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Duke Power
A Duke Energy Company

December 7, 2004

U.S. Nuclear Regulatory Commission
Washington, D.C. 20555-0001

ATTENTION: Document Control Desk

Subject: Duke Energy Corporation

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

License Amendment Request for Technical Specification 3.6.14, CONTAINMENT SYSTEMS, Divider Barrier Integrity - Response to Request for Additional Information

In a previous letter[1] to the NRC, Duke Energy Corporation (Duke) submitted a license amendment request (LAR) for the McGuire Nuclear Station Facility Operating Licenses and Technical Specifications (TS). This LAR proposed changes to TS 3.6.14 to allow a pressurizer hatch to be open for up to 6 hours, an increase from the present 1-hour allowance. In a letter[2] to Duke, the NRC sent a Request for Additional Information (RAI) on this LAR. Duke subsequently responded to the NRC's RAI.[3] Based on further discussion with the NRC Project Manager for McGuire, this letter provides additional information on this matter. Attachment 1 to this letter provides additional information on Questions 1, 2, and 3

[1] Letter, D. M. Jamil, Duke Energy Corporation, to the U. S. Nuclear Regulatory Commission, ATTENTION: Document Control Desk, SUBJECT: McGuire Nuclear Station. License Amendment Request for Technical Specification 3.6.14, Containment Systems, Divider Barrier Integrity, Dated June 3, 2003.

[2] Letter, J. J. Shea, U. S. Nuclear Regulatory Commission, to G. R. Peterson, Duke Energy Corporation, SUBJECT: McGuire Nuclear Station. License Amendment Request for Technical Specification 3.6.14, Containment Systems, Divider Barrier Integrity, Request for Additional Information, Dated July 2, 2004.

[3] Letter, H. B. Barron, Duke Energy Corporation, to the U. S. Nuclear Regulatory Commission, ATTENTION: Document Control Desk, SUBJECT: McGuire Nuclear Station. License Amendment Request for Technical Specification 3.6.14, Containment Systems, Divider Barrier Integrity – Response to Request for Additional Information, Dated July 29, 2004.

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that were contained in the NRC's July 2, 2004 RAI. Attachment 1 contains a restatement of these NRC questions followed by the additional Duke response.

Inquiries on this matter should be directed to J. S. Warren at (704) 875-5171.

Very truly yours,

G. R. Peterson

xc w/Attachments:

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G. R. Peterson, 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.

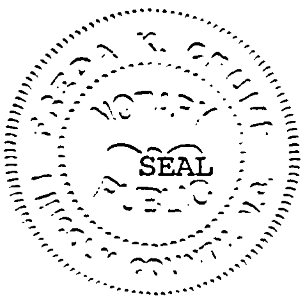
G. R. Peterson

G. R. Peterson, Site Vice President

Subscribed and sworn to me: December 7, 2004
Date

Freda K. Crump, Notary Public

My commission expires: August 17, 2006
Date



Attachment 1

Duke Energy Corporation
McGuire Nuclear Station, Units 1 and 2

Additional Information for NRC Request for Additional Information on a License Amendment Request for Technical Specification 3.6.14, Containment Divider Barrier Integrity

BACKGROUND

Attachment 1 provides additional information in response to an NRC Request for Additional Information dated July 2, 2004. Duke initially responded to this RAI by letter dated July 29, 2004. Additional information is provided on NRC Questions 1, 2, and 3. The following additional information supplements the information provided in Duke's initial response. Each of the NRC questions is stated, followed by the additional information.

