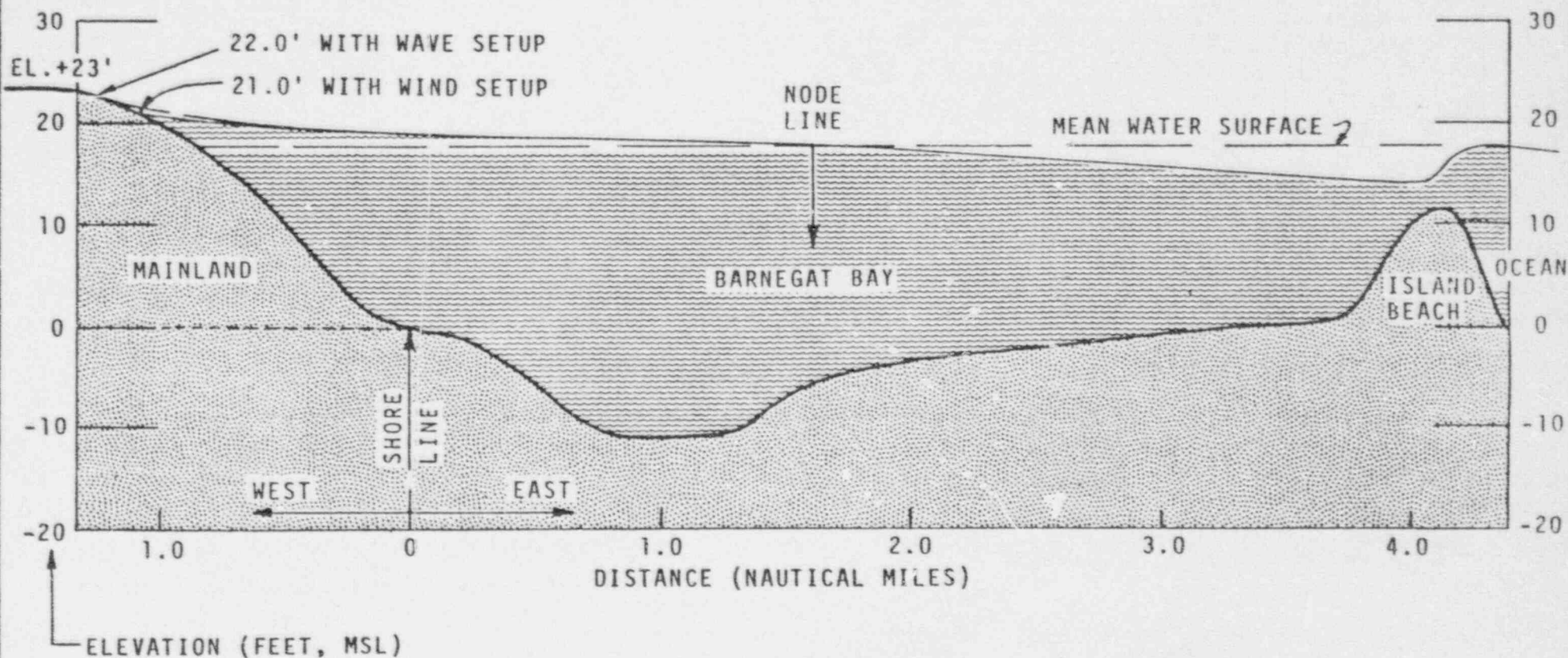
FOR 5 NAUTICAL MILE FETCH

(FETCH SHOWN ON PLATES 4 & 6)

