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June 29, 2005

U.S. Nuclear Regulatory Commission
Attention: Document Control Desk
Washington, D.C. 20555

Subject: Duke Energy Corporation

McGuire Nuclear Station, Units 1 and 2
Docket Numbers 50-369 and 50-370

Catawba Nuclear Station, Units 1 and 2
Docket Numbers 50-413 and 50-414

Amendment to Allow an Additional Operator Action to Manually Start One Containment Air Return Fan in Response to NRC Bulletin 2003-01

Pursuant to 10 CFR 50.90, Duke Energy Corporation (Duke) is submitting a license amendment request (LAR) applicable to Technical Specifications Bases (TSB) Section 3.6.11, "Air Return System (ARS)," and to the Updated Final Safety Analysis Reports (UFSAR), Section 6.2, "Containment Systems," for McGuire Nuclear Station, Units 1 and 2; and Catawba Nuclear Station, Units 1 and 2. Duke proposes to implement an additional manual operator action to respond to NRC Bulletin 2003-01, "Potential Impact of Debris Blockage on Emergency Sump Recirculation at Pressurized-Water Reactors." This will allow plant operators to manually start one air return fan at a containment pressure of 1 psig prior to the automatic 9 minutes (± 1 minute) delayed start described in the UFSAR. The manual start of one air return fan in certain accident scenarios will prevent or delay reaching the initiation pressure setpoint for containment spray and reduce associated problems with sump debris buildup.

The amendments are requested because the existing NRC-approved methodology for analyzing pressure transients in containment does not include small break loss of coolant accident (SBLOCA) analysis. Thus, the change contained in this LAR is not within the plants' current licensing basis, and therefore, requires prior NRC approval.

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The existing large break LOCA containment analysis methodology, NRC-approved Topical Report DPC-NE-3004, Rev. 1, "Mass and Energy Release and Containment Response Methodology," was used by Duke to simulate the response to a SBLOCA transient. This methodology was used with minor modifications to simulate plant response to a SBLOCA transient. Since this methodology was not approved for SBLOCAs, it is necessary for Duke to request NRC approval to implement the change proposed in this LAR.

Duke is requesting that the NRC review and approve this LAR by December 31, 2005, in order to allow prompt implementation of this additional manual operator action. This will provide additional containment sump protection consistent with NRC GL 2004-02, "Potential Impact of Debris Blockage on Emergency Recirculation during Design Basis Accidents at Pressurized-Water Reactors."

Duke has determined that a 60-day implementation period would be required to complete the required operator training associated with this LAR.

In accordance with Duke administrative procedures and the Quality Assurance Program Topical Report, the proposed amendment has been previously reviewed and approved by the McGuire and Catawba Plant Operations Review Committees and by the Duke Nuclear Safety Review Board.

The contents of this LAR submittal package are as follows:

1. Attachments 1a and 1b provide marked copies of the affected TS Bases and UFSAR pages for Catawba and McGuire, respectively, showing the proposed changes.

2. Attachment 2 provides a description of the proposed changes and technical justification.

3. Pursuant to 10 CFR 50.92, Attachment 3 documents Duke's determination that the amendments contain No Significant Hazards Considerations.

4. Pursuant to 10 CFR 51.22(c)(9), Attachment 4 provides the basis for the categorical exclusion from performing an Environmental Assessment/Impact Statement.

5. Attachment 5 provides a description of the method used to evaluate the proposed changes using the Large Break Loss of Coolant Accident (LBLOCA) Analysis Methodology.

6. Attachment 6 provides a description of the effects of the amendment on post accident radiological consequences and containment sump pH.

Pursuant to 10 CFR 50.91, copies of this LAR are being sent to the appropriate officials of the State of North Carolina and the State of South Carolina.

There are no regulatory commitments contained in this letter or its attachments.

Inquiries on this matter should be directed to A. P. Jackson at (803) 831-3742.

Very truly yours,

James R. Morris

APJ/apj

Attachments

James R. Morris affirms that he is the person who subscribed his name to the foregoing statement, and that all the matters and facts set forth herein are true and correct to the best of his knowledge.

James R. Morris, Vice President, Nuclear Support

Subscribed and sworn to me: June 29, 2005
Date

Notary Public

My commission expires: 3/9/2009
Date

BETTY SHARPE GREGORY
NOTARY
My Comm. Exp.
March 09, 2009
PUBLIC
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SEAL

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**ATTACHMENT 2**

**DESCRIPTION OF PROPOSED CHANGES AND TECHNICAL JUSTIFICATION**

**DESCRIPTION OF PROPOSED CHANGES AND TECHNICAL JUSTIFICATION**

DESCRIPTION OF PROPOSED CHANGES

Duke Energy Corporation is proposing to change the Bases for TS 3.6.11, "Air Return System (ARS)," and UFSAR Section 6.2, "Containment Systems," for both McGuire Nuclear Station and Catawba Nuclear Station. The specific changes are described below.

