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ILLINOIS POWER COMPANY



CLINTON POWER STATION, P.O. BOX 678, CLINTON, ILLINOIS 61727

April 17, 1986

Docket No. 50-461

Director of Nuclear Reactor Regulation  
Attention: Dr. W. R. Butler, Director,  
BWR Project Directorate No. 4  
Division Of BWR Licensing  
U. S. Nuclear Regulatory Commission  
Washington, DC 20555

Subject: Clinton Power Station  
Response to Request for Additional Information Related  
to Control Systems Failure (Outstanding Licensing Issue 15)

Dear Dr. Butler:

The attachment provides the additional information related to control systems failure (Outstanding Licensing Issue 15) as requested in your letter, dated March 18, 1986. The specific issues are multiple nonsafety control system failures due to common electrical power source or sensor malfunctions and multiple nonsafety control system failures resulting from individual high energy line breaks (HELB). These issues are related to Staff concerns that failures or malfunctions of nonsafety-related control systems could result in transient or accident consequences more severe than originally considered in the Clinton Power Station (CPS) safety analysis.

As noted in the attached, a "TOP-DOWN" approach was used to resolve this issue which is based on the assumptions that Final Safety Analysis Report (FSAR) Chapter 15 identifies all possible initiating events and any combination of nonsafety-related control system failures can occur to exacerbate the original initiating event. Recent HELB analyses submitted by other nuclear utilities have used a "BOTTOMS-UP" approach. The TOP-DOWN approach is more bounding than the BOTTOMS-UP analysis, since the TOP-DOWN methodology is all-inclusive, i.e., all combinations of nonsafety-related control system failures are considered regardless of power source, common instrument sensor, or proximity to a high energy line.

As noted in the responses to Staff Questions 1, 2, and 3 additional analyses will be required for CPS. As already discussed with Mr. B. L. Siegel, of your staff, these additional analyses will be completed and submitted to the NRC prior to plant operation above 5% of rated reactor power.

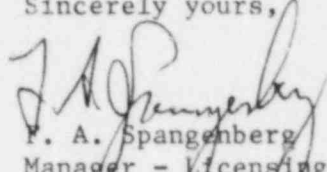
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Following the Staff's review of these responses, please contact me if additional information is required. The information provided herein should be sufficient for the Staff to resolve this issue relative to issuance of the Fuel Load license for CPS.

Sincerely yours,



F. A. Spangenberg  
Manager - Licensing  
and Safety

TLR/ckc

Attachment

cc: B. L. Siegel, NRC Clinton Licensing Project Manager  
NRC Resident Office  
Regional Administrator, Region III, USNRC  
Illinois Department of Nuclear Safety

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1. NRR Concern: Information related to power sources whose failure or malfunction could lead to malfunctions of multiple control systems was reviewed by the Staff. The methodology information states that commonality of power supplies to control systems was determined through the load centers. However, the subject information also indicates that the analysis considered power supplies only up to the load centers. The applicant should verify that their review considered all higher level power sources such that the loss of the next higher level bus initiates an event already bounded by the FSAR Chapter 15 Analyses (e.g., loss of a 480V load center which supplies multiple 480V motor control centers). If not, the effects of failure or malfunction of these higher level power sources on multiple control systems should be analyzed. If the consequences of these failures are bounded by the Chapter 15 analyses, a positive statement to that effect should be provided with specification of the Chapter 15 analysis. If not bounded, then information should be provided to justify the issue.

IP Response: The technique employed in the Control Systems Failure (CSF) Review and Evaluation Program report is referred to as a "TOP-DOWN" approach. The assumptions inherent in this approach are that:

- 1.) Chapter 15 of the Clinton Power Station (CPS) Final Safety Analysis Report (FSAR) identifies all possible initiating events; and
- 2.) any combination of nonsafety-related control system failures can occur to exacerbate the initiating events.

Each FSAR Chapter 15 event is then reviewed to assess the impact of all nonsafety-related control system failures to determine whether an unanalyzed condition would exist. No modifications were made to the existing FSAR Chapter 15 analysis. However, upon further review, it was determined that the CSF analysis did not appropriately consider the effects of all nonsafety-related control system failures on the FSAR Chapter 15 events. Illinois Power Company (IP) is conducting a complete re-review of the Control Systems Failure analysis and will provide the results to NRR prior to exceeding 5% of rated reactor power.

