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August 9, 2012

10 CFR 50.90

U.S. Nuclear Regulatory Commission
Washington, DC 20555-001

ATTENTION: Document Control Desk

Subject: Duke Energy Carolinas, LLC
McGuire Nuclear Station, Units 1 and 2
Docket Nos. 50-369 and 50-370

License Amendment Request for One-Time Change to Technical Specification 3.8.4, "DC Sources-Operating" for Battery Replacement

In accordance with the provisions of 10 CFR 50.90, Duke Energy Carolinas, LLC (Duke Energy) proposes a license amendment request (LAR) for the Renewed Facility Operating Licenses (FOL) and Technical Specifications (TS) for the McGuire Nuclear Station, Units 1 and 2.

The proposed LAR would revise the McGuire TS 3.8.4 Condition A. to allow replacement of the existing 125 VDC vital batteries while at power. This proposed LAR would be applicable one-time for each of the four battery channels. The vital batteries were last replaced in 1997 under a similar one-time TS change. All four battery channels are currently operable but a physical degradation phenomenon will shorten their 20 year nominal service life. Battery replacement is currently scheduled for 2013 and 2014.

Since battery replacement cannot be accomplished within the Completion Times currently allowed by TS 3.8.4 due to the number of activities, inspections, and tests, the proposed LAR would extend the Completion Time to 14 days for each battery channel replacement. During each vital battery replacement, the associated DC channel will remain energized by being cross-tied (bus tie with breakers) to another operable DC channel as allowed by TS 3.8.4 Condition A.

Duke Energy used a combination of a deterministic approach and Probabilistic Risk Analysis (PRA) insights to evaluate operating both units with one vital battery inoperable for an extended period of time. The configuration risk for this temporary one-time change was judged to be insignificant.

Attachment 1 provides Duke Energy's evaluation of the LAR which contains a description of the proposed changes, the technical evaluation, the regulatory analysis, the determination that this

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LAR contains No Significant Hazards Considerations, the basis for the categorical exclusion from performing an Environmental Assessment/Impact Statement, and precedent.

Attachment 2 provides the existing Technical Specification page for McGuire Units 1 and 2, marked-up to show the proposed changes. The reprinted Technical Specification page will be provided to the NRC upon issuance of the approved amendments.

Attachment 3 identifies Regulatory Commitments made in support of this LAR. Attachment 4 contains PRA evaluation specific Tables.

Duke requests NRC review and approval of this LAR by August 1, 2013 to facilitate the current battery replacement schedule. Duke has determined that a 30 day implementation grace period will be sufficient to implement this LAR.

In accordance with Duke internal procedures and the Quality Assurance Topical Report, the proposed amendment has been reviewed and approved by the McGuire Plant Operations Review Committee.

Pursuant to 10CFR50.91, a copy of this LAR has been forwarded to the appropriate North Carolina state officials.

Please direct any questions you may have in this matter to Lee A. Hentz at (980) 875-4187.

Sincerely,

Regis T. Repko

Attachments:

1. Evaluation of Proposed Amendment
2. Marked-Up McGuire Technical Specification Pages
3. Regulatory Commitments
4. PRA Evaluation Tables

cc w/ Attachments:

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Regis T. Repko 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.

Regis T. Repko, Site Vice President, McGuire Nuclear Station

Subscribed and sworn to me: August 9, 2012
Date

_______________, Notary Public

My commission expires: July 1, 2017
Date

ATTACHMENT 1

EVALUATION OF PROPOSED AMENDMENT

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2.0 DETAILED DESCRIPTION

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- 4.1 Applicable Regulatory Requirements/Criteria
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1.0 SUMMARY DESCRIPTION

Pursuant to 10 CFR 50.90, Duke Energy Carolinas, LLC (Duke Energy) proposes a license amendment request (LAR) for the Renewed Facility Operating License (FOL) and Technical Specifications (TS) for McGuire Nuclear Station, Units 1 and 2.

The proposed LAR would revise the McGuire TS 3.8.4 Condition A. to allow replacement of the existing 125 VDC vital batteries while at power. This proposed LAR would be applicable one-time for each of the four battery channels. The batteries were last replaced in 1997 under a similar one-time TS change. All four battery channels are currently operable but a physical degradation phenomenon will shorten their 20 year nominal service life. Battery replacement is currently scheduled for 2013 and 2014.

Since battery replacement cannot be accomplished within the Completion Times currently allowed by TS 3.8.4 due to the number of activities, inspections, and tests, the proposed LAR would extend the Completion Time to 14 days for each battery channel replacement. Battery replacement cannot be performed during a single unit refueling outage either since the batteries are shared between two units. During each vital battery replacement, the associated DC channel will remain energized by being cross-tied (bus tie with breakers) to another operable DC channel as allowed by TS 3.8.4 Condition A. In addition, a temporary, spare battery will be available as an additional, backup DC power supply.

Duke Energy used a combination of a deterministic approach and Probabilistic Risk Analysis (PRA) insights to evaluate operating both units with one vital battery inoperable for an extended period of time. The configuration risk for this temporary one-time change was judged to be insignificant.

2.0 DETAILED DESCRIPTION

The proposed LAR would revise the Completion Time for Required Action A.2.2 of TS 3.8.4, "Restore channel of DC source to OPERABLE status," from 72 hours to 14 days on a one-time temporary basis. A footnote would be added to the TS page stating:

> "The Completion Time that one channel of DC source can be inoperable as specified by Required Action A.2.2 may be extended beyond the "72 hours" up to a total of 14 days as part of the battery replacement project. This allowance may be used one-time for each of the four DC channels. Upon completion of the battery replacement project, this footnote is no longer applicable and will expire on December 31, 2014."

The marked-up TS 3.8.4 page illustrating the proposed change is provided in Attachment 2. The corresponding TS Bases will not require revision for this one-time temporary change.

3.0 TECHNICAL EVALUATION

3.1 System Description

The 125 VDC Vital Instrumentation and Control (I&C) Power System is provided to supply power to nuclear safety related instrumentation and control loads requiring an uninterrupted power source to maintain safe reactor status.

The design of the McGuire 125 VDC I&C power system is such that four batteries, chargers and distribution centers serve both units. Each of the four vital batteries and chargers are connected through their own respective distribution center which is shared by both units. The loads served from these distribution centers are unitized, providing a 125 VDC power panelboard and inverter for each unit. The distribution centers are designed to provide cross-tie capability with its "associated" distribution center of the same train (load group). Updated Final Safety Analysis Report (UFSAR) Figure 8-35 of the Vital I&C power system is attached.

During normal operation, the independent and physically separated batteries are floated on the buses and assume load without interruption upon loss of a battery charger or AC power source. Battery chargers EVCA, EVCB, EVCC, and EVCD provide DC power to their respective distribution centers and maintain their respective batteries at float conditions. The 125 VDC distribution centers supply power to their respective 125 VDC power panelboards and the 120 VAC power inverters (see attached UFSAR Figure 8-35). The distribution center and power panelboard circuit breakers are closed except for the bus tie breakers and the spare battery charger distribution center breakers in EVDS.

When REQUIRED ACTION statement A.2.1 of Technical Specification 3.8.4 is invoked via OPERABLE tie breakers, and one battery and charger is removed from its bus, the distribution center (of the removed battery) and its normal loads are still energized by a full capacity charger and battery of the same affected train. For this alignment (cross-tied), one battery is serving two buses on one train. On the other train, two batteries are serving two buses, while assuring train redundancy at all times. All four vital batteries, including the one serving two buses during the Allowable Outage Time (AOT), are sized to serve normal and emergency loads of both buses. They independently have the capacity to automatically supply minimum engineered safety feature DC loads for accident conditions in one unit and safely shut down the other unit assuming both a loss of offsite power (LOOP) and a single failure in the 125 VDC system.

During a LOOP on one or both trains, the essential motor control centers feeding the Vital I&C battery chargers associated with the affected train will be load shed by the Emergency Diesel Generator (EDG) load sequencer. No more than eleven seconds after the diesel generator start signal, the affected essential motor control centers and battery chargers will be reloaded onto the essential bus by the sequencer. During the time period that the affected essential motor control centers and battery chargers are de-energized, the batteries, alone, feed the vital instrumentation and control loads.

For design basis events, any single vital battery by itself can supply an entire train of DC loads. The interaction between each unit's 125 VDC system is limited such that allowable combinations of maintenance and test operations as governed by the plant Technical Specifications will not preclude the system's capability to automatically supply

power to minimum Engineered Safety Feature (ESF) DC loads in either unit, assuming a LOOP.

3.2 Vital Battery Sizing Analysis

All four vital batteries have been sized to carry the load duty cycle during loss of coolant accident (LOCA) and LOOP conditions for their respective bus/train while maintaining battery terminal voltage above 105 VDC for 60 cells in a cross-tied alignment. Each battery carries DC relays, trip coils, lights and momentary charging spring motor loads, as well as two inverters.

Design Requirements:

1. Should a station blackout (SBO) occur, each battery shall be capable of supplying its respective channel for a period of 1 hour while maintaining a terminal voltage at or above 105 VDC.

2. The duty cycle used in the calculation is consistent with a LOOP or a LOCA without AC power being available to the chargers. Thus, breaker control and spring charging currents are included in the duty cycle. Therefore this duty cycle bounds the situation where no AC power is available from either the standby or offsite source.

3. Each charger is sized to:
   a. Carry its own individual load plus the DC loads of another charger in a back-up capacity;
   b. Recharge its associated battery within eight hours while supplying its normal loads.

Assumptions:

1. The inverter terminal voltage is assumed to be the minimum rated input voltage (100 VDC). A lower input voltage results in higher load currents in the battery duty cycle for constant power loads such as the inverters. The inverter input voltage is expected to be above 100 VDC during the duty cycle. Therefore the use of 100 VDC as the inverter terminal voltage is conservative.

2. In addition to the worst case loading on distribution centers EVDA, EVDB, EVDC, and EVDD each train's distribution center is assumed to have three breaker charging spring motors starting in the 0-1 minute period (74.88 Amps per motor starting) and one charging spring motor running in the 59-60 minute period. This is consistent with the guidance in IEEE 485-1983 sections 4.2.3 and 4.3.2 and IEEE 450-1995.

Design Inputs:

1. McGuire's low voltage load list
2. IEEE 485-1983 for lead acid battery sizing
3. The minimum temperature of the battery room is 60°F, for a temperature correction factor of 1.11

4. The aging factor is for 80% end of life capacity, for a factor of 1.25
5. Load growth factor is 1.15

The following table provides the worst case Vital DC bus loading values for cross- tied alignments.

Train A

EVDA Loads	0-1 minute	1-59 minutes	59-60 minutes
Battery Panelboard EVDA	2.68A	1.52A	1.52A
Battery Panelboard 1EVDA	299.38A	50.75A	135.63A
Battery Panelboard 2EVDA	306.36A	46.86A	131.74A
Inverter Panelboard 1EKVA	104.7A	104.70A	104.7A
Inverter Panelboard 2EKVA	110.35A	110.35A	110.35A
EVDC Loads			
Battery Panelboard EVDC	2.68A	1.52A	1.52A
Battery Panelboard 1EVDC	5.05A	0.90A	0.90A
Battery Panelboard 2EVDC	5.05A	0.90A	0.90A
Inverter Panelboard 1EKVC	64.13A	64.13A	64.13A
Inverter Panelboard 2EKVC	65.49A	65.49A	65.49A
Total Train A cross-tied load	965.87 A	447.11 A	616.87 A

Train B

EVDB Loads	0-1 minute	1-59 minutes	59-60 minutes
Battery Panelboard EVDB	2.68A	1.52A	1.52A
Battery Panelboard 1EVDB	5.05A	0.90A	0.90A
Battery Panelboard 2EVDB	5.05A	0.90A	0.90A
Inverter Panelboard 1EKVB	79.30A	79.30A	79.30A
Inverter Panelboard 2EKVB	80.50A	80.50A	80.50A
EVDD Loads			
Battery Panelboard EVDD	2.68A	1.52A	1.52A
Battery Panelboard 1EVDD	291.53A	37.60A	122.48A
Battery Panelboard 2EVDD	297.46A	40.61A	125.49A
Inverter Panelboard 1EKVD	100.21A	100.12A	100.21A
Inverter Panelboard 2EKVD	97.34A	97.34A	97.34A
Total Train B cross-tied load	961.78 A	440.38 A	610.16 A

Conclusion

The vital batteries are sized according to Train A cross-tied alignment loading since it is the most limiting. From the Table above, Train A loading is equivalent to removing 459 Amp Hours (AH) from the battery in 60 minutes. Adjusting the load for battery aging, temperature, and load growth, 732AH would be the assumed worst case loading on a battery sized at 1944AH.

This analysis demonstrates that, under the cross-tied alignment, the vital batteries are adequately sized to ensure the Vital I&C Power System will perform its design function under worst case conditions.

Battery Testing History

Every 18 months a Modified Performance Test (MPT) is performed in accordance with IEEE Standard 450-1995 to satisfy both the service test and performance test requirements. The MPT uses the Train A cross-tied duty cycle again, since it is the most limiting. The results of the last three tests per battery are shown below. The acceptance criteria is ≥ 80% capacity based on the 75 minute discharge rate, adjusted for temperature to 77°F.

EVCA Battery Test Results

Date	Capacity
07/23/2007	107.0%
3/29/2009	109.8%
02/01/2011	107.2%

EVCB Battery Test Results

Date	Capacity
08/11/2008	110.7%
01/25/2010	110.0%
11/29/2011	106.7%

EVCC Battery Test Results

Date	Capacity
10/15/2007	104.3%
08/18/2009	102.6%
02/08/2011	105.5%

EVCD Battery Test Results

Date	Capacity
09/10/2007	104.7%
06/16/2009	104.0%
04/18/2011	98.6%

3.3 Discussion of Need to Replace Batteries

Each vital battery bank consists of 60 GNB NCN-27 Flooded Lead Calcium (1944 Amp-Hr) battery cells, which were procured through third party qualifier Nuclear Logistics, Inc. (NLI).

The GNB safety related battery cells have a vendor advertised service life of 20 years, however, industry operating experience indicates that 15 to 18 years is a much closer approximation. McGuire's vital batteries were last replaced in 1997. Recent testing on all four batteries demonstrated that three have a capacity in excess of 100% while the fourth battery has a capacity near 99%. In May of 2006, positive post seal nut and jar lid cracking on the battery cells was discovered. This was evaluated by NLI for McGuire and the phenomenon was determined to be nodular corrosion. Approximately 50% of the cells are currently affected by this phenomenon.

Cracks on the positive post seal nuts can and will result in increased terminal and connection resistances over time. The following was provided by NLI:

> The design function of the post seal components is to prevent the release of acid to the atmosphere. The seal nut is a part of the post seal components; its specific function is to compress the o-ring to form a seal.
>
> The post seal components have no structural role in the battery cell. The failure of any of the seal components will not impact the seismic qualification of the battery. The failure of the seal components can result in a path for acid (electrolyte) to travel from the cell to the cell post. This will result in terminal post blackening. This is not an operability issue but may result in additional maintenance work. The long-term effect of the seal leakage is the corrosion product build-up at the intercell connections, with a corresponding build-up of resistance. As leaks continue to occur, the cell post blackens and a layer of corrosion forms between the post and the intercell connectors. Over time this causes a higher joint resistance.

Even though all McGuire's vital battery banks are operable from a capacity standpoint, physical degradation will eventually start to accelerate as a result of the nodular corrosion phenomenon. Consequently, replacing all four vital batteries prior to the end of their 20 year service life needs to be performed.

3.4 Battery Replacement Discussion

The new, replacement vital batteries will be identical to the existing batteries; GNB Type NCN-27. The replacement batteries will be sized in accordance with IEEE Std. 485-1983 and will meet the current licensing basis and perform the same safety function as the existing batteries.

From discussions regarding the nodular corrosion phenomenon with battery vendors, other nuclear stations, and industry experts there is currently no permanent solution to the issue as the batteries age. Different vendors have mitigating strategies, however none are able to guarantee their cells will not experience cracking as the cell ages. As

indicated by the performance tests, the McGuire NCN-27 Batteries have shown minimal capacity loss for their age.

Replacing batteries will require the existing cells to be disconnected and removed from their mounting rack one cell at a time. Each cell weighs approximately 385 pounds and the end of the rack must be removed to push the cells out of the rack then lower onto a conveyor rack, transversed to the adjacent isle, then lowered onto a cart for transportation out of the battery room.

Prior to installation, each new vital battery bank will receive a commissioning charge followed by a Modified Performance Test (MPT). The MPT is a test of battery capacity using a constant current, modified by increasing the current to "bound" the currents required in the battery service test. The MPT will satisfy the TS Surveillance Requirements (SR) 3.8.4.7 (Battery Service Test) and 3.8.4.8 (Performance Discharge Test) requirements.

The new tested cells will be transported to the respective vital battery room, and installed into the racks one cell at a time. New intercell connectors and intertier jumpers and cables will be connected and tested for connection resistance. After installation, the new battery will receive a freshening charge followed by the TS SR voltage and resistance measurements to validate battery operability.

While the intent of performing each MPT prior to installation is to reduce the overall time in the cross-tied alignment to ten days, it may become more practical to perform the MPT after the new battery is permanently installed. If so, a five day contingent during the replacement schedule would be required after equalizing the new battery in its permanent rack. IEEE Standard 450-1995 requires that the battery must be on float charge for 72 hours before performing the MPT. The MPT will take 12 hours to setup and perform. After the MPT the new battery will need to charge 30 hours before it can be put in service. Should the contingent be required, it would take the place of floating the new battery 24 hours before the quarterly inspection in the time line. The additional 60 hour contingency allowance in the time line is to allow for complications during removal or installation of the battery.

It has been determined that the replacement of each battery bank will take a maximum of approximately 14 days. The time that a battery bank is removed from service for replacement will be kept to a minimum. Replacement activities are scheduled for 24 hours per day, 7 days a week.

The replacement time line (per channel) is as follows:

ACTIVITY	TIME REQUIRED (10 day schedule)	TIME REQUIRED (14 day schedule)
Cross-tie the associated channel and take the old battery out of service.	12 hours	12 hours
Remove old battery (isolate power, disconnect cables and connectors, remove cells).	36 hours	36 hours
Transport new cells to battery room.	12 hours	12 hours
Install new battery (install new cells, attach connectors and all associated hardware)	48 hours	48 hours
Re-torque battery rack connections. Torque connectors and connect power cables.	16 hours	16 hours
Check new battery for continuity and grounds. Take baseline resistance measurements.	6 hours	6 hours
Equalize charge on new battery to restore capacity lost during storage/movement.	6 hours	6 hours
Float new battery prior to testing	24 hours	N/A
Pre-MPT new battery float charge	N/A	72 hours
Perform MPT	N/A	12 hours
Post-MPT charge	N/A	30 hours
Perform quarterly maintenance and TS SR voltage and resistance measurements.	10 hours	10 hours
Re-align new battery to the bus.	5 hours	5 hours
Removal/installation contingency allowance	60 hours	60 hours
Total time	235 hours (≈10 days)	325 hours (≈14 days)

3.5 Temporary Battery Discussion

While a vital battery bank is being replaced on-line, McGuire will have available as a contingency an identical full capacity temporary battery bank procured for 1E usage and sized in accordance with IEEE Standard 485-1983. The temporary battery bank will be located in Room 700 of the McGuire Service Building (shared load center room) due to space limitations in the battery room in the Auxiliary Building. The Service Building, which is located between the Unit 1 and 2 Turbine Buildings, is not a Seismic Category structure and the temporary battery will not be seismically mounted. The temporary battery bank will remain disconnected via a disconnect box but available if needed.

If needed, the temporary battery bank will be tied to the DC side of the standby battery charger (EVCS) via safety related EVDS Distribution Center breaker 1B. For the unlikely scenario where the vital battery supporting the cross-tied channels is lost or disabled; the temporary battery would be utilized to support recovery of one of the lost DC channels and associated loads. The temporary battery will not be credited for operability of the associated DC channels. In this scenario, with more than one DC channel

inoperable, McGuire would enter TS 3.8.4 Condition B. This would require both Units to be in Mode 3 within 6 hours and Mode 5 within 36 hours.

The temporary battery will receive a full complement of TS surveillances tests including a MPT prior to the first vital battery replacement. In addition, all applicable TS surveillance tests will be performed on the temporary battery configuration during periods of battery bank replacement.

The ambient temperature and hydrogen concentration of the area containing the temporary battery will be monitored once per a 12-hour shift to ensure they remain within battery specifications. The ventilation in this area will be supplemented with fans to ensure good air flow and mixing across the temporary battery.

At some point after the first battery bank is replaced but prior to the last (fourth) replacement, one of the older, removed batteries will be set-up as the temporary battery so the initial temporary battery can be installed as one of the new vital batteries. As previously stated, the older batteries are fully operable and identical to the replacement batteries.

3.6 Compliance with Current Regulations

This LAR itself does not propose to deviate from existing regulatory requirements, and compliance with existing regulations is maintained by the proposed one time change to the plant's TS requirements. Additional details may be found in the Regulatory Evaluation section of this LAR.

3.7 Defense in Depth Considerations

The proposed change is required to meet the defense-in-depth principle consisting of a number of elements. These elements and the impact of the proposed change on each of these elements are as follows:

- A reasonable balance among prevention of core damage, prevention of containment failure and consequence mitigation is preserved.

The proposed LAR would revise the McGuire TS 3.8.4 Condition A. to allow replacement of the existing 125 VDC vital batteries while at power. This proposed LAR would be applicable one-time for each of the four battery channels. During each vital battery replacement, the associated DC channel will remain energized by being cross-tied (bus tie with breakers) to another operable DC channel as currently allowed by TS 3.8.4 Condition A. All four vital batteries have been sized to carry the load duty cycle during LOCA and LOOP conditions for their respective bus/train while maintaining battery terminal voltage in a cross-tied alignment. Due to this robust design, the safety functions of the 125 VDC I&C system are preserved. In addition, a temporary, spare battery will be available as an additional, backup DC power supply.