For Catawba TS Bases 3.6.11 add the following insert at the end of the "Background" section:

> In response to NRC Bulletin 2003-01, "Potential Impact of Debris Blockage on Emergency Sump Recirculation at Pressurized Water Reactors," Catawba has the option of starting one air return fan at a containment pressure of 1 psig during certain small break LOCA (SBLOCA) transient events. This is an additional manual operator action to prevent or delay reaching the initiation pressure setpoint for containment spray and subsequent sump screen debris buildup.

In addition, for Catawba TS Bases 3.6.11 delete the following sentence in the "Background" section: "The time delay ensures that no energy released during the initial phase of a DBA will bypass the ice bed through the ARS fans." and add the following insert:

> Initially during a design basis accident LOCA or HELB, natural circulation forces steam and air flow from lower containment through the ice condenser to upper containment. Hydrogen accumulation is not a major concern, and adequate mixing of the containment atmosphere occurs. Therefore, the ARS fans are not required until approximately 10 minutes after the design basis accident. The fan start time delay allows the upper and lower containment pressure to equalize and minimize the differential pressure.

Also, for Catawba TS Bases 3.6.11 add the following insert to the "Applicable Safety Analyses Section" after the sentence: "The ARS total response time of 600 seconds includes signal delays."

> In the SBLOCA analysis performed in response to NRC Bulletin 2003-01, one ARS fan is manually placed in operation to prevent or delay the start of the Containment Spray System. This will minimize the amount

of spray water available to transport debris to the containment sump as well as delay swapover from the Refueling Water Storage Tank.

For McGuire TS Bases 3.6.11 add the following insert at the end of the "Background" section:

In response to NRC Bulletin 2003-01, "Potential Impact of Debris Blockage on Emergency Sump Recirculation at Pressurized Water Reactors," McGuire has the option of starting one air return fan at a containment pressure of 1 psig during certain small break LOCA (SBLOCA) transient events. This is an additional manual operator action to prevent or delay reaching the initiation pressure setpoint for containment spray and subsequent sump screen debris buildup.

In addition, for McGuire TS Bases 3.6.11 delete the following sentence in the "Background" section: "The time delay ensures that no energy released during the initial phase of a DBA will bypass the ice bed through the ARS fans." and add the following insert:

Initially during a design basis accident LOCA or HELB, natural circulation forces steam and air flow from lower containment through the ice condenser to upper containment. Hydrogen accumulation is not a major concern, and adequate mixing of the containment atmosphere occurs. Therefore, the ARS fans are not required until approximately 10 minutes after the design basis accident. The fan start time delay allows the upper and lower containment pressure to equalize and minimize the differential pressure.

For the McGuire TS Bases 3.6.11 add the following insert to the "Applicable Safety Analyses Section" after the sentence: "The ARS total response time of 600 seconds includes signal delays."

In the SBLOCA analysis performed in response to NRC Bulletin 2003-01, one ARS fan is manually placed in operation to prevent or delay the start of the Containment Spray System. This will minimize the amount of spray water available to transport debris to the containment sump as well as delay swapover from the Refueling Water Storage Tank.

For Catawba add the following insert under UFSAR section 6.2 at the end of the "Air Return Fans" subsection:

In response to NRC Bulletin 2003-01, "Potential Impact of Debris Blockage on Emergency Sump Recirculation at Pressurized Water Reactors," Catawba has the option of starting one air return fan at a containment pressure of 1 psig during certain small break LOCA (SBLOCA) transient events. This is an additional manual operator action to prevent or delay reaching the initiation pressure setpoint for containment spray and subsequent sump screen debris buildup.

The containment SBLOCA analysis demonstrates that operation of one air return fan between 1 and 3 psig will not result in a malfunction of the Air Return System. During a SBLOCA event, the differential pressure between upper and lower containment remains well below the isolation damper actuator and air return fan design limits. The manual start of one air return fan does not interfere with automatic operation as described above or impact the diesel generator load sequencing as described in the UFSAR section 8.3, "Onsite Power Systems."

For McGuire add the following insert under UFSAR section 6.2 at the end of the "Air Return Fans" subsection:

In response to NRC Bulletin 2003-01, "Potential Impact of Debris Blockage on Emergency Sump Recirculation at Pressurized Water Reactors," McGuire has the option of starting one air return fan at a containment pressure of 1 psig during certain small break LOCA (SBLOCA) transient events. This is an additional manual operator action to prevent or delay reaching the initiation pressure setpoint for containment spray and subsequent sump screen debris buildup.

