Entergy

Entergy Operations, Inc.
17265 River Road
Killona, LA 70066
Tel 504 739 6242

Early C. Ewing III
Director, Nuclear Safety Assurance
Waterford 3

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PR

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U.S. Nuclear Regulatory Commission
ATTN: Document Control Desk
Washington, D.C. 20555

Subject: Waterford 3 SES
Docket No. 50-382
License No. NPF-38
Response to Request for Additional Information Regarding
Waterford 3 Individual Plant Examination of External Events
(IPEEE) Submittals (TAC No. M83692)

Gentlemen:

On August 27, 1999, the Nuclear Regulatory Commission Staff submitted a request for additional information (RAI) to Entergy, Waterford 3, regarding the Waterford 3 Individual Plant Examination of External Events (IPEEE) submittals dated December 29, 1994 and July 28, 1995. That request was subsequent to an earlier RAI dated October 27, 1997. Attached is a response to the August 27, 1999 RAI. The original due date for this response (December 1, 1999) was extended to allow for completion of internal reviews. The need for this extension has been discussed with the Waterford 3 NRR Project Manager.

This submittal has no new commitments. Should you have any questions, please contact O.P. Pipkins at (504) 739-6707.

Very truly yours,

Everett P. Pearson Jr. (for E.C. Ewing)

E.C. Ewing
Director
Nuclear Safety Assurance

A011

ECE/OPP/rtk
Attachment

PDR ADOCK 05000382

cc: E.W. Merschoff (NRC Region IV)
C.P. Patel (NRC-NRR)
J. Smith
N.S. Reynolds
NRC Resident Inspectors Office

Attachment to W3F1-99-0178

Response to NRC Supplemental Request for Additional Information Regarding IPEEE

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NRC Question 1

The Licensee's response to RAI Question 1 relating to the assumed heat release rates (HRR) from electric cabinet fires is not acceptable. The licensee's response to RAI Question 1 reiterates information provided in the submittal and/or traceable to the EPRI Fire PRA [probabilistic risk assessment] Implementation Guide (FPIG), without responding to the issues of the question. During the period between the review of the submittal and the licensee's response to the RAI, the issue of higher HRR has been under discussion between the NRC research (RES) staff and the Nuclear Energy Institute (NEI) staff. Based on such discussions, Reference 2 has been developed by the industry that provides specific guidance on modeling of appropriate HRR for control cabinets and switchgear enclosures. Please consider the new guidance provided in Reference 2, and submit a revised response addressing the issues of RAI Question 1.

Waterford 3 Response

EOI has considered the new guidance provided in Reference 2, "Guidance for Development of Response to Generic Request for Additional Information on Fire Individual Plant Examination for External Events (IPEEE)," in NRC RAI letter dated August 27, 1999. As a measure of conservatism, the analysis was reevaluated using a HRR value of 190 Btu/sec. This revised value did not result in any fire areas requiring additional investigation. Thus the analysis is acceptable using the 190 Btu/sec value as the HRR for cabinets/enclosures. A 65 Btu/sec value for heat release rate is also believed to be applicable for electrical cabinets at Waterford 3 because it closely represents actual plant conditions. This is supported by results of a review of design drawings, interviews with plant electrical engineers and electricians, a limited panel walkdown, and the fact that Waterford 3 uses IEEE 383 rated cabling.

Pertinent excerpts from Reference 2 in NRC RAI Letter dated August 27, 1999 that was reviewed for information pertaining to the HRR for electrical cabinet fires are provided below.

The EPRI guidance states in Section 3, "Supplemental Guidance":

> "*The recommended heat release rate (65 Btu/s) should be applied with caution to electronics cabinets. Electronics cabinets are considered to be vertical cabinets with significant numbers of relays and/or circuit cards. They are typically found in control rooms, relay rooms, auxiliary electric equipment rooms, but may be found in cable spreading rooms as well as other plant locations.*

For electrical cabinets that contain qualified cable, providing the fuel configuration is such that there is a reasonable expectation that the fire will remain confined to a single bundle of cables, a heat release rate of 65 Btu/s is appropriate...

Exposed cable surface can be an important contributor to the intensity of an electrical cabinet fire. Selection of the heat release rate for an electrical cabinet (or any electrical fire source) should take into account the configuration of the combustible, i.e., high density of loose cables and wires. Unfavorable configurations can promote fire propagation and intensity. High combustible loading is a less important factor (particularly in the case of cabinets with qualified cables) if the exposed surface area is reduced with tight bundling of the cables and wires."

