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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"

This letter provides additional information in response to NRC request for additional information dated June 8, 2004, regarding 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,

07-06-04
Executed On

Michael P. Gallagher
Director, Licensing and Regulatory Affairs
AmerGen Energy Company, LLC

Enclosure: Response to Request for Additional Information

cc: H. J. Miller, 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

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ENCLOSURE

RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION

THREE MILE ISLAND, UNIT 1

BULLETIN 2003-01, "POTENTIAL IMPACT OF DEBRIS BLOCKAGE ON EMERGENCY SUMP RECIRCULATION AT PRESSURIZED-WATER REACTORS"

1. **NRC Question**

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.

Response

TMI-1 performed a qualitative assessment in response to the bulletin. The response stated the approach would require a change in what has become the industry wide strategy for responding to accident conditions, which uses "symptom-based" procedures. Securing or reducing Emergency Core Cooling System (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 that excessive ECCS screen blockage was otherwise imminent. Allowing exceptions such as preemptive ECCS throttling would negatively impact the effectiveness of symptom-based behavior and training.

From a quantitative perspective, we had considered using one of the containment spray pumps for delaying switchover by providing some water from the containment sump back to the BWST, but this removes one of two available trains for containment spray flow during the event. This would offset the BWST drawdown rate by up to 1500 gpm. The drawdown rate is much higher, approximately 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 re-align the system during the early stages of a LOCA event.

TMI also considered lining up the Spent Fuel Pool to the BWST. The flow rate from this source is estimated to be approximately 200 gpm. This does not substantially extend the time to switchover. Additionally, the spent fuel pool water or any other alternate water source added to the Reactor Coolant System (RCS) and containment could ultimately impact Environmental Qualification (EQ) instrumentation in the lower sections of containment due to the elevated water level.

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

2. **NRC Question**

In your response to Bulletin 2003-01, as part of the justification for not implementing an interim compensatory measure to ensure that alternative water sources are available to refill the BWST or to otherwise provide inventory to inject into the reactor core and spray into the containment, you state that the plant's current approach is considered adequate. Please provide a description of the current approach and the technical basis for this conclusion. Include a description of the guidance available to the plant operators in your current operating procedures, and the actions they are instructed to take in the event of sump clogging and a loss of emergency core cooling system recirculation capability. Did your justification to not implement this compensatory measure consider each of the debris blockage effects identified in Bulletin 2003-01 (loss of pump net positive suction head, structural reinforcement of the sump screen, flowpath restrictions and downstream effects)?

Response

The plant's current approach is to switch over the ECCS suction from the BWST to the containment sump when the BWST level has dropped to specified limits that ensure no vortexing or air entrainment in the system. At this time, operators throttle the Low-Pressure Injection (LPI) pumps to flows that ensure adequate Net Positive Suction Head (NPSH) margin with the design assumption of 50% sump screen blockage in this configuration.

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:

If at any time LPI pump cavitation is evident (flow, amps, & discharge pressure are degraded or oscillating and/or vibration has risen), then

1. ENSURE the pump suction valve is open
2. THROTTLE both LPI trains to a minimum flow > 1250 GPM per train
3. SHUTDOWN both containment spray trains based on other emergency procedure guidance. (This guidance has 1 train secured immediately, eliminating half of the spray flow, then secures the other train only when containment pressure and atmospheric iodine levels are acceptably low, or there is no indication of serious fuel damage or breach of the containment boundary.)
4. If indications of degraded LPI pump operation persist and both LPI trains are operating, then SHUTDOWN the most affected LPI pump.

This guidance applies to the NPSH margin and the flowpath restriction effects identified in Bulletin 2003-01 because the operator response is based on symptoms. All the necessary indications are readily available to the operators in the control room, including high vibration alarms on the LPI pumps. The LPI pumps are expected to exhibit signs of cavitation prior to the containment spray pumps due to the additional NPSH margin for the containment spray pumps.

The minimum LPI flow rate of 1250 gpm/train provides margin above the maximum ECCS flow rate required for long-term cooling in the event of a single-failure of one of the trains. This analysis determined that the LPI flow rate required for core cooling is less than 1000 gpm by the time the switchover to the ECCS sump has occurred. This is the ECCS flow rate necessary to replace the inventory being boiled away after 15 minutes into the event.

The ECCS sump screen is constructed of 2" x 3/16" stainless steel bearing bars spaced only 1-3/16" apart, with crossbars at 4" spacing, and then covered with a heavy (0.028" diameter wire) stainless steel mesh screen. The structural integrity of this sump screen has been determined to be robust enough to withstand a 2 psi pressure drop across it. Above the sump screen is a trash rack that would capture any larger debris upstream of the sump screen. The sump screen and the trash rack remain fully submerged after switchover to this source of ECCS suction.

