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SUBJECT: Responds to NRC 890914 request for addl info re post-fire safe shutdown methodology.

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AEP:NRC:0692BT

Donald C. Cook Nuclear Plant Units 1 and 2
Docket Nos. 50-315 and 50-316
License Nos. DPR-58 and DPR-74
NRC REQUEST FOR ADDITIONAL INFORMATION
POST-FIRE SAFE SHUTDOWN METHODOLOGY

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

Attn: T. E. Murley

February 21, 1990

Dear Dr. Murley:

This letter provides you a response to the NRC request for additional information (RAI) dated September 14, 1989, from Mr. J. G. Giitter to Mr. M. P. Alexich. The response provided is, however, further based on the requests made and agreements reached during a November 1-2, 1989, meeting with your staff held at Cook Nuclear Plant, as well as several subsequent teleconferences.

Attachment 1 to this letter contains a reiteration of each RAI item with our response. Where appropriate, an account of what transpired in our meeting and teleconferences related to the RAI item is provided. Also contained in Attachment 1 are responses to several issues requested by your staff during the above discussed meeting and teleconferences.

Attachment 2 contains an AEPSC position paper for "multiple high impedance faults" as requested during the November 1-2 meeting. More information regarding that attachment can be found in Attachment 1.

This letter has been prepared following Corporate procedures that incorporate a reasonable set of controls to ensure its accuracy and completeness prior to signature by the undersigned.

Sincerely,

M. P. Alexich
Vice President

MPA/eh
Attachments

A006
1/1

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ATTACHMENT 1 TO AEP:NRC:0692BT

REQUEST FOR ADDITIONAL INFORMATION

SAFE SHUTDOWN METHODOLOGY

COOK NUCLEAR PLANT, UNITS 1 AND 2

(TAC NOS. 65161 AND 65162)

1. "Will all fire barriers which are necessary to satisfy the criteria of Appendix A to Branch Technical Position APCSB 9.5-1 and Section III.G of Appendix R to 10 CFR 50 be maintained and surveilled under the provisions of the plant Technical Specifications?"

   Response

   During the November 1-2, 1989, meeting with NRR and Region III staff, the maintenance and surveillance of our Technical Specification (T/S) 3/4.7.10, "Fire Related Assemblies," was discussed. The following provides a summary of our discussion and required actions.

   The Appendix R fire barriers are being maintained and surveilled under 3/4.7.10 for Units 1 and 2. However, not all the Appendix A fire barriers as originally identified on drawings 12-5971 through 12-5983 in Revision 0 of the Fire Hazards Analysis (FHA) have been maintained and surveilled under 3/4.7.10. This is because not all Appendix A fire barriers meet the current definition of the T/S. Where the Appendix A and Appendix R fire barriers are the same, the Appendix A barriers are being surveilled in accordance with the T/S requirements. In other cases, where the Appendix A and Appendix R barriers are not the same, they are not being surveilled to T/S requirements. When a non-T/S Appendix A barrier or penetration sealing device is found to need repair, a job order is written and the repairs are begun to return the barrier or penetration seal device to proper working condition within a reasonable period of time.

   Beginning under Revision 1 of the FHA, the Appendix A fire area barriers were revised to be the same as those required for Appendix R as given in the Safe Shutdown Capability and Assessment, Proposed Modifications and Evaluations (SSCA), Revision 1, report. The Appendix R fire area barriers are shown on Drawings 12-5162 through 12-5170 of the SSCA. Fire area boundaries are subject to change as can be seen between those required under Appendix A and those required years later under Appendix R. When fire area boundaries change, the new boundaries will be maintained as fire barriers, but the old boundaries will no longer be maintained unless they also fulfill a specific fire boundary commitment made in response to Appendix A to BTP 9.5-1. Changes made to arrive at the current Appendix A/Appendix R fire area

boundaries were previously evaluated during development of the Appendix R safe shutdown systems analysis or through later boundary evaluations. Engineering boundary evaluations currently exist for combining two or more fire areas into one new fire area, adding new plant areas to existing fire areas, and for deficiencies in and variance from the requirements of Appendix A fire barriers. These evaluations and analysis are contained in the Tables 1-1 and 2-2, the engineering discussions and evaluations of Sections 2, 7 and 9, and in the fire zone/area boundary drawings given in Section 2 of the SSCA. Additional engineering evaluations, contained in AEPSC files, are provided in accordance with the criteria contained in Generic Letter 86-10.

