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10 CFR 50.54(f)

5928-05-20005
January 19, 2005

U.S. Nuclear Regulatory Commission
Attn: Document Control Desk
Washington, DC 20555-0001

Three Mile Island, Unit 1 (TMI Unit 1)
Facility Operating License No. DPR-50
NRC Docket No. 50-289

Subject: Response To Request For Additional Information – Bulletin 2003-01, "Potential Impact of Debris Blockage on Emergency Sump Recirculation at Pressurized-Water Reactors"

References:
(1) NRC Bulletin 2003-01, Potential Impact of Debris Blockage on Emergency Sump Recirculation at Pressurized-Water Reactors
(2) Letter from M. P. Gallagher (Exelon Generation Company, LLC) to U.S. Nuclear Regulatory Commission, dated August 6, 2003
(3) Letter from M. P. Gallagher (Exelon Generation Company, LLC) to U.S. Nuclear Regulatory Commission, dated July 6, 2004
(4) Letter from T. G. Colburn (U.S. Nuclear Regulatory Commission) to Christopher M. Crane (Exelon Generation Company, LLC) dated December 17, 2004

This letter provides additional information in response to an NRC request for additional information (RAI) dated December 17, 2004. The RAI is in response to additional questions regarding the TMI Unit 1 response to NRC Bulletin 2003-01, Potential Impact of Debris Blockage on Emergency Sump Recirculation at Pressurized-Water Reactors, submitted to the NRC for review on August 6, 2003. The additional information is provided in Enclosure 1.

No new regulatory commitments are established by this submittal. If any additional information is needed, please contact Doug Walker at (610) 765-5726.

I declare under penalty of perjury that the foregoing is true and correct.

Very truly yours,

1/19/05
Executed On

R. G. West 1/19/05
R. G. West
Site Vice President
AmerGen Energy Company, LLC

Enclosure: Response to Request for Additional Information

cc: S. J. Collins, USNRC Administrator, Region I
D. M. Skay, USNRC Senior Project Manager, TMI Unit 1
D. M. Kern, USNRC Senior Resident Inspector, TMI Unit 1
File No. 02046

ENCLOSURE 1

RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION
THREE MILE ISLAND NUCLEAR STATION, UNIT 1
BULLETIN 2003-01, "POTENTIAL IMPACT OF DEBRIS BLOCKAGE ON EMERGENCY SUMP RECIRCULATION AT PRESSURIZED-WATER REACTORS"

The Nuclear Regulatory Commission (NRC) staff has reviewed the TMI-1 licensee's August 6, 2003, response to Bulletin 2003-01, as supplemented July 6, 2004, and has determined that the additional information requested below is needed for the NRC staff to complete its review.

1. NRC Question

   For TMI-1, has the licensee done any risk-assessment or quantitative/qualitative analysis to evaluate throttling emergency core cooling system (ECCS)/ containment spray (CS) system as a measure to delay switchover to sump recirculation?

   RESPONSE:

   Rather than a quantitative risk assessment of early containment spray throttling, TMI had performed a qualitative assessment in response to Bulletin 2003-01. This information is provided in response to questions no. 2 and 5 of this RAI.

2. NRC Question

   Please re-answer RAI question No. 1 from your July 6, 2004, RAI response letter. The response given (start recirculation EARLY (emphasis added) using one CS pump to refill the borated water storage tank (BWST)), is contradictory to the key premise of the original question (the purpose of refilling the BWST is to DELAY (emphasis added) having to use sump recirculation).

   RESPONSE:

   TMI understands the staff's concern with the initial response and has removed the discussions regarding the use of a containment spray pump to refill the BWST and the potential risk of flooding certain EQ instrumentation in the lower portion of containment. TMI is submitting the following revised response to the original question.

   Question No. 1 from the previous RAI:
   In your response to Bulletin 2003-01, you include qualitative risk insights as part of the justification for not implementing interim compensatory measures to delay the switchover to sump recirculation, and to ensure that alternative water sources are available to refill the Borated Water Storage Tank (BWST) or to otherwise provide inventory to inject into the reactor core and spray into the containment. The staff responses to industry questions and comments on Bulletin 2003-01 (Adams Accession Number ML031810371), question 37, stated that licensees may use quantitative data to justify not taking an interim compensatory measure. Please provide a description of any risk assessment performed, including qualitative and quantitative insights which justify and demonstrate that implementing this compensatory measure is not beneficial at this time.

