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U. S. Nuclear Regulatory Commission
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Braidwood Station, Units 1 and 2
Facility Operating License Nos. NPF-72 and NPF-77
NRC Docket Nos. STN 50-456 and STN 50-457

Byron Station, Units 1 and 2
Facility Operating License Nos. NPF-37 and NPF-66
NRC Docket Nos. STN 50-454 and STN 50-455

Subject: Response to the NRC Request for Additional Information Regarding the Individual Plant Examination of External Events

Reference: Letter from G. F. Dick (U. S. NRC) to O. D. Kingsley, "Byron and Braidwood Stations Request for Additional Information Regarding Plant Individual Plant Examination of External Events (IPEEE)," dated December 1, 2000

In the reference letter, the NRC issued a Request for Additional Information (RAI) related to the Individual Plant Examination of External Events (IPEEE) assessments for fire events for the Braidwood Station and the Byron Station. As requested, we have focused our attention and responses on the treatment of the main control room abandonment scenarios and on the scenarios involving the auxiliary electric equipment room. We received the RAI letter on December 8, 2000, and as requested, the additional information is being provided within 30 days of receipt of the letter (i.e., by January 8, 2001). The requested additional information is provided in the attachment to this letter.

A011

Should you have any questions concerning this letter, please contact Ms. Kelly M. Root at (630) 663-7292.

Respectfully,

R. M. Krich
Director, Licensing
Mid-West Regional Operating Group

Attachment

cc: Regional Administrator - NRC Region III
NRC Senior Resident Inspector - Braidwood Station
NRC Senior Resident Inspector - Byron Station

ATTACHMENT

Response to NRC letter, "Byron and Braidwood Stations Request for Additional Information Regarding Plant Individual Plant Examination of External Events (IPEEE)," dated December 1, 2000

Braidwood Station, Units 1 and 2
Byron Station, Units 1 and 2

Response to Supplemental Request for Additional Information (SRAI) 1 - Fire Frequency for the AEER

"Tables 17-1 and 17-3 of the original RAI #17 responses for both Braidwood and Byron show some of the factors considered in the quantification of the AEER fire CDF (i.e., compartment frequency, individual scenario fire frequencies (partitioned to specific fire sources) and conditional core damage probability (CCDP) values). These tables show the values to be somewhat different between the two plants, and there could be some potential discrepancies. Note that Table 17-1 of each plant's previous RAI responses shows the overall AEER compartment fire frequency to be 2.4E-3/yr (i.e., the overall compartment frequency is the same for both plants). However, the staff is unable to reconstruct this overall compartment frequency accurately for either of the two plants using the individual fire scenario frequency values that appear in Table 17-3. For Byron, summing the individual scenario frequencies for the AEER as shown in Table 17-3 yields a total fire frequency somewhat lower than the overall compartment frequency from Table 17-1. This may be an indication that some ignition sources were screened. A similar exercise for Braidwood yields a summed AEER fire frequency from Table 17-3 that is approximately twice the overall compartment frequency shown in Table 17-1. In each case the inability to reproduce the overall compartment fire frequency is a potential discrepancy that may have impacted the final CDF estimates.

> **Please review the fire frequency values cited in Tables 17-3 for individual fire scenarios within the AEER. Demonstrate that the overall fire frequency for the AEER as given in Table 17-1 is preserved in (or can be reconstructed from) the individual fire scenario frequencies shown in Table 17-3. Identify any individual fire scenarios that have been screened out at this stage of the analysis, and provide a basis for their screening. Please explain or resolve any remaining discrepancies between the overall compartment frequency from Table 17-1 and the individual scenario frequencies from Table 17-3 for each plant. Compare the values in Table 17-3 for the two plants to each other, and justify any numerical differences in the individual fire scenario frequency estimates that might remain between the two plants."**

Response to SRAI 1

The discrepancies between the overall compartment frequency from Table 17-1 and the individual scenario frequencies from Table 17-3 for each plant arise from two sources.

- The frequencies reported in Table 17-1 were calculated in the initial stages of the analysis, and reflect an assumption that cabinets in the Auxiliary Electric Equipment Room (AEER) were typical of cabinets found in other auxiliary building rooms throughout the plant. Detailed analysis revealed that this was not the case, and that the frequency of cabinet fires in the AEERs was being underestimated. The frequency was recalculated assuming the AEER cabinets were similar to Main Control Room (MCR) cabinets. That is, they typically contain numerous relays and circuit cards, which operating experience shows are the primary sources of ignition in MCR cabinets as reported in the Electric Power Research Institute (EPRI) report, "Fire PRA Implementation Guide," December 1995. Before revising the frequencies, the contribution from cabinet fires in each of the Byron and Braidwood Stations' AEERs was 1.6E-03/yr and the overall AEER compartment fire frequency was 2.4E-3/yr. After revising the frequencies, the total (i.e., unscreened) contributions from cabinet fires increased to 9.1E-03/yr [1] for each AEER. Substituting the revised AEER electrical cabinet fire frequency for the original AEER electrical cabinet fire frequency yields a revised overall AEER compartment fire frequency of 9.9E-03/yr [2]. The frequencies in Table 17-3 are derived from the revised calculation.

- The frequencies reported in Table 17-3 are based on the generic ignition frequency for the MCR cabinets as reported in the EPRI report, "Fire-Induced Vulnerability Evaluation (FIVE)," April 1992. The Table 17-3 frequencies also reflect screening of cabinets during the detailed analysis, based on the results of fire modeling calculations and detailed walkdowns. In the analysis for both plants, cabinets were screened if the results of the fire modeling and walkdowns showed that a fire in the cabinet would not affect either safe-shutdown division or offsite power. The Byron Station analysis applied one other significant screening assumption, which is discussed in the following paragraphs.

The differences between the estimates of individual fire scenario frequencies for the two plants reported in the respective Individual Plant Examination of External Events (IPEEE) arise primarily from a difference in screening assumptions between the two plants. The Byron Station analysis assumed that a fire affecting only one safe-shutdown division but not affecting offsite power would be insignificant to risk. The Braidwood Station analysis included such cabinets in the final damage scenarios.
Therefore, the Braidwood Station analysis accounted for cabinet fire frequency contributions from 26 cabinets in the Braidwood Station Unit 1 AEER with a combined frequency of 4.4E-03/yr, or 48% of the revised total cabinet fire frequency for the Braidwood Station Unit 1 AEER before screening. The numbers for the Braidwood Station Unit 2 AEER are similar. The Byron Station analysis accounted for cabinet fire frequency contributions from two cabinets in the Byron Station Unit 1 AEER with a combined frequency of 6.7E-04/yr, or 7% of the revised total cabinet fire frequency for the Byron Station Unit 1 AEER. The numbers for the Byron Station Unit 2 AEER are slightly different, i.e., two cabinets with a combined frequency of 2.5E-04/yr, or 3% of the revised total cabinet fire frequency for the Byron Station Unit 2 AEER.

In order to make the methods consistent between the Byron and Braidwood Stations' fire IPEEEs, the assumptions that were applied in the Braidwood Station analysis will also be applied to the Byron Station analysis. Applying these assumptions, the number of unscreened cabinets in the Byron Station AEERs increases to 22 (i.e., 47% of the revised total cabinet frequency for each AEER) with a combined frequency contribution of 4.3E-03/yr for the Unit 1 AEER and 4.2E-03/yr for the Unit 2 AEER. The effect of this change on the overall Core Damage Frequency (CDF) is discussed in the responses to SRAIs 3 and 6. In addition, the Braidwood Station analysis considered a scenario involving two cabinets in which a fire could potentially result in loss of control of the

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1 Specifically, the cabinet fire contributions for the four AEERs were as follows: Byron Unit 1 AEER = 9.15E-03/yr, Byron Unit 2 AEER = 9.15E-03/yr, Braidwood Unit 1 AEER = 9.10E-03/yr, Braidwood Unit 2 AEER = 9.03E-03/yr.

2 Revised Overall AEER Compartment Fire Frequency = Original Overall AEER Compartment Fire Frequency – Original AEER Electrical Cabinet Fire Frequency + Revised AEER Electrical Cabinet Fire Frequency = 2.4E-03/yr – 1.6E-03/yr + 9.1E-03/yr = 9.9E-03/yr.

pressurizer Power-Operated Relief Valves (PORVs) and potentially impact control circuits for one division of safe shutdown components in an overhead junction box and associated conduits. This scenario has been confirmed by walkdown at Byron Station and is now included in the revised Byron Station analysis discussed in the response to SRAI 3.

SRAI 2 - Conditional Core Damage Probability Estimates for the AEER

"The CCDPs assumed for fire scenarios impacting the AEER appear to be significantly different between Byron and Braidwood even though the room contents, functions, fire sources and postulated fire scenarios appear identical. Table 17-3 shows a compartment CCDP of 8E-4 at Braidwood versus 1.1E-4 at Byron. It is not clear whether this difference is due to physical or functional differences between Byron and Braidwood (e.g., cable routing, plant systems design and physical plant layout) or is due to differences in analysis assumptions (e.g., extent of postulated damage, impact on plant systems, reliability of other mitigating systems, reliability of recovery actions, etc).

> **Please discuss the physical differences between the AEERs at Byron and Braidwood and identify and discuss any differences in analysis assumptions that led to the determination that the CCDP for the AEERs at the two sites were substantially different. For each plant provide an estimate of the CCDP assuming loss of all equipment and functions in the AEER and describe the method of shutdown provided against such a fire loss. Describe how the individual fire scenario CCDP values corresponding to each of the fire scenarios identified in Table 17-3 were derived (e.g., where is the fire assumed to start, what equipment is being damaged in each scenario, where is the damaged equipment located in relation to the fire source, what functions are being impacted by the postulated equipment damage, how is safe shutdown achieved, can the scenario lead to MCR abandonment, was suppression credited in the quantification, and if suppression was credited, was the failure to suppress the fire in a timely manner considered). Identify any fire scenarios where fire modeling and/or judgement were used either explicitly or implicitly as the basis for assuming limited or localized fire damage. For each such case, justify the assumptions that led to the conclusions that fire damage would be limited. Specifically discuss the quantification of fire scenarios in which fire suppression either fails or fails to be effective in a timely manner and the contribution of such scenarios to fire CDF."**

Response to SRAI 2

Detailed fire modeling at the Byron Station and the Braidwood Station identified fire scenarios with three distinctive damage potentials.

- Fires that impact control of one division of safe shutdown that may or may not impact the availability of offsite power. These fires do not require shutdown from outside the MCR since the controls for the unaffected division may be used in the MCR. The question of habitability of the MCR as the result of a fire in the AEER is discussed in the response to SRAI 5. Neither the Byron Station nor the Braidwood Station examination calculated a Conditional Core Damage Probability (CCDP) specifically for these scenarios. They both used a CCDP that was derived for loss of both divisions and manual local action with or without offsite power available.