ADDITIONAL INFORMATION

Question 1:

Attachment 3 to the submittal, dated June 3, 2003, states the following:

A McGuire engineering calculation was performed to ensure that the drop of the largest pressurizer hatch plug on the pressurizer enclosure roof or operating floor, and a drop of the polar crane load block on to the operating floor would not damage any equipment, component, or systems necessary for safe shutdown. … Based on this calculation, the operating floor and the pressurizer enclosure roof can withstand a drop of the largest pressurizer enclosure hatch plug or the polar crane load block. Subsequently the heavy load drop analysis was revised to ensure the calculation enveloped the case of the largest pressurizer hatch plug dropping back into the hole.

a. Describe the assumptions and methodology used in the above revised calculation for the NRC staff's review.

b. Explain how the load drop analysis conforms to the NUREG-0612, Appendix A guidelines for analysis of postulated load drops. Specifically, address NUREG-0612, Appendix A, Section 1, Items 1, 3, 6, and 7.

c. NUREG-0612, Appendix A, Section 2, Item 1 recommends that the impact loads should include the load, the crane load block, and other lifting apparatus. However, your analysis involves dropping of the largest pressurizer hatch plug and the polar crane load block *separately* on structures. Explain how you determine consequences of a postulated load drop involving a drop of the load, the crane load block, and other lifting apparatus *together* on structures.

Question 1a - Additional Information:

Methodology

The methodology in qualifying the dropping of the pressurizer hatch and auxiliary hook on the top of the pressurizer enclosure is discussed below.

Drop Pressurizer Hatch Back into the Hatch Opening

It can be shown that the pressurizer hatch will not fall into the pressurizer cavity by simply showing that the energy available from dropping the hatch from the height allowed in the lift procedure is insufficient to shear the rebar and other steel rods embedded in the concrete. In other words, the energy required to shear off the ledge or lip of the hatch is larger than the energy available from a drop of the hatch.

Drop Auxiliary Hook on the Pressurizer Hatch

The pressurizer hatch plug falls into the hatch opening and then the auxiliary hook falls on top of the center of the hatch. Thus the impacts occur in series and not at the same time, i.e., there are two individual impacts since it is impossible for both the hatch and the hook to impact the top of the pressurizer enclosure at the same time from a single failure of the lift rig above the hook. The analysis is accomplished as follows:

- Determine the velocity of the auxiliary hook at impact on the pressurizer enclosure.

- Determine penetration of the auxiliary hook into the hatch.
- Determine the force of the auxiliary hook impacting the pressurizer hatch.
- Perform analysis of the hatch for impact loads and determine acceptability of the hatch stresses (showing acceptability of the impact load).

Note that the consideration of the auxiliary hook falling on the hatch plug is outside the criteria for NUREG-0612, since the auxiliary hook weighs less than 1500 pounds.

Assumptions

- Conservatively assume that the rebar and rods alone absorb the drop energy of the hatch. This is conservative since:
  - 20 Nelson studs exist that were neglected.
  - Other rebar exists that was neglected.
  - The energy absorbing capacity of shearing the concrete was neglected.
  - The energy absorbing capacity of the metal frames was neglected.
  - All rebar and rods were conservatively assumed to fail when displaced only ¼".
  - Only half of the yield stress was used in the analysis when a more appropriate value is the flow stress.
  - The bars would not simply shear off- they would deform, bend, and absorb a tremendous amount of energy as they transitioned to axial tension.
  - The enhanced material properties due to high strain rates were neglected.

- The edge of the pressurizer hatch over the concrete wall is assumed to carry only ¼ of the total load. This is conservative since it actually will tend to carry more load since load follows stiffness.

- The mass of the hatch over the pressurizer enclosure ledge was included in the analysis evaluating the shearing of the hatch lid, when in reality only the mass over the opening contributes to the shearing of the hatch ledge.

- The polar crane auxiliary hook is at its highest position prior to the postulated load drop. This is the most conservative position for the hook in a drop analysis.

- The pressurizer hatch plug falls into the hatch opening and then the auxiliary hook falls on top of the center of the hatch. The impacts occur in series and not at the same time, i.e., there are two individual impacts since it is impossible for both the hatch and the hook to impact the top of the pressurizer enclosure at the same time from a single failure of the lift rig above the hook. It is conservative to assume the auxiliary hook impacts the center of the hatch plug (maximizes bending stresses in the hatch plug).