The containment SBLOCA analysis demonstrates that operation of one air return fan between 1 and 3 psig will not result in a malfunction of the Air Return System. During a SBLOCA event, the differential pressure between upper and lower containment remains well below the isolation damper actuator and air return fan design limits. The manual start of one air return fan does not interfere with automatic operation as described above or impact the diesel generator load sequencing as described in the UFSAR section 8.3, "Onsite Power Systems."

TECHNICAL JUSTIFICATION

Background

In response to NRC Bulletin 2003-01, "Potential Impact of Debris Blockage on Emergency Sump Recirculation at Pressurized Water Reactors," Catawba and McGuire are requesting the option of starting one air return fan at a containment pressure of 1 psig during certain small break LOCA transient events. This will provide an additional manual operator action to prevent or delay reaching the initiation pressure setpoint for containment spray and subsequent sump screen debris buildup. Also, the earlier air flow through the ice condenser has the added benefit of providing additional ice melt resulting in a higher containment sump level earlier in the event.

Precedents

D.C Cook submitted an amendment request October 1, 1999 and later supplemented the request in November 19, 1999 to modify the delay to the start of the containment air recirculation/hydrogen skimmer fans. That request was granted along with other issues by the Office of Nuclear Reactor Regulation and a Safety Evaluation was issued on December 13, 1999. This amendment included a change in the automatic initiation setpoint for the fans to 1.1 psig and a new delay time of 120 $\pm$ 12 seconds. Catawba and McGuire are requesting an amendment to allow a manual actuation of one ARS fan when containment pressure is between 1 and 3 psig.

Discussion

For both McGuire and Catawba the Air Return System (ARS) is designed to assure the rapid return of air from the upper to the lower containment compartment after the initial blowdown following a Design Basis Accident (DBA). The return of this air to the lower compartment and subsequent recirculation back up through the ice condenser assists in cooling the containment atmosphere and limiting post accident pressure and temperature in containment to less than design values. Limiting pressure and temperature reduces the release of fission product radioactivity from containment to the environment in the event of a DBA.

The ARS also promotes hydrogen dilution by mixing the hydrogen with the containment atmosphere and distributing throughout the containment.

The ARS consists of two separate trains of equal capacity, each capable of meeting the design bases. Each train includes a 100% capacity air return fan, and associated motor operated damper in the fan discharge line to the containment lower compartment. The damper acts as a barrier between the upper and lower compartments to prevent reverse flow which would bypass the ice condenser. The damper is normally closed and remains closed throughout the initial blowdown following a postulated high energy line break. The damper motor is actuated several seconds after the Containment High-High pressure setpoint is reached and a start permissive from the Containment Pressure Control System (CPCS) is present. A backdraft damper is also provided at the discharge of each fan to serve as a check valve. Each train is powered from a separate Engineered Safety Feature Bus.

The ARS fans are automatically started by the containment pressure High-High signal 9 ± 1 minutes after the containment pressure reaches the pressure setpoint and a start permissive from the CPCS is present. The CPCS is provided to prevent excessive depressurization of the containment through inadvertent or excessive operation of certain engineered safety features. The time delay ensures that no energy released during the initial phase of a DBA will bypass the ice bed through the ARS fans. The ARS is an ESF system. It is designed to ensure that the heat removal capability required during the post accident period can be attained. The operation of the ARS, in conjunction with the ice bed, the Containment Spray System, and the Residual Heat Removal System, provide the required heat removal capability to limit post accident conditions to less than the

containment design values.

This LAR addresses an additional manual operator action to manually start one ARS fan early in a SBLOCA event where the containment pressure is greater than 1 psig and less than 3 psig following a reactor trip or safety injection. This manual action would only be taken if a pressurizer power operated relief valve (PORV) did not close or if the steam/feedwater lines were not intact or the reactor coolant system was not intact. Under these scenarios, it would be beneficial to start a fan early to force air and steam through the ice condenser. This would reduce the rate of containment pressure increase and prevent or delay reaching the initiation pressure setpoint for containment spray actuation and potential problems with subsequent sump debris buildup.

During the evaluation of this manual operator action to start the air return fan early, it was determined that operation of the air return fan during a small break LOCA (SBLOCA) essentially expanded the design bases of the system. In addition, no approved methodology was available to perform this SBLOCA evaluation. The evaluation was performed using the methodology described in the UFSAR for the design basis large break loss of coolant accident safety analysis.

