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December 20, 1977  
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Director of Nuclear Reactor Regulation  
Attention: Mr. Steven A. Varga  
Light Water Reactors Branch No. 4  
U. S. Nuclear Regulatory Commission  
Washington, D. C. 20555

Dear Sir:

Three Mile Island Nuclear Station Unit 2 (TMI-2)  
License No. CFP-66  
Docket No. 50-320

Long Term Cooling After A Steam Line Break Accident

In meetings with your staff on September 7, 1977, they raised an additional concern relating to a steam line break accident at TMI-2. The question of long term cooling capability after a steam line break accident was discussed. The concern was expressed in the context of the Appendix 15B accident analysis and "long term cooling" was defined as bringing the plant to a stable, hot shutdown condition. The attachment to this letter addresses this concern and demonstrates the adequacy of the TMI-2 design with respect to this concern.

Appendix 15B of the FSAR will be revised to incorporate recent information on fuel performance and long term cooling prior to receipt of an operating license.

Very truly yours,

Signed J. G. Herbein

J. G. Herbein  
Vice President

JGH:JRS:mmb

Attachment

Long Term Cooling Following Steam Line Break

92 314

cc: Dr. Ernst Volgenau, Director  
Office of Inspection & Enforcement  
U. S. Nuclear Regulatory Commission  
Washington, D. C. 20555

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ATTACHMENT ILONG TERM COOLING FOLLOWING STEAM LINE BREAK

Analysis results indicate the potential for loss of natural circulation subsequent to blowdown following a steamline break accident. For the worst-case accident scenarios presented in Appendix 15B of the TMI-2 FSAR, conditions in the primary system 75 seconds after the accident would be:

RCS Pressure: ~100 psia

Average moderator temperature: ~420F with 2-phase liquid in the primary loop

RCS flow: reactor coolant pump tripped (a worst-case assumption for this situation) due either to loss of offsite power, operator action, or the steam line break environment.

Pressurizer level: zero (saturated steam bubble assumed at the core outlet plenum).

Main feedwater: isolated (a worst-case assumption with respect to long term cooling).

Emergency feedwater: For the maximum core cooldown, the pumps are assumed to be initiated at 2 seconds. For long term cooling, the pumps are assumed ineffective until after the system has been established in a solid water condition. Emergency feedwater is automatically initiated by loss of all four reactor coolant pumps or loss of feedwater pumps. Feedwater pumps would be lost due either to hydraulic upset of the pump as a result of the steam line break, or loss of main steam to run the pumps. Once initiated, emergency feedwater flow is between 470 and 500 gpm and is sufficient to remove decay heat.

High pressure injection: 2 pumps running at ~520 gpm each (based on FSAR Figure 6.3-2). No credit taken for contribution to establishing natural circulation due to HPI flow. System would be in a solid water condition as a result of HPI addition in 10-15 minutes after the accident.

Low pressure injection: running, but not adding fluid due to high RCS pressure.

Maximum heatup rate: more than one (1) hour before system becomes solid, assuming no water addition after 75 seconds. Total power is conservatively estimated as 240 MW from 75 seconds through the course of the event.

MSIV closure: ~2 minutes after accident, isolating the intact steam generator.

Core flood tanks: Inventory added for first 75 seconds. Insignificant volume addition subsequent to this time. No credit for CFT flow assumed in establishing natural circulation flow.

Based on the above initial conditions and assuming 2 HPI pumps running at 520 gpm, the pressurizer would be completely filled in ~ 15 minutes, assuming the operator did not throttle HPI flow prior to this time. (It can be seen the HPI addition, not heatup, has the dominant effect in pressurizing the system.)

Assuming that natural recirculation has been lost in the RCS it can be reestablished in several different ways. First, it can be reestablished assuming no operator action until after the RCS is in a solid water condition.

Water will be relieved through the pressurizer code safety valves, preventing overpressurization of the primary system. By this time, at least one steam generator has been isolated and emergency feedwater is being automatically supplied to both steam generators. The operator will then control plant conditions by taking manual control of the HPI and emergency feedwater systems to maintain hot standby conditions or proceed to cold shutdown if desired. Steam relief from either the atmospheric dump valves of the steam generator safety valves will provide secondary system pressure control and a heat sink is provided by the intact steam generator.

On the other hand, if the operator assumes flow control over the HPI system, he can establish natural circulation without putting the RCS in a solid water condition. He would do this by correlating RC hot leg temperature and pressurizer pressure. Once the RCS is pressurized at least 100 psi above the hot leg saturation temperature, the operator is assured that a solid water condition exists and natural circulation through the core has been reestablished, because of the heat sink provided by the isolated steam generator which is being supplied with emergency feedwater.

This sequence of events does not result in a violation of Appendix G for the first five years of reactor operation (Appendix G limits have only been calculated for the first five years of operation).

Neither does this sequence prevent adequate core cooling. Since the fuel is always covered by (at least) a two-phase fluid, fuel clad temperatures never exceed the saturation temperature of the fluid. Independent of natural circulation, HPI injection will provide further assurance of adequate core cooling.

The analysis of this sequence of events has assumed that natural circulation flow has been lost due to voiding in the RC piping. However, the following considerations support the judgement that natural circulation is never actually lost:

1. Reactor coolant pump coastdown would continue circulation in the RC loop for at least 90 seconds.
2. HPI injection would enhance natural circulation flow.
3. Emergency feedwater would remove heat from the primary system much sooner than is taken credit for. This heat removal would collapse steam voids and enhance the tendency for natural circulation.

In reality, circulation in the RCS system would not be lost and an orderly transition from the steam line break transient to a stable shutdown condition would occur. Regardless of these considerations, we conclude that even the assumed accident scenario (in which only safety grade equipment is assumed), results in no undue risk to the health and safety of the public.

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TO:  
Mr. Steven A. Varga

FROM:  
Metropolitan Edison Company  
Reading, Pa.  
J. G. Herbein

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DESCRIPTION

(1-P)

PLANT NAME: Three Mile Island Unit No. 2  
R/JL 12/28/77

ENCLOSURE

Consists of info. concerning Long Term Cooling after a Steam Line Break Accident...

(3-P)

FOR ACTION/INFORMATION

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