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10 CFR 50.90

September 3, 2019
Serial: RA-19-0316

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

Shearon Harris Nuclear Power Plant, Unit 1
Docket No. 50-400/Renewed License No. NPF-63

Subject: Response to Request for Additional Information Regarding License Amendment Request for Extension of the Essential Services Chilled Water System Allowed Outage Time and Removal of an Expired Note from Technical Specifications

Ladies and Gentlemen:

By letter dated February 18, 2019 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML19049A027), Duke Energy Progress, LLC (Duke Energy), submitted a license amendment request (LAR) for Shearon Harris Nuclear Power Plant, Unit 1 (HNP). The proposed license amendment would modify the HNP Technical Specifications to permit one train of the Essential Services Chilled Water System to be inoperable for up to 7 days, an increase from the current 72 hours allowed outage time. In addition, the amendment would remove an expired note previously added to the Technical Specifications by implementation of License Amendment No. 153.

The U.S. Nuclear Regulatory Commission (NRC) staff reviewed the LAR and determined that additional information is needed to complete their review. Duke Energy received the request for additional information (RAI) from the NRC through electronic mail on July 23, 2019 (ADAMS Accession No. ML19204A268). Response to this request is required by September 3, 2019.

Attachment 1 provides Duke Energy's response to the RAI questions. The information contained within this response does not change the No Significant Hazards Consideration provided in the original submittal.

No regulatory commitments are contained in this letter.

In accordance with 10 CFR 50.91(b), HNP is providing the state of North Carolina with a copy of this response.

Should you have any questions regarding this submittal, or require additional information, please contact Art Zaremba, Manager – Nuclear Fleet Licensing, at (980) 373-2062.

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

Executed on September 3, 2019.

Sincerely,

Tanya M. Hamilton

Tanya M. Hamilton

Attachment:

1. Response to Request for Additional Information

cc: J. Zeiler, NRC Senior Resident Inspector, HNP
W. L. Cox, III, Section Chief N.C. DHSR
M. Barillas, NRC Project Manager, HNP
L. Dudes, NRC Regional Administrator, Region II

RA-19-0316

ATTACHMENT 1

RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION

SHEARON HARRIS NUCLEAR POWER PLANT, UNIT 1

DOCKET NO. 50-400

RENEWED LICENSE NO. NPF-63

(15 pages including cover)

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**RAI 01 – PRA Model Update**

Section 3.3 of Regulatory Guide (RG) 1.200, Revision 2 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML090410014), provides guidance on the technical acceptability of Probabilistic Risk Assessment (PRA) to support an application and one of the aspects is the assurance that the pieces of the PRA used in the application have been performed in a technically correct manner. In addition, RG 1.200, Revision 2, states that the PRA model required to support the application is expected to represent the as-designed or as-built and as-operated plant, which, in turn, implies that the PRA model is up to date and reflects the current design and operating practice, where appropriate.

The licensee stated in Section A.2.1 of Attachment 5 to the license amendment request (LAR) that the internal events PRA model was updated in 2017 and 2018. The internal fire and high winds PRAs use the internal events PRA as the base. The licensee's discussion of the Shearon Harris Nuclear Power Plant (HNP) internal fire and high winds PRAs does not provide information regarding the consistency of their development and update with the internal events PRA model updates. Therefore, the NRC staff is unclear whether the HNP internal fire and high winds PRAs incorporate the 2017 and 2018 updates performed for the internal events PRA.

a. Clarify if the internal fire and high winds PRAs supporting this application incorporate all the 2017 and 2018 updates to the internal events PRA.

b. If the internal fire and high winds PRAs supporting this application do not incorporate all the 2017 and 2018 internal events PRA updates, either justify the exclusion of updates in the context of this application or incorporate the updates, as applicable, into the internal fire and high winds PRAs supporting this application and provide the updated results (i.e., results in Table A.5.8 of Attachment 5 to the LAR).

