NORTHEAST UTILITIES

THE CONNECTICUT LIGHT AND POWER COMPANY
WESTERN MASSACHUSETTS ELECTRIC COMPANY
HOLYOKE WATER POWER COMPANY
NORTHEAST UTILITIES SERVICE COMPANY
NORTHEAST NUCLEAR ENERGY COMPANY

General Offices • Selden Street, Berlin, Connecticut

P.O. BOX 270
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(203) 666-6911

May 3, 1984

Docket No. 50-423
B11154

Director of Nuclear Reactor Regulation
Mr. B. J. Youngblood, Chief
Licensing Branch No. 1
Division of Licensing
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555

Reference: (1) B. J. Youngblood to W. G. Counsil, Draft SER for Millstone Nuclear Power Station, Unit No. 3, dated December 20, 1983.

Dear Mr. Youngblood:

Millstone Nuclear Power Station, Unit No. 3
Environmental and Hydrologic Engineering Branch
Responses to Draft SER Open Items

In Reference (1), six (6) Draft SER open items were identified by the NRC Environmental and Hydrologic Engineering Branch. The status and proposed resolution of each of these open items and the corresponding review questions has been discussed with the EHEB staff reviewer, Mr. Robert Jachowski, and the additional information and clarifications the Northeast Nuclear Energy Company has committed to submit to resolve these items are provided herein (Attachment 1). The responses will be incorporated into the FSAR in a future amendment.

Northeast Nuclear Energy Company considers the additional information contained herein and information provided in previous amendments to the FSAR sufficient to resolve all EHEB open items.

If you have any concerns related to the information contained herein or any questions related to our responses, please contact our licensing representative, Ms. C. J. Shaffer at (203) 665-3285.

Very truly yours,

NORTHEAST NUCLEAR ENERGY COMPANY, et al
By Northeast Nuclear Energy Company, Their Agent

W. G. Counsil

W. G. Counsil
Senior Vice President

B001
1/40

C. Sears

By: C. F. Sears
Vice President Nuclear and
Environmental Engineering

cc: Mr. Robert Jachowski - EHEB
Ms. E. L. Doolittle - Licensing Project Manager

STATE OF CONNECTICUT)
) ss. Berlin
COUNTY OF HARTFORD)

Then personally appeared before me C. F. Sears, who being duly sworn, did state that he is Vice President of Northeast Nuclear Energy Company, an Applicant herein, that he is authorized to execute and file the foregoing information in the name and on behalf of the Applicants herein and that the statements contained in said information are true and correct to the best of his knowledge and belief.

Lorraine J. D'Amico
Notary Public

My Commission Expires March 31, 1988

Millstone Nuclear Power Station, Unit No. 3

Open Items

Environmental and Hydrologic Engineering Branch

EHEB-01 Plant Flooding Effects of
Local Intense Precipitation (Draft SER Section 2.4.2.2)

The applicant evaluated the effect of local intense precipitation of the magnitude of a PMP concentrated on the plant site, assuming complete blockage of the underground storm drainage system. The staff concluded that the site grading would limit ponding of water to a level less than el 24.5 ft MSL, which is the minimum elevation of entrances to safety-related buildings. There was, however, insufficient information available defining the drainage areas, flow patterns, and site grading (including road crown elevations and other structures that would affect flows and ponding levels) for the staff to complete its evaluation. The applicant has been asked to provide additional information and detailed analysis using the most recent PMP guidance available on rainfall depth-duration relations. Until this information and analysis are available, the staff cannot conclude that the plant meets the requirements of GDC 2 with respect to the effects of local intense precipitation runoff on site drainage relative to flooding of safety-related structures. This is an open item.

RESPONSE

Hydrometeorological Report No. 33 was used to develop the design basis probable maximum precipitation for the site. The applicant understands "the most recent PMP guidance available" to mean Hydrometeorological Report 51, and Hydrometeorological Report 52, collectively referred to as HMR-51/52. The precipitation rates provided in this report are extremely conservative, however in the interest of expediting the licensing of Millstone Unit No. 3 a study was performed. Using HMR 51/52 in the study, various drainage alternatives were analyzed to determine the impact of this ultra-conservative PMP induced site flooding on plant safety-related structures.

The site grading plan was revised based on the results of this study. In addition, ground cover for a substantial portion of drainage area C (Figure 2.4-7 attached) was changed from grass to gravel covering. Based on these two measures which are to be implemented, the safe operation of the plant is not compromised even if HMR 51/52 precipitation is assumed.

The maximum water surface elevations would be less than the sill elevations of all openings to safety-related structures except for three normally closed, locked, outward swinging doors in drainage area D. As shown in Figure 2.4.-7, one door leads to the hydrogen recombiner building, another to the main steam valve building, and the third to the auxiliary building. A protective curb will be installed outside the auxiliary building door to prevent any potential in-leakage. Analysis of the hydrogen recombiner and main steam valve buildings showed that the depth of any potential inleakage would be substantially lower than the base of any safety-related equipment.

Runoff from this postulated HMR-51/52 PMP event would not cause any flooding of the safety-related equipment in the intake structure. As described in Section 3.4.1.1 of the FSAR, the pump motors and the associated electrical equipment are protected against flooding to elevation 25.5 feet.

Millstone Nuclear Power Station, Unit No. 3

Open Items

Environmental and Hydrologic Engineering Branch

Attached is the revised Figure 2.4-7 and the details of the analysis that was performed.

FLOODING ANALYSIS

Hydrology

The all season envelope PMP for the site based on HMR-51/52 is tabulated below. PMP values for durations of 5 to 15 minutes for drainage areas of less than 1 square mile are applicable to the Millstone site.

PROBABLE MAXIMUM PRECIPITATION

Duration	Rainfall Depth For 1 Mi^2 of Area	Hydromet Report No.
5 minutes	5.86	52
15 minutes	9.22	52
30 minutes	13.2	52
1 hour	17.4	52
6 hours	26.0	51

The site was divided into drainage areas according to the revised topography and plant layout as shown on Figure 2.4-7. Runoff was calculated using the rational method. The surface area of buildings that were within the drainage areas were included in the runoff calculations. The following two conservative assumptions were made for this analysis--(1). No credit was taken for the site storm drainage system and (2) Very high runoff coefficients due to antecedent precipitation were used. Data for the drainage areas, runoff coefficients, and computed flows are presented in Table 1.

Modifications were made to the grading plan at the site boundary to prevent water in Areas A and B from flowing into Areas C and D where the safty-related structures are located.

Water Surface Computations

Water surface elevations were calculated using the Army Corps of Engineers Hydrologic Engineering Center program HEC-2. The swales and depressions that form channels were divided into reaches to contruct the model. Cross sections were taken to accurately describe the channel, site topography, and project features such as road crowns and railroad tracks. The locations of the cross sections are shown on Figure 2.4-7. Conservative values for Manning's coefficient were chosen as follows: lawn areas 0.05, paved areas 0.015, and gravel covered areas 0.025. PMP runoff computed by the rational method was proportioned into local incremental flows and then introduced at the appropriate cross sections. A complete input listing for the model is provided in Attachment 1.

Millstone Nuclear Power Station, Unit No. 3

Open Items

Environmental and Hydrologic Engineering Branch

The computer water surface elevations at the safety-related structures are summarized in Table 2.

The table shows that the water surface elevation is below the door sill elevation of 24.5 feet for all safety-related structures in drainage area C. In drainage area D, the computer water surface elevation exceeds the door sill elevation of 24.5 feet at the main steam valve building, the auxiliary building, and hydrogen recombiner building. An exterior curb will be installed at the auxiliary building door in area D. The curb will have a top elevation of 25.0 feet to keep runoff from drainage area D away from the door. Provisions will be made to adequately drain the area inside the curb.

The detailed analysis described below was performed to determine the impact of this flood water on the main steam valve building and the hydrogen recombined building.