One of the concerns created by the manual operation of the air return system involves bypassing a differential pressure switch designed to limit the torque loading on the isolation damper actuator. Bypassing the 0.5 psig differential pressure switch permissive creates a potential for the malfunction of the actuator. A second concern involves the potential of air return fan operation in an unstable region of the performance curve as shown in UFSAR Figure 6-106 (CNS) 6-109(MNS). Unstable operation of the air return fan could result from a lower and upper containment differential pressure condition created by the lack of an adequate air and steam flow path through the ice condenser intermediate deck doors and top deck curtain.

As part of the evaluation, a calculation was developed to determine the differential pressure required to lift open the intermediate deck doors. The differential pressures were determined to be less than 0.08 psid. The differential pressure necessary to open the top deck blankets would be less than 0.08 psid. Using the subject calculation and GOTHIC Code (approved methodology for design basis accident) the analysis determined that the open flow area through the ice condenser following a SBLOCA would allow air to flow into the upper

containment, thus preventing development of a lower and upper containment differential pressure condition greater than 0.5 psid and unstable air return fan operation.

The third concern created by the manual operation of the air return system involves potential on and off cycling of the air return fans within the CPCS start and terminate setpoints (0.35 and 0.90 psig, respectively). Cycling of the air return fans will be addressed procedurally by manually placing the controls in the "AUTO" position prior to the containment pressure decreasing to the CPCS terminate setpoint.

It should be noted that manual operation of the fan will not interfere with the automatic containment high-high pressure signal and fan start sequence and operation during a design basis accident. The automatic operation of the ARS would still function as described in the UFSAR if the containment high-high pressure signal is received, including load sequencing of the diesel generator. In addition, the propagation of a SBLOCA into a LBLOCA was considered to be outside the Catawba and McGuire design bases in accordance with ANSI N18.2-1973, Section 2.1.3.3.

Human performance factors were also considered in this technical justification. The methodology used in Attachment 5 evaluated the differential pressures across the divider deck following the early start of one ARS fan. This analysis assumed the manual initiation time for the fan was at 600 seconds into the transient. This was based on timing results to reach the point in the Emergency Procedure to manually start a train of ARS during small break LOCA scenarios on the CNS simulator.

If the operators reached this step at a different point in the transient, either much later or much earlier, there would be no substantial difference in the differential pressures (DPs) across the divider deck. Any intermediate deck doors which would open following the postulated pipe break, would open within seconds due to the air forced into the ice condenser from lower containment. The rate of change in mass release rate for the SBLOCA transients of interest are very slow; there would be no substantial pressure pulses at any point in the transient which would cause the DPs across the divider deck to increase.

In summary, should the operators start an ARS fan much earlier, or much later than 600 seconds into the transient, there would be no substantial increase in the DP across the divider deck than that previously evaluated. Should the

operator fail to start the ARS fan at all, there would be no detrimental impact on the transient response, other than the reduced sump inventory. It is expected that the earlier the operators could manually start the fan, the greater the sump inventory would be (due to increased ice melt) at the time of Refueling Water Storage Tank (RWST) Low Level.

The dose affects of this amendment were evaluated and are described on Attachment 6. This discussion concludes that there are no adverse dose effects from the early start of the ARS fan or from the delay of containment spray based on the current licensing basis.

As part of the amendment review process, it was determined that a sentence in the original TS bases 3.6.11 for both sites could be misleading as to the purpose of the time delay for the ARS fans: "The time delay ensures that no energy released during the initial phase of a DBA will bypass the ice bed through the ARS fans." This sentence will be replaced by a more detailed paragraph based on the Design Basis Documentation for ARS system (Insert 4).

Applicable Regulatory Criteria

This LAR is supported by analyses that show the McGuire and Catawba containment acceptance criteria will continue to be met following implementation of the proposed changes. Consequently, McGuire and Catawba will remain in compliance with the applicable regulations and requirements. These are: 10CFR50, Appendix A, General Design Criterion (GDC) 16, "Containment Design," which requires that the reactor containment and associated systems provide an essentially leak-tight barrier against the uncontrolled release of radioactivity to the environment; GDC 38, "Containment Heat Removal," which requires that a system be provided to remove heat from the reactor containment; and GDC 50, "Containment Design Basis," which requires that the reactor containment structure be designed with conservatism to accommodate applicable design parameters (pressure, temperature, leakage rate). TS 3.6.11 for the ARS satisfies Criterion 3 of 10 CFR 50.36 which is the NRC regulation that addresses the content of nuclear plant TS. This LAR is being submitted in accordance with 10 CFR 50.90.

