December 29, 2005

Mr. Jeffrey S. Forbes
Site Vice President
Arkansas Nuclear One
Entergy Operations, Inc.
1448 S. R. 333
Russellville, AR 72801

SUBJECT: ARKANSAS NUCLEAR ONE, UNIT 1 (ANO-1) AND UNIT 2 (ANO-2) - RE: RESPONSE TO NRC BULLETIN 2003-01, "POTENTIAL IMPACT OF DEBRIS BLOCKAGE ON EMERGENCY SUMP RECIRCULATION AT PRESSURIZED-WATER REACTORS" (TAC NOS. MB9554 AND MB9555)

Dear Mr. Forbes:

This letter acknowledges receipt of your response dated August 7, 2003, to Nuclear Regulatory Commission (NRC) Bulletin 2003-01, "Potential Impact of Debris Blockage on Emergency Sump Recirculation at Pressurized-Water Reactors," dated June 9, 2003. Your response was supplemented by letters dated June 10, 2004, August 31, 2005, and October 19, 2005. The NRC issued Bulletin 2003-01 to all pressurized-water reactor (PWR) licensees requesting that they provide a response, within 60 days of the date of Bulletin 2003-01, that contains either the information requested in following Option 1 or Option 2 stated in Bulletin 2003-01:

Option 1: State that the emergency core cooling system (ECCS) and containment spray system (CSS) recirculation functions have been analyzed with respect to the potentially adverse post-accident debris blockage effects identified in this bulletin, taking into account the recent research findings described in the Discussion section, and are in compliance with all existing applicable regulatory requirements.

Option 2: Describe any interim compensatory measures (ICMs) that have been implemented or that will be implemented to reduce the risk which may be associated with potentially degraded or nonconforming ECCS and CSS recirculation functions until an evaluation to determine compliance is complete. If any of the ICMs listed in the Discussion section will not be implemented, provide a justification. Additionally, for any planned interim measures that will not be in place prior to your response to this bulletin, submit an implementation schedule and provide the basis for concluding that their implementation is not practical until a later date.

Entergy Operations, Inc. (EOI) provided an Option 2 response.

Bulletin 2003-01 discussed six categories of ICMs:

(1) operator training on indications of and responses to sump clogging; (2) procedural modifications if appropriate, that would delay the switch-over to containment sump recirculation

(e.g., shutting down redundant pumps that are not necessary to provide required flows to cool the containment and reactor core, and operating the CSS intermittently); (3) ensuring that alternative water sources are available to refill the refueling water storage tank (RWST) or to otherwise provide inventory to inject into the reactor core and spray into the containment atmosphere; (4) more aggressive containment cleaning and increased foreign material controls; (5) ensuring containment drainage paths are unblocked; and (6) ensuring sump screens are free of adverse gaps and breaches.

You stated in your bulletin response of August 7, 2003, that you will be implementing the following measures, or that these measures were already in place:

(1) Training for licensed operators to recognize and respond to sump clogging. The training was to have been completed by March 31, 2004 and was to include identifications of indications, possible responses, and emergency operating procedure (EOP) and severe accident management guideline (SAMG) instructions for responding to sump clogging. In addition to existing operator training on the monitoring of pumps for indications of loss of net positive suction head (NPSH), such as erratic flow or discharge pressure, training was to have been developed to emphasize the instrumentation available to identify symptoms of sump blockage or degraded sump performance - ICM category (1);

(2) EOI's procedures at the time of its initial Bulletin 2003-01 response were stated to delay switchover to sump recirculation "to the extent practical." An example you gave was that in the ANO-2 EOPs (developed in accordance with CEN-152, "Combustion Engineering Emergency Procedure Guidelines"), direction is provided to throttle or stop safety injection flow into the reactor coolant system (RCS) if certain plant conditions are satisfied (e.g., RCS subcooling, pressurizer level, etc). The NRC staff notes, however, that under loss-of-coolant accident (LOCA) conditions, these plant conditions would not necessarily be satisfied before switchover to emergency sump recirculation. In connection with the issue raised in Bulletin 2003-01 regarding implementing procedural modifications, if appropriate, that would delay switchover to sump recirculation, EOI stated that Arkansas Nuclear One's (ANO) current process for revisions to the EOPs, due to changes in vendor/owners group guidelines, is to evaluate and then incorporate recommendations (those deemed appropriate) from the vendor/owners group, and that deviations from these guidelines would require a site-specific justification. You also stated that, in general, EOI is actively participating in industry efforts to address the potential concerns for sump blockage - ICM category (1);