- The rigging is made up of slings with no below the hook lifting devices, therefore there are no additional significant masses that can impact the top of the pressurizer enclosure.

- The frontal impact area of the auxiliary hook is assumed to be 0.10 ft^2.

- This analysis assumes the hatch plug is undamaged when it drops back into the hatch opening. This is based upon the gross conservatism in the analysis.

Question 1b - Additional Information

Based on NUREG-0612, Appendix A, analysis of postulated load drops should as a minimum include the considerations listed below. Other considerations may be appropriate for the particular load drop being analyzed; for example, for a reactor vessel head assembly or a spent fuel cask drop analysis, the additional considerations listed in Sections A-2 or A-3 should be used. In evaluating the potential for a load to result in criticality, the considerations of A-4 should also be followed. The following should be considered for any load drop analysis, as appropriate:

Attachment 1

1. That the load is dropped in an orientation that causes the most severe consequences;

   The hatch plug is assumed to be oriented in the same position as it was while in place and then drop directly back in the hole. The position of the hatch plug and its height above the top of the pressurizer enclosure is controlled by procedure. The worst case fall for the hatch plug is for it to precisely drop back into the opening where the impact forces are maximized and the concrete ledge is the weakest. If the hatch plug were not oriented in this position, it would not fit back into the opening without wedging in the opening, which would not be the worst case scenario. The following bullets explain how the worst case drop orientation was determined:

   - If only one sling breaks, the hatch will not fall back into the hole due to the presence of the second sling. The hatch center of gravity drops about 1 foot and the available energy is reduced to approximately 1/3 of the original potential energy. The consumed energy from the 1 foot drop is converted to kinetic energy in the form of rotation of the hatch. This is based upon the assumption that the hatch does not impact the enclosure. If the hatch impacts the enclosure, the small energy released will be dispersed on the strongest part of the pressurizer enclosure, thus the damage will be minor. This also assumes that the hatch does not rotate more than approximately 3° about the other horizontal axis. If the hatch rotates more than the above stated angles, the hatch will not fit into the enclosure opening and will wedge in the top of the opening- once again dispersing the energy and causing only minor damage.

   - If both slings break (incredible) the hatch will fall back into the enclosure opening only if it does not rotate more than approximately 3° about any axis. If the rotation exceeds the above angles, the hatch can not possibly fit back into the enclosure opening and will wedge in the top of the opening thus causing only minor damage. This incredible scenario is the scenario that is used in the formal calculation. This scenario also produces the largest energy release from dropping the hatch.

- If one sling breaks and the hatch manages to rotate 90° (also requires less than approximately 3° rotation about the other horizontal axis) about one horizontal axis and then the second sling breaks, the hatch could potentially fit into the enclosure opening. The maximum drop before the edge of the hatch makes contact with the enclosure is 1 foot. This comprises about $^1/_3$ of the energy from a full 3 foot drop as assumed in the formal calculation. A significant amount of the energy from this drop scenario would be converted to rotational energy and would not be available as kinetic energy from vertical velocity. In this scenario, the hatch would contact only 2 edges of the enclosure, but the available energy is only $^1/_3$, at best, of the energy used in the formal calculation.

- If the hatch plug rotated such that one of its corners was oriented vertically downward and dropped into the opening, it would not pass through the opening. The hatch would be arrested with its center of gravity about 1 foot above the top of the enclosure. This is slightly over 1 foot below the maximum height of the center of gravity during the lift. The energy from a drop only slightly over 1 foot is significantly less than that considered in the formal calculation. The hatch would make contact with the top ledge of the enclosure opening and would not cause any significant damage to the hatch or the enclosure.

<u>Conclusion</u>

The scenario analyzed in the formal pressurizer hatch drop analysis is the most conservative drop scenario.