Conclusion

Analyses were performed for various break sizes that demonstrated the differential pressure across the ARS fan isolation damper would not exceed the 0.5 psig design limit of the actuator, and that an adequate air flow path would exist for the ARS fan (see Attachment 5). Thus, after demonstrating that the fan and damper will not malfunction during early manual start, McGuire and Catawba are requesting this amendment be approved to allow this additional manual operator action to be employed at both plants.

**ATTACHMENT 3**

**NO SIGNIFICANT HAZARDS CONSIDERATION DETERMINATION**

**NO SIGNIFICANT HAZARDS CONSIDERATION DETERMINATION**

Requested Change:

Revision of TS Bases 3.6.11 and UFSAR Section 6.2 at McGuire and Catawba No Significant Hazards Determination:

The following discussion is a summary of the evaluation of the changes contained in these proposed amendments against the 10 CFR 50.92(c) requirements to demonstrate that all three standards are satisfied. A no significant hazards consideration is indicated if operation of the facility in accordance with the proposed amendments would not:

1. Involve a significant increase in the probability or consequences of an accident previously evaluated, or

2. Create the possibility of a new or different kind of accident from any accident previously evaluated, or

3. Involve a significant reduction in a margin of safety.

First Standard

Does the change involve a significant increase in the probability or consequences of an accident previously evaluated?

No.

The manual start of an Air Return System (ARS) fan will not result in a significant increase in the probability of an accident previously evaluated. The starting of an ARS fan is not considered to be an initiator of any accident or transient. This action is not taken during normal plant operation, but in response to an accident. The ARS fans do not operate to provide any normal ventilation requirement. The Containment Pressure Control System (CPCS) is provided to prevent excessive depressurization of the containment through inadvertent or excessive operation of certain engineered safety features. The CPCS prevents the inadvertent actuation of an ARS fan during normal operation.

This change is being requested in order to mitigate the consequences of a small break loss of coolant accident (SBLOCA) and help prevent or delay reaching the initiation pressure setpoint for containment spray, thereby reducing associated problems with possible sump debris buildup. SBLOCA events are bounded by the consequences of a design

basis large break LOCA as addressed in Section 15 of the McGuire and Catawba UFSARs. Accordingly, this amendment will not involve a significant increase in the consequences of an accident previously evaluated.

Second Standard

Does the change create the possibility of a new or different kind of accident from any accident previously evaluated?

No.

The change proposed in this LAR does not involve a physical alteration to the plant (i.e., no new or different type of equipment will be installed) or a change in the methods governing any normal plant operation. It does allow for the early start of one ARS fan during a SBLOCA event with containment pressure greater than 1 psig and less than 3 psig. This change will not affect or degrade the ability of the ARS to perform its specified safety functions.

Accidents of a different type are credible accidents that the proposed amendment could create that are not bounded by UFSAR evaluated accidents. This amendment allows for the manual start of an ARS fan following a SBLOCA within the containment. No new failure modes are introduced due to the manual start of an ARS fan. The circuit used to manually start an ARS fan does not interfere with the automatic signal to start an ARS fan. This change does not require any modifications to the control circuitry for the ARS. The starting of an ARS fan is not considered to be an initiator of any accident or transient. This action (starting of an ARS fan) is not taken during normal operation, but in response to an accident. Previous accidents considered incredible are not made more likely by this change. A human performance error, such as starting the ARS fan too early, too late, or not at all, would not result in a substantial difference in the calculated differential pressure across the divider deck. Since no new malfunctions of equipment with a different result are introduced, all effects of any malfunctions are bounded by those already evaluated in the UFSAR. Thus it is concluded that the change contained in this LAR will not create the possibility of a new or different kind of accident from any accident previously evaluated.

Third Standard

Does the proposed change involve a significant reduction in a margin of safety?

No.

The early manual start of an ARS fan for SBLOCA events will not reduce the ability of this system to perform its design functions to assure the rapid return of air from the upper to the lower containment compartment after the initial blowdown following a Design Basis Accident (DBA). The return of this air to the lower compartment and subsequent recirculation back up through the ice condenser assists in cooling the containment atmosphere and limiting post accident pressure and temperature in containment to less than design values. Limiting pressure and temperature also reduces the release of fission product radioactivity from containment to the environment in the event of a DBA. Therefore, there are no adverse dose effects from the early start of the ARS fan or from the delay of containment spray based on the current licensing basis.

