Progress Energy

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SERIAL: BSEP 09-0107

Director, Office of Enforcement
U. S. Nuclear Regulatory Commission
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Subject: Brunswick Steam Electric Plant, Unit Nos. 1 and 2
Renewed Facility Operating License Nos. DPR-71 and DPR-62
Docket Nos. 50-325 and 50-324
Appeal of the Final Significance Determination of White Finding and Reply to a Notice of Violation, EA-09-121

References:

1. EA-09-121, Letter from Mr. Kriss M. Kennedy, Director, Division of Reactor Safety, U.S. Nuclear Regulatory Commission to Mr. Benjamin C. Waldrep, Vice President, Carolina Power and Light Company, Brunswick Steam Electric Plant, "Brunswick Steam Electric Plant, NRC Inspection Report 05000325/2009009 and 05000324/2009009 and Preliminary White Finding," dated June 17, 2009.

2. EA-09-121, Letter from Mr. Luis A. Reyes, Regional Administrator, Region II, U.S. Nuclear Regulatory Commission to Mr. Benjamin C. Waldrep, Vice President, Carolina Power and Light Company, Brunswick Steam Electric Plant, "Final Significance Determination of White Finding and Notice of Violation (NRC Inspection Report No. 05000325/2009010 and 05000324/ 2009010), Brunswick Steam Electric Plant," dated September 14, 2009.

Ladies and Gentlemen:

Carolina Power & Light Company (CP&L), now doing business as Progress Energy Carolinas, Inc., received a Preliminary White Finding from the U.S. Nuclear Regulatory Commission (NRC) in Inspection Report 05000325/2009009 and 05000324/2009009, dated June 17, 2009, (i.e., Reference 1), for the Brunswick Steam Electric Plant (BSEP), Unit Nos. 1 and 2. The Preliminary White Finding is associated with a failure to correctly designate termination points for linking control power to the Emergency Diesel Generators

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resulted in a loss of EDG local control function. At CP&L's request, a Regulatory Conference was held on July 28, 2009, to present CP&L's assessment of the significance of the finding. Based on the risk assessment presented at the Regulatory Conference, CP&L concluded that the finding should be appropriately characterized as having a very low to low increased importance to safety (i.e., Green).

Subsequent to the Regulatory Conference, CP&L received the Final Significance Determination of White Finding and Notice of Violation (NOV) EA-09-121, dated September 14, 2009 (i.e., Reference 2). The NRC concluded that the inspection finding is appropriately characterized as having low to moderate increased importance to safety (i.e., White). The letter provides 30 calendar days from the date of that letter to appeal the NRC staff's significance determination for this finding.

With this letter, CP&L respectfully appeals the characterization of the Final Significance Determination conclusion as White. CP&L has performed a thorough review of the NRC's detailed assessment, and believes that the appeal meets the criteria given in NRC Inspection Manual Chapter 0609, Attachment 0609.02, "Process for Appealing NRC Characterization of Inspection Findings (SDP Appeal Process)."

CP&L agrees with the NRC's characterization of the NOV as a violation of 10 CFR 50, Appendix B, Criterion III, as cited in Reference 2, and the NOV is not in dispute.

Enclosure 1 to this letter provides the bases for CP&L's appeal. Enclosure 2 to this letter provides Calculation BNP-PSA-073, Revision 1. CP&L requests that Enclosure 2 be withheld from public disclosure in accordance with 10 CFR 2.390, since it contains security-related information.

No regulatory commitments are contained in this letter. Please refer any questions regarding this submittal to Ms. Annette Pope, Supervisor - Licensing/Regulatory Programs, at (910) 457-2184.

Sincerely,

Benjamin C. Waldrep

LJG/ljg

Enclosures:
1. Bases for Appeal
2. Calculation BNP-PSA-073, Revision 1 **(Security-Related Information)**

cc (with enclosure):

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Bases for Appeal

Introduction

Carolina Power & Light Company (CP&L), now doing business as Progress Energy Carolinas Inc., has elected to appeal the NRC's Final Significance Determination (FSD) conclusion of a White Finding, and lists the following six bases for its appeal.

1. A sensitivity evaluation performed by CP&L with respect to National Fire Protection Association (NFPA) Standard 805 (i.e., Reference 5), FAQ 08-0048 (i.e., Reference 6), using the current fire bin ignition frequencies in NUREG/CR-6850 (i.e., Reference 8) was not considered as a sensitivity evaluation by the NRC.

2. The NRC did not provide justification as to why a High Energy Arcing Fault (HEAF) fire scenario was considered for Common Substations C and D, and Substations 1L and 2L. Documentation was provided by CP&L noting the end cabinets of the substations contain no mechanical connections and should not be counted as a fire source.

3. The well-sealed construction of the Motor Control Center (MCC) cabinets allow for a reduction in fires propagating beyond the MCC cubicles. The NRC provided no justification in restricting the use of well-sealed cabinets in NUREG/CR-6850 to only apply to weather-tight and waterproof cabinets.

4. The NRC did not provide justification for its position that a 5-minute cable damage delay time is appropriate for crediting solid bottom cable trays. This is not consistent with industry guidance provided in NUREG/CR-6850, Appendix Q.

5. The NRC staff did not consider the timeline for non-suppression probability provided by CP&L. In addition, NRC provided no justification for the 3-minute cable damage delay utilized for coated, qualified cable. Specifically, the NRC's response does not discuss how the fire timeline and fire growth was determined and when the detection occurs. In addition, the timeline does not identify when the limited NRC credit for solid bottom trays and flame retardant coating starts.

6. The NRC did not consider the simulator scenarios and the operator interviews provided, and there was no documented justification as to why this information was not considered, specifically for fires in the Main Control Room (MCR) XU-2 panel, when determining the entry point into the Alternative Safe Shutdown (ASSD) procedure and abandonment of the Control Room.

The appeal is in accordance with NRC Inspection Manual Chapter (IMC) 0609, Attachment 0609.02 (i.e., Reference 4), Paragraph 3, which states the licensee's FSD appeal must fall into one of the following categories:

a. The NRC staff's significance determination process (SDP) was inconsistent with the applicable SDP guidance or lacked justification. Issues involving the staff's choice of probabilistic risk modeling assumptions used in the SDP will not be considered appealable under this process, provided the staff documented its justification in those cases where the licensee presented a different point of view.

b. Actual (verifiable) plant hardware, procedures, or equipment configurations, identified by the licensee to the NRC staff at the Regulatory Conference or in writing prior to the staff reaching a final significance determination, was not considered by the staff.

c. A licensee submits new information which was not available at the time of the Regulatory Conference. New information will only be considered if the licensee informed the NRC during the Regulatory Conference, or in their written response to the preliminary significance determination, that specify additional information was under development. It must be provided within the 30 day appeal period discussed below and it must be complete at the time of the submittal.

The following items provide the detail for the points of appeal. The items are addressed by the same primary refinement areas as documented in Enclosure 2 to NRC's Inspection Report EA-09-121, dated September 14, 2009 (i.e., Reference 2). The NRC responses noted refer to the responses provided in Enclosure 2 of Reference 2, and are an excerpt of those responses (i.e., the area of appeal).

Licensee Refinement Area No. 1: Fire Ignition Frequencies (FIFs)

Background

The NRC's Phase II analysis uses the fire ignition frequencies found in the Fire Protection Significance Determination Process (SDP) in IMC 0609, Appendix F, Attachment 4. Phase III of the SDP process allows for further insights that go beyond the IMC 0609 guidelines.

The following two recent fire Probabilistic Risk Assessment (PRA) refinement documents show that the existing IMC 0609 fire ignition frequencies are not a realistic understanding of the postulated fire scenarios.

- EPRI document 1016735, "Fire PRA Methods Enhancements: Additions, Clarifications, and Refinements to EPRI 1019189," (i.e., Reference 9), Table B-5, and
- Joint NRC/EPRI Fire PRA FAQ 08-0048.

As described in CP&L's submittal, dated July 22, 2009 (i.e., Reference 3), applying the FAQ 08-0048 fire ignition frequencies reduces the NRC calculated Core Damage Frequency (CDF) by approximately 34.7%.

