February 25, 1998

Mr. Joseph V. Sipek
Director - Licensing
Clinton Power Station
P.O. Box 678
Mail Code V920
Clinton, IL 61727

SUBJECT: INDIVIDUAL PLANT EXAMINATION OF EXTERNAL EVENTS (TAC NO. M83607)

Dear Mr. Sipek:

Based on our ongoing review of the Clinton Individual Plant Examination of External Events (IPEEE) submittal, we have developed the attached request for additional information (RAI). The RAI is related to the IPEEE analyses in the seismic and fire areas, and was developed by our contractors, Brookhaven and Sandia National Laboratories, respectively. There are no questions related to high winds, floods, and other external event areas. The questions have been reviewed by an NRC Senior Review Board with probabilistic risk assessment expertise for external events. Please respond to the RAI within 60 days of receipt of this letter.

Contact me if you have any questions.

Sincerely,

Original signed by:
Jon B. Hopkins, Senior Project Manager
Project Directorate III-3
Division of Reactor Projects III/IV
Office of Nuclear Reactor Regulation

Docket No. 50-461

Enclosure: Request for Additional Information

cc w/encl: See next page

Distribution:

Docket File	PUBLIC
PD3-3 R/F	ACRS
ARubin	OGC
EGA1	GGrant, RIII
RSavio	

DF01

Document Name: G:\CLINTON\IPEEE.RAI

OFFICE	PM:PDIII-3	E	LA:PDIII-3	C
NAME	JHopkins		EBarnhill	
DATE	2/25/98		2/25/98	

OFFICIAL RECORD COPY

February 25, 1998

Mr. Joseph V. Sipek
Director - Licensing
Clinton Power Station
P.O. Box 678
Mail Code V920
Clinton, IL 61727

SUBJECT: INDIVIDUAL PLANT EXAMINATION OF EXTERNAL EVENTS (TAC NO. M83607)

Dear Mr. Sipek:

Based on our ongoing review of the Clinton Individual Plant Examination of External Events (IPEEE) submittal, we have developed the attached request for additional information (RAI). The RAI is related to the IPEEE analyses in the seismic and fire areas, and was developed by our contractors, Brookhaven and Sandia National Laboratories, respectively. There are no questions related to high winds, floods, and other external event areas. The questions have been reviewed by an NRC Senior Review Board with probabilistic risk assessment expertise for external events. Please respond to the RAI within 60 days of receipt of this letter.

Contact me if you have any questions.

Sincerely,

Original signed by:
Jon B. Hopkins, Senior Project Manager
Project Directorate III-3
Division of Reactor Projects III/IV
Office of Nuclear Reactor Regulation

Docket No. 50-461

Enclosure: Request for Additional Information

cc w/encl: See next page

Distribution:

Docket File	PUBLIC
PD3-3 R/F	ACRS
ARubin	OGC
EGA1	GGrant, RIII
RSavio	

Document Name: G:\CLINTON\IPEEE.RAI

OFFICE	PM:PDIII-3	E	LA:PDIII-3	C
NAME	JHopkins		EBarnhill	
DATE	2/25/98		2/25/98	

OFFICIAL RECORD COPY

UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D.C. 20555-0001

February 25, 1998

Mr. Joseph V. Sipek
Director - Licensing
Clinton Power Station
P.O. Box 678
Mail Code V920
Clinton, IL 61727

SUBJECT: INDIVIDUAL PLANT EXAMINATION OF EXTERNAL EVENTS (TAC NO. M83607)

Dear Mr. Sipek:

Based on our ongoing review of the Clinton Individual Plant Examination of External Events (IPEEE) submittal, we have developed the attached request for additional information (RAI). The RAI is related to the IPEEE analyses in the seismic and fire areas, and was developed by our contractors, Brookhaven and Sandia National Laboratories, respectively. There are no questions related to high winds, floods, and other external event areas. The questions have been reviewed by an NRC Senior Review Board with probabilistic risk assessment expertise for external events. Please respond to the RAI within 60 days of receipt of this letter.

Contact me if you have any questions.