The proposed LAR does not introduce a new accident or transient since no new equipment is installed, existing equipment is not operated in a new manner, and thus no new accident initiator is introduced. The spare battery remains disconnected via a disconnect box but available if needed. The 125 VDC I&C system is not an initiator of any analyzed design basis events, therefore, the proposed LAR does not increase the likelihood of an accident or transient.

- Over-reliance on programmatic activities to compensate for weaknesses in plant design is avoided.

The proposed LAR does not change the plant design. During each vital battery replacement, certain important equipment will be protected and compensatory measures will be in place. These measures are consistent with normal plant practices. Applicable approved procedures will also be utilized during this activity. This is not considered to be an over-reliance on programmatic activities. No new specific programs are being initiated during the battery replacement evolutions.

- System redundancy, independence and diversity are maintained commensurate with the expected frequency and consequences of challenges to the system.

During each vital battery replacement, the associated DC channel will remain energized by being cross-tied (bus tie with breakers) to another operable DC channel as currently allowed by TS 3.8.4 Condition A. All four vital batteries have been sized to carry the load duty cycle during LOCA and LOOP conditions for their respective bus/train while maintaining battery terminal voltage in a cross-tied alignment. During each vital battery replacement, certain important equipment will be protected and compensatory measures will be in place to offset the impact on system redundancy. In addition, a temporary, spare battery will be available as an additional, backup DC power supply. As such, system redundancy, independence and diversity are maintained.

- Defenses against potential common cause failures are preserved and the potential for the introduction of new common cause failure mechanisms is assessed.

As previously discussed, important equipment will be protected and compensatory measures will be in place to offset the impact on system redundancy and potential common cause failures. These measures will include avoiding (to the extent possible) severe weather conditions and periods of system grid instability during the proposed TS Completion Time extension. As such, appropriate measures will be taken to preserve defenses against potential common cause failures and no new common cause failure mechanisms will be introduced.

- Independence of barriers is not degraded.

The proposed vital battery replacement activity does not directly impact the three principle barriers or otherwise cause their degradation. Independence of barriers is not degraded because the proposed TS Completion Time extension has no impact on the physical barriers.

- Defenses against human errors are preserved.

Appropriate training will be provided to Operations and Maintenance personnel for the battery replacement evolution and, as discussed above, equipment protection and compensatory measures will be in place. Applicable approved procedures will also be utilized during this activity. As such, defenses against human errors are preserved.

- The intent of the plant's Design Criteria is maintained.

This activity is a TS Completion Time extension to allow replacement of the station vital batteries with an identical design. As such, this activity does not modify the plant design or the design criteria applied to systems, structures, or components (SSCs) during the licensing process.

3.8 Evaluation of Safety Margins

Design basis analysis and system design criteria are not impacted by the proposed LAR. As previously discussed, the design, operation and response of the systems addressed are unaffected. Administrative controls are in place in order to prevent the removal of redundant Trains of equipment at the same time. In addition, the safety analysis acceptance criteria stated in the UFSAR are not affected by the requested change. The system requirements credited in the accident analysis will remain the same. It is concluded that safety margins are not impacted by the proposed change.

3.9 Summary of the Risk Evaluation

A one-time (per battery) Technical Specification (TS) change is being requested to extend the Completion Time by 11 days, from the current 72 hours to a total of 14 days.

The analysis calculates the Incremental Conditional Core Damage Probability (ICCDP) and Incremental Conditional Large Early Release Probability (ICLERP) for 14 days to replace each battery, for a total maintenance configuration time of 56 days. The total ICCDP and ICLERP for 56 days is -3.03E-07 and -4.83E-08, respectively. The negative values indicate a reduction in risk, which is achieved by delaying routine maintenance on Systems Structures and Components (SSC) that appear in the cut sets for vital battery internal events sensitivity cases. I.e., the risk increase due to being in the vital DC cross-tie alignment for 14 days is more than offset by deferring routine maintenance on selected SSCs that appear in the cut sets.

The analysis calculates the delta Large Early Release Frequency (LERF) and delta Core Damage Frequency (CDF) for the 11 day extension per battery, for a total extension time of 44 days. The total delta CDF and delta LERF for the 44 additional days incurred by the extension are -2.38E-07/ reactor-operating-state-year and -3.79E-08/ reactor-operating-state-year, respectively.

The risk metrics are within the guidelines in Regulatory Guide 1.174 and 1.177 (< 1E-06 and < 1E-07, respectively). Since the calculated values indicate a risk decrease, it is judged that the configuration risk for the LAR is insignificant.

The risk impact of the proposed increase of the Completion Time (CT) for operating in the cross-tie alignment for the 125VDC Vital I&C system has been evaluated using the NRC three-tier approach suggested in Regulatory Guide 1.177. Although Regulatory Guide 1.177 is primarily intended for permanent changes to plant technical specifications, the general framework of considerations is considered applicable for this application:

Tier 1 – Probabilistic Risk Assessment (PRA) Capability and Insights
Tier 2 - Avoidance of Risk-Significant Plant Configurations
Tier 3 - Risk-Informed Configuration Risk Management

3.9.1 Tier 1 - PRA Capability and Insights

The analysis for this LAR submittal utilizes the McGuire internal events PRA model (with flood analysis update) and the Fire PRA model to determine the risk significance of replacing the four vital batteries.

McGuire Internal Events PRA Model Peer Review

In October 2000, the internal events PRA model received a peer review to certify the acceptability of PRAs before a consensus PRA Standard was available. McGuire participated in the Westinghouse Owners Group (WOG) PRA Certification Program. The industry-developed process and methodology outlined in Nuclear Energy Institute (NEI) 00-02 was used for the peer review. The review process was originally developed and used by the Boiling Water Reactor Owners Group (BWROG) and subsequently broadened to be an industry-applicable process through the NEI Risk Applications Task Force. The resulting industry document, NEI-00-02, describes the overall PRA peer review process. The Certification/Peer Review process is also linked to the ASME PRA Standard 10.

The objective of the PRA Peer Review process is to provide a method for establishing the technical quality and adequacy of a PRA for a range of potential risk-informed plant applications for which the PRA may be used. The PRA Peer Review process employs a team of PRA and system analysts, who possess significant expertise in PRA development and PRA applications. The team uses checklists to evaluate the scope, comprehensiveness, completeness, and fidelity of the PRA being reviewed. One of the key parts of the review is an assessment of the maintenance and update process to ensure the PRA reflects the as-built plant.

The review team for the McGuire PRA Peer Review consisted of six members. Three of the members were PRA personnel from other utilities. The remaining three were industry consultants. Reviewer independence was maintained by assuring that none of the six individuals had any involvement in the development of the McGuire PRA or Individual Plant Examination (IPE).

The results of the review provided strengths, weaknesses, and areas for improvement. Overall, the peer review indicated the process used and technical adequacy was satisfactory and acceptable for use in applications.

A summary of some of the McGuire PRA strengths and recommended areas for improvement from the peer review are as follows:

Strengths:

- Good Summary Report write-up with insights
- Good system notebooks
- Rigorous Level 2 & 3 PRA Model
- Integrated internal and external events model
- Up-to-date plant database using Maintenance Rule
- Ongoing PRA staff interaction with plant staff, plant staff reviews
- PRA personnel knowledge of plant good

Recommended Areas for Improvement:

- Better integration of sequences and recoveries within quantification process needed
- Need to review treatment of events requiring time-phasing in the modeling
- Better approach to closing the loop on PRA update items (tracking of errors/mods) needed
- More thorough, systematic approach to Human Reliability Analysis (HRA) screening values and common cause modeling needed
- Need an approach for reconciling realistic LERF model with NRC expectations from simplistic LERF modeling
- Need to update the PRA model to be more in line with current practices and expectations for state-of-the-art PRA

The significance levels of the WOG Peer Review Certification process have the following definitions:

A. Extremely important and necessary to address to ensure the technical adequacy of the PRA, the quality of the PRA, or the quality of the PRA update process.
B. Important and necessary to address but may be deferred until the next PRA update.

Based on the PRA peer review report, the McGuire PRA received six Fact and Observations (F&O) with the significance level of "A" and 31 F&O with the significance level of "B." All six of the "A" F&O have been resolved and changes are incorporated into the current McGuire internal events PRA model. The "B" F&O have been reviewed and prioritized for incorporation into the PRA. Twelve of the "B" F&O have already been incorporated into the current McGuire internal events PRA model. The 19 remaining F&O are dispositioned in Table 1 of Attachment 4.

The peer review team noted that the Duke Energy method of estimating LERF required a full Level 3 analysis, which was significantly different than the rest of the industry. As a result, the methodology was changed in 2005 to a LERF model based on the simplified containment event tree method described in NUREG/CR-6595. A focused peer review has not been performed for the upgraded LERF model, but a self assessment was

performed as described in the following section. Due to the overall decrease in LERF in the analysis, LERF is not significant for the application.

McGuire Internal Events PRA Model Self Assessment to Regulatory Guide 1.200

Subsequent to the previously discussed peer review, the ASME/ANS PRA Standard was developed and issued. A self assessment gap analysis was performed to evaluate the differences between the original peer reviews conducted using NEI 00-02 and RA-S-2008 of the ASME/ANS PRA Standard. The self assessment was performed in 2008, and minor revisions were performed in 2009. The results of this self assessment are documented in Duke Calculation DPC-1535.00-00-0013 Revision 2. The following discussion summarizes the self assessment.

Duke Energy performed a self assessment of the McGuire PRA against Regulatory Guide 1.200, Revision 1, "An Approach for Determining the Technical Adequacy of Probabilistic Risk Assessment Results for Risk-Informed Activities" and RA-S-2008 of the ASME/ANS PRA Standard. The assessment indicated that 230 of the 306 Supporting Requirements (SRs) for Revision 1 were fully met. In addition, 24 of the SRs were not applicable to McGuire, either because the referenced techniques were not used in the PRA or because the SR was not required for Capability Category (CC) II. Of the 52 open SRs, 42 require enhanced documentation, and only 10 were of a technical nature. The self assessment team indicated that none of the open items are expected to have a significant impact on the PRA results or insights. The SRs that were determined to be not met are dispositioned in Table 2 of Attachment 4.

PRA Maintenance and Update

The PRA is maintained and updated such that its representation of the as-built, as-operated plant is sufficient to support the applications for which it is used. Duke Energy maintains workplace procedures that evaluate and prioritize changes in PRA inputs as well as address discovery of new information that could affect the PRA.

The PRA model is reviewed whenever plant accident response characteristics are changed by hardware modifications. Any identifiable plant change is analyzed for its risk significance. This includes plant modifications, changes to Emergency or Abnormal Procedures, as well as Technical Specifications and Selected Licensee Commitment changes. The Duke Energy PRA group is on distribution for receipt of these changes from McGuire.

The PRA Section has implemented a living PRA database program (PRA Tracker) to provide the means for formal documentation, tracking and resolution of any potential changes to the PRA based on plant modifications, discovered errors or industry information. When an issue is identified that calls into question some aspect of the PRA model or related analysis, or if during the review of a site design change package some issue is identified, the issue is entered into the PRA Tracker program. At that time a determination of the risk significance of the issue based on CDF and LERF is made, placing the issue in one of the following three categories:

- the change in CDF or LERF is less than 1.0E-06 or 1.0E-07 / reactor-year, respectively = LOW risk significance

- the change in CDF or LERF is between 1.0E-06 to 1.0E-05 / reactor-year or 1.0E-07 to 1.0E-06 / reactor-year, respectively = MEDIUM risk significance
- the change in CDF or LERF is greater than 1.0E-05 or 1.0E-06 / reactor-year, respectively = HIGH risk significance

All open PRA Tracker items are reviewed prior to the start of an application for their impact on that application. There are no open HIGH PRA Tracker items. There are 12 open MEDIUM PRA Tracker items, which are dispositioned in Table 3 of Attachment 4.

Three LOW PRA tracker items were judged to have an impact on this application and were incorporated into the analysis, and are dispositioned in Table 4 of Attachment 4.

Flood Modeling Update to the Internal Events PRA Model

Westinghouse conducted a peer review of the McGuire Internal Flooding PRA update to RA-Sa-2009 of the ASME/ANS PRA Standard. The ASME/ANS PRA Standard contains a total of 316 numbered supporting requirements for internal events and internal flooding in nine technical elements. This focused-scope peer review covered a total of 62 supporting requirements associated with the Internal Flood PRA. One of the SRs was determined to be not applicable to the McGuire Internal Flood PRA. Of the 61 remaining SRs, 44 were rated as SR Met, Capability Category I/II, or greater. One SR was rated as Category I and 16 SRs were rated as not met. The 16 SRs rated as not met and the one SR rated as Category I have been addressed and there are no open issues. The 16 SRs not met and the SR rated as CC I are dispositioned in Table 5 of Attachment 4.

Fire PRA

The fire risk was evaluated using the McGuire Fire PRA. The Fire PRA was used to develop an ICCDP and ICLERP for each of the four battery maintenance configurations, and this ICCDP and ICLERP is summed with the results of the internal events PRA model sensitivity cases to produce the final values for the LAR.

In April 2010 Westinghouse conducted a peer review of the McGuire Fire PRA to the ASME/ANS PRA Standard. Section 4 of the ASME/ANS combined PRA Standard (Reference 1) contains a total of 182 Supporting Requirements (SRs) under thirteen technical elements, and configuration control from Section 1.5. Of these 182 SRs, thirty were determined to be not applicable to the McGuire Fire PRA. There were 16 SRs that were found to be not met, and of these 15 have been resolved and one item is a documentation issue judged to be insignificant to this risk evaluation.

The review team found that, in general, the methodologies being used were appropriate and sufficient to meet the standard. There were some areas where additional justification or documentation of the methodology or assumptions was needed. Based on the review team's conclusions and the subsequent resolution of the SRs not met, the McGuire Fire PRA is adequate for use in the vital battery LAR risk evaluation. The 16 SRs that were not met are dispositioned in Table 6 of Attachment 4.

External Events

Regulatory Guide 1.200 Revision 2 includes external events in the PRA quality assessment and provides a position to the current revision of the ASME / ANS PRA quality standard. Section 1-3 of the Standard outlines the risk assessment application process.

Seismic Assessment

The McGuire seismic PRA model is not used for this analysis, because it has not been peer reviewed. Therefore, the seismic risk is evaluated deterministically. The following two deterministic considerations for seismic risk during the vital battery replacement activities were considered:

- The risk of a seismic event directly causing a failure of a vital DC control power SSC was considered. Since the vital DC control power SSCs are located in a seismically qualified structure and are seismically mounted, it is expected that seismic event of sufficient magnitude to damage a vital DC SSC will likely damage multiple vital DC SSCs. This is true for configurations where there is no battery maintenance in progress, as well as for the proposed battery replacement configuration. Therefore, the analysis for the vital battery LAR application is not considered to be sensitive to failures of vital DC control power SSCs caused by seismic events.

- A seismic event could result in a LOOP, but since the seismic Initiating Event Frequency (IEF) is approximately two orders of magnitude less than the LOOP IEF, LOOP events are significantly more likely to occur due to non-seismic events. Therefore, the analysis for the vital battery LAR application is not considered to be sensitive to LOOP events resulting from seismic initiators.

Tornado / High Winds Assessment

The McGuire tornado PRA model has not been peer reviewed. Therefore, the tornado risk for this LAR submittal is evaluated deterministically. The following two deterministic considerations for tornado risk during the vital battery replacement activities were considered:

- The vital DC control power SSCs are located in a structure qualified to withstand tornados. It is expected that a tornado will not directly cause damage to vital DC control power SSCs. This is true for configurations where there is no battery maintenance in progress, as well as for the proposed battery replacement configuration. Therefore, the analysis for the vital battery LAR application is not considered to be sensitive to failures of vital DC control power SSCs caused by tornado events.

- A tornado event could result in a LOOP, but since the tornado Initiating Event Frequency (IEF) is approximately two orders of magnitude less than the LOOP IEF, LOOP events are significantly more likely to occur due to causes other than

tornados. Therefore, the analysis for the vital battery LAR application is not considered to be sensitive to LOOP events resulting from tornado initiators.

Truncation Limit

Regulatory Guide 1.177 states that if the component in question appears in the cut sets near the truncation limit (e.g., all appearances are in cut sets within a factor of 10 of the truncation limit), it may be necessary to reduce the truncation limit. This is not an issue for this analysis; there is adequate representation of the expected failure in the results that drive the answer so that there was no need to solve to any lower truncation levels.

Uncertainty and Sensitivity

As stated in Regulatory Guide 1.177 Section 2.3.5, risk analyses of CT extensions are relatively insensitive to uncertainties. The PRA did not credit equipment repair so there are no uncertainties to be evaluated for that issue. Important systems are required to remain in service during the CT so no issues with mean downtimes should exist. Thus uncertainty and sensitivity are not expected to alter the conclusions of the evaluation.

Internal Events Risk Insights

The internal events PRA model with updated flood modeling was used for this analysis. Base CDF and LERF are 3.42E-05/ reactor-year and 2.64E-06/ reactor-year, respectively.

Base Case Model Modifications

The base model was modified by incorporating applicable PRA Tracker items and removing modeling for fire events (Modeling for fire events was removed because the Fire PRA was used to evaluate the fire risk). The resulting modified base CDF and LERF are 5.59E-05/ reactor-year and 6.79E-06/ reactor-year, respectively. When adjusted to reactor-operating-state-year values using a capacity factor of 0.9, the resulting base CDF and LERF are 6.21E-05/ reactor-operating-state-year and 7.54E-06/ reactor-operating-state-year, respectively.

Nominal Maintenance Sensitivity Cases

An internal events sensitivity case was performed for each of the four batteries in maintenance. The ICCDP and ICLERP were calculated based on the proposed 14 day CT. The delta CDF and delta LERF were calculated based on the 11 day extension. The sensitivity case analysis was performed by setting the applicable battery maintenance event to 1 and updating the T14 initiator to reflect the battery in maintenance. Additionally, for the sensitivity cases for batteries EVCA and EVCD, the control power logic for essential switchgear ETA and ETB was modified to reflect that with these batteries in maintenance, the control power logic relies on batteries EVCC and EVCB. Battery EVCC produced no change in risk, because the equipment supplied by EVCC is less risk significant that the other three batteries. Specifically, the other three batteries supply various combinations of control power for pressurizer power operated relief valves (PORVs) and/or Refueling Water Storage Tank (RWST) level channels. EVCC does not supply this equipment.

Internal Events Sensitivity Cases (Nominal Maintenance)				
	ICCDP	ICLERP	delta CDF	delta LERF
Battery EVCA	1.70E-08	2.13E-09	1.34E-08	1.67E-09
Battery EVCB	2.98E-08	2.56E-09	2.34E-08	2.01E-09
Battery EVCC	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Battery EVCD	5.11E-08	5.11E-09	4.02E-08	4.02E-09
Sum	9.79E-08	9.80E-09	7.70E-08	7.70E-09

Eight Fire PRA sensitivity cases were performed, four per unit (the Fire PRA is a dual unit model). Due to asymmetries in the physical layout of plant equipment, the results were different between Unit 1 and Unit 2. The highest result for each battery was used in the analysis, and the results are summarized in the following table:

Fire PRA Sensitivity Cases				
	ICCDP	ICLERP	delta CDF	delta LERF
Battery EVCA	1.92E-08	3.45E-09	1.51E-08	2.71E-09
Battery EVCB	2.30E-08	1.15E-09	1.81E-08	9.04E-10
Battery EVCC	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Battery EVCD	3.45E-08	4.22E-09	2.71E-08	3.32E-09
Sum	7.67E-08	8.82E-09	6.03E-08	6.93E-09

The four internal events sensitivity cases and the highest results of the fire PRA sensitivity cases for each battery are summed to produce a combined ICCDP and ICLERP. The following table summarizes the combined results.

Summed Internal Events and Fire PRA Sensitivity Cases				
	ICCDP	ICLERP	delta CDF	delta LERF
Internal Events Sensitivity Cases	9.79E-08	9.80E-09	7.70E-08	7.70E-09
Fire PRA Sensitivity Cases	7.67E-08	8.82E-09	6.03E-08	6.93E-09
Total	1.75E-07	1.86E-08	1.37E-07	1.46E-08

Restricted Maintenance Sensitivity Cases

To further reduce the risk of the maintenance configuration, additional internal events sensitivity cases were performed for each battery assuming zero maintenance on key equipment appearing in the cut sets. This equipment is listed in the compensatory

measures by stating that maintenance will not be allowed. The ICCDP and ICLERP results for the additional sensitivity cases are provided in the following table. The negative number results indicate that deferring routine maintenance on the equipment reduces the risk to less than the base case.

Internal Events Sensitivity Cases (Restricted Maintenance)				
	ICCDP	**ICLERP**	**delta CDF**	**delta LERF**
Battery EVCA	-1.36E-07	-1.96E-08	-1.07E-07	-1.54E-08
Battery EVCB	-1.32E-07	-2.00E-08	-1.04E-07	-1.57E-08
Battery EVCC	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Battery EVCD	-1.11E-07	-1.75E-08	-8.71E-08	-1.37E-08
Sum	-3.79E-07	-5.71E-08	-2.98E-07	-4.48E-08

To simplify the modeling, restricted maintenance evaluations were not performed for the Fire PRA sensitivity cases. This is conservative because applying restricted maintenance evaluations to the Fire PRA sensitivity cases would produce a lower risk result (more negative).

The results of the internal events sensitivity cases with maintenance restricted on selected equipment are summed with the highest results of the Fire PRA sensitivity cases to produce a total ICCDP and ICLERP for the configuration. The results are provided in the following table:

Summed Internal Events Sensitivity Cases (Restricted Maintenance) and Fire PRA Sensitivity Cases				
	ICCDP	**ICLERP**	**delta CDF**	**delta LERF**
Internal Events Sensitivity Cases (Restricted Maintenance)	-3.79E-07	-5.71E-08	-2.98E-07	-4.48E-08
Fire PRA Sensitivity Cases	7.67E-08	8.82E-09	6.03E-08	6.93E-09
Total	-3.03E-07	-4.83E-08	-2.38E-07	-3.79E-08

Regulatory Guide 1.177 indicates that the ICCDP and ICLERP should be less than 1.0E-06 and 1.0E-07, respectively. The total ICCDP and ICLERP indicate a risk decrease, which meets the guideline. Due to the calculated ICCDP and ICLERP being negative values (i.e. risk is less than the base case due to deferring routine maintenance on selected equipment), it is judged that the risk of the requested Completion Time extension is insignificant.

