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Ms. Cindy Bladey, Chief
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Office of Administration
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U.S. Nuclear Regulatory Commission
Washington, DC 20555-0001

Subject: Response to Request for Comments Concerning NUREG-1934 (EPRI 1023259), "*Nuclear Power Plant Fire Modeling Application Guide (NPP FIRE MAG), Second Draft Report for Comment*" - Federal Register Notice 76FR46330, dated August 2, 2011, Docket ID NRC-2009-0568

Exelon Generation Company, LLC (Exelon) is submitting this letter in response to the U.S. Nuclear Regulatory Commission's (NRC's) request for comments concerning NUREG-1934 (EPRI 1023259), "*Nuclear Power Plant Fire Modeling Application Guide (NPP FIRE MAG), Second Draft Report for Comment.*"

NUREG-1934 was written as a collaborative effort by the NRC and the Electric Power Research Institute (EPRI) to provide guidance on using fire modeling for nuclear power applications. The NRC issued a first draft of NUREG-1934 for public comment in December 2009 (74FR68872). The NRC made available this second draft of NUREG-1934 for comment because of the extensive interest generated by the first draft and the numerous comments that were received and addressed in this second draft.

Exelon appreciates the opportunity to comment on the second draft of NUREG-1934 and offers the attached comments for consideration by the NRC.

If you have any questions or require additional information, please do not hesitate to contact Richard Gropp at 610-765-5557.

Respectfully,

Michael D. Jesse
Director – Licensing and Regulatory Affairs
Exelon Generation Company, LLC

Attachment

SUNSI Review Complete
Template = ADM-013

E-RIDS = ADM-03
Add = D. Stroup (DSW4)

General Comments

1. **Section 2.2.4 - Credited Fire Protection**

When discussing the credit for fire barriers in the draft NUREG, the following statement is made on Page 2-7:

> *"...Another example would be passive fire protection systems that are rated against an ASTM E119 (2008) fire exposure. Such systems may not provide sufficient fire resistance for a flame impingement fire exposure or a hydrocarbon pool fire scenario...."*

Exelon is requesting further clarification concerning this statement since it appears to be based on information from NUREG-1547, *"Methodology for Developing and Implementing Alternative Temperature-Time Curves for Testing the Fire Resistance of Barriers for Nuclear Power Plant Applications,"* which researched the viability of potential alternative time-temperature curves for fire barriers in nuclear power plant applications as a potential resolution to *Thermo-Lag* qualification concerns. Ultimately, NUREG-1547 and SECY-96-0162, *"Nuclear Power Plant-Specific Time-Temperature Curves for Testing and Qualifying Fire Barriers,"* concluded that the research necessary to pursue this approach could not be completed in time to meet the NRC's schedule to resolve *Thermo-Lag*, and follow-up actions appear to have ceased. Section 3.10.2 of NUREG-1547 recommended six additional tasks that would be required in order to implement alternate time-temperature curves (as noted below).

Excerpt for NUREG-1547, Section 3.10.2, *"Recommended Tasks"*

Consistent with the above, it is recommended that the following tasks be carried out with the goal of establishing a reliable methodology for evaluating NPP fire barrier performance:

1. *Develop a new, special-purpose, NPP-specific fully-developed fire model capable of simulating fire environments that threaten NPP fire barriers. It is recommended that this be developed as an advanced version of an existing multi-room compartment fire model, e.g., CFAST [3-25]. The new model should include the advanced modeling features identified in the section 3.7.3 "Features of a Compartment Fire Model Suitable For Evaluating Direct and Indirect Threats to NPP Fire Barriers." These include: the simulation of fully-developed burning of extensive dense arrays of cable trays, both under fuel-controlled and ventilation-controlled conditions; the simulation of combustible/flammable liquid pool fires; the simulation of the fire environment in multi-room facilities (at least two adjacent spaces); and advanced means of modeling ventilation and radiation-heat-transfer-related phenomena.*

2. *Carry out full-scale experimental verification of the advanced modeling methods of item 1, especially those aspects of the new model associated with the simulation of burning cable trays and combustible/flammable fuel fires in enclosed spaces. Also, carry out experiments to better evaluate and characterize the fire hazard in NPPs introduced by electrical panels/cabinets.*

3. *Use new model simulations to determine the direct-exposure threat to fire barriers, and use these to establish experimental methods to evaluate barrier fire performance relative to the direct exposure threat.*

4. *Use the new model to carry out an extensive simulation study of selected NPPs. Results of this would be used to establish the characteristics of real, fire-barrier-threatening, NPP fire environments and to identify a series of NPP-specific test fire curves to replace the ASTM E 119 standard fire curve.*

5. *Carry out an experimental study on available ASTM E 119-type test furnaces to establish that the new test fire curves of item 4 are attainable and reproducible.*

6. *Use the results of items 4 and 5 to establish an ASTM E 119-type method of evaluating the performance of structural fire barriers relative to the indirect exposure; establish corresponding methods for wrap-assembly fire barriers.*

While Tasks 1 and 2 described above from NUREG-1547, Section 3.10.2, appear to be underway or complete, it is unclear how Tasks 3, 4, 5, and 6 have been addressed; further clarification would be helpful.