**Duke Energy Response to RAI 01**

INTERNAL FIRE:

a. The internal fire PRA supporting this application does not incorporate all the 2017 and 2018 updates to the internal events PRA.

b. The 2017 and 2018 internal events PRA updates were assessed (Reference A.1) and the updates applicable to the internal fire PRA were incorporated into the latest internal fire PRA model documented in Reference A.2. The incorporation of the updates resulted in a reduced delta-risk during the assessed AOT compared to the initial submittal (see Table 1 below). Therefore, the initial assessment without the 2017 and 2018 internal events updates incorporated bounds the risk impact with the updates incorporated, and the updates can be excluded for consideration in the context of this application.

Table 1
Comparison of Initial AOT Risk to AOT Risk with Internal Events PRA Updates Incorporated

| Model | Initial Delta /yr | New Delta /yr |
|---|---|---|
| CDF | 8.18E-07 | 5.15E-07 |
| LERF | 1.37E-08 | 8.76E-09 |
| Note: Initial and new risk deltas obtained from References A.6 and A.1, respectively. | | |

HIGH WINDS:

a. The high winds PRA supporting this application does not incorporate all the 2017 and 2018 updates to the internal events PRA.

b. High winds are not considered a significant hazard for HNP and have been screened as a negligible contributor for HNP as discussed below, in lieu of providing updated results that incorporate the 2017 and 2018 internal events PRA updates.

   The high wind treatment is divided into three distinct categories, as follows:

   - Hurricanes
   - Straight-Line Winds
   - Tornadoes

   The end goal for high winds treatment for the application is to screen the hazard in accordance with Section 6-2 of the ASME/ANS RA-Sa 2009 PRA standard (Reference A.3). Specifically, Section 6-2.3 states the following:

*An event can be screened out either*

*(a) If it meets the criteria in the NRC's 1975 Standard Review Plan (SRP) or a later revision; or*

*(b) If it can be shown using a demonstrably conservative analysis that the mean value of the frequency of the design-basis hazard used in the plant design is less than ~$10^{-5}$/yr and that the conditional core damage probability is <$10^{-1}$, given the occurrence of the design-basis hazard event; or*

*(c) If it can be shown using a demonstrably conservative analysis that the CDF is <$10^{-6}$ /yr.*

The following sections provide justification for screening high winds from inclusion in the ESCWS AOT LAR in accordance with the criteria above.

<u>HURRICANES</u>

The ESCWS AOT is proposed to be applied to at-power operations and not for shutdown conditions. Additionally, the site procedure for response to severe weather directs Operations to place the plant in Mode 3 at least two hours prior to the anticipated arrival of sustained winds in excess of 74 mph at the site. Hurricanes therefore do not apply to the ESCWS AOT in the at-power PRA model and can be screened from inclusion in calculations.

<u>STRAIGHT-LINE WINDS</u>

The straight-line wind hazard includes winds primarily from thunderstorms and extratropical storms. Since these events involve a lower wind speed, the primary consideration is a loss of offsite power (LOOP).

Since LOOP events are considered and modeled in the internal events PRA model, the hazard associated with straight-line winds is considered in the ESCWS AOT calculations and need not be calculated separately. Including the risk associated with straight-line wind-induced LOOP events in the ESCWS AOT calculations would effectively constitute double counting with the internal events model.

<u>TORNADOES</u>

Per the assessment of high winds in Section 3.3 of the HNP Final Safety Analysis Report (FSAR), structures, systems, or components (SSCs) whose failure (due to design wind loading, tornado wind loading, or associated missiles) could prevent safe shutdown of the reactor, or result in significant uncontrolled release of radioactivity from the unit, are protected from such failure by one of the following methods:

a) the structure or component is designed to withstand design wind, tornado wind and tornado generated missiles, or

b) the system or components are housed within a structure which is designed to withstand the design wind, tornado wind and tornado generated missiles.