The NRC reviewers requested that fire barriers necessary to meet our licensing commitments for Appendix A be added to the T/S. It was agreed that this would include the Appendix A to BTP APCSB 9.5-1, Section F barriers and their penetration sealing devices, as well as unrated hatches. As a result of this agreement to change the T/S wording to include these fire barriers, the NRC would permit more flexibility in compensatory measures provided for the Appendix A T/S barriers and sealing devices. We are at this time developing T/S wording, based on discussions held with your staff, for future submission.

The need for modifications of certain features of Appendix A barriers have been identified. These modifications are scheduled for completion by December 1991. Prior to this completion date, appropriate administrative controls will be implemented through plant procedures to compensate for any identified deficiencies.

2. "The licensee states that a separation analysis of the HVAC system was not required. The staff is concerned that a fire could result in the loss of ventilation to safe shutdown components, resulting in failure of redundant systems. Provide the technical justification to support the conclusion that a separation analysis was not necessary."

<u>Response</u>

As part of our analysis effort with respect to 10 CFR 50, Appendix R, certain systems were designated as "safe shutdown." For the purpose of ease of analysis, engineering judgement was used to select those systems that constituted the minimum amount of safety-related systems that could support safe shutdown and satisfy the functional requirements delineated in Appendix R. Summarized below are the results of an evaluation performed to determine the need for the HVAC function for essential safe shutdown systems to ensure their availability following postulated fire scenarios.

The following approach was taken for HVAC support corresponding to credited safe shutdown equipment:

(1) HVAC was shown to not be necessary for support of equipment operation in the post-fire shutdown scenario, or

(2) it was shown that the fire that requires use of certain safe shutdown components will not concurrently disable the HVAC corresponding to that component.

The method that is preferred is (1) above. Only when this approach did not produce satisfactory results was method (2) used.

Method (1) first required the development of time-temperature curves (TTCs) for the plant areas containing the safe shutdown equipment of concern. It was then determined whether the equipment could operate in the environment given by the TTCs for a period of 72 hours. This required an investigation into the survivability of motor oil, motor bearings, pump bearings, and other vital subcomponents of safe shutdown pumps and motors, as well as the survivability of the other equipment such as inverters and transformers.

A conservative time of 72 hours was used as the time of operation of safe shutdown equipment, both for hot standby and cold shutdown equipment. This corresponds to the time to achieve cold shutdown conditions allowed by 10 CFR 50, Appendix R. It was demonstrated by analysis, given the safe shutdown systems selected, that this requirement could be met; therefore, it is conservative to assume a 72-hour operation time for both hot standby and cold shutdown equipment. The cumulative time of operation for this equipment to achieve the required conditions was shown to be less than 72 hours. If survivability could not be verified for a particular piece of equipment, based on TTC, then a more realistic time of operation, with an appropriately documented basis, was used. For cold shutdown equipment, procedures are not required for repairs made after the 72-hour time period. Therefore, in the case of the residual heat removal (RHR) pumps, it was assumed that portable fans could be employed to provide cooling after this 72-hour period, if necessary.