The analysis shows a decrease in CDF and LERF, which meets the recommendations in Regulatory Guide 1.174 for delta CDF and delta LERF.

3.9.2 Tier 2 - Avoidance of Risk-Significant Configurations

Risk significant plant equipment outage configurations were identified using PRA insights gained from review of the cut sets.

The insights gained from the cut sets review show that LOOP events are the dominant risk contributor. Based on these insights, the analysis was refined to assume that no elective maintenance would be performed on the following SSCs during the vital battery replacements. Note that vital battery EVCC maintenance does not result in as much risk as the other batteries because the equipment receiving control power from battery EVCC is less significant than the other vital batteries. However, standard plant practices do not typically allow work on opposite train equipment, so from a practical standpoint a comparable list of equipment is established for deferral of routine maintenance.

Compensatory Measures

1. The following SSCs will be protected and routine maintenance deferred during each respective vital battery replacement:

   Battery EVCA replacement

   - Vital channels B, C, D
   - McGuire Switchyard
   - Safe Shutdown facility and associated equipment (SSF)
   - Emergency Diesel Generators (EDG) 1B, 2B
   - Component Cooling water trains (KC) 1B, 2B
   - Nuclear Service Water trains (RN) 1B, 2B
   - Motor driven Auxiliary Feedwater (CA) pumps 1B, 2B
   - Unit 1 and 2 Turbine driven CA pumps
   - Diesel powered Instrument Air (VI) compressors G, H

   Battery EVCB replacement

   - Vital channels A, C, D
   - McGuire Switchyard
   - SSF
   - EDG 1A, 2A
   - KC trains KC 1A, 2A
   - RN trains RN 1A, 2A
   - Motor driven CA pumps 1A, 2A
   - Unit 1 and 2 Turbine driven CA pumps
   - Diesel powered VI compressors G, H

Battery EVCC replacement

- Vital channels A, B, D
- McGuire Switchyard
- SSF
- EDG 1B, 2B
- KC trains KC 1B, 2B
- RN trains RN 1B, 2B
- Motor driven CA pumps 1B, 2B
- Unit 1 and 2 Turbine driven CA pumps
- Diesel powered VI compressors G, H

Battery EVCD replacement

- Vital channels A, B, C
- McGuire Switchyard
- SSF
- EDG 1A, 2A
- KC trains KC 1A, 2A
- RN trains RN 1A, 2A
- Motor driven CA pumps 1A, 2A
- Unit 1 and 2 Turbine driven CA pumps
- Diesel powered VI compressors G, H

2. A temporary battery located in the Service Building is available as a defense in depth measure. The temporary battery will be charged and has the necessary connections to tie-in to any of the four DC distribution centers, if necessary.

3. The ambient temperature and hydrogen concentration of the area containing the temporary battery will be monitored once per a 12-hour shift to ensure they remain within battery specifications.

4. The ventilation in the area containing the temporary battery will be supplemented with fans to ensure good air flow and mixing across the temporary battery.

5. Appropriate training will be provided to Operations Shift personnel regarding the vital battery replacement evolution, emergency procedures, and spare battery alignment.

6. Pre-job briefings will be provided to Maintenance and Vendor personnel each shift during the vital battery replacement evolutions.

7. Prior to the start of each TS Completion Time extension, McGuire will monitor the National Weather Service for potential severe weather conditions. To the extent practical, severe weather conditions will be avoided.

8. Prior to the start of each TS Completion Time extension, McGuire will contact the Transmission Control Center (TCC) regarding system grid stability. To the extent practical, system grid instability will be avoided.

3.9.3 Tier 3 - Risk-Informed Configuration Risk Management

10 CFR 50.65 (a)(4), Regulatory Guide 1.182, and NUMARC 93-01 require that prior to performing maintenance activities, risk assessments shall be performed to assess and manage the increase in risk that may result from proposed maintenance activities. These requirements are applicable for all plant modes. NUMARC 91-06 requires utilities to assess and manage the risks that occur during the performance of outages.

The proposed LAR is not expected to result in any significant changes to the current configuration risk management program. The existing program uses a blended approach of quantitative and qualitative evaluation of each configuration assessed. The McGuire on-line computerized risk software, Electronic Risk Assessment Tool (ERAT), considers both internal and external initiating events with the exception of seismic events. Thus, the overall change in plant risk during maintenance activities is expected to be addressed adequately considering the proposed amendment.

McGuire has several Nuclear System Directives (NSD) and Work Process Manual (WPM) procedures that are in place to ensure that risk significant plant configurations are avoided. These documents are used to address the Maintenance Rule requirements, including the on-line (and off-line) Maintenance Policy requirement to control the safety impact of combinations of equipment removed from service. The key documents are as follows:

- NSD 213, "Risk Management Process"
- NSD 403, "Shutdown Risk Assessment (Modes 4, 5, 6, and No-Mode) per 10 CFR 50.65 (a)(4)"
- NSD 415, "Operational Risk Management (Modes 1-3) per 10 CFR 50.65 (a)(4)"
- WPM-609, "Innage Risk Assessment Utilizing Electronic Risk Assessment Tool (ERAT)"
- WPM-608, "Outage Risk Assessment Utilizing Electronic Risk Assessment Tool (ERAT)"

More specifically, the NSDs referenced above address the process; define the program, and state individual group responsibilities to ensure compliance with the Maintenance Rule. The Work Process Manual procedures provide a consistent process for utilizing the computerized software assessment tool, ERAT, which manages the risk associated with equipment inoperability.

The Electronic Risk Assessment Tool (ERAT) is a Windows-based computer program used to facilitate risk informed decision making associated with station work activities. Its guidelines are independent of the requirements of the Technical Specifications and Selected Licensee Commitments and are based on probabilistic risk assessment studies and deterministic approaches.

Additionally, prior to the release of work for execution, Operations personnel must consider the effects of severe weather and grid instabilities on plant operations. This qualitative evaluation is inherent of the duties of the Work Control Center Senior Reactor Operator (WCC SRO). Responses to actual plant risk due to severe weather or grid instabilities are programmatically incorporated into applicable plant emergency or response procedures.

The key safety significant systems impacted by this proposed LAR are currently included in the Maintenance Rule program, and as such, availability and reliability performance criteria have been established to assure that they perform adequately.

3.10 Conclusion

Even though all the current McGuire vital battery banks are operable from a capacity standpoint, physical degradation will eventually start to accelerate as a result of the nodular corrosion phenomenon. Consequently, replacing all four vital batteries prior to the end of their 20 year service life needs to be performed.

During the time period of each vital battery bank replacement, the associated DC channel will remain energized by being cross-tied to another operable DC channel as allowed by TS 3.8.4 Condition A. In addition, a temporary, spare battery will be available as an additional, backup DC power supply.

Duke Energy used a combination of a deterministic approach and Probabilistic Risk Analysis (PRA) insights to evaluate operating both units with one vital battery inoperable for an extended period of time. The configuration risk for this temporary one-time change was judged to be insignificant.

Given the above, there is no significant decrease in margin of safety or increased risk of core damage associated with this license amendment request.

4.0 REGULATORY EVALUATION

4.1 Applicable Regulatory Requirements/Criteria

10 CFR 50, Appendix A, General Design Criterion (GDC) 17, "Electric Power Systems," requires, in part, that "An onsite electric power system and an offsite electric power system shall be provided to permit functioning of structures, systems, and components important to safety ... The onsite electric power supplies, including the batteries, and the onsite electric distribution system, shall have sufficient independence, redundancy, and testability to perform their safety functions assuming a single failure. Provisions shall be included to minimize the probability of losing electric power from any of the remaining supplies as a result of, or coincident with, the loss of power generated by the nuclear power unit, the loss of power from the transmission network, or the loss of power from the onsite electric power supplies."

10 CFR 50, Appendix A, GDC 18, "Inspection and Testing of Electric Power Systems," requires, in part, that "Electric power systems important to safety shall be designed to permit appropriate periodic inspection and testing ... "

10 CFR 50.63, "Loss of All Alternating Current Power," requires, in part, that "Each light-water-cooled nuclear power plant licensed to operate must be able to withstand for a specified duration and recover from a station blackout ..."

During the time period of each vital battery bank replacement, the associated DC channel will remain energized by being cross-tied to another operable DC channel as allowed by TS 3.8.4 Condition A. In addition, a temporary, spare battery will be available as an additional, backup DC power supply.

For all design basis events, any single battery by itself can supply an entire train of DC loads. The interaction between each unit's 125 VDC system is limited such that allowable combinations of maintenance and test operations as governed by the plant Technical Specifications will not preclude the system's capability to automatically supply power to minimum ESF DC loads in either unit, assuming a LOOP.

All four vital batteries have been sized to carry the load duty cycle during LOCA and LOOP conditions for their respective bus/train while maintaining battery terminal voltage above 105 VDC for 60 cells in a cross-tied alignment. Each battery carries DC relays, trip coils, lights and momentary charging spring motor loads, as well as two inverters.

Thus during the replacement periods, compliance with the above regulatory requirements will not be affected. In addition, the new 125 VDC batteries are identical in design and function to the existing batteries thus will continue to meet the above regulatory requirements.

4.2 Precedents

The following License Amendment Requests to replace the station batteries have been submitted and approved by the NRC. McGuire has reviewed these Amendments, the RAIs, and the NRC Safety Evaluations and has modeled this submittal after these:

1. Duane Arnold received NRC approval on October 1, 2002 (NRC ADAMS ML No. 022280041).
2. Indian Point received NRC approval on September 19, 2001 (NRC ADAMS ML No. 011990082).
3. Braidwood received NRC approval on March 26, 1999 (NRC ADAMS ML No. 021820479).
4. McGuire received NRC approval on February 7, 1997 (NRC ADAMS ML No. 013230346).
5. Oconee Nuclear Station received NRC approval on August 30, 2010 (NRC ADAMS ML No. 102210354).
6. Salem Unit 2 received NRC approval on September 1, 2010 (NRC ADAMS ML No. 102150499)

4.3 Significant Hazards Consideration

Pursuant to 10 CFR 50.90, Duke Energy Carolinas, LLC (Duke Energy) proposes a license amendment request (LAR) for the Renewed Facility Operating License (FOL) and Technical Specifications for McGuire Nuclear Station, Units 1 and 2.

The proposed LAR would revise the McGuire TS 3.8.4 Condition A. to allow replacement of the existing 125 VDC vital batteries while at power. This proposed LAR would be applicable one-time for each of the four battery channels. The vital batteries were last replaced in 1997 under a similar one-time TS change. All four vital battery channels are currently operable but a physical degradation phenomenon will shorten their 20 year nominal service life.

Since vital battery replacement cannot be accomplished within the Completion Times currently allowed by TS 3.8.4 due to the number of activities, inspections, and tests, the proposed LAR would extend the Completion Time to 14 days for each battery channel replacement. During the time period of each battery bank replacement, the associated DC channel will remain energized by being cross-tied to another operable DC channel as allowed by TS 3.8.4 Condition A. In addition, a temporary, spare battery will be available as an additional, backup DC power supply.

Duke Energy has concluded that operation of the McGuire Nuclear Station Units 1 & 2 in accordance with the proposed changes to the Technical Specifications (TS) does not involve a significant hazards consideration. Duke Energy's conclusion is based on its evaluation, in accordance with 10CFR50.91(a)(1), of the three standards set forth in 10CFR50.59(c) as discussed below:

1. Does the proposed amendment involve a significant increase in the probability or consequences of an accident previously evaluated?

   Response: No.

   All four vital batteries are sized to serve normal and emergency loads of both buses. They independently have the capacity to automatically supply minimum engineered safety feature DC loads for accident conditions in one unit and safely shut down the other unit assuming both a loss of offsite power and a single failure in the 125 VDC system. So the probability of accident conditions occurring is not impacted by removing a vital battery for replacement.

   The consequences associated with permitting a vital battery to be out of service for up to 14 days have been evaluated and determined to be risk insignificant with equipment protection and compensatory measures in place. The use of this provision is also infrequent since vital battery replacement is performed at or near the end of the designed 20 year life.

   Therefore, the proposed change does not involve a significant increase in the probability or consequences of an accident previously evaluated.

2. Does the proposed amendment create the possibility of a new or different kind of accident from any accident previously evaluated?

   Response: No.

   Operation in accordance with the proposed LAR will not result in any new permanent plant equipment, alter the present plant configuration, nor adversely affect how the plant is currently operated. During the time period of each vital battery bank replacement, the associated DC channel will remain energized by being cross-tied to another operable DC channel as designed and as allowed by TS 3.8.4 Condition A.

   No new accident causal mechanisms are created as a result of this proposed LAR. No changes are being made to any structure, system, or component which will introduce any new accident causal mechanisms. This LAR does not impact any plant systems that are accident initiators and does not impact any safety analysis.

   Therefore, the proposed changes do not create the possibility of a new or different kind of accident from any accident previously evaluated.

3. Does the proposed amendment involve a significant reduction in the margin of safety?

   Response: No.

   The proposed LAR does not physically alter the present plant design nor affect how the plant is currently operated. This activity only extends the amount of time that vital DC channels are allowed to be cross-tied. So a significant reduction in the margin of safety does not occur.

   Margin of safety is related to the confidence in the ability of the fission product barriers to perform their design functions during and following an accident situation. These barriers include the fuel cladding, the reactor coolant system, and the containment system. The performance of the fuel cladding, reactor coolant and containment systems will not be impacted by the proposed LAR.

   Therefore, it is concluded that the proposed changes do not involve a significant reduction in the margin of safety.

4.4 Conclusions

Based upon the above evaluation, Duke Energy concludes that the proposed amendment presents no significant hazards consideration under the standards set forth in 10 CFR 50.92(c) and, accordingly, a finding of "no significant hazards consideration" is justified.

In conclusion, based the considerations discussed above, (1) there is reasonable assurance that the health and safety of the public will not be endangered by operation in

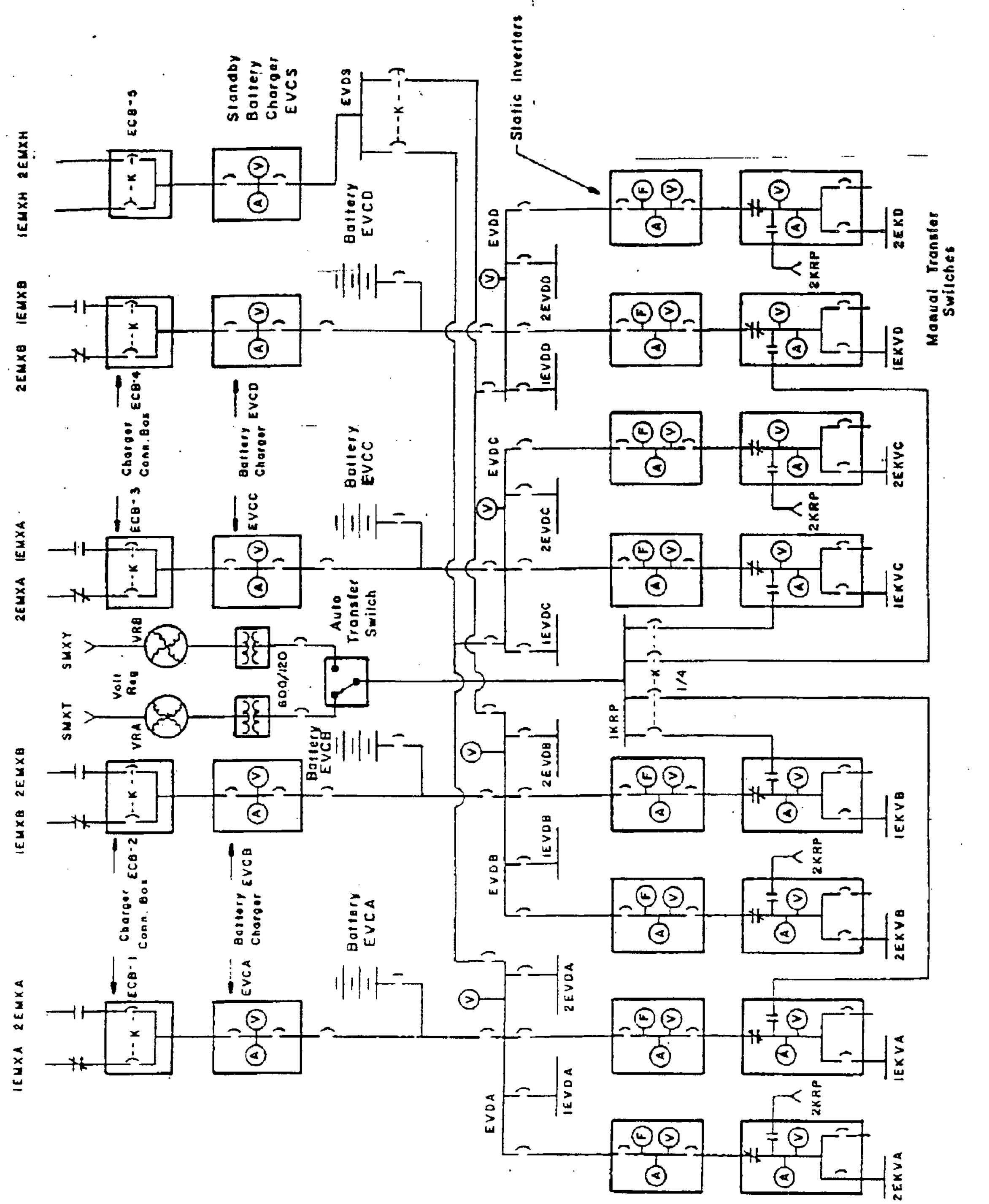
the proposed manner, (2) such activities will be conducted in compliance with NRC regulations, and (3) the issuance of the amendment will not be inimical to the common defense and security or to the health and safety of the public

5.0 ENVIRONMENTAL CONSIDERATIONS

A review by Duke Energy has determined that the proposed amendment would temporarily change a requirement with respect to use of a facility component located within the restricted area, as defined in 10 CFR 20. However, the proposed amendment does not involve (i) a significant hazards consideration, (ii) a significant change in the types or significant increase in the amounts of any effluent that may be released onsite, or (iii) a significant increase in individual or cumulative occupational radiation exposure. Accordingly, the proposed amendment meets the eligibility criterion for categorical exclusion set forth in 10 CFR 51.22(c)(9).

Therefore, pursuant to 10 CFR 51.22(b), no environmental impact statement or environmental assessment need be prepared in connection with the proposed amendment.

Figure 8-35. Vital Instrument and Control Power System (EPG)



ATTACHMENT 2

Marked-Up McGuire Technical Specification

3.8 ELECTRICAL POWER SYSTEMS

3.8.4 DC Sources — Operating

LCO 3.8.4 The four channels of DC sources shall be OPERABLE.

APPLICABILITY: MODES 1, 2, 3, and 4.

ACTIONS

CONDITION	REQUIRED ACTION	COMPLETION TIME
A. One channel of DC source inoperable.	A.1 Restore channel of DC source to OPERABLE status.	2 hours
	OR	
	A.2.1 Verify associated bus tie breakers are closed between DC channels.	2 hours
	AND	
	A.2.2 Restore channel of DC source to OPERABLE status.	72 hours *
B. Required Action and Associated Completion Time not met.	B.1 Be in MODE 3.	6 hours
	AND	
	B.2 Be in MODE 5.	36 hours

* The Completion Time that one channel of DC source can be inoperable as specified by Required Action A.2.2 may be extended beyond the "72 hours" up to a total of 14 days as part of the battery replacement project. This allowance may be used one-time for each of the four DC channels. Upon completion of the battery replacement project, this footnote is no longer applicable and will expire on December 31, 2014."

ATTACHMENT 3

Regulatory Commitments

REGULATORY COMMITMENTS

The following Table identifies those actions committed to by Duke Energy McGuire in this document. Any other statements made in this submittal are provided for informational purposes and are not considered to be regulatory commitments.

COMMITMENT	TYPE	DUE DATE
During replacement of battery EVCA, the following systems and components will be protected and routine maintenance deferred: • Vital channels B, C, D • McGuire Switchyard • Safe Shutdown facility and associated equipment (SSF) • Emergency Diesel Generators (EDG) 1B, 2B • Component Cooling water trains (KC) 1B, 2B • Nuclear Service Water trains (RN) 1B, 2B • Motor driven Auxiliary Feedwater (CA) pumps 1B, 2B • Unit 1 and 2 Turbine driven CA pumps • Diesel powered Instrument Air (VI) compressors G, H	One time	During EVCA battery replacement.
During replacement of battery EVCB, the following systems and components will be protected and routine maintenance deferred: • Vital channels A, C, D • McGuire Switchyard • SSF • EDG 1A, 2A • KC trains KC 1A, 2A • RN trains RN 1A, 2A • Motor driven CA pumps 1A, 2A • Unit 1 and 2 Turbine driven CA pumps • Diesel powered VI compressors G, H	One time	During EVCB battery replacement.

COMMITMENT	TYPE	DUE DATE
During replacement of battery EVCC, the following systems and components will be protected and routine maintenance deferred: • Vital channels A, B, D • McGuire Switchyard • SSF • EDG 1B, 2B • KC trains KC 1B, 2B • RN trains RN 1B, 2B • Motor driven CA pumps 1B, 2B • Unit 1 and 2 Turbine driven CA pumps • Diesel powered VI compressors G, H	One time	During EVCC battery replacement.
During replacement of battery EVCD, the following systems and components will be protected and routine maintenance deferred: • Vital channels A, B, C • McGuire Switchyard • SSF • EDG 1A, 2A • KC trains KC 1A, 2A • RN trains RN 1A, 2A • Motor driven CA pumps 1A, 2A • Unit 1 and 2 Turbine driven CA pumps • Diesel powered VI compressors G, H	One time	During EVCD battery replacement.
A temporary battery located in the Service Building is available as a defense in depth measure. The temporary battery will be charged and has the necessary connections to tie-in to any of the four DC distribution centers, if necessary.	One time	During each TS Completion Time extension
The ambient temperature and hydrogen concentration of the area containing the temporary battery will be monitored once per a 12-hour shift to ensure they remain within battery specifications.	Ongoing until spare battery is removed.	Prior to installation of spare battery.

