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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

Subject: Response to the NRC Request for Additional Information to Support Resolution of Unresolved Items

Reference: Letter from J.A. Grobe (U. S. NRC) to O. D. Kingsley, "Braidwood – NRC Inspection Report 50-456/00-06(DRS); 50-457/00-06(DRS)," dated January 8, 2001

In the reference letter, the NRC identified five issues that were designated as unresolved items (URIs) and stated that several of these issues require additional information to support the Braidwood Station position that these issues do not represent violations of the Braidwood Station's licensing basis. Attachment 1 of the referenced NRC letter, Request for Additional Information to Support Resolution of Unresolved Items, listed six specific issues requiring additional response. As requested, the additional information is provided in Attachment 1 to this letter.

Additional report comments and clarifications are included in Attachment 2.

Should you have any questions concerning this letter, please contact Mr. T. W. Simpkin at (815) 458-2801, extension 2980.

Respectfully,

G. K. Schwartz
Station Manager
Braidwood Station

Attachment

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

ADD1

# ATTACHMENT 1

**Response to NRC letter, "Braidwood – NRC Inspection Report 50-456/00-06(DRS); 50-457/00-06(DRS), Attachment 1, Request for Additional Information to Support Resolution of Unresolved Items," dated January 8, 2001**

**Braidwood Station, Units 1 and 2**

**Response to Request for Additional Information (RAI) 1**

**Provide a description of the safe shutdown licensing basis for Fire Zones 11.5-0 and 11.6-0.**

**Response to RAI 1**
(URI 50-456/00-06-02(DRS); 50-457/00-06-02(DRS))

A. Safe Shutdown (SSD) Analysis / Methodology

Licensing Basis Provided in 1986:

The safe shutdown analysis (SSA) for zones 11.5-0 and 11.6-0 was submitted in Fire Protection Report (FPR) Amendment 7 on May 2, 1986. In addition, a comparison of the Braidwood SSA versus the previously approved Byron SSA was submitted on May 27, 1986. The staff's evaluation and approval of Braidwood FPR Amendment 7 versus BTP CMEB 9.5-1, including the differences between Byron and Braidwood, is documented in Braidwood SSER 2.

- The criteria used for the SSA was that for a fire in any given zone in the plant, sufficient redundant and/or diverse equipment will remain operable to ensure that the capability to achieve and maintain safe shutdown exists independent of equipment or systems located within or affected by a fire in the affected zone. (FPR Section 2.4.1.2)

- In response to a NRC request for a comparison to Appendix R of our fire protection program, we identified and documented for each zone in the plant where the separation requirements of III.G of Appendix R were not met (even though Appendix R did not apply to Braidwood). For all such cases, justification for the existing separation was provided, or the separation was upgraded to a justifiable level. (FPR Section 2.4.1.2)

- For fires outside the Control Room (i.e., 11.5-0 or 11.6-0), the operators are assumed to remain in the control room and to utilize the instruments and controls to the greatest possible extent, in accordance with existing procedures. Where the SSA shows that control cables from both redundant trains of equipment are located in the same fire zone, credit is taken for alternate shutdown via local operation of equipment as specified in various plant procedures. (FPR Section 2.4.1.5)

  Note: The use of the "alternate" in Section 2.4.1.5 of the FPR indicates that an acceptable method of "normal" redundant shutdown is provided, which represents an acceptable level of safety to that achieved by conformance with Section C.5.b.2 of BTP CMEB 9.5-1. It did not mean that local operation of "normal" redundant safe shutdown systems constituted "Dedicated" or "Alternative" shutdown capability as described in C.5.b.3. Therefore, the presence of unprotected redundant control cables in a zone was not considered a deviation to Appendix R Section III.G.2, provided that the ability to locally operate one of the redundant systems / equipment was available (e.g., power cables were protected). The only zones that originally credited "Alternative" shutdown capability were the Control Room and the AEER's, because they resulted in Control Room evacuation and credited the use of "Alternative" shutdown systems (i.e., Remote Shutdown Panel and Fire Hazards Panel).

In fire zones 11.5-0 and 11.6-0, the safe shutdown methodology ensuring sufficient redundant equipment will remain operable to ensure that the capability to achieve and maintain safe shutdown exists independent of equipment or systems located within the fire zone or affected by a fire in the fire zone was described in Sections 2.4.2.45 and 2.4.2.50 of the FPR. Division 11 "power" cables in the zone were originally protected with a 3-hour rated fire wrap material. Subsequently, the Division 11 power cables were rerouted outside the zone(s) to resolve generic issues regarding the inadequacy of Thermo-Lag fire wrap material. Additionally, there are control cables for both divisions that were neither protected or re-routed because of the ability to locally operate the redundant systems (i.e., an acceptable method of "normal" shutdown.) Thus, no deviation from Section III.G.2 of Appendix R was documented, and the use of Alternative or Dedicated shutdown capability was not necessary. Because Alternative or Dedicated shutdown capability was not being relied upon (along with the fact that Appendix R did not apply to Braidwood), conformance with III.G.3 was not necessary.