If Method (1) was not successful in demonstrating survivability of a particular piece of safe shutdown equipment, then it was assumed that HVAC support is required for that equipment. An Appendix R separation analysis was then performed to determine whether HVAC control or power cabling was lost in the same fire scenario necessitating use of the safe shutdown equipment to which the HVAC corresponds. It is important to note that if HVAC cabling was assumed lost due to postulated fire in an area complying with Section III.G.3 of Appendix R (alternative safe shutdown), it would only be necessary to verify that HVAC cabling from the opposite unit did not enter that area due to the use of opposite unit equipment for Section III.G.3 compliance.

As a result of the evaluation described above, it was determined that HVAC is either not required for cooling support of safe shutdown equipment, or, if it is, then it will be available based on its meeting the separation criteria of Section III.G of Appendix R with only one exception. That exception is in the case of auxiliary feedwater, where it was found necessary to open the doors to each unit's West MDAFW pumps, due to a loss of their HVAC support, if a fire is identified in two separate fire scenarios postulated in two plant areas. A combination of conductive heat transfer and natural air circulation will limit room air temperatures sufficiently to allow continued pump operation. Neither fire scenario which required opening the West MDAFW pump room doors postulated the fire in an area adjacent to the pump rooms (i.e., door was not opened exposing equipment of concern to fire). Appropriate procedural direction has been provided to the operator for this scenario.

3. "Provide a list of any safe shutdown components, such as valve assemblies and heat exchangers, that are assumed not to be damaged by fire regardless of existing fire protection features."

<u>Response</u>

As was discussed in the November 1-2, 1989, NRC meeting, passive components include the following:

- o tanks
- o heat exchangers
- o coolers
- o gate valves
- o check valves
- o butterfly valves
- o safety valves
- o globe valves
- o needle valves
- o restricting orifices
- o strainers
- o expansion joints

Where these types of components, as well as piping, are found in safe shutdown system flow paths, they are assumed to be unaffected by the fire event.

4. "The licensee's submittal has not identified any diagnostic instrumentation as being required for post-fire-safe shutdown. This does not appear to be consistent with the methodology described. Identify such instrumentation and summarize how the taking of readings has been incorporated in the emergency shutdown procedures."

Response

Discussion of the process monitoring to be provided consistent with Cook Nuclear Plant's safe shutdown methodology is contained in Sections 4.0 and 5.0 of the original 1983 SSCA. In addition, an acknowledgement of the types of process monitoring to be provided post-fire is contained on pp. 10-11 of the November 22, 1983, NRC Safety Evaluation Report (SER). Revision 1 to the SSCA does not represent any change in the methodology for Appendix R compliance insofar as process monitoring is concerned.

The above-referenced SER further discusses that monitoring of the unaffected unit's equipment, utilized for alternative safe shutdown per the requirements of Section III.G.3 of Appendix R, is provided from the unaffected unit's control room. Although diagnostic instrumentation, per se, was not explicitly included in the Appendix R separation analysis, the availability of it can reasonably be surmised based on the general inter-unit separation of cabling and equipment.

In spite of the reasons provided above, further assurance of the availability of shutdown functions is provided via operational surveillances conducted per the safe shutdown system T/Ss submitted in AEP:NRC:0692AJ on May 30, 1986. Specifically, these proposed T/Ss are currently being implemented through a Plant Manager Standing Order (PMSO) which ensures the availability of designated flow paths, establishes pump performance criteria, and verifies adequate tank inventories (i.e., CST and RWST) for the safe shutdown methodology. In the case of the RWST, for example, calculations assuming worst-case shrinkage and spurious operator losses required a RWST make-up volume of approximately 87,000 gallons. The T/S minimum volume for the RWST in Modes 5 and 6 of 90,000 gallons will be maintained during the time the opposite unit is in an operating mode. If PMSO criteria cannot be met, compensatory measures as contained in the proposed T/Ss are taken.

Based on the above, we believe that adequate assurance of safe shutdown equipment availability, consistent with methodology delineated in the SSCA, is provided without the inclusion of further diagnostic instrumentation.