NRC Response (Area of Appeal)

The following response is an excerpt from NRC letter EA-09-121, dated September 14, 2009.

> The NRC accepted the use of these revised FIFs for fire PRAs performed for NFPA 805 transition for best-/point-estimate calculations of fire risk CDF with the following provision: the fire PRA must include a sensitivity evaluation of the risk and delta-risk results to evaluations performed using the current fire bin ignition frequencies in NUREG/CR-6850. With respect to FAQ 08-0048, CP&L did not perform the sensitivity evaluation.

In addition,

> Since this frequency reduction ratio is outside of the NUREG/CR-6850 methodology, and a sensitivity analysis was not performed, the NRC did not incorporate CP&L's reduced frequencies into a final risk determination.

Appeal Criteria and Basis

A sensitivity evaluation was performed by CP&L with respect to NFPA 805, FAQ 08-0048, for electrical cabinets and Main Control board (i.e., Bins 15 and 4) using the current fire bin ignition frequencies in NUREG/CR-6850, while the sensitivities of the other fire bin frequencies were made using a ratio reduction method. This evaluation was not considered as a sensitivity evaluation by the NRC staff. Therefore, this meets Criteria 3.b. of NRC IMC 0609, Attachment 0609.02, as a basis for appeal.

CP&L Response

The sensitivity evaluation was performed for electrical cabinets and Main Control board (i.e., Bins 15 and 4), consistent with FAQ 08-0048 requirements, while the sensitivities of the other fire bin frequencies were made using a ratio reduction method, which meets the intent of the FAQ 08-0048 sensitivity requirement. The sensitivity evaluation was documented in Table 5-4 of calculation BNP-PSA-073 (i.e., Reference 7), and was provided to the NRC at the Regulatory Conference on July 28, 2009. The sensitivity evaluation used the current FIFs from NUREG/CR-6850. A frequency factor, using a ratio of the FIFs from NUREG/CR-6850 and EPRI Document 1016735, as allowed by FAQ 08-0048, was applied to the NRC IMC 0609, Appendix F (i.e., Reference 10) ignition frequencies to arrive at the updated FIFs used.

Specifically, the sensitivity evaluation was performed as follows:

a. The FIFs for Electrical Panels (i.e., Bin 15), and Main Control board (i.e., Bin 4) came from NUREG/CR-6850.
b. The application of NUREG/CR-6850, Section 6.4.3, recommends a cabinet count. The electrical cabinet count used for Bin 15 was 750, the same as that considered in the NRC IMC 0308, Appendix F (i.e., Reference 11).
c. The Main Control board count was the plant specific count of one.
d. The fire frequency for Bin 15 was then divided by the bin count to provide a fire frequency per cabinet. This results in the same fire frequency that is used in the NRC IMC 0609, Appendix F, as follows:

    4.5E-02 / 750 = 6.0E-05 per electrical section. The IMC 0308, Appendix F, makes a further simplification and divides the switchgear cabinets into thermal and energetic fires resulting in 5.5E-05 (i.e., thermal) and 4.7E-06 (i.e., energetic).

e. The same method was done using the EPRI Document 1016735 fire frequency to determine the change in fire frequency for Bin 15 (i.e., Electrical Cabinets) as follows:

    2.36E-02 / 750 = 3.15E-05

    The same reduction used in IMC 0308, Appendix F, was applied for switchgear cabinets divided into two categories (i.e., thermal and energetic), which results in a FIF for Bin 15 switchgear cabinets of 2.88E-05 (i.e., thermal), or a 52% reduction in thermal FIF from IMC 0308, Appendix F, and IMC 0609, Appendix F.

f. Similarly, for Main Control board cabinets, NUREG/CR-6850 uses a FIF for Bin 4 of 2.5E-03, with a count of one, and EPRI 1016735 Bin 4 has 8.24E-04, or a 33% reduction on FIF.
g. The percentage change was then applied to the transformer FIF values provided in NRC letter EA-09-121, dated June 17, 2009 (i.e., Reference 1) to determine the potential change in CDF that could be made if application of FAQ 08-0048 was applied.

h. The HEAF/energetic switchgear FIF was calculated by using the simple ratio between NUREG/CR-6850 (i.e., Bin 16) HEAF value of 1.50E-03, and the revised EPRI Document 1016735 (i.e., Bin 15.2) value of 1.06E-03. This results in an actual HEAF FIF increase above that being used by the NRC, specifically:

   1.5E-03 / 1.06E-03 = 0.71

   Applying the 0.71 ratio to the HEAF fire frequency used in IMC 0609, Appendix F:

   4.7E-06 x 0.71 = 3.32E-06, for HEAF per section.

   Thus, the HEAF FIF value used in the NRC analysis was increased as follows:

   1.60E-06 (i.e., from Reference 1) increased to 3.32E-06 as provided in the July 22, 2009, CP&L submittal (i.e., Reference 3).

i. The results of this sensitivity evaluation were presented to the NRC in CP&L's submittal dated July 22, 2009, and in Table 5-4 of Calculation BNP-PSA-073, which was presented to the NRC at the Regulatory Conference. As described in those documents, this sensitivity evaluation provided a CDF reduction of approximately 34.7%.

The NRC uses IMC 0609, Appendix F, as the primary guidance to perform fire SDP analyses. The ignition frequency values provided in IMC 0609 are generic values that may be applied in the absence of plant specific data. However, with the use of the methodology contained within NUREG/CR-6850, it is possible to generate plant specific ignition frequency values that more accurately reflect the characteristics of the plant.

Applying the NUREG/CR-6850 methodology, a walk-down was performed to identify and count the Bin 15 ignition sources. The effort resulted in a combined Unit1 and Unit 2 Bin 15 electrical cabinet count of 2185, based on 733 Unit 2 cabinets, 719 shared cabinets, and 733 estimated Unit 1 cabinets. The Unit 2 and shared electrical cabinets were walked-down and documented in Reference 15, Attachment 19. The Bin 15 ignition source count was applied to the generic ignition frequency values provided in NUREG/CR-6850 and EPRI 1016735, to generate updated electrical cabinet ignition frequency values.

The updated values were used to perform an ignition frequency-based CDF sensitivity analysis. The sensitivity analysis compares the initial CDF estimate that was based upon ignition frequency values from IMC 0609, Appendix F, with more recent generic ignition frequency values. The resulting CDF values were 13.9% and 20.9% lower than the base rate using EPRI 1016735 Bin 4 and Bin 15 ignition frequency values respectively, with a resulting CDF of 9.03E-07 (i.e., approximately 50% reduction). The final results of the analysis shown in Table 1 reflect the sensitivity of new fire ignition frequencies and the resultant impact on CDF.

Table 1: Sensitivity of new Fire Ignition Frequencies

	NRC USED	NUREG/ CR-6850	EPRI-1016735	BNP Specific Data	Updated Frequency	Updated Basis	Resulting CDF	Delta CDF for FAQ 08-0048
NRC Base – Bin 15	5.5E-05	-	-	-	-	-	1.83E-06	-
Switchgear Cabinets (Without FAQ 08-0048) Bin 15	-	4.50E-02	-	2185	4.119E-05	(2) 4.50E-02 /2185	1.58E-06	-
Switchgear Cabinets (With FAQ 08-0048) Bin 15	-	-	2.36E-02	2185	2.16E-05	(2) 2.36E-02 /2185	1.25E-06	3.3E-07
NRC Base – Bin 4	3.2E-03	-	-	-	-	-	1.83E-06	-
Main Control Board (Without FAQ 08-0048) Bin 4	-	2.5E-03	-	1	2.5E-03	-	1.73E-06	-
Main Control Board (With FAQ 08-0048) Bin 4	-	-	8.24E-04	1	8.24E-04	-	1.49E-06	2.4E-07

For the updated CDF reductions, see the Table provided in the Conclusion on Page 25 of 27.

Conclusion

CP&L performed a sensitivity evaluation for electrical cabinets and Main Control boards (i.e., Bins 15 and 4) consistent with FAQ 08-0048 requirements, which was documented in calculation BNP-PSA-073, and provided to the NRC at the Regulatory Conference. The use of actual plant-specific electrical cabinet count further reduces the overall CDF. This evaluation will result in a significant risk reduction, and should have been considered by the NRC staff.