- Fires that can impact control of both divisions of safe shutdown with or without impact on availability of offsite power. Braidwood Station fire modeling identified one panel in the Unit 1 AEER (i.e., 1PA52J) and several potential transient fire locations within the AEERs where such damage potential was determined to be possible. A CCDP was calculated assuming loss of both divisions and local manual actions to operate the necessary equipment. The scenario description in Table 17-3 in the Reference 1 letter reflects the assumed target damage. Byron Station fire modeling identified locations within the AEERs where a potential transient fire could be close enough to impact cabinets of both divisions (i.e., fire scenario 40c). Byron Station fire modeling also identified a location in the Unit 2 AEER that could impact offsite power cables (i.e., fire scenario 41e). The scenario description in Table 17-3 in the Reference 2 letter reflects the assumed target damage.

- Fires that can impact control of one division of safe shutdown with potential impact on pressurizer PORV circuits. Such a scenario was initially identified at Braidwood Station only (i.e., fire scenario 40c). This scenario was confirmed at Byron Station during this re-analysis and has been added to this revision. These fires do not require shutdown from outside the MCR since the controls to the unaffected division may be used in the MCR. The question of habitability of the MCR as the result of a fire in the AEERs is discussed in the response to SRAI 5. A CCDP for scenarios potentially impacting pressurizer PORV circuits was calculated at Braidwood Station using the general transient initiator as offsite power circuits were determined to be unaffected by fires in the PORV panels. After confirming a similar configuration at Byron Station, the same CCDP was used for these fire scenarios at Byron Station for this re-analysis.

Details of the AEER fire scenarios are provided in Table 2-1 for the Braidwood Station AEERs and Table 2-2 for the Byron Station AEERs. The first three columns of these tables show the fire scenarios and the CCDPs, as reported in the response to RAI question 17 (Refs. 2 and 1) for the Byron Station and the Braidwood Station, respectively, which were used to calculate the CDFs reported in the respective IPEEEs (Refs. 3 and 4) for the Byron Station and the Braidwood Station, respectively. The last two columns provide detailed fire scenario descriptions obtained from the Byron Station and the Braidwood Station fire modeling reports and the results of the re-analysis of the CCDPs. The IPEEE and the RAI response applied simplifications that have been removed in the current revision of the AEER scenarios. The fire scenarios have been divided into the specific fire scenarios that the detailed fire modeling identified. Then the CCDPs were re-defined for these fire scenarios on the basis of the equipment lost to the fire.

In both the Byron and Braidwood Stations' IPEEEs, the CCDP for a Loss of Offsite Power (LOOP) and loss of automatic control of both divisions of safe shutdown pumps was used for nearly all AEER scenarios because it bounds those with less equipment affected by the fire.

For Braidwood Station, this CCDP was calculated based on local manual actions at the 4 KV switchgear panels to load the Auxiliary Feedwater (AF), Centrifugal Charging (CV), Component Cooling (CC), Residual Heat Removal (RH), and Essential Service Water (ESW), i.e., SX pumps onto the emergency buses, or to locally start the diesel driven AF pump in accordance with Braidwood Station Abnormal Operating Procedure BwOA ELEC-5, "Local Emergency Control of Safe Shutdown Equipment." In the Braidwood Station IPEEE analysis, the Emergency Diesel Generators (EDGs) were assumed to be manually started at the local control panels in accordance with procedure BwOA ELEC-3, "Loss of 4KV ESF Bus." The circuits from Instrument Buses 111 and 114 that affect autosequencing of the safe shutdown loads were assumed to be damaged. Failing these instrument bus circuits concurrently with a LOOP prevents automatic loading of the safe shutdown loads onto the 4KV buses. As previously stated, procedure BwOA ELEC-5 for local, manual starts of the safe shutdown pumps was credited. This analysis produced a CCDP equal to 8.0E-04.

For Byron Station, this CCDP was also calculated based on manual actions at the 4 KV switchgear panels to load the AF, CC, CV, RH, and SX pumps onto the emergency buses, or to locally start the diesel driven AF pump in accordance with Byron Abnormal Operating Procedure BOA ELEC-5, "Local Emergency Control of Safe Shutdown Equipment)." In the Byron Station IPEEE analysis, since the Undervoltage (UV) relays that autostart the EDGs under LOOP conditions are not located in the AEER, the EDGs were assumed to start automatically. While Instrument Buses 111 and 114 circuits were not explicitly failed in the Byron Station CCDP calculation, the effects of losing the instrument buses were implicitly included in the Byron Station CCDP calculation by requiring local, manual starts of the AF, CC, CV, RH, and SX pumps. This analysis produced a CCDP equal to 1.1E-04.

The respective AEER, safe shutdown strategy, electrical and instrumentation configurations[3], and procedures which determine this CCDP (i.e., local, manual start of both divisions of safe shutdown pumps) at the Byron Station and the Braidwood Station are almost identical. Therefore, it would be expected that the CCDP values at the two plants should also be approximately the same. In order to make the methods consistent between the Byron and Braidwood Stations' fire IPEEEs, the assumptions applied in the Braidwood Station analysis will also be applied to Byron Station. Thus, the Byron Station CCDP for single train or limited dual train damage will be revised to be 8.0E-04.

In addition, for consistency with the MCR model, when a fire in the AEER requires shutdown from outside the MCR due to loss of control functions for significant dual train equipment, the ex-MCR (i.e., outside the MCR) safe shutdown values will be used. Note that these values do account for instances where manual action at the switchgear is required. The response to SRAI 5 discusses the MCR habitability in the event of a fire in the AEER.

The effect of these changes on the AEER CDFs for the Byron Station and the Braidwood Station is discussed in the response to SRAI 3.

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[3] The exception is that, due to the fact that conduits were typically field-routed at both plants, conduit routing in the AEERs is unique at each plant. Moreover, conduit routing in one unit's AEER does not mirror routing in the opposite unit's AEER. The unique conduit routing gives rise to asymmetries seen between the Unit 1 and the Unit 2 scenarios and between the Byron Station and the Braidwood Station scenarios.

Table 2-1 - Braidwood Auxiliary Electric Equipment Room (AEER) Fire Scenarios and the Conditional Core Damage Probabilities (CCDPs)

Fire Scenarios from Braidwood Fire IPEEE submittal (Ref. 4) and RAI response (Ref. 1)			Fire Scenario Description from Braidwood fire modeling report	Revised CCDP in this re-analysis(see scenario description in previous column)
No.	**Description**	**CCDP**		
U1 = 40a, U2 = 41a	Description [Table 17-3] Cabinet fire - Div. 11 (21), Div. 12 (22), and LOOP, no PORVS. Basis Three different fire scenarios were combined for simplification. The CCDP for loss of both divisions with LOOP was conservatively used. This CCDP was calculated based on LOOP initiator and local manual operation of the needed safe shutdown equipment.	8.0E-4	Description from fire modeling This fire scenario involves fire in a single critical cabinet that impacts only one division or offsite power. These fires do not require shutdown from outside the MCR. Adequate controls will be available to achieve safe shutdown from inside the control room using the available division. The CCDP that was calculated based on local manual operation of both divisions of equipment has been conservatively used for this scenario.	8.0E-4
			A fire in division 12 electrical cabinet 1PA52J can cause damage to overhead division 11 junction box 1JB881A-1C and associated conduits. Panel 1PA52J is a Safety Related Panel, which has Division 12 circuits for the Reactor Vessel Level Indicating System (RVLIS) and Core Exit Thermocouples (CETs). A fire in Panel 1PA52J could not affect division 12 Solid State Protection System (SSPS) actuation and reset circuitry. Therefore, the Div. 12 ESF Safe Shutdown Equipment would be available for auto starting or manual starting from the MCR. Therefore the CCDP that was calculated based on local manual operation of both divisions of equipment has been conservatively used for this scenario.	8.0E-4
			One electrical cabinet was identified (in Unit 1 only) that can cause damage to one division of control and offsite power. A fire in offsite power cabinet 1PA23J can cause damage to division 11 conduits C0A71P9-1C and C0A81X9-1C. These fires do not require shutdown from outside the MCR. The plant can be shutdown using the controls for division 12 equipment from the control room. The CCDP that was calculated based on local manual operation of both divisions of equipment has been conservatively used for this scenario.	8.0E-4

Table 2-1 - Braidwood AEER Fire Scenarios and the CCDPs (cont'd)

U1 = 40b, b+	Description [Table 17-3] Transient @ column/wall - Div. 11, Div. 12, and LOOP, no PORVS Basis These scenarios represent transient fires in certain locations in the AEER (17% of the available floor area) that can cause damage to two divisions or one division and offsite power control circuits. The CCDP for loss of both divisions with LOOP was conservatively used. This CCDP was calculated based on a LOOP initiator and local manual operation of the needed safe shutdown equipment.	8.0E-4	A transient fire in front or to the side of division 12 cabinet 1PA52J potentially damaging division 11 cabinets 1IP03J, 1PA27J, 1PA24J and 1PA15J, OR, a transient fire in front of division 11 cabinet 1PA51J, potentially damaging division 12 cabinets 1MS018B and C. This area covers 8% of the Unit 1 AEER floor area. These fires require manual start of the safe shutdown equipment from outside the control room at the switchgear. The value calculated for MCR evacuation, i.e., 1.2E-2 (see the response to question 4) has been used for these fire scenarios.	1.2E-2
			A transient fire in front of offsite power cabinets 1PA23J and 1PA29J could damage division 11 cabinets 1PA09J, 1PA11J and 1PA33J. This area covers 9% of the available floor space in the Unit 1 AEER. These fires can be controlled from within the control room using the available division. The CCDP that was calculated based on local manual operation of both divisions of equipment has been conservatively used for this scenario.	8.0E-4
U2 = 41b, b+	Description [Table 17-3] Transient @ column/wall - Div. 21, Div. 22, and LOOP Basis The CCDP for loss of both divisions with LOOP was conservatively used. This CCDP was calculated based on a LOOP initiator and local manual operation of the needed safe shutdown equipment.	8.0E-4	A transient fire in 3 locations within the Unit 2 AEER may cause damage to both divisions of control. This area covers 4% of the available floor area. These fires require manual start of the safe shutdown equipment from outside the control room at the switchgear. The value calculated for MCR evacuation, i.e., 1.2E-2 (see the response to question 4) has been used for these fire scenarios.	1.2E-2
			A transient fire in 4 locations within the Unit 2 AEER may cause damage to one division (21 or 22) and offsite power control circuits. This area covers 8% of the available floor area. These fires can be controlled from within the control room using the available division. The CCDP that was calculated based on local manual operation of both divisions of equipment has been conservatively used for this scenario.	8.0E-4
			A transient fire in the aisle separating panels 2PA13J, 2PA52J and 2PA29J may cause damage to both division and offsite power control circuits. This area covers 1% of the available floor area. These fires require manual start of the safe shutdown equipment from outside the control room at the switchgear. The value calculated for MCR evacuation with offsite power unavailable, i.e., 1.8E-2 (see the response to question 4) has been used for these fire scenarios.	1.8E-2
U1 = 40c U2 = 41c	Description [Table 17-3] Cabinet fire - Div. 11 (or 21), 12 (or 22) (PORVs) Basis The CCDP was calculated for a general transient, operation of the unaffected division equipment and manual local start of the affected division.	7.4E-4	Fire modeling identified that a fire in one of the PORV cabinets, 1PA04J or 1PA06J in Unit 1 (2PA04J or 2PA06J in Unit 2) has the potential to impact division 11 (division 21 in Unit 2) control circuits overhead. The same CCDP is used.	7.4E-4