Impact on Hydrogen Recombiner Building And Main Steam Valve Building

Each building is a reinforced concrete structure having only one exterior opening, a personnel door hinged to open out with sill elevation 24.5'. Both buildings are normally unmanned. For security purposes, the door to each building is alarmed and card controlled. All equipment and apparatus inside the hydrogen recombiner building rest on concrete pads. The top of the pads are a minimum of 0.5 feet above the floor. All equipment inside the main steam valve building is a minimum of 0.7 feet above the floor. Each building is equipped with floor drains. The locations of these two doors are shown on Figure 2.4-7.

An unsteady flow analysis was performed to determine the duration of the water surface above the door sill elevation, 24.5 feet. The results of this analysis are presented in Figure 1 which is a plot of water surface elevation versus time. Using this information, a conservative analysis was performed to calculate the volume of water that would enter each structure with the door closed. The open door condition was not applicable for this analysis for the following reasons: (1) door use is controlled, (2) opening of the door is annunciated, and (3) because the doors open out, the flood water would produce a pressure differential that would resist door opening and assist in door closure. Water levels inside the structures were calculated by dividing the above computed volume by the clear floor area. The results of this analysis are summarized in Table 3.

As Table 3 shows, this flooding does not impact the safety-related equipment inside these two buildings. Note that the above analysis is conservative since no credit was taken for the floor drains which should handle 75 gpm of the water entering the structure and the critical equipment height is substantially higher than the elevation of the mounting pad that it is on.

STATUS (4/84)

DSER Open Item EHEB-01: CLOSED

Millstone Nuclear Power Station, Unit No. 3

Open Items

Environmental and Hydrologic Engineering Branch

TABLE 1

DRAINAGE AREA CHARACTERISTICS

Drainage Area	Surface Area (ac)	Runoff Coefficient	Concentration Time (Minutes)	Intensity (in/hr)	Computed Flow (cfs) at Downstream End of Drainage Area
A	20.73	0.8	12	41.0	680
B	5.18	1.0	5	70.4	365
A&B	25.91	0.84	15	36.9	803
C	6.99	1.0	7	54.3	380
D	6.52	1.0	5	70.4	459[1]

(1) Computed flow at cross section 2 (hydrogen recombiner building) is 218 cfs on an applicable drainage area of 3.10 acres.

Millstone Nuclear Power Station, Unit No. 3

Open Items

Environmental and Hydrologic Engineering Branch

TABLE 2

COMPUTED WATER SURFACE ELEVATIONS
AT SAFETY RELATED STRUCTURES

Drainage Area	Structure	Maximum W.S. Elevation At Doors to Structure (ft MSL)
C	Auxiliary Building	24.30
C	Control Building	24.11
C	Emer. Gen. Enclosure	24.11
D	Main Steam Valve Building	24.96
D	Hydrogen Recombiner Bldg.	24.81
D	Auxiliary Building	24.96

Millstone Nuclear Power Station, Unit No. 3

Open Items

Environmental and Hydrologic Engineering Branch

TABLE 3

SUMMARY OF ANALYSIS OF
WATER LEVELS INSIDE STRUCTURES

Building	Volume of Water (cu ft)	Clear Floor Area (sq ft)	Height of Water (ft)	Minimum Height of Base Equipment Above Floor (ft)
Hydrogen Recombiner[1]	73	473	0.15	0.5
Main Steam Valve[2]	75	767	0.10	0.7

1 Analysis based on a 4 foot wide door with 1/2-inch saddle, weather stripped and assuming a 1/8 inch gap due to weather strip wear.

2 Analysis based on a 3 foot wide door with 1/2-inch saddle, weather stripped and assuming a 1/8 inch gap due to weather strip wear.

ATTACHMENT 1

HEC-2 INPUT DATA

ECHO PRINT OF INPUT DATA


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                     00000000011111111112222222222333333333344444444445555555555666666666677777777778
                     12345678901234567890123456789012345678901234567890123456789012345678901234567890

Section              T1       LOCAL (SITE) PMP RUNOFF ELEVATIONS DETERMINATION
Number On            T2       MILLSTONE NUCLEAR POWER STATION-UNIT NO. 3
Figure 2.4-7         T3       AREA B OUTLET-HWR 52   CHANNEL BY WAREHOUSES 1&2
                     J1              2                     .01                            25.0
                     J2      -1      1       0                                -1                15.
                     J3      38     39      42      43       1       2       3      17       5 26.
                     J3      25     34       4
                     NC     .05    .05     .05      .1      .3
                     QT       1    515
     1               X1020090        6     100     744       0       0       0
                     GR      30    100      28     290      26     427      24     590    23.2     743
                     GR      30    744
     2               X1020095        6     100     681      70      70      70
                     GR      30    100      28     315      26     462      24     605    24.8     680
                     GR      30    681
                     NC    .015   .015    .015
     3               X1020100       10     100     660      45      45      45
                     GR    31.2    100      30     210      29     290      28     360    27.5     390
                     GR      26    470    25.8     505      25     583      26     453      30    660.
     4               X1020105       11     505     623       1      43      43
                     GR    31.2    100      30     210      29     290      28     360    27.5     390
                     GR      26    470    25.8     505    25.6     560    25.7     602      26    622.
                     GR      30    623
                     QT       1    526
     5               X1020110        8     390     501       1     113     113
                     GR    31.2    100      30     210      29     290      28     360    27.5     390
                     GR      27    458      28     500      35     501
                     QT       1    635
     6               X1020115        5     290     369       1     110     110
                     GR    31.2    100      30     210      29     290    28.5     368      35     369
                     QT       1    744
     7               X1020120        6     294     381       1      60      60
                     GR      32    100    31.2     184      30     294    29.5     355  29.[illegible]     380
                     GR      35    381
     8               X1020125        6     184     372       1      60      60
                     GR      32    100    31.2     184      30     244    29.5     313    29.8     371
                     GR      35    372
     9               X1020130        6     100     341      40      40      40
                     GR      32    100      31     158      30     204    29.5     277    29.8     340
                     GR      35    341
    10               X1020135        5     100     178     105     105     105
                     GR    33.5    100      32     132    29.5     159    29.8     177      35     178
                     QT       1    680
    11               X1020150        8     281     553       1     150      55
                     GR    33.5    100    32.2     281      32     312    31.6     359    31.4     429
                     GR    31.6    495      32     553      33     618
                     EJ

                     ER
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3 APR 1984 15.23.19

HEC-2 WATER SURFACE PROFILES EN193 VERSION 00 LEVEL 02
LINKAGE-EDITOR 81.105 17.25.51
RUN-DATE 3 APR 1984

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HEC2 RELEASE DATED NOV 76 UPDATED APRIL 1980
ERROR CORR - 01,02,03,04
MODIFICATION - 50,51,52,53,54
****

NOTE- ASTERISK (*) AT LEFT OF CROSS-SECTION NUMBER INDICATES MESSAGE IN SUMMARY OF ERRORS LIST

AREA B OUTLET-MHR 52

SUMMARY PRINTOUT

	SECNO	XLCH	ELMIN	Q	CWSEL	CRIWS	EG	H*XNCH	10K*S	VCH	AREA	.01K	TOPWID
	20090.000	0.0	23.20	515.00	24.70	24.31	24.81	50.00	100.15	2.75	187.47	51.46	209.90
	20095.000	70.00	24.00	515.00	25.50	25.21	25.68	50.00	149.97	3.40	151.52	42.05	167.31
*	20100.000	45.00	25.00	515.00	26.16	26.16	26.47	15.00	40.36	4.48	115.05	81.06	191.75
*	20105.000	43.00	25.60	515.00	26.47	26.47	26.79	15.00	33.80	4.78	114.40	88.59	176.98
*	20110.000	113.00	27.00	526.00	28.22	28.22	28.58	15.00	30.42	4.98	111.61	95.37	155.26
*	20115.000	110.00	28.50	635.00	29.94	29.94	30.38	15.00	26.43	5.66	128.38	123.52	153.45
*	20120.000	60.00	29.50	744.00	30.97	30.97	31.41	15.00	25.21	5.71	150.13	148.18	174.85
	20125.000	60.00	29.50	744.00	31.37	30.71	31.50	15.00	5.60	2.89	259.09	314.45	204.95
	20130.000	40.00	29.50	744.00	31.41	30.67	31.52	15.00	4.76	2.64	281.47	341.00	206.77
*	20135.000	105.00	29.50	744.00	32.42	32.42	33.32	15.00	28.96	7.64	97.32	138.25	54.40
	20150.000	55.00	31.00	680.00	33.41	32.26	33.43	15.00	0.74	1.22	628.15	791.92	504.82