Analyses have shown that there will be no fan or damper malfunction due to the early manual start of a fan. The other functions of the system are not affected by the change proposed in this LAR. The manual start of the ARS during a SBLOCA will help maintain the margin of safety by forcing air and steam through the ice condenser with a subsequent reduction in the rate of pressure increase in the containment, and a delay in reaching the actuation setpoint for the containment spray system. The containment spray system will continue to be initiated at the normal setpoint pressure of the system (~3 psig). Therefore, the proposed changes listed above do not involve a significant reduction in a margin of safety.

Based on the above discussion, Duke has concluded that the change contained in this LAR does not involve a significant hazards consideration.

**ATTACHMENT 4**

**ENVIRONMENTAL ASSESSMENT/IMPACT STATEMENT CONSIDERATION**

**ENVIRONMENTAL ASSESSMENT/IMPACT STATEMENT CONSIDERATION**

Pursuant to 10 CFR 51.22(b), an evaluation of this license amendment request (LAR) has been performed to determine whether or not it meets the criteria for categorical exclusion set forth in 10 CFR 51.22(c)(9) of the regulations.

In response to NRC Bulletin 2003-01, "Potential Impact of Debris Blockage on Emergency Sump Recirculation at Pressurized Water Reactors," McGuire and Catawba are requesting the option of starting one air return fan at a containment pressure of 1 psig during certain small break LOCA transient events. This will provide an additional manual operator action to prevent or delay reaching the initiation pressure setpoint for containment spray and possible sump screen debris buildup.

Implementation of this amendment will have no adverse impact upon the McGuire or Catawba units; neither will it contribute to any additional quantity or type of effluent being available for adverse environmental impact or personnel exposure.

It has been determined there is:

1. No significant hazards consideration,

2. No significant change in the types, or significant increase in the amounts, of any effluents that may be released offsite, and

3. No significant increase in individual or cumulative occupational radiation exposures involved.

Therefore, this LAR has been determined to meet the criteria of 10 CFR 51.22(c)(9) for categorical exclusion from the requirements to perform an environmental assessment/impact statement.

ATTACHMENT 5

A DESCRIPTION OF
THE METHOD USED TO EVALUATE THE PROPOSED CHANGES
USING LBLOCA ANALYSIS METHODOLOGY

A set of small break LOCA (SBLOCA) simulations were analyzed with the GOTHIC Version 4.0/DUKE (GOTHIC) containment analysis code. The goal of these simulations was to demonstrate that initiation of the containment air return fan during certain SBLOCA scenarios would not cause the fan to operate in an unstable region of the fan performance curve. (Unstable fan operation would begin at 2.4 inches of water gauge (in.WG) for McGuire (MNS), and 4.85 in.WG for Catawba (CNS), for the air densities in containment following a SBLOCA.)

The GOTHIC containment analysis code is used for these simulations. The MNS/CNS containment model described in the Duke topical report DPC-NE-3004, Revision 1, "Mass and Energy Release and Containment Response Methodology," was used as the baseline simulation model. This model was designed to simulate the containment response to the large break LOCA and Main Steam Line Break transients, and in general can be applied for SBLOCA simulations, although this application has not been presented in the topical report. Several modifications are made to adapt the existing GOTHIC model for SBLOCA phenomena. Five changes to the existing GOTHIC model were made, 1) the addition of flowpaths to model the vent curtains, 2) modeling the intermediate deck doors as a closed flowpath, 3) additional axial nodalization in the lower containment region, 4) use of representative SBLOCA mass and energy release information, and 5) consideration of lower containment ventilation. These changes are described below.

The addition of a set of junctions to model the ventilation flowpaths, or vent curtains, is necessary for simulating the SBLOCA containment response. These flowpaths are extraneous in the LBLOCA scenario, because the large forces generated during the LBLOCA blowdown phase quickly open all of the intermediate deck doors (IDDs) and top deck blankets. The vent curtain flowpaths, which are described in Section 6.2.2.11 of the McGuire UFSAR and Section 6.7.11 of the Catawba UFSAR, are parallel to these door openings, and the smaller flow areas for the vent curtain flowpaths make them insignificant in the LBLOCA simulation.

Also, the IDDs themselves are not modeled in the LBLOCA simulation model, since the blowdown forces would instantly open them. These doors may not open in SBLOCA scenarios; forces at least as great as those given in MNS/CNS Tech Spec Surveillance Requirement (S.R.) 3.6.13.7 are necessary to open the IDDs. In the GOTHIC simulation, these doors are assumed to remain closed until a differential pressure greater than that corresponding to the S.R. forces required to open the doors is demonstrated.

