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

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March 16, 1984

Docket No. 50-336
B11055

Director of Nuclear Reactor Regulation
Attn: Mr. James R. Miller
Operating Reactors Branch #3
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555

Gentlepersons:

Millstone Nuclear Power Station, Unit No. 2
Request for Additional Information
Irradiated Capsule Report
Pressure-Temperature Limit Curves

By letter dated January 4, 1984(1) Northeast Nuclear Energy Company (NNECO) submitted proposed changes to the Millstone Unit No. 2 Technical Specifications revising the Pressure-Temperature Limits and maximum Heat-Up rate for the reactor coolant system as well as a revised reactor vessel material radiation specimen withdrawal schedule.

These revisions were prepared to account for surveillance capsule W-97 analysis results, increased irradiation to the reactor vessel as a result of the removal of the thermal shield and changes to Appendices G and H of 10CFR50. Additionally, the Irradiated Capsule Report for capsule W-97 was provided for Staff review.

The purpose of this letter is to docket information transmitted informally to the NRC as a result of conversations held with the Staff Reviewer and Millstone Unit No. 2 Project Manager on this subject. Accordingly, please find attached NNECO's response to the Staff's concerns.

NNECO trusts you will find this information satisfactory. We remain available should you wish to discuss this subject further.

Very truly yours,

NORTHEAST NUCLEAR ENERGY COMPANY

W. G. Counsil
Senior Vice President

(1)W. G. Counsil letter to J. R. Miller dated January 4, 1984.

A001
1/1

Question 1:

What is the status of the Heavy Section Steel Technology (HSST) material included in the Millstone Unit No. 2 surveillance program?

Response:

As reported in the "Program for Irradiation Surveillance of Millstone Point, Unit 2 Reactor Vessel Materials"[2] nc HSST specimens were contained in capsule W-97. However, twelve (12) such specimens are contained in capsule W-104 which is scheduled for next withdrawal.

Question 2:

Figure V-24 of the Irradiated Capsule Report for W-97 illustrates 1/4T and 3/4T irradiated weld properties. How are these curves related to the unirradiated weld properties?

Response:

As shown in the Irradiated Capsule Report, Charpy Surveillance Specimens were cut from the weld metal test material extending between 1/4T and 3/4T inclusive. For unirradiated specimens, small variations in copper content are unlikely to introduce much scatter in impact properties. Thus, the unirradiated weld properties apply for both 1/4T and 3/4T locations.

Question 3:

What is the RCS design pressure?

Response:

Table 4.3-1 of the FSAR lists the RCS design pressure as 2485 psig.

Question 4:

What are the target capsule fluences? What is the capsule to vessel inner diameter lead factor?

Response:

Page 76 of the Irradiated Capsule Report for capsule W-97 lists the capsule to vessel inner diameter lead factor as 1.36.

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[2]D. C. Switzer letter to C. Lear, dated December 14, 1977.

The target fluences are listed below:

Capsule	Proposed Schedule (EFPY)	Fluence (n/cm^2, E 1MeV)
W-97	3.0	$3(10)^{18}$
W-104	10.0	$1.5(10)^{19}$
E-284	17.0	$3.0(10)^{19}$
E-263	24.0	$4.8(10)^{19}$
E-277	32.0	$6.6(10)^{19}$
W-83		
W-97 (flux monitor)	10.0*	$1.1(10)^{19}$

*Installed at 5 EFPY of exposure.

Question 5:

Provide a description of the transient thermal analysis.

Response:

The thermal analysis for the heat-up ramp was analyzed using ABAQUS, a general purpose finite element code and verified by finite difference hand calculations. The model is a one dimensional heat transfer model which accounted for temperature dependent properties of clad and base metal. The heat-up was modeled as a ramp input at the fluid-clad interface for 40, 50 and 100°F per hour assuming an infinite convective heat transfer coefficient.

The attached tables present the output of the transient thermal analysis (page 10/26) and the results of the evaluation of the 1/4T outer diameter (OD) flaw (page 11/26) which governs in this case. The procedure is as follows:

1. Based upon Δt (T base/clad - T_{OD}) calculate K_{IT}, $K_{IT} = Mt\Delta t$, Mt = .35, figure G-2214-2, ASME III Appendix G.

2. Using $T_{3/4T}$ calculate K_{IR}, RT_{NDT} 3/4T = 123°F for a fluence of $.173(10)^{19}$, figure G-2214.1 ASME III, Appendix G.