Sincerely,

Jon B. Hopkins

Jon B. Hopkins, Senior Project Manager
Project Directorate III-3
Division of Reactor Projects III/IV
Office of Nuclear Reactor Regulation

Docket No. 50-461

Enclosure: Request for Additional Information

cc w/encl: See next page

Joseph V. Sipek
Illinois Power Company

Clinton Power Station, Unit 1

cc:

John G. Cook
Senior Vice President
Clinton Power Station
P.O. Box 678
Clinton, IL 61727

Larry Wigley
Manager Nuclear Station
Engineering Department
Clinton Power Station
P.O. Box 678
Clinton, IL 61727

Resident Inspector
U.S. Nuclear Regulatory Commission
RR#3, Box 229 A
Clinton, IL 61727

R. T. Hill
Licensing Services Manager
General Electric Company
175 Curtner Avenue, M/C 481
San Jose, CA 95125

Regional Administrator, Region III
U.S. Nuclear Regulatory Commission
801 Warrenville Road
Lisle, IL 60532-4351

Chairman of DeWitt County
c/o County Clerk's Office
DeWitt County Courthouse
Clinton, IL 61727

J. W. Blattner
Project Manager
Sargent & Lundy Engineers
55 East Monroe Street
Chicago, IL 60603

Illinois Department of Nuclear Safety
Office of Nuclear Facility Safety
1035 Outer Park Drive
Springfield, IL 62704

REQUEST FOR ADDITIONAL INFORMATION

CLINTON POWER STATION

Docket No. 50-461

Seismic

1) According to the Individual Plant Examination of External Events (IPEEE) submittal, the preferred success path for the Clinton Power Station (CPS) relies on the reactor core isolation cooling (RCIC) system, and RCIC alone, for reactor coolant system (RCS) inventory control. The RCIC system, which uses a turbine-driven pump, is a single train system with only moderate reliability. According to EPRI NP-6041, "the use of single-train systems with recognized poor availability" should be "treated with caution" (for non-seismic-caused component or system unavailability). EPRI NP-6041 further states that "one should have reasonable assurance that the plant level non-seismic system unavailability is no more than about 0.01 [per demand]" and RCIC is cited as an example of systems with poor non-seismic failure probabilities. For Clinton, the independent failure probability of the RCIC system used in the Individual Plant Examination (IPE), as indicated in some of the Level 1 core damage sequences (from the IPE analyses), is 0.0546 per demand, higher than that specified in EPRI NP-6041 (i.e., about 0.01). The failure probability may increase for IPEEE application because of the longer mission time required for the IPEEE (72 hours for IPEEE versus 24 hours for IPE). The use of generic data from NUREG-1150 for turbine-driven pumps (3E-2 per demand for failure to start, 5E-3/hour for failure to run, and 1E-2/demand for unavailability due to test and maintenance) would yield a higher failure probability for a 72-hour mission time. The reliance on RCIC alone for high pressure injection in the preferred success path is therefore questionable. To address this issue, the high pressure core spray (HPCS) system is also required in the IPEEE for some other BWR6/Mark III plants as a back-up to the RCIC system. In these IPEEEs, although either the RCIC system or the HPCS system can satisfy the success criteria for high pressure injection, both systems are included in the safe shutdown equipment list (SSEL) for seismic evaluation. Please provide additional basis for the use of RCIC alone in the preferred success path for RCS inventory control and discuss the seismic capacity of the HPCS system.

2) It is stated in the submittal that "Operators use existing procedures to operate all of the systems in both of the success paths and are trained extensively on the use of these procedures in an on-going operator training program," but no details are provided. Since operator actions following a review level earthquake (RLE) are crucial for the successful shutdown of the plant, please discuss in more detail the types of operator actions needed, the locations where they have to be performed, the time available for these actions, and the estimated failure rates (e.g., obtained from IPE). Please also provide a discussion concerning the anticipated effects of the RLE on rates of operator errors which may impact the integrity of the preferred and the alternate success paths, as well as a more detailed discussion of the on-going operator training program and its effect on the IPEEE.