90000158

DAMES & MOORE

# SITE



POOR ORIGINAL

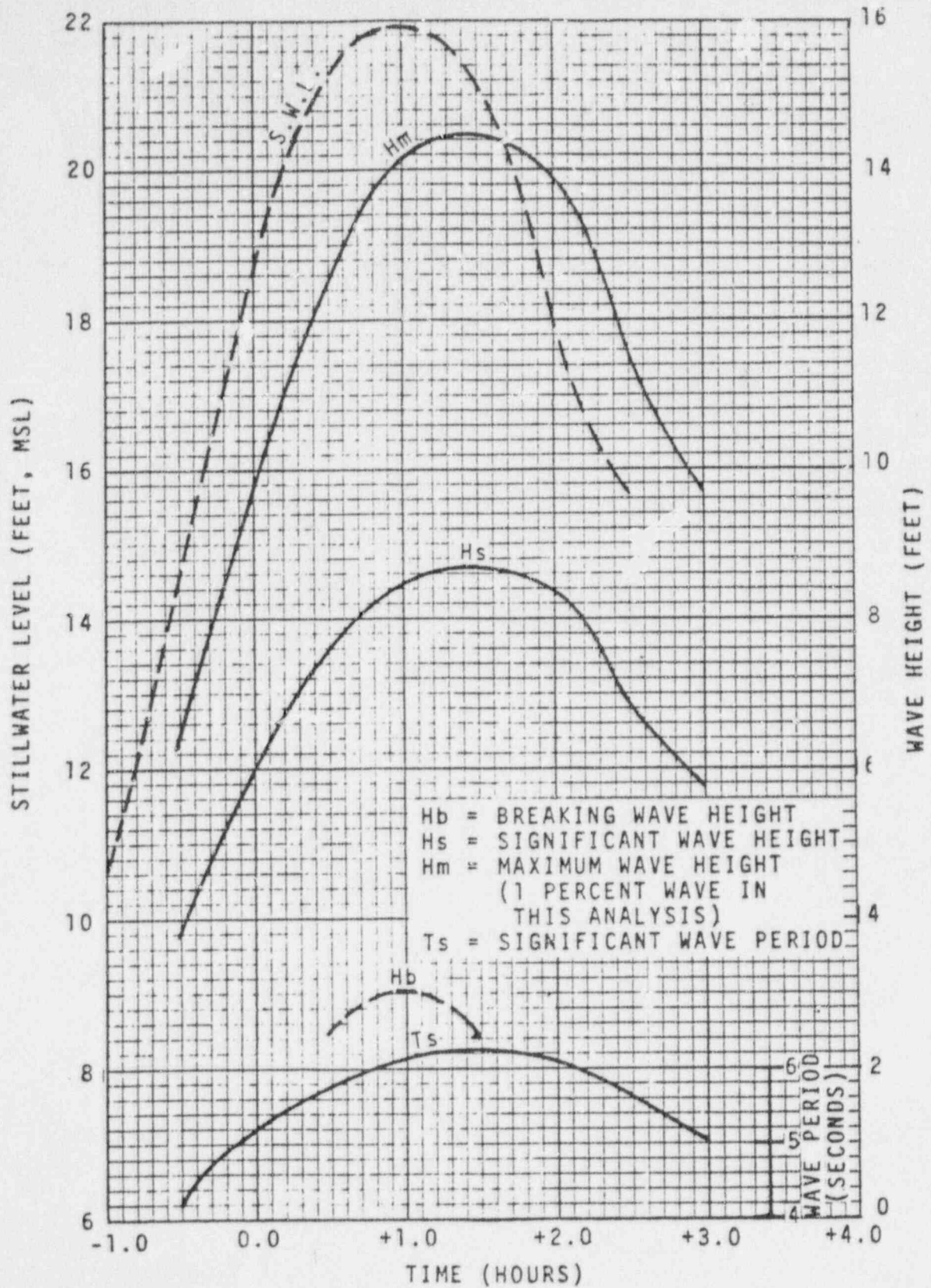
## STORM TRAVERSE DEPTH PROFILE

90000159

DAVID B. MOORE



POOR ORIGINAL

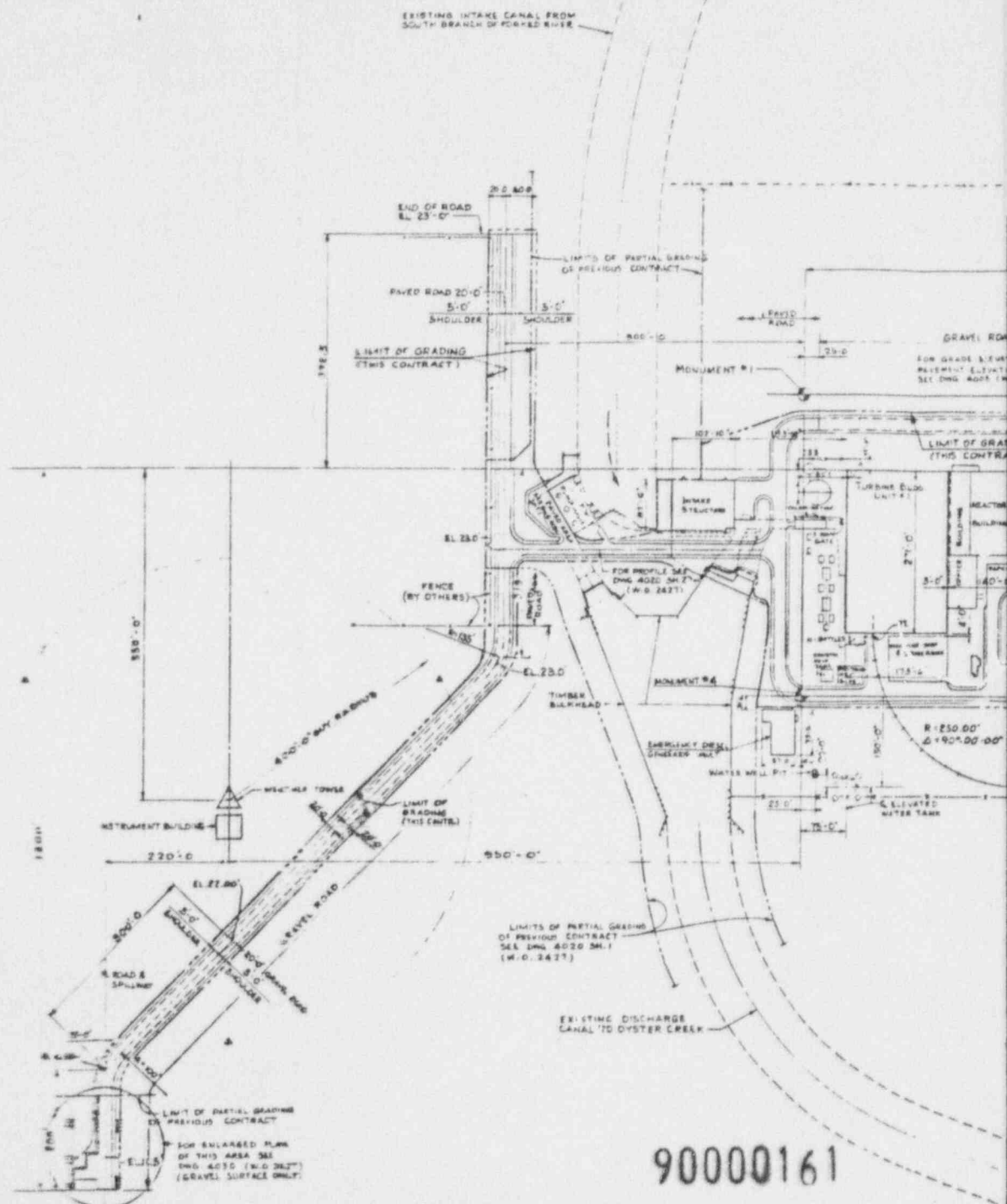


WAVE CHARACTERISTICS & STILLWATER  
LEVELS VS. TIME

90000160

DAMES & MOORE

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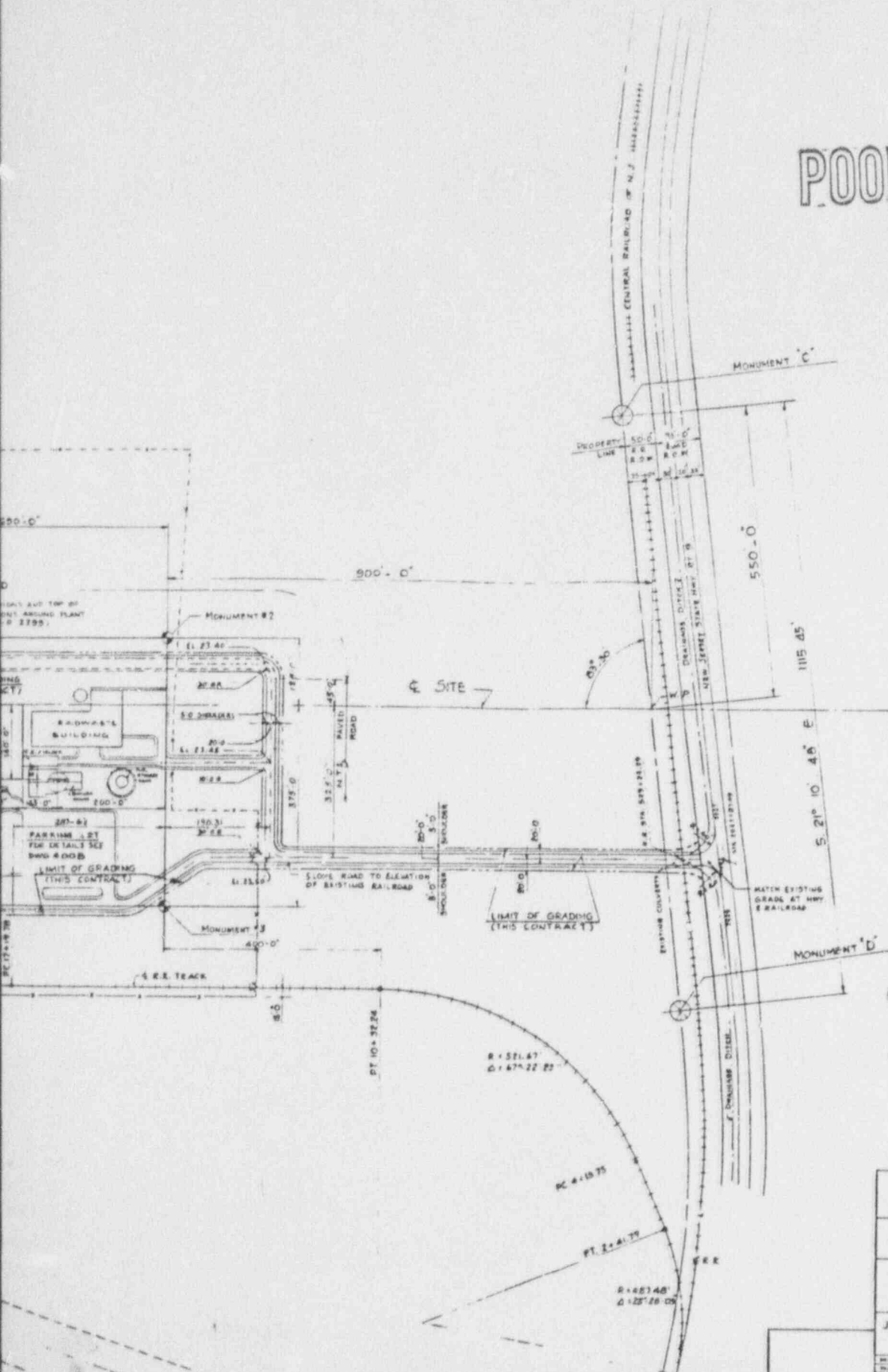


90000161

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| 2   | 10-1-58 | W.D. 2427 | W.D. 2427 | W.D. 2427 | 10-1-58 |
| 3   | 10-1-58 | W.D. 2427 | W.D. 2427 | W.D. 2427 | 10-1-58 |
| 4   | 10-1-58 | W.D. 2427 | W.D. 2427 | W.D. 2427 | 10-1-58 |
| 5   | 10-1-58 | W.D. 2427 | W.D. 2427 | W.D. 2427 | 10-1-58 |
| 6   | 10-1-58 | W.D. 2427 | W.D. 2427 | W.D. 2427 | 10-1-58 |
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| 10  | 10-1-58 | W.D. 2427 | W.D. 2427 | W.D. 2427 | 10-1-58 |



POOR ORIGINAL



90000162

WORK THIS DWG. WITH DWG. 4005, 4006  
(4008)



GENERAL ELECTRIC COMPANY  
ATOMIC POWER EQUIPMENT DEPT.  
SAN JOSE, CALIFORNIA

BURNS AND ROE, INC.  
ENGINEERS AND CONSTRUCTORS  
NEW YORK, N.Y.