(3) EOI stated that ANO's SAMGs do not adequately address alternative water sources, as phrased in Bulletin 2003-01 ("ensuring that alternative water sources are available to refill the RWST or to otherwise provide inventory to inject into the reactor core and spray into the containment atmosphere"), and that, in this, regard EOI was to have enhanced the ANO SAMGs by January 15, 2004 (see discussion of candidate operator action (COA) 5 and COA 6 below);

(4) EOI stated that it controls the ANO-1 borated water storage tank (BWST) and the ANO-2 refueling water tank (RWT) above low level alarm setpoints/administrative low-level limits and below administrative upper level limits, providing additional volume for RCS injection - ICM category (3);

(5) EOI stated that it implements an aggressive containment building closeout process to leave the ANO-1 and ANO-2 containment buildings as clean as practical following an outage, with items authorized to be left in containment secured in their proper locations. Operations personnel inspect the containment for loose debris which could be transported to the sump. If during an outage the sump is accessed, foreign material exclusion controls are implemented and items are logged into and out of the sump. Once the sump has received its closeout inspection, personnel access to the internal sump area is prohibited. Post-outage conditions are procedurally maintained if at-power containment building entries are required. Affected areas are verified to have no loose debris present before the containment is exited - ICM category (4);

(6) EOI stated that outage procedures include sump inlet visual inspections for debris, and that critical floor drains, which are routed to the sump, are verified to be in their proper configurations with their required gratings and screens in place. By September 15, 2003, you stated that procedures would be in place to verify water freely flows from these drains to the sump ("hydraulic communication") - ICM category (5);

(7) EOI described the robust nature of sump screen components. You stated that after major containment work has been completed and equipment has been properly stored in the containment building, a sump cleanliness and integrity inspection is performed in accordance with site procedures. You stated that sump screens are inspected to ensure that there are no openings in or around the sump screen larger than the screen mesh size, and sump components are inspected for evidence of structural distress or corrosion - ICM category (6).

In its June 10, 2004, supplemental letter responding to NRC questions provided in an April 19, 2004, telephone conference call, EOI stated that:

(1) The operator training recently implemented on indications of and responses to sump clogging consisted of a computer based training course, which included a comprehensive discussion of the issue, a discussion of compensatory measures taken, symptoms of sump screen blockage, potential water sources, and pictures of specific instrument indications - ICM category (1);

(2) In the early minutes following a LOCA, the operators are extremely busy responding to the event in accordance with their symptom-based procedures, focusing on the restoration of critical safety functions when degraded conditions exist (the operator need not diagnose the event in order to respond to re-establish and maintain a safe plant configuration). In rejecting the stopping of one train of ECCS before switchover to sump recirculation, EOI stated that to be effective in delaying the switchover to containment sump recirculation, operator actions to stop one train of ECCS must be taken in the first few minutes of the accident. EOI concluded that any risk benefit achieved by these types of actions would be offset by the additional risk from errors by operators who must conduct manual switchover to sump recirculation. EOI provided significant additional detail regarding risk-benefit versus risk-increase considerations relating to operator workload, manual sump switchover procedures, debris transport restrictions, containment flow velocities (which are less than the limiting published incipient tumbling velocities for expected LOCA zone-of-influence debris), and average flume velocities in the vicinity of the sump;

(3) In response to the NRC's request that EOI review new Westinghouse Owners Group operational guidance in response to Bulletin 2003-01 (WCAP-16204 "Evaluation of Potential ERG [Emergency Response Guideline] and EPG [Emergency Procedure Guideline] Changes to Address NRC Bulletin 2003-01 Recommendations PA-SEE-0085)," EOI stated that new revisions to the Babcock and Wilcox Owners Group (B&WOG) EOPs Technical Bases document 74-115-2414, "Generic Emergency Operating Procedure Guidelines" and to CEN-152, "Combustion Engineering Emergency Procedure Guidelines" had recently been received at ANO. EOI further stated that it would review these documents by August 15, 2004, and incorporate the recommendations as appropriate; and

(4) The SAMGs for both ANO units had been revised to address available onsite alternative water sources for RCS injection or refueling tank refill, including, for ANO-1, residual post-switchover BWST inventory, clean waste receiver tank inventory, excess spent fuel pool inventory, batch boric acid and water additions to the BWST, condensate storage tank inventory, pure unborated makeup water, and including, for ANO-2, residual post-switchover RWT inventory, boric acid makeup tank (BAMT) inventory, excess spent fuel pool inventory, batch boric acid addition via the BAMT, the volume control tank, condensate storage tank inventory, and pure unborated makeup water - ICM category (3);

In an August 31, 2005, response to an April 20, 2005, request for additional information requesting technical analyses resulting from EOI's review of the eleven WCAP-16204 Candidate Operator Actions (COAs) - potential ICM's for emergency sump blockage), you responded regarding ANO-1 (Babcock and Wilcox PWR) and ANO-2 (Combustion Engineering PWR) individually.