Table 2-2 - Byron Auxiliary Electric Equipment Room (AEER) Fire Scenarios and the Conditional Core Damage Probabilities (CCDPs)

Fire Scenario (from Byron Fire IPEEE submittal (Ref. 3) and RAI response (Ref. 2)			**Fire Scenario (from Byron fire modeling report)**	**Revised CCDP (see scenario description in previous column)**
No.	**Description**	**CCDP**		
U1 = 40a, b	Description [Table 17-3] Cabinet fire - Div. 11 and LOOP - 1PA09J or 1PA23J. Basis The CCDP for loss of both divisions with LOOP was conservatively used. This was calculated based on a LOOP initiator and local manual operation to load both division pumps onto the emergency bus. The diesel generator was assumed to start automatically and load onto the bus.	1.1E-4	Two electrical cabinets (in each AEER), 1PA09J and 1PA23J, can impact one division (11) and potentially damage offsite power. The safe shutdown strategy, electrical and instrumentation configurations, and procedures which determine this CCDP at Byron and Braidwood are identical. Therefore, it would be expected that the CCDP values at the two plants should also be identical. Thus, the Byron CCDP is revised to 8.0E-04.	8.0E-4
U2 = 41a, b	Description [Table 17-3] Cabinet Fire - 2 trains - 2PA10J or 2PA32J. Basis The CCDP for loss of both divisions with LOOP was conservatively used for this scenario. This was calculated based on a LOOP initiator and local manual operation to load both division pumps onto the emergency bus. The diesel generator was assumed to start automatically and load onto the bus.	1.1E-4	A fire in division 22 panel 2PA10J could damage circuits in division 21 conduits C0A7319, C0A73R5 and C0A73R3. The most severe potential damage from this fire scenario is loss of control for division 22 components (in 2PA10J panel) and control to division 21 motor driven AFW pump (safety related feedwater control cable in C0A73R3). This would require manual start of AFW from the switchgear room. This scenario requires only one manual action at the switchgear, i.e., start of the AFW pump A. The CCDP calculated at 8E-4 is based on start of both of these pumps locally at the switchgear. A fire in division 22 panel 2PA32J could damage circuits in division 21 conduit C0A7319 overhead. The panel contains safety related division 22 annunciator circuits and the conduit contains 2 instrument power cables. None of the affected circuits cause loss of control for critical equipment but may impair annunciators and instruments.	8.0E-4
U1 = 40c U2 = 41c	Description [Table 17-3] Transient - 2 trains Basis The CCDP for loss of both divisions with LOOP was conservatively used. This was calculated based on a LOOP initiator and local manual operation to load both division pumps onto the emergency bus. The diesel generator was assumed to start automatically and load onto the bus.	1.1E-4	A transient fire in front of or to the side of the division 12 cabinet 1PA52J, potentially damaging division 11 cabinets 1IP03J, 1PA27J and 1PA24J, OR, a transient fire in front division 11 cabinet 1PA31J, potentially damaging division 12 cabinets 1MS018B and C. The total area ratio is 7% of the AEER available floor space. A transient fire in the aisle in front of division 21 panels (2PA13J, 2PA15J, 2PA24J, 2PA27J, 2MS018JA, 2MS018JD) and division 22 panels (2PA52J, 2MS018JC, 2MS018JB, 2IP04J) potentially damaging both division circuits.	1.2E-2

Table 2-2 - Byron AEER Fire Scenarios and the CCDPs (cont'd)

U1 = 40d U2 = 41d	Description [Table 17-3] Transient - Div. 11 (or 21) and LOOP Basis The CCDP for loss of both divisions with LOOP was conservatively used. This was calculated based on a LOOP initiator and local manual operation to load both division pumps onto the emergency bus. The diesel generator was assumed to start automatically and load onto the bus.	1.1E-4	A transient fire in back of offsite power cabinets 1PA23J and 1PA29J, potentially damaging division 11 cabinets 1MS018JB and C, OR, a transient fire in front of offsite power cabinets 1PA23J and 1PA29J potentially damaging division 11 cabinets 1PA09J, 1PA11J, 1PA13J and 1PA33J. The total area ratio is 12% of the AEER available floor space. A transient fire in the aisle between division 21 panels (2PA09J, 2PA11J, and 2PA33J) and offsite power panels (2PA23J, 2PA29J) potentially damaging division 21 and offsite power circuits. These fires can be controlled from within the control room using the available division. The CCDP that was calculated based on local manual operation of both divisions of equipment has been conservatively used for this scenario.	8.0E-4
U2 = 41e	Description [Table 17-3] Transient - 2 trains and LOOP Basis The CCDP for loss of both divisions with LOOP was conservatively used. This was calculated based on a LOOP initiator and local manual operation to load both division pumps onto the emergency bus. Diesel generator was assumed to start automatically and load onto the bus.	1.1E-4	A transient fire in the aisle in front of division 21 cabinets 2PA09J, 2PA11J and 2PA13J, division 22 cabinet 2PA52J and offsite power cabinet 2PA29J, potentially damaging control circuits for both divisions and offsite power. These fires require manual start of the safe shutdown equipment from outside the control room at the switchgear. The value calculated for MCR evacuation with offsite power unavailable, i.e., 1.8E-2 (see response to question 4) has been used for these fire scenarios.	1.8E-2
U1 = 40f U2 = 41f	These fire scenarios were not included in the IPEEE submittal they were identified in a walkdown of the Byron AEER.	N/A	A fire in one of the PORV cabinets (unit 1 1PA04J or 1PA06J and unit 2 panels 2PA04J or 2PA06J) with potential impact on division 11 control circuits. The circuits in the panels were confirmed to be the same in both plants. Both plants have division 11 circuits routed overhead. Therefore the CCDP calculated for the similar scenario in Braidwood where control of all safety related division 11 equipment is lost (fire scenario 40 and 41c) has been used for Byron.	7.4E-4

SRAI 3 - CDF Contribution for the AEER:

"The quantification of fire-induced CDF resulted in significant differences in the CDF contributions for the AEERs at Byron and Braidwood both in terms of the absolute value of the CDF and in the relative importance of the AEER to plant fire risk.

> **Please consider the responses to SRAIs 1 and 2, and reassess the CDF contribution of the AEER at both Byron and Braidwood. Compare the results for the two plants and provide a basis for any remaining differences."**

<u>Response to SRAI 3</u>

Tables 3-1 and 3-2 provide details from the re-analysis of the Braidwood Station and the Byron Station AEERs, respectively. The revised values for ignition frequencies (i.e., in SRAI 1) and for CCDPs (i.e., in SRAI 2) have been used in these fire scenarios.

For fire scenarios in the AEER where control circuits for offsite power, or division 1, or division 2, or offsite power plus one division are affected by the fire, the reactor can be shutdown from the MCR without the need for evacuation (i.e., in the response to SRAI 5 for habitability). The IPEEE analysis of these scenarios used the CCDPs that were previously calculated (i.e., 8.0E-04 for Braidwood Station and 1.1E-04 for Byron Station). The revised analysis presented here uses a CCDP of 8.0E-04 for both plants as discussed in the response to SRAI 2.

In fire scenarios where control circuits for both divisions of safe-shutdown equipment are affected by the fire, shutdown from outside the MCR may be required. For these fire scenarios revised CCDPs developed for MCR evacuation (i.e., in the response to SRAI 4), i.e., 0.012 with offsite power available and 0.018 with offsite power unavailable, have been used.

A summary of the re-analysis for the Byron and Braidwood Stations' AEER is provided below. The re-analysis shows that 80-90% of the CDF in the AEERs in either plant is the result of fires that do not require ex-MCR shutdown. This is in large part due to the following factors.

- Most panels in the AEER are unvented and have low voltage, and nearly all overhead cables that traverse the room run through conduits. This limits fires propagating out of cabinets and via exposed cables, contributing to the low likelihood of electrical cabinet fires involving two divisions.
- Only one panel in the Braidwood Station Unit 1 AEER (i.e., 1PA52J) and two panels in the Byron Unit 2 AEER (i.e., 2PA10J and 2PA32J) were identified that are vented with opposite division conduits running overhead causing a potential for ex-MCR fire scenarios. Closer analysis of the circuits in the conduits reveals that only one of the three has the potential to damage control circuits for auto-start of the opposite division AF pump.
- Nearly all fire scenarios requiring ex-MCR shutdown are the result of potential transient fires in the aisles between panels of opposite divisions (i.e., these panels are far enough apart to preclude radiant heat damage if a fire occurs inside a panel). Fire modeling identified locations within the AEER where this potential exists. Details are provided in Table 3-1 and Table 3-2.

	CDF/yr	%	CDF/yr	%
	Unit 1		**Unit 2**	
Braidwood				
AEER	8.2E-7 (7.0E-7)		7.8E-7 (7.0E07)	
In-MCR AEER fire scenarios	7.0E-7	85%	7.0E-7	89%
Ex-MCR AEER fire scenarios	1.2E-7	15%	8.3E-8	11%
Byron				
AEER	8.0E-7 (1.1E-8)		8.0E-7 (4.9E-9)	
In-MCR AEER fire scenarios	6.9E-7	86%	6.7E-7	84%
Ex-MCR AEER fire scenarios	1.1E-7	14%	1.3E-7	16%

Note: Values in the parentheses are the original CDF for the AEER as reported in the fire IPEEE submittal and response to RAI question 17.

As seen above, the fire-induced CDF in the AEERs changes significantly for Byron Station but little or not at all for Braidwood Station. Several factors contribute to the increase at Byron Station. First, we added a fire scenario to the Byron Station analysis where damage is limited to a single critical panel (i.e., in-MCR scenarios). These fires were considered insignificant to risk at Byron Station previously but were included in the Braidwood Station evaluation. This contributes 60% of the revised CDF in the AEER at Byron Station. Note that no examination of the actual circuits lost to the fire was done for either the Byron Station or the Braidwood Station, conservatively assuming complete loss of control for all equipment in one division or complete loss of offsite power where a panel with offsite power circuits was involved. The remaining increase is due to higher CCDPs used for AEER fire scenarios requiring shutdown from outside the MCR (i.e., in the response to SRAI 2).

Even with higher CCDPs, scenarios for fires requiring shutdown from outside the MCR contribute only 11-16% of the total AEER fire-induced risk. A number of factors, including good separation of redundant trains, enclosed (i.e., unvented) panels, and routing of cables in conduits, contribute to limiting the frequency of scenarios where damage to more than one division of controls for safe shutdown equipment can occur.