SITE PLAN

JERSEY CENTRAL POWER & LIGHT CO.  
OYSTER CREEK STATION UNIT #1

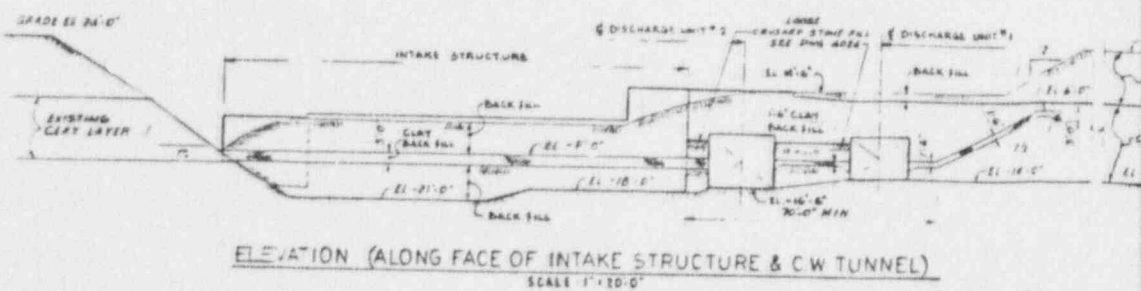
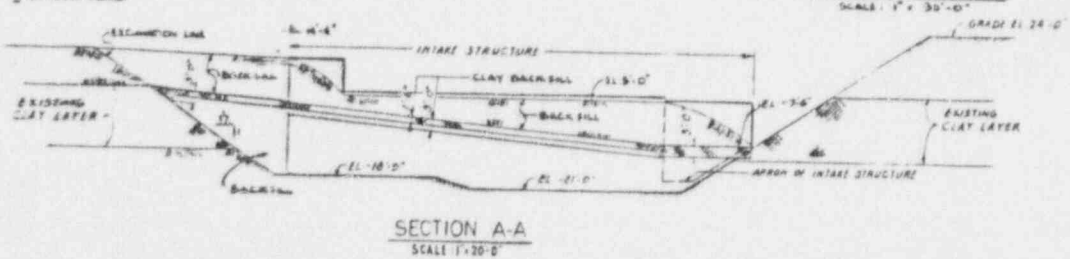
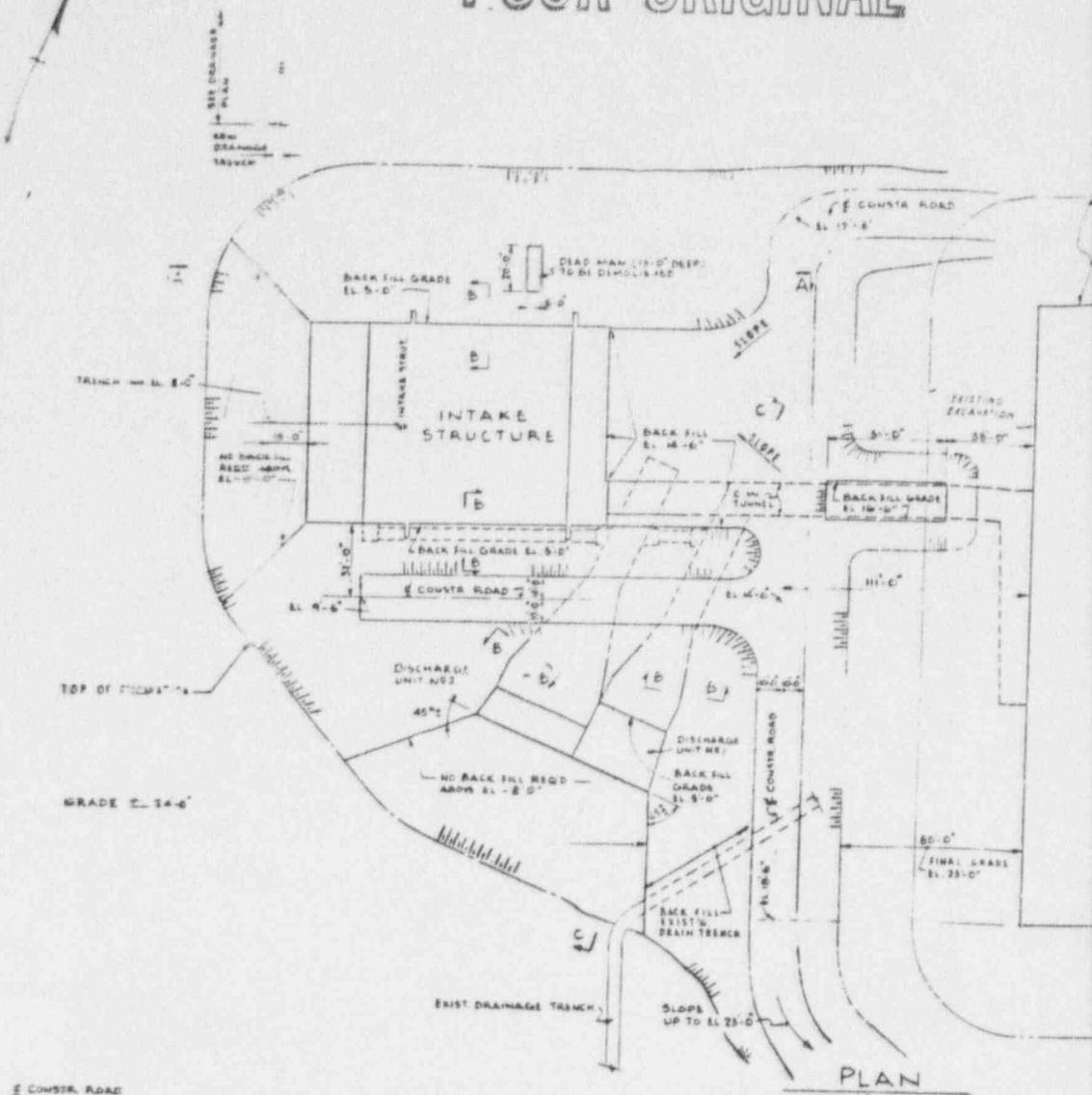
DESIGNED BY: J. E. Moore  
CHECKED BY: J. E. Moore  
DATE: 1/22/58  
W.O. 2299

DAMES & MOORE

*John E. Moore*  
ENGINEER

DWG. 4005-1

# POOR ORIGINAL



90000163

| REV | DATE    | BY       | CHKD | APP | REVISION                                     |
|-----|---------|----------|------|-----|--|
| 1   | 10/1/68 | W. J. B. |      |     | REVISED PLAN REV TO INCLUDE AS BUILT CHANGES |
| 2   | 10/1/68 | W. J. B. |      |     | REVIEWED FOR "AS BUILT" CONDITIONS           |

SCALE 1" = 400'-0"

- 1 CLAY BALLAST TO BE PLACED IN 6" MAX LAYERS AND COMPACTED WITH SHEEPSFOOT ROLLER PER SPECS AND WITH NOT LESS THAN 4 PASSES PER LAYER
- 2 DESIGNED TO EXISTING CONTOURS, LIMITS OF EXISTING STRUCTURES OF FILL MATERIAL AND WASTE RECLAMATION DISPERSED AREAS
- 3 SEE DMS 8002 AND EXAMINE SITE FOR EXCAVATION AND BACK FILL FORMED BY OTHERS UNDER PREVIOUS SUBCONTRACT
- 4 CONSTRUCT ROAD SURFACING TO BE AS REQUIRED FOR ACCESS FOR CONSTRUCTION OF BOLD FOUNDATIONS AND CUL WATER SYSTEM STRUCTURES

90000164



GENERAL ELECTRIC COMPANY  
ATOMIC POWER EQUIPMENT DEPT.  
SAN JOSE, CALIFORNIA

BURNS AND ROE, INC.  
ENGINEERS AND CONSTRUCTORS  
NEW YORK, N. Y.