Change to Approved Fire Protection Program in 1996:

In 1996, it was determined that redundant Control Room HVAC (VC) damper control cables were located in the zone(s). As a result of postulated damper failure, the Control Room would gradually heat up, and certain instrumentation (i.e., monitoring capability) in the Control Room may eventually become unreliable. To address this condition, each zone was re-categorized to "Alternative" shutdown because reliance was placed on "Alternative" equipment (e.g., instruments at the fire hazards panel) should Control Room evacuation become necessary. The main control room will initially remain manned while stable conditions are established in the plant. If temperatures become excessive, shutdown can be continued and accomplished from outside the control room using the remote shutdown panel, local controls, and the fire hazards panel (FHP). This would not occur any sooner than 3-hours into the event, conservatively assuming no mitigating actions are taken (i.e., open doors, stage portable ventilation equipment, etc.).

When the zones were re-classified as Alternative shutdown, the original Appendix R comparison documentation (although historical in nature) was revised to note that the fire zones are not completely covered by a fixed suppression system. However, the configuration complies with the BTP, which does not require suppression in such zones. In addition, the configuration is technically acceptable because:

- The fire barriers combined with the sprinkler system protecting the open hatchway (i.e., center stairwell) are adequate to prevent the spread of fire to adjacent zones.

- The zone is fully protected with an automatic detection system and manual suppression capability (i.e., hose stations).

- The construction of the zone is non-combustible.

- The primary combustible material within the zone is cable insulation qualified to IEEE-383 and the type of fire expected develops slowly.

- The fire protection features described in the FHA are adequate for the hazards.

- All fire prevention and protection administrative controls required for areas containing safety related equipment, including controls for transient combustible material, are applicable to these zones.

The fire protection features described above ensure that a fire will not rapidly spread throughout the zone and will not spread to adjacent zones; and, since an "Alternative" shutdown train is provided, the unavailability of redundant VC cables in these zones will not affect the shutdown capabilities of the plant. The principal purpose of adding a sprinkler system to these zones would be to control a postulated fire and prevent its spread to adjacent zones; however, the fire protection features provided are adequate for that purpose. Therefore, the addition of a sprinkler system to these zones to would not provide a substantial increase in the level of safety of the plant.

The classification change from "normal" to "Alternative" shutdown was made in accordance with Generic Letter 86-10 and the standard license condition under 10 CFR 50.59. The classification change was deemed acceptable because:

- The change credited the same strategies and systems previously approved for other "Alternative" shutdown zones (Control Room and AEER.) If a fire of significant magnitude occurs and damages both divisions of VC, a shutdown method is available which is outside of these locations. No loss of shutdown capability occurs and, therefore, a fixed fire suppression system is not necessary to achieve an acceptable level of fire safety. This justification is even more robust for zones 11.5-0 and 11.6-0, when compared to the original "Alternative" shutdown zones; because control room evacuation, if required, would be necessary much later in the scenario than for the original "Alternative" shutdown zones.

- The fire protection features provided in zones 11.5-0 and 11.6-0 provide a level of protection equivalent to that provided in the original "Alternative" shutdown zones.

- The change did not adversely affect the ability to achieve and maintain safe shutdown.

- The change did not otherwise involve a change to a Technical Specification or result in an unreviewed safety question.

References:


- May 2, 1986 letter from ComEd to NRC transmitting FPR Amendment 7.
- May 27, 1986 letter from ComEd to NRC providing supplemental summary of changes to FPR Amendment 7.
- Braidwood SSER 2, dated October, 1986.

B. Associated Circuit Licensing Basis

FPR Amendment 7 was submitted on May 2, 1986. Section 2.4.1.5.5 described the methods for analyzing associated circuits as defined in the NRC's April 6, 1982 clarification letter to Generic Letter 81-12:

- Circuits sharing a common power supply with safe shutdown equipment were dispositioned by electrical protection. Specifically, coordinated short circuit protection is provided such that an open circuit, ground or hot short of these cables will not affect the system with which the power source or raceway is shared.

- Circuits sharing a common enclosure were dispositioned by the fact that the cables meet the flame test of IEEE 383-1974 and the cables are separated in eight separate divisions. Therefore, associated cables of different divisions do not share a common cable tray, conduit, or raceway.

- Spurious operation due to fire induced faults in cables (including associated circuits) was dispositioned by the Spurious Operation Analysis performed in response to FSAR Question Q10.65.

The staffs evaluation and approval of Braidwood FPR Amendment 7, including the methods of associated circuit analysis, is documented in SSER 2. The same method of analysis for associated circuits at Byron was previously approved in Byron SSER 5.

Note: Formal calculations to support the evaluation of multiple high impedance faults (MHIF) were not completed for the approved Braidwood SSA. During initial licensing, the NRC closed MHIF issue based on existing breaker coordination studies that demonstrated electrical coordination was adequate (Refer to NRC Inspection Report 50-454(455)/86-39(33)). However, MHIF calculations recently completed as part of the SSA Improvement Project have confirmed that MHIF is not a concern at Braidwood.

References:

- May 2, 1986 letter from ComEd to NRC transmitting FPR Amendment 7.
- Braidwood SSER 2, dated October, 1986.
- Byron SSER 5, dated October, 1984.