3. Determine K_{IM} allowable, $2K_{IM} + K_{IT} = K_{IR}$, G-2215 Figure 1, ASME III, Appendix G.

4. Determine allowable pressure from σm, iterating for values of M_m based upon $\sigma/\sigma y$.

Attached please find for your information a copy of the ABAQUS input parameters.

Question 6:

Please provide the transition temperature at 1/4T and the inner diameter (ID).

Response:

RT_{NDT} 1/4T = 139°F for the projected fluence of $.48(10)^{19}$ at 7 EFPY.

RT_{NDT} = 149°F at ID for projected ID fluence of $.815(10)^{19}$ at 7 EFPY.

40- 50 - 100 °F /Hr

TFLUID	TBASELOAD	T4t	T34t	TOD	ΔT	KIT
70	70	70	70	70	0	0
86	83.47	78.09	73.11	72.57	10.9	3.815
106	102.3	93.095	84.91	83.82	18.48	6.468
126	121.8	112.1	101.2	99.85	21.96	7.683
146	141.6	131.2	117.4	118.0	23.6	8.26
166	161.5	150.8	138.5	137	24.5	8.575
186	181.5	170.5	158	156.5	25	8.75
205	200.2	188.6	175.7	174.1	26.1	9.135
225	219.8	207	192.6	190.9	28.9	10.115
245	239.6	226.1	210.9	209.0	30.6	10.71
265	259.5	245.6	229.8	227.9	31.6	11.06
285	279.5	265.3	249.2	247.2	32.3	11.305
305	298.6	283	266.3	264.3	34.3	12.005
325	317.2	297.6	277.3	274.9	42.3	14.805
345	336.3	314.1	290.4	287.6	48.7	17.045
365	355.7	331.5	305.2	302	53.7	18.795
385	375.3	349.5	321.2	317.7	57.6	20.16
405	395.1	368	338.1	334.4	60.7	21.245
425	414.8	386.8	355.6	351.8	63	22.05
445	434.7	405.9	373.7	369.7	65	22.75
465	454.6	425.1	392.1	388.1	66.5	23.275
485	474.5	444.5	410.8	406.7	67.8	23.73
505	494.5	464	429.7	425.5	69	24.15
525	514.5	483.5	448.7	444.4	70.1	24.535
545	534.4	503.1	467.8	463.4	71	24.85
550	539.4	508	472.6	468.2	71.2	24.92

ED4297 5-80

NORTHEAST UTILITIES SERVICE COMPANY

SUBJECT Heat up 40°F/Hr 70-200 °F
50°F/Hr To 300 °F
100 °F/Hr To 550°F

BY Stokes DATE 12/2/93

CHKD. BY [illegible] DATE 12/3/93

CALC. NO. 83060-242 GP REV. 0

SHEET NO. 10 OF 26

40-50-100 °F/hr

TFLUID	T34L	KGT	KZR	KZM	MM	GM	PSIG Pall	PSIA
70	70							
86	73.11	3.815	32.866	14.526	2.76	5,263	538	
106	84.91	6,468	34.002	13.767	2.75	5.006	511	
126	101.2	7,683	35.926	14.122	2.76	5.117	523	
146	119.4	8.26	38.688	15.214	2.76	5.512	563	
166	138.5	8.575	42.488	16.957	2.76	6.144	628	
186	158	8.75	47.622	19.436	2.77	7.017	717	
205	175.7	9.135	53.72	22.292	2.77	8.048	822	
225	192.6	10.115	61.2	25.543	2.78	9.188	938	953
245	210.9	10.71	71.66	30.475	2.79	10.923	1,116	1131
265	229.8	11.06	85.8	37.375	2.8	13.348	1363	1378
285	249.2	11.305	104.99	46.841	2.8	16,729	1,709	1,716
305	266.3	12.005	126.993	57.494	2.82	20,388	2,083	2098
325	277.3	14.805	144.323	64.759	2.83	22,883	2,337	2352
345	290.4	17.045	168.911	75.933	2.85	26,643	2,721	
365	303.2	18.795	200	90.603	—	—	—	
385	321.2	20.16	—	—	—	—	—	
405	338.1	21.245	—	—	—	—	—	
425	355.6	22.05	—	—	—	—	—	
445	373.7	22.75	—	—	—	—	—	
465	392.1	23.275	—	—	—	—	—	
485	410.8	23.73	—	—	—	—	—	
505	429.7	24.15	—	—	—	—	—	
525	448.7	24.535	—	—	—	—	—	
545	467.8	24.85	—	—	—	—	—	
550	472.6	24.92	—	—	—	—	—	