As such, the design basis for this event meets the criteria in the 1975 SRP and can be screened from inclusion in the calculations. Additionally, the most likely damage would be a LOOP event, which is already included in the internal events PRA model.

Thus, the high winds hazard for HNP can be screened from the ESCWS AOT LAR. Since it is conservative to leave the high winds PRA results in the calculation of total and delta risk for the ESCWS AOT LAR, new results are not provided.

**RAI 02 – High Winds**

Section 2 of RG 1.200, Revision 2, states that one acceptable approach to demonstrate a technically acceptable PRA is by using a national consensus PRA standard that addresses the scope of the PRA used in the decision-making, and performing a peer review for the PRA using endorsed peer review guidance. Following the guidance in RG 1.200, Revision 2, may obviate the need for an in-depth review of the base PRA by NRC reviewers, allowing them to focus their review on key assumptions and areas identified by peer reviewers as being of concern and relevant to the application.

The licensee used the HNP high winds PRA model as described in Section A.2.4 of Attachment 5 to the LAR. In Section B.4 of Attachment 5 of the LAR, the licensee provided a discussion of four high winds finding level facts and observations (F&Os) that remained open and concluded that they have no impact on this application. The concerns in F&O ID: Observation #1, associated with supporting requirement WFR-B2, are dispositioned as documentation issues. It does not appear to be only a documentation issue to the NRC staff. The disposition for item 1a discusses the potential for either an updated wind pressure fragility for the Dedicated Shutdown Diesel Generator (DSDG) or the screening of the DSDG from the wind pressure fragility analysis. However, the NRC staff is unclear about the disposition and update, if any, of the DSDG wind pressure fragility analysis. If the DSDG wind pressure fragility has not been updated, or the updated value has not been included, or has been screened out in the high winds PRA supporting this application, justify the disposition of the cited F&O and discuss the impact on this application.

**Duke Energy Response to RAI 02**

The wind pressure fragility of the DSDG has not been updated nor has the DSDG been screened from the wind pressure fragility analysis. The design basis wind speed is computed from the overturning moment capacity of the DSDG because neither the support conditions nor the component's design wind load information were available. The computed design basis wind speed for the DSDG is 202 mph. No information was available regarding the DSDG anchorage, thus it was not accounted for in the wind pressure fragility calculation. The DSDG would have higher wind load capacity if the anchorage was accounted for.

The anchorage for the DSDG is not considered in the calculation of the wind pressure fragility for the high winds PRA (i.e., only the weight of the DSDG was considered in the fragility), which leads to a conservatively high wind pressure fragility (failure probability) of the DSDG. Thus, this is a documentation issue only as the wind pressure fragility was properly incorporated into the high winds PRA, but the conservative treatment of disregarding the anchorage in the fragility calculation was not sufficiently described.

The DSDG provides back-up power to the loss of systems that are affected by the ESCWS LAR. The ESCWS supports HVAC to the charging safety injection pumps (CSIPs) and the Switchgear Rooms. Charging is the normal source of reactor coolant pump (RCP) seal injection and the DSDG supports a redundant seal injection source. Therefore, conservative modeling of the DSDG is conservative for change in risk calculations that consider the impact of loss of ESCWS.

Note that based on the response to RAI 01 the high winds contribution to the ESCWS AOT LAR has been screened.

**<u>RAI 03 – Uncertainties and Sensitivity Studies</u>**

Section 2.3.5 of RG 1.177, Revision 1 (ADAMS Accession No. ML100910008) requires that sensitivity and uncertainty analyses relating to assumptions in Technical Specification changes be evaluated. RG 1.174, Revision 3 (ADAMS Accession No. ML17317A256), states: “the results of the sensitivity studies should confirm that the guidelines are still met even under the alternative assumptions (i.e., change generally remains in the appropriate region).”