Generic Applicability

None.

<u>Licensee Refinement Area No. 2:</u> Motor Control Center (MCC) High Energy Arcing Fault

CP&L accepts the NRC position.

<u>Licensee Refinement Area No. 3:</u> Source Applicability

<u>Background</u>

Based on the actual plant physical configuration, two vertical sections in each Cable Spread Room for the Common Substations C and D, and 1L and 2L Substations, have no ignition source within the cabinets and thus are not considered as fire sources. These vertical sections are included as "General Electrical" sections of the substations. These cabinets fit into two categories as follows:

- Cabinets containing incoming power cables and manual disconnect switches. These disconnect switches are similar to a bus bar in a static position.
- Cabinets containing only incoming power cables to transformers. This type of electrical cabinet is a wireway or an enclosed cable tray for routing purposes, and is not counted as electrical cabinet ignition sources.

As described in CP&L's submittal, dated July 22, 2009, application of this refinement reduces the NRC calculated CDF by approximately 27.4%.

<u>NRC Response</u> (Area of Appeal)

The following response is an excerpt from NRC letter EA-09-121, dated September 14, 2009.

> Based on subsequent review of the additional drawings and pictures provided by the licensee for the substations vertical sections in question, the NRC considered instead in the final evaluation the following:
>
> - Common Substations C and D incoming power sections were modeled similar to a bus duct in that only a HEAF fire scenario was considered.
> - Substations 1L and 2L disconnect switch sections were modeled as a breaker with both fire and HEAF scenarios.

<u>Appeal Criteria and Basis</u>

The NRC staff did not provide justification as to why a HEAF fire scenario was considered for Common Substations C and D, and Substations 1L and 2L. The end cabinets of the Common Substations C and D contain no mechanical connections and should not be counted as a fire source. Therefore, this meets Criteria 3.a. of NRC IMC 0609, Attachment 0609.02, as a basis for appeal.

CP&L Response

One vertical section in each cable spread room for Common Substations C and D has no ignition source within the cabinet and is not considered as a fire source. Verification was provided that shows the end cabinets for Common Substations C and D are only "conduits" or "pull boxes" for the routing of cable to the transformer section in the adjacent cabinet. There are no mechanical connectors in these end cabinets capable of causing a HEAF. CP&L stated that this cabinet should not be counted as a fire source due to the fact that there is no mechanical joint within this cabinet. The electrical connection joint resides in the transformer section in the adjacent cabinet. The NRC counted the end cabinets of the Common Substations C and D as a bus duct with an assigned fire frequency, when no actual electrical connection exists (i.e., a HEAF is not credible). NFPA 805, FAQ 07-0035 (i.e., Reference 12), states on page 5 of 16:

> *…in those events occurring at the termination points, all had been included in the "high energy arc fault (switchgear and load centers)" or "catastrophic failure (transformers)" events sets for the end devices as fire ignition sources in NUREG/CR-6850. Hence, these events are already accounted for in the methodology and are treated as originating in the end device. Because non-segmented bus ducts (Category 1) and cable ducts (Category 3) have no transition points other than terminations at the end devices, no treatment of bus ducts faults/fires independent from the treatment of fires for the end device is required.*

CP&L does not agree that the Substation 1L and 2L static disconnect switch sections should have the same fire frequency as a breaker, due to the large disparity in construction with lack of control circuits and other potential fault initiators. This device is comparable to a bus duct due to being in a fixed locked position with no control devices or components, lacking all the features that exist for a breaker.

For the updated CDF reductions, see the Table provided in the Conclusion on Page 25 of 27.

Conclusion

Two vertical cabinets, one each in Common Substations C and D, are only conduits for the routing of cable to the transformer section in adjacent cabinets. There are no mechanical connectors in these end cabinets capable of causing a HEAF and should not be counted as an additional fire source, as discussed in FAQ 07-0035 outlined above. Also, CP&L does not agree that the Substation 1L and 2L static disconnect switch sections should have the same fire frequency as a breaker, due to a lack of many of the features present in a breaker that could initiate a fire. Additionally, due to the distances involved for any bus or cable duct, and the intervening solid steel tops and nearby steel-bottom trays, no damage would occur to the overhead cable trays.

Generic Applicability

The position stated in the NRC response above conflicts with the NRC guidance provided in FAQ 07-0035, "Bus Duct Counting Guidance for High Energy Arcing Faults," (i.e., Reference

12) in two distinct areas. First, is the assignment of fire to termination end-points, and second, on the subsequent fire zone of influence.

For termination end-points of cable or bus ducts, no independent treatment of fire beyond the end device is required. Combustible or flammable materials will not be considered exposed if they are protected by a fire-rated raceway wrap, conduit, or solid steel panels.

CP&L was directed by the NRC staff to apply FAQ 07-0035 in a Request for Additional Information (RAI) regarding a license amendment request to adopt NFPA 805 at Progress Energy's Shearon Harris Nuclear Plant (i.e., Reference 18, RAI 5-28), and considers FAQ 07-0035 the best information currently available for bus duct and cable duct treatment. This section indicates that damage is restricted by solid metal panels and steel tops.

Licensee Refinement Area No. 4: Source Heat Release Rates (HRR)

CP&L accepts the NRC position.

Licensee Refinement Area No. 5: MCC Fire Growth Rates and MCC Configurations

Background

The MCCs, with the exception of the transformer cubicle, are constructed without any ventilation openings, and the individual doors of the cubicles are attached with hex head mechanical fasteners. In addition, the electrical connections were made via conduits. This configuration is consistent with well-sealed electrical cabinets as described in NUREG/CR-6850, and can be excluded as a fire source that impacts external targets. However, for this analysis, CP&L conservatively included these MCCs in the evaluation. The fraction of fires propagating beyond the MCC cubicles is estimated to be 0.05 (i.e., 5.0%), based on the following.

- Not all fires originating in the MCC cubicle will be energetic enough to blow open the rigidly secured door. It is conservatively assumed that 10% of the fires are capable of this.
- Based on detailed fire modeling (i.e., Reference 15, Attachment 18), only the upper half of the MCC sections will be capable of producing a zone of influence that can impact any of the overhead cable trays. The bottom half of each vertical section is excluded, due to the source to target distances.

Therefore, considering only the top half of each vertical section, and excluding the bottom half, would yield 0.05 (i.e., 0.10 x 0.5), or a 5.0% MCC fire growth factor.

As described in CP&L's submittal, dated July 22, 2009, application of this refinement reduces the NRC calculated CDF by approximately 13.9%.

<u>NRC Response</u> (Area of Appeal)

The following response is an excerpt from NRC letter EA-09-121, dated September 14, 2009.

> Based on the NEMA-1 rating, construction details, and pictures of the MCCs, the NRC determined that these MCCs do not meet the requirements for sealed cabinets provided in FAQ 08-0042.

In addition,

> The licensee's MCC configuration includes some ventilation openings and with its NEMA-1 rating does not meet the weather-tight and waterproof requirements to be considered a sealed cabinet exempt from treatment as an ignition source. Therefore, the NRC considered that fires initiated within the MCC panel were capable of spreading out of the panels to secondary combustibles. Additionally, the licensee's fire modeling only considered that the upper 1/2 MCC sections are capable of producing a zone of influence that can impact the overhead trays. The NRC disagreed with this concept because this is not consistent with IMC 0609, Appendix F or NUREG/CR 6850.