C. Spurious Operation Licensing Basis (FSAR Question Q10.65)

In FSAR Question Q10.65, the NRC asked, "for each fire area, identify the plant transients that could be initiated by fire-induced spurious operation equipment. Identify the instrumentation available to the operator to assess the transient and necessary corrective actions to be taken. Identify how the corrective actions identified into the shutdown action identified for Question Q10.64."

The original response to Q10.65 was submitted for Byron on August 2, 1984, and revised responses were provided on October 15, 1984 (Byron), and August 22, 1986 (Braidwood). The responses provided the results of an analysis performed to identify those valves that are subject to spurious operation due to fire and could impact safe shutdown capability. Key assumptions included:

- All safe shutdown equipment which could be disabled by a fire in this fire zone is disabled and is thus not available for mitigation of the spurious operation. Additionally, all circuits with cables in the fire zone are assumed to be disabled and no credit is taken for automatic functions initiated by these circuits.

- Spurious operation of a valve results from hot short or open to power or control cables.

- Only one spurious actuation occurs per single fire (except for hi-low pressure interfaces).

Actions to mitigate spurious valve operations that could potentially affect safe shutdown included electrical isolation and/or manual actions. The Spurious Operation Analysis provided in response to FSAR Question Q10.65 was referenced in Byron SSER 5 and Braidwood SSER 2.

References:


- August 2, 1984 letter from ComEd to NRC transmitting responses to various fire protection questions.
- October 15, 1984 letter from ComEd to NRC providing additional information regarding fire protection at Byron and Braidwood.
- August 22, 1986 letter from ComEd to NRC transmitting response to FSAR Question Q10.65.
- Byron SSER 5, dated October, 1984.
- Braidwood SSER 2, dated October, 1986.

RAI 2

**Assuming a fire in Fire Zones 11.5-0 or 11.6-0, describe the provisions incorporated in the Braidwood Station's Fire Protection Program that assure for any fire-induced failures to the charging system that these failures will not prevent operation of the safe shutdown method credited for each fire zone.**

**Response to RAI 2**
(URI 50-456/00-06-04(DRS); 50-457/00-06-04(DRS)
(URI 50-456/00-06-05(DRS); 50-457/00-06-05(DRS))

A. Purpose

The purpose of this evaluation is to demonstrate that fire-induced failures to the charging system for a fire in fire zone 11.5-0 or 11.6-0, including circuits associated with the charging pump suction valves, will not prevent operation of the safe shutdown method credited for each zone.

B. Background

In fire zones 11.5-0 and 11.6-0, control cables associated with VCT outlet valves CV112B and CV112C are present in the zone. There is the potential that one of these valves could spuriously close if subjected to a fire induced "hot short". If this potential event is not mitigated, the flow path to the charging pump operating at the time of spurious closure would be isolated. If an alternate flowpath is not established, or if the operating pump is not shutdown within a short period of time, pump damage could result. The Division 12 (22) charging pump is credited in the Safe Shutdown Analysis (SSA) for these zones since the power cable for the pump is routed outside these zones. However, the concern is that the credited charging pump is operating when the potential fire induced spurious closure occurs, thus damaging the pump due to the loss of the suction source.

C. Post-Fire Safe Shutdown Capability

In the postulated scenario, charging flow is assured by providing a means to detect a fire in its incipient stage and taking operator action to preclude the consequences of fire induced spurious closure of the normally open VCT outlet valve(s). Specifically, an automatic ionization fire detection system is provided to detect the fire in its incipient stage and annunciate a fire alarm in the Main Control Room (MCR), and the fire alarm response procedures initiate the action to preclude the consequences of the spurious operation.

At the first MCR indication of a fire in these zones (MCR Annunciator Alarm "Unit 1 (2) Area Fire"), the Operator will respond with the associated annunciator response procedure, Unit 1 BwAR 0-37-A4 or Unit 2 BwAR 0-39-A4. The procedure directs that an operator be dispatched to investigate the fire. Subsequent steps direct the Unit Operator to align the operating charging pump to the RWST via any one of four flowpaths. If there is damage to plant equipment, the reactor will be tripped, if it has not already done so. All these actions, which are specified in the existing fire alarm annunciator response procedures, can be completed within 6 minutes after the fire alarm annunciates. After the completion of the above actions, the subsequent spurious closure of a VCT outlet valve has no detrimental effects upon the capability to shutdown the reactor.

In an effort to further strengthen the operator response, additional procedure changes will be made. The changes will direct the operator to stop the running charging pump for a fire which damages permanent plant equipment in the fire zones where the VCT outlet valves are subject to spurious closure, until another suction flowpath from to the charging pump has been aligned. With this change we have determined we could trip the running charging pump within two minutes of receiving the fire alarm. With the consideration of the defense-in-depth fire protection features described below, we conclude this will prevent CV pump damage. This provides an improvement over the current procedures in two respects: (1) by more precisely defining the severity level of fire at which the desired action will be taken ("damages permanent plant equipment"); and (2) by taking the proactive step of stopping the running charging pump for all such fires in the affected zones, until an alternate flowpath has been aligned.