Table 3-1 - Re-analysis of Braidwood Auxiliary Electric Equipment Room (AEER) Fire Scenarios

Comp	Fire Zone	Zone Description	Scenario	Scenario Description	Source Type	FF	SF	MS	NSP(as)	NSP(fb)	ARatio	CCDP 1	CCDP 2	CDF 1	CDF 2
40	5.5-1	Unit 1 AEER	40a	A fire in a single electrical cabinet that does not extend beyond the initial panel. Potential loss of division 11, 12, OR offsite power control circuits. Shutdown from the MCR with control of available division(s).	Electrical Cabinet	3.25E-03	0.2		1	1		8.0E-04		5.20E-07	
				A fire in division 12 electrical cabinet 1PA52J panel can cause damage to overhead division 11 junction box 1JB881A-1C and associated conduits. Panel 1PA52J is a Safety Related Panel, which has Division 12 circuits for the Reactor Vessel Level Indicating System (RVLIS) and Core Exit Thermocouples (CETs). A fire in Panel 1PA52J could not affect division 12 SSPS actuation and reset circuitry. Therefore, the Div. 12 ESF Safe Shutdown Equipment would be available for auto-starting or manual starting from the MCR.	Electrical Cabinet	3.20E-05	0.2		1	1		8.0E-04		5.12E-09	
				A fire in offsite power cabinet 1PA23J can cause damage to division 11 conduits C0A71P9-1C and C0A81X9-1C.	Electrical Cabinet	4.81E-04	0.2		1	1		8.0E-04		7.70E-08	
			40b	A transient fire (caused by welding) in front or to the side of division 12 cabinet 1PA52J, potentially damaging division 11 cabinets 1IP03J, 1PA27J, 1PA24J and 1PA15J; or a transient fire in front of division 11 cabinet 1PA51J potentially damaging division 12 cabinets 1MS018B and C. Potential damage to control circuits of both divisions. This area covers 8% of Unit 1 AEER floor area.	Transient, welding	4.40E-04		0.12	1	1	0.08	1.2E-02		5.07E-08	
				A transient fire (caused by welding) in front of offsite power cabinets 1PA23J and 1PA29J could damage division 11 cabinets 1PA09J, 1PA11J and 1PA33J. This area covers 9% of the available floor space in the Unit 1 AEER.	Transient, welding	4.40E-04		0.12	1	1	0.09	8.0E-04		3.80E-09	
			40b+	A transient fire in front or to the side of division 12 cabinet 1PA52J, potentially damaging division 11 cabinets 1IP03J, 1PA27J, 1PA24J and 1PA15J; or a transient fire in front of division 11 cabinet 1PA51J, potentially damaging division 12 cabinets 1MS018B and C. Potential damage to control circuits of both divisions . This area covers 8% of the available floor space in the Unit 1 AEER.	Transient	1.10E-04		0.65	1	1	0.08	1.2E-02		6.86E-08	
				A transient fire (caused by welding) in front of offsite power cabinets 1PA23J and 1PA29J could damage division 11 cabinets 1PA09J, 1PA11J and 1PA33J. This area covers 9% of the available floor space in the Unit 1 AEER.	Transient	1.10E-04		0.65	1	1	0.09	8.0E-04		5.15E-09	
			40c	A fire in one of the PORV cabinets (1PA04J or 1PA06J) with potential impact on division 11 control circuits.	Electrical Cabinet	5.90E-04	0.2		1	1		7.4E-04		8.73E-08	
											In-MCR Scenarios			7.0E-07	85%
											Ex-MCR Scenarios			1.2E-07	15%
											Total Unit 1 AEER CDF			8.2E-07	

Table 3-1 - Re-analysis of Braidwood AEER Fire Scenarios (cont'd)

Comp	Fire Zone	Zone Description	Scenario	Scenario Description	Source Type	FF	SF	MS	NSP(as)	NSP(fb)	ARatio	CCDP 1	CCDP 2	CDF 1	CDF 2
41	5.5-2	Unit 2 AEER	41a	A fire in a single electrical cabinet that does not extend beyond the initial panel. Potential loss of division 21, 22, OR offsite power control circuits. Shutdown from the MCR with control of available division(s).	Electrical Cabinet	3.76E-03	0.2		1	1			8.0E-04		6.02E-07
			41b	A transient fire (caused by welding) in 3 locations within the Unit 2 AEER may cause damage to both division of control.	Transient, welding	4.40E-04		0.12	1	1	0.04		1.2E-02		2.47E-08
				A transient fire (caused by welding) in 4 locations within the Unit 2 AEER may cause damage to one division and offsite power control circuits.	Transient, welding	4.40E-04		0.12	1	1	0.08		8.0E-04		3.29E-09
				A transient fire (caused by welding) in the aisle separating 2PA13J, 2PA52J and 2PA29J may cause damage to both divisions and offsite power control circuits.	Transient, welding	4.40E-04		0.12	1	1	0.01		1.8E-02		1.06E-08
			41b+	A transient fire in 3 locations within the Unit 2 AEER may cause damage to both divisions of control. This area covers 7% of the floor area.	Transient	1.10E-04		0.65	1	1	0.04		1.2E-02		3.34E-08
				A transient fire in 4 locations within unit 2 AEER may cause damage to one division and offsite power control circuits	Transient	1.10E-04		0.65	1	1	0.08		8.0E-04		4.46E-09
				A transient fire in the aisle separating 2PA13J, 2PA52J and 2PA29J may cause damage to both divisions and offsite power control circuits	Transient	1.10E-04		0.65	1	1	0.01		1.8E-02		1.43E-08
			41c	A fire in one of the PORV cabinets (2PA04J or 2PA06J) with potential impact on division 21 control circuits.	Electrical Cabinet	5.90E-04	0.2		1	1			7.4E-04		8.73E-08

In-MCR Scenarios	89%	7.0E-07
Ex-MCR Scenarios	11%	8.3E-08
Total Unit 2 AEER CDF		7.8E-07

FF - Ignition Frequency for Fire Scenario
SF - Severity Factor for Specific Fixed Ignition Source
MS - Manual Suppression Failure Probability
NSP(as) - Non-Suppression Probability for Automatic Sprinklers
NSP(fb) - Non-Suppression Probability for Manual Fire Brigade Suppression
ARatio - Area Ratio

Table 3-2 - Re-analysis of Byron Auxiliary Electric Equipment Room (AEER) Fire Scenarios

Comp	Fire Zone	Zone Description	Scenario	Scenario Description	Source Type	FF	SF	MS	NSP(as)	NSP(fb)	ARatio	CCDP 1	CCDP 2	CDF 1	CDF 2
40	5.5-1	Unit 1 AEER	40* (Note 1)	A fire in a single electrical cabinet that does not extend beyond the initial panel. Potential loss of division 11, 12, OR offsite power control circuits. Shutdown from the MCR with control of available division(s).	Electrical Cabinet	3.01E-03	0.2 (Note 3)		1	1		8.0E-04		4.82E-07	
			40a	Cabinet fire damaging division 11 and offsite power - Fire in panel 1PA09J	Electrical Cabinet	1.92E-04	0.2		1	1		8.0E-04		3.07E-08	
			40b	Cabinet fire damaging division 11 and offsite power - Fire in panel 1PA23J.	Electrical Cabinet	4.83E-04	0.2		1	1		8.0E-04		7.73E-08	
			40c	Transient fire damaging both divisions - A transient fire in front of or to the side of the division 12 cabinet 1PA52J, potentially damaging division 11 cabinets 1IP03J, 1PA27J and 1PA24J; OR a transient fire in front of division 11 cabinet 1PA31J, potentially damaging division 12 cabinets 1MS018B and C. Total area ratio is 7% of the AEER available floor space.	Transient	4.79E-04		0.28	1	1	0.07	1.2E-02		1.13E-07	
			40d	Transient fire damaging division 11 and offsite power - A transient fire in back of offsite power cabinets 1PA23J and 1PA29J, potentially damaging division 11 cabinets 1MS018JB and C; OR a transient fire in front of offsite power cabinets 1PA23J and 1PA29J, potentially damaging division 11 cabinets 1PA09J, 1PA11J, 1PA13J and 1PA33J. Total area ratio is 12% of the AEER available floor space.	Transient	4.79E-04		0.28	1	1	0.12	8.0E-04		1.29E-08	
			40f (Note 2)	A fire in one of the PORV cabinets (1PA04J or 1PA06J) with potential impact on division 11 control circuits	Electrical Cabinet	5.90E-04	0.2		1	1		7.4E-04		8.73E-08	
											In-MCR Scenarios			6.9E-07	86%
											Ex-MCR Scenarios			1.1E-07	14%
											Total Unit 1 AEER CDF			8.0E-07	

Notes:

1. The fire scenario 40* is the new scenario added to the Byron Station AEER analysis (consistent with Braidwood Station). This represents fires limited to one panel with potential damage to division 11 (or 21), OR, division 12 (or 22), OR offsite power control circuits.
2. This fire scenario was identified during the re-analysis as the result of the Byron Station walkdown.
3. The electrical cabinet fire severity factor for AEER panels for Byron Station has been revised to reflect the fire severity factor for MCR electrical cabinets, in accordance with the EPRI Fire PRA Guide. This is consistent with the analysis of the Braidwood Station AEERs.

Table 3-2 - Re-analysis of Byron AEER Fire Scenarios (cont'd)

Comp	Fire Zone	Zone Description	Scenario	Scenario Description	Source Type	FF	SF	MS	NSP(as)	NSP(fb)	ARatio	CCDP 1	CCDP 2	CDF 1	CDF 2
41	5.5-2	Unit 2 AEER	41* (Note 1)	A fire in a single electrical cabinet that does not extend beyond the initial panel. Potential loss of division 21, 22, OR offsite power control circuits. Shutdown from the MCR with control of available division(s).	Electrical Cabinet	3.36E-03	0.2		1	1			8.0E-04		5.38E-07
			41a	A fire in division 22 panel 2PA10J could damage circuits in division 21 conduits C0A7319, C0A73R5 and C0A73R3. The most severe potential damage from this fire scenario is loss of control for division 22 components (in 2PA10J panel) and control to division 21 motor driven AFW pump (safety related feedwater control cable in C0A73R3). This would require manual start of AFW from the switchgear room. This scenario requires only one manual action at the switchgear, i.e., start of the AFW pump A. The CCDP calculated at 8E-4 is based on start of both of these pumps locally at the switchgear	Electrical Cabinet	1.92E-04	0.2		1	1			8.0E-04		3.07E-08
			41b	A fire in division 22 panel 2PA32J could damage circuits in division 21 conduit C0A7319 overhead. The panel contains safety related division 22 annunciator circuits and the conduit contains 2 instrument power cables. None of the affected circuits cause loss of control for critical equipment but may impair annunciators and instruments.	Electrical Cabinet	5.65E-05	0.2		1	1			8.0E-04		9.04E-09
			41c	A transient fire in the aisle in front of division 21 panels (2PA13J, 2PA15J, 2PA24J, 2PA27J, 2MS018JA, 2MS018JD) and division 22 panels (2PA52J, 2MS018JC, 2MS018JB, 2IP04J) potentially damaging both division circuits.	Transient	4.79E-04		0.28	1	1	0.05		1.2E-02		8.05E-08
			41d	A transient fire in the aisle between division 21 panels (2PA09J, 2PA11J, and 2PA33J) and offsite power panels (2PA23J, 2PA29J) potentially damaging division 21 and offsite power circuits.	Transient	4.79E-04		0.28	1	1	0.05		8.0E-04		5.36E-09
			41e	A transient fire damaging both divisions and offsite power - A transient fire in the aisle in front of division 21 cabinets 2PA09J, 2PA11J and 2PA13J, division 22 cabinet 2PA52J and offsite power cabinet 2PA29J, potentially damaging control circuits for both divisions and offsite power.	Transient	4.79E-04		0.28	1	1	0.02		1.8E-02		4.83E-08
			41f (Note 2)	A fire in one of the PORV cabinets (2PA04J or 2PA06J) with potential impact on division 21 control circuits.	Electrical Cabinet	5.90E-04	0.2		1	1			7.4E-04		8.73E-08

In-MCR Scenarios	84%	6.7E-07
Ex-MCR Scenarios	16%	1.3E-07
Total Unit 2 AEER CDF		8.0E-07

SRAI 4 - Remote Shutdown and MCR Abandonment Scenarios

"The remote shutdown process for both Byron and Braidwood is described as involving coordination of a number of proceduralized actions taken from the control room and possibly from multiple remote locations. Throughout the IPEEE fire study the numerical values for remote shutdown CCDPs (i.e., the conditional probability of failure to control the plant during remote shutdown operations) appear to be optimistic for such a distributed shutdown effort requiring actions in multiple plant locations. The values also appear optimistic in comparison to analysis results for other plants, even including plants with localized remote shutdown capabilities that do not require significant actions in other than a single location. It is also not clear which control room abandonment scenarios have been included in the final CDF quantification. For example, the previous RAI responses state that MCR abandonment may occur due to fires in the AEER, but it is not apparent that any such scenarios have been quantified. Hence, it is not possible to determine how important the assumed reliability of remote shutdown was to the quantification of fire CDF at either plant.