For ANO-1, EOI responded as follows:

(1) COA A1a, "Secure One Spray Pump," and COA A1b, "Secure Both Spray Pumps," this step was already in the ANO-1 EOPs. However, in an October 19, 2005, response to an October 12, 2005, set of NRC comments, EOI stated that ANO-1 does not secure either reactor building spray (RBS) pump prior to sump recirculation, and that, in response to sump blockage, one spray pump is secured if there is indication of a containment breach or two spray pumps are secured if there is no indication of containment breach;

(2) COA A2, "Manually Establish One Train of Containment Sump Recirculation Prior to Automatic Actuation," automatic actuation of sump recirculation is not applicable to ANO-1, and that transfer of one train of sump recirculation early was unacceptable due to NPSH requirements, BWST drawdown rate, and valve stroke times;

(3) COA A3, "Terminate One Train of HPSI [High Pressure Safety Injection]/High-Head Injection After Recirculation Alignment," EOI is maintaining the same vendor high pressure injection termination criteria (which are applicable both before and after sump recirculation) as have been in effect - "ECCS flows shall not be throttled while the core outlet is not subcooled other than that required for pump protection" (actual sump blockage indication);

(4) COA A4, “Early Termination of One Low-Pressure Safety Injection (LPSI)/Residual Heat Removal (RHR) Pump Prior To Recirculation Alignment,” EOI is maintaining the same vendor low pressure injection (LPI) termination criteria (which are applicable both before and after sump recirculation) as have been in effect - “ECCS flows shall not be throttled while the core outlet is not sub-cooled other than that required for pump protection” (actual sump blockage indication) (RWST);

(5) COA A5, “Refill of Refueling Water Storage Tank (RSWT),” the repetitive task to conduct BWST refill upon sump transfer to recirculation is proceduralized within Operating Procedure (OP) OP-1202.012 - ICM category (3);

(6) COA A6, “Inject More Than One RWST Volume From a Refilled RWST or by Bypassing the RWST,” this step is currently covered under the SAMGs. In an October 19, 2005, response to an October 12, 2005, set of NRC comments, EOI stated that SAMG Chapter III.D step 3.8.2 informs the operators that additional borated water sources can be made available for injection into the RCS and they include but are not limited to any remaining or refilled BWST inventory, clean waste receiver tanks via BWST, batch boric acid additions via BWST, delivered offsite sources, or unborated water via the spent fuel pool. As a last resort, pure unborated water can be provided to the BWST for injection by the LPI pumps. A proceduralized method of adding inventory to the RCS, bypassing the BWST, is via normal makeup from the makeup tank - ICM category (3);

(7) COA A7, “Provide More Aggressive Cooldown and Depressurization Following a Small Break LOCA (SBLOCA),” EOI stated that current EOPs expedite cooldown during a LOCA and state that cooldown limits do not apply when the core exit thermocouples are not sub-cooled, but that OP-1203.040 ("Forced Flow Cooldown") is written for a plant cooldown under LOCA conditions where sub-cooling margin is adequate so normal cooldown limits apply. In an October 19, 2005, response to an October 12, 2005, set of NRC comments , EOI stated that for ANO-1 the term “rapid cooldown” has a specific procedure-based meaning (a rate faster than technical specification (TS) limits, but that ANO-1 operators are trained to perform all other cooldowns as quickly as possible within TS limits - ICM category (2);

(8) COA A8, “Provide Guidance on Symptoms and Identification of Containment Sump Blockage,” this guidance is in the currently approved ANO-1 EOPs (OP-1202.012 “Repetitive Tasks,” Step 15.G, which provides detailed symptoms of sump blockage, as well as indications to monitor. In an October 19, 2005, response to an October 12, 2005, set of NRC comments, the symptoms were described as lowering sump level and fluctuation in ECCS pump performance, including erratic indication of suction and discharge pressure, flow, and amperage (with specific instruments listed in the EOP) - ICM category (1);