<u>Appeal Criteria and Basis</u>

The construction of the cabinets allow for a reduction in fires propagating beyond the MCC cubicles. NUREG/CR-6850, Section 6.5.6, states:

> *..."well-sealed" means there are no open or unsealed penetrations, there are no ventilation openings, and potential warping of the sides/walls of the panel would not open gaps that might allow an internal fire to escape. "Robustly secured" means that any doors and/or access panels are all fully and mechanically secured and will not create openings or gaps due to warping during an internal fire. For example, a panel constructed of sheet metal sides "tackwelded" to a metal frame would not be considered well-sealed because internal heating would warp the side panels allowing fire to escape through the resulting gaps between weld points. A panel with a simple twist-handle latch mechanism would not be considered robustly secured because the twist handle would not prevent warping of the door under fire conditions. In contrast, a water-tight panel whose door/access panel is bolted in place or secured by mechanical bolt-on clamps around its perimeter would be considered both well-sealed and robustly secured.*

It is clear from this definition of a well-sealed cabinet that weather-tight and waterproof cabinets are not the only types of cabinets that would qualify as well-sealed. The intent of this section of NUREG/CR-6850 is to articulate that cabinets that are well-sealed and capable of resisting warping due to internal heating, are not capable of supporting sustained combustion. Based on this definition and intent, the NRC staff provided no justification in limiting this section to only apply to weather-tight and waterproof cabinets. Therefore, this meets Criteria 3.a. of NRC IMC 0609, Attachment 0609.02, as a basis for appeal.

CP&L Response

The application of a sealed cabinet having to be weather-tight and waterproof is not a limiting requirement as defined in NUREG/CR-6850 and FAQ 08-0042 (i.e., Reference 13). Current research has shown that ventilation limited conditions in electrical cabinets with small leakage rates are enough to inhibit fire growth and propagation (i.e., Reference 16). CP&L believes that the NRC's definition too narrowly defines what constitutes a sealed cabinet.

The MCCs, with the exception of the transformer cubicle, are constructed without any ventilation openings, and the individual doors of the cubicles are attached with hex head mechanical fasteners that have rubber door gaskets restricting air into the cabinets. In addition, the electrical connections were made via conduits. This configuration is consistent with well-sealed electrical cabinets as described in NUREG/CR-6850, and can be excluded. However, for this analysis, CP&L conservatively included these MCCs in the evaluation. The fraction of fires propagating beyond the MCC cubicles is estimated to be 0.05 (i.e., 5.0%), based on the following:

- Not all fires originating in the MCC cubicle will be energetic enough to blow open the rigidly secured door. It is conservatively assumed that 10% of the fires are capable of this.

- Based on detailed fire modeling using the Fire Dynamics Tools (FDTs) (i.e., Reference 7, Attachment 18), only the upper one half of the MCC sections will be capable of producing a zone of influence that can impact any of the overhead cable trays. The bottom half of each vertical section is excluded, due to the source-to-target distances being greater than that required for the centerline plume temperature to damage critical targets.

Additionally, although vertical wireways do exist within the MCC enclosure, the cabinets, which include the wireways, are well-sealed consistent with NUREG/CR-6850 (i.e., Reference 8, Section 6.5.6). This results in limited fire propagation internal to the cabinet, and fire induced plume effects would continue to issue from the postulated open cubicle, where the fire initiated. With no openings or vents in the top half of the MCCs to allow for the fire and plume to escape above the source cubicle location, any fires started in the lower half of the MCC would not be expected to grow up the wireways and cause a fire energetic enough to open well-sealed upper-half MCC cubicle doors; therefore, no external fire damage would result.

Therefore, considering only the top half of each vertical section, and excluding the bottom half, would yield 0.05 (i.e., 0.10 x 0.5), or a 5.0% MCC fire growth factor.

For the updated CDF reductions, see the Table provided in the Conclusion on Page 25 of 27.

Conclusion

The MCCs construction meets the intent of the guidance in NUREG/CR-6850 and FAQ 08-0042 for sealed cabinets. It is a realistic assumption that only a fraction of fires initiated within the MCC panels are capable of spreading out of the panels to secondary combustibles.

Generic Applicability

The NRC position has implications for future applications to NUREG/CR-6850 for Fire Probabilistic Risk Assessment (PRA), including NFPA 805. The NRC's position is restrictive in the determination of a sealed cabinet and will result in cabinets that meet the intent of NUREG/CR-6850 as being well-sealed, but may not be waterproof and weather-tight, being considered as fire sources that always have a zone of influence beyond the source itself. This further complicates the ability of Fire PRA practitioners to understand and consistently apply the NRC endorsed guidance. Additionally, FAQ 08-0042 is currently under active NRC staff consideration, and the restrictive position taken may result in premature disposition of this technical issue.

Licensee Refinement Area No. 6: Solid Bottom Trays

Background

Credit for solid bottom trays to both delay fire growth and prevent fire damage for low HRR fires as discussed in NUREG/CR-6850, Attachment Q, has been factored into CP&L's final analysis.

As described in CP&L's submittal, dated July 22, 2009, application of this refinement reduces the NRC calculated CDF by approximately 36.7%.

NRC Response (Area for Appeal)

The following response is an excerpt from NRC letter EA-09-121, dated September 14, 2009.

> The licensee's analysis considers a 20 minute delay prior to cable ignition for trays protected with a solid bottom tray barrier in accordance with NUREG/CR 6850, Appendix Q, Section Q.2.2. The NRC reviewed the fire testing referenced by NUREG/CR 6850 providing results of protection afforded by solid bottom tray barriers.

In addition,

> The NRC considered that for the above described test applicability limitations, it was not appropriate to credit a 20 minute cable ignition delay for solid bottom cable tray barriers. The NRC's final SDP analysis utilized a 5 minute cable damage delay for the configurations protected with solid bottom cable tray barriers. Therefore, no additional credit was provided.

Appeal Criteria and Basis

NUREG/CR-6850, Section Q.2.2, states:

> *Barriers seem to substantially delay cable damage for qualified cable. However, the barriers did not delay cable damage for nonqualified cable. For application to the Fire PRA, the barrier test findings are considered most appropriate to exposure fires with smaller heat release rates and to cable trays in a stack threatened by fires in lower trays. In these cases, each barrier prevents cable tray ignition until well after the fire brigade reaches the scene (i.e., greater than 20 minutes), and damage in qualified cable with solid tray bottom covers until well after the fire brigade reaches the scene.*

Section Q.2.2 indicates that for exposure fires with smaller heat release rates, the test data is applicable. The tests offer data that clearly suggest that solid bottom cable trays offer significant cable damage delay for IEEE-383 qualified cable. The NRC's position is that a 5-minute cable damage delay is appropriate for crediting solid bottom cable trays for the Brunswick postulated 211 kW fire scenarios. The NRC staff has not provided an adequate justification for the 5-minute damage delay time.

Therefore, this meets Criteria 3.a. of NRC IMC 0609, Attachment 0609.02, as a basis for appeal.

CP&L Response

The referenced tests in Appendix Q of NUREG/CR-6850 for both solid bottom trays and fire retardant coatings used, in part, a 41 kW gas burner located 4.75 inches below the target cable tray. It is CP&L's position that the fire tests immersed the first target cable tray in direct flame. The heat flux on a unit basis is severe due to the direct flame impingement. It is expected that the heat flux per unit area from a 211 kW fire located further away (i.e., nominally 24 to 36 inches away) would be bounded by the test configuration with the smaller heat release rate.

The test protocol, for the propane burner tests, involved an intermittent fire source (i.e., 5 minutes on and 5 minutes off). The test authors have indicated that "previous tests had shown 5-minute periods as optimum for creating the largest donor fire in a cable tray loaded with IEEE 383 qualified cable." The collective test data supports a reasonable conclusion that fire retardant coated IEEE-383 qualified cable, located in a solid bottom cable tray would likely not ignite. Further, test data allows for a reasonable conclusion to be made that circuit integrity would be maintained for 20 minutes.

NUREG/CR-6850, Appendix Q, provides guidance on crediting passive fire protection features which include the use of flame retardant coatings, and solid bottom cable trays and fire stops (i.e., Section Q.2). The amount of fire protection these passive fire features provide (i.e., the delay associated with onset of cable damage and cable ignition) is based upon testing.