> **Please describe in greater detail the actions required to achieve safe shutdown given abandonment of the MCR (e.g., what functions, controls and indications are available to support remote shutdown operations, what specific actions must be taken, where does each action take place, what is the time frame available to complete the actions, what are the consequences of failure to complete each action in a timely manner, how are actions coordinated, and what training is provided to the operators with regard to remote shutdown actions). Describe the human reliability analysis (HRA) analysis that was performed to assess the reliability of these actions. Justify the assumed remote shutdown reliability estimate (0.003 failure probability) or provide a revised estimate of remote shutdown reliability. Identify all of the fire scenarios that might lead to MCR abandonment and a reliance on remote shutdown. Describe how each such scenario was quantified (or screened) and quantify the total contribution of such scenarios to plant fire CDF. Evaluate the change in the fire CDF if the remote shutdown failure probability is arbitrarily increased by one order of magnitude."**

Response to SRAI 4

The question raises three issues.

1) Localized remote shutdown versus those requiring actions in multiple locations,
2) Basis for the value used for the P_{RSP}, and
3) Discussion of scenarios that lead to MCR abandonment.

This response addresses these three issues.

Part 1 – Remote (i.e., Outside MCR) Shutdown Strategy at the Byron Station and at the Braidwood Station

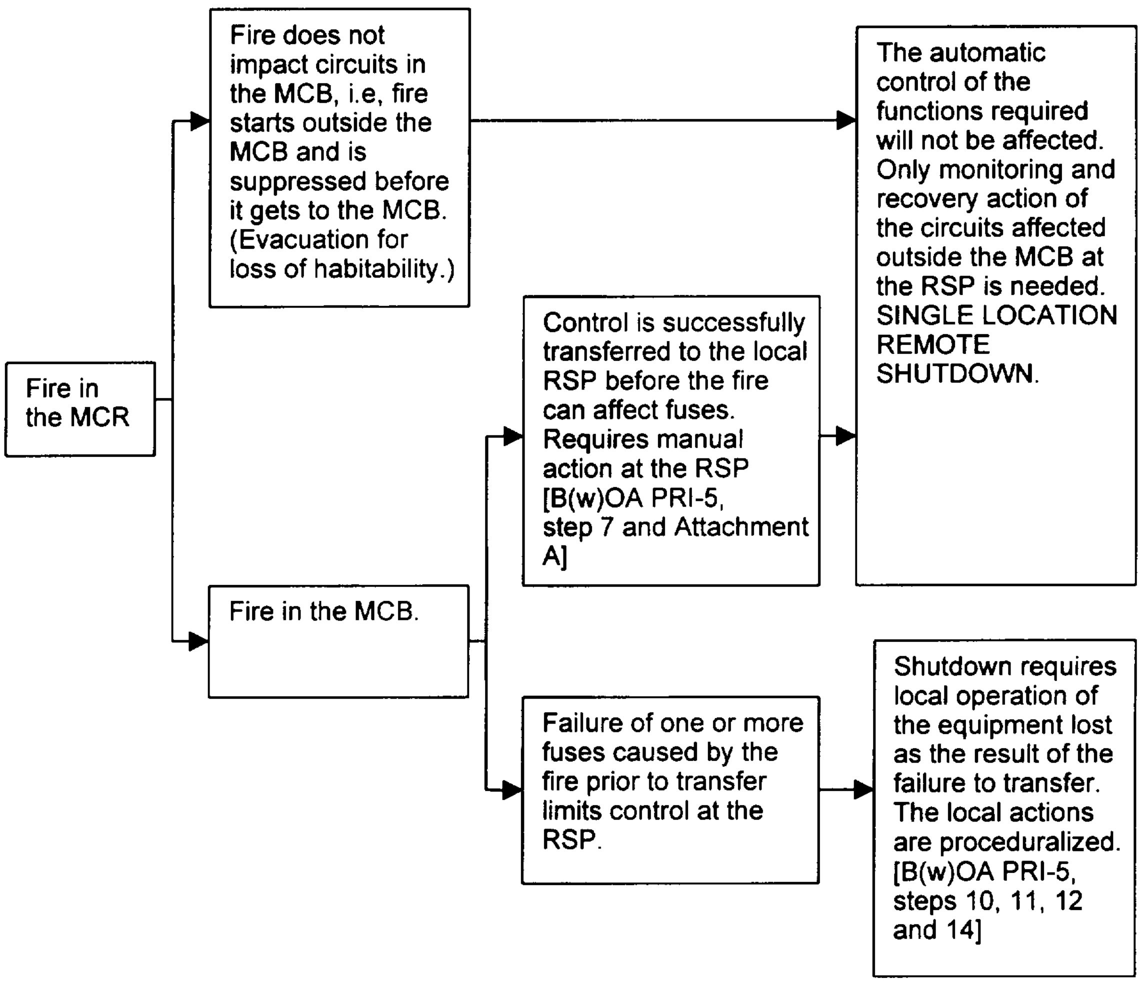
As stated in the response to RAI question 4 in the Reference 1 letter, control capability is available at a number of locations following a fire that requires MCR abandonment and plant shutdown from outside the MCR. However, use of all of these remote panels is not needed for every fire that requires ex-MCR shutdown.

The Byron and Braidwood Stations' fire IPEEE assumes that Hot Standby (i.e., Mode 3) conditions need to be maintained following a MCR evacuation (Ref. 3, pages 4-75 and Ref. 4, pages 4-67 respectively). Hot Standby represents $K_{eff} < 0.99$ and $T_{avg} \geq 350\ ^{o}F$ per the Byron and Braidwood Stations' Technical Specifications. The Remote Shutdown Panels (RSPs) 1/2PL04J, 1/2PL05J and 1/2PL06J at the Byron Station and the Braidwood Station provide control functions needed to achieve Hot Standby after a successful transfer to local control at the RSPs. A fire in the Main Control Board (MCB), however, may result in control circuit fuses blowing prior to the transfer switches being aligned for local control at the RSP, resulting in failure to transfer the control functions to the RSP.

Therefore, remote shutdown for the Byron Station and the Braidwood Station can be performed at the RSP except for a fire that spreads through the MCB causing failure of transfer. This scenario was included in the response to question 2 in the Reference 2 letter.

With successful transfer of control functions, Hot Standby condition can be maintained automatically by their respective control systems, and operator actions (i.e., intervention) are only needed if the automatic control system(s) are not functioning properly. For modeling P_{RSP}, the Byron and Braidwood Stations' fire IPEEE conservatively assumes that the automatic control systems are not functioning properly and operator intervention is needed per the Abnormal Operating Procedure BwOA/BOA PRI-5, "Control Room Inaccessibility," Response Not Obtained (RNO) in half the situations (i.e., the 0.5 multiplier in the equation for P_{RSP}) requiring entry into PRI-5. Note that for consistency, the response to this SRAI refers to the revisions of B(w)OA PRI-5 that were current at the time that the Byron Station IPEEE Submittal Report and the Braidwood Station IPEEE Submittal Report were submitted to the NRC.

The following represents a pictorial summary.



Byron Station Abnormal Operating procedure BOA PRI-5 provides the following instructions to maintain the plant in Hot Standby mode. Braidwood Station Abnormal Operating procedure BwOA PRI-5 provides similar instructions.

- Step 10: Maintain Tave between 550°F - 561°F
- Step 11: Maintain pressurizer level between 28% - 33%
- Step 12: Maintain pressurizer pressure between 2210 - 2260 psig
- Step 14: Maintain Steam Generator (SG) wide range level between 65% - 78%.

These parameters are maintained automatically by their respective control systems. The operator actions (i.e., intervention) are only needed if the automatic control system(s) are not functioning properly.

The following is a list of actions that are required to perform the above steps.

Step 10. CHECK RCS AVERAGE TEMPERATURE

a) Determine Tave
b) Maintain RCS Tave below 561°F. Perform the following to decrease Tave to 557°F
   i) Manually open SG PORV(s), or
   ii) Locally open SG PORV(s) per BOP MS-6
c) Maintain RCS Tave above 550F, isolate all MSIVs. If RCS Tave is less than 525°F, then borate 35 gal for each°F below 525°F
   i) Start the Boric acid transfer pump
   ii) Open emergency boration valve 1CV8104

Step 11. CHECK PRESSURIZER LEVEL

a) Maintain pressurizer level greater than 17%, If pressurizer level is less than 17%, perform the following:
   i) Verify letdown isolation valves closed
   ii) Verify group A and B pressurizer heaters are off
   iii) Increase charging flow to restore pressurizer level to greater than 17%
b) Verify charging and letdown
c) Verify pressurizer level trending to 28%. If pressurizer level is not trending to 28%, manually control the flow control valve or flow control bypass valve to adjust pressurizer level

Step 12. CHECK PRESSURIZER PRESSURE

a) Pressurizer pressure > 2210 psig. If a controlled depressurization was previously in progress, then maintain pressurizer pressure stable and Go to Step 13. If not, then verify pressurizer backup heaters are on. If backup heaters can not be energized and pressurizer level is greater than 17%, then
   i) locally energize heaters, or
   ii) locally close PORV block valves, or
   iii) trip ALL RCPs supplying spray flow
b) Pressurizer pressure < 2260 psig. Perform the following
   i) Verify the pressurizer backup heaters are off
   ii) Control pressure using the pressurizer aux. spray valve 1CV8145
c) Pressurizer pressure stable at or trending to 2235 psig. Manually control pressurizer pressure TO 2235 psig with pressurizer heaters and the pressurizer aux spray valve

Step 14. CHECK STEAM GENERATOR LEVELS

a) Manually start one AF pump
b) Manually control AF flow to maintain all SG wide range levels - Between 65% AND 78%

The Reference 2 letter describes the steps that are taken prior to MCR evacuation.