ECHO PRINT OF INPUT DATA

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Section
Number On
Figure 2.4-7

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     C
     C      1
     C 010110  EMERGENCY GENERATOR ENCLOSURE (CONTROL BUILDING)
     T1        LOCAL (SITE) PMP RUNOFF ELEVATIONS DETERMINATION
     T2        MILLSTONE NUCLEAR POWER STATION-UNIT NO. 3
     T3        AREA C EY DRAWING SITE-CHANNEL BY MACHINE SHOP-MOST OF TRANS AREA
     J1              2                      .005                            21.0
     J2     -1       1       0
     J3     38      39      42      43       1       2       3      17       5 26.
     J3     25      34       4
     NC   .025    .025    .025      .1      .3
     QT      3     360     320     320
     X1110085       11     100     243       0       0       0
     GR     30     100      20     101      19     112    18.2     126      19     155
     GR     20     178      22     210      23     225    23.5     230      24    242.
     GR     30     243
     X1110087       11     100     264      95      58      95
     GR     30     100    22.1     101      22     110      20     163    19.5     176
     GR     20     194      22     226      23     240      24     264      24    302.
     GR     30     303
     NC   .021    .021    .021
1    X1110090        8     100     176      90      70      90
     GR     30     100    20.9     101    20.7     116      22     136      23     146
     GR     24     176      24     228      30     229
2    X1110095       11     100     150      30      70      30
     GR     30     100    20.9     101    20.9     114      22     127      23     132
     GR     24     149    23.5     158      23     182      24     183      24    200.
     GR     30     201
3    X1110097        9     100     178      54      15      54
     GR     30     100    21.9     101    21.5     134      22     148      23     164
     GR     23     178      23     202      24     234      30     235
4    X1110098       12     100     256      35       1      35
     GR     30     100    24.7     101      24     132      23     150      22     168
     GR   21.8     196      22     216      23     242      23     256      23    280.
     GR     24     312      30     313
     NC   .025    .025    .025
     QT      1     333
5    X1110100        9     100     286      30       1      30
     GR     26     100      24     154      23     182      22     222      23     272
     GR     23     286      23     310      24     342      30     343
     QT      1     319
6    X1010110        9     100     256      50      20      50
     GR     26     100      24     146    23.0     170    22.2     200      23     224
     GR     23     256      23     280      24     296      30     297
     QT      2     283     256
7    X1010112        8     100     271      70      70      70
     GR     26     100      24     130    23.0     146    22.4     174      23     194
     GR   22.9     256      24     270      30     271
     QT      2     253     237
8    X1010113        8     100     261      56      56      56
     GR     26     100      24     120    23.0     130    22.6     156      23     172
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   GR  23.6     244      24     260      30     261
   QT     2     216     208
9  X1010115       8     100     241      80      80      80
   GR    26     100      24     112    23.0     120    22.8     136      23     148
   GR  23.0     218      24     240      30     241
   QT     2     161     134
10 X1010117       6     100     237     107     107     107
   GR    26     100      24     110   23.15     128      23     208      24     236
   GR    30     237
   QT     2     110      64
11 X1010120       6     100     239     112     112     112
   GR    26     100      24     110    23.5     128    23.5     216      24     238
   GR    30     239
   EJ


   ER
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9 APR 1984 09.04.34

HEC-2 WATER SURFACE PROFILES EN193 VERSION 00 LEVEL 02
LINKAGE-EDITOR 81.105 17.25.51
RUN-DATE 9 APR 1984

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HEC2 RELEASE DATED NOV 76 UPDATED APRIL 1980
ERROR CORR - 01,02,03,04
MODIFICATION - 50,51,52,53,54
****

NOTE- ASTERISK (*) AT LEFT OF CROSS-SECTION NUMBER INDICATES MESSAGE IN SUMMARY OF ERRORS LIST

AREA C EY DRAWING SITE-

SUMMARY PRINTOUT

	SECNO	XLCH	ELMIN	Q	CWSEL	CRIWS	EG	K*XNCH	10K*S	VCH	AREA	.01K	TOPWID
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*	110087.000	95.00	19.50	380.00	21.13	21.13	21.59	25.00	97.44	5.41	70.21	38.50	79.19
*	110090.000	90.00	20.70	380.00	22.67	22.67	23.36	21.00	62.27	6.67	56.94	48.16	41.91
*	110095.000	30.00	20.90	380.00	23.10	23.10	23.89	21.00	58.02	7.13	53.47	49.89	37.54
	110097.000	54.00	21.50	380.00	23.94	0.0	24.02	21.00	5.11	2.35	177.77	168.17	131.34
	110098.000	35.00	21.80	380.00	23.99	0.0	24.04	21.00	3.61	1.78	227.94	200.11	179.48
	110100.000	30.00	22.00	333.00	24.00	0.0	24.05	25.00	6.41	1.73	202.72	131.49	187.91
	10110.000	50.00	22.20	319.00	24.03	0.0	24.09	25.00	11.09	2.12	155.26	95.80	150.56
	10112.000	70.00	22.40	283.00	24.11	0.0	24.16	25.00	7.78	1.79	158.52	101.47	141.65
	10113.000	56.00	22.60	253.00	24.16	0.0	24.21	25.00	11.52	1.92	131.75	74.55	141.64
	10115.000	80.00	22.80	216.00	24.24	0.0	24.28	25.00	5.25	1.48	146.40	94.30	129.47
	10117.000	107.00	23.00	161.00	24.30	0.0	24.33	25.00	3.82	1.20	134.20	82.37	127.57
	10120.000	112.00	23.50	110.00	24.36	0.0	24.37	25.00	4.91	1.10	99.75	49.64	129.83

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                      00000000011111111112222222222333333333344444444445555555555666666666677777777778
                      12345678901234567890123456789012345678901234567890123456789012345678901234567890

                      C
                      C       1
                      C 131130  AT SOUTHWEST CORNER OF HYDROGEN RECOMBINER BLDG.
   Section            T1        LOCAL (SITE) PMP RUNOFF ELEVATIONS DETERMINATION
  Number On           T2        MILLSTONE NUCLEAR POWER STATION-UNIT NO. 3
 Figure 2.4-7         T3        AT REACT. BLDG.-WHR 52  70.4 IN./HR. INTENSITY-NRTH OF RR TRCKS
                      J1              2                            -1                              24
                      J2     -1       1                                              -1
                      J3     38      39        42        43         1         2         3        17        5 26.
                      J3     25      34         4
                      NC    .03     .03       .03        .1        .3
                      QT      1     157
      1               X1131100        7       162       216         0         0         0
                      GR     25     100      24.5     100.1      24.5       118      24.1       162      23.7   216.
                      GR   23.2   279.9        25       280
                      X1131105        0         0         0         5         5         5
                      X1131120        4       100       186        45       105       165
                      GR     25     100        24     100.1        24     105.9        25       186
      2.              X1131130        0         0         0        10        10        10
                      QT      1     146
      3               X1131140        8       100       312       100       100       100
                      GR     26     100        24     100.1        24       216        27     216.1        27  249.9
                      GR     24     250        24     311.9        26       312
                      EJ