Table Q-1 of NUREG/CR-6850 presents a summary of test data based on the following basic test protocol:

1. The presented data in Table Q-1 is for fire retardant coated, *non-IEEE 383 qualified* cable.
2. The tests were designed to identify both cable damage time *and* cable ignition time. It was acknowledged that these two data points were not expected to occur at the same time.
3. The tests involved a two gallon hydrocarbon pool fire (i.e., diesel fuel) contained in a 1.5 feet by 3 feet pan (i.e., 4.5 square feet) (i.e., Reference 17, page 17). Using the FDTs, "Estimating the Burning Duration of a Liquid Pool Fire," this correlates to approximately a 650 kW fire.
4. The diesel fire was located 4.75 inches (12.1 cm) below the bottom cable tray.
5. The cable tray stack consisted of two cable trays with no barrier being placed between them.
6. The test duration was driven by the time for the diesel fire to self-extinguish (i.e., nominally 13 minutes, based on the test configuration).

Appendix Q states that the "*diesel fuel fire tests are indicative of the actual response of a coated two-tray stack to a relatively severe exposure fire that bounds the heat release rate for most ignition sources found in an area containing important cables*." The application of this information indicates a delay to cable damage and ignition for non-IEEE 383 qualified cables coated with various vendor flame retardant products of 3 to 11 minutes for damage, and up to 12 minutes for ignition.

This timing is applicable in general to most electrical cabinet fires (i.e., non-HEAF) due to the very high heat flux generated by the diesel pool fire located directly below the test cable tray, compared to the lower heat flux generated by electrical fires and the greater distances typically involved with the fire source and the potential target cable tray. The tests placed the diesel fire 4.75 inches away from the bottom of the first tray. Based on fire modeling with the FDTs, it has been determined that the approximate initial diesel fuel pool fire size associated with the tests was 650 kW, and exposure temperatures (i.e., as documented in the test report, Table 7, Reference 17) were greater than 1400 °F. Consequently, it can be inferred that the incident heat flux on the cable trays is much higher than that associated with a 211 kW electrical fire located at a greater distance from the tray. At Brunswick, it is typical for the first cable tray to be 24 to 36 inches away from the nearest effective ignition source, which would result in a smaller heat flux for a similar fire, and resulting in longer cable damage and ignition delay times. For Brunswick in particular, there are three different cable tray configurations to consider.

1. Above the front of the electrical cabinets are solid bottom cable trays which are approximately one to two feet above the postulated fire source. The front of the electrical cabinets is where the fires are postulated to exist, since this is where the cubicles that contain the breakers and wire bundles are.

2. The cable trays, without solid bottoms, are either directly above or nearly in the center of the electrical cabinet, and thus are not subject to the maximum centerline plume temperatures. The trays are spared direct damage, or are completely protected from fire damage, by the solid top of the electrical cabinet.

3. The third group of cable trays to consider are vertical trays that support cable coming out of the top of the electrical cabinets (i.e., those that supply cable to loads from the breakers). The cables come out of the back of the electrical cabinet where the bus bars are located, which provides no fire loading in the back portion of the cabinet to support continued combustion. Additionally, these vertical wireways contain no loss-of-offsite power cables and the cables are IEEE-383 qualified with fire retardant coatings.

Several tests were conducted using both propane burners and a diesel fuel pool fire to test the effectiveness of fire retardant coatings in delaying the onset of circuit failure and cable ignition. The tests allowed for an effective comparison to be made between the relative performances of the fire retardant coatings that were evaluated, however, important insight can, and should, be applied to the treatment of these passive fire protection features in the Fire PRA. The diesel fuel pool fire test results are explicitly identified in NUREG/CR-6850 as being relevant and bounding for the ignition sources likely to be encountered in a nuclear power plant. The data presented in Appendix Q, Table Q-1, should be applied to this analysis. The use of this data alone is conservative based on the test data being obtained for non-IEEE 383 qualified cables without any presence of solid bottom trays. The use of IEEE-383 qualified cable and solid bottom trays in the exact same test would undoubtedly result in significantly longer delay times associated with both damage and ignition of the circuits as suggested in Appendix Q, Section Q.2.

Section Q.2.2 of NUREG/CR-6850 discusses other fire protective features such as solid bottom cable trays that either completely prevent fire damage for low energy fires, or delay fire damage and subsequent cable ignition for greater than 20 minutes (i.e., HRR dependent) for qualified cable. The test was conducted with the smaller propane fire source (i.e., 41 kW) but was placed very close (i.e., 4.75 inches) to the cable, and thus had a relatively high heat flux imparted on the target cable tray.

For the updated CDF reductions, see the Table provided in the Conclusion on Page 25 of 27.

<u>Conclusion</u>

The NRC stated that the Tables in Appendix Q of NUREG/CR-6850 cannot be used generically. The NRC response listed the following reasons:

1. The testing only utilized small HRR fires of approximately 41 kW intensity.
2. The fire source was intermittently applied (5 minutes on and 5 minutes off) and did not represent a continuous exposure.
3. NUREG/CR 6850 states that these tests were conducted in a manner identical to the gas burner cable coating tests which utilized a removal insulating barrier that was present between the two trays during the period when the gas burner fire was on and removed when the gas burner was off.
4. One of the early SNL reports (ref: SAND77-1424, pg. 10) states:

   "The objective of the test was to develop the severest fire possible in one tray without influencing adjacent trays and then determine if the fire sustained only by the cable as fuel would propagate through the stacked trays."

The SDP analysis considered sustained external exposure fires (e.g., electrical cabinet fires) and excluded self-ignited cable fires.

5. Testing infrared thermography revealed that the fire grew primarily in an upward direction spreading horizontally only as it progressed from level to level.
6. Brunswick's configuration also includes some cable tray stacks which do not incorporate solid bottom tray barriers on the lowest trays.

The statements that the testing did not include 200 kW fires or that it is not applicable for continuous burning fires is contrary to industry practice and the application of NUREG/CR-6850 to other fire PRA methodology. As discussed above, the HRR of the test fire is not the critical element as much as the heat flux incident upon the test area and the increased distances involved between the fire source for the Brunswick specific configuration and the test distances used.

Table 5 of Reference 17 has comparative data that clearly demonstrates that cable damage delay for qualified cable in a solid bottom tray is significantly greater than 5 minutes (i.e., damage never occurs), and greater than that associated with non-qualified cable in solid bottom trays.

As discussed above, there are some cable trays that do not have solid bottoms, which are located away from the direct fire plume. Additionally, the major targets of interest (i.e., off-site power cables) are located in the cable stacks that have solid bottom trays or are shielded by the solid steel cabinet tops, except for the small portion between the substations. Thus, any damage to the other cable trays will not result in the NRC postulated implementation of the Alternative Safe Shutdown procedures.

Generic Applicability

The application of Appendix Q of NUREG/CR-6850 for passive fire features is a an example of data used for development and implementation of Fire PRA and Regulatory Guide 1.200 (i.e., Reference 19), where Fire PRA models and supporting information are developed to produce a best estimate of fire risk. The NRC position that the information in Appendix Q, and the supporting test data, is not applicable for nuclear plant electrical fires introduces significant regulatory uncertainty into any application for which fire is an important contributor. Additionally, this regulatory uncertainty could become a significant issue during the inspection process for various licensee fire protection programs and the supporting Fire PRA. Thus, for future applications of NUREG/CR-6850 for Fire PRA, including NFPA 805, consistency is required to ensure predictable and repeatable results from both the licensee and the various NRC branches.

Licensee Refinement Area No. 7: Non-Suppression Probability (NSP)

Background

Fire modeling was conducted to determine the potential for fire induced damage to critical circuits that would lead to operators having to implement the ASSD procedure. NUREG/CR-6850 fire modeling guidance was used in conjunction with the FDTs.

The guidance in NUREG/CR-6850 for determining NSP has been updated in FAQ 08-0050 (i.e., Reference 14), which is a NRC accepted position for calculating NSP. This removes the conservatism associated with Fire Brigade response times which further reduces the likelihood of ASSD entry.

Special attention was placed on the Cable Spread Rooms for Unit 1 and Unit 2. Consistent with the plant licensing basis, the cables are IEEE-383 qualified and those in cable trays have spray-on flame-retardant coatings applied to them. Additionally, there are solid bottom trays above fixed sources in key locations.