(9) COA A9, “Develop Contingency Actions in Response to Containment Sump Blockage, Loss of Suction, and Cavitation,” EOI provided the B&WOG interim guidance for whenever ECCS is placed on reactor building sump recirculation and there are symptoms of sump degradation: verify suction lineups, throttle LPI to minimum flow rate, if both RBS trains are operating then stop one RBS train, if no evidence of containment breach then stop all RBS pumps, and refer to station management (Technical Support

Center (TSC)). In an October 19, 2005, response to an October 12, 2005, set of NRC comments, EOI stated that if the sump were to clog, the SAMG would direct the TSC staff to consider such actions as injecting additional coolant into the RCS - ICM category (1);

(10) COA A10, "Early Termination of One Train of HPSI/High-Head Injection Prior to Recirculation Alignment," EOI is maintaining the same vendor high pressure injection termination criteria (which are applicable both before and after sump recirculation) as have been in effect - "ECCS flows shall not be throttled while the core outlet is not subcooled other than that required for pump protection" (actual sump blockage indication); and,

(11) COA A11, "Prevent or Delay Containment Spray for Small Break LOCAs (<1 Inch Diameter) in Ice Condenser Plants," you concluded that since ANO-1 does not have an ice condenser, this COA was not applicable.

For ANO-2, EOI responded as follows:

(1) COA A1a, "Secure One Spray Pump," and COA A1b, "Secure Both Spray Pumps," operator actions to secure containment spray (CS) pumps require confirmation that they have performed their safety function. As part of that determination, operators must specifically determine that CSS pumps will not be required for decay heat removal after a recirculation actuation signal (RAS) - automatic switchover to emergency sump recirculation), recognizing that RAS acts automatically to secure the LPSI pumps and to align service water for the containment fan coolers to the shutdown cooling (SDC) heat exchanger. In an October 19, 2005, response to an October 12, 2005, set of NRC comments, you stated that CSS pumps are only secured based on plant conditions (i.e. normal spray termination criteria or indication of sump blockage). Therefore, ANO-2 procedures do not implement COA A1a nor COA A1b.

(2) COA A2, "Manually Establish One Train of Containment Sump Recirculation Prior to Automatic Actuation," the current NPSH margin is small (requiring a complete injection of a normal RWT volume), and this step would create greater opportunity for operator error. Therefore, this COA will not be implemented at ANO-2;

(3) COA A3, "Terminate One Train of HPSI/High-Head Injection After Recirculation Alignment," CEN-152 calls for securing one HPSI train after recirculation alignment if two HPSI trains are not needed for core heat removal (but specifies this step as a plant specific or optional instruction). EOI stated that, given that deliberate manual securing of one HPSI train is not considered a "failure," failure of the remaining train would result in interruption of core flow until the operator could re-start the standby HPSI pumps, which could result in significant increase in the fuel peak cladding temperature (PCT) and, consequently, a significant increase in radiological dose to the public. Therefore, this COA would not be implemented at ANO-2;

(4) COA A4, "Early Termination of One LPSI/RHR Pump Prior To Recirculation Alignment," EOI stated that, given that deliberate manual securing of one LPSI/SDC train is not considered a "failure," failure of the remaining train would result in interruption of core flow until the operator could re-start the standby LPSI/SDC pumps, which could result in

significant increase in the fuel PCT and, consequently, a significant increase in radiological dose to the public. Therefore, this COA would not be implemented at ANO-2;

(5) COA A5, "Refill of RWST," EOI stated that the step to refill the RWT prior to RAS is currently in the ANO-2 EOP (OP-2202.003, Section 3, Step 18). Multiple flowpaths are specified in the ANO-2 EOPs - ICM category (3);

(6) COA A6, "Inject More Than One RWST Volume From a Refilled RWST or by Bypassing the RWST," ANO-2 SAMGs state that additional borated water sources available for injection are the BAMT, the RWT residual or re-filled inventory, excess spent fuel pool (SFP) inventory, any hold-up tank inventory, the volume control tank, batch additions to the BAMTs, unborated water additions to the SFP, or pure unborated makeup water provided directly to the suction of the charging pumps or into the RWT for injection by the HPSI pumps - ICM category (3);

(7) COA A7, "Provide More Aggressive Cooldown and Depressurization Following a SBLOCA," EOI stated that current EOPs contain a floating step to initiate cooldown upon entry into the EOPs with maximum cooldown rate within TS limits, and that the primary strategy of the SBLOCA procedure is to minimize primary break flow while performing a "controlled" cooldown with RCS pressure 100 pounds per square inch, absolute above minimum reactor coolant pump (RCP) NPSH requirements (or margin to saturation of 10-45 degrees F if no RCPs are running). In an October 19, 2005, response to an October 12, 2005, set of NRC comments, you stated that operators are trained to perform cooldowns associated with medium or SBLOCAs as quickly as TSs allow - ICM category (2);