   REVISED RESPONSE

   TMI-1 performed a qualitative assessment in response to the bulletin. The response stated that the approach would require a change in the industry wide standard for responding to accident conditions, which uses "symptom-based" procedures. Securing or reducing ECCS

flows, as a preemptive measure, is contrary to the philosophy that has been ingrained in the operating crews and would require making the assumption early in an event that excessive ECCS screen blockage was otherwise imminent.

In the initial minutes of a LOCA event, the operating crew is extremely busy implementing the existing emergency procedures, on which all crews have been trained. These ensure adequate core cooling and reactor coolant system inventory. To be effective in significantly delaying switchover to sump recirculation, any additional actions would need to be taken in the first few minutes of an accident. However, including additional operator actions at this time will increase the risk of operator errors or delays in other important operator decisions/actions. This is not considered a prudent risk to take, considering that TMI-1's switchover, occurring as early as 28 minutes in the most limiting LOCA events, provides for a relatively long drawdown time already.

From a quantitative perspective, we had considered securing one of the containment spray pumps for delaying switchover, but this significantly reduces the dose-mitigating capability during the event. This would have the desired effect of offsetting the BWST drawdown rate by up to 1100 gpm. The remaining drawdown rate is at least 9000 gpm for the remaining ECCS needs. Thus, the possible benefit to this approach would be to extend the minimum BWST drawdown time by no more than 5 minutes. We consider that our BWST switchover, occurring as early as 28 minutes in the most limiting Loss-of-Coolant Accident (LOCA) events, provides for a relatively long initial core cooling period, such that the benefit of extending this by up to 5 more minutes is minimal. Additionally, this creates an additional burden on the operations staff to secure the system during the early stages of a LOCA event.

The other component of this assessment is the risk of excessive sump screen blockage. Since TMI-1's ECCS sump is located outside of the secondary shield and the reactor coolant piping is located inside the secondary shield, debris generated by the LOCA would not immediately be deposited in the sump. Until switchover, the pool of water in the containment basement would continue to rise to a depth of at least three feet. During sump recirculation, the upstream flow path to the sump crosses large open sections of flooring where the water velocity is expected to be relatively low, thus limiting debris transport to that which is suspended in the water or moved across the floor by tumbling. Additionally, at the sump, a six-inch squared curb at the sump would further impede any tumbled debris. Therefore, the flow dynamics of TMI's existing configuration tend to decrease the likelihood of excessive or rapid sump screen blockage.

TMI also considered lining up the Spent Fuel Pool to the BWST. However, the expected flow rate from this source is no more than 200 gpm, without installing additional pumping capability, and this does not substantially extend the time to switchover. There is an existing procedure for this evolution, thereby making it a convenient option for later restoring flow from the BWST if sump screen blockage completely disabled the recirculation path. In order to preserve the spent fuel inventory, it is appropriate to use this approach only if the sump recirculation path could not provide higher flow rates.

Therefore, TMI did not identify compensatory measures that provided substantial benefit or were without potential adverse results.

3. NRC Question

Has, or will, the licensee provide training to inform operators to consider the option of aggressive cooldown as a strategy for small loss-of-coolant accident (LOCA) events? If not, why not?

RESPONSE:

The plant operators have received classroom training on the containment debris and ECCS sump screen blockage concern in LOCA scenarios. This training raised their awareness of the issue and reviewed the specific guidance for recognizing sump screen blockage and taking prompt action. TMI has determined that there is not a specific need for additional aggressive cooldown consideration for sump screen blockage concerns in small break LOCA events. Operators are already aware that the leakage rate, and thus the necessary injection rate, will be lower as reactor coolant pressure is reduced. As such, they will not inhibit the cooldown unnecessarily.