The response to question 4 in the Reference 1 letter provides a description of the remote shutdown capability to bring the reactor from Hot Standby to Cold Shutdown (i.e., Mode 5). These steps were not modeled in the P_{RSP}.

Part 2 – Basis for the P_{RSP} (CCDP for MCR Abandonment Scenarios)

The development and application of the remote shutdown estimate P_{RSP} was detailed in fire IPEEE Section 4.6.4.2.5.2 for the Byron Station and in fire IPEEE Section 4.7.4.2.5.2 for the Braidwood Station.

P_{RSP} was defined as the probability of failure to maintain the plant in stable Hot Standby conditions from the RSP following MCR evacuation.

P_{RSP} applied to cases of MCR evacuation necessitated by a loss of habitability or smoke obscuring the panels, not to cases of postulated fire damage to safe shutdown equipment. No critical MCR safe shutdown equipment on the MCB "horseshoe" was considered damaged since these panels are directly exhausted to the MCR ventilation system and would not contribute to evacuation.

The MCB panels were evaluated separately in the IPEEE and discussed in Section 4.6.4.2.5.1 for the Byron Station and in Section 4.7.4.2.5.1 for the Braidwood Station, "Probability of Safe Shutdown from the MCR," and in Section 4.6.4.2.6.2 for the Byron Station and in Section 4.7.4.2.6.2 for the Braidwood Station, "Fire Resulting in a Loss of Critical Cabinet." P_{RSP} was not a factor in these analyses. Therefore, evacuation was not initially considered for the following panels for Unit 1.

1PM06J(A1) - MCB ESF Panel, left side
1PM06J(A2) - MCB ESF Panel, right side
1PM05J(B1) - MCB Reactor Control Panel, left side
1PM05J(B2) - MCB Reactor Control Panel, right side
1PM04J - MCB Feedwater Control Panel

IPEEE Section 4.6.4.2.5.2 for the Byron Station and IPEEE Section 4.7.4.2.5.2 for Braidwood Station discussed the procedures used for MCR evacuation, provided a brief description of a RSP as it applied to the modeling of P_{RSP}, and discussed the detailed development of the Human Reliability Analysis (HRA) modeling.

In modeling P_{RSP}:

- Procedure 0B(w)OA PRI-5 includes action for realigning the MCR ventilation system to place the Recirculation Charcoal Absorber in operation, purging the MCR with 100% outside air, and donning Self-Contained Breathing Apparatus (SCBA). These actions extend the time before the MCR must be evacuated considerably past the 15 minutes assumed in the analysis, but were not credited.

- The pre-planned smoke removal plan for the MCR also extends the time for evacuation, but was not credited.

- 0B(w)OA PRI-5 also provided that control at the RSP need only be taken for those functions that are lost in the MCR. This feature was included in the modeling.

- The initial steps in procedure 1/2B(w)OA PRI-5 are completed before the MCR is evacuated and the RSP manned. For P_{RSP} the reactor was already shut down and these steps were not modeled.

- P_{RSP} only modeled the essential RSP actions in 1/2B(w)OA PRI-5 to maintain hot standby.
    - Step 10: Maintain T_{AVG} between 550°F - 561°F
    - Step 11: Maintain pressurizer level between 28% - 33%
    - Step 12: Maintain pressurizer pressure between 2210 - 2260 psig

- Step 14: Maintain SG wide range level between 65% - 78%.

These parameters are maintained automatically by their respective control systems. The RSP operator actions (i.e., interventions) are only needed if the automatic control system(s) are not functioning properly. For conservative modeling, intervention was modeled for half the cases (i.e., the 0.5 multiplier in the equation for P_{RSP}).

- Procedure PRI-5 includes instructions for returning these parameters to the desired band if they stray either high or low. Only one instruction for high or low is necessary. P_{RSP} conservatively modeled both instructions.

- The value of P_{RSP} included a diagnostic or cognitive component (P_c) and an execution component (P_e):

$$P_{RSP} = P_c + P_e$$

Pc was determined from the THERP[4] Annunciator Response Model, Table 20-23. Stress is included in the T20-23 values.

Pe included errors of omission (i.e., skipping a step in the procedure) and errors of commission (i.e., selecting the wrong control switch or turning it in the wrong direction if correctly selected). The Human Error Probability (HEP) values were also taken from the tables in Chapter 20 of THERP.

- A stress multiplier of "5" was applied to Pe to account for the presumed high level of stress caused by the fire, the MCR evacuation, and the infrequent use of PRI-5. This is conservative, and in keeping with HRA techniques.

- Potential recovery mechanisms such as verification or revisitation of procedural steps, or alternate steps accomplishing the same action, were considered if they were included in the procedure and would be read in accordance with the procedure format. B(w)OA PRI-5 Step 17 is such a verification step and was modeled in P_{RSP} as $P(r_1)$:

17.b. Maintain RCS T_{AVG}
17.c. Maintain pressurizer pressure
17.d. Maintain pressurizer level
17.e. Maintain SG wide range levels

- Each Unit 1 and Unit 2 RSP is manned by a Unit Supervisor and the Unit Nuclear Station Operator (NSO). The Supervisor's function as procedure reader served as a recovery for verification of the NSOs actions and an "extra crew" recovery (i.e., $P(r_2)$) was included in the determination of P_{RSP}.

- Finally, the HRA methodology used in the Byron and Braidwood Stations' fire IPEEEs is the same methodology that was used in the Byron and Braidwood Stations' Internal Events IPEs.

[4] Handbook of Human Reliability Analysis with Emphasis on Nuclear Power Plant Applications, Final Report, NUREG/CR-1278, August 1983 (with September 1, 1985 Addendum #1 from Dr. Swain's Process Safety Institute HRA Course).

The MCR Center Desk NSO and the "Extra" on-shift MCR NSO are also assigned to the RSPs in procedure PRI-5. Their presence and assistance were not credited in determining P_{RSP}.

MCR evacuation is an "Alert" declaration in the station's Emergency Plans requiring manning of the Technical Support Center (TSC). Assistance from the TSC was also not credited.

Part 3 – Fire Scenarios Requiring Shutdown Outside the MCR

Fire in the MCR

IPEEE Section 4.6.4.2.6.1 for the Byron Station and IPEEE Section 4.7.4.2.6.1 for the Braidwood Station provided the results for two fire scenarios in the MCR that may require MCR Evacuation.

- Fire in one of 14 back panels not ventilated by the MCR HVAC system. [P_{RSP} = 0.002]
- Fire in one of three panels (i.e., 1PM01J, 2PM01J, or 0PM03J) whose failure could lead to loss of offsite power, potentially compromising operation of the MCR HVAC system. [P_{RSP} = 0.002 + 0.006 = 0.008 to account for locally restoring the diesel generators (HEP = 0.006).]

The following MCR evacuation scenarios were reported in the Byron Station (Table 4.6.4-5) and Braidwood Station (Section 4.7.4.2.6.1) Fire IPEEE submittals.

Scenario	**FF_{CRE}**	**NSP**	**P_{RSP}**	**CDF_{CRE}/yr**
Offsite Power (OSP) failed	6.86E-05	3.40E-03	0.008	1.87E-09
OSP available	3.20E-04	3.40E-03	0.002	2.18E-09
Total CDF for fires leading to CR evacuation				4.05E-09

These scenarios were significantly revised in response to questions 1, 2, and 4 in the previous RAIs (Refs. 1 and 2). As the result of these changes, the P_{RSP} had been revised to 0.012 and 0.018 for offsite power available and unavailable respectively. The following is a summary.

In Response to RAI Fire Question 1 (Ref. 2)

As noted above, the initial steps in procedure 1/2B(w)OA PRI-5 are completed before the MCR is evacuated and the RSP manned. For P_{RSP} the reactor was already shut down and these steps were not modeled.

In RAI Fire Question 1, the reviewers requested a re-assessment if it is assumed that the pre-evacuation actions could not be completed and had to be performed from outside the MCR.

The impact of the pre-evacuation actions on the CDF was assessed by assuming that the pre-evacuation actions are as likely as the post-evacuation actions. The MCR evacuation scenarios were re-evaluated by adding 0.008 to P_{RSP} to account for the additional probability of human error attributed to performing the pre-evacuation actions. $P_{RSP(REV\ 1)}$ becomes 0.002 + 0.008 = 0.010 for the case with OSP available and 0.008 + 0.008 = 0.016 for the case of OSP failed.

Below is the revised CDF_{CRE}'s (i.e., Core Damage Frequencies - Control Room Evacuation) for the Byron Station and the Braidwood Station with pre-evacuation actions.

Scenario	FF_{CRE}	NSP	$P_{RSP(REV\ 1)}$	CDF_{CRE}/yr
OSP failed	6.86E-05	3.40E-03	0.016	3.74E-09
OSP available	3.20E-04	3.40E-03	0.010	1.09E-08
Total CDF for fires leading to CR evacuation				1.46E-08

<u>In Response to RAI Fire Questions 2b,2d, 2e (Ref. 2)</u>

The response to RAI Fire Questions 2b, 2d, and 2e addressed the reviewer's request to reassess the MCR CDF contribution considering more extensive fire spread within the MCB. An additional evacuation scenario was developed in response to the reviewer request.

- Fires arising in one of the eight panels in each unit's horseshoe panel areas (i.e., 1PM01J, 1PM02J, 1PM03J, 1PM04J, 1PM05J(B2), 1PM05J(B1), 1PM06J(A2), and 1PM06J(A1) in the Unit 1 horseshoe or 2PM01J, 2PM02J, 2PM03J, 2PM04J, 2PM05J(B2), 2PM05J(B1), 2PM06J(A2), and 2PM06J(A1) in the Unit 2 horseshoe) whose failure could lead to a loss of offsite power.

Below are the results of the additional scenario coupled with including pre-evacuation actions in the value for P_{RSP} for the Byron Station and the Braidwood Station.

Scenario	FF_{CRE}	NSP	$P_{RSP(REV\ 1)}$	CDF_{CRE}/yr
Non-vent OSP available	3.20E-04	3.40E-03	0.010	1.09E-08
OSP failed	6.86E-05	3.40E-03	0.016	3.74E-09
U1 Horseshoe, OSP failed	1.83E-04	3.40E-03	0.016	9.96E-09
U2 Horseshoe, OSP failed	1.83E-04	3.40E-03	0.016	9.96E-09
Total CDF for fires leading to CR evacuation				3.45E-08

<u>In Response to RAI Fire Question 4 (Ref. 1)</u>

The response to RAI Fire Question 4 provided the basis for a revised P_{RSP} where credit had been taken for operation of RSP controls that are not electrically independent and may have been affected by a fire in the MCB horseshoe panels. Alternate actions were identified and the calculation for P_{RSP} revised.

Below are the non-independent RSP controls modeled in P_{RSP}.