5. "For a fire in a number of locations, such as area 1, the licensee appears to be taking credit for manual actions to achieve safe shutdown. These actions are required to be taken in the fire area itself. Identify all such locations, the time to achieve this action before an unrecoverable plant condition occurs and the justification to support the conclusion that entry into the fire area is achievable."

<u>Response</u>

A study has been completed that identified manual/remote actions and their viability. In other words, the purpose of the study was to verify that all specified manual actions required to mitigate a fire event were feasible. This involved:

(1) identifying specified manual actions,

(2) determining fire scenarios that necessitated the manual action,

(3) defining access and egress routes to equipment requiring remote/manual operation, and

(4) determining the timing of and function requiring the manual action (e.g., required to achieve cold shutdown conditions).

For the purpose of this study, the fire duration is assumed to be one hour.

The conclusions reached as a result of this study were the following:

- All local/manual actions taken for components located within a fire area of concern are post-fire and, thus, are achievable.

- The Emergency Operating Procedures (EOPs) for the post-fire scenario incorporate all of the required manual actions identified.

6. "The licensee also appears to be taking credit for manual actions outside of the fire areas, such as those associated with mitigating the consequences of spurious, fire-induced signals. The staff is concerned that a sufficient safety margin of time may not be available between the occurrence of a fire and an unrecoverable plant condition that is prevented by the manual action. Identify all such manual actions that must occur within the first half hour of a fire event."

   Response

   Spurious operations of concern are identified and addressed within the EOP for emergency remote shutdown (ERS) or Appendix R safe shutdown. Those of particular concern are those identified as worst-case spurious operators on the primary and secondary sides, specifically the steam generator (SG) and pressurizer (PZR) PORVs. Worst-case operators are those on primary- and secondary-side pressure boundaries that contribute to the greatest mass flows. As such, although all spurious operators of concern are identified and addressed in the ERS procedure to ensure that the desired flow paths are established, the PZR and SG PORVs are the most limiting from the standpoint of time available to mitigate.

   Calculations have been performed, based on conservative core and RCS conditions, to determine the time available to accomplish isolation of the SG and PZR PORVs. Neither a spuriously opened SG or PZR PORV produced an "unrecoverable condition" within the first half hour of the event.

   However, an operator time study was performed to verify that, based on appropriate procedural direction, isolation was accomplished within an acceptable timeframe (based on the calculations performed). As a result of this study, worst-case spurious operators are appropriately accounted for by the ERS procedure. Further, based on the grouping of actions taken to isolate all identified spurious operators, worst-case spurious operation mitigation bounds all identified spurious operators.

7. "The licensee has not clearly described how common enclosure type associated circuits have been protected against fire damage. The licensee appears to indicate that non-fire propagating type cable insulation will preclude damage. This is not consistent with the guidance issued in Generic Letter 81-12. For these types of associated circuit indicate how the guidance in the generic letter has been satisfied."

Response

As was requested during the NRC meeting of November 1-2, we are supplementing our previous description of Cook Nuclear Plant protection against associated circuits of concern by common enclosure. The SSCA, Revision 1 discussion provided with respect to protection against "fire propagation" focused on the use of non-propagating cable jacket materials.

As was discussed during our meeting, this protection could be strengthened further by crediting the use of rated barrier configurations at cable tray penetrations through fire area boundaries. That is, where cable trays penetrate barriers designated as fire area boundaries, fire-rated penetration seals are provided to impede propagation of fire across the boundary and into the common enclosure. This, in addition to the use of non-propagating cable jacket material, should prevent the propagation of fire from one fire area, along cabling associated by common enclosure, into another fire area containing safe shutdown equipment or cabling of concern.

The discussion provided by SSCA, Revision 1 to address the "electrical protection" aspects of Generic Letter 81-12 guidance on associated circuits by common enclosure was considered to be adequate by the NRC reviewers.