The auxiliary hook was also assumed to fall on top of the pressurizer hatch plug. The rigging between the auxiliary hook and the hatch plug consists of flexible slings, therefore the failure of the lift devise such that both the auxiliary hook and the pressurizer hatch plug both fall on the pressurizer enclosure roof would be two separate events. The pressurizer hatch plug would fall into the opening and then the auxiliary hook would fall on top of the hatch plug.

Note that the consideration of the auxiliary hook falling on the hatch plug is outside the criteria for NUREG-0612, since the auxiliary hook weighs less than 1500 pounds.

The NRC also expressed a concern in regard to a "run away lift" while lifting the pressurizer hatch plug. Duke interprets "run away lift" as any unexpected movement of the crane. The Duke response to NUREG-0612 is based on Phase-1 requirements where defense in depth is applied. Credit is taken for the crane preventative maintenance program, controlling procedures, and operator training to respond to any unplanned movement of the crane. In the case of the pressurizer hatch plug, or any lift made with the polar crane/auxiliary hoist, the operator can stop unexpected movement by several means. The operator can reverse the controls, hit the emergency stop button, or release the "dead man" foot switch. Lastly, credit is taken for the upper lift limits on the hoist which would stop upward movement to prevent "two blocking."

2. That fuel impacted is 100 hours subcritical (or whatever the minimum that is allowed in facility technical specifications prior to fuel handling);

   N/A for the pressurizer hatch plug removal.

3. That the load may be dropped at any location in the crane travel area where movement is not restricted by mechanical stops or electrical interlocks;

   The hatch plug is lifted up directly above the opening and immediately moved laterally a few feet toward the crane wall where it is lowered to the top of the pressurizer enclosure. The lift and load path are controlled by procedure. Therefore, a drop back into the opening is the worst case.

4. That credit may not be taken for spent fuel pool area charcoal filters if hatches, wall, or roof sections are removed during the handling of the heavy load being analyzed, or whenever the building negative pressure rises above (-) 1/8 inch (-3 m) water gauge;

   N/A for the pressurizer hatch plug removal.

5. Analysis that relies on results of Table 2.1-1 or Figures 2.1-1 or 2.1-2 for potential offsite doses or safe decay times should verify that the assumptions of Table 2.1-1 are conservative for the facility under review. X/Q values should be derived from analysis of on-site meteorological measurements based on 5% worst meteorological conditions;

   N/A for the pressurizer hatch plug removal.

6. Analysis should be based on an elastic-plastic curve that represents a true stress-strain relationship.

   The pressurizer hatch plug drop analysis conservatively ignored the elastic energy absorption abilities of the materials. Only plastic energy was credited in the analysis.

   Note that the consideration of the auxiliary hook falling on the hatch plug is outside the criteria for NUREG-0612, since the auxiliary hook weighs less than 1500 pounds.

7. The analysis should postulate the "maximum damage" that could result, i.e., the analysis should consider that all energy is absorbed by the structure and/or equipment that is impacted.

   The analysis of the pressurizer hatch plug drop assumed all of the energy from the falling hatch plug is absorbed by the pressurizer enclosure opening ledge and the hatch plug ledge independently.

   Note that the consideration of the auxiliary hook falling on the hatch plug is outside the criteria for NUREG-0612 since the auxiliary hook weighs less than 1500 pounds.

8. Loads need not be analyzed if their load paths and consequences are scoped by the analysis of some other load.

   N/A for the pressurizer hatch plug removal since no other loads are moved over the pressurizer enclosure.

9. To overcome water leakage due to damage from a load drop, credit may be taken from borated water makeup of adequate concentration that is required to be available by the Technical Specifications.

   N/A for the pressurizer hatch plug removal.

10. Credit may not be taken for equipment to operate that may mitigate the effects of the load drop if the equipment is not required to be operable by the Technical Specifications when the load could be dropped.

    N/A for the pressurizer hatch plug removal.