COMMITMENT	TYPE	DUE DATE
The ventilation in the area containing the temporary battery will be supplemented with fans to ensure good air flow and mixing across the temporary battery.	Ongoing until spare battery is removed.	Prior to installation of spare battery.
Prior to the start of each TS Completion Time extension, McGuire will monitor the National Weather Service for potential severe weather conditions. To the extent practical, severe weather conditions will be avoided.	One time	Prior to the start of each TS Completion Time extension
Prior to the start of each TS Completion Time extension, McGuire will contact the Transmission Control Center (TCC) regarding system grid stability. To the extent practical, system grid instability will be avoided.	One time	Prior to the start of each TS Completion Time extension
Appropriate training will be provided to Operations Shift personnel regarding the vital battery replacement evolution, emergency procedures, and spare battery alignment.	One time	Prior to battery replacements.
Pre-job briefings will be provided to Maintenance and Vendor personnel each shift during the vital battery replacement evolutions.	Ongoing	Prior to battery replacements.

ATTACHMENT 4

PRA Evaluation Tables

#	Table 1: McGuire Internal Events PRA Model Peer Review Open F&Os	
	Peer Review F&O Description	Disposition
1	The failure rate of CMS in Rev. 2 and in the generic data of Rev. 3 is 2.9E-2 in both, but after Bayesian updating, in Rev. 3, the failure rate is 3.2E-5. The demand data for CMR and CMS grouped Reciprocating Compressors A, B, C, D, E, & F, and Compressor 1A1, 1A2, 1B1, & 1B2 together. Compressors 1A1, 1B1, 1A2, 1B2 only have 1 start and 8760 hours running for each, whereas the Reciprocating Compressors have 54 starts and 14 hours running for each. Given the significantly different operating experience, these two kinds of compressors should not be grouped together to evaluate the failure rate. The failure rate for the compressor is significantly reduced from Rev 2 to Rev 3 and is greatly below the generic data. The reviewers suspect that this is because of the inappropriate combination of the demands and failures noted above. Possible Resolution: Separate the compressors into two groups and evaluate the failure rates separately.	The air compressors identified in this F&O are not significant for event sequences involving vital DC control power. Dominant event sequences related to vital DC control power are LOOP events that rely on the diesel air compressors, which are not impacted by this F&O.
2	Loss of HVAC initiator was removed, because operators may shut down the plant from remote locations (the Auxiliary Shutdown Panel and the SSF) if the Control Room is incapable of maintaining inventory control. Not only the control room, but also the switch gear room may be affected by the failed HVAC. A particular example of interest is the possibility that the switch gear room AHU might fail but the HVAC chiller is working, in which case operators may not realize the situation in time. CDF may be affected by such an initiator. Possible Resolution: Perform/document additional evaluation of loss of switchgear room HVAC and, if appropriate, develop a new event tree to analyze the sequence of loss of switch gear room cooling.	Information in the Basis for Selected Licensee Commitment (SLC) 16.9.22 (Switchgear Room Ventilation System) indicates that the purpose of the switchgear room HVAC is to assure equipment service life, and short term failure of the HVAC does not affect operability. This F&O will not impact the risk evaluation for the vital battery LAR application.
3	An analysis is available of the effect of overpressurizing the RHR discharge line to the RCS. The analysis considers the effect of static pressure on the piping integrity by comparing the calculated hoop stress from static RCS pressure and the ultimate strength of the piping. The results show that expected hoop stresses are below the ultimate strength and thus piping failures are not expected to occur. The analysis then assesses the impact of damaging all sealant materials in the lines (gaskets, valve packing, etc.) to conclude that the break area can be conservatively bounded by a 13.5 inch equivalent diameter break. Based on this, all ISLOCAs go to core damage.	Implementation of the new ISLOCA methodology (WCAP-17154-P, Rev. 0) is expected to result in a decrease in CDF and LERF. The conclusions of the vital battery LAR risk

#	Table 1: McGuire Internal Events PRA Model Peer Review Open F&Os	
	Peer Review F&O Description	**Disposition**
	The present approach does not consider dynamic effects of the isolation valve failures with respect to piping integrity. The present approach also does not factor in later industry generic analyses and methodology, e.g., NUREG/CR-5744. If piping failures are considered to have a non-zero failure probability, then other specific failure locations can be considered for which some response is available to avoid core damage. As documented in NUREG/CR-5744, other components such as RHR heat exchanger components, flanges, etc. often represent the weak links. Rather than consider these as a single equivalent large break, as was done for the current McGuire ISLOCA evaluation, specific scenarios could be addressed explicitly, following the NUREG methodology. In addition, there would be a scenario involving a small but nonzero pipe rupture probability to address. In summary, assigning a zero probability of gross piping system rupture due to a simple pipe hoop stress computation is not consistent with current PRA practice for these events; the present approach may not be sufficiently realistic, and may overstate the ISLOCA CDF contribution. Since the ISLOCA is the major contributor to LERF, changes in the ISLOCA model could have a significant impact on the McGuire LERF calculations. Possible Resolution: Consider implementing the more recent methodology, including the dynamic effects of valve rupture on piping integrity and possibly incorporating the results of the ongoing risk-informed in-service inspection of piping study if appropriate, to ensure that the McGuire approach is sufficiently realistic.	evaluation are conservative.

#	Table 1: McGuire Internal Events PRA Model Peer Review Open F&Os	
	Peer Review F&O Description	Disposition
4	There is a significant amount of operator action and equipment recovery credited in the CET. · There is insufficient basis presented for the recovery probabilities. Since the present CET was done before the development of McGuire SAMG, the basis for the recovery probabilities is not clear, are they from the EOPs? from EPRI-TR-101689? from Draft WOG SAMG? · The basis for the operator action success is not apparent; a rigorous HRA does not appear to have been used. · It appears that the equipment recovery was determined from a review of the cut sets that end up in each PDS. This avoids double counting of equipment usage as long as the Level 1 PRA "recovery" is adequately designated in the PDS. The split fractions used in the CET should be more rigorously developed, especially for the operator actions. Proposed Resolution: Implement a more rigorous treatment of HRA, including supporting timing and success criteria analyses if necessary, to quantify CET operator actions and equipment recovery.	A recent update of the Oconee PRA model demonstrated that the HRA methodology for operator actions used at the time of the McGuire peer review produced conservative results, largely due to overestimation of the impact of dependencies. The peer review team noted that the Duke method of quantifying LERF was significantly different than the rest of the industry. As a result, the LERF model was upgraded in 2005 to the simplified method described in NUREG/CR-6595. This F&O is not expected to affect the overall conclusions of the vital battery LAR submittal.
5	The McGuire CET is more complete than most industry efforts in terms of the modeling of equipment recovery and post-core damage operator actions. However, this modeling was done prior to the development of the McGuire SAMG. Thus the CET may not be consistent with current accident management practices at McGuire station. Could impact CET results, but not likely to impact LERF results.	The peer review team noted that the Duke method of quantifying LERF was significantly different than the rest of the industry. As a result, the LERF model was upgraded in 2005 to the

#	Table 1: McGuire Internal Events PRA Model Peer Review Open F&Os	
	Peer Review F&O Description	Disposition
		simplified method described in NUREG/CR-6595. This F&O is not expected to affect the overall conclusions of the vital battery LAR submittal.
6	The Level 2 analysis was done with MAP 3b, Versions 11 and 16. Significant improvements to MAAP code models have been implemented in both MAAP 3b (up to Version 21) and MAAP 4.0 since that time. The impact of these improvements on the McGuire Level 2 and LERF results is unclear. Could impact CET results, but is not likely to impact LERF results. Thus, for applications sensitive to releases other than LERF, this could be important.	Same as disposition for Item # 5.
7	There is no room heatup analysis notebook / evaluation of loss of HVAC to equipment rooms for the McGuire PRA, and apparently no retrievable room heatup calculations or documentation to support the assumption that room cooling need not be modeled in the PRA. Other PRAs have found that room cooling is required for some rooms such as electrical equipment rooms and small rooms housing critical pumps. (Internal Duke corrspondence, and past interactions with NRC, have also identified this as an area requiring attention.) Failure of room cooling is typically detectable such that recovery actions are possible to limit impacts. However, without an evaluation, it is difficult to ascertain whether or not there are specific areas requiring cooling for equipment success. Proposed Resolution: Perform an evaluation, with equipment room-specific calculations, if possible, of the potential for, and magnitude of the room heatup for rooms housing electrical equipment, pumps, and other key equipment credited in the PRA. Document the basis for any determinations that equipment will survive the anticipated room heatups, and model loss of room cooling as a failure mode in the system fault trees (with recoveries as appropriate) for equipment that may not survive the anticipated heatup for the PRA mission time.	This F&O is under evaluation as part of the in-progress McGuire PRA model update. Equipment rooms that have not been screened or previously modeled will be modeled as part of the update. Based on the results of a recent model update at Oconee, it is the judgment of the analyst that any potential impact from HVAC failures at McGuire would be small and would not change the overall conclusions of the vital battery LAR analysis.
8	Appendix F.5, Auxiliary Feedwater System (CA) states that "If, during CA operation, the suction pressure drops below a preset pressure for three seconds, the RN (Nuclear Service Water) System water source is aligned automatically" [pg. F.5-7, Rev 3]. Design Basis Specification for the CA System, Spec. MCS-1592.CA-00-0001, Revision 12, page 50, section 31.3.2.6 lists six valves that must automatically swap position (closed to open) to	This F&O is under evaluation as part of the in-progress McGuire PRA model update. The failure

#	Table 1: McGuire Internal Events PRA Model Peer Review Open F&Os	
	Peer Review F&O Description	**Disposition**
	provide nuclear service water to the suction of the auxiliary feedwater pumps based on the response of six suction pressure switches. These pressure switches do not seem to be modeled nor is an operator action to open the six RN suction supply valves to CA due to CCF of the pressure switches to provide signal to automatically open the supply valves. An operator action to open the RN supply to CA in the event of automatic swapover failure could be an important event in the PRA model; the impact of the actuation logic components should also be addressed so that the model is complete. Proposed Resolution: Evaluate the need for modeling of the pressure switches and/or operator action discussed above; incorporate into the model or document the rationale for excluding.	of the assured path due to clam clogging is the dominant failure mode. Other failures of equipment in this path will be overshadowed by the clogging failure. Engineering judgment is that any potential impact from pressure switch failures at McGuire would be small and would not change the overall conclusions of the vital battery LAR analysis.
9	The Nuclear Service Water (RN) supply to the Auxiliary Feedwater System (CA) contains a total of six valves which must open automatically (3 per train) to provide RN to the auxiliary feedwater pumps suction. The model does not appear to include any common-cause failure of these valves to open to provide water to the CA system. The common-cause failure of these valves could be a significant contributor to cut sets involving the failure of the CA system. Possible Resolution: Consider adding CCF events for the RN/CA supply to the CA pump suction, or providing, in the documentation, the rationale for excluding this.	Addition of this common cause event to the CA model is expected to be of low impact. There are multiple suction paths so that the loss of any one path does not have a large impact on overall failure rates. In addition, the failure of the assured path due to clam clogging is the dominant failure mode. Other failures of equipment in this path will be overshadowed by the clogging failure. Engineering judgment is that any potential impact from common cause failures at McGuire would be small and would not change the overall

#	Table 1: McGuire Internal Events PRA Model Peer Review Open F&Os	
	Peer Review F&O Description	Disposition
		conclusions of the vital battery LAR analysis.
10	The McGuire Flood Analysis assumes that only 15% of the flood probability value is applicable to the CA Pump room even though the primary flood contribution effect comes from the CA room. The RN suction piping and strainers are located in the CA room, including a stainless steel expansion bellows of 0.05 thickness (minimum). The previous value used in the PRA for the flood probability from this room was 50% and there appears to be limited basis for the reduction. When 50% is used in the flooding calculations, the flood probability goes from 4.41E-6 to 1.47E-5. This increases core melt frequency by about 5%. High flooding failure probability produces a significant increase in core melt frequency. Possible Resolution: Provide a sound engineering basis for the percentage of flooding probability to be assigned to the CA room. Alternatively (or in addition), determine and document the sensitivity of the PRA results to the selected value, and identify this as a key PRA assumption if appropriate.	This has been addressed in the internal flood update to the PRA model, and is included in the model used for the risk evaluation for the vital battery LAR application.

#	Table 1: McGuire Internal Events PRA Model Peer Review Open F&Os	
	Peer Review F&O Description	**Disposition**
11	The Flood Analysis for the CA Pump room uses a calculation to determine the effective leakage area for the RN suction expansion bellows (thickness from 0.05 to 0.5 inches) so that a leakage flow can be calculated. The calculated leakage rate from the RN expansion bellows (0.05 inches minimum thickness) is essentially the same as that calculated for the 30 inch service water piping which is 0.375 inches thick. Thus, it seems that the leakage rate from a break in the expansion bellows could be understated. If so, the time before critical flood levels are reached could be less than currently predicted. The potential loss of safety related equipment could occur much more rapidly than expected adversely affecting core melt frequency. Posible Resolution: Review the Flood Analysis to ensure calculated leakage rates have a sound basis and reflect expected leakage rates and provide updated flood probabilities as necessary. If there are uncertainties in the expected leakage rates, evaluate their impacts via sensitivity or uncertainty evaluation as appropriate.	Same as disposition for Item # 10.
12	No specific guidance is given regarding modeling of system dependencies in the system notebooks; however, a highly knowledgeable analyst could reproduce the given results. A dependency matrix is provided but contains little detailed explanation of how dependencies were determined. Flood Analysis does not seem to provide detail required to reproduce the results except by a highly knowledgeable analyst. Sufficient guidance should be provided to explain how dependencies are treated in the PRA, such that the approach can be explained, reviewed, and defended, and so that future PRA updates are performed correctly and consistently. Possible Resolution: Provide guidance for treatment of dependencies, including types of dependencies treated in the model, approaches used to model dependencies, and important considerations regarding how dependencies may affect the model and results.	The peer review comments indicate that a highly knowledgeable analyst could reproduce the given results. This indicates that there is not an issue with the analysis; rather the issue is with documentation needing improvement. There is no impact on the analysis performed for the vital battery LAR application.

#	Table 1: McGuire Internal Events PRA Model Peer Review Open F&Os	
	Peer Review F&O Description	Disposition
13	Many of the T/H success criteria applied in the MNS PRA have been performed with older versions of the MAAP code, MAAP3B revision 16 or earlier. Many improvements have been implemented in the MAAP code since this time. The success criteria database should be reconstituted by employing MAAP4 or other currently accepted codes/analyses. This review should include but not necessarily be limited to the following: - pumps and accumulators required for large LOCA - break ranges for various LOCA sizes - pumps required for small and medium LOCAs - containment response to small LOCA - NS operates - feed and bleed success criteria - SGTR success criteria Actual F&O Wording:Success criteria for some systems are supported by MAAP runs with MAAP 3b, Version 16. This version of MAAP has been found to have deficiencies which can impact conclusions and results. In particular for the McGuire PRA, the simple pressurizer model impacts the analyses that involve RCS cooldown and depressurization using SG heat removal by permitting RCS depressurization to match RCS cooldown for transients, without the possible need for pressurizer PORVs, spray or aux spray.	MNS success criteria runs were performed by a vendor since the peer review was performed, and found similar results to the previous analyses. This F&O is not expected to affect the overall conclusions of the vital battery LAR application.
14	Success Criteria analyses were not done for the range of possible plant conditions to which they are applied. For example, MLOCA success criteria analyses are done for a 3.5 inch break, while the MLOCA is defined as a 2 to 5 inch break. The combinations of systems and operator recoveries that are defined as success at 3.5 inches may not be success at 2 inches or at 5 inches. This issue also applies to large LOCA (8.25 ft2 break analyzed) vs a break range down to 6 inches, and small LOCA (1 inch break analyzed) vs. break sizes from 3/8 to 2 inches. Also, MAAP is not an appropriate code to use in performing analyses for rapid blowdown events such as large and some medium LOCAs.	Same as disposition for Item # 13.
15	Success Criteria do not appear to have been sufficiently reviewed. The reviewers identified several apparent errors in the MAAP analyses, including the following: 1) The MLOCA MAAP runs do not appear to disable accumulators when defining the minimum ECC requirements, but accumulators are not required by the resulting MLOCA success criteria. 2) The secondary side heat removal case (SAAG-98) shows no RCS pressure increase when 180 gpm of CA is supplied to 1SG and NC pumps are tripped. 3) For the F/B case, it appears that full CA was used in the MAAP run rather than the defined success criteria of 1 CA pump to 2 SG.	Same as disposition for Item # 13.

#	Table 1: McGuire Internal Events PRA Model Peer Review Open F&Os	
	Peer Review F&O Description	Disposition
16	There do not appear to be success criteria analyses to support timing for operator actions. Further, most analysis do not include the effects of possible operator interventions. Even where they do, the minimum time window for operator action is not analyzed. For example, in the feed and bleed case, two pressurizer PORVs are opened at 10% SG level (per EOPs) and flow from 1 ECC pump is modeled. This results in a core heatup to about 1800 F. If this were to be used to define the basis for an operator action success, the results would have to be interpreted as indicating that there must be instantaneous operator actions without any recovery time for the HRA analysis. Analyses should be available to support available time windows for modeled operator actions. Further, the success criteria analyses should reflect impacts of anticipated operator interventions.	A recent update of the Oconee PRA model demonstrated that the HRA methodology for operator actions used at the time of the McGuire peer review produced conservative results, largely due to overestimation of the impact of dependencies. This F&O is not expected to affect the overall conclusions of the vital battery LAR submittal.
17	Table 2 of SAAG-501 lists the pre-initiator HIs considered in the analysis. The table does not include HIs for modeling instrument miscalibration events. Further, no systematic process to identify pre-initiator human actions is identified in the HRA calc.	Based on preliminary evaluations using the EPRI HRA calculator, calibration errors that result in failure of a single channel are expected to fall in the low 10-3 range. Calibration errors that result in failure of multiple channels are expected to fall in the low 10-5 range. Relative to post-initiator Human Error Probabilities (HEPs), equipment random failure rates and maintenance unavailability, calibration HEPs are not expected to contribute significantly to overall equipment unavailability. Recent

#	Table 1: McGuire Internal Events PRA Model Peer Review Open F&Os Peer Review F&O Description	Disposition
		modeling updates for the Oconee PRA support this position. This F&O is not expected to affect the overall conclusions of the vital battery LAR submittal.
18	Some of the Type Cp HIs are evaluated using the HCR model. For these, the only performance shaping factors considered are time available and operator response time. Table 4 of SAAG-501 lists the potential effects of additional PSFs, such as operator experience, but table 4 does not appear to have been applied in the quantification of HI events.	Same as disposition for Item # 16.
19	In Rev 3, the documentation of the HEPs for single events is not reproducible. The HRA method calculated 3 different HEP contributors for each HI [HCR, P(e) and P(c)]. In many circumstances, one element is assumed to be dominant and the others are neglected. In support of this, summary judgments are made like - "execution errors were assessed negligible", "event not evaluated in detail because was time critical", "cause based calculation not performed because action is time critical". The time is not referenced to any T/H basis or generic analysis. The basis for assumptions and criteria is not documented. In general, there is limited documentation for the HRA in the following areas. 1. The sequence context of each HI is not stated. 2. The previous failures in the event sequence, the performance shaping factors, or stress levels are not stated. 3. Procedural steps applicable to each HEP are not consistently provided. 4. Basis (T/H) for timing of each action is not provided. The lack of these types of information in the documentation of the HRA limits the ability to verify and reproduce the results, and to determine their applicability in specific scenarios.	Same as disposition for Item # 16.

Table 2: Summary of McGuire Internal Events Model Self Assessment				
SR	**Category II Requirements**	**Comments**	**Met?**	**Expected Impact on Applications**
AS-B3	For each accident sequence, IDENTIFY the phenomenological conditions created by the accident progression. Phenomenological impacts include generation of harsh environments affecting temperature, pressure, debris, water levels, humidity, etc. that could impact the success of the system or function under consideration [e.g., loss of pump net positive suction head (NPSH), clogging of flow paths]. INCLUDE the impact of the accident progression phenomena, either in the accident sequence models or in the system models.	Accident sequence notebooks and system model notebooks should identify those environmental effects of the initiating event and the impact on mitigation systems.	Partial	Phenomenological effects are already considered in the model, but were not well documented. This is not expected to impact the overall conclusions of the vital battery LAR application.
DA-A1a (old) DA-A2 (new)	ESTABLISH definitions of SSC boundaries, failure modes, and success criteria consistent with corresponding basic event definitions in Systems Analysis (SY-A5, SY-A7, SY-A8, SY-A10 through SY-A13 and SY-B4) for failure rates and common cause failure parameters, and ESTABLISH boundaries of unavailability events consistent with corresponding definitions in Systems Analysis (SY-A18).	Revise the data calc. to discuss component boundaries definitions.	No	The Oconee PRA model was recently updated, and the Systems Analysis in the updated model was found to be consistent with the previous modeling. The McGuire PRA model was developed by the same personnel using a similar process. Therefore, this gap is considered to be a documentation issue and will not affect the overall conclusions of the vital battery LAR application.
DA-B1	For parameter estimation, GROUP components according to type (e.g., motor-operated pump, air-operated valve) and according to the characteristics of their usage to the extent supported by data: (a) mission type (e.g., standby, operating) (b) service condition (e.g., clean vs. untreated water, air)	Revise the data calc. to segregate standby and operating component data. Segregate components by service condition to the extent supported by the data.	Partial	This is a refinement to the equipment failure rates. However, since most components are grouped appropriately, the overall impact should be small. This gap is not expected to affect the overall conclusions of the vital battery LAR application.