8. "The licensee's assumptions regarding the low probability of three phase and single phase -a.c. faults (cases 1 and 4 of the 1987 submittal) are not consistent with the guidance issued in Generic Letter 86-10. Three phase - a.c. cable-to cable faults need be considered credible for hi-low pressure interfaces only. Describe how spurious signals resulting from such faults will be mitigated to assure the post-fire viability of the safe shutdown capability."

Response

An August 22, 1983, submittal (AEP:NRC:0692H), which supplemented our original 1983 SSCA Report, provided an extensive discussion of the methodology to be used to analyze associated circuits by spurious operation. The three-phase and single-phase a.c. faults of concern were "considered of sufficiently low likelihood that they were assumed not to require additional analyses or modification."

This position was clearly acknowledged by a November 22, 1983, SER (p. 5-6). The SER cover letter further stated the proposed shutdown capability, which relied upon the described analysis methodology, complies with the requirements of Sections III.G and III.L of Appendix R.

This issue was comprehensively discussed in a November 15, 1989, teleconference that involved NRR technical and licensing personnel. As a result of that teleconference, it was ageed that, in spite of the guidance on this issue contained in Generic Letter 86-10, we were not required to provide an analysis of hi-low pressure interfaces beyond our original licensing basis, as described in the 1983 NRC SER.

9. "The licensee states that the RHR system is required for hot shutdown and that repairs will be implemented following a fire. This is not consistent with the criteria delineated in Section III.L of Appendix R. The licensee should clarify the need for any repairs associated with achieving hot shutdown conditions following a fire."

Response

As explained in the November 1-2, 1989 meeting, the AFW system is used to proceed from hot standby to hot shutdown conditions. RHR is then used, once the appropriate RCS conditions are achieved, to proceed from hot shutdown to cold shutdown conditions. The EOP for emergency remote shutdown (ERS) instructs the operator to align RHR once RCS temperature is less than 350^{o}F and pressure is less than 363 psig (i.e., into Mode 4 or hot shutdown conditions). Therefore, it should not be interpreted that RHR is required to achieve hot shutdown. Per the requirements of 10 CFR 50, Appendix R, Section III.L.5 permits the repair of such systems (i.e., RHR) given the above. Appropriate materials and procedures to effect such repairs will be available per Section III.L.5.

A second concern raised during the NRC visit of November 1-2, 1989, dealt with the repair procedure for repowering one train of RHR from the opposite unit. The ERS procedure instructs the operators to use maintenance procedure 1-MHP-2140.082.001 (2-MHP-2140.082.002) to repower an RHR pump from the fire unaffected unit (submitted June 6, 1986, via AEP:NRC:0692AK). A caution note within this procedure instructs the plant staff to "consult with the IAG, corporate engineering support team and TSC/EOF staff to aid in selection of a temporary 4kV supply from the opposite Unit." The NRC questioned the need for the plant staff to consult these external support organizations on which source to use.

The Initial Assessment Group (IAG) at corporate and the Technical Support Center (TSC)/Emergency Off-site Facility (EOF) at the site are emergency response organizations set up to help the plant deal with emergency situations. They are of particular use in the repair procedure discussed above from the standpoint of providing engineering assistance on power source selection. This is based on an engineering evaluation of the appropriate breaker and relay settings associated with the power source to support the equipment required. Further, given the timing of the subject step (i.e., when repair of cold shutdown equipment is being effected), we do not believe that this direction presents any logistical difficulty.

10. "Provide a description as to how the hot shutdown panel area is electrically independent from the control room. The staff is concerned that a fire in this area will adversely affect the shutdown capability from the control room."

<u>Response</u>

A fire in the hot shutdown panel could possibly adversely affect shutdown capability in it's associated control room. In addition, the control room and it's associated hot shutdown panel share a common cable vault located below the control room. The hot shutdown panel was not intended, however, for use in the Appendix R safe shutdown scenario. The hot shutdown panel was originally installed per GDC-19 criteria. The remote or alternate shutdown location to the control room for an Appendix R safe shutdown scenario is the Local Shutdown Indication (LSI) panels.