Fires

1) The heat loss factor is defined as the fraction of energy released by a fire that is transferred to the enclosure boundaries. This is a key parameter in the prediction of component damage, as it determines the amount of heat available to the hot gas layer. In Fire-Induced Vulnerability Evaluation (FIVE), the heat loss factor is modeled as being inversely related to the amount of heat required to cause a given temperature rise. Thus, for example, a larger heat loss factor means that a larger amount of heat (due to a more severe fire, a longer burning time, or both) is needed to cause a given temperature rise. It can be seen that if the value assumed for the heat loss factor is unrealistically high, fire scenarios can be improperly screened out. Figure A.1 provides a representative example of how hot gas layer temperature predictions can change assuming different heat loss factors. Note that: 1) the curves are computed for a 1000 kW fire in a 10m x 5m x 4m compartment with a forced ventilation rate of 1130 cfm; 2) the FIVE-recommended damage temperature for qualified cable is 700°F for qualified cable and 450°F for unqualified cable; and 3) the curve (SFPE) in the figure is generated from a correlation provided in the Society for Fire Protection Engineers Handbook [1].

Based on evidence provided by a 1982 paper by Cooper et al. [2], the *EPRI Fire PRA Implementation Guide* recommends a heat loss factor of 0.94 for fires with durations greater than five minutes and 0.85 for "exposure fires away from a wall and quickly developing hot gas layers." However, as a general statement, this appears to be a misinterpretation of the results. Reference [2], which documents the results of multi-compartment fire experiments, states that the higher heat loss factors are associated with the movement of the hot gas layer from the burning compartment to adjacent, cooler compartments. Earlier in the experiments, where the hot gas layer is limited to the burning compartment, Reference [2] reports much lower heat loss factors (on the order of 0.51 to 0.74). These lower heat loss factors are more appropriate when analyzing a single compartment fire. In summary, (a) hot gas layer predictions are very sensitive to the assumed value of the heat loss factor; and (b) large heat loss factors cannot be justified for single-room scenarios based on the information referenced in the EPRI Fire PRA Implementation Guide.

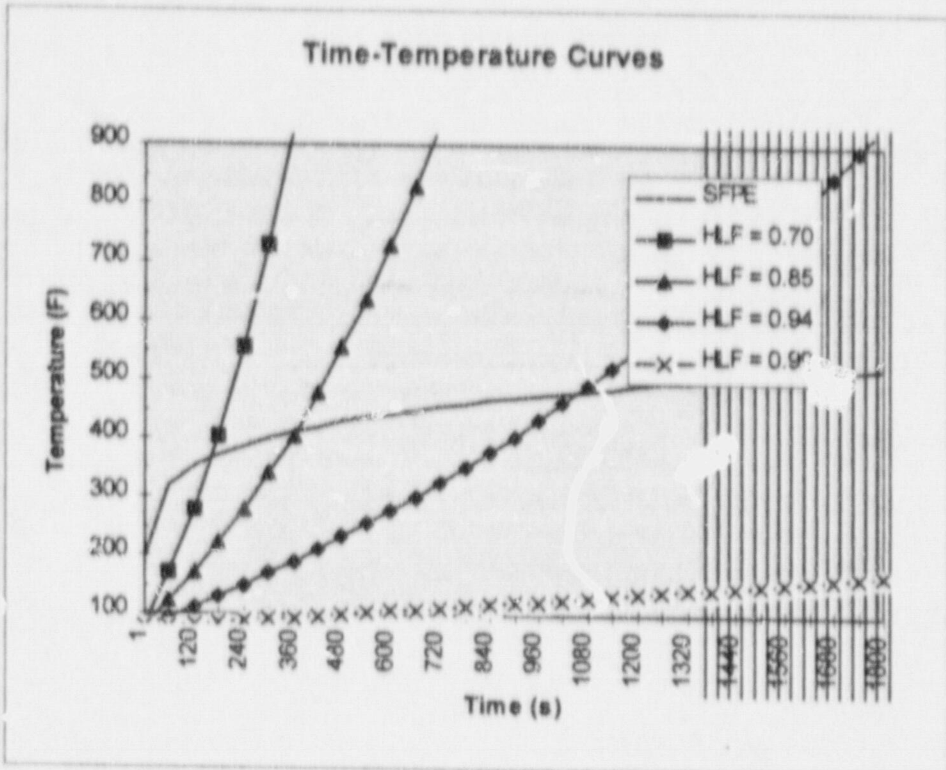

Figure A.1 Sensitivity of the hot gas layer temperature predictions to the assumed heat loss factor