INTAKE & TURBINE AREA  
EXCAVATION & BACKFILL PLAN &  
SECTIONS

JERSEY CENTRAL POWER & LIGHT CO  
OYSTER CREEK STATION-UNIT #1

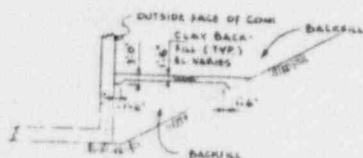
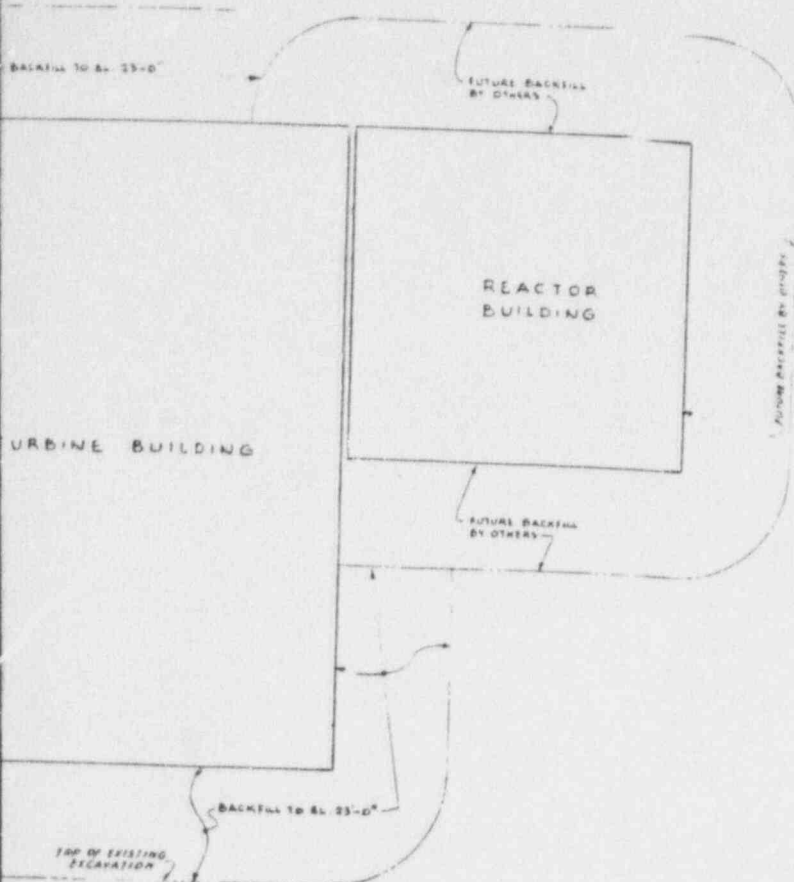
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|---------------|------|-----|----|
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| DATE OF DEATH | 1995 | AGE | 50 |

|              |      |       |
|--------------|------|-------|
| INITIALS BY  | DATE | CLASS |
| APPROVED FOR |      |       |

|           |           |
|-----------|-----------|
| W.O. 2299 | W.O. 2299 |
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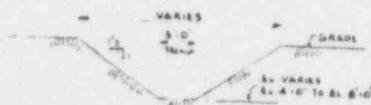
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DAMES &amp; MOORE



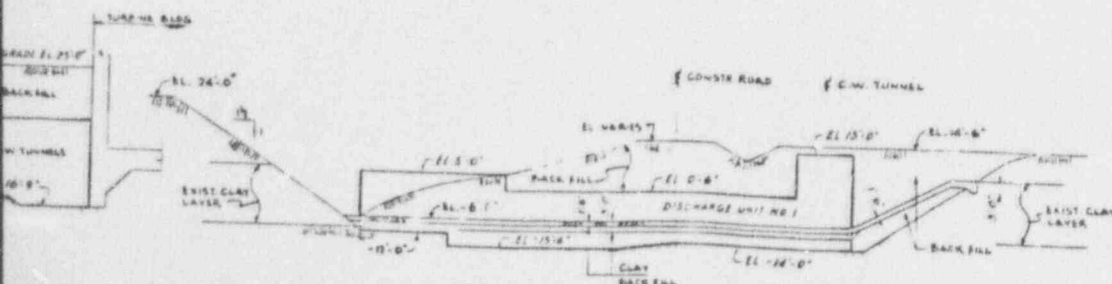
SECTION B-B

SCALE 1"=20'-0"



TYPICAL DRAINAGE TRENCH

NOT TO SCALE



SECTION C-C

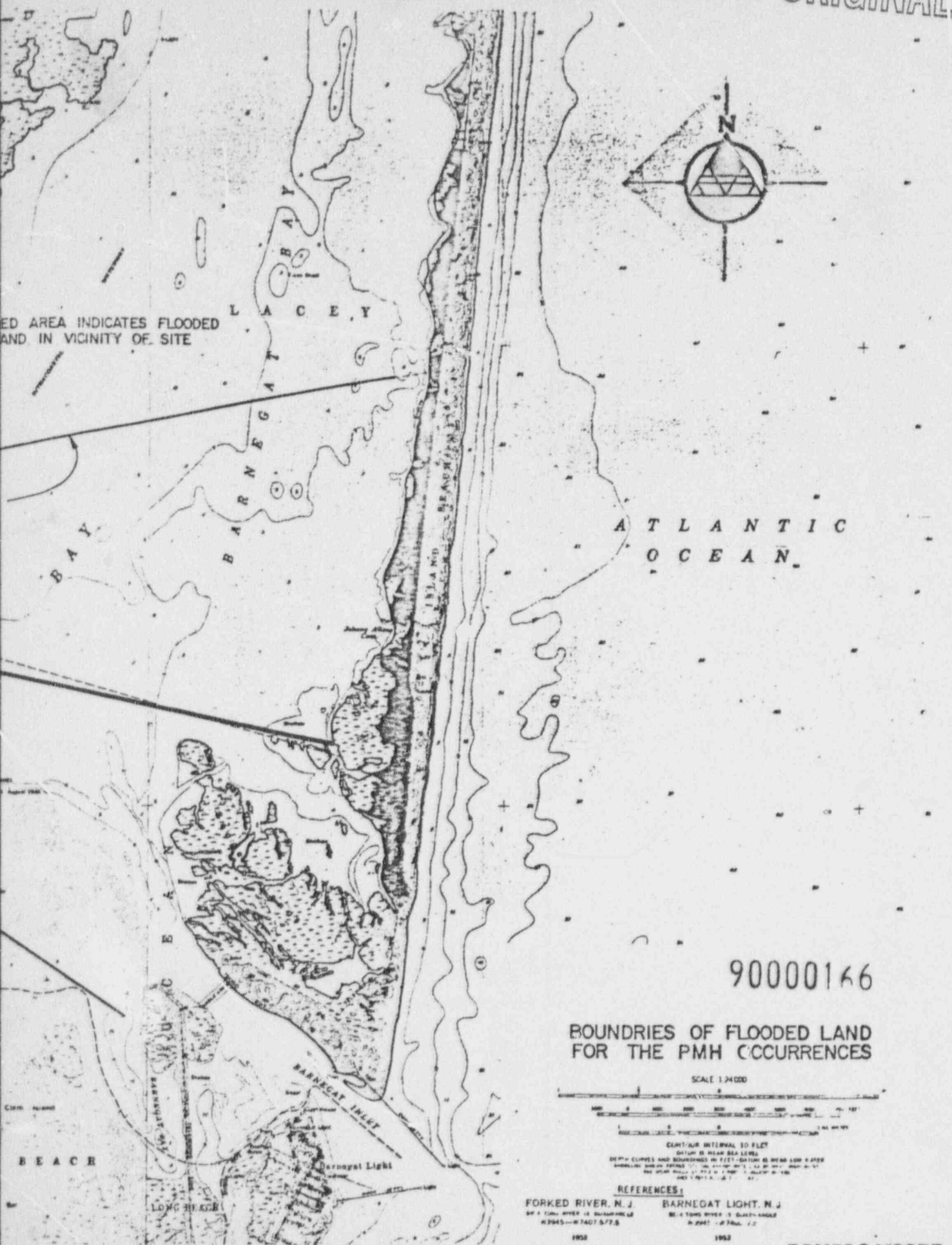
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POOR ORIGINAL