The licensee stated in Section A.3 of Attachment 5 to the LAR that three key assumptions are applied to the PRA analysis. The third assumption is related to the human failure events (HFEs) to open doors and implement portable fans as alternate means of cooling the Switchgear Room and Charging Safety Injection Pump (CSIP) Room. In addition, in Section A.10 of Attachment 5 to the LAR the licensee provides the uncertainty considerations of the extended CT [completion time] in the internal events, internal fire, high winds and internal flooding PRA models. Based on the evaluations, three key sources of uncertainty are identified as room heat-up calculations (Table A.10.1, item 9), operability of equipment in beyond design basis environments (Table A.10.1, item 14), and HVAC performance (Table A.10.2, item 5). These three sources of uncertainty are associated with operator actions to meet the PRA success criterion. A sensitivity analysis was performed assuming the operators fail to take action to provide emergency cooling by opening doors and implementing portable fans as an alternate means of cooling the Switchgear Room and CSIP and an examination of the delta risk cut sets for the analysis by the licensee indicated an increase in core damage frequency (CDF) greater than $1\times10^{-6}$ /year and an increase in large early release frequency (LERF) greater than $1\times10^{-8}$ /year. However, the impact of removal of the operator actions to provide emergency cooling on the proposed extension is unavailable.

**RAI 03.a**

Provide the results (i.e., the results in Table A.5.8 of Attachment 5 to the LAR) with guaranteed failure of operators to take action to provide emergency cooling by opening doors and implementing portable fans as an alternate means of cooling the Switchgear Room and CSIP in the base and the completion time extension case.

**Duke Energy Response to RAI 03.a**

The results in the colored columns in the tables below are the cases requested, compared to the original cases, in the uncolored columns. To quantify the newly-requested cases, the two operator actions were failed (i.e., set to 1.0) and propagated through the dependence analysis. The newly-requested cases were quantified with new Human Reliability Analysis (HRA) recovery rules to account for the assumed failures of the two operator actions in question. Note that fire was analyzed with pre-solved cutsets and cutset manipulation as opposed to full model solves, unlike the rest of the hazards. Also note that with the screening of the high wind hazard, there are no rows in the tables for high winds, and the totals have been adjusted accordingly.

| | Base CDF | Conditional CDF | ΔCDF | Base HRA CDF | Conditional HRA CDF | ΔCDF (HRA) |
|---|---|---|---|---|---|---|
| Internal Events | 2.86E-06 | 2.87E-06 | 2.77E-09 | 5.09E-06 | 5.13E-06 | 3.33E-08 |
| Internal Flood | 6.07E-06 | 6.08E-06 | 1.73E-09 | 7.14E-06 | 7.15E-06 | 1.74E-09 |
| Fire | 2.30E-05 | 2.37E-05 | 7.23E-07 | 2.52E-05 | 2.71E-05 | 1.97E-06 |
| Total | **3.19E-05** | **3.26E-05** | **7.27E-07** | **3.74E-05** | **3.94E-05** | **2.01E-06** |

| | Base LERF | Conditional LERF | ΔLERF | Base HRA LERF | Conditional HRA LERF | ΔLERF (HRA) |
|---|---|---|---|---|---|---|
| Internal Events | 1.07E-06 | 1.07E-06 | 1.29E-10 | 1.34E-06 | 1.34E-06 | 1.68E-09 |
| Internal Flood | 4.70E-07 | 4.70E-07 | 9.40E-11 | 5.33E-07 | 5.34E-07 | 1.63E-10 |
| Fire | 4.75E-06 | 4.75E-06 | 1.04E-09 | 4.76E-06 | 4.76E-06 | 1.04E-09 |
| Total | **6.29E-06** | **6.29E-06** | **1.26E-09** | **6.63E-06** | **6.64E-06** | **2.88E-09** |

**RAI 03.b**

If the results in item (a) exceed the risk acceptance guidelines in RG 1.177, Revision 1, or RG 1.174, Revision 3, describe the approach used to develop the human error probabilities (HEPs) for the operator actions to provide emergency cooling by opening doors and implementing portable fans as an alternate means of cooling the Switchgear Room and CSIP. The discussion should provide numerical values of the HEPs and include sufficient detail for each of the HEPs on the following:

i. How these operator actions are credited in the internal events, internal flooding, internal fire, and high winds PRAs for the accident sequences consequential to this application.