Without completing the research described in NUREG-1547, the statement quoted above from NUREG-1934 might pose implementation concerns, and could possibly raise additional questions that might be difficult to answer. In addition, the statement *"...Such systems may not provide sufficient fire resistance for a flame impingement fire exposure or a hydrocarbon pool fire scenario,"* seems to have a negative connotation. NUREG-1547 indicates that direct flame impingement is certainly a possibility for any fire barrier, but that in most cases, combustibles are distributed well enough that direct flame impingement would be a transitory phenomenon, and not a concern to the survivability of a barrier. Further, concerning hydrocarbon pool fires, NUREG-1547 was concerned with large hydrocarbon pool fires (e.g., diesel generator fuel spills), which is a fairly specific scenario to evaluate.

2. **<u>Appendix A - Cabinet Fire in Main Control Room, Section A.2 - Description of the Fire Scenario</u>**

This section discusses a fire scenario igniting within a control cabinet containing XPE/neoprene cables. This example uses a value of 702 kW for the heat release rate associated with the fire in the Main Control Room (MCR) control cabinet. NUREG-/CR-4527, *"An Experimental Investigation of Internally Ignited Fires in Nuclear Power Plant Control Cabinets,"* discusses a heat release rate of 69 kW for a fire in a control cabinet, which is probably more representative of the heat release rates for fires in MCR control cabinets at U.S. nuclear power plants.

The citation provided for using 702 kW is based on information discussed in NUREG/CR-6850, *"Fire PRA Methodology for Nuclear Power Facilities,"* which was obtained from testing performed by *VTT* of Finland[1]. A review of the *VTT* testing indicates that the cabinets they tested are not necessarily representative of U.S. nuclear power plant MCR control cabinets, and especially not representative of cabinets with flame retardant insulation and components. Some key differences between these tests and MCR tests are noted below.

- <u>Cabling used in the tests was not flame retardant.</u> The cabling in these tests was PE/PVC jacketed. Based on the descriptions in the tests, the cable was easily ignited with one or two matches. This does not meet IEEE-383 or previous UL flame retardant protocols for control cable.

- <u>Cabling was low-mass, electronic/instrument wiring.</u> The lower the mass, the easier the fire can heat the cable to the point of ignition. The cables in these tests were electronic wires, and not control cables. As the wire size becomes smaller, the ratio of insulation to conductor mass increases, and the surface area of the fuel also increases. This makes the wires in these tests easier to ignite, and also makes them produce heat at a more rapid rate (HRR) than a cabinet with control cables.

- <u>Cabinets contained large amounts of non-flame retardant plastic materials.</u> The cabinets in these tests contained several racks of plastic electronic cards. These items are not flame retardant, are low mass, and easily ignited. There are no known items similar to this in a typical U.S. control cabinet.

- <u>These tests conservatively drove the cabinets to failure.</u> The intent of these tests was to determine the heat release rate from the cabinets to the surrounding environment, based on establishing a significant fire in the cabinet, and also demonstrating the effects of oxygen deprivation on the heat release rate. For these tests to be meaningful, the cabinet had to become fully engulfed in fire. In the cases where the fire self-extinguished, repeated attempts to ignite the cabinet were made (spreading out cable bundles) until the cabinet contents burned in a self-sustaining fashion. Modifying the configuration of the wires in order to further the test goals does not form the basis for a representative test.

Therefore, using the 702 kW value and assuming that it is the *"98th percentile fire"* for a cabinet that it may not resemble, may not be appropriate under these circumstances.

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[1] VTT Reports cited:

1. Fire Safety Journal 38 (2003) pages 165-186, "Calorimetric fire experiments on electronic cabinets". VTT Technical Research Center of Finland
2. VTT Publication 186, "Full scale fire experiments on electronic cabinets", 1994
3. VTT Publication 269, "Full scale fire experiments on electronic cabinets II", 1996

For comparison purposes, NUREG-1547 describes a worst case hydrocarbon pool fire as having a peak heat release rate of 158 kW/m^2. It is most likely that a fire in a control cabinet containing flame-retardant and/or self-extinguishing materials would not have a heat release rate that is 4.4 times more severe than that of a fuel oil spill.

Therefore, Exelon is requesting further clarification concerning the basis for the use of 702 kW heat release rate value used in this example.

3. **Appendix D - Motor Control Center Fire in Switchgear Room, Section D.2 - Description of the Fire Scenario**

This section also discusses using heat release rates for fires in cabinets containing flame-retardant cables that may not be indicative of U.S. nuclear power plants (i.e., 702 kW vs. 69 kW from NUREG/CR-4527).

Typically, a single Motor Control Center (MCC) compartment contains only a single bundle of cables, not multiple bundles. Within a single compartment, there may be only a total of a few feet of exposed cable inside the compartment. If the entire MCC is assumed to burn, this is not specifically discussed in this section, or how the user is to determine if this is an appropriate scenario for the application. MCCs contain numerous internal partitions, so it is unclear how a heat release rate of 702 kW could occur.

Therefore, Exelon is requesting further clarification concerning the basis for the use of 702 kW heat release rate value used in this example.

4. **Appendix E - Modeling Objectives, Section E.2 - Description of the Fire Scenario**

Exelon is requesting further clarification and discussion regarding how cable trays with solid bottoms are modeled. This is a common configuration within many U.S. nuclear power plants and very little contemporary documentation provides advice on how to treat these when performing fire models or significance determination process reviews. Providing additional information and clarification on how to model these solid-bottom trays would be beneficial and help to improve the users' models for similar configurations, thereby helping to remove unnecessary conservatism from users' models.