Our analysis has determined that any debris small enough to pass through the sump screen would not degrade any of the ECCS pumps or clog the containment spray nozzles. Flow control valves downstream of the ECCS pumps are not susceptible to debris clogging because they either do not contain cage assemblies, or in the case of the manual LPI throttle valves, the cage assemblies would not be affected by debris small enough to pass through the ECCS sump screen openings.

3. **NRC Question**

The Westinghouse Owners Group (WOG) has developed operational guidance in response to Bulletin 2003-01 for Westinghouse- and CE-type pressurized water reactors (PWR). For Byron and Braidwood, your response stated that you will monitor the WOG activities and will consider implementation of any issued guidance. Although TMI Unit 1 is a B&W designed PWR, please discuss your plans to consider the WOG issued guidance and implementing similar guidance for TMI Unit 1. Include a discussion of the WOG recommended compensatory measures that have been or will be implemented for TMI Unit 1, and the evaluations or analyses performed to determine that these compensatory measures are acceptable for TMI Unit 1. Provide technical justification for those WOG compensatory measures not being implemented by your plant. Also include a detailed discussion of the procedures being modified, the operator training being implemented, and your schedule for implementing these compensatory measures.

Response

This NRC request recognizes that TMI Unit 1 is not a Westinghouse plant. TMI has implemented the latest Babcock & Wilcox Owners Group (BWOG) Generic Emergency Operation Guidelines (GEOG) pertaining to this issue. The BWOG Operator Support Committee has reviewed the WOG guidance and the 2003-01 Bulletin recommendations and developed specific guidance for recognition and mitigation of sump blockage conditions that threaten adequate NPSH for ECCS pumps.

The procedural elements identified in our response to question 2 are the result of implementing this GEOG guidance. ECCS throttling as a preemptive measure is not appropriate because adequate core cooling and fluid subcooling must be achieved and maintained in the early stages of an accident. The GEOG guidance does recognize that other pertinent core cooling actions are already in place. Direct throttling of reactor coolant system (RCS) injection or containment spray is directed based on scenario symptoms, with the result being that the time to sump switchover would be extended and the potential for debris transport to the sump screen reduced. The specific actions in TMI Unit 1's emergency procedures are:

- If the High-Pressure Injection (HPI) pump throttling criteria (Greater than 25 degrees subcooling margin, or LPI established and greater than 1250 gpm/train) is satisfied prior to sump switchover, then the HPI system is throttled or shutdown.
- If containment spray actuates, then when containment pressure has been returned to normal levels and if containment radiation levels are not excessive, then containment spray is shutdown.

The WOG guidance provided the following actions for consideration as interim measures:

(a) Secure one or both trains of containment spray prior to switchover

(b) Manually switch over one ECCS train to sump suction prior to required switchover

(c) Secure one train of ECCS in conjunction with switchover

(d) Refill the BWST

(e) Supply ECCS from additional sources

(f) More aggressive cooldown in small-break LOCA events

(g) Determine symptoms and identification of sump blockage, and develop operator response guidelines

(h) Early termination of HPI

The plant has incorporated a modified version of (a) into symptom-based guidance, as described in the question 2 response above, to reduce draw on the sump whenever containment spray is not absolutely needed for dose or containment pressure reduction.

Although consideration (c) is directed at securing a single train, TMI considers its symptom-based guidance for throttling both LPI pumps to be reasonably similar, while still protecting the ability of the system to more easily tolerate a single-failure of any ECCS train. Reducing the flow of both LPI pumps increases their NPSH margin, while having one LPI pump operating with no flow reduction provides no NPSH benefit.

TMI has already considered (d) and (e) as discussed in the question 1 response above, and has implemented (g) as described in the question 2 response.

Consideration (h) is included as HPI pumps are shutdown as soon as RCS pressure allows the HPI throttling criteria to be met, and this will reduce the unnecessary draw on the BWST.

TMI-1 has not implemented (b) and (f) as means of reducing BWST drawdown because the system's relatively long drawdown time allows for substantial core cooling prior to switchover.

4. **NRC Question**

Bulletin 2003-01 provides possible interim compensatory measures licensees could consider to reduce risks associated with sump clogging. In addition to those compensatory measures listed in Bulletin 2003-01, licensees may also consider implementing unique or plant-specific compensatory measures, as applicable. Please discuss any possible unique or plant-specific compensatory measures you considered for implementation at your plant. Include a basis for rejecting any of these additional measures considered.

Response

In the plant's review of alternatives to address Bulletin 2003-01, we did not identify any unique compensatory measure that existed for our plant.