POOR ORIGINAL





Docket No. 50-219

ATTACHMENT E

OYSTER CREEK NUCLEAR GENERATING STATION

CODES AND STANDARDS FOR  
CATEGORY 1 STRUCTURES

90000167

December, 1979

OYSTER CREEK  
COMPONENT/SUBSYSTEM

## QUALITY GROUP

## SEISMIC

## REMARKS

NOTE  
1PLANT  
DESIGNR.G. 1.26  
SRP 3.2.2PLANT  
DESIGNR.G. 1.29  
SRP 3.2.1STRUCTURES

1. REACTOR BLDG

ASME SEC. VIII  
1962 Edition & IV  
1270N-5  
1272N-5  
1271N

CLASS I

SEISMIC  
CATEGORY I  
(SEE)

R.G. 1.29 C.1.0/(V.3.5)

2. DRYWELL, TORUS, VENTS

CLASS I

R.G. 1.29 C.1.0/(V.3.5)

3. CONTROL ROOM PANELS

CLASS I

I

R.G. 1.29 C.1.n/(V.3.5)

4. SPENT FUEL POOL

SEC. VIII  
ASA, IEEE, ASTM,  
AWS, NBFU & FED  
STATE & LOCAL

CLASS I

I

R.G. 1.29 C.1.1/(V.3.5)

5. VENT STACK

CLASS I

NSI (OBE)

6. TURBINE BLDG.

CLASS II

7. RADWASTE BLDG.

CLASS II

NONSEISMIC  
CATEGORY I  
(OBE)

SEE SRP 11.3

2,3

9. INTAKE &amp; DISCHARGE

CLASS II

SEISMIC I

IF THIS IS ULTIMATE HEA  
SINK IT SHOULD BE SI  
R.G. 1.29(1g).

10. SCREEN HOUSE

CLASS II

EQUIPMENT  
NSSS

2,3

1. REACTOR VESSEL

ASME BPV  
SECT. I  
ASME BPV  
SECT. IASME BPV  
SECT. III

A CLASS I

SEISMIC I

Pg. IV-1-1/R.G. 1.29  
C.1.a/(V.3.5)

2

2. CRDS Housing

ASME BPV  
SECT. I

A CLASS I

SEISMIC

R.G. 1.29 (C.2/(V.3.5))

2

Supports

GE

CLASS I

SEISMIC I

R.G. 1.29 C.2/(V.3.5)

2,3

3. RV SUPPORTS

GE

CLASS I

SEISMIC I

R.G. 1.29 C.2/(V.3.5)

2,3

4. FUEL ELEMENTS

GE

CLASS I

SEISMIC I

R.G. 1.29 C.1.b/(V.3.5)

2,3

5. CORE SHROUD

GE

CLASS I

SEISMIC I

R.G. 1.29 C.1.b/(V.3.5)

2,3

6. CORE SUPPORTS

GE

CLASS I

SEISMIC I

R.G. 1.29 C.1.b/(V.3.5)

2,3

7. STEAM SEPARATOR

ASME S IX

CLASS I

SEISMIC I

R.G. 1.29 C.1.b/(V.3.5)

90000168

N/A

N/A

| OYSTER CREEK<br>COMPONENT/SUBSYSTEM |  | QUALITY GROUP   |                            | SEISMIC                 |                        | REMARKS                                       |
|-------------------------------------|--|---|----------------------------|-------------------------|------------------------|---|
| NOTE                                |  | PLANT<br>DESIGN   | R.G. 1.26<br>SRP 3.2.2     | PLANT<br>DESIGN         | R.G. 1.29<br>SRP 3.2.1 |   |
| 1                                   | 8. STEAM DRYER   | ASME S IX   | N/A                        | CLASS I                 | SEISMIC I              | R.G. 1.29 C.1.b/V.3.5                         |
| 1,2,3                               | 9. PIPING FROM REACTOR<br>VESSEL TO 1st ISOLATION<br>VALVE EXTERNAL TO DRYWELL | ASME SI 1965 to first<br>ISO VALVE OUTSIDE DRYWELL<br>then ANSI B31.1-1965<br>& NUC Code Cases to<br>2nd ISO valve. | ASME BPV SIII C1<br>A      | CLASS I                 | SEISMIC I              | R.G. 1.29 C.1.a                               |
|                                     | RECIRCULATION<br>SYSTEM  |   |                            |                         |                        |   |
| 1                                   | 1. PUMPS   | ASA B31.1   | ASME BPV SIII C1 A         | CLASS I                 | SEISMIC I              | VI-1-1/R.G. 1.29 C.1.a                        |
| 1                                   | 2. VALVES  | ASME BPV I  | " A                        | CLASS I                 | SEISMIC I              | IV-1-2/R.G. 1.29 C.1.a                        |
| 1                                   | 3. PIPING  | ASME BPV I<br>ASA B31.1   | " A                        | CLASS I                 | SEISMIC I              | IV-1-2/R.G. 1.29 C.1.A                        |
|                                     | EMERGENCY SYSTEMS  |   |                            |                         |                        |   |
| 2,3                                 | 1. ISOLATION CONDENSER<br>SHELL  | ASME BPV<br>SECT. VIII  | C                          | CLASS I                 | SEISMIC I              | IV-1-2<br>R.G. 1.29 C.2                       |
| 1,2,3                               | TUBE   | ASME BPV<br>S.III C1.A  | ASME BPV SIII C2<br>B      | CLASS I<br>SIII CLASS 2 | SEISMIC I              | R.G. 1.29 C.1.b                               |
| 1,2,3                               | PIPING   | ASME Sec. 1<br>1965   | ASME BPV<br>SIII CLASS 2 B | CLASS I                 | SEISMIC I              | R.G. 1.29 C.1.b                               |
| 3*                                  | 2. LIQUID POISON SYS.<br>* Only if CRDS fails to<br>operate                    | ASME 31-1965<br>ANSI B-31.1-1965<br>& NCC   | ASME BPV<br>SIII CLASS 2 B | CLASS I                 | SEISMIC I              | R.G. 1.29 C.1.b                               |
|                                     | PUMP<br>TANK   | ASME SIII C1C<br>API  | B<br>B                     |                         |                        |   |
| 1,3                                 | 3. CORE SPRAY SYS.<br>PIPING   | ASA B31.1   | ASME BPV SIII C2<br>A/B    | CLASS I<br>"            | SEISMIC I<br>CLASS I   | R.G. 1.29 C.1.c/VI.6.2                        |
| 2                                   | 4. REACTOR BLDG<br>CLOSED LOOP COOLING   | ANSI-B31.1-1965 &<br>Nuclear Code Cases   | ASME BPV<br>SIII CL 3 C    | CLASS I                 | SEISMIC I              | V.3.5/R.G. 1.29 C.1.g                         |
| 3                                   | 5. AUTOMATIC DEPRESSUR-  |   | A                          |                         |                        | Part of ECCS; should be<br>Seismic I, Class 2 |