The LSI panels contain the set of process monitoring instrumentation necessary to monitor safe shutdown of the plant. These panels are redundant to each other and have the ability, as described in the SSCA, to be repowered from the opposite fire unaffected unit. LSI indications are electrically and physically isolated from the control room. Physically, indication from loops 1&4 are routed separately from indications from loops 2&3. Electrically, the indications are routed to the LSI panels first and then to the control room. The LSI panel and control room current loops are isolated using I/I converters. Therefore, there is no one fire that will eliminate either all control room indication or all local shutdown indication.

11. "What precautions have been taken to preclude water from fire fighting activities from flowing down through the hatchways and damaging redundant safe shutdown systems below?"

Response

As discussed in the November 1-2, 1989 NRC meeting, our contention is redundant safe shutdown systems are not susceptible to damage from fire fighting water flowing down through hatchways. This conclusion is based on information provided to the NRC in AEP:NRC:0692BE dated October 16, 1987.

This submittal provided supplemental information to information previously submitted to support the various unrated hatches located within the Cook Nuclear Plant. Specifically, NRC staff requested information pertaining to the location of redundant safe shutdown equipment and cabling contained in areas on each side of the hatches.

As a result of examination of the details provided in Attachment 1 to the AEP:NRC:0692BE submittal, it was concluded that only cabling, redundant to equipment and/or cabling located above a hatch, is contained in the elevation below the hatch. Therefore, based on the consideration that water impingement should have no impact on the cabling used at Cook Nuclear Plant, water flow down through the hatches of concern does not pose a potential impact on safe shutdown capability.

12. "Are all proposed fire protection modifications being implemented in accordance with the applicable NFPA standards (detection and suppression system) and manufacturers installation practices (cable wraps)?"

Response

The fire detection and suppression systems proposed in Revision 1 of the SSCA have been installed using the guidance of the applicable NFPA Standards. These standards included NFPA 13, 72D, and 72E. In support of this, an NFPA code compliance review has been performed for the fire protection systems protecting safety related systems and equipment. This code compliance review included the fire detection and suppression systems proposed in Revision 1 of the SSCA. Any deviations which may have been justified have been reviewed and provided with an engineering justification or a modification has been initiated.

As was discussed in the meeting of November 1-2, 1989, our NFPA Code Deviation Report will be expanded. A review will be performed to identify fire detection and suppression systems not in the scope described above which should be added. These systems will be reviewed against the "significant" deviations that were found in our current NFPA Code Deviation Report.

As for the question regarding adherence to manufacturer's installation guidelines for one-hour rated cable wraps provided for 10 CFR 50, Appendix R, Section III.G.2(c), we do follow manufacturer's recommendations. Procedures for installation are essentially directly taken from manufacturer's recommendations.

13. "What testing, if any, has been performed on the field fabricated fire damper referenced in Section 9.7?"

<u>Response</u>

Section 9.7 of the SSCA, Revision 1, provides an engineering boundary evaluation for the installation of a "field fabricated fire" damper in the fire barrier separating Fire Area 13 (Unit 1 Diesel Oil Pump Room) and Fire Area 14 (Unit 1 Transformer Room). This damper (1-HV-DOD-1), as well as its Unit 2 counterpart evaluated in Section 9.8 (2-HV-DOD-1), were actually shop fabricated by American Warming and Ventilating, Inc. These dampers were built for installation in fire barriers having fire resistance ratings of 3 hours or more by using the design guidance of the Factory Mutual (FM) System, Loss Prevention Data Section 1-45, "Air Conditioning and Ventilation Systems". Further, these dampers are routinely tested in accordance with our Technical Specifications under Procedure 12-SHP-4030STP.009, "Inspection of Fire Dampers Protecting Safety Related Areas."

