UNITED STATES
NUCLEAR REGULATORY COMMISSION
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MEMORANDUM FOR: Z. R. Rosztoczy, Chief, Analysis Branch Task Force

FROM: B. W. Sheron, Analysis Branch Task Force

SUBJECT: POOL BOILING-CONDENSATION NATURAL CIRCULATION IN TMI-2

During the course of the accident at Three-Mile Island, conditions were reached which apparently should have established a pool-boiling/condensation mode of natural circulation. However, such a mode was not established due to steam generator secondary side water level setpoints and relative elevations of components in lowered-loop B&W plants. The following explanation may prove helpful in understanding this aspect of the TMI-2 event, in particular the code analyses presently being performed.

Three Mile Island Event

At approximately 105 minutes into the TMI-2 event, the operators shut off the last operating pump, collapsing the two-phase mixture in the system. Plant data shows that subsequent to this, but prior to the PORV block valve being closed, the "A" OTSG was filled to the 50 percent range and available for decay heat removal. Secondary pressure in the available steam generator was around 700 psi at the time. At 2.3 hours into the event, the operators closed the PORV block valve, and plant data shows that the system repressurized up to about 2100 psi. Had a pool boiling/condensation mode of natural circulation been established with the active steam generator to remove decay heat, the pressurization should not have occurred.

One explanation that a pool boiling/condensation mode of natural circulation was not established is as follows:

Immediately after the pump was tripped, some steam condensation did take place and primary condensate began to accumulate in the lower part of the steam generator and suction piping connecting the steam generators and pumps. The condensate accumulated until it reached the same level as the secondary side water level. The water accumulated because sufficient static head was not available to raise the water in the suction piping to the pump so it could then flow into the vessel. Once the primary and secondary levels were equal, an adequate steam condensing surface was no longer available. The water in the primary tubes of the steam generator equilibrated to the secondary water temperature and secondary water boiling ceased. Since secondary water level was not dropping due to boiling, the feedwater controller stopped the feedwater flow to the steam generator. When the feedwater spray was stopped, condensation above the secondary water level was also stopped. Thus, the system began to repressurize. This repressurization may have begun before the PORV block valve was closed according to some data, and the valve closure only served to accelerate the repressurization.