Recent Control Systems Failure analyses submitted by other nuclear utilities have used a "BOTTOMS-UP" approach for the common power bus failure, common sensor, and high energy line break (HELB) analyses. The BOTTOMS-UP approach for the common power bus failure analysis, for example, would proceed as follows:

- 1.) The motor control center (MCC) electrical schematics and single line power distribution diagrams are used to determine the nonsafety-related electrical loads and the power bus "tree".

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- 2.) The failure of each MCC is assumed, then the failure of each higher level power bus is assumed. The transient effects for all failures are then determined.
- 3.) Each transient is compared to a bounding FSAR Chapter 15 event; any event outside the bounds of FSAR Chapter 15 would be analyzed further.

The TOP-DOWN approach is more bounding than the BOTTOMS-UP analysis, since the TOP-DOWN methodology is all-conclusive, i.e., all combinations of nonsafety-related control system failures are assumed regardless of power source, common instrument sensor, or proximity to a high energy line. Therefore, the effects of loss of all higher level buses is, by definition, included in the TOP-DOWN analysis performed for the Clinton Power Station. In some instances, power loss to components sharing no common bus is assumed and the transient effects are determined.

2. NRR Concern: The approach taken by the Clinton applicant appears not to meet the intent of the control systems failures question. The applicant considered the effects of postulated control system failures on Chapter 15 events and modified the event analysis to include the nonsafety control system failures. The intent of the control system failures issue was not to require modifications to the FSAR analyses but to determine whether combined potential multiple control system failures resulting from (1) common power source or sensor (including impulse lines) malfunctions or (2) each postulated potential high energy line break could result in consequences more severe than those previously analyzed for in FSAR Chapter 15 (could such failures result in an unanalyzed event). If it is determined that all possible combinations of simultaneous malfunctions of control systems are bounded by the previous FSAR Chapter 15 analyses, then a positive statement to that effect should be provided including specification of the bounding FSAR analyses. If the Chapter 15 event analyses were modified to compensate for the multiple control system failure consequences or if conservatisms were not included in the HELB, common power source, sensor or sensor impulse line evaluations consistent with those assumed for FSAR Chapter 15 analyses, details should be provided for Staff review. If no modifications to the FSAR analyses were made or reduction in conservatisms accounted for, then it should be so stated.

IP Response: As discussed in the response to NRR Concern #1, the CPS FSAR Chapter 15 was not modified. Rather, the effects of all combinations of nonsafety control system failures on FSAR Chapter 15 events were considered to completely envelop the control systems failure question. The latter portion of this concern will be addressed in the IP re-review discussed in the response to NRR Concern #1.

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3. NRR Concern: The response states that the limiting HELB is a line break in the turbine building. This break was examined for its effects on the loss of feedwater heating (LOFH) event. It is not clear whether this is the limiting break in terms of the most severe consequences resulting from the turbine building HELB (i.e., worst-case line break at Clinton which creates most severe combined effects that could occur from multiple control system failures) or the most limiting in terms of making the LOFH event itself more severe. Thus, the Staff is not assured that the effects of each postulated HELB event were considered. The applicant should provide information to clarify the issue. The information should include a description of the procedure by which the location of nonsafety-related control system components that could be affected by high energy line breaks was determined (i.e., zone analysis and plant walkdown, etc.).

IP Response: The first portion of this concern will be addressed in the IP re-review discussed in the response to NRR Concern #1. Regarding the latter portion of this concern dealing with the location of components, a zone analysis and plant walkdown does not apply to the TOP-DOWN approach used in the CPS HELB analysis. Rather, this concern relates to the BOTTOMS-UP approach, which specifically locates each nonsafety-related control component in a pressure-tight zone and identifies each high energy line residing in this zone. A plant walkdown verifies the location of the components, the zones, and the high energy lines. Then, the effects of each line break, i.e., pipe whip, jet impingement, and/or environmental effects, are determined within each zone and the consequences compared with the FSAR Chapter 15 events.

The CPS CFS analysis which used the TOP-DOWN approach, as defined in the IP Response to NRR Concern #1, does not rely on a zone analysis nor a plant walkdown.

4. NRR Concern: The applicant should verify that a single active failure in the safety systems used to mitigate the consequences of high energy line breaks was assumed in the analysis performed.