Additionally, Section 4.12 of the EPRI guidance states:

"Plants should examine electrical cabinets, primarily located in (but not limited to) control rooms, relay rooms, auxiliary electric equipment rooms and cable spreading rooms, if they were analyzed using a heat release rate of 65 Btu/s. If the cabinets contain qualified cable and the fuel configuration is such that there is a reasonable expectation that the fire will remain confined to a single bundle of cables, the cabinets need not be reevaluated. Otherwise the cabinets should be reevaluated using a heat release rate of 200 kW (190 Btu/s).

Note that the fire may not remain confined to a single bundle if:

- *cable bundles in the same cabinet are separated by less than 1.5 ft (based on calculation of the critical radiant flux distance using a HRR of 65 Btu/s);*
- *There is a propagation path such as a diagonal cable between two cable bundles separated by >1.5 feet;*
- *There is the potential for a mini hot gas layer to develop within the cabinet;*
- *There are significant amounts of other fuels in the cabinet (e.g. circuit cards) and the fuels are distributed within the cabinet."*

In addition, the following should be considered when evaluating the HRR for electrical cabinets:

- Rated cable will burn when an ignition source is present however ignition from electronic ignition has proven to be very difficult. NUREG/CR-4570, pg. 25 states, "that no self-sustaining fire has been electrically initiated in an IEEE-383 qualified cable; the results are not entirely conclusive..."

- Further tests were conducted and reported in NUREG/CR-4527 which indicated that rated cable would burn but only when an ignition source of acetone (one quart) and kimwipes was placed in a cabinet (with no doors) and the cable bundle was loosened. A situation not typically found at Waterford 3.

- The report, NUREG/CR-4527, further states (page 65) that "these tests have shown that qualified cable is difficult to ignite and keep burning even under optimal burning conditions" and

- "Direct flame impingement for a relatively long duration (ten minutes) is necessary to ignite and propagate a fire in qualified cable" and

- "Tests have shown that qualified cable is difficult to ignite and keep burning even under optimal burning conditions (page 47)."

- Since MCCs and switchgear at Waterford 3 contain IPCEA or IEEE-383 rated cable, they were given a heat release rate (HRR) of 65 Btu/s (Test ST 7, 95 Btu/s minus 30 Btu/s for the transient ignition source).

- Also, from NUREG/CR-4527, it was concluded that if fire spread cannot be ruled out, it should be assumed that no significant heat release will occur from the adjacent cabinet for 15 minutes. This assumption is substantiated by the fact that the MCCs and switchgear contain IPCEA or IEEE-383 rated cable and are separated by the metal enclosures. For a fire to spread it must exit one cubicle, travel up to a cable tray, travel horizontally down the tray a few feet and then vertically down into another cubicle (a highly unlikely event).

- Additionally, it was assumed that an electrical cabinet that is totally enclosed (no vents, cooling fans, air dropped cables, etc.) would not allow fire propagation and thus could be eliminated as an ignition source.

NRC Question 2

The licensee's response to RAI Question 2 relating to the treatment of fires involving transient combustibles (TC) sources is not acceptable. NUREG-1407 notes that the fire-induced vulnerability evaluation (FIVE) methodology, which the licensee cites, was an acceptable methodology for IPEEE fire analysis submittals. The FIVE methodology clearly states that TC should be modeled for its impact on the overall fire core damage frequency (CDF) and included in the submittal. The licensee's response to RAI Question 2 reiterates information provided in the submittal and/or traceable to the EPRI FPIG, without responding to the issues of the question. Reference 2 provides recently developed industry guidance on explicit treatment of TC sources. Please consider the

guidance provided in Reference 2, and submit a revised response addressing the issues of RAI Question 2, including the impact of TC sources on overall fire CDF.

Waterford 3 Response

Waterford 3 has evaluated the new guidance. Transient fires were considered in all fire areas and no fire area was prematurely screened based on any transient fires.

One of the steps in the FIVE screening analyses is to determine the probability of ignition sources being located in a fire area under consideration. The ignition sources could either be fixed (permanent) or transient. The transient ignition source evaluated in this analysis was a trash container. The probability of a trash container being in a fire area, using the methodology specified in FIVE is relatively low compared to other ignition sources such as electrical cabinets, motors, etc. and does not impact the total ignition source probability number. However, phase 2 step 1 (Compartment Fire Frequency, F1) of the FIVE program was reviewed and it was determined that, if every fire area contained a transient ignition source, the compartment fire frequency would not be impacted.