<u>Component</u>	<u>MCB Location</u>
Main Steam Isolation Valves (MSIVs)	The MSIVs are located at the far left of ESF Panel 1PM06J(A1).
Pressurizer Heaters	The pressurizer heaters are located on the right side of 1PM05J(B2)
Reactor Coolant Pumps (RCPs)	The RCPs can be tripped from the RSP. The MCB breaker controls are also located on the right side of 1PM05J(B2)
AF Pumps	The MCB controls for the motor driven AF pump are located on 1PM06J(A1). The controls for the diesel driven AF pump are on 1PM06J(A2).

This table emphasizes that the controls that are not electrically independent, and for which alternate actions were modeled in the revised P_{RSP}, are located on different sections of the MCB horseshoe, i.e., 1PM06J(A1), 1PM06J(A2), and 1PM05J(B2). Therefore, the revised P_{RSP} models multiple fires in the MCB horseshoe. The revised P_{RSP} is therefore very conservative.

As in the original derivation, P_{RSP} includes intervention to return the particular parameters to their desired band from both extremes (i.e., too high or too low). As intervention is necessary only for one extreme, the revised P_{RSP} is conservative.

The response to RAI Fire Question 4 provided the modeling and the revised values for P_{RSP}.

$P_{RSP(REV\ 2)}$ = 0.003 (Damage to MCB, no LOOP)
$P_{RSP(REV\ 2)}$ = 0.009 (Damage to MCB, LOOP)

Including the change to P_{RSP} from RAI Fire Question 1 to include the pre-evacuation actions.

$P_{RSP(REV\ 3)}$ = 0.003 + 0.009 = 0.012 (Damage to MCB, no LOOP)
$P_{RSP(REV\ 3)}$ = 0.009 + 0.009 = 0.018 (Damage to MCB, LOOP)

In summary, in response to questions 1, 2, and 4 in the previous RAIs (Refs. 1 and 2), the P_{RSP} has been revised to 0.012 and 0.018 for offsite power available and offsite power unavailable, respectively. The revision includes.

- Local performance of pre-evacuation actions (RAI Fire Question 1)
- Fire in an MCB panel leading to a LOOP (RAI Fire Question 2)
- Modeling of alternative actions for RSP controls that are not electrically independent (RAI Fire Question 4)

On this basis, the MCR evacuation scenarios for the Byron Station and the Braidwood Station were revised to the following.

Scenario	FF_{CRE}	NSP	$P_{RSP(REV\ 3)}$	CDF_{CRE}/yr
Non-vent OSP available	3.20E-04	3.40E-03	0.012	1.31E-08
OSP failed	6.86E-05	3.40E-03	0.018	4.20E-09
U1 Horseshoe, OSP failed	1.83E-04	3.40E-03	0.018	1.12E-08
U2 Horseshoe, OSP failed	1.83E-04	3.40E-03	0.018	1.12E-08
Total Revised CDF for fires leading to CR evacuation				3.97E-08

These revised values for $P_{RSP(REV\ 3)}$ and MCR evacuation scenarios resulted in the MCR CDF of 8.7E-08/yr and 6.8E-08/yr for the Byron Station and the Braidwood Station, respectively. These numbers reflect a 70% and 100% increase over the values reported in the Fire IPEEE submittals for the Byron Station and the Braidwood Station, respectively.

Fires in the Auxiliary Electrical Equipment Rooms Requiring Ex-MCR Shutdown

Severe fires that cause considerable damage to both divisions in the AEER and require shutdown outside the MCR are listed in AEER fire scenario description tables in response to SRAI 3, Tables 3-1 and 3-2 . It should be noted that none of these fires require evacuation of the MCR. Rather the MCR remains occupied and used as a central point for coordination of the activities needed outside the MCR.

Summary of Fire Scenarios Requiring Ex-MCR Shutdown

Following is a summary of the scenarios that require shutdown from outside the MCR and their contribution to plant fire CDF.

CDF Source	Byron		Braidwood	
	Unit 1	Unit 2	Unit 1	Unit 2
MCR fires leading to Ex-MCR shutdown	4.0E-08		4.0E-08	
AEER fires leading to Ex-MCR shutdown	1.1E-07	1.3E-07	1.2E-07	8.3E-08
Total Ex-MCR shutdown	1.5E-07	1.7E-07	1.6E-07	1.2E-07
TOTAL Fire-Induced CDF	5.0E-06	6.1E-06	4.1E-06	3.9E-06
Contribution form Ex-MCR Fire Scenarios	3%	3%	4%	3%

None of the changes made in the MCR or AEER identified any vulnerabilities.

The revision in P_{RSP} resulted in small impact on the contribution from MCR fires requiring ex-MCR shutdown. The revision of the AEER fires scenarios, however, shows significant increase for these scenarios at Byron Station bringing it closer to Braidwood Station estimates. Currently, less than 5% of the fire-induced risk at either the Byron Station or the Braidwood Station is the result of fires requiring plant shutdown from outside the MCR.

SRAI 5 - MCR Controllability and Habitability Issues due to AEER Fires:

"In the original IPEEE submittal and in the licensee's responses to original fire RAIs #1, #2, and #3, the AEER was likened to a control room in terms of cabinet functions and cabinet contents. Original fire RAI #3 specifically asked whether complications related to control of the plant due to AEER fires resulted in MCR evacuation scenarios. The question concerned both the loss of control of systems from the control room ("controllability") as well as smoke migration into the control room that could necessitate evacuation ("habitability"). The RAI response indicated that for AEER fires, plant control issues were addressed through a combination of actions within the MCR as well as outside of the control room. Numerical evaluations in Table 17-3 are presumed to already include these actions. The responses to the original RAIs are acceptable on this point (controllability). However, with regard to habitability concerns, smoke migration into the MCR from postulated AEER fires, according to the RAI response, is precluded by seals and dampers. Plant drawings appear to indicate at least one doorway between each AEER and the MCR. Also, testing of the seals during licensing was mentioned, but no maintenance or later validation testing was described. Finally, fire doors and penetration seals are designed to preclude the spread of fire and flames, but may allow for the spread of smoke and toxic gasses. For penetration seals, decomposition of the seal materials themselves may lead to toxic gas production on the protected side of the barrier.

> **Please state whether or not there are doorways between the AEERs and control room. If such doorways do exist, provide a description of the doors and discuss how the potential for smoke or toxic gas spread through the doors was addressed. Estimate the fire CDF contribution if it is assumed that fires in the**

AEER may force a total abandonment of the MCR due to habitability concerns (i.e., assuming that no further actions could be taken from the MCR)."

<u>Response to SRAI 5</u>

This question is related to migration of smoke from the AEER into the MCR, leading to evacuation of the MCR. The Byron and Braidwood Stations' MCRs are located on the 451 foot elevation of their respective Auxiliary Buildings. The AEERs are located directly north and south of the respective MCRs. The relationship of the AEERs to the MCR at both plants is illustrated in Figure 5-1. The MCRs are separated from the AEERs by 12-inch-thick masonry walls carrying a 3-hour fire rating. The MCRs communicate with the AEERs via double doors in the northwest and southwest corners at Byron Station and via double doors in the northeast and southeast corners at Braidwood Station. The doors are Label "A" rated fire doors (Ref. 6).

In the event of a fire in the AEER, several mitigating factors prevent smoke from causing evacuation of the MCR. These mitigating factors include,

i) The primary source of high-density smoke in the AEER is cable insulation. Fire modeling shows that there is a low likelihood for propagation of a fire outside a single panel. Moreover, most cables outside the panels are routed through conduits or from the top of a panel directly up to a ceiling penetration. This configuration requires significant fire growth to cause high smoke levels, particularly to cause smoke to migrate into the MCR.

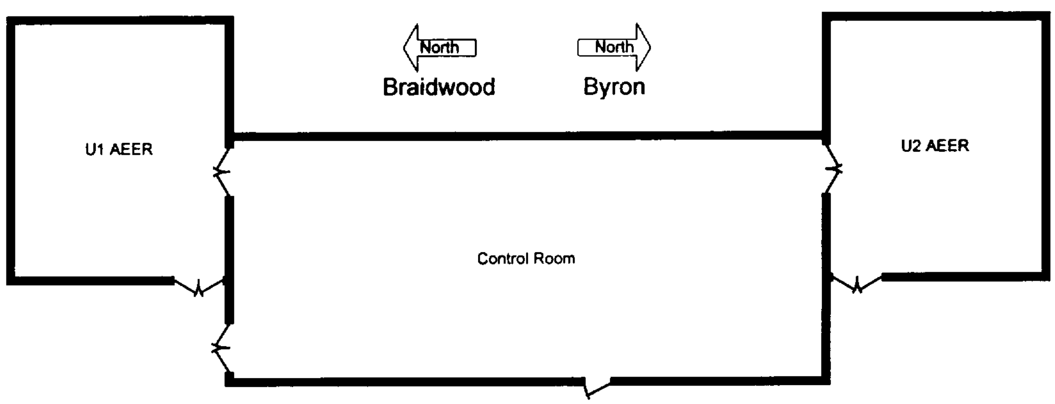


Figure 5-1 - Layout of the Main Control Rooms and AEERs at Byron and Braidwood

ii) Smoke detectors are installed in the AEER and in the ventilation system for early detection and warning in the MCR. The MCR ventilation can then be switched into the purge mode to avoid migration of smoke into the MCR.

iii) The rated barriers between the AEERs and the MCR may not be smoke tight but can provide adequate time for detection of a fire in an AEER and realignment of the MCR ventilation, in order to remove or slow introduction of smoke, if any, into the MCR.

SRAI 6 - AEER versus MCR Fire CDF

"The AEERs at each plant would appear quite similar to a MCR at other plants in terms of the room contents, functions and fire sources. Such comparisons were made in both the original IPEEE submittal and in the responses to the original fire RAIs. For example, the Byron and Braidwood IPEEE submittals note that the relay and circuit card cabinets normally found in the MCR are predominantly located in the AEERs. As a result, much of the control room fire frequency was allocated to the AEERs. The most significant apparent difference between the AEERs and a typical MCR appears to be the fact that the Byron and Braidwood AEERs are not continuously manned, whereas MCR areas are. In general, substantial credit is given in fire probabilistic risk assessments (PRAs) to the fact that the MCR is continuously manned so that rapid intervention in fires that do occur can be assumed with a high reliability. At Byron and Braidwood, the CDF contributions for the AEER are lower than typically cited estimates of MCR fire CDF at other plants. Nominally, because the AEERs look much like unmanned control room spaces, one would anticipate that the CDF contribution would be comparable to, if not greater than, the CDF contribution for MCR areas in other plants. Furthermore, at Byron, the AEERs' contributions to the fire CDF are approximately a factor of eight and a factor of sixteen less than that of the corresponding control rooms.

> **Please review the estimates of the AEER fire CDF (including the responses to SRAIs 1-5 above). Provide a specific justification for the relative contribution of the MCR and AEER to fire CDF at each plant in light of the above discussions."**

<u>Response to SRAI 6</u>

The AEER re-quantification is included in the response to SRAI 3. Table 6-1 and Table 6-2 summarize revision of the summary tables in the Braidwood Station (Table 4.11) and the Byron Station (Table 4.6.5-1) Fire IPEEE submittals based on the response to the RAI and SRAI.