IP Response: The TOP-DOWN approach begins with the FSAR Chapter 15 initiating events and assesses the impact of all nonsafety-related control system failures to determine whether an unanalyzed condition would exist. Since the FSAR Chapter 15 analyses detail the effects of single active failures in all safety systems, a failure in the safety systems used to mitigate the consequences of high energy line breaks is part of the analysis and, thus, is accounted for.

5. NRR Concern: The applicant should provide a description of the harsh environments assumed in the analysis performed, including a discussion on the effects of pressure, temperature, and humidity in addition to pipe whip and jet impingement.



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IP Response: As detailed in the response to NRR Concern #1, the TOP-DOWN approach does not specifically assume a particular harsh environment exists, but rather investigates the combinatory failure of all nonsafety-related control systems, regardless of zone. Thus, a discussion of the effects of pressure, temperature, humidity, pipe whip, and jet impingement is not applicable.

6. NRR Concern: The applicant addressed pipe breaks within the turbine building which could impact the FSAR analyses for various events (loss of feedwater heating, feedwater controller failure, and recirculation pump trip). It appears that credit is being taken for the reactor vessel water level (L8) trip of the feedwater pumps to mitigate the events in combination with manual actions in some cases if required. The L8 trip on most BWRs is nonsafety-related. Information should be provided to discuss the design criteria (i.e., compliance with IEEE 279, IEEE 338, etc.) associated with the L8 trip including details on Technical Specification surveillance requirements. This information should provide correlation with the dependence upon manual operator actions (i.e., discuss the extent of reliance on manual operator action for these events and justify its reliability based on currently acceptable models).

The above information is required to address the potential development of the following situation. Assuming a failure of the L8 trip (nonsafety-related) and no operator action, reactor power and vessel water level would continue to rise until a turbine trip (and subsequent reactor trip) will occur due to high vibration caused by moisture in the steam lines. For the worst-case, this could occur before the reactor power level reaches the APRM high power level reactor trip setpoint. The Staff is concerned that this could lead to a turbine trip without bypass event from a higher power level than previously analyzed for in the FSAR. If it is concluded that such a condition could develop, the applicant should verify that the consequences are bounded by the Chapter 15 analyses.

As related to this same issue, the applicant should address the possible consequences resulting from water entering the steam lines. The LOFH event assumes steam to be discharged to the suppression pool via the safety relief valves (SRVs) as a result of main condenser failure. However, with a failure of the turbine bypass system and the main turbine and feedwater pump trips, it is conceivable that water could flow into the steam lines. The Staff is concerned that the SRVs and their discharge lines are not qualified for the passage of high pressure liquid. Failure of the SRVs or associated discharge lines could lead to higher containment pressures than previously analyzed.

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IP Response: The initial two paragraphs of this concern are predicated on the statement: "The L8 trip on most BWRs is nonsafety-related." However, Clinton Power Station (CPS) is a BWR6; a design feature of the BWR6 is safety-related L8 trip functions. Design criteria (e.g., compliance with IEEE 279, IEEE 338) associated with the L8 trips are detailed in CPS FSAR Chapter 7. Surveillance requirements are detailed in Tables 4.3.1.1-1 (Reactor Protection System), 4.3.3.1-1 (Emergency Core Cooling System), 4.3.5.1-1 (Reactor Core Isolation Cooling System), and 4.3.9.1-1 (Containment Spray, Feedwater, and Main Turbine Trip Systems) of the CPS Technical Specifications. In addition, any manual operator actions assumed are already addressed in the accepted FSAR Chapter 15 event analyses. No modelling of operator reliability is required by Chapter 15. Therefore, the concerns related to the above statement are not applicable to CPS.

The Staff concern related to a turbine trip without bypass event initiated from a higher power level than previously analyzed in the FSAR will be addressed in the IP re-review discussed in the response to NRR Concern #1.

The final concern requests IP to address the possible consequences resulting from water in the steam lines and SRV qualification for passage of high pressure liquid. Not only are the L8 trip functions safety-related, but the entire issue of water in the steam lines being discharged through the SRVs was fully addressed by BWR Owners Group work reported in Supplement No. 5 to the CPS Safety Evaluation Report (SER) and accepted by the Staff. Section 5.2.2 of Supplement No. 5 provides the CPS response to TMI Action Plan Item II.D.1, which specifically addresses the issue of water entering the steamlines and into the SRV discharge line. Since this issue is resolved with the Staff, no further work is required in response to this question.