These dampers, as well as other plant fire dampers installed in fire rated assemblies, are included in our Fire Damper Closure Study. This study was requested to be performed by Region III inspectors during our February, 1989, routine safety inspection. The inspectors requested that the engineering evaluation of the 10 CFR Part 21 report for Ruskin Fire Dampers be expanded to include other manufacturers of fire dampers used at Cook Nuclear Plant. These required actions are considered an open item (315/89004-01(DRS); 316/89004-01(DRS)) pending review and acceptance of the fire damper test results. The fire rated assemblies include those required by Appendix A to BTP APCSB 9.5-1 and Appendix R to 10 CFR 50.

Other 11/1-2/89 Items

The NRC staff requested AEPSC's position on Multiple High Impedance Faults. This is shown as Attachment 2. The paper reflects current system conditions and because of these conditions the assumption is made that a high impedance fault is not a credible event for the Cook Nuclear Plant. Identical to the NRC accepted San Onofre Nuclear Plant position, it is highly unlikely that the upstream main feeder breaker would trip before the tripping of the individual branch circuit breakers because of the coordination margin provided and the low probability of the simultaneous progression of multiple high impedance faults to low impedance faults. This coordination margin is spelled out in the Nuclear Engineering Department's Engineering Guide No. 73, "Electrical Protective Device Coordination and Setting Criteria". This, coupled with the issues addressed in Attachment 2, should serve to clarify our position.

Dates were requested for completion of modifications discussed during the November 1-2, 1990 meeting. The first date requested was the date for completion of the addition of air supervision to the drumming area sprinkler system. That modification is scheduled for completion by September 1990. The other date requested was that for the addition of detection system reflash capability in the control rooms. This modification is being developed with a target completion by December 1991.

Two further issues require NRC staff action for final resolution. It is understood that the NRC will amend previous positions with respect to (1) control room carpeting, and (2) conduit sealing.

The first issue is minor in that the previous SER dated June 16, 1988, on carpeting used in the control room was, in part, based on a flame spreading value. Flame spread value is no longer ascribed to carpeting. The NRC verbally approved the new carpeting to be installed on the basis of not exceeding a radiant heat flux of 0.45 watts/cm^2. The NRC was to clarify the June 16, 1988, SER by prescribing only the parameter of radiant heat flux as acceptance criteria for carpet acceptability.

The conduit sealing SER dated June 7, 1989, was discussed during the November 1-2, 1989 meeting. The NRC staff agreed to revise several conditions contained in that June 7, 1989, SER in the upcoming SSCA, Rev. 1 SER.

ATTACHMENT 2 TO AEP:NRC:0692BT

POSITION PAPER ON HIGH IMPEDANCE FAULTS

EFFECT ON ASSOCIATED CIRCUITS

High Impedance Faults Effect On Associated Circuits

The Safe Shutdown Capability Assessment (SSCA) of Appendix R is based on the ability of circuit protective devices (fuses and breakers) to coordinate over a range of electrical faults. Generic Letter 86-10 postulates the simultaneous occurrence of sustained faults with sufficiently high impedance to limit the current in each circuit below the tripping level of the individual circuit protective device; the total fault current, however, is assumed to be above the tripping level of the protective device of the source. This would result in losing coordination and deenergizing the total load connected to this source.

Appendix R SSCA does not consider the simultaniety of multiple high impedance faults to be a credible event. In addition, evaluating the effect of multiple faults would require a detailed review of the cable routing of virtually every circuit in the plant that is associated with safe shutdwn equipment. Since multiple circuits exist in the fire zones, rerouting of a significant number of cables would be unavoidable. Such extensive modifications would impact existing conformance to isolation and separation criteria, require recalculation of seismic qualification and cable tray loading and have a generally adverse effect on overall plant safety.