Table 2: Summary of McGuire Internal Events Model Self Assessment				
SR	Category II Requirements	Comments	Met?	Expected Impact on Applications
DA-D4	When the Bayesian approach is used to derive a distribution and mean value of a parameter, CHECK that the posterior distribution is reasonable given the relative weight of evidence provided by the prior and the plant-specific data. Examples of tests to ensure that the updating is accomplished correctly and that the generic parameter estimates are consistent with the plant-specific application include the following: (a) confirmation that the Bayesian updating does not produce a posterior distribution with a single bin histogram (b) examination of the cause of any unusual (e.g., multimodal) posterior distribution shapes (c) examination of inconsistencies between the prior distribution and the plant-specific evidence to confirm that they are appropriate (d) confirmation that the Bayesian updating algorithm provides meaningful results over the range of values being considered (e) confirmation of the reasonableness of the posterior distribution mean value	Enhance the documentation to include a discussion of the specific checks performed on the Bayesian-updated data, as required by this SR.	Partial	This is a documentation issue only. Workplace procedures are in place to ensure that the Bayesian update results are reviewed for reasonableness by the data analyst.
DA-D6	USE generic common cause failure probabilities consistent with available plant experience. EVALUATE the common cause failure probabilities consistent with the component boundaries.	Provide documentation in SAAG 637 of the comparison of the component boundaries assumed for the generic CCF estimates to those assumed in the McGuire PRA to ensure that these boundaries are consistent.	Partial	The self assessment team indicated that none of the open items are expected to have a significant impact on the PRA results or insights. No technical issues were identified for this gap. This is a documentation issue only and is not expected to affect the overall conclusions of the vital battery LAR application.

Table 2: Summary of McGuire Internal Events Model Self Assessment				
SR	**Category II Requirements**	**Comments**	**Met?**	**Expected Impact on Applications**
HR-A2	IDENTIFY, through a review of procedures and practices, those calibration activities that if performed incorrectly can have an adverse impact on the automatic initiation of standby safety equipment.	Enhance the HRA to consider the potential for calibration errors.	Partial	Based on preliminary evaluations using the EPRI HRA calculator, calibration errors that result in failure of a single channel are expected to fall in the low 10-3 range. Calibration errors that result in failure of multiple channels are expected to fall in the low 10-5 range. Relative to post-initiator Human Error Probabilities (HEPs), equipment random failure rates and maintenance unavailability, calibration HEPs are not expected to contribute significantly to overall equipment unavailability. Recent modeling updates for the Oconee PRA support this position. This F&O is not expected to affect the overall conclusions of the vital battery LAR application.
HR-A3	IDENTIFY which of those work practices identified above (HR-A1, HR-A2) involve a mechanism that simultaneously affects equipment in either different trains of a redundant system or diverse systems [e.g., use of common calibration equipment by the same crew on the same shift, a maintenance or test activity that requires realignment of an entire system (e.g., SLCS)].	Identify maintenance and calibration activities that could simultaneously affect equipment in either different trains of a redundant system or diverse systems.	No	Based on preliminary evaluations using the EPRI HRA calculator, calibration errors that result in failure of a single channel are expected to fall in the low 10-3 range. Calibration errors that result in failure of multiple channels are expected to fall in the low 10-5 range. Relative to post-initiator Human Error Probabilities (HEPs), equipment random failure rates and maintenance unavailability, calibration HEPs are not expected to contribute significantly to overall equipment unavailability. Recent modeling updates for the Oconee PRA support this position. This F&O is not expected to affect the overall conclusions of the vital battery LAR submittal.

Table 2: Summary of McGuire Internal Events Model Self Assessment				
SR	Category II Requirements	Comments	Met?	Expected Impact on Applications
HR-D6	PROVIDE an assessment of the uncertainty in the HEPs. USE mean values when providing point estimates of HEPs.	Develop mean values for pre-initiator HEPs.	No	This item has been closed. Mean values for pre-initiator HEPs have been developed and are in use.
HR-G3	When estimating HEPs EVALUATE the impact of the following plant-specific and scenario-specific performance shaping factors: (a) quality [type (classroom or simulator) and frequency] of the operator training or experience (b) quality of the written procedures and administrative controls (c) availability of instrumentation needed to take corrective actions (d) degree of clarity of the meaning of the cues/indications (e) human-machine interface (f) time available and time required to complete the response (g) complexity of detection, diagnosis and decision-making, and executing the required response (h) environment (e.g., lighting, heat, radiation) under which the operator is working (i) accessibility of the equipment requiring manipulation (j) necessity, adequacy, and availability of special tools, parts, clothing, etc.	Document in more detail the influence of performance shaping factors on execution human error probabilities.	Partial	A recent update of the Oconee PRA model demonstrated that the HRA methodology for operator actions used at the time of the McGuire peer review produced conservative results, largely due to overestimation of the impact of dependencies. This F&O is not expected to affect the overall conclusions of the vital battery LAR submittal.
HR-G4	BASE the time available to complete actions on appropriate realistic generic thermal-hydraulic analyses, or simulation from similar plants (e.g., plant of similar design and operation) (See SC-B4.). SPECIFY the point in time at which operators are expected to receive relevant indications.	Enhance HRA documentation accordingly.	Partial	Same as response to gap for SR HR-G3.
HR-G6	CHECK the consistency of the post-initiator HEP quantifications. REVIEW the HFEs and their final HEPs relative to each other to check their reasonableness given the scenario context, plant history, procedures, operational practices, and experience.	Document a review of the HFEs and their final HEPs relative to each other to confirm their reasonableness given the scenario context, plant history, procedures, operational practices, and experience.	No	Same as response to gap for SR HR-G3.

Table 2: Summary of McGuire Internal Events Model Self Assessment				
SR	**Category II Requirements**	**Comments**	**Met?**	**Expected Impact on Applications**
HR-G9 (old) HR-G8 (new)	Characterize the uncertainty in the estimates of the HEPs, and PROVIDE mean values for use in the quantification of the PRA results.	Develop mean values for post-initiator HEPs.	No	This item has been closed. Mean values for post-initiator HEPs have been developed and are in use.
HR-H2	CREDIT operator recovery actions only if, on a plant-specific basis: (a) a procedure is available and operator training has included the action as part of crew's training, or justification for the omission for one or both is provided (b) "cues" (e.g., alarms) that alert the operator to the recovery action provided procedure, training, or skill of the craft exist (c) attention is given to the relevant performance shaping factors provided in HR-G3 (d) there is sufficient manpower to perform the action	Develop more detailed documentation of operator cues, relevant performance shaping factors, and availability of sufficient manpower to perform the action.	Partial	Same as response to gap for SR HR-G3.
IE-A1	IDENTIFY those initiating events that challenge normal plant operation and that require successful mitigation to prevent core damage using a structured, systematic process for identifying initiating events that accounts for plant-specific features. For example, such a systematic approach may employ master logic diagrams, heat balance fault trees, or failure modes and effects analysis (FMEA). Existing lists of known initiators are also commonly employed as a starting point.	Enhance the IE documentation (as was done in OSC-9068).	Partial	The McGuire PRA model is undergoing a complete update, and the complete list of Initiating Events in the update was found to be consistent with the previous modeling. Therefore, this gap is considered to be a documentation issue and will not affect the overall conclusions of the vital battery LAR application.

Table 2: Summary of McGuire Internal Events Model Self Assessment				
SR	Category II Requirements	Comments	Met?	Expected Impact on Applications
IE-A3	REVIEW the plant-specific initiating event experience of all initiators to ensure that the list of challenges accounts for plant experience. See also IE-A7	Perform a review of the plant-specific initiating event experience of all initiators to ensure that the list of challenges accounts for plant experience.	Partial	PRA Change Form M-07-0012 identifies two flooding events that were not initially included in the quantification of the CA Pump Room flood frequency. This has been addressed by the flood model update to the internal events PRA, which was used for the vital battery LAR application analysis. Similarly, a review of the PIP database for fire events that did not lead to plant trip could affect the frequency of a fire initiator. This has been addressed in the recently completed Fire PRA. Other initiators (except for ATWS) result in plant trip and the generation of an LER.
IE-A3a (old) IE-A4 (new)	REVIEW generic analyses of similar plants to assess whether the list of challenges included in the model accounts for industry experience.	Ensure the list of challenges included in the McGuire PRA accounts for industry experience using a more recent reference, such as the WOG PSA Model and Results Comparison Database - Revision 4.	Partial	Same as response to gap for SR IE-A1.
IE-A4 (old) IE-A5 (new)	PERFORM a systematic evaluation of each system where necessary (e.g., down to the subsystem or train level), including support systems, to assess the possibility of an initiating event occurring due to a failure of the system. USE a structured approach [such as a system-by-system review of initiating event potential, or an FMEA (failure modes and effects analysis), or other systematic process] to assess and document the possibility of an initiating event resulting from individual systems or train failures.	Provide documentation of a systematic evaluation of all plant systems, including support systems (including those not explicitly modeled in the PRA), to assess the possibility of an initiating event occurring due to a failure of the system.	Partial	Same as response to gap for SR IE-A1.

Table 2: Summary of McGuire Internal Events Model Self Assessment				
SR	**Category II Requirements**	**Comments**	**Met?**	**Expected Impact on Applications**
IE-A4a (old) IE-A6 (new)	When performing the systematic evaluation required in IE-A4 (new SR number is IE-A5), INCLUDE initiating events resulting from multiple failures, if the equipment failures result from a common cause, and from system alignments resulting from preventive and corrective maintenance.	Enhance the IE documentation (as was done in OSC-9068).	Partial	Same as response to gap for SR IE-A1.
IE-A5 (old) IE-A7 (new)	In the identification of the initiating events, INCORPORATE (a) events that have occurred at conditions other than at-power operation (i.e., during low-power or shutdown conditions), and for which it is determined that the event could also occur during at-power operation. (b) events resulting in a controlled shutdown that includes a scram prior to reaching low-power conditions, unless it is determined that an event is not applicable to at-power operation.	Enhance the IE documentation (as was done in OSC-9068).	Partial	Same as response to gap for SR IE-A1.
IE-A6 (old) IE-A8 (new)	INTERVIEW plant personnel (e.g., operations, maintenance, engineering, safety analysis) to determine if potential initiating events have been overlooked.	Obtain plant personnel input (as was done in OSC-9068).	No	Same as response to gap for IE-A1.
IE-A7 (old) IE-A9 (new)	REVIEW plant-specific operating experience for initiating event precursors, for the purpose of identifying additional initiating events. For example, plant specific experience with intake structure clogging might indicate that loss of intake structures should be identified as a potential initiating event.	Include review of precursor events for their potential to be initiating events.	Partial	Same as response to gap for SR IE-A1.
IE-B1	COMBINE initiating events into groups to facilitate definition of accident sequences in the Accident Sequence Analysis element (para. 4.5.2) and to facilitate quantification in the Quantification element (para. 4.5.8).	Enhance the IE documentation (as was done in OSC-9068).	No	Same as response to gap for SR IE-A1.
IE-B2	USE a structured, systematic process for grouping initiating events. For example, such a systematic approach may employ master logic diagrams, heat balance fault trees, or failure modes and effects analysis (FMEA).	Document a structured, systematic grouping of initiating events (as was done in OSC-9068).	Partial	Same as response to gap for SR IE-A1.

Table 2: Summary of McGuire Internal Events Model Self Assessment				
SR	**Category II Requirements**	**Comments**	**Met?**	**Expected Impact on Applications**
IE-B3	GROUP initiating events only when the following can be assured: (a) events can be considered similar in terms of plant response, success criteria, timing, and the effect on the operability and performance of operators and relevant mitigating systems; or (b) events can be subsumed into a group and bounded by the worst case impacts within the "new" group. DO NOT SUBSUME events into a group unless: (1) the impacts are comparable to or less than those of the remaining events in that group, AND (2) it is demonstrated that such grouping does not impact significant accident sequences.	Enhance documentation of the grouping process (as was done in OSC-9068).	Partial	Same as response to gap for SR IE-A1.
IE-D3	DOCUMENT the assumptions and sources uncertainty with the initiating event analysis.	Enhance the IE documentation (as was done in OSC-9068).	No	Same as response to gap for SR IE-A1.
IF-B3 (old) IFSO-A5 (new)	For each source and its identified failure mechanism, IDENTIFY the characteristic of release and the capacity of the source. INCLUDE: (a) a characterization of the breach, including type (e.g., leak, rupture, spray) (b) range of flow rates (c) capacity of source (e.g., gallons of water) (d) the pressure and temperature of the source	Enhance the Internal Flood analysis to address the potential for spray, jet impingement, and pipe whip failures. Additionally, document how these failures are included in the quantification.	Partial	This has been addressed by the flood model update to the internal events PRA which was used for the vital battery LAR application analysis.

Table 2: Summary of McGuire Internal Events Model Self Assessment				
SR	Category II Requirements	Comments	Met?	Expected Impact on Applications
IF-C2c (old) IFSN-A5 (new)	For each flood area not screened out using the requirements under IF-B1b, IDENTIFY the SSCs located in each defined flood area and along flood propagation paths that are modeled in the internal events PRA model as being required to respond to an initiating event or whose failure would challenge normal plant operation, and are susceptible to flood. For each identified SSC, IDENTIFY, for the purpose of determining its susceptibility per IF-C3, its spatial location in the area and any flooding mitigative features (e.g., shielding, flood or spray capability ratings).	Given the expected increase in number of flood areas needed to satisfy requirement IF-A1, additional equipment will need to be identified and discussed in order to meet the requirements of the ASME Standard. The current flooding analysis does not discuss flood mitigative features and this will have to be corrected to satisfy the requirements of the ASME Standard.	Partial	Same as response to gap for SR IF-B3.
IF-C3 (old) IFSN-A6 (new)	For the SSCs identified in IF-C2c, IDENTIFY the susceptibility of each SSC in a flood area to flood-induced failure mechanisms. INCLUDE failure by submergence and spray in the identification process. ASSESS qualitatively the impact of flood-induced mechanisms that are not formally addressed (e.g., using the mechanisms listed under Capability Category III of this requirement), by using conservative assumptions.	The current flooding analysis identifies the submergence failure height of the equipment important to accident mitigation, but, except for the Aux. Shutdown Panel, never addresses the impact of spray. Spray as a failure mechanism needs to be addressed in the analysis or a note made explaining why it was omitted.	Partial	Same as response to gap for SR IF-B3.
IF-C3b (old) IFSN-A8 (new)	IDENTIFY inter-area propagation through the normal flow path from one area to another via drain lines; and areas connected via back flow through drain lines involving failed check valves, pipe and cable penetrations (including cable trays), doors, stairwells, hatchways, and HVAC ducts. INCLUDE potential for structural failure (e.g., of doors or walls) due to flooding loads and the potential for barrier unavailability, including maintenance activities.	Provide more analysis of flood propagation flowpaths. Address potential structural failure of doors or walls due to flooding loads and the potential for barrier unavailability.	Partial	Same as response to gap for SR IF-B3.

Table 2: Summary of McGuire Internal Events Model Self Assessment				
SR	Category II Requirements	Comments	Met?	Expected Impact on Applications
IF-E6b (old) IFQU-A9 (new)	INCLUDE, in the quantification, both the direct effects of the flood (e.g., loss of cooling from a service water train due to an associated pipe rupture) and indirect effects such as submergence, jet impingement, and pipe whip, as applicable.	Address potential indirect effects.	Partial	Same as response to gap for SR IF-B3.
IF-F2 (old) N/A	DOCUMENT the process used to identify flood sources, flood areas, flood pathways, flood scenarios, and their screening, and internal flood model development and quantification. For example, this documentation typically includes (a) flood sources identified in the analysis, rules used to screen out these sources, and the resulting list of sources to be further examined (b) flood areas used in the analysis and the reason for eliminating areas from further analysis (c) propagation pathways between flood areas and assumptions, calculations, or other bases for eliminating or justifying propagation pathways (d) accident mitigating features and barriers credited in the analysis, the extent to which they were credited, and associated justification (e) assumptions or calculations used in the determination of the impacts of submergence, spray, temperature, or other flood-induced effects on equipment operability (f) screening criteria used in the analysis (g) flooding scenarios considered, screened, and retained (h) description of how the internal event analysis models were modified to model these remaining internal flooding scenarios (i) flood frequencies, component unreliabilities/unavailabilities, and HEPs used in the analysis (i.e., the data values unique to the flooding analysis) (j) calculations or other analyses used to support or refine the flooding evaluation (k) results of the internal flooding analysis, consistent with the quantification requirements provided in HLR QU-D	Need to document how the analysis addressed all of the items identified in this requirement.	Partial	Same as response to gap for SR IF-B3.

Table 2: Summary of McGuire Internal Events Model Self Assessment				
SR	Category II Requirements	Comments	Met?	Expected Impact on Applications
LE-C6 (old) LE-C7 (new)	In crediting HFEs that support the accident progression analysis, USE the applicable requirements of para. 4.5.5, as appropriate for the level of detail of the analysis.	Explicitly model RCS depressurization for small LOCAs and perform the dependency analysis on the HEPs.	Partial	This issue affects some small LOCAs. Because the small LOCA contribution to LERF is small, the impact to the analysis for the vital battery LAR application is insignificant.
LE-F2	PROVIDE uncertainty analysis that identifies the sources of uncertainty and includes sensitivity studies for the significant contributors to LERF.	Perform and document sensitivity studies to determine the impact of the assumptions and sources of model uncertainty on the LERF results.	Partial	Same as response to gap for SR DA-D6.
LE-F3	IDENTIFY contributors to LERF and characterize LERF uncertainties consistent with the applicable requirements of Tables 4.5.8-2(d) and 4.5.8-2(e). NOTE: The supporting requirements in these tables are written in CDF language. Under this requirement, the applicable requirements of Table 4.5.8 should be interpreted based on LERF, including characterizing key modeling uncertainties associated with the applicable contributors from Table 4.5.9-3. For example, supporting requirement QU-D5 addresses the significant contributors to CDF. Under this requirement, the contributors would be identified based on their contribution to LERF.	Compare LERF results and uncertainties to similar plants and include in the LERF documentation.	Partial	Same as response to gap for SR DA-D6.
LE-G3	DOCUMENT the relative contribution of contributors (i.e., plant damage states, accident progression sequences, phenomena, containment challenges, containment failure modes) to LERF.	Evaluate the relative contribution of the various contributors to the total LERF.	Partial	Same as response to gap for SR DA-D6.
LE-G4	DOCUMENT assumptions and sources of uncertainty associated with the LERF analysis, including results and important insights from sensitivity studies.	Perform and document sensitivity studies to determine the impact of the assumptions and sources of model uncertainty on the LERF results.	Partial	Same as response to gap for SR DA-D6.

Table 2: Summary of McGuire Internal Events Model Self Assessment				
SR	Category II Requirements	Comments	Met?	Expected Impact on Applications
LE-G5	IDENTIFY limitations in the LERF analysis that would impact applications.	Include in the LERF documentation an assessment that identifies the limitations in the LERF analysis that could impact applications.	No	Same as response to gap for SR DA-D6.
LE-G6	DOCUMENT the quantitative definition used for significant accident progression sequence. If other than the definition used in Section 2, JUSTIFY the alternative.	Provide a discussion of the significant cut sets and sequences.	Partial	Same as response to gap for SR DA-D6.
QU-D3 (old) QU-D4 (new)	COMPARE results to those from similar plants and IDENTIFY causes for significant differences. For example: Why is LOCA a large contributor for one plant and not another?	Perform and document a comparison of results between the MNS PRA and other similar plants.	No	Same as response to gap for SR DA-D6.
QU-E4	EVALUATE the sensitivity of the results to model uncertainties and assumptions using sensitivity analyses [Note (1)].	Perform and document a set of sensitivity cases to determine the impact of the assumptions and sources of model uncertainty on the results.	No	Same as response to gap for SR DA-D6.
QU-F2	DOCUMENT the model integration process, including any recovery analysis, and the results of the quantification including uncertainty and sensitivity analyses. For example, documentation typically includes (a) records of the process/results when adding nonrecovery terms as part of the final quantification (b) records of the cutset review process (c) a general description of the quantification process including accounting for systems successes, the truncation values used, how recovery and post-initiator HFEs are applied (d) the process and results for establishing the truncation screening values for final quantification demonstrating that convergence towards a stable result was achieved (e) the total plant CDF and contributions from the different initiating events and	Expand the documentation of PRA model results to address all required items.	Partial	Same as response to gap for SR DA-D6.

Table 2: Summary of McGuire Internal Events Model Self Assessment				
SR	Category II Requirements	Comments	Met?	Expected Impact on Applications
	accident classes (f) the accident sequences and their contributing cutsets (g) equipment or human actions that are the key factors in causing the accident sequences to be nonsignificant (h) the results of all sensitivity studies (i) the uncertainty distribution for the total CDF (j) importance measure results (k) a list of mutually exclusive events eliminated from the resulting cutsets and their bases for Elimination (l) asymmetries in quantitative modeling to provide application users the necessary understanding regarding why such asymmetries are present in the model (m) the process used to illustrate the computer code(s) used to perform the quantification will yield correct results process			
QU-F6	DOCUMENT the quantitative definition used for significant basic event, significant cutset, significant accident sequence. If other than the definition used in Section 2, JUSTIFY the alternative.	Document the required definitions.	Partial	Same as response to gap for SR DA-D6.
SC-A4 (old) SC-A3 (new)	SPECIFY success criteria for each of the key safety functions identified per SR AS-A2 for each modeled initiating event [Note (2)].	Improve the documentation on the TH bases for all safety function success criteria for all initiators.	Partial	MNS success criteria runs were performed by a vendor since the peer review was performed, and found similar results to the previous analyses. This F&O is not expected to affect the overall conclusions of the vital battery LAR application.
SC-B5	CHECK the reasonableness and acceptability of the results of the thermal/hydraulic, structural, or other supporting engineering bases used to support the success criteria. Examples of methods to achieve this include: (a) comparison with results of the same analyses performed for similar plants, accounting for differences in unique plant features (b) comparison with results of similar analyses performed with other plant-specific codes (c) check by other means appropriate to the particular analysis	Provide evidence that an acceptability review of the T/H analyses is performed.	Partial	Same as response to gap for SR SC-A4.