For each scenario where the hot gas layer temperature was calculated, please specify the heat loss factor value used in the analysis. In light of the preceding discussion, please either: a) justify the value used and discuss its effect on the identification of fire vulnerabilities, or b) repeat the analysis using a more justifiable value and provide the resulting change in scenario contribution to core damage frequency.

References:

(1) "SFPE Handbook of Fire Protection Engineering," 2nd Edition, P.J. DiNenno, et al, eds., National Fire Protection Association. 1995, pp. 3-140.

(2) L.Y. Cooper, M. Harkleroad, J. Quintiere, W. Rinkinen, "An Experimental Study of Upper Hot Layer Stratification in Full-Scale Multiroom Fire Scenarios," Journal of Heat Transfer, v. 104, 741-9 (November 1982).

2) In the EPRI Fire PRA Implementation Guide, test results for the control cabinet heat release rate have been misinterpreted and have been inappropriately extrapolated. Cabinet heat release rates as low as 65 Btu/sec are used in the Guide. In contrast, experimental work has developed heat release rates ranging from 23 to 1171 Btu/sec.

Considering the range of heat release rates that could be applicable to different control cabinet fires and to ensure that cabinet fire areas are not prematurely screened out of the analysis, a heat release rate in the mid-range of the currently available experimental data (e.g., 550 Btu/sec) should be used for the analysis.

Discuss the heat release rates used in your assessment of control cabinet fires. Please provide a discussion of changes in the IPEEE fire assessment results if it is assumed that the heat release from a cabinet fire is increased to 550 Btu/s.

3) The main control room (MCR) analysis employs a non-suppression probability of 3.4E-3. The use of this value is equivalent to assuming that control room operators are equally effective as optimally-placed in-cabinet smoke detectors in detecting fires. Please provide additional justification for this assumption, including a discussion of possible MCR fire scenarios (including their locations, initial severities, and progression) and the effects of control room ventilation. Also describe the fire detection system in the underflour area and discuss the impact on detection due to the use of Tezfel cables.

4) The submittal notes the importance of fire suppression to the plant core damage frequency (CDF) in the observation that not crediting fire suppression raises the plant CDF by a factor of 266 (Section 4.6.2). The unreliability of the suppression system is stated as 2%. Such low unreliability may be reasonable for systems designed, installed, and maintained in accordance with industry standards, such as National Fire Protection Association (NFPA). It is difficult to understand the result in terms of a simple sensitivity to the non-suppression probability since this can account for a factor of fifty, at most, in the contribution of this scenario.

Please provide an explanation of this result that includes

- the modeling assumptions used in evaluating conditional core damage probabilities (CCDPs) of any sub-scenarios, including their dependence on the non-suppression probability,
- the expression used to determine the contribution to the CDF,
- the parameter values used and their justifications, such as whether the suppression systems were installed and maintained in accordance with industry standards,
- should errors be identified, a new estimate of the contribution to the CDF.

5) The IPEEE submittal does not address initiating events (e.g., loss-of-coolant accidents, loss of offsite power, etc.) caused by fire as a separate subject. No list is provided as to which initiating events were analyzed and no description is provided concerning final conclusions as to which initiating events are possible. It is also difficult to understand which system failures lead to core damage for various fire scenarios. The submittal

does not explain how the event trees and fault trees were developed/modified for the fire CDF evaluation. Please provide the following information:

- a list of initiating events that were addressed, as well as the conclusion and basis as to which initiating events could be caused by fire in each fire zone,
- an explanation of how the event trees and fault trees were developed and/or modified for the fire risk assessment,
- a listing of dominant core damage sequences in terms of areas involved, system-train failures, and CDF contribution for the most significant fire scenarios.