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29 MAR 1984 12.05.14

HEC-2 WATER SURFACE PROFILES EN193 VERSION 00 LEVEL 02
LINKAGE-EDITOR 81.105 1?.25.51
RUN-DATE 29 MAR 1984

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HEC2 RELEASE DATED NOV 76 UPDATED APRIL 1980
ERROR CORR - 01,02,03,04
MODIFICATION - 50,51,52,53,54
****

NOTE- ASTERISK (*) AT LEFT OF CROSS-SECTION NUMBER INDICATES MESSAGE IN SUMMARY OF ERRORS LIST

AT REACT. BLDG.-HHR 52

SUMMARY PRINTOUT

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	131105.000	5.00	23.20	157.00	24.19	24.03	24.30	30.00	49.74	1.52	63.15	22.26	127.62
	131120.000	165.00	24.00	157.00	24.77	24.47	24.86	30.00	32.92	2.37	66.36	27.36	85.95
	131130.000	10.00	24.00	157.00	24.81	24.47	24.89	30.00	27.82	2.25	69.81	29.76	85.96
	131140.000	100.00	24.00	146.00	24.96	24.27	24.97	30.00	3.26	0.86	170.37	80.86	177.96

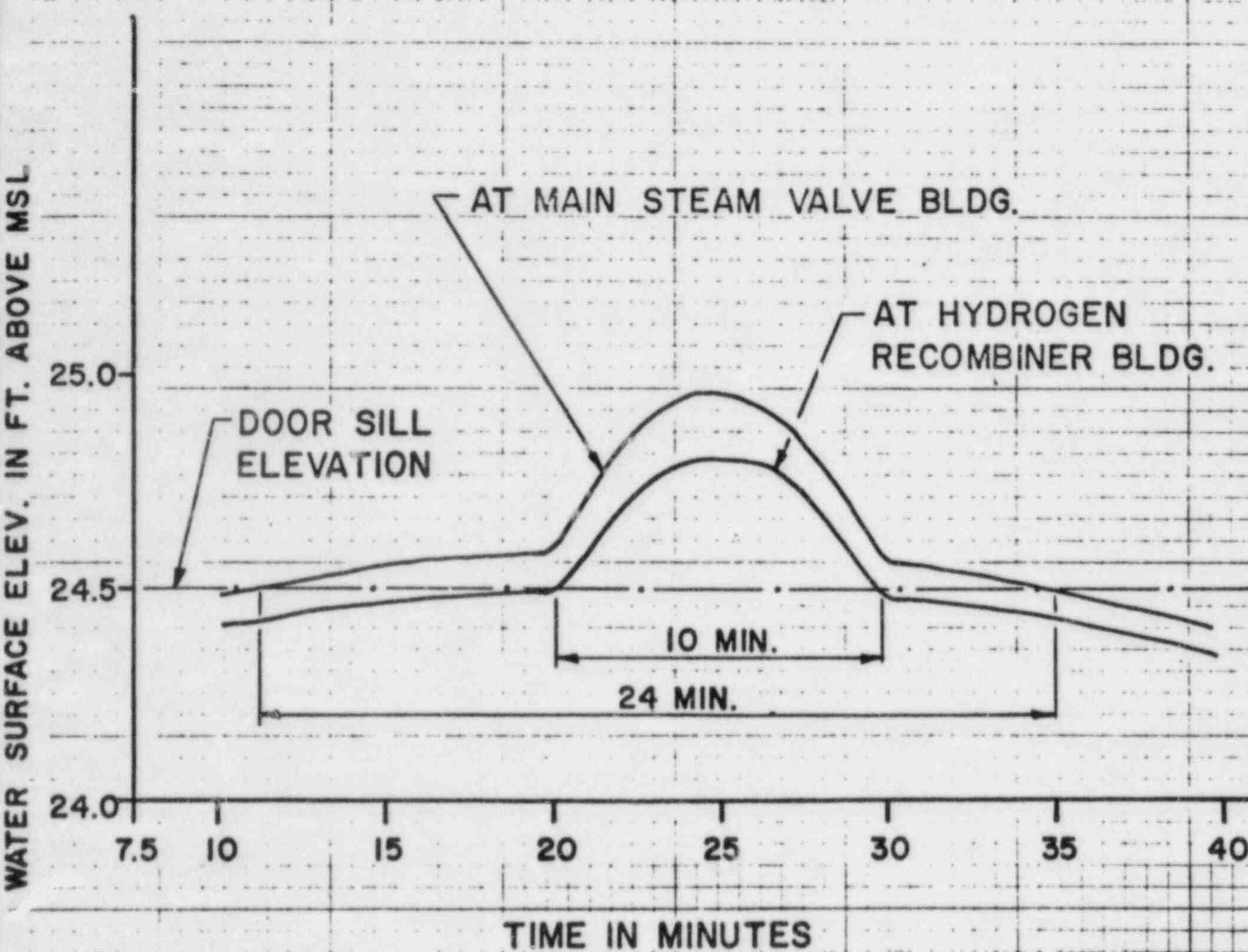

FIGURE 1

WATER SURFACE ELEVATION DURING PMP VS. TIME IN YARD AREA BY UNIT 3 CONTAINMENT

MILLSTONE NUCLEAR POWER PLANT UNIT 3

FINAL SAFETY ANALYSIS REPORT

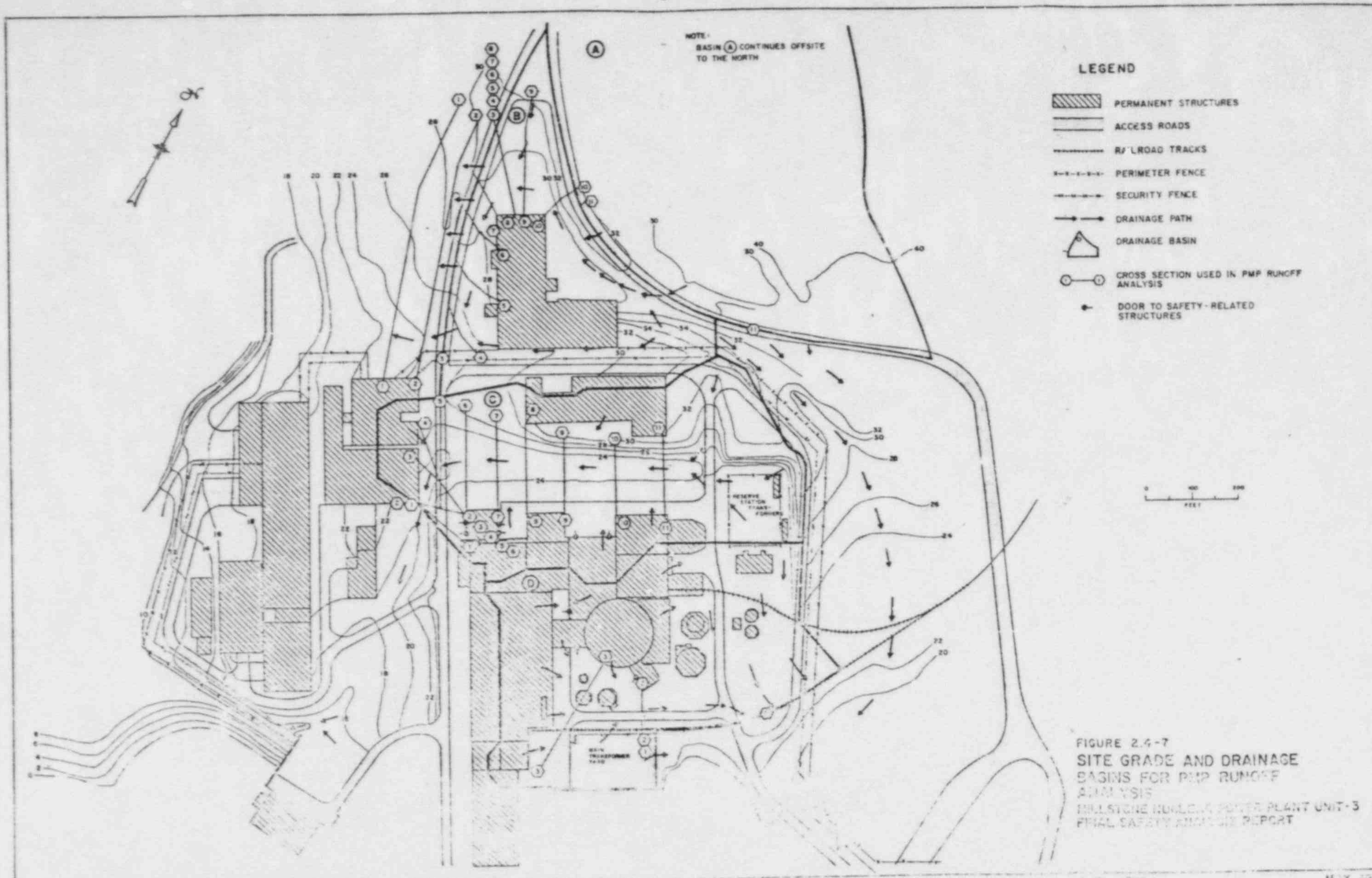

FIGURE 2.4-7
SITE GRADE AND DRAINAGE BASINS FOR PMP RUNOFF ANALYSIS
MILLSTONE NUCLEAR POWER PLANT UNIT-3
FINAL SAFETY ANALYSIS REPORT

MAY 1984

Millstone Nuclear Power Station, Unit No. 3

Open Items

Environmental and Hydrologic Engineering Branch

EHEB-02 Plant Flooding Effects of
Intense Local Precipitation (Draft SER Section 2.4.2)

Roof Drainage System - Ponding on Safety-Related Structures

The applicant has indicated that the roofs of safety-related buildings are designed to dispose of local severe precipitation up to and including the local PMP as defined in the U.S. Weather Service Hydrometeorological Report No. 33 (1956) and EM 1110-2-1411 (1965). Parapets around the perimeters of safety-related buildings have been either designed with scuppers or as low curbing so that if internal roof drains become clogged, the water would overflow before basic roof loading would be exceeded. Because there was insufficient information available to enable the staff to reach the same conclusion, the applicant has been asked to provide addition information and detailed analysis of the roof drainage system including the ponding levels on roofs of safety-related structures. The applicant also was asked to consider the most recent PMP guidance available on rainfall depth-duration relations. Until the additional information and analysis are available, the staff cannot conclude that the plant meets the requirements of GDC 2 with respect to the effect of local intense precipitation on roofs. This is an open item.

Response

A detailed analysis of the roof drainage system including the ponding levels on roofs of safety-related structures was provided in Amended FSAR Section 2.4.2.3 (Response to Questions 240.10 and 240.11) on January 16, 1984. (Amendment 6). The NRC reviewer has determined this information is adequate to conclude that the plant meets the requirements of GDC 2 with respect to the effect of local intense precipitation on roofs. Northeast Nuclear Energy Company hereby considers the above Draft SER Open Item (EHEB-02) and Questions 240.10 and 240.11 to be closed.

Status (4/84)

DSER Open Item EHEB-02: CLOSED

Question 240.10: CLOSED

Question 240.11: CLOSED

Millstone Nuclear Power Station, Unit No. 3

Open Items

Environmental and Hydrologic Engineering Branch

EHEB-03 Service Water Pump Cubicle Flood Protection from Probable Maximum Hurricane Surge

As indicated in Section 2.4-1, except for the two watertight doors into the service water pump cubicles located within the intake structure, all accesses to safety-related structures are at or above el 24 ft 6 in. MSL (6 in. above plant grade). The applicant has indicated that the watertight service water pump cubicles are flood protected to el 25.5 ft MSL. The staff has requested the applicant to provide additional information regarding certain flood protection aspects of these cubicles. This is an open item.

Response

Northeast Nuclear Energy Company provided additional information regarding certain flood protection aspects of the service water pump cubicles in Amendment 6 to the FSAR on January 16, 1984. Our responses to Question 240.12 and 240.13 have been reviewed by the NRC Staff and the information provided has been determined adequate to resolve any concerns related to flood protection of the pump cubicles.