D. Evaluation of Post Fire Safe Shutdown Capability

Fire zone 11.5-0, the 401' General Area of the Auxiliary Building, has a floor area of 20,080 $ft^2$ with a twenty-five foot ceiling and a low fire loading of approximately 79,200 $Btu/ft^2$. Fire zone 11.6-0, the 426' General Area of the Auxiliary Building, has a floor area of 7,872 $ft^2$ with a twelve foot ceiling and a low fire loading of approximately 56,200 $Btu/ft^2$. Each zone is protected with area wide ceiling mounted ionization smoke detectors that alarm in the MCR. In addition, manual hose stations are located within and adjacent to each zone so the fire brigade can suppress a fire at any location in either zone. Permanently mounted fire extinguishers are mounted in the areas and adjacent areas for use by early responders to the fire, and the primary combustible material in the affected areas of each zone consists of IEEE 383 rated cable in trays.

The safe shutdown capability described in Section C above was evaluated to assess its effectiveness to mitigate the consequences of fire induced spurious isolation of an operating charging pump's suction flow path. A spectrum of fire severity and availability of offsite power sources was evaluated to bound the most potentially significant scenarios. The spectrum was established by considering: 1) design basis fire that quickly damages all unprotected components/cables in the area and 2) an exposure fire damaging components in a local area that slowly spreads until extinguished by the fire brigade.

For a design basis fire scenario that quickly damages all unprotected components/cables within the zone, at time zero, a fire alarm will be received in the MCR from the fire detection system. Upon receipt of the alarm, the MCR operator will respond to the alarm by entering the fire alarm annunciator response procedure, Unit 1 BwAR 0-37-A4 or Unit 2 BwAR 0-39-A4. Immediate operator actions directed by the procedure include dispatching an operator to investigate the fire and the fire brigade to initiate fire suppression. Subsequent steps direct the operator to establish a suction flowpath from the RWST to the CV pump by either opening valve 1(2)CV112D, 1(2)CV112E, 1(2)SI8807A, or 1(2)SI8807B. Since offsite power circuits are located in these zones, a design basis fire is assumed to result in a loss of offsite power. A loss of automatic or remote control function for all components having unprotected control cables present in the zone will also occur. In these zones, the Division 12(22) emergency diesel generator (EDG) and its output breaker have control cables present in the zone. Also, some 4 KV safe shutdown loads have control cables located in these zones. Therefore, the start of the Division 12(22)

EDG, the closure of its output breaker, and the start of 4 KV safe shutdown loads (including the charging pump) require local manual actions as directed by station procedures BwOA ELEC-3 and BwOA ELEC-5. The effects of a postulated spurious closure of a VCT outlet valve will not have detrimental effects on safe shutdown for the following reasons. If the spurious valve closure occurs prior to the completion of the above manual actions to re-start the charging pump and realignment to another suction flowpath, there will not be an operating charging pump subject to loss of its suction flow path. If the spurious VCT outlet valve closure is postulated to occur after the ESF bus has been re-energized and the charging pump re-started using the local manual actions described above, the operator will have already aligned the charging pump suction to the RWST. The actions to align to the RWST, as directed in the fire alarm annunciator response procedure, can and will be performed prior to 4 KV ESF bus being restored and the safe shutdown pumps re-started. Therefore, the safe shutdown capability described in Section C is effective to mitigate the consequences of fire induced spurious isolation of an operating charging pump's suction flow path.

The opposite end of the spectrum for a postulated fire scenario is an exposure fire that damages components in a local area that slowly spreads until extinguished by the fire brigade. In this scenario, a local exposure fire postulated in any location in the zone may not directly cause the loss of offsite power or a reactor trip. Control functions susceptible to fire damage may still be functioning. The charging pump operating before the fire may be still running. In this scenario, the fire detection system will detect the fire and annunciate an alarm in the MCR, damage will be localized to the source of the fire (i.e., transient combustible fire), and fire will not propagate along the cable trays. The Unit Area Fire annunciator response procedure (BwAR 0-37-A4 or BwAR 0-39-A4) specifies actions, which are described above, that ensure the operating charging pump suction will be aligned to the RWST within 6 minutes. The prompt alignment to the RWST is assured because of radio communications between the MCR operator and the operator investigating the fire, and the capability to perform the alignment using control switches located on MCR panels that are readily available to the operator. The postulated fire damage to control cables, resulting "hot short", and spurious closure of a VCT outlet valve is not likely to occur in the initial 6 minutes due to several factors. The plant configuration of the control cables for the VCT outlet valves have been evaluated and each has design features or other aspects that provide reasonable assurance that an exposure fire would not cause a "hot short" within the first six minutes of the event. These plant configuration features or aspects are listed below but vary for each cable routing.