ii. Existence of procedures and training governing the actions, the specific instructions for the actions, including the cues or indications operators will use to initiate these actions.

iii. The timeline for the actions and the basis for estimation of time available and time required to complete the actions.

iv. The HFE dependency analysis between each of the actions and other operator actions modeled in the PRAs.

v. How these actions are consistent with the supporting requirements associated with high-level requirements (HLR) HR-E, HR-F, HR-G, and HR-H of ASME/ANS RA-Sa-2009, as endorsed by RG 1.200, Revision 2.

**Duke Energy Response to RAI 03.b**

The above results (for CDF) do exceed the guidelines referenced. These numbers include capacity factors. Therefore, responses to parts i through v of this part of the RAI are provided below. The above results were produced using the same model files as the original LAR submittal, for consistency.

i. For all hazard models, OPER-67 is credited for sequences in which cooling has been lost to one or both of the CSIP Rooms. This could be caused by an air handler failure, or ESCW failure, and can be for a number of different initiators where CSIPs are required. This includes the need for a CSIP for RCP seal cooling as well as for Reactor Coolant System (makeup). Failure of the power supply for the portable fan is included in the PRA model such that credit is only taken for this action when power is available to the fan. This is conservative since just opening the door to the CSIP room will provide some cooling and additional time to address the issue. OPER-73 is credited for sequences in which adequate cooling has been lost to one or both of the Switchgear Rooms. This can be caused by a damper failure or failure of an air handler flow path (or related air handler support equipment), or an ESCW failure, and can be for a number of different initiators.

   The value of the independent failure rates for these HFEs is calculated using the EPRI HRA calculator. The cognitive error probability is calculated using either the Human Cognitive Reliability (HCR)/Operator Reliability Experiment (ORE) method or the Cause Based Decision Tree Method (CBDTM). Whichever method produces the higher failure rate is used for a given HFE. The execution error probability is calculated using the Technique for Human Error Rate Prediction (THERP) methodology. The action performed by the operators in each HFE is the same for all hazards, however there are minor differences in the way the failure rate is calculated and/or applied to each hazard model as discussed below.

<u>Internal Events</u>:
In the internal events model, the value of HFE OPER-67 is 3.80E-02 and the value of HFE OPER-73 is 9.1E-04. There are no modifications to the way in which the HFE is calculated or applied in the model.

<u>Internal Flooding</u>:
For the internal flooding model, a review of HFEs included in the internal events PRA model was performed. The HEPs for the internal events addressed operator mitigating actions related to non-flooding initiating events. These HEPs were then evaluated to determine if the associated HEPs need to be modified due to the effects of flooding. The review was completed utilizing criteria included in EPRI document 1019194, "Guidelines for Performance of Internal Flooding Probabilistic Risk Assessment," December 2009. Per the EPRI guideline, the evaluation included the following modifications:

1. The flood analysis addressed physical plant access during the local mitigation of a flood initiating event.

2. All actions credited in the non-flood plant response were revisited to verify that the procedural path, etc., is still valid. Because of the large number of failures that potentially occur during a large flood, the event-based abnormal operating procedures (AOPs) may be less relevant than for more straightforward internal events. Discussions with experienced operations personnel helped to determine how the events would be expected to proceed.

3. Limited credit was taken for human interactions occurring within the period immediately following the flood. It is reasonable to assume that the Control Room staff will be unable to respond effectively to many events immediately following the flooding event. Before any local actions are credited, it was confirmed that no access limitations or restrictions exist. Physical damage to the plant may significantly increase the execution time for local actions. A screening approach, as presented below, was used for these events:

    3.1. All HEPs that required local action in an area where access would be restricted were set to a failure probability of 1.0.