Northeast Nuclear Energy Company hereby considers the above Draft SER Open Item (EHEB-03) and Questions 240.12 and 240.13 to be closed.

Status (4/84)

DSER Open Item EHEB-03: CLOSED

Question 240.12: CLOSED

Question 240.13: CLOSED

Millstone Nuclear Power Station, Unit No. 3

Open Items

Environmental and Hydrologic Engineering Branch

EHEB-04 Design Basis for Shore Protection Structures (Draft SER Section 2.4.10)

The stability of the shoreline slope was analyzed by the applicant using computer program LEASE II (Limiting Equilibrium Analysis of Slopes and Embankments). Both static and dynamic loads were considered in the analysis. The calculated factor of satety against a slope failure through the 5H:1V section of shoreline slope is 1.44 under the seismic loading condition.

However, the staff has found that the as-built and subsurface conditions of the slope are not compatible with those used in the applicant's analysis and that the applicant has not provided information about the seawall design. Therefore, the staff cannot confirm the adequacy of the shoreline slope and the seawall design at this time.

Response

Northeast Nuclear Energy Company provided additional information regarding the as-built conditions of the shoreline slope and retaining wall design in our responses to Questions 240.15, 241.21, and 241.22 (Amendment 5 to the FSAR, dated November 29, 1983). Revision 1 of the response to Question 241.22 provides the design loads and cross-sections of the west retaining wall. This information has been provided to the Structural and Geotechnical Branch reviewer and will be included in Amendment 8 to the FSAR scheduled for submittal in May 1984.

The Environmental and Hydrologic Engineering Branch (EHEB) has reviewed the additional information submitted in Amendment 5 and determined it adequate to resolve concerns regarding the slope stability and retaining wall design.

Northeast Nuclear Energy Company hereby considers the above Draft SER Open Item (EHEB-04) and EHEB review Question 240.15, and SGEB review Questions 241.21 and 241.22 to be closed.

Status (4/84)

DSER Open Item EHEB-04: CLOSED

Question 420.15: CLOSED

Millstone Nuclear Power Station, Unit No. 3

Open Items

Environmental and Hydrologic Engineering Branch

EHEB-05 Thermal Aspects of Ultimate Heat Sink (Draft SER Section 2.4.11.2)

Because there was insufficient information for the staff to determine if the 75°F maximum temperature of the ultimate heat sink (UHS) exceeds the maximum rated cooling water temperature of safety-related equipment, the applicant has been requested to identify the equipment with the lowest rated maximum cooling water temperature. Until this information is available, the staff cannot conclude that the plant meets GDC 44 with respect to the thermal aspects of the UHS. This is an open item.

Response:

All components cooled by the service water system have been designed to perform based on a maximum service water inlet temperature of 75°F. Refer to revised FSAR Section 2.4.11.6 (page 2.4-19) and Section 9.2.1.1 (page 9.2-3). These revisions are being provided as they will appear in Amendment 8 to the FSAR, scheduled for submittal in May 1984.

Northeast Nuclear Energy Company trusts the attached information will resolve your concerns related to the thermal aspects of the ultimate heat sink, therefore we consider the above Draft SER Open Item (EHEB-05) to be closed.

Status (4/84)

DSER Open Item EHEB-05: CLOSED

The design low water level of el -8.0 feet msl for the service water pumps includes added conservatism to the calculated extreme low water level of el -5.35 feet msl (Section 2.4.11.2). The suction bells of the Millstone 3 circulating and service water pumps are located at el -19.5 feet msl and el -13.0 feet msl, respectively; well below the low water levels. Therefore, during all operating conditions, sea water is available to the safety related service water pumps. Table 9.2-1 gives the minimum cooling water flow required accident conditions for safety related service water loads. The circulating water system cooling water flow required during normal operating conditions is 912,000 gpm. Circulating water is not required during accident conditions.