For the small break LOCA GOTHIC simulation, it was necessary to add an additional axial node into the lower containment region to provide a more representative calculation of the pressure differential across the lower inlet doors. With this refinement, the GOTHIC door model will accurately simulate the door behavior when the pressure differential across the lower inlet doors decreases to a very small value, or becomes slightly negative. This level of nodalization detail was not necessary to provide a reasonable containment response for the LBLOCA simulation.

Mass release rates which were typical for the various size breaks were utilized in the GOTHIC simulations. These mass release rates were estimated based on previous calculations performed with the RELAP5/MOD3.1DUKE computer code Energy releases corresponding to the energy content of Reactor Coolant System (RCS) inventory at HFP were assumed. As the RCS depressurizes, the mass release rate is assumed to slowly decrease. The exact values of the mass and energy release boundary condition are not important since a range of cases were considered to bound the SBLOCA response.

The lower containment ventilation system was also modeled. This system is not represented in the LBLOCA methodology, but to maintain containment temperatures within technical specification limits during normal operation, the lower containment ventilation system must be in operation. Therefore, this system is modeled in the SBLOCA analyses.

A spectrum of different break sizes was simulated. From the results of these analyses, the manual initiation of a single air return fan at 1 psig in containment was justified in three categories:

1) For break sizes above approximately 0.005 $ft^2$ (1 inch diameter break), the resulting differential pressure across the IDDs is in excess of that required to open the doors, per S.R. 3.6.13.7. Within the first few seconds of the transient, the release of RCS inventory into lower containment forces enough air through the lower inlet doors and into the ice condenser to generate this force against the bottom of the IDDs, forcing them open. This creates a significant flow area for air to pass through the ice condenser and into the ice condenser upper plenum, and then passing through the top deck door blankets into upper containment. At the time the air return fan is manually started, there is sufficient flow area to prevent the fan motors from experiencing a high differential pressure across the divider deck. (The divider deck $\Delta P$ remains well below 2.4 in WG for MNS, and 4.85 in WG for CNS.)

2) For break sizes below approximately 0.0025 $ft^2$ (1/2 inch diameter break), the resulting differential pressure across the IDDs is never high enough to open them. However, this break size is so small that 1 psig in containment is never reached. Therefore, the manual start of an air return fan will never be initiated.

3) For break sizes between 0.005 ft2 and 0.0025 $ft^2$, it is possible that the differential pressure across the IDDs will never be high enough to open any of the doors, or would only be enough to cause one or more of the IDDs to open and possibly re-close intermittently. This would not provide a continual, open flow area for air to pass all the way through the ice condenser. However, the vent curtain flowpaths (discussed above) are present, and by design these flowpaths allow for the movement of air around the IDDs during momentary periods of pressure imbalance. For break sizes in this range, the air being moved by manual operation of a air return fan would pass through these vent curtain flowpaths (in addition to the existing, smaller leakage area across the divider deck) and return to upper containment. The GOTHIC analyses showed that with a constant air return fan flow and with the fan manually started at the earliest expected point in the transient, the resulting divider deck differential pressure remains below that which would cause the air return fans to be in a region of unstable operation. The calculated differential pressure for the limiting GOTHIC cases was about 25% below the shutoff head for the MNS air return fans, and about 55% below the point of unstable operation for the CNS air return fans.

Sensitivity calculations to assess the impact of changes to the containment initial conditions (which included pressure, temperature, and relative humidity), RCS depressurization rates, lower containment ventilation cooling capacities (including a complete loss in containment ventilation), and lower ice condenser inlet door behavior were performed. It was determined that none of these factors resulted in a substantial impact on the calculated divider deck differential pressures.

Also, sensitivity calculations to assess the impact of variations in the vent curtain resistance on the divider deck differential pressure were performed. These sensitivities determined that the analysis conclusions are not altered by a reasonable variation in the flow path resistance.

In summary, the results of the containment simulations demonstrate that following a SBLOCA in which one air return fan was started at 1 psig, the fan would continue to operate within the stable regions of the fan's performance curve. The

analysis for this event also showed that the maximum peak differential pressure between lower and upper containment was below the design basis differential pressure for the affected containment air return system dampers.

# ATTACHMENT 6

# A DESCRIPTION OF THE EFFECTS OF THE AMENDMENT ON POST ACCIDENT RADIOLOGICAL CONSEQUENCES AND CONTAINMENT SUMP PH

EFFECT OF THE AMENDMENT ON POST LOCA RADIATION DOSES

The ARS fans are provided to force recirculation of air between the upper and lower compartments of the containment following an accident with mass-energy releases to containment, ensuring the flow of air and steam through the ice condenser. The ice condenser is designed to condense steam following an accident, maintaining reduced post accident pressure in containment. The limiting of the design basis accidents for the ARS fans is the design basis (DB) LOCA.