- Protection of the electrical raceway with a fire barrier wrap material (i.e., Thermo-Lag or 3M) that has been abandoned in place but still affords a level of protection for a sufficient period of time to complete the necessary actions for protecting the charging pump
- Testing by NEI and others has demonstrated that an original 3-hour designed Thermo-Lag fire barrier installation, as installed on portions of the subject electrical raceways at Braidwood, will provide a 1-hour fire rating
- A 3M Interam 3-hour designed electrical raceway fire barrier installation, as installed on a portion of the subject electrical raceways at Braidwood, will provide a 3-hour fire rating
- Vertical separation from the floor (e.g., solid bottom cable tray routed 19 feet above the floor elevation)
- Lack of permanent or transient combustible materials or ignition sources

- Certain cable configurations require a cable to cable hot short (i.e., no normally energized conductor within the cable)
- Separation from potential exposure fires by physical interference such as other electrical raceways constructed of noncombustible material
- IEEE 383 qualified cable limits rate of fire growth
- Partial automatic sprinkler protection over electrical raceway

The capability to remotely align to the RWST from the MCR is demonstrated in the following evaluation. There are four separate flow paths to accomplish the alignment of the charging pump to the RWST. Establishing any one of these four flow paths ensures a proper suction source to the charging pump. Each of the four flow paths contain an isolation valve (1(2)CV112D, 1(2)CV112E, 1(2)SI8807A, and 1(2)SI8807B), which are motor operated valves with control switches located on the MCR panels. In order to evaluate the operator capability to successfully and promptly realign the suction path to the charging pumps as necessary, a severe exposure fire was postulated in all zone 11.5-0 and 11.6-0 locations that can damage control cables associated with the VCT outlet valves 1(2)CV112B and 1(2)CV112C. The evaluation considered the physical separation between the postulated fire location and the cables associated with the four available RWST flow path valves. It was determined that for each postulated fire location, more than 20 feet of horizontal separation exists between the cable tray/riser containing the VCT outlet valve cable(s) and at least one of the four RWST flowpath valve cables or the power cable for the Division 11(21) charging pump. The evaluation also determined that the control cables for valve 2CV112E are not routed through zone 11.5-0 or 11.6-0. Therefore, for a Unit 2 fire in either zone the MCR operator will be able to realign the CV pump suction flowpath to the RWST via 2CV112E. Since there is 20 feet of separation, the zones are protected with an automatic detection system, and the primary combustible material in each zone is IEEE-383 rated cable, a local exposure fire with the potential to cause damage to a VCT outlet valve control circuit cannot also cause damage to the remote control capability for all four alternate suction flowpaths or prevent the successful realignment to an RWST suction source. The prompt and proactive actions to realign the pump suction source or secure the pump combined with the design features or other aspects described above provide reasonable assurance that a "hot short" will not occur prior to the operating charging pump being aligned to the RWST. Also, it was determined that four of the eight postulated local exposure fires which could affect the VCT outlet valves cables, would not be capable of also damaging the Division 11(21) charging pump power cable due to a minimum of 20' horizontal separation. Therefore, the safe shutdown capability described in Section C is effective to mitigate the consequences of fire induced spurious isolation of an operating charging pump's suction flow path.

This safe shutdown capability will be further strengthened by implementing procedure changes that direct the operator to stop a running charging pump for a fire which damages permanent plant equipment in zones where the VCT outlet valves are subject to spurious closure.

The specific RWST flow path available for each postulated fire location is evaluated below.

Fire Zone 11.5-0, Unit 1

- A fire which damages permanent plant equipment is postulated near cable riser 1R226 that can potentially spuriously close VCT outlet valve 1CV112B (cable 1CV069). Two independent flow paths remain available from the MCR, valves 1CV112E and 1SI8807B whose control cables are separated 24' and 41' from the fire damaged cables of 1CV112B.
- A fire which damages permanent plant equipment is postulated near cable riser 1R277 and trays 1889B - 1895B that can potentially spuriously close VCT outlet valve 1CV112C (cable 1CV075). The routing of cable 1CV075 in the tray in zone 11.5-0 is a long run in relatively close proximity at different points to cables associated with valves 1CV112D, 1SI8807A, and 1SI8807B. When considering failure of cable 1CV075 causing spurious closure of valve 1CV112C, it is not credible to assume that a fire will involve the entire length of the 140' long tray. Therefore, the fire was postulated at various locations along the tray where it approached the closest cable associated with an RWST valve. At these locations, the separation was assessed for the four RWST flowpath isolation valves. At each postulated location, at least 21' of separation to cables associated with valves 1CV112D, 1SI8807A, or 1SI8807B was demonstrated.

Fire Zone 11.5-0, Unit 2

- A fire which damages permanent plant equipment is postulated near cable riser 2R216 that can potentially spuriously close VCT outlet valve 2CV112B (cable 2CV069). Two independent flow paths remain available from the MCR, valves 2CV112E (which has no cables in the zone) and 2SI8807B whose control cables are separated by 38' from the fire damaged cables of 2CV112B.
- A fire, which damages permanent plant equipment is postulated near cable riser 2R254 and trays 2952L - 2926L that can potentially spuriously close VCT outlet valve 2CV112C (cable 2CV075). Three independent flow paths remain available from the MCR, valves 2CV112E (which has no cables in the zone) and 2CV112D and 2SI8807A whose control cables are separated by 22' (2CV112D) and 25' (2SI8807A) from the fire damaged cables of 2CV112B.

