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
HARTFORD, CONNECTICUT 06141-0270
(203) 666-6911

May 9, 1984

Docket No. 50-423
B11167

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

Gentlemen:

Millstone Nuclear Power Station, Unit No. 3
Probabilistic Safety Study
RWST Depletion and Core Uncovery

Attached is Northeast Nuclear Energy Company (NNECO) justification concerning their assumed time limit for depletion of the Refueling Water Storage Tank (RWST) and core uncovery during small LOCA's with emergency core cooling (ECC) recirculation failure. This information was requested by the Staff and their Consultants at the March 5, 1984 Probabilistic Safety Study meeting held in our engineering office in Berlin.

Very truly yours,

NORTHEAST NUCLEAR ENERGY COMPANY

W. G. Counsil

W. G. Counsil
Senior Vice President

B001
1/1

8405180058 840509
PDR ADOCK 05000423
A PDR

Millstone Nuclear Power Station, Unit No. 3
Probabilistic Safety Study

BACKGROUND

This summarizes calculations which have been performed in support of assumptions made in the Millstone Unit 3 Probabilistic Safety Study (PSS). Specifically, one important assumption which was made in the study is that, because of the large capacity of the refueling water storage tank (RWST) at MP-3, RWST depletion and core uncovery could be extended beyond a day if emergency core cooling (ECC) recirculation failed during a small loss-of-coolant accident (LOCA). For this to be the case, the operator would need to identify the loss of ECC recirculation capability early on and take measures to conserve RWST inventory as prescribed in the emergency operating procedures. The necessary operator actions would involve:

1) termination of quench spray as early as possible,

2) cooldown/depressurization of the primary side using the secondary side,

3) reduction of safety injection flow.

ANALYSES

Three scoping calculations were first performed to determine the relative importance of quench spray flow rate on RWST depletion. These calculations were very similar to those performed in the PSS for small LOCA/recirculation failure (2-inch break, 1 ECCS train), and indeed used the MARCH 1.1 SL sequence input as a base. The input was modified to take full credit for the RWST capacity, as opposed to conservative assumptions made in the PSS. In Cases 1 to 3, the quench spray flow rates were varied and the times to RWST depletion and core uncovery were noted (see Table 1).

In Case 1, a quench spray flow rate of 4000 GPM was assumed, while Case 2 assumed an effective flow rate of 1000 GPM, and Case 3 assumed no quench spray. In these calculations, there was no recirculation spray assumed; however, the timings are independent of recirculation spray assumptions. Figure 1 shows containment pressure response.

These calculations clearly show the importance of reducing/terminating quench spray in order to extend the core uncovery time (given failure of ECC recirculation).

Case 4 was also performed using the MARCH code with the important assumption that 1 quench spray and 2 recirculation sprays are available. Under these assumptions, containment returns to subatmospheric conditions in less than 1 hour. If quench spray were terminated at this time, the need to go onto ECC recirculation would be extended to greater than 16 hours. One should note that, although the assumption regarding recirculation sprays affects the containment depressurization rate, it does not affect the analysis of core uncovery time.

Finally, Case 5 represents the best estimate analysis of time to RWST depletion assuming that operator action OA-2 in the small LOCA event tree was

successful. The calculations were performed by hand assuming a range of break geometries and number of available trains of quench spray and ECCS. As in Case 4, quench spray is assumed terminated at 1 hour.

The results show that 10 to 12 hours are available from the time of ECC switchover (indication of ECC recirculation failure) to RWST depletion. Possible recovery actions could include replenishing RWST or restoration of ECC recirculation. Core uncovery, assuming no corrective action, would occur in the 18 to 27 hour time frame. Again, this is for the limiting 2-inch break, and more time would be available for smaller breaks. These results are also independent of the assumptions made regarding recirculation spray.

CONCLUSIONS

The results indicate that, assuming operator action to depressurize the primary system and terminate quench spray, at least 10 to 12 hours would be available to take corrective actions. Core uncovery would not occur until at least 18 to 27 hours. Of the two measures, quench spray termination and primary depressurization, early termination of quench spray is by far the more important.

TABLE 1. SMALL LOCA/RECIRC FAILURE TIMING (HR)

	CASE 1	CASE 2	CASE 3	CASE 4	CASE 5
QUENCH SPRAY ON	0.25	0.25	--	0.25	0.25
RECIRC SPRAY ACTIVATED	--	--	--	0.33	0.33
SWITCHOVER TO ECC RECIRCULATION (SIGNAL)	2.3	6.0	11.0	8.6	6-13
RWST DEPLETION	4.0	9.6	19.0	16.0	16-25
CORE UNCOVERY	5.3	11.3	21.0	18.0	18-27

CASE 1: 1 train quench spray (4000 GPM), no recirc spray, no primary depressurization.

CASE 2: Quench spray cycled off and on to an effective 1000 GPM, no recirc spray, no primary depressurization.

CASE 3: No quench or recirc sprays, no primary depressurization.

CASE 4: 1 train quench spray at 4000 GPM operates until containment returned subatmospheric at 1 hr, 2 recirculation spray pumps, no primary depressurization.

CASE 5: Quench spray operating until 1 hour, primary system cooldown and depressurized over 3 hr period, w or W/o recirc spray.

FIGURE 1

MP3
SMALL LOCA (2" BREAK)
SUCCESSFUL ECC INJECTION