    3.2. All new HEPs, or pre-existing HEPs, where the relevant instrumentation or controls could be impacted by the flood, which are required within 30 minutes after the flood event, were set to a probability of 1.0.

3.3. For HEPs required within one hour after the flood event, first check to see if there is a procedure to direct the action and there is sufficient time available to complete the action. If both these conditions are satisfied, then increase the existing internal events HRA for the case with written procedure. In the case of HNP, the AOP for loss of Service Water (Reference A.10) was used since current analysis shows that coping with a Service Water induced flood is the most limiting of flooding scenarios.

3.4. Other HEPs (physically not affected by the flood, with more than one hour available to perform the action) were left at their nominal values.

Since there are 2 hours available to perform HFE OPER-67 and 15 hours available to perform OPER-73 (see response to item 3.b.iii, below), these HFEs were left at their nominal values of 3.8E-02 and 9.1E-04, respectively. However, it should be noted that blocked travel paths were included for this event, despite the long time available to perform the action.

High Winds: Since the high wind hazard has now been screened, this portion of the question no longer applies.

ii. OPER-67 – CSIP

All hazards credit the HNP annunciator response procedure (Reference A.7) for cue/cognition. Upon a loss of HVAC due to loss of ESCW, annunciator panels 1-18 for chiller A trouble and 2-18 for chiller B trouble will actuate, in addition to several other annunciators. Reference A.7 directs operators to restore the ESCWS to service, and prompts entry into the HNP AOP for loss of ESCWS (Reference A.9) if the chiller is tripped. Licensed operator training includes training on all AOPs, including entry conditions into the AOP. Normal progression through the procedure directs operators to place a temporary fan in the in-service CSIP doorway. The fan is located on the same elevation and is only used for this action. Although there is not a specific job performance measure (JPM) for the action to place the fan, this action is occasionally performed by Operations in preparation for short-term chiller maintenance activities.

OPER-73 – Switchgear

All hazards credit the HNP annunciator response procedure (Reference A.8) for cue/cognition as well as execution. Upon a loss of HVAC or related trouble with the ESCWS causing high Switchgear Room return air temperature, annunciator panel 8-5, “Computer Alarm Ventilation,” will actuate and Engineering Response Facility Information System (ERFIS) will identify Reactor Auxiliary Building Switchgear Room return air temperature as the problem. Reference A.8 directs operators to dispatch Security to open the door(s) between the affected Switchgear Room and the Turbine Building. There are also a number of other redundant and diverse indications which serve as alternate cues for this action. Since this action is simply to open a door, and fifteen hours are available, there is no JPM for this action.

iii. <u>OPER-67 – CSIP</u>

All hazards utilize a system window ($T_{SW}$) of 120 minutes within which operators must enable backup cooling for the CSIP rooms. Failure to establish room cooling results in loss of the CSIP. This time limit is supported by a Room Heatup calculation performed with the GOTHIC computer code. This calculation was supplemented by actual temperature data from an extended pump run with no ventilation.

All hazards specify a time of cognition of 40 minutes (fire is an exception with 45 minutes to account for fire considerations), which accounts for attempts to start/restart ESCW components before arriving at the decision to deploy the portable fan. This time is supported by interviews with Operations.

All hazards specify an execution time of 10 minutes. This includes the time (including travel time) between operator dispatch and the portable fan skid being placed into operation at the CSIP Room door. The portable fan skid is located on the same elevation of the Auxiliary Building as the CSIP Rooms and must be pushed to the door, with airflow directed into the CSIP Room. This time is supported by interviews with Operations.

<u>OPER-73 – Switchgear</u>

All hazards utilize a system window ($T_{SW}$) of 15 hours within which operators must establish cooling for the Switchgear Room. Failure to establish room cooling within that time results in loss of the equipment in the room. This time limit is supported by a Room Heatup calculation performed with the GOTHIC computer code.