NUREG/CR-6850 states that damage to coated, non-qualified cables will occur in 3 to 11 minutes in the first tray, and 7 or more minutes in the second tray. Ignition of coated, non-qualified cables will not occur for at least 12 minutes in the first tray.

The research sponsored by the NRC and performed by Sandia National Labs in 1978, concluded that IEEE-383 qualified cable that is coated with a flame-retardant coating had significant ignition delays when subjected to severe fire scenarios (i.e., diesel fuel pool fire) and did not propagate vertically to the next cable tray. The same research indicated that for IEEE-383 qualified cable located in a solid-bottom cable tray, no fire developed after six cycles of the ignition source. Solid-bottom cable trays with IEEE-383 qualified cable that is also coated with a spray-on flame-retardant coating, would make the expected cable performance significantly better than those that were tested in the Sandia Labs studies.

The research and test data support CP&L's analytical assumption that damage is significantly delayed for coated IEEE-383 qualified cable located in a solid-bottom cable tray when subjected to a severe fire scenario. This is a significant contributor when calculating the NSP because the test data (i.e., Appendix Q of NUREG/CR-6850) suggests that the cable tray configuration and characteristics are not conducive to vertical flame spread from the originating ignition source. Further analysis demonstrates that the initiating ignition sources alone do not produce conditions that would damage component circuitry needed for a safe reactor shutdown during the duration of an electrical fire profile (i.e., a 12 minute fire growth followed by 8 minutes of maximum HRR, followed by fire decay as fuel in the cabinet is consumed, as defined in NUREG/CR-6850).

The fire analysis demonstrates that the plausible fire scenarios do not involve fire sizes that are capable of vertical propagation given the presence of IEEE-383 qualified cable, spray-on flame-retardant coating, and solid-bottom cable trays near the ignition sources. Based on existing cable routing information, key safe shutdown components are not impacted and entry into the ASSD procedure is unlikely.

As described in CP&L's submittal, dated July 22, 2009, application of this refinement reduces the NRC calculated CDF by approximately 83.2%.

<u>NRC Response</u> (Area of Appeal)

The following response is an excerpt from NRC letter EA-09-121, dated September 14, 2009.

> The licensee's analysis stated that having solid bottom trays and cables sprayed with Flame-Master 71A or Flame-Master 77 flame retardant coatings halts vertical fire propagation. The NRC considered that appropriate ignition delay to account for solid bottom trays and cables sprayed with flame-retardant coatings has already been provided. Therefore, no additional credit was granted. The NRC's evaluation performed in accordance with IMC 0609, Appendix F, determined that all four ignition sources in the cable spreading rooms will cause cable damage to the lowest target trays for 200 kW HRR fires. The NRC also noted locations where cable trays were exposed to ignition sources without solid bottom shielding. The NRC's evaluation has considered the actual configuration and fire test data, and concluded that solid bottom trays and cables sprayed with Flame-Master 71A or Flame-Master 77 flame retardant coatings will not prevent fire ignition or fire growth but will only delay the onset of ignition and propagation allowing more time for fire brigade response. The NRC reviewed the fire testing referenced by NUREG/CR-6850 applicable to these passive fire protection features and considered that the licensee was not appropriately characterizing the test data. Limitations in the test data relative to the credit for solid bottom cable tray barriers were discussed in item 6 above. Regarding the credit for fire retardant cable coatings, the NRC has noted the following test/configuration limitations:
>
> 1. A test was performed using a continuous exposure to a diesel fuel source lasting 12-13 minutes. The relevant test observations' cited below are taken mainly from pages 46-48 of NUREG/CR-0381. Limitations of this test included:
>   a. The fire was of 12-13 minutes duration which coincided with depletion of the diesel fuel. The MCCs and Substations fire scenarios would not be limited to a 13 minute fire duration.
>   b. For the Flame-Master coatings the nonqualified cables in the first tray continued to burn for approximately 30-42 minutes after the exposure fire had burned out. BSEP cable trays contain a small number of nonqualified (thermoplastic) fiber optic cables which would ignite earlier than the qualified cables and act as an additional fire source facilitating damage to the qualified (thermoset) cables.
>   c. For the Flame-Master coatings, it was observed that "the top tray had molten PVC bubbling from cracks in the coating." (PVC was the cable insulation material.)
>   d. For the Flame-Master coatings, cables in both the upper and lower trays experienced electrical failure during the test.
>   e. The cable monitoring circuit used to determine cable failure times was based on a low-voltage (< 24VAC) circuit integrity measurement system. More

> recent testing has revealed that low-voltage monitoring systems do not adequately represent cable performance for more typical control circuit voltages (e.g., 120 VAC or 125VDC). Hence, the time to failure results from these early tests, while valid in a comparative sense (i.e., comparing test-to-test within this test series), are considered unreliable and potentially optimistic in a more absolute sense (i.e., extrapolating these tests to real-world applications).

The NRC considered that for the above test applicability limitations, it was not appropriate to credit a 13 minute cable ignition delay for cables sprayed with Flame-Master 71A or Flame-Master 77 flame retardant coatings. The NRC's final SDP analysis utilized a 3 minute cable damage delay for the configurations with cables sprayed with Flame-Master 71A or Flame-Master 77 flame retardant coatings. Therefore, no additional credit was provided.

The licensee's evaluation also utilized revised non-suppression probabilities in accordance with FAQ 08-0050. However, since the use of FAQ 08-0050 is not finalized, these reduced probabilities were not incorporated into the NRC's final analysis. Nonetheless, the NRC performed a sensitivity analysis using these reduced probabilities and determined that the proposed reduced non-suppression probabilities did not result in a risk reduction significant enough to change the characterization of the finding. Furthermore, because of the size of the postulated fires and the automatic wet pipe sprinkler configuration in the cable spreading rooms, use of FAQ 08-0050 may not be appropriate in the cable spreading room.

Appeal Criteria and Basis

The NRC staff did not consider the timeline for non-suppression probability provided by CP&L. In addition, NRC provided no justification for the 3 minute cable damage delay utilized for coated, qualified cable. Specifically, the NRC's response does not discuss how the fire timeline and fire growth was determined and when the detection occurs. In addition, the timeline does not identify when the limited NRC credit for solid bottom trays and flame retardant coating starts. Therefore, this meets Criteria 3.a. and 3.b. of NRC IMC 0609, Attachment 0609.02, as a basis for appeal.

CP&L Response

Consistent with the NUREG/CR-6850 methodology, the ignition sources of interest in this analysis are 211 kW fires that are expected to follow a t^2 growth curve, reaching peak heat release 12 minutes from the point of initial flaming combustion. Both the NRC and the industry agree that this fire growth curve is only directly applicable to a fire started with an external accelerant, where non-energetic electrical fires have a slower growth curve. This curve disregards the significant pre-combustion, incipient stage for non-HEAF fires. The fire growth time in NUREG/CR-6850 was determined using test data that used accelerants to "start" the fire, effectively eliminating the early stages of electrical fire combustion from the fire growth curves that are used (i.e., 12 minutes to reach peak heat release). Electrical fires would exhibit a longer pre-ignition, smoldering phase, that would be detectable by Brunswick's smoke detection system. In addition, the fire growth profile is highly dependent on a number of variables such as ventilation, fuel configuration, and fuel type.

The incipient stage of the fire development (i.e., prior to t = 0 by the current fire growth curve), is characterized by the slow degradation of electrical components, often resulting in heavy smoke production. It is during this time that most electrical fire precursors can be detected. The application of the detection time for use in determining the fire suppression probability is critical and the incipient stage of smoldering combustion should be considered.

Based on field walk-downs and extensive research of design documents, all of the cables in the Cable Spread Room, including the fiber optic cables, are IEEE-383 qualified cables with flame-retardant coating (i.e., Reference 20 for fiber optic cable coating).

Additionally, CP&L's presentation at the Regulatory Conference provided a timeline which included fire growth, supporting the non-suppression probability that was used. The NRC evaluation does not address this timeline, nor does it provide any justification of the fire growth that was used by the NRC.

For the updated CDF reductions, see the Table provided in the Conclusion on Page 25 of 27.