Another transient evaluation was performed if all of the fixed ignition sources in a compartment did not cause failure. This was performed to ensure that every possible ignition source, including a transient fire, would not cause damage. Based on the methodology specified in FIVE in phase 2 step 3 (Probability of Critical Combustible Loading Damage, F3), the probability of a transient fire allowed it to be screened based on such factors as procedural controls for transients, the high cleanliness of the plant (in other words, a small quantity of transient combustibles), the large size of the rooms compared to the small size of the transient combustibles, and the small square footage of exposed surface relative to the total surface. The EPRI guidance states in section 3.14:

> *"The compartment may be screened following the fixed ignition source screening if the compartment CDF, considering the remaining fixed sources and transient fires, drops below the cutoff core damage frequency (i.e., 1E-06/yr)."*

Additionally, section 4.14 states:

> *"Possibility of transient fires should not be excluded if all fixed fire sources are screened. This is consistent with both FIVE and Fire PRA Methodologies.*
>
> *Provide a justification for any compartment in which transient fires are not considered. If necessary include transient fire scenarios and revise the compartment and plant CDF."*

NRC Question 3

The licensee's response to RAI Question 5 relating to the assumed heat loss factor (HLF) is not acceptable. The licensee's response to RAI Question 5 reiterates information provided in the submittal and/or traceable to the EPRI FPIG, without responding to the issues of RAI Question 5. In particular, the use of HLF (0.85) in some fire areas where the resulting temperature rise is 0.88-0.99 of that required for damage is suspect. Also of interest are those fire areas that were screened when a value of 0.85 was assumed, and the HLF values assigned to the fire analysis of the charging pump room. During the period between the review of the submittal and the licensee's response to this RAI, the issue of lower HLF has been under discussion between the RES and the NEI staff. Based on such discussions, Reference 2 has been developed by the industry that provides guidance on the assignment of appropriate HLF to fire areas. Please consider the guidance in Reference 2, and submit a revised response addressing the issues of RAI Question 5, including the impact of potential use of lower HLF values for 10 fire scenarios on overall fire-induced CDF.

Waterford 3 Response

Originally, a HLF of .7 was used in all except seven compartment scenarios. Since that time, Waterford 3 has considered the new guidance. Utilizing the guidance in the EPRI document, these seven scenarios were re-evaluated using a HLF of 0.7 and with the location of the fire being at the floor for the electrical cabinet fire (This includes the charging pump room). These data input changes did not introduce any failures in any of the fire models. No further evaluations are required based on these results.

The guidance applicable to this RAI is in section 2 of the EPRI guidance and it states:

> *"FIVE recommended use of 0.7 heat loss factor (HLF) for all fire scenarios. The Fire PRA Guide recommends values of 0.85 and 0.94 in special circumstances. The Generic RAI (Ref. 2) requests justification for use of values other than 0.7.*
>
> *After thorough review of the evidence and discussion with the staff, we agree that use of 0.94 generally provides non-conservative results and should not be used unless its use is demonstrated to be applicable for the scenario under consideration. The 0.85 HLF, used with the FIVE model, provides realistic hot gas layer HGL temperatures for fire scenarios where the virtual surface of the fire is assumed to be above the floor level (thus reducing the HGL volume), such as in an electrical cabinet/cable tray fire. However, use of 0.85 HLF may result in non-conservative HGL temperatures during the initial stages of a floor-based fire (e.g., oil pool fire). The HLF of 0.7 generally results in conservative HGL*

temperatures throughout the fire events and may yield overly conservative temperatures for extended duration events as the FIVE model continues to add heat to the enclosure at a faster rate than supported by any of the available tests. Supplemental guidance is provided to clarify this position including consideration of the HGL temperature in determining exposure at the target.

During our discussions with the staff they offered the compromise position of using 0.7 for all fire scenarios with the virtual surface of the fire for electrical cabinet/cable tray fires located at the floor instead of top of the cabinet."

Section 4.2 additionally states:

"The instructions provided here are in accordance with the supplemental guidance provided in the Section 3.2 and are applicable only to those submittals that have used HLFs greater than 0.70 in the FIVE fire models.

Any screening of fire compartments that assumes failure of all circuits/components in the compartment (in accordance with FIVE steps 1 and 2 or EPRI Fire PRA Method steps 1 through 4) is not affected by the HLF and the compartments do not require consideration in response to this question.

If HLF = 0.85 was used for single compartment scenarios involving electrical cabinet fires or elevated cable tray fires, and the hot gas layer was conservatively assumed to descend only to the top of the cabinet or to the elevation of the lowest tray (virtual surface 0.40H above the floor, where H = ceiling height), the scenario need not be revised.

If HLF = 0.94 or 0.85 was used for other single compartment scenarios, revise the HLF to 0.7 unless it can be demonstrated that the resulting damage was bounding with the higher heat loss factor and the analysis did not credit timing.

The user should develop a quantified justification for the use of 0.94 in multi-Compartment fire scenarios. Factors to consider in the justification may include:

- *The percentage of combustible materials in the exposing compartment that become involved in the fire,*

- *The extent of failure of the barrier between the exposing and exposed compartments and its impact on migration of hot gases."*