At 2 hours, the temperature in the room reaches the alarm setpoint of 120 degrees Fahrenheit, which directs operators to utilize the annunciator response procedure to mitigate the condition. Note that a warning setpoint of 90 degrees Fahrenheit will actuate beforehand. Procedures specify that operators dispatch Security to open the doors. A required time of 30 minutes is used, which should be bounding, in which a Security officer is dispatched to the Switchgear Room to open the door. This time has been supported by interviews with Operations.

iv. An HFE dependency analysis was performed on the base model for each hazard, either using the HRA calculator dependency analysis tool, or a spreadsheet that performs a similar calculation. These dependency analyses address commonalities between HFEs within the same accident sequence (i.e., cutset) and determine a dependency level between each pair of HFEs that are in chronological sequence (i.e., between the first and the second, between the second and the third, etc.). The value of the dependent event is based on both the independent failure rate for that event and the dependency level between it and the prior event. The independent events in the cutset are then all set to a value of 1.0 in the cutset, and a dependent event is added which accounts for all of the HFEs and the dependency level between them. Note that for the requested sensitivity in response to RAI 3.a, above, the independent value of 1.0 was inserted into the dependency analyses for HFEs OPER-67 and OPER-73 for each hazard, and new dependent event values were generated and used in the quantifications.

v. <u>HLR-HR-E</u>: A systematic review of the relevant procedures shall be used to identify the set of operator responses required for each of the accident sequences.

The set of procedures for both actions have been explicitly reviewed for the cases credited in the fault tree. The actions have been verified as proceduralized and feasible by Operations.

<u>HLR-HR-F</u>: Human failure events shall be defined that represent the impact of not properly performing the required responses, in a manner consistent with the structure and level of detail of the accident sequences.

Both actions are modeled consistently with the consequences in the fault tree (i.e., failure of the operator actions fails credit for the associated equipment in the PRA model).

<u>HLR-HR-G</u>: The assessment of the probabilities of the post-initiator HFEs shall be performed using a well-defined and self-consistent process that addresses the plant-specific and scenario-specific influences on human performance, and addresses potential dependencies between human failure events in the same accident sequence.

These operator actions were modeled with EPRI's HRA Calculator, which is recognized as an accepted industry tool for estimating the probability of human failure. The maximum of the HCR/ORE or CBDTM was used for all cognitive failure probability while the THERP methodology was used for all execution failure probabilities. Given the subjective nature of HRA, within the tool, a consistent approach was applied for all actions regarding cues, critical step identification, performance shaping factors, and other considerations. A dependency analysis is performed for all significant combinations of HFEs for each hazard based on relative timing, common cues, number of available operators, intervening successes, etc.

<u>HLR-HR-H</u>: Recovery actions (at the cutset or scenario level) shall be modeled only if it has been demonstrated that the action is plausible and feasible for those scenarios to which they are applied. Estimates of the probabilities of failure shall address dependency on prior human failures in the scenario.

Recovery actions are vetted for plausibility and feasibility through evaluation of the time required vs. time available, availability of procedures, ability to get to the required equipment (for actions external to main control room), and through interviews with Operations personnel. A dependency analysis is performed for all significant combinations of HFEs for each hazard based on relative timing, common cues, number of available operators, intervening successes, etc.

**RAI 04 – PRA Model for Auxiliary Relay Cabinet Room**

Section 2.3.3 of RG 1.177, Revision 1, states that specific systems or components involved in the change should be modeled in the PRA to evaluate a TS change. In addition, if the PRA does not model the system for which the TS change is being requested, specialized analyses may be necessary when requesting changes to the TS for these systems.