NORTHEAST UTILITIES SERVICE COMPANY

ED4297 5-80

SUBJECT Heatup 40-50-100 °F/hr BY DTARC DATE 12/6/83

CHKD. BY [illegible] DATE 12/13/83

CALC. NO. 83-000-242 GP REV. 0

SHEET NO. 11 OF 26

A B A Q U S / E P G E N

THIS PROGRAM HAS BEEN DEVELOPED BY

HIBBITT,KARLSSON & SORENSEN,INC.
35 SOUTH ANGELL STREET
PROVIDENCE, R.I.02906

FOR ASSISTANCE OR ANY OTHER INFORMATION CALL

401-861-0820

A B A Q U S I N P U T E C H O

```
                5   10   15   20   25   30   35   40   45   50   55   60   65   70   75   80
                ----------------------------------------------------------------------------
                *HEADING
                HEAT TRANSFER IN THE MP2 VESSEL WALL
                *NODE,NSET=ALL
                1,-0.026,0.,0.
CARD     5      2,0.,0.,0.
                3,0.0898,0.,0.
                4,0.1797,0.,0.
                5,0.2695,0.,0.
                6,0.3594,0.,0.
CARD    10      7,0.4492,0.,0.
                8,0.5390,0.,0.
                9,0.6289,0.,0.
                10,0.7187,0.,0.
                *ELEMENT,ELSET=CLAD,TYPE=DC1D2
CARD    15      1,1,2
                *ELEMENT,ELSET=VESS,TYPE=DC1D2
                2,2,3
                3,3,4
                4,4,5
CARD    20      5,5,6
                6,6,7
                7,7,8
                8,8,9
                9,9,10
CARD    25      *ATTRIBUTE
                1.0
                *MATERIAL,ELSET=CLAD
                *CONDUCTIVITY
                8.6,70.
CARD    30      8.7,100.
                9.0,150.
                9.3,200.
                9.6,250.
                9.8,300.
CARD    35      10.1,350.
                10.4,400.
                10.6,450.
                10.9,500.
                11.1,550.
CARD    40      *SPECIFIC HEAT
                0.116,70.
                ----------------------------------------------------------------------------
                5   10   15   20   25   30   35   40   45   50   55   60   65   70   75   80
```

CLAD

BASE METAL

CLAD CONDUCTIVITY

CLAD, SPECIFIC HEAT

```
                5   10   15   20   25   30   35   40   45   50   55   60   65   70   75   80
-------------------------------------------------------------------------------------------
                0.117,100.
                0.119,150.
                0.122,200.
CARD   45       0.124,250.
                0.125,300.
                0.127,350.
                0.129,400.
                0.130,450.
CARD   50       0.131,500.
                0.132,550.
                *DENSITY
                490.
                *MATERIAL,ELSET=VESS
CARD   55       *CONDUCTIVITY
                21.8,70.
                22.0,100.
                22.3,150.
                22.4,200.
CARD   60       22.4,250.
                22.4,300.
                22.4,350.
                22.3,400.
                22.1,450.
CARD   65       22.0,500.
                21.8,550.
                *SPECIFIC HEAT
                0.106,70.
                0.108,100.
CARD   70       0.112,150.
                0.115,200.
                0.117,250.
                0.120,300.
                0.123,350.
CARD   75       0.125,400.
                0.127,450.
                0.130,500.
                0.133,550.
                *DENSITY
CARD   80       490.
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                *INITIAL CONDITIONS,TYPE=TEMPERATURE
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CARD   85       *STEP,INC=500
                *HEAT TRANSFER,TEMTOL=.001
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                5   10   15   20   25   30   35   40   45   50   55   60   65   70   75   80
```

CLAD SPECIFIC HEAT

BASE METAL CONDUCTIVITY

BASE METAL SPECIFIC HEAT

40, 50, 100°F/HR RAMP , 70°F → 550°F

```
                5   10   15   20   25   30   35   40   45   50   55   60   65   70   75   80
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                .05,8.0
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                9,R2,200.,0.
CARD   90       *BOUNDARY,AMP=RAMP
                1,11,11,550.
                *NODE FILE,NSET=ALL
                2
                *NODE PRINT,NSET=ALL
CARD   95       2
                *END STEP
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                5   10   15   20   25   30   35   40   45   50   55   60   65   70   75   80
----------------------------------------------------------------------------------------------
```