Flow between the lower and upper compartments and through the ice condenser forced by the ARS fans is simulated in the analysis of radiological consequences of a LOCA. Activation of the ARS fans on a hi-hi containment pressure (Sp) signal and with a 10 minute delay is simulated. In the analyses in the current licensing basis (CLB), credit is taken for the ice condenser to remove diatomic (elemental) iodine from the airflow through the ice condenser. This credit does not begin until simulated start of the ARS fans. Therefore, simulating earlier start of an ARS fan using the methods in the CLB will yield lower simulated releases of radioactivity and lower radiation doses at offsite locations and to the control room operators.

The activation of the ARS fans is the same for both McGuire and Catawba: 9 minutes +/- 1 minute following the Sp signal. The simulation of the ARS fans activation and operation is the same in the calculations of radiation doses following a DB LOCA at McGuire and Catawba. That is, in the analyses in the current licensing bases for both plants, credit is taken for cleanup of diatomic iodine from the flow stream of the ice condenser beginning with the activation of the ARS fans (10 minutes after event initiation) and ending with meltout of the first ice bed. Simulated early start of an ARS fan would only increase the effect of the ice condenser and therefore yield lower values of radiation doses.

Another containment safeguard for which credit is taken in the analyses of radiological consequences of a design basis (DB) loss of coolant accident (LOCA) at Catawba and McGuire is the Containment Spray System (CSS). Credit is taken for washout of fission products (excluding noble gases) from the upper compartment atmosphere by the CSS with design basis values calculated or otherwise taken for the following parameters:

- Washout time constant
- Decontamination factors
- CSS start time.

The values taken in the current licensing basis for CSS washout time constants and decontamination factors are not affected by the proposed early start of an ARS fan. Limiting design basis values are taken for these parameters and therefore would not be affected. This leaves the potential for effect of an early ARS fan start on the assumed CSS start time. This is evaluated for a DB LBLOCA and a SBLOCA.

Radiation Doses Following a LBLOCA

The early manual start of an ARS fan will not occur for a LB LOCA due to the immediate initiation of the hi-hi containment pressure signal. Accordingly, the start time assumed in the containment analyses was not adjusted given the proposed early start of an ARS fan. The assumed start time of an ARS fan would have no impact therefore on the CLB calculations of radiation doses for the DB LOCA at Catawba and McGuire.

Radiation Doses Following a SBLOCA

No analyses of radiological consequences of a SB LOCA is included as part of the CLB for either Catawba or McGuire (i.e., none is reported in UFSAR 15.6.5.3 for either site). However, radiological consequences of the DB rod ejection accident (REA) at McGuire and Catawba are analyzed as a SB LOCA. In particular, no credit is taken for the CSS in the CLB analysis of radiological consequences of the DB REA for either Catawba or McGuire. Therefore, an early ARS fan start has no affect on the radiological consequences of the DB REA as analyzed for the Catawba and McGuire CLB.

EFFECT ON CONTAINMENT SUMP PH FOLLOWING A DESIGN BASIS LOCA

Calculations of containment sump pH have been performed for both Catawba and McGuire Nuclear Stations. For both stations, the calculations show that the containment sump pH following a design basis LOCA remains within the CLB upper and lower limits at all times.

Separate calculations are performed to obtain lower bound and upper bound values for the post LOCA containment sump pH.

The calculations of lower bound values for containment sump pH following a design basis LOCA simulate the accumulation of boric acid (from the Reactor Coolant System - RCS, Refueling Water Storage Tank - RWST, and cold leg accumulators) and sodium tetraborate (from the ice condenser) in the containment sump. In particular, the inventory of sodium tetraborate in

the ice condenser is the one source of alkaline material taken into account in these calculations. It accumulates in the containment sump with ice melt.

Discussion

A single upper bound value for post LOCA containment sump pH is calculated assuming that the containment sump contains only ice melt. This calculation yields an upper bound value that does not exceed the upper limit in the CLB.

Ice melt is facilitated by the ARS fans. Earlier start of the ARS fans would accelerate ice melt. This yields higher values of transient containment sump pH, thereby providing additional margin to the lower CLB limit. Equilibrium value of post LOCA containment sump pH is determined by the inventories and boron concentrations in the RCS, cold leg accumulators, RWST, and ice condenser. As such, it is not affected by early start of the ARS fans.

Evaluation

It has been noted that early ARS fan start would not occur for the design basis LOCA. As noted above, the CLB calculations of containment sump pH are based on the design basis LOCA. As such, they are not affected by the proposed early start of the ARS fans.