The temperature extremes of the water in Niantic Bay and Long Island Sound are 75°F maximum and 33°F minimum (see Section 9.2.1.1). Long Island Sound and Niantic Bay can provide a 30-day supply of service water that does not exceed the design temperature under any 30-day meteorological conditions that result in maximum evaporation.

The applicants have no knowledge of any history of significant ice formation in Niantic Bay. It is considered highly unlikely that ice would form or collect in a manner or amount sufficient to obstruct the flow to the service water and circulating water pumps (Section 2.4.7). However, as a preventative measure, part of the effluent from the circulating water discharge tunnel can be recirculated to a concrete chamber located in front of the pumphouse and then distributed to each pump bay. A reinforced concrete curtain wall located at the front of the pumphouse and extending down to el -7.0 feet msl acts as an air seal and will also prevent floating or partially submerged debris and ice from entering the pumphouse.

Sedimentation that would affect the safety function of the service water pumps is considered unlikely. The suction bells of the circulating water pumps are at an el 6.5 feet lower than the suction bells of the service water pumps. The rated flow capacity of the circulating water pumps is approximately ten times larger than that of the service water pumps. Therefore, any sediment that might settle in the pump bays downstream of the traveling screens would be removed by suction through the circulating water pumps before it could block the inlets to the safety related service water pumps. In the event that significant sedimentation should deposit on the floor of the pumphouse bays, it will be removed by occasional dredging.

2.4.12 Dispersion, Dilution, and Travel Times of Accidental Releases of Liquid Effluents in Surface Waters

Dispersion characteristics and dilution capability of Niantic Bay and Long Island Sound for an accidental release through the circulating water discharge tunnel is the only case discussed here. Section 2.4.13 discusses the effects of contamination of groundwater, which subsequently flows into Long Island Sound.

The service water system provides cooling water during all operating conditions, at a maximum sea water temperature of 75°F coincident with either the service water pump design low water level (el -6.0 feet) or the maximum flood protection level (el +25.5 feet), and at all intermediate water levels.

The service water system accommodates individual isolation of all pumps, heat exchangers served by the systems, piping, strainers and control valves to maintain system operation during equipment repair and maintenance periods.

The service water pump requirements for various modes of operation of the service water system are as follows:

Mode of Operation	Number of Service Water Pumps Required
Normal Operation	2
Normal Cooldown	2
DBA coincident with LOP	
Minimum ESF	1
Normal ESF	2
Loss of power	
Hot shutdown	2
Cold shutdown	1

The design pressure and temperature of the service water system is 100 psig and 95°F, except for the service water discharge lines from the containment recirculation coolers which have a design temperature of 135°F, and the discharge lines from the MCC and rod control area booster pumps which have a design pressure of 145 psig. The operating pressure of the service water system is 45 psig, except for the lubricating water lines to the service and circulating water pumps. The operating pressure of the circulating water pump lubricating water lines is 30 psig. The operating pressure of the service water pump, lubricating water lines is 20 psig. The inlet operating temperature extremes of the service water system are 75°F maximum and 33°F minimum, determined by the ambient sea water temperature in Niantic Bay. These requirements are based on a maximum inlet service water temperature of 75°F.

Table 9.2-1 lists the service water system flow requirements and Table 9.2-2 lists the service water system waste heat transfer requirements from the components listed to the ultimate heat sink, Long Island Sound (Section 9.2.5).

The service water system and its components are designed for a plant life of 40 years.

9.2.1.2 System Description

The service water system consists of two redundant flow paths, each consisting of two service water pumps, two service water self-cleaning strainers, two booster pumps, piping, and valves. The

Millstone Nuclear Power Station, Unit No. 3

Open Items

Environmental and Hydrologic Engineering Branch

EHEB-06 Design Basis for Groundwater
Levels of Safety-Related Structures (Draft SER Section 2.4.12)

The applicant has stated that there is no safety-related permanent dewatering system for Millstone Unit 3 and that safety-related structures are designed for ground water pressure and buoyancy forces consistent with the design of the gound water surface levels. These design ground water levels (contours) vary from plant grade on the northwest to 18 ft below plant grade on the southwest side of the plant facilities. On the basis of information provided in the FSAR, the staff believes that the ground water levels are not of a sufficiently conservative basis for design. This is an open item.

Response

Northeast Nuclear Energy Company has provided additional information regarding the design basis groundwater levels used for safety-related structures in our revised response to Question 241.16 (SGEB) and revised FSAR Section 2.5.4.6 and Table 2.5.4-14. Table 2.5.4-14 indicates the actual groundwater elevation used in the design of the structures. The revised FSAR Sections and response to Question 241.16 are provided herein as they will appear in Amendment 8 to the FSAR scheduled for submittal in May 1984.

Northeast Nuclear Energy Company hereby considers the above Draft SER Open Item (EHEB-06) to be closed.

Status (4/84)

DSER Open Item EHEB-06: CLOSED

NRC Letter: May 3, 1983 1.9

Question No. Q241.16 (Section 2.5.4.10.3 and SRP Section 2.5.4) 1.12

Lateral Earth Pressure 1.13

Provide the design values of the lateral earth pressures used in the 1.14
design of rigid, unyielding, foundation walls.

Response: 1.15

FSAR Figure 2.5.4-43 shows the lateral pressure distribution used in 1.16
designing rigid unyielding foundation walls. The figure has been 1.17
revised to correct errors and to add the unit weight of backfill.
Also, FSAR Section 2.5.4.10.3 has been changed to correct 1.20
typographical errors.

A limited review of structure stability was performed for the 1.21
emergency generator enclosure tank vault, the service building, and 1.22
the containment structure, considering the effect of increasing the
groundwater level to site grade, elevation +24 feet. The review was 1.24
limited to evaluating structure stability against flotation, the
strength of the base mat, and the strength of the vertical perimeter 1.25
walls below grade. In addition, the effect of increasing the 1.26
coefficient of lateral earth pressure at rest from the design value
of 0.5 to a value of 0.7 was evaluated for the auxiliary building and 1.27
the engineered safety features building. The results were combined 1.28
such that the effect of both the increase in groundwater level and
the increase in K_o were considered on the vertical perimeter walls 1.29
below grade for all five structures listed above. These structures 1.30
were selected because they are representative of all plant structures
for the conditions evaluated.

All structures were found to be within allowable design criteria for 1.31
both static and dynamic conditions for all combinations of loading. 1.32

A discussion of the plant design basis for groundwater is included in 1.33
revised FSAR Section 2.5.4.6, and the design basis for lateral earth 1.34
pressure is discussed in Section 2.5.4.10.3.

2.5.4.5.3 Extent of Dredging 1.12

To facilitate the flow of water into the service and circulating water 1.13
pumphouse, an intake channel has been dredged to the limits shown on 1.16
Figure 2.5.4-41. Side and longitudinal slopes of the intake channel are 1.17
designed at 10 and 5 percent, respectively. The beach slope varies from 1.18
20 to 10 percent and is protected with heavy armor, as discussed in
Section 2.5.5.1.

Borings and laboratory testing in the beach area adjacent to the 1.19
circulating and service water pumphouse indicate that the beach sands 1.20
are generally moderately dense, with occasional thin zones of less dense
material. Liquefaction analyses of these sands, discussed in 1.21
Section 2.5.4.8.3.2, indicate that a general liquefaction of the sand 1.22
adjacent to the pumphouse is highly unlikely. If the looser zones do 1.23
liquefy, the extent of the failure would be strictly local and would not
cause a massive soil movement into the dredged channel. 1.24

2.5.4.6 Groundwater Conditions 1.26

Groundwater observations have been documented in previous reports 1.27
(Ebasco 1966; Bechtel Corporation 1969). Water level readings in 1.29
borehole piezometers were taken for the Millstone 3 site study between
1971 and 1973. In addition, pressure testing of rock in three boreholes 1.30
and during installation of rock anchors in the turbine and service 1.31
buildings was conducted to determine the permeability of the rock mass.
Also, temporary drains were installed in sections of the containment 1.32
excavation face and the inflow of water into all excavations was 1.33
observed throughout construction. These observations form the design 1.34
bases for groundwater at the site, as discussed below.