<u>Conclusion</u>

No justification was provided for the 3 minute cable damage delay utilized by the NRC. NUREG/CR-6850, Appendix Q, Table Q-1, presents a list of fire retardant coatings and the associated cable ignition and damage delay times associated with each product. It is reasonable to choose the delay times based on the plant-specific product that was installed. Defaulting to the worst performing product provides a 3 minute damage delay time; however, using the plant-specific products installed will provide, at a minimum, 6 minutes of cable damage delay time.

For the circuits of interest in this analysis, the flame-retardant coating installed at Brunswick has a minimum of at least a 6 minute cable damage delay, as provided by the guidance in Table Q-1 of NUREG/CR-6850. The determination of the point of fire detection during the fire timeline is also a significant contributor to the determination of the non-suppression probability. Most fires are detected well before full fire HRR, due to either fire detection systems (i.e., smoke or thermal), or due to the precursor events such as the faulted component being de-energized (i.e., one of the substations or loads in the MCCs).

Additionally, Table 6 of Reference 17 indicates that for coated, qualified cables the cable damage delay is significantly longer than those given in Table Q-1 of NUREG/CR-6850. It has been determined that the applicable cables installed at Brunswick are all IEEE-383 qualified, including the fiber optic cables. The CP&L analysis for damage to target cables was performed by adding full credit for solid bottom trays (i.e., 15 minutes) plus an additional 3 minutes for coatings to the NRC non-suppression probability to determine a new non-suppression probability.

<u>Generic Applicability</u>

The fire growth curve is currently a significant source of uncertainty driving the Fire PRA results and can result in significant divergence in the non-suppression probability determination. Similarly, the credit for solid bottom trays and fire retardant will also generate significantly different results if the information provided in NUREG/CR-6850 is not realistically and consistently applied. There are significant industry and NRC resources being used to develop more realistic fire growth curves, because of this recognized large uncertainty. A determination that fire detection occurs sometime after every fire reaches maximum heat release rate is not consistent with the intent of NUREG/CR-6850 or fire PRA applications.

Licensee Refinement Area No. 8: Alternative Safe Shutdown (ASSD) Implementation

Background

In order to address the unlikely event that the ASSD procedures are entered, a decision tree was developed to determine the change in risk rather than assuming the generic industry value 0.1 failure probability.

A significant factor to determine the risk involved with this analysis is the decision of the Operators to implement the ASSD procedures for Main Control Board fires, Control Room cabinet fires, and fires in the Cable Spread Room. To support the assessment in the Cable Spread Room, the target raceways in the zone of influence were examined to identify the set of equipment that might be expected to fail as the fire progresses.

To assess the significance of the adverse Emergency Diesel Generator (EDG) condition identified, the focus of the CP&L analysis is to determine the set of circumstances that would cause Control Room Operators to implement the ASSD procedure. For the EDG modification to have an impact, a loss-of-offsite power (LOOP) condition must be in effect, followed by entry into the ASSD procedure. If operators do not enter the ASSD procedure, the EDG ASSD lockout is not a factor and, therefore, cannot adversely impact the calculated plant risk. The fire modeling and risk insight that are included in the CP&L ASSD event tree provide an assessment of the likelihood of Control Room Operators entering the ASSD procedure. This analysis was based on interviews with licensed reactor operators and the conclusions were validated by performing simulator scenarios based on the potential impact of the evaluated fires.

The potential equipment losses associated with this condition are not sufficient to result in the implementation of the ASSD procedures. Additionally, this conclusion is based upon the analyzed fire sources and realistic impact.

As described in CP&L's submittal, dated July 22, 2009, application of this refinement reduces the NRC calculated CDF by approximately 81.9%.

NRC Response (Area for Appeal)

The following response is an excerpt from NRC letter EA-09-121, dated September 14, 2009.

> The licensee's position is that the NRC's analysis assumption on ASSD entry is too high. The NRC's analysis assumed that 10% of fires would remain unsuppressed and grow to the point where enough ASSD equipment is damaged and/or instrumentation reading erroneously that the Senior Control Operator would choose to enter the ASSD procedures.

> The licensee has developed a decision tree to calculate the probability of ASSD procedure entry for cable spreading room fire scenarios. This decision tree has established criteria for ASSD entry which is based on a 15 minute unsuppressed fire as threshold for ASSD entry.

In addition,

> Contrary to the above, the NRC's analysis determined the time to damage offsite power cables and then assumed that a fraction of those fires would grow enough to lead to conditions for which ASSD/MCR evacuation would be necessary. The NRC's basis for the 10% ASSD factor is based upon a review of the potential spurious equipment and instrument actuation possible from cables which would be damaged at the same time as the offsite power cables. This would require the operators to simultaneously combat a loss of offsite power as well as many spurious equipment and instrument actuations including: 230kV bus differential instrumentation, main and auxiliary transformer instrumentation, reactor runback control, turbine supervisory instrumentation and several secondary pump motors and feedwater heater controls.

Additionally,

> The Performance Shaping Factors (PSFs) were similar except for Experience & Training and Ergonomics, where NRC has adjusted each PSF up one level from the licensee's selection of nominal. The NRC determined that the implementation of local 4kV bus crosstie under Station Blackout (SBO) conditions (i.e., using emergency lighting) during a severe fire is not an evolution which is routinely trained on and does not represent nominal control room ergonomic conditions. Using the NRC HEP value in the licensee's decision tree resulted in an ASSD factor of approximately 0.15. Decision tree cases were run for a 200 kW fire, a high energy arc fault fire, and a MCC fire and the average ASSD value was slightly greater than 0.1. This sensitivity analysis supports the original ASSD factor of 10%. Therefore, the ASSD factor was not changed in the final best estimate analysis.

<u>Appeal Criteria and Basis</u>

The NRC did not consider the simulator scenarios and the operator interviews provided, and there was no documented justification as to why this information was not considered, specifically for fires in the Main Control Room (MCR), XU-2 panel, when determining the entry point into the Alternative Safe Shutdown (ASSD) procedure and abandonment of the Control Room. Therefore, this meets Criteria 3.a. and 3.b. of NRC IMC 0609, Attachment 0609.02, as a basis for appeal.

<u>CP&L Response</u>

The LOOP scenario is practiced frequently on the simulator as a training topic for continuing operator training, and there are several methods to combat this scenario other than MCR evacuation. If habitability is a concern, or if all methods of regaining power to the blacked out unit are exhausted, then 0ASSD-02 would be the correct procedure to enter. Entry into the procedure is based on the loss of control, and not the loss of power as described in assumption 2 of NRC Inspection Report 2009009.

Attachment 16 to Reference 7 discusses in detail the fact that the licensed operators would not enter the 0ASSD-02 procedure based on the LOOP and loss of the applicable Unit's EDG controls from the respective XU-2 panel. All SROs are trained on evacuation of the Control Room and implementation of the ASSD procedure. Each interviewed operator expressed that maintaining control of the plant was of paramount importance, and some provided examples of equipment malfunctions that would prompt them to evacuate the Control Room for the remote shutdown panels (i.e., Safety/Relief Valves cycling sporadically, Motor Operated Valves randomly repositioning, pumps stopping and starting for no apparent reason). Thus, a 2-meter fire growth would be more appropriate for implementing the ASSD due to loss of control.

During interviews with the Reactor Operators, most expressed the position that the LOOP was not, by itself, criteria to abandon the MCR; that this event is trained on extensively and that entry into 0ASSD-02 will not be required until all efforts to cross-tie the electrical plant have been exhausted. This conclusion was based on the extent of training and working knowledge of the Station Blackout procedure. The operators discussed the available options for cross-tying the electrical plant from the opposite Units control board, as well as locally at the breakers.

The NRC staff assumed a 100% ASSD factor for fires in XU-2 and 10% factor for other fires resulting in entry into the ASSD procedures. The NRC staff's basis for the 10% factor is:

> *. . . the potential spurious equipment and instrumentation actuation possible from cables which would be damaged at the same time as the offsite power cables. This would require the operators to simultaneously combat a loss of offsite power as well as many spurious equipment and instrument actuations including: 230 kV bus differential instrumentation, main and auxiliary transformer instrumentation, reactor runback control, turbine supervisory instrumentation, and several secondary pump motors and feedwater heater controls.*

CP&L acknowledges that a fire could affect the operation of any of this equipment and instrumentation. However, CP&L believes that none of this would impact the operators' ability to stabilize the plant and energize the emergency buses. As such, this does not increase the likelihood of entry into ASSD procedures. This factor alone has a significant impact on the calculated CDF and the relevant postulated fire scenarios.