The results show that the revised CDF due to MCR fires is about double that reported in the IPEEE for both the Byron Station and the Braidwood Station. However, these values are still not included in the fire compartments that contribute over 90% of fire risk at either plant. The MCR fire CDF is less than 2% of the total fire CDF of either unit of both plants. Thus, the revised values of MCR fire CDF do not identify any previously unrecognized vulnerabilities and do not identify any new insights.

The revised Braidwood Station CDFs due to AEER fires have increased from 7.0E-7/yr for either unit to 8.2E-7/yr and 7.8E-7/yr for Units 1 and 2, respectively. Both the initial submittal and this revision identify the AEERs as a top contributor to fire risk at Braidwood Station. The relative contribution of the AEER to total risk changed from 30% to 20% due to the increase in total fire-induced CDF.

The revised Byron Station CDFs due to AEER fires show significant increase, which brings them closer to the Braidwood Station estimates for fire risk in the AEERs. The basis for the revision of the Byron Station AEER estimates is provided in the responses to SRAIs 1, 2 and 3. The results of this revision are that the AEERs are among the major contributors to fire risk at Byron Station contributing 16% and 13% to fire risk for Unit 1 and 2, respectively. While this provides a significant insight into the fire risk importance of the AEERs at Byron Station, it does not identify any previously unrecognized vulnerabilities.

With respect to the change in plant fire risk, nearly all the increase, compared to the original IPEEE submittal, is the result of changes made in responses to RAIs submitted during 1999 (Refs. 1, 2, and 5). Most of the changes in this revision are the result of changes in the Byron Station AEER estimates. The revised total fire risk for both plants is about an order of magnitude lower than the risk estimated due to internal events.

The only insight gained is that the AEERs are major contributors to fire risk at Byron Station, as they were at Braidwood Station. Fire risk resulting from fires in the MCR remains low. We attribute this to the Byron Station and the Braidwood Station design, where the control areas are in fact the combined MCR/AEER areas, since the majority of the plant control circuitry is located in the AEERs instead of the MCRs. In fact the combined MCR and AEERs CDF is what is more comparable with estimates of MCR risk at plants without AEERs (i.e., also referred to as Relay Rooms). Significantly lower fire risk in the MCRs compared to AEERs at the Byron Station and the Braidwood Station can be attributed to these factors:

1. Most of the hazard associated with a MCR in the form of electrical cabinets is located in the AEERs. The MCRs on the other hand have much fewer panels, and the MCB contains mostly instruments and switches as opposed to relays and circuit cards, i.e., the primary electrical ignition sources.
2. The MCR is continuously occupied providing a significantly better chance for detection and suppression prior to significant damage to critical equipment.

Table 6-1 - Revised Summary of Braidwood Compartment Core Damage Frequencies

Fire Compartment	Original CDF (IPEEE Submittal)		Revised CDF (Based on this and the previous responses)	
	Unit 1	**Unit 2**	**Unit 1**	**Unit 2**
Unit 2 Lower Cable Spreading Room Nonsegregated Bus Duct Area (3.2A-2)		5.50E-07		1.60E-06
Unit 1 Lower Cable Spreading Room Nonsegregated Bus Duct Area (3.2A-1)	5.40E-07		1.52E-06	
Unit 1 Auxiliary Electrical Equipment Room (5.5-1)	***7.00E-07***		***8.2E-07***	
Unit 2 Auxiliary Electrical Equipment Room (5.5-2)		***7.00E-07***		***7.8E-07***
Unit 2 Division 21 Misc. Electric Equipment Room (5.6-2)		3.90E-07		7.00E-07
Unit 1 Division 11 Misc. Electric Equipment Room (5.6-1)	3.10E-07		5.40E-07	
Auxiliary Building General Area 426' Elevation (11.6-0)	3.70E-07	1.20E-07	6.10E-07	2.00E-07
Auxiliary Building General Area 401' Elevation (11.5-0)	2.00E-07	3.00E-07	2.70E-07	4.00E-07
Unit 1 Cable Tunnel (3.1-1)	2.30E-07		1.01E-07	
Main Control Room (2.1-0)	***3.27E-08***	***3.27E-08***	***6.8E-08***	***6.8E-08***
Unit 2 Cable Tunnel (3.1-2)		2.10E-07		5.91E-08
Unit 1 Division 12 4.16KV Switchgear Room (5.1-1)	5.90E-08		5.90E-08	
Unit 2 Division 22 4.16KV Switchgear Room (5.1-2)		5.90E-08		5.90E-08
Units 1 & 2 Turbine Building 451' Elevation (8.6-0)	5.90E-08	5.90E-08	5.90E-08	5.90E-08
Unit 1 Division 11 4.16KV Switchgear Room (5.2-1)	1.60E-08		1.60E-8	
Unit 2 Division 21 4.16KV Switchgear Room (5.2-2)		1.60E-08		1.60E-08
Auxiliary Building General Area 383' Elevation (11.4-0)	1.40E-09	3.00E-10	1.90E-09	4.20E-10
Auxiliary Building General Area 364' Elevation (11.3-0)	7.70E-10	3.00E-11	1.30E-09	5.10E-11
Unit 2 Division 22 Misc. Electric Equipment Room (5.4-2)		2.90E-10		2.90E-10
Unit 1 Division 12 Misc. Electric Equipment Room (5.4-1)	2.80E-10		2.80E-10	
Auxiliary Building General Area 346' Elevation (11.2-0)	1.40E-10	1.40E-10	1.50E-10	1.50E-10
TOTAL UNIT FIRE-INDUCED CDF	**2.5E-06**	**2.4E-06**	**4.1E-06**	**3.9E-6**

Bold-italic formatting indicates the fire compartments affected as the result of the response to this SRAI.

Table 6-2 - Revised Summary of Byron Compartment Core Damage Frequencies

Fire Compartment	Original CDF (IPEEE Submittal)		Revised CDF (Based on this and the previous responses)	
	Unit 1	Unit 2	Unit 1	Unit 2
Unit 2 UCSR (3.3B-2)		2.70E-07[1]		1.30E-06
Auxiliary Building General Area Elevation 426' (11.6-0)	1.68E-07[2]	2.18E-07[2]	8.43E-07	9.91E-7
Unit 1 Auxiliary Electrical Equipment Room (5.5-1)	***1.10E-08***		***8.0E-07***	
Unit 2 Auxiliary Electrical Equipment Room (5.5-2)		***4.90E-09***		***8.0E-07***
Auxiliary Building General Area Elevation 346' (11.2-0)	7.40E-07	7.40E-07	7.40E-07	7.40E-07
Auxiliary Building General Area Elevation 401' (11.5-0)	1.10E-07[2]	1.19E-07[2]	6.36E-07	6.45E-7
Unit 2 Division 21 4.16KV Switchgear Room (5.2-2)		2.00E-07[3]		5.40E-07
Laundry Room (11.6C-0)	1.40E-07		4.60E-07	
Unit 1 Division 11 4.16KV Switchgear Room (5.2-1)	3.90E-08[3]		3.70E-07	
Unit 1 Division 12 4.16KV Switchgear Room (5.1-1)	1.80E-07		2.10E-07	
Auxiliary Building General Area Elevation 383' (11.4-0)	1.40E-07	1.40E-07	2.57E-07	2.61E-7
Unit 1 Division 11 Misc. Electrical Equipment Room (5.6-1)	1.80E-07		1.80E-07	
Unit 2 Division 22 4.16KV Switchgear Room (5.1-2)		1.50E-07		1.70E-07
Unit 2 Division 21 Misc. Electrical Equipment Room (5.6-2)		1.60E-07		1.60E-07
Unit 1 Lower Cable Spreading Room Nonsegregated Bus Duct Area (3.2A-1)	1.10E-07		1.30E-07	
Unit 2 Cable Tunnel (3.1-2)		3.00E-07		1.15E-7
Unit 1 Cable Tunnel (3.1-1)	4.70E-07		1.13E-7	
Unit 2 Lower Cable Spreading Room Nonsegregated Bus Duct Area (3.2A-2)		3.90E-08		1.08E-7
Auxiliary Building General Area Elevation 364' (11.3-0)	3.30E-08	2.80E-08	9.50E-08	9.10E-08
Main Control Room (2.1-0)	***5.10E-08***	***5.10E-08***	***8.7E-08***	***8.7E-08***
Unit 1 Division 12 Misc. Electrical Equipment Room (5.4-1)	5.10E-08		5.10E-8	
Unit 2 Division 22 Misc. Electrical Equipment Room (5.4.2)		5.10E-08		5.10E-08
Unit 1/2 Turbine Building Elevation 451' (8.6-0)	6.10E-09	6.10E-09	6.10E-09	6.10E-09
Unit 1 Turbine Building Elevation 426' (8.5-1)	8.40E-12		3.90E-11	
Unit 2 Turbine Building Elevation 426' (8.5-2)		8.40E-12		3.90E-11
TOTAL UNIT FIRE-INDUCED CDF	**2.4E-06**	**2.5E-06**	**5.0E-06**	**6.1E-06**

Bold-italic formatting indicates the fire compartments affected as the result of the response to this SRAI.

1. The CDF for Upper Cable Spreading Room (UCSR) Fire Zone 3.3B-2 was revised in the January 29, 1999 RAI Submittal. The revision is due to a correction made to a CCDP that was used for this zone.
2. The CDFs in the Auxiliary Building General Areas at elevations 401 feet (i.e., Fire Zone 11.5-0) and 426 feet (i.e., Fire Zone 11.6-0) have been revised since the submittal of the Byron Station IPEEE submittal. The revision is due to an error in the floor area ratio in transient fires damaging cable tray risers (i.e., scenarios 66-37 and 66-43h in Table 17-3). These floor area ratios were revised from 23% and 41% to 3% and 11%, respectively, after a confirmatory walkdown of these two areas. These revisions were included in the January 29, 1999 RAI Submittal.
3. The CDFs for Switchgear Room Fire Zones 5.2-1 and 5.2-2 were revised in the January 29, 1999 RAI Submittal. The revisions are due to typographical errors in the Byron Station IPEEE Submittal Report.

REFERENCES

1 Letter from R. M. Krich (ComEd) to U.S. NRC, "Response to Request for Additional Information Regarding Individual Plant Examination of External Events," July 15, 1999

2 Letter from R. M. Krich (ComEd) to U.S. NRC, "Response to Request for Additional Information Regarding Individual Plant Examination of External Events," January 29, 1999

3 Letter from K. L. Graesser (ComEd) to U.S. NRC, "Transmittal of Byron Station Individual Plant Examination of External Events Submittal Report," December 23, 1996

4 Letter from G. Stanley (ComEd) to U.S. NRC, "Transmittal of Braidwood Station Individual Plant Examination of External Events Submittal Report," July 27, 1997

5 Letter from R. M. Krich (ComEd) to U.S. NRC, "Response to Request for Additional Information Regarding Individual Plant Examination of External Events," September 30, 1999

6 Letter from T. Tulon (ComEd) to U.S. NRC, "Fire Protection Report - Amendment 18," dated December 16, 1998