2.5.4.6.1 Design Basis for Groundwater 1.36

Groundwater observations at the site prior to construction were made in 1.37 241.16
piezometers installed in several borings. Listings of the water 1.39
elevations and dates of reading are presented in Table 2.5.4-17. Three 1.40
borings, 303, 310, and 311, were continually monitored over a 2-year
period. A plot of elevation vs date for water levels in these boreholes 1.41
is shown on Figure 2.5.4-38. As a result of these observations, a 1.42
stabilized groundwater level contour map, based on the water levels
measured in January 1972, shown on Figure 2.5.4-37, is used as the basis 1.43
for determining hydrostatic loadings on structure foundations. 1.44

Localized perched groundwater conditions probably exist because of the 1.45
irregular distribution of ablation till materials of varying gradation 1.46
and porosity. It is also likely that shallow, ponded water exists in 1.47
localized bedrock troughs. The prevalence of bedrock outcrops to the 1.48
north and northwest of the site indicates that bedrock acts as a
groundwater divide, isolating the soils of the tip of Millstone Point 1.49
from soils further inland. Thus, groundwater recharge would primarily 1.50
be due to absorption of local precipitation, with probable migration of
the waters to the immediately adjacent Long Island Sound. Little 1.52
groundwater is present in the crystalline bedrock, and virtually all of
the groundwater movement is restricted to the soil overburden. 1.53

Measurements taken during previous investigations (Bechtel 1.54
Corporation 1969) showed average influx rates into test pits of about 1.56
8 gallons per hour, and it was concluded that both the ablation and 1.57
basal tills were relatively impervious. The ablation till soils are 1.58
more pervious than the basal tills and occasionally exhibit partial
stratification, including sporadic sand lenses. Thus, the upper 1.60
portions of the soil will transmit water more readily than the
underlying dense basal tills.

All structures are designed for the groundwater levels shown in 2.1
Table 2.5.4-14 which are based on groundwater contours plotted on 2.2
Figure 2.5.4-37. No safety-related permanent dewatering system is 2.3
required to lower groundwater levels. These groundwater contours 2.4
represent average groundwater elevations of the site prior to the start
of construction. A comparison of groundwater contours with the top of 2.5
basal till contours on Figure 2.5.4-36 verifies that the primary medium 2.6
for groundwater flow is the permeable surficial soil overlying the basal
till. Recharge of the groundwater occurs mainly from precipitation 2.7
infiltrating through the surficial soils, and flowing toward Long Island 2.8
Sound and the outwash deposits above the till.

Construction of the plant results in large changes to the site 2.9 241.16
geohydraulic conditions. Site grade will be lowered to a uniform 2.10
elevation of +24 feet from the original site grade which varied from
elevation 26 feet to 30 feet. The major plant structures are founded at 2.12
approximately elevation 0 feet on blasted rock excavations and
backfilled from subgrade level to the ground surface with fill materials 2.13
of relatively high permeability. The backfilled zones under and around 2.14
these structures and the circulating water intake pipelines provide a
continuous hydraulic conduit for groundwater flow from the plant area to 2.15
Long Island Sound. Therefore, the average water levels prior to 2.16
construction are not necessarily representative of post-construction
groundwater conditions. Design groundwater levels used in plant design 2.18
are shown in Table 2.5.4-14.

A seepage diversion system, consisting of a series of underdrains and 2.19
porous concrete, has been installed under and around several structures 2.20
to minimize the amount of seepage into the basement of structures
founded below the groundwater table. The quantity of seepage expected 2.22
to be diverted through the system will be small, due to the low
permeability of the basal till and rock at the site. This system is not 2.24
considered safety related because dewatering is not necessary to ensure
the stability of any structure, and failure of the system would not 2.25
result in a significant inflow of water into the basement levels of any
structures. The containment and all other Category I structures are 2.27
protected from groundwater inflow by a waterproof membrane below the 2.28
groundwater level.

Water levels measured in borings taken at the site in early 1972 2.29
indicate a groundwater piezometric surface with a 3-percent gradient 2.30
generally sloping from northeast to southwest, as shown on
Figure 2.5.4-37.

As discussed in Section 2.4.5.2, Flood Design Considerations, the controlling event for flooding at the Millstone 3 site is a storm surge resulting from the occurrence of the probable maximum hurricane (PMH). The maximum stillwater level resulting from hurricane surge was calculated to be elevation 19.7 feet msl. As shown on Figure 2.4-9, the water level drops significantly with time, so that after 2 hours the flood level is at elevation 17 feet and after 6 hours the surge level subsides to elevation 10 feet. A continuous hydraulic connection would occur across the site from the main structure area to the shorefront through the backfill placed around structures and the backfill placed in the circulating water pipeline trench. It can be expected that the maximum groundwater level due to flooding would not exceed elevation 19.7 feet and would probably be less because of head losses in the soil. According to Figure 2.4-9, the water level will drop to 17 feet after 2 hours.

The design groundwater levels for major safety-related structures shown on Table 2.5.4-14 are all equal to or greater than elevation 19 feet with the exception of the hydrogen recombiner building, which has a design groundwater level of 18 feet. However, founding grade is at elevation 20 feet for this structure, which is founded on concrete fill placed directly on bedrock. Design criteria for flood conditions are discussed in Section 3.4.

2.5.4.6.2 Groundwater Conditions During Construction

During construction, the inflow of water into the excavations was controlled by pumping from sumps located outside of the building lines adjacent to structures. Most flow through the overburden was transported through the sand lenses. All water-softened material was removed and replaced with a fill concrete working mat as described in Section 2.5.4.5.1. The rate of inflow was sufficiently low to allow enough time to pour the concrete working mat without further softening of the till.

241.

Drainage pipes were installed in the southwest face of the containment excavation in order to relieve the hydrostatic pressure on the bedrock joint and foliation surfaces. Very little water was observed flowing through these pipes, indicating that the quantity of flow through the bedrock is small and that the permeability of the rock is low.

Water pressure tests were performed in three boreholes prior to construction. These tests indicated that the rock within the site area is generally massive with slight to moderate interconnected jointing. A summary of the water pressure test data from the boreholes is included in Table 2.5.4-16. Additional pressure tests were performed prior to installation of rock anchors in the turbine and service buildings. These tests further verified the low permeability of the rock mass.

These observations suggest that the permeability of the bedrock is extremely low, and that little or no groundwater or seawater is expected to seep through the fresh rock mass.

2.5.4.7 Response of Soil and Rock to Dynamic Loading 3.11

All Seismic Category I structures and associated piping are founded 3.12
either on bedrock, basal till, or structural backfill. Portions of the 3.15 241.4
circulating water discharge tunnel are founded on ablation till in the
vicinity of the ventilation stack north of Millstone Unit 1. A listing 3.18
of the founding strata for all Category I structures is included in
Table 2.5.4-14.

Hard crystalline bedrock forms the basement complex of the area. The 3.20
overlying dense basal till consists of a hard, compact soil which has
been heavily preloaded by continental ice. Static and dynamic 3.21
properties of the basal till and bedrock are discussed in
Sections 2.5.4.2.5 and 2.5.4.2.6, respectively. Static and dynamic 3.23
properties for the compacted structural backfill are discussed in
Section 2.5.4.5.2.

The bedrock, basal till, ablation till, and structural backfill are 3.24 241.4
stable materials under vibratory motion caused by the SSE. The basal 3.26
till, ablation till, and structural backfill are not susceptible to
liquefaction, as discussed in Section 2.5.4.8. 3.27 241.4

The soil-structure interaction analyses for Seismic Category I 3.28
structures founded on soil were performed using the computer program 3.29
PLAXLY-3. The nonlinear behavior of the subgrade was accounted for by 3.30
use of the computer program SHAKE (LaPlante and Christian 1974) which 3.31
was used to determine the strain-corrected soil properties. The 3.32 241.4
subsurface material properties used in the SSI analysis are discussed in
Section 2.5.4.7.1. The method of SSI analysis and the results are 3.33
discussed in Section 3.7.2.4.