Table 2: Summary of McGuire Internal Events Model Self Assessment				
SR	Category II Requirements	Comments	Met?	Expected Impact on Applications
SC-C1	DOCUMENT the success criteria in a manner that facilitates PRA applications, upgrades, and peer review.	Improve the documentation on the TH bases for all safety function success criteria for all initiators.	Partial	Same as response to gap for SR SC-A4.
SC-C2	DOCUMENT the processes used to develop overall PRA success criteria and the supporting engineering bases, including the inputs, methods, and results. For example, this documentation typically includes: (a) the definition of core damage used in the PRA including the bases for any selected parameter value used in the definition (e.g., peak cladding temperature or reactor vessel level) (b) calculations (generic and plant-specific) or other references used to establish success criteria, and identification of cases for which they are used (c) identification of computer codes or other methods used to establish plant-specific success criteria (d) a description of the limitations (e.g., potential conservatisms or limitations that could challenge the applicability of computer models in certain cases) of the calculations or codes (e) the uses of expert judgment within the PRA, and rationale for such uses (f) a summary of success criteria for the available mitigating systems and human actions for each accident initiating group modeled in the PRA (g) the basis for establishing the time available for human actions (h) descriptions of processes used to define success criteria for grouped initiating events or accident sequences	Improve the documentation on the TH bases for all safety function success criteria for all initiators.	Partial	Same as response to gap for SR SC-A4.

Table 2: Summary of McGuire Internal Events Model Self Assessment				
SR	**Category II Requirements**	**Comments**	**Met?**	**Expected Impact on Applications**
SY-A14 (old) SY-A15 (new)	In meeting SY-A12 and SY-A13, contributors to system unavailability and unreliability (i.e., components and specific failure modes) may be excluded from the model if one of the following screening criteria is met: (a) A component may be excluded from the system model if the total failure probability of the component failure modes resulting in the same effect on system operation is at least two orders of magnitude lower than the highest failure probability of the other components in the same system train that results in the same effect on system operation. (b) One or more failure modes for a component may be excluded from the systems model if the contribution of them to the total failure rate or probability is less than 1% of the total failure rate or probability for that component, when their effects on system operation are the same.	Provide quantitative evaluations for screening.	Partial	Same as response to gap for SR DA-D6.
SY-A4	PERFORM plant walkdowns and interviews with system engineers and plant operators to confirm that the systems analysis correctly reflects the as-built, as-operated plant.	Enhance the system documentation to include an up-to-date system walkdown checklist and system engineer review for each system. Consider revising workplace procedure XSAA-106 to require that such documentation be revisited with each major PRA revision.	Partial	Same as response to gap for SR DA-D6.

Table 2: Summary of McGuire Internal Events Model Self Assessment				
SR	Category II Requirements	Comments	Met?	Expected Impact on Applications
SY-A8	ESTABLISH the boundaries of the components required for system operation. MATCH the definitions used to establish the component failure data. For example, a control circuit for a pump does not need to be included as a separate basic event (or events) in the system model if the pump failure data used in quantifying the system model include control circuit failures. MODEL as separate basic events of the model, those subcomponents (e.g., a valve limit switch that is associated with a permissive signal for another component) that are shared by another component or affect another component, in order to account for the dependent failure mechanism.	Enhance systems analysis documentation to discuss component boundaries.	No	Same as response to gap for SR DA-D6.
SY-B8	IDENTIFY spatial and environmental hazards that may impact multiple systems or redundant components in the same system, and ACCOUNT for them in the system fault tree or the accident sequence evaluation. Example: Use results of plant walkdowns as a source of information regarding spatial/environmental hazards, for resolution of spatial/environmental issues, or evaluation of the impacts of such hazards.	Per Duke's PRA modeling guidelines, ensure that a walkdown/system engineer interview checklist is included in each system notebook. Based on the results of the system walkdown, summarize in the system write-up any possible spatial dependencies or environmental hazards that may impact system operation.	Partial	Same as response to gap for SR DA-D6.

Table 2: Summary of McGuire Internal Events Model Self Assessment				
SR	Category II Requirements	Comments	Met?	Expected Impact on Applications
SY-B15 (old) SY-B14 (new)	IDENTIFY SSCs that may be required to operate in conditions beyond their environmental qualifications. INCLUDE dependent failures of multiple SSCs that result from operation in these adverse conditions. Examples of degraded environments include: (a) LOCA inside containment with failure of containment heat removal (b) safety relief valve operability (small LOCA, drywell spray, severe accident) (for BWRs) (c) steam line breaks outside containment (d) debris that could plug screens/filters (both internal and external to the plant) (e) heating of the water supply (e.g., BWR suppression pool, PWR containment sump) that could affect pump operability (f) loss of NPSH for pumps (g) steam binding of pumps (h) harsh environments induced by containment venting or failure that may occur prior to the onset of core damage	The impact of adverse environmental conditions on SSC reliability is considered but not documented.	Partial	Same as response to gap for SR DA-D6.
SY-C2	DOCUMENT the system functions and boundary, the associated success criteria, the modeled components and failure modes including human actions, and a description of modeled dependencies including support system and common cause failures, including the inputs, methods, and results. For example, this documentation typically includes: (a) system function and operation under normal and emergency operations (b) system model boundary (c) system schematic illustrating all equipment and components necessary for system operation (d) information and calculations to support equipment operability considerations and assumptions (e) actual operational history indicating any past problems in the system operation (f) system success criteria and relationship to accident sequence models (g) human actions necessary for operation of system (h) reference to system-related test and maintenance procedures (i) system dependencies and shared component interface (j) component	Enhance system model documentation to comply with all ASME PRA Standard requirements.	Partial	Same as response to gap for SR DA-D6.

Table 2: Summary of McGuire Internal Events Model Self Assessment				
SR	Category II Requirements	Comments	Met?	Expected Impact on Applications
	spatial information (k) assumptions or simplifications made in development of the system models (l) the components and failure modes included in the model and justification for any exclusion of components and failure modes (m) a description of the modularization process (if used) (n) records of resolution of logic loops developed during fault tree linking (if used) (o) results of the system model evaluations (p) results of sensitivity studies (if used) (q) the sources of the above information (e.g., completed checklist from walkdowns, notes from discussions with plant personnel) (r) basic events in the system fault trees so that they are traceable to modules and to cutsets. (s) the nomenclature used in the system models.			

Table 3: Open PRA Tracker Items of MEDIUM Risk Significance		
Tracker #	**Description**	**Disposition**
M-02-0001	Determine whether NI173 and NI178 would be expected to close against the possibly higher differential pressure (dp) induced by an ISLOCA. Update the ISLOCA analysis to incorporate the insights from PA-RMSC-0464, "Consensus ISLOCA PRA Model."	This change is related to ISLOCA, and does not interact with vital DC control power. The impact of this change is not considered to be significant for this application and is not included in the analysis.
M-04-0014	MNS PRA model is not taking credit for a recovery that is credited in SGTR WCAP.	This change would result in a risk decrease. Therefore, the analysis performed for this application is conservative and the change is not included.
M-06-0004	Revise HRA as needed per comments in PIP M-06-00652.	The available time to throttle AFW was reduced from 60 minutes to 50 minutes. This resulted in an increase in the HEP failure probability for FCATHRODHE. This change was incorporated into the analysis for the vital battery LAR submittal.
M-06-0011	Operator Recovery is needed in the SG PORV logic on a loss of instrument air (VI) pressure	This change would result in a risk decrease. Therefore, the analysis performed for this application is conservative and the change is not included.
M-07-0015	(1) Revise the CA system model to reflect the capability of being supplied externally via a fire hose. (2) Revise the ND system model to reflect the capability of supplying the RWST externally via a fire hose. Correction: (PRA Tracker Form M-11-0001 was created to deal with using b.5.b equipment to supply the CA system whereas tracker form M-07-0015 will deal with utilizing b.5.b equipment to supply the RWST for ND use.) ~JRE 3/9/2011	This change would result in a risk decrease. Therefore, the analysis performed for this application is conservative and the change is not included.

Table 3: Open PRA Tracker Items of MEDIUM Risk Significance		
Tracker #	**Description**	**Disposition**
M-08-0007	Revise the McGuire seismic PRA to remove plant level (surrogate) fragilities and reinstate component level fragilities per the IPEEE. Reference is Attachment B of DPC-1535.00-00-0006 (CNC-1535.00-00-0069 and MCC-1535.00-00-0058)	The seismic PRA is not used in this LAR application. Instead, seismic is evaluated qualitatively. Therefore, this change does not affect the vital battery LAR application.
M-10-0001	The ECCS Water Management Project was initiated due to the following issue: At the time of FWST depletion and ND pump swap-over to the ECCS sump, the sump level is marginal for a small spectrum of Small Break LOCAs. The sump inventory contribution from ice melt is minimal for these smaller SBLOCAs. To account for this, the project has determined that it is feasible to raise the containment spray set-point, and to rely on manual containment spray actuation during the ECCS recirculation phase.	ECCS water management modification affects FWST water conservation and eliminates NS pump automatic operation. This does not impact the vital battery LAR application. Additionally, this modification will result in a risk decrease. Therefore, the analysis performed for this application is conservative and the change is not included.
M-11-0001	The NRC has required the capability to provide additional accident mitigation functions with pumps commonly referred to as the B.5.b pumps. Revise the CA system model to reflect the capability of being supplied externally via a fire hose. (This PRA Tracker Form was created to split the entries in PRA Tracker Form M-07-0015 in regard to the CA and ND systems. Tracker form M-11-0001 will deal with using B.5.b equipment to supply the CA system whereas tracker form M-07-0015 will deal with utilizing B.5.b equipment to supply the RWST for ND use.)	This change would result in a risk decrease. Therefore, the analysis performed for this application is conservative and the change is not included.

Table 3: Open PRA Tracker Items of MEDIUM Risk Significance		
Tracker #	Description	Disposition
M-12-0008	[Affected PRA element: SY.] Revise the CA system model to reflect the need for the operators to manually open CA161, CA162 to provide an alternate supply to the CA TDP.	This change was determined to impact the LAR risk evaluation and was incorporated into the analysis.

Table 4: Low PRA Tracker Items Affecting the Vital Battery LAR Application		
Tracker #	**Description**	**Disposition**
M-03-0003	Steam Generator Power Operated Relief Valves power supplies not included in the model.	This change is included in the application by adding DC panel board transfers as an input to SG PORV logic.
M-04-0015	The T14 (Loss of Vital I&C) frequency in the initiator notebook (SAAG 594) does not agree with the frequency in the I & C Notebook (SAAG 407).	This change is included in the application by increasing the base case T14 IEF to 2.64E-02, and the sensitivity cases T14 IEF to 4.0E-02.
M-11-0007	SYSTEM ANALYSIS - Remove RN Recovery from Unit 2 (gate WRNUNIT2) from the RN system model.	This change was incorporated by changing the CAFTA database value of WRNUNT2DHE to 1.73 for the base and the sensitivity cases. PRA Short Calculation # 288 describes the method used to develop the multiplier.

Table 5: Flood Modeling Peer Review Facts and Observations for Supporting Requirements Not Met and Capability Category 1 Item			
SR	**Element**	**Peer Review Assessment**	**Resolution**
IFPP-A5	CONDUCT plant walkdown(s) to verify the accuracy of information obtained from plant information sources and to obtain or verify: (a) Spatial information needed for the development of flood areas (b) Plant design features credited in defining flood areas	The peer review assessment concluded that this SR was not met in the original analysis and F&O IFPP A5-01 and IFSN A17-01 were identified. The basis for this determination is as follows: *Based on walkdowns performed by the Peer Review Team, several rooms were identified that are not included in the current walkdown forms for the Plant.*	A follow-on walkdown was performed by WEC on October 24th-25th, 2011. No missing rooms were identified during the walkdown, but some walkdown sheets were documented on a flood area basis rather than a plant room basis. This is acceptable to meet The ASME/ANS PRA Standard (Ref. 12.3), and is consistent with the original internal flooding evaluation which was performed to some CC-I SRs. An additional walkdown was performed and walkdown forms which represented flood areas identified what plant features correspond to each individual room so that it would not appear any plant rooms were missed. Any rooms which were identified as grouped during the original evaluation are now identified individually in each flood area.
IFPP-B3	DOCUMENT sources of model uncertainty and related assumptions (as identified in QU-E1 and QU-E2) associated with the internal flood plant partitioning.	The peer review assessment concluded that this SR was not met in the original analysis and F&O IFPP B3-01 was identified. The basis for this determination is as follows: *Some of the key assumptions and areas of uncertainty were not all identified as such. These should appear in Section 4.4 but are found throughout the documents. Many of the assumptions are not called assumptions but are identified as expectations.*	The existing analysis was reviewed to identify any missing assumptions. Any missing assumptions have been identified, included in that particular calculation note assumption section (Section 4.4) and have been characterized as part of the uncertainty evaluation. The uncertainty evaluation has been attached in Appendix C and will be used to update Appendix E in CN-RAM-10-010 (Ref. 9). The following set of additional assumptions were identified and captured in the identified calculation notes: Additional assumption to be included into CN-RAM-10-003 (Ref. 5): 1. "KC was assumed to be lost when the surge tank is empty. The KC was therefore identified as a potential flood source. Breach of the KC pressure boundary including pipe failure and rupture of the surge tanks was identified as a flooding mechanism." Additional assumption to be included into CN-RAM-10-004 (Ref. 6):

Table 5: Flood Modeling Peer Review Facts and Observations for Supporting Requirements Not Met and Capability Category 1 Item			
SR	**Element**	**Peer Review Assessment**	**Resolution**
			1. "For an RN flood, the operator response involves the identification of the break location and isolation of the flood source. It was assumed that the operator response is not timely enough to prevent a plant trip. The successful isolation of an RN flood would render the affected RN train inoperable. The standby train would then be placed in operation. Therefore, RN flood scenarios require additional consideration as flood initiating events." Additional assumptions to be included into CN-RAM-10-005 (Ref. 7): 1. "Passive failure of liquid pipes is based on a model that assumes that through-wall flaws are precursors to cracks, leaks, floods and major structural failures. Pipe failure frequency categories are constructed based on EPRI TR 1013141 in Table 5-3." 2. "Flooding events were assumed to cause a direct failure of the ruptured system (except for spray events) and/or indirect failure of one or more PRA-related equipment (due to spray, submergence or steam) such that a reactor trip or plant shutdown is required. The reactor trip or plant shutdown may be a result of the system failure or the consequential failure of PRA-related equipment. This is significant for operating systems whose failure will cause a reactor trip." 3. "Depending on the location of a pressure boundary failure, certain systems may not cause a plant trip, and this was analyzed on an individual basis." 4. "Given that one of both doors to the Battery Room flood area (door PD-2) was assumed to be opened for a limited duration, a flood-induced event caused by a

Table 5: Flood Modeling Peer Review Facts and Observations for Supporting Requirements Not Met and Capability Category 1 Item			
SR	Element	Peer Review Assessment	Resolution
			re-configured fluid system would propagate to the Battery Room flood area. The 125 VDC batteries and 125 VDC distribution centers are located in this flood area. The flood would cause a reactor trip for the operating unit due to the submergence of vital electrical equipment. The 125 VDC distribution buses for both units would also fail." 5. "The fraction of time during which door PD-2 is assumed to be open also applies to door PD-7, which is the door in the TB to the EDG room, and is assessed in the model as an additional maintenance activity." 6. "For a Pre-Initiator Error Probability, the ASEP HRA Methodology (Ref. 8) was assumed to be applicable and was used to determine a screening value for the probability that operators will induce a flood during a maintenance activity. The ASEP method uses a screening value of .03 for pre-initiators and this value is assumed to be bounding for this probability." 7. "Based on a review of the statistical data included in Appendix A of (Ref. 5), the 5% and 95% data limits were used to establish appropriate passive failure error factors (EFs) for various pipe systems." Additional assumption to be included into CN-RAM-10-006 (Ref. 8): 1. "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.

Table 5: Flood Modeling Peer Review Facts and Observations for Supporting Requirements Not Met and Capability Category 1 Item			
SR	**Element**	**Peer Review Assessment**	**Resolution**
			Physical damage to the plant may significantly increase the execution time for local actions."
IFSO-A4	For each potential source of flooding, IDENTIFY the flooding mechanisms that would result in a release. INCLUDE: (a) Failure modes of components such as pipes, tanks, gaskets, expansion joints, fittings, seals, etc. (b) Human-induced mechanisms that could lead to overfilling tanks, diversion of flow-through openings created to perform maintenance; inadvertent actuation of fire-suppression system (c) Other events resulting in a release into the flood area	The peer review assessment concluded that this SR was not met in the original analysis and F&O IFSO A4-01 was identified. The basis for this determination is as follows: *Although there is a discussion of Maintenance-Induced flood scenarios in MCC-1535-0124, the assumptions noted in this section do not appear to be valid or defendable. These assumptions could result in potential maintenance-induced floods not being identified and modeled appropriately.* *For example, the first assumption (5a) states that reconfiguration of a fluid system for maintenance activities is performed while the unit is in cold shutdown conditions. It was therefore assumed that major pumps relied on for power production have been secured and would influence the flow rate.* *Although it is agreed that most preventive maintenance is performed while a unit is in shutdown conditions (hot shutdown or cold shutdown), corrective maintenance, and some preventive maintenance activities, which require system reconfigurations while the unit at power are not precluded unless Technical Specifications exist which would not allow them to be performed in the Tech Spec allowed outage time. For example, fluid systems with a 3 day allowed outage time that have more pumps than are required for continued operation (component cooling*	The peer review team identified that Assumption 5a was not valid given that MNS Units 1 & 2 does periodically perform at-power maintenance. However, this maintenance is infrequent, major system reconfiguration is typically not performed at power and plant staff is well aware of the maintenance. Therefore Assumption 5a has been rewritten. Plant staff being immediately aware of flooding events greatly increases successful event mitigation. Assumption 5a has been rewritten as follows and will be updated in CN-RAM-10-005 (Ref. 7): "Reconfiguration of a normally operating fluid system for maintenance activities is typically performed while the unit is in cold shutdown conditions. Additionally, plant staff will be immediately aware of any possible flooding events resulting from potential maintenance-induced flooding scenarios. It was therefore assumed that major pumps relied on for power production have been secured and would not influence the flow rate." Additionally, some examples are given by the team of specific at-power flooding events, however no changes are made to the MNS Units 1 & 2 maintenance induced flood assessment as their maintenance activities have been thoroughly evaluated and the applicable maintenance induced flooding scenarios have already been included in the analysis. However, industry operating experience specifically dealing with maintenance induced flooding events was not evaluated, and this information has been reviewed and identified as such in the analysis. (Note, the peer review team provided the industry experience data.) The industry

Table 5: Flood Modeling Peer Review Facts and Observations for Supporting Requirements Not Met and Capability Category 1 Item			
SR	**Element**	**Peer Review Assessment**	**Resolution**
		water, service water, charging) could have valve maintenance performed that requires system reconfigurations that have the potential to result in maintenance induced floods with the unit at power. Additionally, when valves require maintenance (e.g. internals replacement following valve failure), isolation valves are typically closed under a clearance order, or a freeze seal is used to isolate the valve for work. However, there have been instances where the isolation valve or freeze seal has failed resulting in a flood path through the removed internals. The potential for these types of maintenance induced floods need to be evaluated. *The second set of assumptions (6a-g) is not supported by actual industry OE. For example, several events have occurred in the industry that were not readily recognizable by the personnel who initiated the event, but were identified by operations when levels raised/lowered unexpectedly in tanks/sumps. The time to diagnose and respond to the induced floods by the operators exceeded five minutes for each task, the actions required to mitigate the flood were not always simple, and stress levels were not low.*	experience reviewed is captured in this letter report in Appendix B. This Appendix is referred to as Appendix D in the quoted excerpt intended to be included in CN-RAM-10-005 (Ref. 7) documented below. The table is a collection of human-induced floods from the following resources: • Table C-2 of EPRI TR-1013141, which documents significant internal flood events at nuclear power plants world-wide from 1970 to 2002. • INPO Operating Experience databases from 1980 to 2008, which includes US & foreign events. • Licensee Event Reports (LERs) from 1980 to 2008, through the INPO website. • NRC Information Notice 2009-06 "Construction-Related Experience with Flood Protection Features". • SOER 85-5 "Internal Flooding of Power Plant Bldgs." • SER 3-98 "Flooding of ECCS Rooms Caused by Fire Protection System Water Hammer." No new maintenance induced scenarios have been identified in the McGuire internal flooding analysis as a result of this review. The following should replace the discussion present in Section 5.1 in CN-RAM-10-005 (Ref. 7): "The primary source of rupture data used here is the 2006 EPRI report on pipe rupture frequencies (Ref. 5). In this EPRI report, the rupture frequency is expressed as a per unit length of line of a specific line diameter, magnitude of the discharge, and type of pipe service. This report notes that the piping failure data include all failures associated with valve bodies, heat exchangers and other similar components. The data does include components susceptible to

Table 5: Flood Modeling Peer Review Facts and Observations for Supporting Requirements Not Met and Capability Category 1 Item			
SR	Element	Peer Review Assessment	Resolution
			flow-accelerated corrosion and expansion joints in the Circulating Water System (RC) for which specific failure rates are presented. In other words, the EPRI report asserts that the frequency with which a rupture would occur in a specific system in a specific flood area can be adequately predicted from counts of the total length of line of a specific size in that flood area and that the presence of valves and other equipment can be ignored. Baseline frequencies obtained using the EPRI method are presented in Table 5-1. The last 10 years of the MNS Units 1 & 2 PIPs database was searched using the following keywords: "flood, HELB, rupture, overfill, submerge, overflow, spray, or pipe." Additionally, the MNS Units 1 & 2 LER database over the past 10 years was reviewed to ensure no key occurrences were missed as part of the evaluation. Key issues identified were incorporated into the flooding evaluation as appropriate. The following two issues were identified and explicitly modeled as part of the internal flooding evaluation: • Condenser Circulating Water System (RC) floods in the Turbine Building which may induce a dual unit Loss of Offsite Power (LOOP). • Flooding backflow via the Groundwater Drainage System (WZ) into the CA Pump Rooms. Additionally, maintenance process documents were evaluated to ensure that maintenance activities would prevent maintenance induced flooding events. The MNS Units 1 & 2

Table 5: Flood Modeling Peer Review Facts and Observations for Supporting Requirements Not Met and Capability Category 1 Item			
SR	Element	Peer Review Assessment	Resolution
			"Operational Risk Management" (Ref. 9), "Work Activity Risk Management Process" (Ref. 10) and the "Risk Management Process" (Ref. 11) process documents were specifically reviewed. Key issues were identified and incorporated into the evaluation. Furthermore, industry maintenance events were specifically examined and insights were incorporated as appropriate into the existing analysis. These issues are discussed in detail in Section 5.5. Additionally, the "Operational Risk Management" (Ref. 11) Nuclear Policy Manual states that: "If the evaluation determines that there is a risk of causing flood damage to equipment identified in the Electronic Risk Assessment Tool, the following risk mitigation strategies shall be considered: • Development of a Complex/Critical Activity Plan containing risk management actions as described in Appendix E (Risk Management Actions). Guidance for developing a Complex/Critical Activity Plan can be found in NSD 213 (Risk Management Process). • Consider revising the isolation plan to include double isolation between the open piping and the water source, tagging of pumps which could move the water to the open piping, or draining piping to eliminate the water source. • When possible, work activities and isolations shall be structured such that a flooding potential does not impact redundant trains of equipment identified in the Electronic Risk Assessment Tool.