EVALUATION OF PHENOMENON

Cable faults which may start as high impedance faults, rapidly evolve into low impedance (high current) faults or faults where the impedance is primarily the source and remaining circuit loop impedance, with a small component contributed by the arc itself. High impedance faults are highly unstable and either rapidly degrade to low impedance faults with a current large enough to be detected and cleared or, in low energy circuits, burn open as the faulted component melts or vaporizes. It is highly unlikely that a fault will stabilize at a current level significantly below the available circuit fault level at the point of fault. A sustained condition where two or more circuits would be undergoing this phenomona at the same time is not credible.

DISTRIBUTION SYSTEMS 600V AND BELOW

Distribution cabinets are characterized by rapid dispersion of circuits and have very few runs where many cables fed from the same cabinet are likely to be exposed to the same fire at the same time or at the same intensity. There is therefore limited opportunity for cable from the same distribution cabinet to be exposed to the same fire conditions even if the cable is located in the same fire zone. Differences in cable conductor size, insulation, jacketing and circuit rating further reduce the liklihood that the postulated conditions could occur.

Circuits fed from 600V Switchgear are run in their own embedded conduit for almost all of their run. Exposure occurs only at cable ends and intermediate pull points. This is extremely limited exposure. These are also high energy circuits where the fault would approach detectable levels very rapidly and where other circuits in the same fire zone would have to be at some significant distance due simply to the physical constraints associated with installing and providing adequate space for the associated mechanical system component maintenance.

4KV DISTRIBUTION

The main power distribution is at 4KV grounded wye. The feeds at this voltage are relatively large and are run primarily in embedded conduit. The relaying for electrical faults is a combination of phase fault, ground fault and overload protection.

The opportunity for exposure to an area fire is small due to the very limited portion of the runs that are exposed. The cable used is shielded and the shields are grounded. A fire involving this cable will predictably result in a grounded condition early in the fire. This grounded condition will be sensed by extremely sensitive ground detection relaying and the circuit will be tripped. The probability of having a sustained phase fault without involving ground is negligible. Hence the concerns of the Generic Letter are inherently accounted for in the design.

FIRE DEGRADATION MECHANISMS

Appendix R postulates an area fire with potentially total area burn out. This postulation is conservative in that it is made without consideration of the fire retardant properties of the combustible inventory and many other limiting considerations. A high impedance fault is based on the supposition that it is possible to have a condition where, over a fire area, conditions can exist that would produce a thermal degradation of the cable insulation enough to produce fault currents that are stable and of a magnitude in the range of load currents. For this to happen it would be necessary for a significant length of the affected cable to be involved and the level of degradation would have to be relatively uniform. Without these two conditions being met in some reasonably consistent relationship, the energy dissipation from fault current would produce very rapid local degradation of the remaining cable insulation and create local hot spots that would not be stable. These points of instability would predictably revert to low impedance faults or produce locally high temperatures that would cause melting or vaporization of the conduction path and ultimately circuit separation or fault extinction.

The fault mechanism described is not stable for one cable. The assumption that this mechanism could exist in multiple cables at the same time is not credible.

Sprinklers are provided in most areas of the plant. Introduction

of water onto burning cables would cause rapid transition from a high impedance fault to a bolted or solid fault.

In reality, there are not many areas of the plant where many cables fed from coordinated distribution cabinets share long runs in common fire areas; each cable will have a different set of parameters relating to its exposure to the fire, local heatsinks, other cables and its own makeup. Most cables entering a given fire area will do so at different points (plan and elevation), making the argument for coincidence even more untenable.

RECOMMENDATIONS

The generic letter GL 86-10 postulates a fault potentially affecting associated safe shutdown circuits that is unlikely to happen and does not justify detailed evaluation.

The plant in its current state, with its emergency procedures in place to handle unspecified failures that might result from a fire or attempts to contain and extinguish a fire, is adequately prepared to deal with such a low probability event.

No action should be taken in respect to the Appendix R assessment or with respect to plant emergency procedures in response to the issue raised in GL 86-10 relating to postulated high impedance faults.

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Approved R. C. Carruth — R. C. Carruth   Date 6/17/88

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