The response of buried piping to seismic loadings is discussed in 3.34
Section 3.7.3.12.

The shorefront west of the circulating and service water pumphouse 3.35
consists of a structural fill and beach and outwash and slope varying 3.37 241.4
from 5H:1V to 10H:1V, protected by graded layers of armor stone. A plan 3.38
showing the extent of the shoreline protection system is presented on 3.39
Figure 2.5.4-41. A typical section is shown on Figure 2.5.5-1. Static 3.41
and dynamic properties of the beach sands are discussed in Section
2.5.4.2.2 and documented in the reports in Appendix 2.5G. The 3.43
liquefaction potential of the beach and outwash sand is discussed in 241.4
Section 2.5.4.8. The stability of the shoreline slopes under static and 3.44
dynamic loading is discussed in Section 2.5.5.2.

The service water intake pipes, between the circulating and service 3.51
water pumphouse and the main plant area, are embedded in a rectangular 3.52
concrete encasement. Soils encountered in the pipeline excavation 3.53
include beach and outwash sands, unclassified stream deposits, and 241.4
ablation till. These soils were removed under the pipeline to dense 3.55
basal till and replaced with Category I structural backfill. The fill 3.56
was placed at a 1:1 slope from the till surface to the base of the 3.57
encasement and compacted to the requirements outlined in 3.58
Section 2.5.4.5.2. The sides of the encasement were backfilled with 3.59

nonstructural fill similar to the material used to backfill behind
retaining walls and described in Section 2.5.4.10.3. The backfill was 4.1
compacted to 90 percent of maximum dry density as determined by
ASTM 1557, Method D.

2.5.4.7.1 Subsurface Material Properties Used in SSI Analysis 4.9

The subsurface profiles used in the soil-structure interaction analyses 4.10
for the control building and the emergency generator enclosure (EGE) are 4.12
idealized, horizontal profiles based on subsurface explorations
conducted at the site and described in Section 2.5.4.3. Both of these 4.14
structures are founded on dense basal till overlying bedrock. The 4.15
computer program SHAKE was used to determine strain corrected values of
shear modulus obtained from low strain values previously determined from 4.16
field testing, laboratory testing, or empirical formulae based on
laboratory test data. The program iterates to obtain values of modulus 4.18
that are compatible with strain levels induced in a particular soil
layer by a specific earthquake. The strain levels normally induced by 4.20
earthquakes of magnitudes similar to the Millstone SSE are several
orders of magnitude higher than the low strain levels achieved during 4.21
laboratory or field testing, resulting in a reduction in shear modulus 4.23
when these properties are corrected for strain and input into PLAXLY-3.

The soil-structure model used in the EGE analyses is shown on 4.24
Figure 2.5.4-72. This idealized profile was selected to conservatively 4.25
model the subsurface conditions under the EGE and in the free-field. 4.26
The geologic profiles presented in Figures 2.5.4-55, 2.5.4-56, and 4.27
2.5.4-71 indicate that the rock surface slopes from approximately 4.28
elevation 0 feet at the east end of the structure to at least elevation
-10 feet at the west end. In the north-south direction, the sloping 4.30
evacuation face between the control building and the south end of the
EGE was backfilled with structural fill over the basal till. The extent 4.32
of structural fill is shown on Section J-J (Figure 2.5.4-55) and
Figure 2.5.4-54. Because the depth and extent of the structural fill 4.33
under the EGE is limited, it was assumed that the model used in the
SHAKE analysis is sufficiently conservative to account for local 4.34
variations in the subgrade and their effect on structural response. 4.35

The soil properties input into the SHAKE calculation are listed in 4.36
Table 2.5.4-21A for the free-field model and 2.5.4-21B for the 4.37
structure-effects model. Three earthquake time histories, from the 4.38
Taft, Parkfield-Temblor, and Pacoima Dam earthquakes, were normalized to
the site SSE peak acceleration value of .17g and input at bedrock. 4.39
Shear modulus and damping iterations were performed within the SHAKE 4.40
program in accordance with the curves marked "Resonant Column Test" on 4.41
Figures 2.5.4-73 and 2.5.4-74. These curves were developed from 4.42
empirical formulae and resonant column tests performed on samples of
compacted structural fill from the Millstone site. These test results 4.44
are presented on Figure 2.5.4-42. The tests show good correlation with 4.45
curves present by Seed and Idriss in the SW-AJA report (1972).

The strain corrected values of shear modulus and damping in the free- 4.46
load are presented in Table 2.5.4-21A. The mean value for each layer 4.47
was calculated and used to represent the individual soil layer

properties used in the PLAXLY model shown on Figures 3.7B-11 and 4.48
3.7B-12. The Millstone site artificial earthquake was input at bedrock 4.49
and the soil was modeled as a finite element mesh. The use of SHAKE to 4.50
perform shear modulus and damping iterations precludes the need to 8
iterate in the PLAXLY model. A discussion of the soil-structure 4.51
interaction analysis is presented in Section 3.7B2.4.

241.4

For the control building, the soil profile analyzed in SHAKE and used in 4.52
the soil-structure interaction analysis was the section where rock was 4.53
the deepest; i.e., top of rock at elevation -15 feet. Shear wave 4.54
velocities were used to define soil stiffness. The low strain and 4.55
strain-corrected soil properties for the free field case are listed in
Table 2.5.4-22.

2.5.4.8 Liquefaction Potential 4.57

The foundation materials beneath some of the Seismic Category I 4.58
structures consist of limited depths of dense to very dense basal tills 4.59
and/or compacted select granular backfill. These materials are not 5.1
susceptible to liquefaction under earthquake motions as described in the
following sections.

2.5.4.8.1 Structural Backfill 5.3

Based on studies of soils where liquefaction has been observed (Seed 5.4
1968, Lee and Fitton 1969, Kishida 1969), it is concluded that the 5.6

TABLE 2.5.4-14

FOUNDATION DATA FOR MAJOR STRUCTURES

Structure	Foundation Bearing Load (psf)	Founding Grade (ft)	Founding Material	Average Thickness Till (ft)	Average Thickness Structural Fill (ft)	Dimensions of Foundation (ft)	Design Groundwater Elevation (ft)	Maximum Calculated Static Settlement (in)
Containment	8,250	-38.7	Rock	-	-	158 diameter	21	0.04
Main Steam Valve	5,000	+9.0	Rock	-	-	70 x 60	19	0.01
Auxiliary	4,450	-0.5	Rock	-	-	177 x 164	23	0.02
Engineered Safety Features	2,950	-0.5	Rock	-	-	139 x 47	21	0.01
Control	3,500	-0.5	Till	0 to 10	-	125 x 105	19	0.02 to 0.03
Emergency Generator Enclosure (EGE)	4,000	+9.0	Till	10		10' Strip	19	0.01 to 0.4
Emergency Generator Oil Tank	1,600	+1.5	Till	10	4	65 x 32	19	less than 0.01
Emergency Generator Mats	1,500	+18.50	Structural Backfill	17	9.5	44 x 12	19	0.25
Refueling Water Storage Tank	4,000	+15.0	Rock	-	-	45 diameter	-	less than 0.01
Demineralized Water Storage Tank	4,000	+14.5	Rock	-	-	35 diameter	-	less than 0.01
Fuel	5,500	+3.0	Rock		-	93 x 112	23	less than 0.01
Waste Disposal (Liquid)	4,100	+0.5	Till	2 to 8	-	112 x 48	23	0.02
Waste Disposal (Solid)	3,500	+19.5	Structural Backfill	23	7	114 x 38	23	0.25
Hydrogen Recombiner	4,400	+20.0	Concrete Fill	-	-	39 x 27	18	less than 0.01

NOTE: All foundations are structural mat except EGE which is strip footing and slab on grade.