Table 5: Flood Modeling Peer Review Facts and Observations for Supporting Requirements Not Met and Capability Category 1 Item			
SR	Element	Peer Review Assessment	Resolution
			• When possible, work activities and isolations shall be structured such that a flooding potential does not impact redundant functions. For example, the SSF performs a function that is redundant to the centrifugal charging pumps. If an activity is in progress that presents a flood risk to a centrifugal charging pump, consideration should be given to not performing activities that could affect the ability of the SSF to perform its redundant function. • Identify items such as valves or pumps in the path from the water source to the breach that could be used to isolate or stop a flood." Note, the previously referenced "Appendix E" refers to an appendix in the "Operational Risk Management" (Ref. 11) Nuclear Policy Manual. This risk mitigation approach identified in the "Operational Risk Management" (Ref. 11) Nuclear Policy Manual ensures that maintenance procedures will not produce flooding events. The results of the PIPs and LER search can be found in Appendices B and C respectively while the industry operating experience specifically dealing with maintenance induced floods can be found in Appendix D. This treatment is intended to meet IFEV-A6 at CC-II/III."
IFSO-A5	For each source and its identified failure mechanism, IDENTIFY the characteristic of release and the capacity	The peer review assessment concluded that this SR was not met in the original analysis and F&O IFSO A5-01 was identified. The basis for this determination is as follows:	Walkdown forms have been reviewed to ensure all fields have been filled out. Additionally, the temperatures and pressures of the plant fluid systems do not need to be defined as all flooding impacts are inherently considered due to Assumption 2 in CN-RAM-10-004 (Ref. 6) that all

Table 5: Flood Modeling Peer Review Facts and Observations for Supporting Requirements Not Met and Capability Category 1 Item			
SR	Element	Peer Review Assessment	Resolution
	of the source. INCLUDE: (a) A characterization of the breach, including type (e.g., leak, rupture, spray) (b) Flow rate (c) Capacity of source (e.g., gallons of water) (d) The pressure and temperature of the source	*A review of the Internal Flooding notebooks did not identify where the characterization of each source and flood mechanism was documented. The flood scenarios in MCC-1535-123 did discuss some of the required information such as type of breach, but not all the required information. Although the walkdown forms provided in Appendix A of MCC-1535-121 has fields available for some of the required information, these fields were not always filled out, and some of the required information was not listed on the walkdown forms so it was not looked for during the walkdowns.*	equipment in the flood area where a flood initiating in, is failed. (Note, Assumption 2 has been rewritten so that this treatment is clearer.) Therefore, the following statement should be added to the end of Section 5.3 in CN-RAM-10-003 (Ref. 5): "The temperatures and pressures of the plant fluid systems do not need to be defined as all flooding impacts are inherently considered due to Assumption 2 in CN-RAM-10-004 which identifies that all equipment in the flood area in which a flood initiates, is assumed failed. Therefore it is not necessary to describe systems in terms of pressure and temperature to determine potential flood induced failure modes." The following modification to Assumption 2 is provided for replacing the wording of the existing assumption in the original analysis, CN-RAM-10-004 (Ref. 6): "All components within a flood area where the flood originates were assumed susceptible and failed as a result of the flood, spray, steam, jet impingement, pipe whip, humidity, condensation and temperature concerns except when component design (e.g., water-proofing) spatial effects, low pressure source potential or other reasonable judgment could be used for limiting the effect."
IFSO-B1	DOCUMENT the internal flood sources in a manner that facilitates PRA applications, upgrades, and peer review.	The peer review assessment concluded that this SR was not met in the original analysis and F&O IFPP B1-01 was identified. The basis for this determination is as follows: *Documentation is not easy to follow in a few spots. Difficult to see why specific flood sources screened. The analysis also lacks a*	Documentation has been reviewed to ensure that the difficulty the peer review team had reviewing screened flood sources is addressed. Documenting plant walkdowns on a room-by-room basis rather than a flood area basis was performed. This is intended to aid in the peer review process. Additionally, by not identifying the list of critical component heights found in CN-RAM-10-004 (Ref. 6) Appendix A, the peer review team considered the

Table 5: Flood Modeling Peer Review Facts and Observations for Supporting Requirements Not Met and Capability Category 1 Item			
SR	**Element**	**Peer Review Assessment**	**Resolution**
		list of critical component heights.	documentation difficult to follow. Therefore, no change is needed to address that comment. No additional issues with regard to the difficulty the team had reviewing the documentation were identified.
IFSO-B3	DOCUMENT sources of model uncertainty and related assumptions (as identified in QU-E1 and QU-E2) associated with the internal flood sources.	The peer review assessment concluded that this SR was not met in the original analysis and F&O IFPP B3-01 was identified. The basis for this determination is as follows: *Some of the key assumptions and areas of uncertainty were not all identified as such. These should appear in Section 4.4 but are found throughout the documents. Many of the assumptions are not called assumptions but are identified as expectations.*	Same as IFPP-B3-01 from above.
IFSN-A4	ESTIMATE the capacity of the drains and the amount of water retained by sumps, berms, dikes, and curbs. ACCOUNT for these factors in estimating flood volumes and SSC impacts from flooding.	The peer review assessment concluded that this SR was not met in the original analysis and F&O IFSN A4-01 was identified. The basis for this determination is as follows: *The analysis states that two inch line breaks were screened due to the fact that the floor drain had the capacity to contain the water. There is no documentation to support this.* *The analysis states that spray events were screened from the flood analysis due to the fact that the floor drain had the capacity to contain the water. There is no documentation to support this.* *It should be noted that very few floor drains were noted in the Auxiliary Building during the Plant walkdown.*	Piping less than two inches was not screened from the analysis. In some cases piping less than two inches was not measured and included in the pipe length for a given flood area, but this was only done when appropriate. Assumption 2 in CN-RAM-10-005 (Ref. 7) provides justification for this approach: "Pipe sizes of less than or equal to 2 inch diameter were not included in generating pipe break frequencies resulting from floods or major floods, however they were considered for spray effects on an individual basis. Flood areas that only contained piping less than 2 inches in diameter were not screened from the analysis if no other larger piping was present in the flood areas. Not including piping less than 2 inches in diameter only marginally reduced the Initiating Event Frequency (IEF), and did not impact the methodology used in the evaluation. This reduction is not verified anywhere but is generally understood as the less than 2 inch diameter

Table 5: Flood Modeling Peer Review Facts and Observations for Supporting Requirements Not Met and Capability Category 1 Item			
SR	Element	Peer Review Assessment	Resolution
			piping only provides a small length of pipe compared to the rest of the piping in the rooms. Additionally, if the initiating event frequencies are examined, the larger piping has greater IEFs by an order of magnitude. Therefore, no comparison was performed. Additionally, the impact of the less than 2 inch diameter piping when compared to the larger piping is significantly less. Finally, in cases in which none of these assumptions hold true, the impact of the less than 2 inch diameter piping is explicitly evaluated. This treatment is intended to support IFSO-A1 at CC-I/II/III." All spray events were not screened from the analysis. Spray events were evaluated to determine whether or not a pressure boundary failure of a nearby fluid source spraying onto a set of equipment could lead to a plant trip. As part of this evaluation the floor drains present in the flood area were considered. As appropriate floor drains were credited as a way of mitigating the accumulation of the water in a flood area from a spray event. Documentation to more clearly state this treatment is being incorporated into the flooding evaluation. The MNS Units 1&2 floor drain calculation, MCC-1206.47-69-1001 (Ref. 10), should be referenced in the Calculation Note to further justify the treatment. The following is recommended to replace Assumption 3 in CN-RAM-10-004 (Ref. 6) to clarify this treatment: "Floor drains were assumed to be capable of controlling water levels for spray events. This is based on the expectation that a spray event will not result in a significant accumulation of standing water. During plant walkdowns it was observed that drain entrances were maintained in proper working conditions and free of debris. Additionally, walkdowns confirmed that drains were present in all flood areas where spray

Table 5: Flood Modeling Peer Review Facts and Observations for Supporting Requirements Not Met and Capability Category 1 Item			
SR	Element	Peer Review Assessment	Resolution
			events were considered. Reviews of several Problem Investigation Process (PIP) reports suggest that the floor drains that discharge to sumps that provided level alarms in the control room are maintained in working conditions. Finally, MCC-1206.47-69-1001 (Ref. 15) has verified that drains present in identified flood areas are capable of adequately relieving flood area water levels due to spray events. Drains were not credited for any flood or major flood events. Table 4.4-1 provides a summary of spray event treatment in the analysis."
IFSN-A5	For each flood area not screened out using the requirements under other Internal Flood Supporting requirements (e.g. IFSO-A3 and IFSN-A12), IDENTIFY the SSCs located in each defined flood area and along flood propagation paths that are modeled in the internal events PRA model as being required to respond to an initiating event or whose failure would challenge normal plant operation, and are susceptible to flood. For each identified SSC, IDENTIFY, for the purpose of determining its susceptibly per IFSN-A6, its spatial location in the area and any flooding mitigative features (e.g.,	The peer review assessment concluded that this SR was not met in the original analysis and F&O IFSN A5-01 was identified. The basis for this determination is as follows: *Although some of the flood areas appear to identify all PRA related SSCs in them, others do not. For example, the Unit 2 AFW Pump Room only lists the major pumps and the Safe Shutdown Panels. No additional valves or other PRA-related equipment located in the room are identified. Additionally, no spatial information of any of the PRA-related equipment in the flood areas appears to be documented in the Internal Flooding Analysis. Table 5-5 screening criteria may not be appropriate.*	See Section 2.21.3 for resolution of PRA equipment documentation. Assumption 2 in CN-RAM-10-004 (Ref. 6) provides justification as to why only limited equipment spatial information is documented. Additionally, justification for not providing a full set of PRA equipment listing in the internal flooding documentation is provided in Section 2.21.3. In all cases equipment was conservatively assumed to fail as a result of the different flooding mechanisms (as appropriate) and then refinement was performed as appropriate. Documentation includes spatial information as appropriate as refinement to the modeled scenarios were performed. For example, the CA pump room includes a detailed discussion of equipment in the room and its proximity to potential flooding hazards. No change is made to Table 5-5 in CN-RAM-10-003 (Ref. 5) as no example of issues were provided other than asking that the table be verified. The table was compiled based on numerous flooding efforts and was cross-checked with McGuire plant staff to ensure Table 5-5 appropriately represented plant equipment susceptibility. No documentation change is recommended as a result of this F&O.

Table 5: Flood Modeling Peer Review Facts and Observations for Supporting Requirements Not Met and Capability Category 1 Item			
SR	Element	Peer Review Assessment	Resolution
	shielding, flood, or spray capability ratings).		
IFSN-A8	IDENTIFY inter-area propagation through the normal flow path from one area to another via drain lines; and areas connected via backflow through drain lines involving failed check valves, pipe and cable penetrations (including cable trays), doors, stairwells, hatchways, and HVAC ducts. INCLUDE potential for structural failure (e.g., of doors or walls) due to flooding loads.	The peer review assessment concluded that this SR was met in the original analysis at CC-I; however F&O IFSN A8-01 was identified as a suggestion. The basis for this determination is as follows: *A review of the analysis did not identify anywhere that potential connections between areas due to back flow through drains with failed check valves, pipe, and cable penetrations including cable trays or HVAC ducts were evaluated. Additionally, no discussion of potential for structural failures due to flooding loads resulting in additional propagation pathways could be found.*	It is likely the peer review team did not identify a specific assessment of this SR in the assessment due to the fact that this SR is inherently addressed throughout the analysis. The following provides a simple high-level justification as to how each of the inter-area propagation pathways is treated in the analysis. Each of the potential inter-area propagation mediums was not addressed separately, but rather was addressed as appropriate in Section 5.0 in CN-RAM-10-004 (Ref. 6) as the propagation means was applicable to the scenario and flood areas being discussed. Each scenario identified in Section 5.0 in CN-RAM-10-004 (Ref. 6) identifies the flooding initiator, the pathway (and the inter-area propagation means taken by the flooding source along that pathway) and the impacted equipment. The following explicit discussion on inter-area propagation pathways will be included after paragraph one in Section 4.3 in CN-RAM-10-004 (Ref. 6): "The following provides an explicit description on each of the inter-area propagation pathway means required in SR IFSN-A8 to meet CC-II: • **Drain lines** – MNS Units 1 & 2 drainage systems were specifically addressed throughout the analysis. The groundwater drainage system (WZ) especially, was thoroughly analyzed and Sensitivity Study 6 was included in the analysis to determine the degree of interaction between flood areas due to this inter-connected drainage system. All plant drainage systems were evaluated in the internal flooding analysis and the connection between flood areas was identified to determine the potential impact. • **Backflow through drain lines** – Backflow through drain lines was evaluated for all drainage

Table 5: Flood Modeling Peer Review Facts and Observations for Supporting Requirements Not Met and Capability Category 1 Item			
SR	Element	Peer Review Assessment	Resolution
			systems at MNS Units 1 & 2. The WZ system was identified as a system which could potentially impact plant risk from an internal flooding perspective, and this scenario is explicitly evaluated in the analysis. Flooding connections between the CA pump rooms for Unit 1 and Unit 2 was discussed in the evaluation and is described here as an example of one of the backflow scenarios evaluated in the analysis. • **Failed check valves** – No potential scenarios were identified with potential backflow issues aside from the WZ system scenarios. This scenario did not credit check valves, and therefore failed check valves are inherently included in the assessment. No other systems were identified due to the wide-open nature of the plant and subsequent defined wide-open flood areas. • **Pipe and cable penetrations** – During plant walkdowns all penetrations were identified and documented in the walkdown forms which were deemed important to the internal flooding analysis (penetrations which were either sealed or higher than potential flood levels were not documented). It is reasonable to expect that the non-water tight door(s) associated with the flood area would fail prior to the accumulation of water to these penetration elevations. No penetrations were identified which would impact a propagation pathway. This does not imply that no penetrations exist within the plant, but rather no penetrations exist which would provide a propagation pathway which would either change the described pathway, or produce a new propagation pathway. Penetrations were identified as sealed throughout the plant. • **Doors** – Doors were identified and included in all the described scenarios.

Table 5: Flood Modeling Peer Review Facts and Observations for Supporting Requirements Not Met and Capability Category 1 Item			
SR	Element	Peer Review Assessment	Resolution
			• **Stairwells** – Stairwells were identified and included in all the described scenarios. • **Hatchways** – Equipment hatchways identified throughout the plant were determined to be sealed and did not provide a propagation pathway from one flood area to another. Additionally, in all cases the potential new propagation pathway that the hatchway would have provided would not change the analyzed propagation pathway. For example, flooding from the 716' elevation through the equipment hatches would lead to flooding out the 695' elevation. The impact of the hatchway propagation path is the same as the propagation pathway analyzed via the open stairwell from the 716' elevation to the 695' elevation. • **HVAC ducts** – Similarly to pipe and cable penetrations, all HVAC ducts were identified and documented in the walkdown forms which were deemed important to the internal flooding analysis (ducts which were higher than potential flood levels were not documented). It is reasonable to expect that the non-water tight door(s) associated with the flood area would fail prior to the accumulation of water to these HVAC duct elevations. No HVAC ducts were identified which would impact a propagation pathway. This does not imply that no HVAC ducts exist within the plant, but rather no HVAC ducts exist which would provide a propagation pathway which would either change the described pathway, or produce a new propagation pathway. • **Structural failure** – No break-out walls or structural failures aside from doors or the plug between the Service Building and the Auxiliary Building were identified. The only potentially structural failures were discussed in detail as appropriate in the documentation."

Table 5: Flood Modeling Peer Review Facts and Observations for Supporting Requirements Not Met and Capability Category 1 Item			
SR	**Element**	**Peer Review Assessment**	**Resolution**
IFSN-A12	SCREEN OUT FLOOD AREAS where flooding of the area does not cause an initiating event or a need for immediate plant shutdown, AND either of the following applies: (a) The flood area (including adjacent areas where flood sources can propagate) contains no mitigating equipment modeled in the PRA; OR (b) the flood area has no flood sources sufficient (e.g., through spray, immersion, or other applicable mechanism) to cause failure of the equipment identified in IFSN-A5. DO NOT USE failure of a barrier against inter-area propagation to justify screening (i.e., for screening, do not credit such failures as a means of beneficially draining the area). JUSTIFY any other qualitative screening criteria.	The peer review assessment concluded that this SR was not met in the original analysis and F&O IFSN A12-01 was identified. The basis for this determination is as follows: *Based on the write-ups in MCC-1535-122, several potential flood areas were screened based on potentially invalid criteria/assumptions. For example, Section 5.2.1 screens out the Annulus regions based on the length of the piping being relatively short, the PRA-components being primarily valves which are not susceptible to submergence, and that the unavailability of these valves are "not expected to" result in a reactor trip. Regardless of the length of the piping, the potential/frequency of a pipe break needs to be evaluated; no listing of PRA-components or their physical location in the flood area is provided nor is the potential impact of spray on them causing them to fail discussed; the actual impact of a failure of these valves on continued plant operations needs to be validated. It is not appropriate to screen out a flood area based on these assumptions since they do not meet the criteria for screening.* *Section 5.2.4 screens out the AFW isolation valves as not being impacted by a flood event since the valves are normally open and fail open on a loss of power. There is no discussion of the potential impact of spray on the valves causing them to spuriously close resulting in a partial loss of AFW following a loss of MFW due to the break in the Dog House. The spurious closing of the AFW Isolation valves in this scenario would result in*	The Annulus was not screened due to relatively short piping. This was a poor choice of words used to describe the flood area. The Annulus was initially screened due to the fact that no equipment in that flood area could lead to a plant trip or immediate plant shutdown. Identification of short piping in the Annulus was to support the stance that the piping was sufficiently short to allow that flooding initiator to be subsumed under the loss of system initiators corresponding to the fluid systems in the flood area. Upon further investigation however it was determine that additional scenarios warranted modeling in the Annulus. Scenarios requiring modeling included Pressure Boundary Failures (PBFs) in the ND, NV and KC systems causing a plant trip and a consequential failure of the standby makeup pump for the standby shutdown facility. The following required documentation changes needed to include these scenarios in the model are identified below. No CDF or LERF changes were identified due to these additional scenarios. The contribution to plant risk was not great enough to be retained after quantification truncation limits were applied. In addition to the changes identified below, the quantification Calculation Note CN-RAM-10-010 (Ref. 9) has been updated to reflect the identified model changes. These changes have not been included in this letter report due to the large number of changes and will be incorporated in the revision of CN-RAM-10-010 (Ref. 9). Refer to LTR-RAM-II-11-112 Section 2.18.3 for a detailed discussion of the updated annulus modeling. AFW isolation valves were addressed in Section 2.17.3 as follows: Plant personnel confirmed that neither the PORV controllers (Ref. 11) nor the CA isolation valves (Ref. 12) are susceptible to spray and therefore no change to the existing analysis is appropriate.