Section 3.2 of Attachment 1 to the LAR discusses the room heatup analysis and identifies three plant areas where operator actions may be warranted to ensure temperatures are maintained within acceptable limits should the ESCWS fail. One of these areas is the Auxiliary Relay Cabinet Room. The results of the heatup analysis discussed in LAR Section 3.2 indicate that operator action may be needed to maintain acceptable temperatures in the Auxiliary Relay Cabinet Room within 24 hours following a loss of ESCWS. This would suggest that the Auxiliary Relay Cabinet Room should be included in the PRA model based upon the heatup analysis. However, LAR Section 3.2 states, “[t]he Auxiliary Relay Cabinet Room is not included in the HNP PRA Model based upon the results of the heatup analysis.” Therefore, the basis and impact of the exclusion of the Auxiliary Relay Cabinet Room from the HNP PRA model is unclear to the NRC staff.

a. Justify the exclusion of the Auxiliary Relay Cabinet Room from the HNP PRAs based on the heatup analysis and the impact on this application.

b. If the exclusion of the Auxiliary Relay Cabinet Room from the HNP PRAs cannot be justified for this application, include the room in the appropriate HNP PRAs and provide the impact on this application including updated risk results (i.e., results in Table A.5.8 of Attachment 5 to the LAR).

**Duke Energy Response to RAI 04**

a. The Auxiliary Relay Cabinet Room and Main Control Room have separate air handling units; thus, opening the doors between the Auxiliary Relay Cabinet Room and the adjacent Main Control Room after a loss of HVAC event provides an acceptable pathway for heat removal. However, the action to open the doors between the Main Control Room and the Auxiliary Relay Cabinet Room following a loss of HVAC is regarded as a compensatory action for defense-in-depth with no effect on PRA component operability.

   The timing requirement of 10 hours to perform the action following a loss of HVAC event was derived from an HNP-specific calculation (Reference A.4) which assumed a room temperature limit of 120°F. A fleet-wide basis for further screening of HVAC systems from the PRA models is provided in a Duke Energy calculation (Reference A.5), which applies the Arrhenius thermal aging model to demonstrate typical PRA components can operate in ambient temperatures that are beyond those for which they are qualified for continuous operation. As discussed in Section 4.4.1 of EPRI Technical Report 1021067, "Plant Support Engineering: Nuclear Power Plant Equipment Qualification Reference Manual," both the NRC and IEEE Std. 323 consider the Arrhenius methodology an acceptable method for addressing time-temperature aging effects. Application of the Arrhenius thermal aging model in Reference A.5 indicates that typical PRA components can operate in ambient temperatures up to 150°F for significantly longer than 24 hours.

   Using this 150°F criterion, the compensatory action to open the doors between the Main Control Room and the Auxiliary Relay Cabinet Room has no effect on PRA component operability. Thus, the compensatory action is provided only as an additional level of defense-in-depth.

   Therefore, no HRA event is needed and the exclusion of the Auxiliary Relay Cabinet Room from the HNP PRA models based on the heatup analysis and the impact on this application is justified.

b. Not applicable.

**References**

A.1 HNP-F/PSA-0126, "Harris FPRA, FPRA Update to Incorporate HNP2019 Internal Events Model for ESCW LAR RAIs," Revision 0

A.2 HNP-F/PSA-0079, "Harris Fire PRA – Quantification," Revision 5

A.3 ASME/ANS RA-Sa-2009, "Addenda to ASME/ANS RA-S-2008 Standard for Level 1/Large Early Release Frequency Probabilistic Risk Assessment for Nuclear Power Plant Applications," ASME and the American Nuclear Society, February 2009

A.4 HNP-F/PSA-0058, "Appendix J – Room Heatup Analysis," Revision 2

A.5 DPC-1535.00-00-0025, "Criterion for Screening Room HVAC Systems from PRA Models," Revision 0

A.6 HNP-F/PSA-0114, "Risk Determination for Proposed Harris Extended ESCW LCO LAR," Revision 2

A.7 APP-ALB-023, "Auxiliary Equipment Panel No. 1," Revision 51

A.8 APP-ALB-028, "Main Control Board," Revision 17

A.9 AOP-026, "Loss of Essential Services Chilled Water System," Revision 15

A.10 AOP-022, "Loss of Service Water," Revision 38