The basis for this position is as follows:

- 230 kV bus differential instrumentation failure resulting in a loss of offsite power will, by design, result in a reactor scram, an automatic start of the EDGs, and energization of emergency buses. The operators would then focus on stabilization and cool-down of the reactor.
- A LOOP coincident with damage to main and auxiliary transformer instrumentation will, by design, result in a reactor scram, an automatic start of the EDGs, and energization of emergency buses. The operators would then focus on stabilization and cool-down of the reactor.
- A LOOP will always result in a loss of power to the reactor recirculation pumps, a reactor scram, an automatic start of the EDGs, and energization of emergency buses. As such, the operators would not be involved in response to a reactor runback and the operator response would not be further complicated by spurious or damaged reactor runback control.

- A LOOP will always result in a loss of the balance-of-plant electrical buses, a reactor scram, an automatic start of the EDGs, and energization of emergency buses. The loss of the balance-of-plant buses will de-energize the secondary plant pumps. Operators would focus on stabilization and cool-down of the reactor. With no condensate pumps, condensate booster pumps, or reactor feedwater pumps in service, the operators would be unconcerned with feedwater heater level issues. Therefore, malfunction of secondary pumps and feedwater heater controls has no impact on operator response to a LOOP.

A crew of licensed operators was exposed to the XU-2 MCR fire scenario on the simulator and concluded that entry into 0ASSD-02 would not be made based solely on the presence of fire (i.e., provided that satisfactory environmental conditions were not in jeopardy). The operating crew concluded that they would remain in the MCR until it is determined that safe shut down is not possible from the MCR.

For the updated CDF reductions, see the Table provided in the Conclusion on Page 25 of 27.

Conclusion

To assist in determining when Operators implement ASSD, simulator scenarios were conducted and interviews with Operators were performed to determine the minimum entry point for the Control Room Operating staff to implement the ASSD procedure and to evacuate the MCR. Additionally, the Brunswick Operations Manager specifically discussed, during the Regulatory Conference, the fact that it was not considered a MCR evacuation situation that the NRC postulated. The diverse electrical system at Brunswick was discussed in detail, which provides alternate capabilities to crosstie the two Units and avoid MCR evacuation. The NRC evaluation assumes that all fires which consume the XU-2 cabinet (i.e., based on a fire growing one meter) in the Control Room will always result in the Control Room staff implementing the ASSD procedure. This is contrary to the licensed Operator interviews, the results of the simulator scenarios tested, and training provided.

Generic Applicability

None.

Final Conclusion

Based on the analysis documented in this submittal, CP&L contends that the finding is most appropriately classified as having very low safety significance (i.e. Green), using NRC reviewed or approved methodologies now available to the industry. The following table summarizes the impact of revising the more significant areas of conservatism.

Area of Conservatism	CP&L Probability/Value	NRC Probability/Value	% CDF Reduction to NRC's CDF
Fire Ignition Frequency	XU-2 8.24E-04 XU-5 8.24E-04 Electrical Cabinets 2.16E-05	XU-2 3.2E-03 XU-5 3.2E-03 Electrical Cabs 5.5E-05	50.6
Source Applicability	End Cabinet (Common D) Screened out. Disconnect Switch (2L) Screened out.	End Cab Bus Bar 1.6E-06 Disconnect Swch 5.5E-05	5.5 6.6
Probability of Non-Suppression	XU-2 (Appx. L @ 2 meters*0.9) 4.0E-04	@ 1 meter 3.0E-03	18.0
Flame Coating on Cables	6 minutes (NSP = 0.218)	3 minutes (NSP = 0.25)	4.4
Solid Bottom Cable Trays	20 minutes (NSP = 0.06)	5 minutes (NSP = 0.25)	27.3
Total of All	4.74E-07	1.83E-06	74.9

Using the methodologies described in the above evaluation, CP&L has determined that the total CDF associated with this condition is 4.74E-07 for both Units 1 and 2.

References

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2. EA-09-121, Letter from Mr. Luis A. Reyes, Regional Administrator, Region II, U.S. Nuclear Regulatory Commission to Mr. Benjamin C. Waldrep, Vice President, Carolina Power and Light Company, Brunswick Steam Electric Plant, "Final Significance Determination of White Finding and Notice of Violation (NRC Inspection Report No. 05000325/2009010 and 05000324/ 2009010), Brunswick Steam Electric Plant," dated September 14, 2009.

3. BSEP 09-0068, Letter from Mr. Benjamin C. Waldrep, Vice President, Brunswick Nuclear Plant to the U. S. Nuclear Regulatory Commission, Document Control Desk, "Submittal of Supporting Documentation for the July 28, 2009, Regulatory Conference Regarding Preliminary White Finding," dated July 22, 2009.

4. NRC Inspection Manual Chapter 0609, Attachment 0609.02, "Process for Appealing NRC Characterization of Inspection Findings (SDP Appeal Process).

5. National Fire Protection Association (NFPA) Standard 805, "Performance-Based Standard for Fire Protection for Light Water Reactor Electric Generating Plants."

6. NFPA 805, FAQ 08-0048, "Joint NRC/EPRI Fire PRA Memorandum of Understanding (MOU)."

7. BNP-PSA-073, Revision 0, "Risk Evaluation for SDP Associated with EDG Local Transfer Switch Modification."

8. NUREG/CR-6850, "EPRI/NRC-RES Fire PRA Methodology for Nuclear Power Facilities, Volume 2: Detailed Methodology."

9. EPRI Document 1016735, "Fire PRA Methods Enhancements: Additions, Clarifications, and Refinements to EPRI 1019189."

10. NRC Inspection Manual Chapter 0609, Attachment F, "Fire Protection Significance Determination Process."

11. NRC Inspection Manual Chapter 0308, Attachment F, "Technical Basis - Fire Protection Significance Determination Process (Supplemental Guidance for Implementing IMC 0609, Appendix F) At Power Operations."

12. NFPA 805, FAQ 07-0035, "Bus Duct Counting Guidance for High Energy Arcing Faults."

13. NFPA 805, FAQ 08-0042, "Fire Propagation from Electrical Cabinets."

14. NFPA 805, FAQ 08-0050, "Manual Non-Suppression Probability," (Draft NRC Interim Position)

15. BNP-PSA-073, Revision 1, "Risk Evaluation for SDP Associated with EDG Local Transfer Switch Modification."

16. Fire Protection Information Forum, Savannah, Georgia, September 22, 2009, "Maximum Fire Size in Closed Vented Electrical Panels," Sean P. Hunt.

17. NUREG/CR-0381, "A Preliminary Report on Fire Protection Research Program Fire Barriers and Fire Retardant Coatings Tests."

18. Letter from Ms. Marlayna Vaaler, Plant Licensing Branch II-2, U.S. Nuclear Regulatory Commission, to Mr. Chris L. Burton, Vice President, Shearon Harris Nuclear Power Plant, "Shearon Harris Nuclear Power Plant, Unit 1, Request for Additional Information Regarding License Amendment Request to Adopt National Fire Protection Association Standard 805, "Performance-Based Standard For Fire Protection For Light Water Reactor Generating Plants" (TAC No. MD8807)," dated August 6, 2009.

19. Regulatory Guide 1.200, Revision 2, "An Approach for Determining the Technical Adequacy of Probabilistic Risk Assessment Results for Risk-Informed Activities."

20. Brunswick Plant Modification, PM-84-340, Field Revision 0, "ERFIS Plant Modification, Package no. 2, 10-25-85."

SECURITY-RELATED INFORMATION

WITHHOLD UNDER 10 CFR 2.390

Brunswick Steam Electric Plant
Unit Nos. 1 and 2

Calculation BNP-PSA-073, Revision 1