Table 5: Flood Modeling Peer Review Facts and Observations for Supporting Requirements Not Met and Capability Category 1 Item			
SR	Element	Peer Review Assessment	Resolution
		a situation that cannot be screened.	A discussion justifying this treatment has been added to the existing analysis. The following should be input to Section 5.2.4, paragraph six in CN-RAM-10-003 (Ref. 5): "Furthermore, both AFW isolation valves and PORV controllers were examined to determine if spray event could impact this equipment. Discussions with plant personnel confirmed that neither the PORV controllers (Ref. 54) not the CA isolation valves (Ref. 55) is susceptible to spray, and therefore has not been incorporated into the analysis. Additionally, the PORV controllers are listed as EQ equipment in a harsh environment and are expected to operate in the defined spray scenario." Screening criteria, which was used to screen out potential flood areas, were revisited. Upon review no instances aside from those in the previously discussed flood areas were identified which required reassessment. Therefore, with the recommended changes, the screening criteria used to screen potential flood areas are valid and complete.
IFSN-A17	CONDUCT plant walkdown(s) to verify the accuracy of information obtained from plant information sources and to obtain or verify: (a) SSCs located within each defined flood area	The peer review assessment concluded that this SR was not met in the original analysis and F&O IFSN A17-01 was identified. The basis for this determination is as follows: *A review of the walkdown forms provided in Appendix A of MCC-1535-121 identified that some critical information required to support the SRs mentioned above was not available*	Walkdowns have been verified and forms have been reviewed to ensure all fields have been filled out. The items identified by the peer review team have been addressed with the exception of more fully listing the PRA equipment located in a flood area. The walkdown sheets continue to identify only the PRA-related equipment critical to developing the internal flooding PRA model sufficient to capture the impact of the flooding events. For example, a flood area may contain a motor-driven pump

Table 5: Flood Modeling Peer Review Facts and Observations for Supporting Requirements Not Met and Capability Category 1 Item			
SR	**Element**	**Peer Review Assessment**	**Resolution**
	(b) Flood/spray/other applicable mitigative features of the SSCs located within each defined flood area (e.g., drains, shields, etc.) (c) Pathways that could lead to transport to the flood area	*on the walkdown forms. For example, although the forms contained a field for Flood Sources, this appeared to only include tanks, and not piping in the area (note states that piping and corresponding lengths were determined from isometric and layout drawings), and the volume of the tanks was not always provided. Although there is a field on the form for PRA-related equipment in the Area, this information was not filled out consistently, resulting in some of the flood zones only listing major equipment such as pumps and panels, but not all PRA equipment in the room so it is not always possible to determine what is susceptible to flood-related impacts, including submergence and/or spray impacts in the room. Additionally, some of the information provided is contradictory for example, on the walkdown for Unit 2 CA Pump Room although doors are listed, the Door Type and Door Sizes are given as N/A, and no information is provided with respect to which way the door opens. Some of the walkdown forms said they assumed the information was the same as Unit 1 which implies that an actual walkdown of the room was never performed.* *Since some of the original walkdowns are incomplete with respect to identifying all the information required to satisfy the requirements of SRs IFSO-A6, IFPP-A5, IFSN-A17, IFQU-A11 (e.g. equipment locations in the rooms, door propagation pathways, some information on the forms is assumed information, pipe lengths and sizes are taken from isometric and layout drawings, etc.) walkdowns to verify the information not*	and associated motor operated suction and/or discharge valves. The impact on system operation is the same if either the motor-driven pump or motor operated valve is affected by a flooding event. It is therefore not necessary to list both the pump and valves to assess the flooding impact. Inclusion of either the pump or valve(s) is sufficient to assess the flooding impact on PRA-related equipment in the flood area. This is consistent with an inquiry and subsequent response by the NRC on the topic. The inquiry is identified below: **File # 08-503** **Subject: SR IF-C2c [IFSN-A5]** Applicability: RA-Sc-2007 up to and including RA-Sa-2009 Date Issued: September 10, 2009 Question: Is it the case that SR IF-C2c [IFSN-A5] can only be met if individual components located in the flood area are documented? Response: No. However if individual components are not identified, adequate justification to support the level at which SSCs are modeled should be documented. As a result the level of detail presented in the walkdown forms is adequate and a statement justifying the level of detail presented has been incorporated into the documentation. The following statement is recommended to be added to Section 5.0 at the end of Part B in CN-RAM-10-002 (Ref. 4): "The walkdown sheets identify only the PRA equipment critical to developing the internal flooding PRA model sufficient to capture the impact of the flooding events. This is consistent with NRC inquiry and subsequent response by the NRC on the topic. The inquiry is identified below:

Table 5: Flood Modeling Peer Review Facts and Observations for Supporting Requirements Not Met and Capability Category 1 Item			
SR	**Element**	**Peer Review Assessment**	**Resolution**
		documented during the original walkdowns are required to ensure validity of the information.	**File # 08-503** **Subject: SR IF-C2c [IFSN-A5]** Applicability: RA-Sc-2007 up to and including RA-Sa-2009 Date Issued: September 10, 2009 Question: Is it the case that SR IF-C2c [IFSN-A5] can only be met if individual components located in the flood area are documented? Response: No. However if individual components are not identified, adequate justification to support the level at which SSCs are modeled should be documented."
IFSN-B1	DOCUMENT the internal flood scenarios in a manner that facilitates PRA applications, upgrades, and peer review.	The peer review assessment concluded that this SR was not met in the original analysis and F&O IFPP B1-01 was identified. The basis for this determination is as follows: *Documentation is not easy to follow in a few spots. Difficult to see why specific flood sources screened. The analysis also lacks a list of critical component heights.*	Same as IFPP B1-01.
IFSN-B3	DOCUMENT sources of model uncertainty and related assumptions (as identified in QU-E1 and QU-E2) associated with the internal flood scenarios.	The peer review assessment concluded that this SR was not met in the original analysis and F&O IFPP B3-01 was identified. The basis for this determination is as follows: *Some of the key assumptions and areas of uncertainty were not all identified as such. These should appear in Section 4.4 but are found throughout the documents. Many of the assumptions are not called assumptions but are identified as expectations.*	Same as IFPP B3-01.

Table 5: Flood Modeling Peer Review Facts and Observations for Supporting Requirements Not Met and Capability Category 1 Item			
SR	**Element**	**Peer Review Assessment**	**Resolution**
IFEV-B1	DOCUMENT the internal flood scenarios in a manner that facilitates PRA applications, upgrades, and peer review.	The peer review assessment concluded that this SR was not met in the original analysis and F&O IFPP B1-01 was identified. The basis for this determination is as follows: *Documentation is not easy to follow in a few spots. Difficult to see why specific flood sources screened. The analysis also lacks a list of critical component heights.*	Same as IFPP B1-01.
IFEV-B3	DOCUMENT sources of model uncertainty and related assumptions (as identified in QU-E1 and QU-E2) associated with the internal flood scenarios.	The peer review assessment concluded that this SR was not met in the original analysis and F&O IFPP B3-01 was identified. The basis for this determination is as follows: *Some of the key assumptions and areas of uncertainty were not all identified as such. These should appear in Section 4.4 but are found throughout the documents. Many of the assumptions are not called assumptions but are identified as expectations.*	Same as IFPP B3-01.
IFQU-11	CONDUCT walkdown(s) to verify the accuracy of information obtained from plant information sources and to obtain or verify inputs to: (a) Engineering analyses (b) Human reliability analyses (c) Spray or other applicable impact assessments (d) Screening decisions	The peer review assessment concluded that this SR was not met in the original analysis and F&O IFSN A17-01 was identified. The basis for this determination is as follows: *A review of the walkdown forms provided in Appendix A of MCC-1535-121 identified that some critical information required to support the SRs mentioned above was not available on the walkdown forms. For example, although the forms contained a field for Flood Sources, this appeared to only include tanks, and not piping in the area (note states that piping and corresponding lengths were determined from isometric and layout drawings), and the volume of the tanks was*	Same as IFSN A17-01.

Table 5: Flood Modeling Peer Review Facts and Observations for Supporting Requirements Not Met and Capability Category 1 Item			
SR	Element	Peer Review Assessment	Resolution
		not always provided. Although there is a field on the form for PRA-related equipment in the Area, this information was not filled out consistently, resulting in some of the flood zones only listing major equipment such as pumps and panels, but not all PRA equipment in the room so it is not always possible to determine what is susceptible to flood-related impacts, including submergence and/or spray impacts in the room. Additionally, some of the information provided is contradictory for example, on the walkdown for Unit 2 CA Pump Room although doors are listed, the Door Type and Door Sizes are given as N/A, and no information is provided with respect to which way the door opens. Some of the walkdown forms said they assumed the information was the same as Unit 1 which implies that an actual walkdown of the room was never performed. *Since some of the original walkdowns are incomplete with respect to identifying all the information required to satisfy the requirements of SRs IFSO-A6, IFPP-A5, IFSN-A17, IFQU-A11 (e.g. equipment locations in the rooms, door propagation pathways, some information on the forms is assumed information, pipe lengths and sizes are taken from isometric and layout drawings, etc.) walkdowns to verify the information not documented during the original walkdowns are required to ensure validity of the information.*	

Table 5: Flood Modeling Peer Review Facts and Observations for Supporting Requirements Not Met and Capability Category 1 Item			
SR	Element	Peer Review Assessment	Resolution
IFQU-B3	DOCUMENT sources of model uncertainty and related assumptions (as identified in QU-E1 and QU-E2) associated with the internal flood accident sequences and quantification.	The peer review assessment concluded that this SR was not met in the original analysis and F&O IFPP B3-01 was identified. The basis for this determination is as follows: *Some of the key assumptions and areas of uncertainty were not all identified as such. These should appear in Section 4.4 but are found throughout the documents. Many of the assumptions are not called assumptions but are identified as expectations.*	Same as IFPP B3-01.

Table 6: Fire PRA Peer Review Findings			
SR #	SR	Peer Review Assessment	Resolution
PP-B2	If partitioning credits wall, ceiling, or floor elements that lack a fire resistance rating, justify the judgment that the credited element will substantially contain the damging effects of fires given the nature of the fire sources present in each compartment separated by the nonrated partitioning element.	Section 7.1 of plant partitioning and ignition frequency calculation states "The fire compartments were mapped directly to fire areas; therefore no crediting of partitioning features that do meet the formal NUREG/CR-6850 criteria for compartments was applied. Consequently, MNS 'compartments' are enclosed rooms with rated fire barriers." Drawing MC-1384-07.17-00 Note (1) states that six HVAC penetrations through the reactor building wall do not contain fire dampers - there is no mention of this in the partitioning documentation or why this is acceptable. Fire areas 25 to 32 and/or 33. Additional examples in F&O description. The SR is not met.	The six non-rated HVAC penetrations through the reactor building wall (per drawing MC-1384-07.17-00) have no impact on the FPRA. There are no in-situ combustibles or fixed ignition sources which would contribute to fire propagating across the boundary.
PP-B7	Conduct a confirmatory walkdown of locations within the global analysis boundary to confirm the conditions and characteristics of credited partitioning elements.	No description of walkdown for plant partitioning was given in the documentation. Nothing noted that a walkdown related to plant partitioning occurred. Discussion with plant analyst determined that additional walkdown information related to plant partitioning was not confirmed or documented since the plant partitioning is based upon room barriers. Therefore, the SR is not met.	Since fire compartments correspond to fire area boundaries, the burden for maintaining the condition of the portioning elements is programmatically addressed. Fire boundary conditions and characteristics were documented in the Multi-Compartment Analysis (Attachment D of the Scenario Development Report) under the Fire Zone Configuration Notes column.
PP-C3	Document the general nature and key or unique features of the partitioning elements that define each physical analysis unit defined in plant partitioning in a manner that facilitates Fire PRA applications, upgrades, and peer review.	Description of the general nature and key or unique features of the partitioning elements is limited to a single statement that plant fire areas/rooms are used as the plant partitions. This is not sufficient documentation of these elements as fire barriers as noted in F&O PP-B2-01. Basis for Significance: Documentation does not meet the requirement to describe elements of the partitioning.	Fire Area boundaries are described in the Fire Protection Design Basis Specification (MCS-1465.00-00-0008).

Table 6: Fire PRA Peer Review Findings			
SR #	SR	Peer Review Assessment	Resolution
CS-C1	Document the cable selection and location methodology applied in the Fire PRA in a manner that facilitates Fire PRA applications, upgrades, and peer review.	The Cable Selection document is well organized, but requires more detail in order to facilitate Fire PRA applications, upgrades and peer review. Therefore, the SR is judged to be not met.	Enhanced details on Y1 and Y2 cables were added to section 2 of the Cable Selection Report. The report states that Y1 and Y2 cables are comprised of thermoset cables constructed with flame retardant cross-linked polyethylene insulation, an interlocking armor and a PVC exterior jacket.
CS-C3	If the provision of SR CS-A11 is used, document the assumed cable routing and the basis for concluding that the routing is reasonable in a manner that facilitates Fire PRA applications, upgrades, and peer review.	As noted for SR CS-A11, assumed cable routing appears to be reasonable, however more detailed documentation is judged to be needed to facilitate Fire PRA applications, upgrades and peer review. Therefore, the SR is judged to be not met.	A clearer basis for the Y3 cable routing was included in section 2.3 of the Cable Selection Calculation. Additionally, cable selection has since been expanded to address numerous Y3 components.
CS-C4	Document the review of the electrical distribution system overcurrent coordination and protection analysis in a manner that facilitates Fire PRA application, upgrades, and peer review.	The electrical distribution system over current coordination and protection analysis is judged to be reasonable based on review. However, documentation is not yet complete. Therefore, the SR is judged to be not met.	The peer review stated that this is a documentation issue and that analysis is judged to be reasonable. This item does not affect the conclusions of the vital battery LAR analysis.
PRM-B2	Verify the peer review exceptions and deficiencies for the Internal Events PRA are dispositioned, and the disposition does not adversely affect the development of the Fire PRA plant response model.	Appendix E of the McGuire and Catawba PRA Technical Adequacy for NFPA-805 report provides exceptions and deficiencies for the Internal Events PRA. Of the 55 open SRs, 14 are of a technical nature. All dispositions were documented to not adversely affect the development of the Fire PRA plant response model. However, the findings are judged to not be conclusive. In particular, basic event data is out-of-date (pre-NUREG/CR-6928), which doesn't account for running/standby components. Additionally, no pre-initiator HEPs have been modeled. Certain pre-initiator HEPs have the potential to impact the PRA results with some significance. For	All known deficiencies identified as having a potentially significant impact on the FPRA have been addressed (refer to PRM-B11-01). The FPRA Model Development Report was updated (Section 4) to acknowledge that internal events open items are addressed during applications consistent with the IEPRA practice.

Table 6: Fire PRA Peer Review Findings			
SR #	SR	Peer Review Assessment	Resolution
		example, miscalibration of RWST and containment sump level indicators could potentially be significant for an ice condenser plant. Therefore, the SR is judged to be not met.	
PRM-B11	Model all operator actions and operator influences in accordance with the HRA element of this Standard.	This SR is considered to be not met because of a number of issues associated with the identification and incorporation of fire related HFEs. See HRA F&Os.	All findings associated with HRA SRs have been resolved. Also, Duke has updated the HEP values as necessary to address the use of mean values. The updated HEP values have been incorporated into the recovery rule file used for FPRA quantification.
FSS-C5	Justify that the damage criteria used in the Fire PRA are representative of the damage targets associated with each fire scenario.	The MNS FPRA uses thermo set damage criteria for their cable damage criteria. Justification for use of this damage criteria is provided in Section 6.1 of Calculation MCC-1535.00-00-0104(Draft), "MNS Fire Scenario Report." Based on the justification the criteria provided in NUREG/CR-6850, Section H.1.3 for the treatment of thermo set cable with a thermoplastic coating is discussed. This discussion concludes the cable used at MNS (armored thermo set with thermoplastic coating) has a thermo set damage temperature. In addition to the predominant use of armored thermo set cables with thermoplastic coating, a smaller but not insignificant number non-armored thermoplastic cables are routed in plant cable trays. More robust justification than that provided in Calculation MCC-1535.00-00-0104 (Draft), is needed to justify the use of thermo set cable damage temperatures in the presence of thermoplastic coating material and cables that would be expected to ignite at damage temperatures lower that that for thermo set insulated cables. This SR requires that the damage criteria used in the Fire PRA be	As described in Section 6.1 of the Fire Scenario Report, the thin layer of flame- retardant PVC jacket material surrounding the armored cable is considered insignificant to impact the results. Non-armored (but not necessarily thermoplastic) cables at MNS are primarily related to security and communication (phone, LAN, or fiber optic cables). The low concentration of non-qualified cables, which are not associated with credited circuits, is considered insufficient to impact the results.

Table 6: Fire PRA Peer Review Findings			
SR #	SR	Peer Review Assessment	Resolution
		representative of the damage targets. Because the target sets include materials and cables that may ignite and/or damage at temperatures lower than the damage temperature used this SR is considered not met. F&Os have been generated for the issues identified above.	
HRA-A1	For each fire scenario, for each safe shutdown action carried over from the Internal Events PRA, determine whether or not each action remains relevant and valid in the context of the Fire PRA consistent with the scope of selected equipment per the ES element and plant response model per the PRM element of this Standard, and in accordance with HLR-HR_E and its SRs in Part 2 with the following clarifications: (a)Where SR HR-E1 mentions "in the context of the accident scenarios," specific attention is to be given to the fact these are fire scenarios, and (b) Develop a defined basis to suppor tthe claim of nonapplicability of any of the requirements under HLR-HR-E in Part 2.	At least one human action was found that the timing from the internal events model would not be applicable for all fire scenarios in an identified enclosure. No adjustment for this timing change was made in the HEP. Additionally, the lack of internal events pre-initiators and the use of median vs. mean values from the internal events PRA will requires some level of reanalysis and requantification of the fire CDF once incorporated. See F&Os PRM-B2-01 and PRM-B11-01	The FPRA Model Report has been updated to document the review of the quantification of basic event RNCBLKVDHE which revealed that the HEP is not sensitive to the time available even with 3 PORVs open based on MAAP runs performed by Duke. Consequently, no adjustment to the HEP for this action is required for the possibility of multiple spurious PORV operation.

Table 6: Fire PRA Peer Review Findings			
SR #	SR	Peer Review Assessment	Resolution
HRA-E1	Document the Fire PRA HRA including (a) those fire-related influences that affect the methods, processes, or assumptions used as well as the identification and quantification of the HFEs/HEPs in accordance with HLR-HR-I and its SRs in Part 2, and develop a defined basis to suppor the claim of nonapplicability of any ot the requirements under HLR-HR-I in Part 2, and (b) any defined bases to support the claim of nonapplicability of any of the referenced requirements in Part 2 beyond that already covered by the clarifications in the Part.	There is no traceable path from the documented definition of screening criteria to the documented HEP values for use in the FPRA. The SR is judged to be not met.	The criteria used to develop adjust HEPs in Appendix B of the FPRA Model Report outlined in sections 5.3.1 and 5.3.2 has been updated to eliminate inconsistencies. The report provides details on increasing the HEP value by a specified factor depending on action time and complexity of the action for operator actions inside and outside the control room.
SF-A2	For those physical analysis units within the Fire PRA golobal plant analysis boundary, (a) Review installed fire detection and suppression systems and provide a qualitative assessment of the potential for either failure (e.g., rupture or unavailability) or spurious operation during an eqrthquake, and (b) Assess the potential impact of system rupture or spurious operation on post earthquake plant response including the potential for flooding relative to water-based fire	Addressed by walkdown review with the exception of loss of habitability and suppression system diversion. The SR is judged to be not met.	The FPRA Summary Report has been updated to address habitability impacts beyond what was captured in the IPEEE documentation. The Halon cylinders are located in the Turbine Building basement. In the unlikely event of an earthquake causing a cylinder to rupture, the Halon would be dissipated over the very large volume of the Turbine Building and the resulting concentration levels would not be expected to significantly impact habitability.

Table 6: Fire PRA Peer Review Findings			
SR #	SR	Peer Review Assessment	Resolution
	suppression syste, loss of habitability for gaseous suppression systems, and the potential for diversion of suppressantes from areas where they might be needed for those fire suppression systems associated with a common suppressant supply.		
SF-A3	Assess the potential for common-cause failure of multiple fire suppression systems due to the seismically induced failur of supporting systems such as fire pumps, fire water storage tanks, yard mains, gaseous suppression storage tanks, or building standpipes.	This item is not directly addressed in the FPRA MCS-1465 00-00-0008, Rev. 9 (FP DBD) indicates (Section C.18.4) that fire pumps are located in a non-seismic Cat III intake. Not clear if this indicates a potential common mode failure. A reference to procedures for recovering from a loss of fire water system pumps was provided (OP/0/B/6400/002 D) and appears to address the specific concern identified above. An evaluation of other potential common cause losses of fire system equipment appears to be necessary to meet this requirement. This SR is judged to be not met.	No impact on quantification of FPRA or Change Evaluations (seismic-fire interaction is purely qualitative per NUREG/CR-6850. The Fire Protection Specification notes that the fire pumps are located in a non seismic structure. In the event that the fire pumps are disabled, TSC Volume 2, Enclosures 46 & 47 provide for the deployment of a portable (Hale) pump or use of the CACST to pressurize the RY header if necessary for fire suppression (stated in the Summary Report, section 3.13).
SF-A4	Review plant seismic response procedures and Qualitatively assess the potential that seismically induced fire, or the spurious operation of fire suppression systems, might compromise post earthquake plant response.	Need Procedures required by the SR. Therefore, this SR is judged to be not met.	No impact on quantification of FPRA or Change Evaluations (seismic-fire interaction is purely qualitative per NUREG/CR-6850). It is noted that Earthquake Procedure RP/0/A/5700/007 does not reference fire response procedure AP-45 or TSC Volume 2, Enclosure 46 & 47; however, in the event of a seismic induced fire it is expected that multiple procedures will be used in parallel as necessary. The entry conditions for the fire response procedure (via fire

Table 6: Fire PRA Peer Review Findings			
SR #	SR	Peer Review Assessment	Resolution
			alarm annunciator or report of a fire) apply at all times and under any plant operating conditions.
SF-A5	Review (a) plant fire brigade training procedures and assess the extent to which training has prepared firefighting personned to respond to potential fire alarms and fires in the wake of an earthquake and (b) the storage and placement of firefighting support equipment and fire brigade access routes, and (c) assess the potential that an earthquake might compromise one or more of these features.	Need Procedures required by the SR. Therefore, this SR is judged to be not met.	No impact on quantification of FPRA or Change Evaluations (seismic-fire interaction is purely qualitative per NUREG/CR-6850). See qualitative discussion of seismic fires in the McGuire Fire PRA Summary Report.
SF-B1	Document the results of the seismic/fire interaction analysis, including the results and insights gained from any unique fire scenrios that were identified, in a manner that failitates Fire PRA applications, upgrades, and peer review.	See F&Os associated with SF-A1 through A5. The SR is judged to be not met.	The seismic-fire interactions found by SF-A2 through A5 have been addressed above and are also documented in the seismic-fire interactions assessment, Section 3.13 of the McGuire Fire PRA Summary Report.