Question 1c - Additional Information:

Although dropping the pressurizer hatch plug back into the opening is highly unlikely, it is the worst case scenario for maximizing the potential energy of the hatch plug by maximizing the height of the center of gravity of the hatch plug. The hatch plug is assumed to remain horizontal above the opening thus allowing it to fall its maximum height before it impacts the pressurizer hatch plug ledge or the pressurizer opening ledge. If the pressurizer hatch plug was in any orientation other than horizontal (aligned so that it can fit exactly back into the opening) it could not free fall back into the pressurizer opening without first striking the top of the pressurizer enclosure, thus restricting the kinetic energy.

The slings are not likely to break, however they are conservatively assumed to fail and allow the pressurizer hatch plug to fall.

The maximum lift height of the pressurizer hatch plug above the pressurizer enclosure roof is restricted to 1 foot per procedure. This limits the maximum drop distance to 3′-2″.

The pressurizer hatch plug and/or opening may suffer minor damage such as concrete spalling or chipping, since it probably will not fall directly back into the pressurizer enclosure opening. This damage is not expected to create a sealing problem since a new gasket and anchor bolt are required to be available to replace the existing gasket and one bolt if they are damaged when the pressurizer hatch plug is removed. If the pressurizer hatch plug falls directly back into the pressurizer enclosure opening, the damage to the hatch ledges or pressurizer enclosure ledges is expected to be minimal since the drop analysis employed so many conservative assumptions.

Question 2:

Explain how you satisfy the following of NUREG-0612: (1) general guidelines in Section 5.1.1 and (2) guidelines on minimizing the possibility of failing safe shutdown equipment as a result of a load drop in Section 5.1.5.

Question 2 - Additional Information:

The safe load path is controlled by procedures to minimize the lift height and travel path. The pressurizer hatch plug is only allowed to be above the pressurizer enclosure. The hatch plug is lifted directly above the opening a maximum of 1 foot and immediately moved laterally a few feet toward the crane wall where it is lowered to the top of the pressurizer enclosure. The weakest part of the pressurizer enclosure is the hatch opening where the drop is assumed to occur.

Question 3:

You have stated it may be necessary to enter the pressurizer cavity to perform inspections and maintenance requiring the hatch to be opened longer than one hour during plant operation. Provide details on situations that would require the hatch to be opened for up to six hours as proposed in this amendment.

Attachment 1

Question 3 - Additional Information:

Duke's July 29, 2004, response[1] to Question 3 provided several examples of situations that would require the pressurizer hatch to be opened for up to six hours during plant operation (for the purposes of this RAI response, MODES 1 through 4, which is the applicability of TS 3.6.14). Initially, the handling of heavy loads was not performed at McGuire during MODES 1 through 4. As part of McGuire's response to an NRC generic letter dated December 22, 1980, and NUREG-0612, Duke provided a letter[2] to the NRC dated July 26, 1982. This letter stated that during MODES 1 through 4, miscellaneous hoists are used for minor repair work or for obtaining cold shutdown, but do not handle heavy loads. Further, operation of the polar crane was restricted as specified by a station directive. The restriction was that the polar crane should not be operated over the steam generator compartments. Based on this information, it was concluded that a heavy load drop could not occur, thus precluding the need to investigate further the heavy load handling systems or operation during MODES 1 through 4, including the pressurizer roof area. This information was also reflected in the NRC SER[3] for control of heavy loads at McGuire. In 1982, the use of the polar crane to move heavy loads in containment during MODES 1 through 4 was not anticipated. The regulatory provisions, criteria and guidelines for the handling and control of heavy loads do not actually prohibit heavy load lifts in containment during power operations. As noted in NUREG-0612, Section 5.1.3, specific criteria for load handling operations in the reactor building are described. For the movement of heavy loads within the containment, one of the following three criteria needs to be satisfied: 1) use of a single failure proof crane, or 2) rapid containment isclation, or 3) heavy load drop analysis is

[1] Letter, H. B. Barron, Jr., Duke Energy Corporation to U. S. Nuclear Regulatory Commission, ATTENTION: Document Control Desk, SUBJECT: McGuire Nuclear Station, Units 1 and 2, Docket Nos. 50-369, 50-370, License Amendment Request for Technical Specification 3.6.14, CONTAINMENT SYSTEMS, Divider Barrier Integrity – Response to Request for Additional Information, Dated July 29, 2004.