Fire Zone 11.6-0, Unit 1

- A fire which damages permanent plant equipment is postulated near cable risers 1R226 and 1R267 and trays 11316B - 11341B that can potentially spuriously close VCT outlet valve 1CV112B (cables 1CV067, 1CV069). One flow path remains available from the MCR, valve 1SI8807B whose control cables are separated 20' from the fire damaged cables of 1CV112B.
- A fire which damages permanent plant equipment s postulated near cable risers 1R277 and 1R370 and trays 11461J, 11807J - 11810J that can potentially spuriously close VCT outlet valve 1CV112C (cables 1CV073, 1CV075). Two independent flow paths remain available from the MCR, valves 1CV112D and 1SI8807A whose control cables are separated by 25' from the fire damaged cables of 1CV112B.

Fire Zone 11.6-0, Unit 2

- A fire which damages permanent plant equipment is postulated near cable risers 2R236 and 2R216 and trays 21340B - 21306B that can potentially spuriously close VCT outlet valve 2CV112B (cables 2CV067, 2CV069). Two independent flow path remains available from the MCR, valve 2CV112E (which has no cables in the zone) and valve 2SI8807B whose control cables are separated by 21' from the fire damaged cables of 2CV112B.
- A fire which damages permanent plant equipment is postulated near cable risers 2R254 and 2R255 and trays 21401T - 21399T that can potentially spuriously close VCT outlet valve 2CV112C (cables 2CV073, 2CV075). Three independent flow paths remain available from the MCR, valve 2CV112E (which has no cables in the zone) and valves 2CV112D and 2SI8807A whose control cables are separated 35' from the fire damaged cables of 2CV112B

**RAI 3**

**Assuming a fire in Fire Zones 11.5-0 or 11.6-0 that results in fire-induced failures that include degradation to RCP seal integrity, describe the provisions incorporated in the Braidwood Station's Fire Protection Program that assure fire protection safe shutdown performance objectives are met and RCP integrity is maintained.**

**Response to RAI 3**
(URI 50-456/00-06-04(DRS); 50-457/00-06-04(DRS))

A. Purpose

The purpose of this evaluation is to demonstrate Fire Protection Safe Shutdown Performance Objectives and RCP Seal Integrity considering the effects of fire induced failures that result in degradation of RCP seal cooling.

B. Background

Two makeup flow paths to the reactor coolant system are credited in the safe shutdown analysis. The primary flow path is via the reactor coolant pump seal injection lines. The secondary makeup flow path is through the cold leg injection lines (one of the two motor operated valves 1/2SI8801A or 1/2SI88801B may be opened). Either of these flow paths is capable of providing adequate makeup flow.

The Braidwood/Byron reactor coolant pump seals are designed to withstand a complete loss of seal cooling at RCS pressure and temperature with the limitation that seal cooling should not be restored with seal leakoff temperatures greater than 235 degrees F after the pumps are tripped. RCP seal cooling is provided by seal injection flow from the charging system (CV) and Component Cooling Water (CCW) flow to the thermal barrier. Normal monitored RCP seal parameters include seal leakoff temperatures and flow, and seal injection flow from the CV charging pumps. Main Control Room(MCR) indications and process computer points monitor seal leakoff temperatures and flow. In addition, pump lower radial bearing temperatures are available via MCR indications and process computer points. RCP trip criteria for these parameters include seal leakoff temperatures greater than 235 degrees F, seal leakoff flow less than 0.2 gpm, or pump lower radial bearing temperatures greater than 225 degrees F. Normally for a loss of seal injection the 225 degree F temperature limit for the pump lower bearing temperature limit would be reached first. There is divisional separation 11(12) and 21(22) for the cables associated with these parameters. However, the concern is that a spurious actuation signal (e.g., spurious signal causing a Phase B Containment Isolation) may cause a degradation of RCP seal cooling and plant operators may not have adequate diagnostic capability to mitigate the postulated scenario. Specifically, the operators must recognize the need to trip the RCPs (if not already tripped earlier in the scenario) when seal temperatures exceed 235 degrees F, and to comply with the limitation that seal cooling should not be restored with seal leakoff temperatures above 235 degrees F.

C. Evaluation of Post-Fire Safe Shutdown Capability

A spectrum of fire severity and availability of offsite power source was evaluated to bound the most potentially significant scenarios. The spectrum considered: 1) design basis fire that quickly damages all unprotected components/cables in the area and 2) an exposure fire damaging components in a local area that does not necessarily cause a loss of offsite power or the loss of all control and instrumentation functions.

Since there are offsite power cables routed through these zones, a design basis fire scenario that quickly damages all component/cables in the fire zone (e.g., zones 11.5-0 and 11.6-0) will cause a loss of off-site power with subsequent manual reactor trip and RCP trips. A design basis fire scenario with a loss of offsite power would result in a complete loss of seal cooling, until the onsite power sources are manually restored and safe shutdown loads manually connected to the ESF buses. The RCPs would trip on the loss of power, and seal cooling would be isolated prior to restoring the charging and CCW systems to maintain seal integrity. The loss of RCP seal cooling is covered under BwOA RCP-2. This operating procedure provides the necessary guidance to isolate seal cooling and execute a controlled seal package cooldown to prevent thermal shock to the RCP seals. Catastrophic failure of the RCP seals will not occur based on Westinghouse analysis and testing. The alternate makeup flow path through the cold leg injection lines is available to maintain RCS inventory and provide for boration of the RCS during cooldown. During this phase, wide range hot and cold leg temperature indication is the primary means to monitor RCS conditions for safe shutdown.