In small break LOCA events, TMI-1's BWST provides the normal cooling source for a considerable amount of time, on the order of hours, since the injection rate will correspond to the smaller break size, and containment spray will not actuate. In fact, only one train of low-pressure injection (LPI) will be needed to supply the high-pressure injection (HPI) pumps. So the other LPI train will be configured for normal decay heat removal when reactor coolant system pressure is low enough. This keeps the second train free of any debris from the ECCS sump. Additionally, the remote location of the sump outside the secondary shield, coupled with the much lower ECCS flow condition of the small break, will minimize debris impact on the sump if the condition were to progress to sump recirculation prior to the transition to normal decay heat removal operation.

4. NRC Question

Please provide a more detailed discussion regarding TMI-1 evaluations of ECCS pump and valve susceptibility to clogging/damage/loss of lubrication/loss of cooling (e.g., wetted soft-surface pump bearings, pump flow channels, and valve seats) due to small debris downstream of sump screens.

RESPONSE:

TMI has completed an assessment of ECCS downstream components potentially in the path for recirculation of fluid from the sump.

The smallest opening identified in the downstream piping and valves is currently 0.31 inches. This is in the minimum recirculation flow valves for the low-pressure injection pumps. Additionally, new HPI throttle valves to be installed in the Fall 2005 refueling outage will have cage openings of 0.213 inches. These openings are larger than the 1/8-inch openings in the plant's ECCS sump screen.

The HPI pump vendor had previously provided an assessment that the 1/8-inch ECCS sump screen openings provided adequate protection for those pumps. These pumps were our main concern when lined up to the sump since they are multi-stage units with small

clearances. The LPI or containment spray pumps are single stage, lower speed, centrifugal pumps, and as such, they are believed to be capable of handling debris-laden fluid.

All of the ECCS pumps [high-pressure injection (HPI), low-pressure injection (LPI), and containment spray) have an identical arrangement for flushing the mechanical seal with clean water. Each of these pumps has one or more cyclone separators for removing debris from the fluid prior to the seal flush. The smallest opening on these cyclone separators is 3/8 inch, which is also much larger than the 1/8-inch openings in the ECCS sump screen. All of these pumps have separate oil systems for lubrication and are cooled by closed cooling water systems, so these functions are not provided by potentially debris-laden fluid.

5. NRC Question

On page 4 of the July 6, 2004, RAI response, the licensee correctly stated that "the WOG [Westinghouse Owners Group] guidance provided the following actions for consideration as interim measures: (a) Secure one or both trains of containment spray prior to switchover." On that same page, the licensee stated that TMI-1 "has incorporated a modified version of (a) into symptom-based guidance... to reduce draw on the sump whenever containment spray is not absolutely needed for dose or containment pressure reduction." On page 2 of the licensee's July 6, 2004, response, the licensee also stated, "in response to Bulletin 2003-01, we enhanced the emergency procedures to provide the following guidance in regard to ECCS operation after switchover to ECCS sump suction: ...3. SHUTDOWN both containment spray trains based on other emergency procedure guidance..."

Please provide the rationale for not implementing procedures to secure one or both CS trains prior to sump recirculation.

RESPONSE:

The response to question 2 provides the risk assessment considerations for our decision to not prematurely secure containment spray. The essence is that the extended time to switchover is not considered a significant benefit because the existing duration of at least 28 minutes with abundant core cooling is adequate to cool the core to where substantially throttled injection pump flow still provides adequate core cooling and inventory control. Furthermore, with TMI's sump located outside of the secondary shield, the transport of debris is expected to cause only a gradual, instead of a sudden, clogging of the sump screen after switchover to sump recirculation. Therefore, operators will have adequate time to recognize sump screen blockage symptoms and take the prescribed actions to preserve some injection capability.

Upon excessive screen blockage, the LPI pumps, with their higher NPSH requirement, would be the first to exhibit signs of this clogging. Our procedures then throttle these pumps first to provide immediate relief in terms of NPSH margin and the rate of debris transport to the sump. One or both trains (depending on potential dose consequences) of containment spray are then promptly secured, further limiting debris transport and screen blockage concerns. At this point in a large-break LOCA event, the coolant boil-off rate has dropped below 300 gpm, so the LPI pumps are more than sufficient to protect the core even when substantially throttled.