[2] Letter, W. O. Parker, Jr., Duke Power Company, to U. S. Nuclear Regulatory Commission, ATTENTION: E. G. Adensam, SUBJECT: McGuire Nuclear Station, Docket Nos. 50-369, 50-370, Control of Heavy Loads, NUREG-0612, Dated July 26, 1982.

[3] Letter, Thomas. M. Novak, U. S, Nuclear Regulatory Commission, to H. B. Tucker, Duke Power Company, SUBJECT: Control of Heavy Loads, Dated March 12, 1985.

performed. Subsequent to its initial response to the December 22, 1980 generic letter and NUREG-0612, Duke performed analyses to reevaluate the acceptability of McGuire handling heavy loads during MODES 1 through 4. This reevaluation was conducted under the 10 CFR 50.59 process. No unreviewed safety question concerns were identified. This conclusion was communicated[4,5] to the NRC under the reporting requirements of 10 CFR 50.59 and station procedures were revised accordingly. NRC Bulletin 96-02, "Movement of Heavy Loads Over Spent Fuel, Over Fuel in the Reactor Core, or Over Safety-Related Equipment," requested further action from licensees in regard to the handling of heavy loads. The Duke response[6] to Bulletin 96-02 reiterated that since McGuire originally responded to NUREG-0612, it had been determined that the polar cranes are required for some at-power activities, including lifts associated with removing the pressurizer enclosure hatch plugs. Again, this information was also reflected in the subsequent NRC SER[7] for McGuire's Bulletin 96-02 response. Presently, current McGuire station procedures permit the handling of heavy loads during plant operation.

[4]Letter, T. C. McMeekin, Duke Power Company, to U. S. Nuclear Regulatory Commission, ATTENTION: Document Control Desk, SUBJECT: McGuire Nuclear Station, Docket Nos. 50-369, 50-370, Dated October 20, 1994.

[5] Letter, H. B. Barron, Duke Energy Corporation, to U. S. Nuclear Regulatory Commission, ATTENTION: Document Control Desk, SUBJECT: McGuire Nuclear Station, Docket Nos. 50-369, 50-370, Dated November 15, 2000.

[6] Letter, M. S. Tuckman, Duke Energy Corporation, to U. S. Nuclear Regulatory Commission, ATTENTION: Document Control Desk, SUBJECT: McGuire Nuclear Station, Units 1 & 2, Docket Nos. 50-369, 50-370; Catawba Nuclear Station, Units 1 & 2, Docket Nos. 50-413, 50-414; Oconee Nuclear Station, Units 1, 2, & 3, Docket Nos. 50-269, 50-270, 50-287; Response to NRC Bulletin 96-02, Movement of Heavy Loads Over Spent Fuel, Over Fuel in the Reactor Core, or Over Safety-Related Equipment, Dated May 13, 1996.

[7]Letter, Frank Rinaldi, U. S. Nuclear Regulatory Commission, to M. S. Tuckman, Duke Energy Corporation, SUBJECT: Completion of Licensing Action for NRC Bulletin 96-02, "Movement of Heavy Loads Over Spent Fuel, Over Fuel in the Reactor Core, or Over Safety-Related Equipment," Dated April 11, 1996, for McGuire Nuclear Station, Units 1 and 2 (TAC Nos. M95605 and M95606) and Catawba Nuclear Station, Units 1 and 2 (TAC Nos. M95569 and M95570), Dated May 1, 1998.