90000169

| NOTE | OYSTER CREEK<br>COMPONENT/SUBSYSTEM           | QUALITY GROUP  |                            | SEISMIC         |                        | REMARKS  |
|------|---|--|----------------------------|-----------------|------------------------|--|
|      |   | PLANT<br>DESIGN  | R.G. 1,26<br>SRP 3,2,2     | PLANT<br>DESIGN | R.G. 1,29<br>SRP 3.2,1 |  |
| 1    | REACTOR EMERGENCY SYS.                        |  |                            |                 |                        |  |
| 3    | SERVICE WATER SYSTEM                          | ASME BPV<br>SI & IX<br>TO 1st ISO-<br>LATION VALVE<br>REST ASA<br>1331.1-1955+<br>CHANGES TO<br>1966 | ASME BPV<br>SIII CLASS 3 C | CLASS I         | SEISMIC I              | R.G. 1.29 C.1.g/X-3-2  |
| 3    | CONTAINMENT SPRAY<br>SYSTEM                   | ASA B31.1<br>ASME S VIII<br>TO 1st VALVE<br>OUTSIDE<br>CONTAINMENT                                   | ASME BPV<br>SIII CLASS 2 B | CLASS I         | SEISMIC I              | R.G. 1.29 C.1.c/VI-7-1   |
| X    | STANDBY GAS TREAT. SYS                        | GE   | B**                        | CLASS I         | SEISMIC I*             | No description of system<br>*if system removes H <sub>2</sub><br>**no req't if post accid fission<br>product removal is not basis.<br>O.C. uses H <sub>2</sub> inerting system |
| X    | SPENT FUEL AND NEW<br>FUEL STORAGE FACILITIES | ASTM, A373,<br>A245, 6VA, B&C<br>ASTM, A240 C1<br>304L   |                            | CLASS I         | SEISMIC                | Fuel Handling Not Covered by R. G.<br>1.26; R.G. 129 C.1.L requires seismic<br>I   |
| 1,3  | EMERGENCY ELEC. SYS.<br>BATTERIES             | ASA, ASTM, ASTM,<br>IEEE NEMA, NFBJ<br>NEMA, LOCAL   | } N/A                      | CLASS I         | SEISMIC I              | R.G. 1.29 (G.1.q) CLASS IE ONSITE<br>POWER SUPPLIES IEEE 344. SRP 8.3.2  |
| 2,3  | DIESEL GENERATOR                              | ASME, ASA, ASTM,<br>IEEE, NEMA, NFBJ<br>DEMH, LOCAL  |                            |                 |                        | R.G. 1.29 C.1.q Class IE Onsite<br>Power   |
| 2,3  | EMERGENCY BUSES,<br>ETC.                      | ASA, IEEE,<br>ASTM, NEMA   |                            |                 |                        | R.G. 1.29 C.1.8 Class IE Onsite<br>Power Supplies IEEE 344. SRP 8.3.   |

90000170



90000171

OYSTER CREEK  
COMPONENT/SUBSYSTEM

QUALITY GROUP

SEISMIC

REMARKS

PLANT  
DESIGNR.G. 1.26  
SRP 3.2.2PLANT  
DESIGNR.G. 1.29  
SRP 3.2.1

## STEAM SYSTEM

1. Piping to Ist.I.V.

ASME BPV  
SECT. IASME BPV  
A III CLASS I A

CLASS I

SEISMIC I

R.G. 1.29 C.1.a/IV-1-2

2. Piping to Turb SV

ASA B31.1

ASME BPV  
SIII CLASS 2 B

SEISMIC I

R.G. 1.29 C.1.e

3. MSIV VALVE

ASME BPV  
SECT. L  
ASA B31.1  
GE SPECSASME BPV  
SIII CLASS 1 A

CLASS I

SEISMIC I

R.G. 1.29 C.1.a/IV-1-2

4. TURBINE STOP VALVE

ANSI B31.1.1.0 D

NON SEISMIC I

SRP 3.2.1

5. SAFETY VALVE

ASME BPV  
SECT. I  
XNCC-1271NASME BPV  
SIII CLASS 1 A

CLASS I

SEISMIC I

R.G. 1.29 C.1.a/IV-1-2

6. RELIEF VALVE

ASME BPV  
SECT IASME BPV  
SIII CLASS 1 A

CLASS I

SEISMIC I

R.G. 1.29 C.1.a/IV-1-2

SHUTDOWN COOLING  
SYSTEMS  
PUMPS-----  
ASME BPV  
SECT.III-----  
ASME BPV  
SIII CLASS 2 CCLASS II  
CLASS II-----  
SEISMIC IX-2-2  
R.G. 1.29-C.1.dSHUTDOWN COOLING  
TUBEASME BPV  
SIII  
CLASS CASME BPV  
SIII CLASS 2 C

CLASS II

SEISMIC I

R.G. 1.29 C.1.d

NOTE  
1

1

1

1

1

2

2

90000172

| NOTE | OYSTER CREEK<br>COMPONENT/SUBSYSTEM  | QUALITY GROUP               |                             | SEISMIC   |                        | REMARKS  |
|------|--------------------------------------|-----------------------------|-----------------------------|---|------------------------|--|
|      |                                      | PLANT<br>DESIGN             | R.G. 1.26<br>SRP 3.2.2      | PLANT<br>DESIGN   | R.G. 1.29<br>SRP 3.2.1 |  |
| 1    |                                      |                             |                             |   |                        |  |
| 2    | x SHELL                              | ASME BPV<br>SECT. VIII      | ASME BPV<br>SIII CLASS 2 C  | CLASS II<br>SIII CLASS 2                                  | SEISMIC I              | R.G. 1.29 C.1.g  |
|      | CONDENSATE STORAGE<br>TANKS & PUMPS  |                             |                             | CLASS II<br>Analysed for<br>0.11g seismic<br>event - 0,K. | SEISMIC II             | CONDENSATE STORAGE SYSTEM IS<br>RELATED TO SAFETY; ECCS SMALL<br>BREAKS USE CRD WHICH HAS NORMA<br>SUCTION FROM CST ISOLATION<br>CONDENSER CAN ALSO TAKE SUCTION<br>FROM CST.  |
| X    | LIQUID WASTE SYSTEM                  | API 650<br>STANDARD         | ASME BPV<br>SIII CLASS 3 D  | CLASS II  |                        | WASTE MANAGEMENT SYSTEMS IS<br>UNDER DEVELOPMENT SRP 5.4.8<br>REQUIRES THAT PIPING FROM THE<br>RECIRCULATION LOOP TO THE<br>OUTERMOST ISOLATION VALVE BE<br>CLASS A, SEISMIC I |
| X    | REACTOR CLEANUP SYS.                 | ASME BPV<br>SIII<br>CLASS C | ASME BPV<br>SIII CLASS 3 C  | CLASS II  | NON-SEISMIC            | X-2-1  |
| X    | AIR COMPRESSOR &<br>RECEIVERS        |                             | NOT COVERED<br>BY R.G. 1.26 | CLASS II  | NON-SEISMIC            | AIR OPERATED VALVES IMPORTANT T<br>SAFETY ARE REQUIRED TO HAVE<br>SEISMIC ACCUMULATORS   |
| 2,3  | STATION AUXILIARY BUSES              |                             | N/A                         | CLASS II  |                        |  |
| X    | MOISTURE SEPARATORS AND<br>REHEATERS | ASME SEC.<br>VIII           | N/A                         | CLASS II  |                        |  |

NOTE 1 - #1 denotes equipment required to hold together to prevent a LOCA due to the seismic event  
 #2 denotes equipment required to shutdown & hold in safe shutdown condition following seismic event  
 #3 denotes equipment required if plant experiences a LOCA  
 X denotes equipment not needed for safety during seismic event