For a postulated exposure fire that damages permanent plant equipment initially in a local area, the operators would still occupy the MCR. A single spurious valve closure would not cause a complete loss of RCP seal cooling. For a spurious valve closure that causes the loss of CCW to the thermal barrier with the RCPs running, the seal temperatures would not be expected to exceed 235 degrees F. For a loss of seal injection, the expected response would be a gradual increase in seal temperatures, since CCW flow to the thermal barriers would not be affected; but eventually the temperatures would exceed 235 degrees F at which time the RCPs would be tripped. Cables for RCP seal parameter monitoring and pump lower radial bearing temperatures instruments have divisional separation provided by routing cables for different divisions in separate cable raceways. In addition, design features or other controls such as cable trays covered with noncombustible material, IEEE 383 qualified cable, and control of permanent or transient combustible material or ignition sources help mitigate fire damage. Therefore, a simultaneous loss of all RCP seal parameter and pump lower radial bearing temperature monitoring capability is not considered credible. The operators while in the control room would have indications that the seal temperatures have increased and trip the RCPs (if not already tripped in the event.)

For fire scenarios where the loss of all RCP cooling is postulated, the loss of RCP seal cooling is covered under BwOA RCP-2. This operating procedure provides the necessary guidance to isolate seal cooling and execute a controlled seal package cooldown to prevent thermal shock to the RCP seals. Hot and cold leg temperature indication from the main control board or Fire Hazards Panel may be utilized to estimate seal temperatures during the RCS cooldown. Similarly, BwOA PRI-6 covers CCW restoration and has a similar caution for seal leakoff temperatures.

These procedures would be used for the normal case where the control room is manned.

For scenarios where evacuation of the MCR is required, hot and cold leg temperature indication is available at the Remote Shutdown Panel and the Fire Hazard Panel . However, RCP seal parameter indications may not be available. Operator response to this postulated scenario will be strengthened by enhancing procedures to require that the affected RCPs be tripped for a fire that damages permanent plant equipment in the MCR or in other zones where a loss of seal injection is postulated and seal parameter indications for those RCPs become unavailable. Also, the guidance in BwOA PRI-5 will be enhanced to include the specific temperature limitation for seal cooling and CCW restoration, and the measures to prevent thermal shock to the RCP seals.

Therefore, the safe shutdown capability described above is effective to diagnose and mitigate the consequences of fire induced spurious isolation of RCP seal cooling flow. However, some procedure enhancements are warranted to strengthen the operator response to mitigate the postulated scenario.

**RAI 4**

**Describe the safe shutdown analysis and methodology used to ensure proper re-classification of Fire Zones 11.5-0 and 11.6-0 from areas requiring safe shutdown capability to alternative or dedicated shutdown capability.**

**Response to RAI 4**

(URI 50-456/00-06-02(DRS); 50-457/00-06-02(DRS))

The safe shutdown analysis and methodology used to ensure proper reclassification of Fire Zones 11.5-0 and 11.6-0 from areas requiring normal or redundant shutdown to alternative or dedicated shutdown capability is described in Section A of the response provided to RAI 1. Also, alternatives to return these fire zones to normal or redundant shutdown capability by performing manual actions to establish temporary ventilation with portable fans are being evaluated.

RAI 5

**When the Braidwood Station's spurious operational analysis was performed, were combinations of fire induced failures (i.e., hot shorts, open circuits, and shorts to ground) considered in a single circuit, or was a spurious actuation that required more than one failure screened from further analysis?**

**Response to RAI 5**
(URI 50-456/00-06-04(DRS); 50-457/00-06-04(DRS)
(URI 50-456/00-06-05(DRS); 50-457/00-06-05(DRS))

Combinations of fire induced failures (i.e., hot shorts, open circuits, and shorts to ground) were considered. Specifically, the analysis methodology ensures that combinations of fire induced failures were considered and that a spurious actuation requiring more than one failure was not screened from further analysis, as follows:

- If a control cable for a component was present in the fire zone under consideration, the current spurious operation analysis conservatively assumed that fire induced spurious actuation of that component occurred, irrespective of the number of circuit failures necessary to cause the actuation. The spurious actuation was then evaluated to determine if it could adversely affect safe shutdown (SSD) capability or if redundant SSD equipment is available.

- If additional detailed circuit evaluation was necessary, multiple failure modes and their effect on the circuit were considered. For example, as described in Section 2.4.2.45 of the safe shutdown analysis (SSA), an engineering evaluation was completed to demonstrate that fire-induced faults on cables for the Emergency Diesel Generator (EDG) cooling water valves will not prevent the valves from opening and cannot cause spurious closure of the valves (Reference NDIT BB-EXT-0990). The conclusion that spurious closure would not occur was not based on the fact that multiple failures were required to cause the spurious actuation.

- In addition, the spurious operation analysis methodology for the SSA improvement project is similar to that described above and ensures that multiple circuit failures are considered.