(8) COA A8, "Provide Guidance on Symptoms and Identification of Containment Sump Blockage," EOI stated that the ANO-2 EOPs initiate sump blockage monitoring upon receipt of a recirculation actuation signal pre-trip annunciator (RWT level less than 40%) using OP-2202.003, Standard Attachment 43. This procedure directs the monitoring of HPSI and CS pump suction pressure, discharge pressure, flow, motor amperage, and pump noise, as well as emergency diesel amperage. Operators are trained in the process of discriminating between an individual component problem versus actual sump blockage - ICM category (1);

(9) COA A9, "Develop Contingency Actions in Response to Containment Sump Blockage, Loss of Suction, and Cavitation," EOI stated that upon diagnosis of sump clogging, the EOPs direct operators to secure one CSS and HPSI train. In an October 19, 2005, response to an October 12, 2005, set of NRC comments, EOI stated that should loss of pump suction continue, operators are trained to secure the second CS pump and throttle the remaining HPSI pump to achieve maximum flow while minimizing cavitation. If adequate HPSI flow can not be maintained, then all HPSI pumps are secured and further operator actions would be directed by the TSC, which would consider injecting additional coolant into the RCS - ICM category (1);

(10) COA A10, "Early Termination of One Train of HPSI/High-Head Injection Prior to Recirculation Alignment," you stated that, given that deliberate manual securing of one HPSI train is not considered a "failure," failure of the remaining train would result in

interruption of core flow until the operator could re-start the standby HPSI pumps, which could result in significant increase in the fuel PCT and, consequently, a significant increase in radiological dose to the public. Therefore, for this reason and the greater opportunity for operator error associated with this manual operation, this COA would not be implemented at ANO-2; and

(11) COA A11, "Prevent or Delay Containment Spray for Small Break LOCAs (<1 Inch Diameter) in Ice Condenser Plants," you concluded that since ANO-2 does not have an ice condenser, this COA was not applicable.

The NRC staff has considered your Option 2 response for compensatory measures that have been or will be implemented to reduce the risk which may be associated with potentially degraded or nonconforming ECCS and CSS recirculation functions. Based on its response, the NRC staff considers EOI actions to be responsive to and meet the intent of Bulletin 2003-01. Please retain any records of your actions in response to Bulletin 2003-01, as the NRC staff may conduct subsequent inspection activities regarding this issue.

Should you have any questions, please contact me at 301-415-1436 or the lead Project Manager for this issue, Alan Wang, at 301-415-1445.

Sincerely,

/RA/

Drew G. Holland, Project Manager
Plant Licensing Branch IV
Division of Operating Reactor Licensing
Office of Nuclear Reactor Regulation

Docket Nos: 50-313, 50-368

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If adequate HPSI flow can not be maintained, then all HPSI pumps are secured and further operator actions would be directed by the TSC, which would consider injecting additional coolant into the RCS - ICM category (1);

(10) COA A10, "Early Termination of One Train of HPSI/High-Head Injection Prior to Recirculation Alignment," you stated that, given that deliberate manual securing of one HPSI train is not considered a "failure," failure of the remaining train would result in interruption of core flow until the operator could re-start the standby HPSI pumps, which could result in significant increase in the fuel PCT and, consequently, a significant increase in radiological dose to the public. Therefore, for this reason and the greater opportunity for operator error associated with this manual operation, this COA would not be implemented at ANO-2; and

(11) COA A11, "Prevent or Delay Containment Spray for Small Break LOCAs (<1 Inch Diameter) in Ice Condenser Plants," you concluded that since ANO-1 does not have an ice condenser, this COA was not applicable.

The NRC staff has considered your Option 2 response for compensatory measures that have been or will be implemented to reduce the risk which may be associated with potentially degraded or nonconforming ECCS and CSS recirculation functions. Based on EOI response, the NRC staff considers EOI actions to be responsive to and meet the intent of Bulletin 2003-01. Please retain any records of your actions in response to Bulletin 2003-01, as the NRC staff may conduct subsequent inspection activities regarding this issue.

Should you have any questions, please contact me at 301-415-1436 or the lead Project Manager for this issue, Alan Wang, at 301-415-1445.

Sincerely,
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ACCESSION NO: **ML053480199** **NRR-106** *No substantial change from SE input

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