OYSTER CREEK  
COMPONENT/SUBSYSTEM

## QUALITY GROUP

## SEISMIC

## REMARKS

NOTE

|      |                                      | PLANT<br>DESIGN   | R.G. 1.26<br>SRP 3.2.2 | PLANT<br>DESIGN | R.G. 1.29<br>SRP 3.2.1   |                        |
|------|--------------------------------------|---|------------------------|-----------------|--|------------------------|
|      |                                      |   |                        |                 |  |                        |
| 1    | INSTRUMENT AND CONTROL               |   |                        |                 |  |                        |
| 2, 3 | REACTOR LEVEL INSTR.                 | B31.1 SI & VI<br>ASA, IEEE, ASME,<br>ASTM, ANS, NBFU,<br>& STATE & LOCAL  |                        | CLASS I         | SEISMIC I  | R.G. 1.29 C.1.k/V.3.6  |
| 2, 3 | FEED WATER CONTROL VALVES            |   |                        | "               | "  | "                      |
| 2*   | LIQUID POISON SYS. INSTR.            |   |                        | "               | "  | "                      |
|      | ANUAL REACTOR CONTROL                |   |                        | "               | "  | "                      |
| 2, 3 | CONTROL ROD INST                     | ASA & IEEE  | N/A                    | "               | "  | "                      |
| 2, 3 | CONT. ROD POSITION                   |   |                        | "               | "  | "                      |
| 2, 3 | INDICATING SYST.                     |   |                        | "               | "  | "                      |
| 2, 3 | REACTOR PROTECTION SYSTEM            |   |                        | "               | "  | "                      |
| 2, 3 | NEUTRON MONITOR SYSTEM               | ASME III C1.A<br>Pressure Parts   |                        | "               | "  | "                      |
|      | FUEL RUPTURE DETECTION SYST.         |   |                        | "               | "  | "                      |
|      | AREA MONITORS                        |   |                        | "               | "  | "                      |
|      |                                      |   |                        | CLASS I         | -----  | -----                  |
| X    | TURBINE GENERATOR                    | ASME, ASA, ASTM,<br>IEEE, NEMA, NBFU<br>STDS OF TUBULAR<br>EXCHANGER MANU-<br>FACTUREPS ASSO-<br>CIATION CLASS R.<br>NJ & LOCAL CODES | N/A                    | Class II        |  | No Seismic Req't/V-3-6 |
|      |                                      |   |                        |                 |  |                        |
|      |                                      |   |                        |                 |  |                        |
|      |                                      |   |                        |                 |  |                        |
| X    | CONDENSER                            | HEAT EXCHANGER<br>INSTITUTE   | N/A                    | Class II        | Dynamic analysis<br>for 0.11g seismic<br>event   |                        |
|      | FEEDWATER SYSTEM<br>HEATERS<br>PUMPS | ASME S1-1965<br>RV TO 1st VALVE<br>OUTSIDE CONTAIN-<br>MENT<br>ASME SECT. VIII &<br>TFMA STDS.  |                        | CLASS II        | *<br>*=The FWS is used as r<br>dundant ECCS to the ADS for Small Brks<br>and single failure requirements. This<br>would require that the FWS seismic I,<br>Amend. 38 presents results of seismic<br>analysis to show that the feedwater in |                        |

90000173

QUALITY STANDARDS

NRC QUALITY GROUP A

ASME Boiler and Pressure

Vessel Code, Section III

Class 1

or

ASME Boiler and Pressure

Vessel Code, Section III

Class A

(pressure vessels)

NRC QUALITY GROUP B

Class 2

or

Class C

(pressure vessels)

NRC QUALITY GROUP C

Class 3

--

NRC QUALITY GROUP D

ASME, Sec. VIII  
(pressure vessels)  
ANSI B31.1.0  
(piping and valves)  
Mfg. Stds. (pumps)

--

NRC Quality Group A equivalent to Licensee Safety Class 1

NRC Quality Group B equivalent to Licensee Safety Class 2

NRC Quality Group C equivalent to Licensee Safety Class 3

NRC Quality Group D equivalent to Licensee Safety Class 4 or NNS

) Also seismic Category I

) Not always seismic Category I

) Non-seismic Category I

90000174



Docket No. 50-219

ATTACHMENT F  
OYSTER CREEK NUCLEAR GENERATING STATION  
LOADS COMBINATION

90000175

December, 1979

QUESTION

1. A Describe the load combinations and provide the stress level tables as requested per question IV-1.

ANSWER

The information requested is presented in the attached Tables 1-A-1 through 1-A-5.

90000176

TABLE 1-A-1

ALLOWABLE STRESSES FOR DRYWELL CONCRETE SHIELD

| <u>Loading Condition</u>  | <u>Reinforced Steel<br/>Maximum Allowable<br/>Tension Stress</u> | <u>Reinforced Steel<br/>Maximum Allowable<br/>Compression Stress</u> | <u>Concrete<br/>Maximum Allowable<br/>Compression Stress</u> | <u>Concrete<br/>Maximum Allowable<br/>Shear Stress</u> | <u>Concrete<br/>Maximum Allowable<br/>Peripheral Shear</u> |
|---|--|--|--|--|--|
| 1. Dead Load Plus Live Load<br>Plus Overpressure<br>Plus Maximum Temperature<br>Plus Design Earthquake        | 0.5 Fy   | 0.34 Fy  | 0.45 f' <sub>c</sub>   | $1.1\sqrt{f'_c}$                                       | $2\sqrt{f'_c}$   |
| 2. Dead Load Plus Live Load<br>Plus Maximum Temperature<br>Plus Overpressure<br>Plus Double Design Earthquake | 0.5 Fy   | 0.34 Fy  | 0.45 f' <sub>c</sub>   | $1.467\sqrt{f'_c}$                                     | $2.667\sqrt{f'_c}$   |
| 3. Dead Load Plus Live Load<br>Plus Maximum Temperature<br>Plus Design Earthquake<br>Plus Jet Force           | 0.667 Fy   | 0.454 Fy   | 0.60 f' <sub>c</sub>   | $1.467\sqrt{f'_c}$                                     | $2.667\sqrt{f'_c}$   |

- NOTES:
- Dead loads and live loads include contributing maximum loadings from building floors, columns and walls, pool walls, slabs and plug.
  - Overpressure = Maximum 20 psi reaction from compressible joint.
  - Temperature = 55° F maximum gradient
  - Design earthquake = Loads due to 0.11g basic ground acceleration and includes proportions of the drywell vessel, the surrounding building, the reactor vessel and reactor building equipment.
  - Jet Force = 566 kips over a 3.14 ft<sup>2</sup> area at any point of the spherical portion and 466 kips over a 2.54 ft<sup>2</sup> area at any point of the cylindrical portion (below El. 94'-9").

90000177

OC-22

1-A-2

TABLE 1-A-2

## ALLOWABLE STRESSES FOR REACTOR VESSEL CONCRETE PEDESTAL

| Loading Condition  | Reinforced Steel<br>Maximum Allowable<br>Tension Stress | Reinforced Steel<br>Maximum Allowable<br>Compression Stress | Concrete<br>Maximum Allowable<br>Compression Stress                                       | Concrete<br>Maximum Allowable<br>Shear Stress |
|--|---|---|---|---|
| 1. Dead Load Plus Equipment<br>Load Plus Jet Load<br>Plus Temperature<br>Plus Design Earthquake        | 0.25 Fy   | 0.10 Fy   | $\begin{cases} 0.133 f'_c & \text{(bending)} \\ 0.116 f'_c & \text{(direct)} \end{cases}$ | $0.55\sqrt{f'_c}$                             |
| 2. Dead Load Plus Equipment<br>Load Plus Jet Load Plus<br>Temperature<br>Plus Double Design Earthquake | 0.25 Fy   | 0.10 Fy   | $\begin{cases} 0.267 f'_c & \text{(bending)} \\ 0.232 f'_c & \text{(direct)} \end{cases}$ | $1.1\sqrt{f'_c}$                              |

- NOTES: a. Jet plus seismic loads per J. A. Blume's "Earthquake Analysis: Reactor Pressure Vessel."  
b. Temperature = 40°F maximum gradient