7. NRR Concern: It should be verified that the consequences of the worst-case event combination considered in the HELB analysis are bounded by a small fraction ( 10%) of 10CFR Part 100 guidelines.

IP Response: As defined in CPS FSAR Section 15.0.3.1.2, an unacceptable safety result for infrequent incidents is the release of radioactivity which results in dose consequences that exceed a small fraction of 10CFR100. HELB accidents are considered limiting faults and, thus, their consequences must not exceed the unacceptable results defined in CPS FSAR 15.0.3.1.3, i.e., radioactive material release which results in dose consequences that exceed the guideline values of 10CFR100. However, regardless of the frequency classification, the consequences of the worst case event combination considered in the HELB analysis are bounded by a small fraction of 10CFR100 guidelines. The re-review identified in IP Response to Concern #1 will confirm this and provide assurance that a radiological analysis is not necessary.

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8. NRR Concern: Information should be provided to clarify the utilization of nonsafety-related equipment for the mitigation of the effects of high energy line breaks and consequential control system failures. If nonsafety-related equipment is being utilized for accident mitigation purposes, then details should be provided for each case with justification.

IP Response: No nonsafety-related equipment, beyond that assumed in the FSAR Chapter 15 analysis, was used for mitigation of the effects of high energy line breaks and consequential control system failures. The Staff has already accepted the FSAR Chapter 15 analyses and their bases.

9. NRR Concern: It does not appear that all the Chapter 15 FSAR events were evaluated in conjunction with worst-case consequences resulting from high energy line break effects (i.e., turbine trip without bypass event, MSIV closure events, etc.). The turbine trip without bypass event is often the limiting Chapter 15 event for a BWR. Provide information to verify that all Chapter 15 FSAR events were considered in conjunction with the HELB analyses.

IP Response: Apparently, a few pages are missing from the report submitted to the Staff; IP has forwarded a complete copy of the original report. As evidenced by the original report, all FSAR Chapter 15 events were considered in conjunction with the CSF analysis.

10. NRR Concern: It appears that credit is being taken for reactor vessel water level trip signals L2, L3, and L4 to mitigate the loss of feedwater flow and feedwater line break events. Provide a description of the design criteria (compliance with IEEE 279, IEEE 338, etc.) associated with these subject trip signals. This information should include details on Technical Specification surveillance requirements.

IP Response: Reactor vessel water level trip signals L2 and L3 are safety-related as defined in the CPS FSAR; credit for their proper operation has always been a design criteria of this plant and for all BWR product lines. Design criteria (e.g., compliance with IEEE 279, IEEE 338) associated with the L2 and L3 trips are detailed in CPS FSAR Chapter 7. Surveillance requirements are detailed in Tables 4.3.1.1-1 (Reactor Protection System), 4.3.2.1-1 (Containment and Reactor Vessel Isolation Control System), 4.3.3.1-1 (Emergency Core Cooling System), and 4.3.5.1-1 (Reactor Core Isolation Cooling System) of the CPS Technical Specifications. There is no reactor vessel water level trip signal associated with L4; L4 serves an alarm function only.



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11. NRR Concern: It appears that credit is being taken for operator actions required to mitigate the consequences of an instrument line break event. Information should be provided to clarify this understanding and to describe the details of the extent that manual action is required. This should include justification for reliance on operator action based on currently acceptable models.

IP Response: The operator actions assumed in the CSF analysis are identical to those assumed in the current FSAR Chapter 15 event analysis including those for the instrument line break. The Staff has already accepted the manual actions described in the Chapter 15 analyses.

12. NRR Concern: In Part B of the feedwater controller failure event verify whether "Turbine Trip Failure" refers to turbine trip failure @ L8. If so, provide a response consistent with Question No.2. If not, please clarify the basis for the turbine trip failure.

IP Response: The turbine trip failure identified in Part B of the feedwater controller failure event refers to failure of the L8 turbine trip function. Refer to Concern #6 for a discussion of L8 trip functions.

13. NRR Concern: The reference to the FSAR Chapter 15.2-48 in Part A of the failure of RHR shutdown cooling event is incorrect. Provide information to clarify this.

IP Response: The appropriate reference should be to FSAR Section 15.2.9.2.3.