RAI 6

**Can fire damage to cables associated with the Plant Process Computer (PPC) located in the Remote Shutdown Panel (RSP) rooms result in erroneous indication parameters being displayed at the RSP PPC? Specifically, can fire damage to the PPC result in operators believing RCP seal temperatures are still acceptable, when in fact they are not?**

**Response to RAI 6:**
(URI 50-456/00-06-04(DRS); 50-457/00-06-04(DRS))

All PPC data is processed in the computer room located adjacent to the Main Control Room. All graphics generation is done on the server(s) located in the computer room and the elements of the screen are sent via fiber optic network cabling to the PPC terminals, including the terminal at the RSP. This graphic transmission occurs on a minimum frequency of once every five seconds. A high level network protocol (TCP/IP) is used along this link and requires fully formed 'packets' to be transmitted from one device to the other before they will be accepted as valid data on the receiving end.

Fiber optic cable would melt 'open' under fire conditions, thereby breaking the transmission of data on the line instead of 'shorting it to ground' like a wire cable might. Given the design of the PPC system, the loss of a connection from the RSP PPC terminal to the PPC room and its associated server will result in a frozen screen, i.e. no updates will be shown on the screen. The data that is displayed at the time of cable damage will lock and will not be updated. This includes the time display in the upper left hand corner of the screen and any times associated with trends that are displayed in the Trend Page section. If the display is in this condition and a restart of the local PPC display terminal is attempted by the operator, it will fail to connect back to the PPC room and no data of any kind would be displayed at that point.

One of three scenarios can occur, and each provides enough information for the operator to make a decision to trip the RCPs.

- No fire damage to the PPC system and accurate seal temperatures will be displayed. The operator would continue to monitor seal temperatures.
- Fire damage to the PPC system occurs when the RSP PPC display terminal is not activated. The system will fail to connect if an attempt is made to activate the terminal, producing a blank screen. The operator would respond by tripping the RCPs.
- Fire damage to the PPC system occurs after the PPC terminal at the RSP is activated, resulting in locked data and time display. Upon observing the locked time display, the operator would recognize the indication to be unreliable and trip the RCPs.

Therefore, fire damage to the PPC cannot result in operators believing RCP seal temperatures are still acceptable when in fact they are not, and sufficient diagnostic capability is provided to determine if the RCPs need to be tripped due to increased seal temperatures or unavailability of indication.

## ATTACHMENT 2

**Additional Information in Response to NRC letter, "Braidwood – NRC Inspection Report 50-456/00-06(DRS); 50-457/00-06(DRS), dated January 8, 2001**

**Braidwood Station, Units 1 and 2**

**Additional Information Provided Regarding NRC Inspection Report 50-456/00-06(DRS); 50-457/00-06(DRS)**

**Comment on Section 1R05.3.b, Findings – The Effects of Associated Circuits Not Isolated from Alternative Shutdown Capability.**

The report states that a fire in the Unit 1 Auxiliary Electric Equipment Room (AEER) could produce a Containment Phase B (CISB) actuation signal and a loss of suction sources to the centrifugal charging pumps (CCPs) that would result in Reactor Coolant Pump (RCP) seal failure and a small Loss of Coolant Accident (LOCA). As a result, the inspectors concluded that the potential effects of fire damage on associated circuits related to safe shutdown components in the AEER and the resultant spurious actuation of such components was a URI (URI 50-456/-00-06-03(DRS); 50-457/00-06-03(DRS).

As previously demonstrated by evaluation of plant drawings, a fire induced spurious close signal to either of the series connected Volume Control Tank (VCT) outlet valves (1CV112B and 1CV112C) cannot be generated by a fire in the Solid State Protection System (SSPS) cabinet or AEER unless a parallel connected RWST outlet valve (1CV112D and 1CV112E) is in the open position. Therefore, a loss of suction to the CCPs is not credible since circuit configurations do not allow the VCT outlet valves to close unless a flowpath from the RWST to the CCPs is established via either valve 1CV112D or 1CV112E. Also, the associated circuits present in the AEER cannot cause a spurious closure of the RWST outlet valves, 1CV112D or 1CV112E. Therefore, a suction flowpath to the centrifugal charging pump will be available in the event of a fire in the AEER and safe shutdown capability is not adversely affected.

**Comment on Section 1.R05.1, Systems Required to Achieve and Maintain Post-Fire Safe Shutdown**

The report states "The licensee stated in the Braidwood Station's FPR, Chapter 3, "Guidelines of BT 9.5-1," that the Braidwood Station's FPP complied with the above requirements." This statement implies full compliance to the stated requirements. Braidwood Station's method of compliance to BTP CMEB 9.5-1 is stated in the Fire Protection Report (FPR) Section 3.0, Guidelines of BTP CMEB 9.5-1, column titled "Implementation or Justification for Noncompliance". The information provided in this column typically refers to other sections of the FPR that provide more detail regarding post-fire safe shutdown capability. The approved fire protection program as described in the FPR states that certain plant configurations exist where the requirements are satisfied by crediting other plant design and protection features described in FPR Section A5.8, Deviations From Section III.G of 10CFR50 Appendix R.