TABLE 1-A-3

## ALLOWABLE STRESSES FOR CONCRETE VENTILATION STACK

| Loading Condition                                       | Reinforced Steel<br>Maximum Allowable<br>Tension Stress | Reinforced Steel<br>Maximum Allowable<br>Compression Stress | Concrete<br>Maximum Allowable<br>Compression Stress | Concrete<br>Maximum Allowable<br>Shear Stress |
|---|---|---|---|---|
| 1. Dead Load Plus Wind Load                             | 0.30 Fy   | -   | $0.375 f'_c$  | $1.1\sqrt{f'_c}$                              |
| 2. Dead Load Plus Wind<br>Plus Temperature              | 0.54 Fy   | -   | $0.67 f'_c$   | $1.1\sqrt{f'_c}$                              |
| 3. Dead Load Plus Design<br>Earthquake Load             | 0.30 Fy   | -   | $0.375 f'_c$  | $1.1\sqrt{f'_c}$                              |
| 4. Dead Load Plus Design<br>Earthquake Plus Temperature | 0.54 Fy   | -   | $0.67 f'_c$   | $1.1\sqrt{f'_c}$                              |
| 5. Dead Load Plus Double<br>Design Earthquake           | 0.96 Fy   | -   | $0.67 f'_c$   | $1.1\sqrt{f'_c}$                              |

- NOTES: a. Maximum wind velocity = 110 mph  
b. Seismic loads per J. A. Blume's "Earthquake Analysis: Ventilation Stack."  
c. Temperature = 100°F maximum gradient



TABLE 1-A-4

ALLOWABLE STRESSES FOR a) REACTOR BUILDING FLOOR SLABS, BEAMS, COLUMNS, WALLS, STORAGE POOLS AND FOUNDATION  
 b) CONTROL ROOM SLABS AND WALLS  
 c) BATTERY ROOM SLAB AND WALLS  
 d) EMERGENCY DIESEL GENERATOR AND TANK VAULT  
 \*e) INTAKE STRUCTURE (SERVICE WATER AND CIRCULATING WATER PUMP AREAS)  
 f) STARTUP TRANSFORMER FOUNDATION

| Loading Condition   | Reinforced Steel<br>Maximum Allowable<br>Tension Stress | Reinforced Steel<br>Maximum Allowable<br>Compression Stress | Concrete<br>Maximum Allowable<br>Compression Stress | Concrete<br>Maximum Allowable<br>Shear Stress | Reinforced Concrete<br>Shear Walls Allow-<br>able Unit Stress | Concrete<br>Maximum Allowable<br>Peripheral Shear | Concrete<br>Maximum Allowable<br>Bearing                        | O.C.S. |
|---|---|---|---|---|---|---|---|--------|
| 1. Dead Load Plus Live Load<br>Plus Operating Load<br>Plus Design Earthquake        | 0.5 Fy  | 0.34 Fy   | 0.45 f' <sub>c</sub>                                | 1.1 f' <sub>c</sub>                           | 0.05 f' <sub>c</sub>  | 2 f' <sub>c</sub>                                 | 0.25 f' <sub>c</sub> (Full A)<br>0.375 f' <sub>c</sub> (<1/3 A) |        |
| 2. Dead Load Plus Live Load<br>Plus Operating Load<br>Plus Wind                     | 0.667 Fy  | 0.454 Fy  | 0.60 f' <sub>c</sub>                                | 1.467 f' <sub>c</sub>                         |   | 2.667 f' <sub>c</sub>                             | 0.333 f' <sub>c</sub> (Full A)<br>0.50 f' <sub>c</sub> (<1/3 A) |        |
| 3. Dead Load Plus Live Load<br>Plus Operating Load<br>Plus Double Design Earthquake | 0.9 Fy  | 0.6 Fy  | 0.9 f' <sub>c</sub>                                 | 1.7 f' <sub>c</sub>                           |   | 3.4 f' <sub>c</sub>                               | 0.333 f' <sub>c</sub> (Full A)<br>0.50 f' <sub>c</sub> (<1/3 A) |        |

\* Although the intake structure is defined as a Class II structure, the supporting slabs and walls for the service water and circulating water pumps have been investigated and have been found adequate to withstand seismic loads of 0.11g and 0.22g using the tabulated allowable stresses.

90000179

TABLE 1-A-5

ALLOWABLE STRESSES FOR STRUCTURAL STEEL FOR:

- a) REACTOR BUILDING ROOF STEEL, CRANEWAY COLUMNS,  
CRANE GIRDERS, VERTICAL BRACING
- b) DRYWELL RADIAL STEEL FRAMING AND RECIRCULATING
- c) REACTOR BUILDING PLATFORMS

| Loading Condition   | Tension On<br>Net Section | Shear On<br>Gross Section | Compression                         | Bending<br>Tension and<br>Compression | A325 H. S. Bolts<br>With Thread<br>Excluded from<br>Shear Plane |                     | A141 Rivets         |                     |
|---|---------------------------|---------------------------|-------------------------------------|---------------------------------------|---|---------------------|---------------------|---------------------|
|   |                           |                           |                                     |                                       | Tension<br>(psi)  | Shear<br>(psi)      | Tension<br>(psi)    | Shear<br>(psi)      |
| 1. Dead Load Plus Live Load<br>Plus Operating Load<br>Plus Design Earthquake                            | 0.60 Fy                   | 0.40 Fy                   | Varies with<br>Slenderness<br>Ratio | 0.60 Fy *<br>to<br>0.66 Fy            | 40,000<br>(0.50 Fy)   | 22,000<br>(0.27 Fy) | 20,000<br>(0.56 Fy) | 15,000<br>(0.42 Fy) |
| 2. Dead Load Plus Live Load<br>Plus Operating Load<br>Plus Wind (For steel<br>listed as item "a" above) | 0.80 Fy                   | 0.533 Fy                  | Varies with<br>Slenderness          | 0.80 Fy*<br>to<br>0.88 Fy             | 53,300<br>(0.667 Fy)  | 29,300<br>(0.37 Fy) | 26,700<br>(0.74 Fy) | 20,000<br>(0.56 Fy) |

\* 0.60 Fy or 0.80 Fy is reduced for members with excessive unbraced compression flange length in accordance with A. I. S. C. Specifications.

Docket No. 50-219

ATTACHMENT G  
OYSTER CREEK NUCLEAR GENERATING STATION  
METHOD OF COMBINING STRESSES

90000181

December, 1979

## QUESTION

IV. Structures

1. Please provide tables, similar to tables V-3-2 and V-3-3 in the FD&SAR for all Class I structures and components. Specify the method for combining loads to a loss-of-coolant with "normal" and seismic loads.

## ANSWER

a. ALLOWABLE STRESSES FOR CLASS I PIPING

|    | <u>Loading Condition</u> | <u>Allowable Stress</u>        |
|----|--------------------------|--------------------------------|
| 1. | Thermal Expansion        | $S_A$                          |
| 2. | M.O.L. + S.L.            | $S_h$                          |
| 3. | M.O.L. + 2 x S.L.        | Safe shutdown can be achieved. |

M.O.L. = Maximum operating loads including design pressure and temperature, weight of piping and contents including insulation and the effect of supports and other sustained external loadings.

S.L. = Seismic loads due to the design earthquake.

2 x S.L. = Seismic loads due to twice the design earthquake.

$S_A = f (1.25 S_c + 0.25 S_h)$ .

where:

$f$  = stress range reduction factor for cyclic conditions.

$S_c$  = allowable stress in cold condition per ASA B31.1.

$S_h$  = allowable stress in the hot condition (design temperature) per ASA B31.1.

The two classes of structures applicable to the earthquake design requirements are as follows:

Class I - Structures and equipment whose failure could cause significant release of radioactivity or which are vital to a proper shutdown of the plant and the removal of decay heat.

Class II - Structures and equipment which are both essential and nonessential to the operation of the station, but which are not essential to a proper shutdown.

90000182



b. REACTOR VESSEL SUPPORTS

1. Seismic - Allowable stress = normal AISC allowable stresses.
2. Seismic + Jet - Allowable stress = 150% of normal AISC allowable stresses.
3. 2 Seismic - Allowable stress = 150% of normal AISC allowable stresses.

c. INSTRUMENTATION

The control room panels and auxiliary racks are usually shipped assembled and therefore these units must be designed for normal shipping shock which is in the order of several g's acceleration. Certain components are removed and padded to reduce vibration effect and excessive acceleration. In all cases, however, the design analysis is made of the panels and instruments. All relays in safety circuits are energized; and since they are capable of closing against 1.0 g, they can certainly maintain contact during an acceleration of 0.22 g.

90000183