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Docket Nos. 50-315
and 50-316

Mr. John Dolan, Vice President
Indiana and Michigan Electric Company
c/o American Electric Power Service Corporation
1 Riverside Plaza
Columbus, Ohio 43216

Dear Mr. Dolan:

SUBJECT: FIRE PROTECTION RULE-ALTERNATE SAFE SHUTDOWN CAPABILITY-SECTIONS III.G.3 AND III.L OF APPENDIX R TO 10 CFR 50-DONALD C. COOK NUCLEAR PLANT, UNIT NOS. 1 AND 2

We have completed our review of the subject as noted above based on your submittals dated March 27, 1981, March 31, 1983, and August 22, 1983. Our enclosed Safety Evaluation provides the results of our review. The alternate safe shutdown of Donald C. Cook Nuclear Plant, Unit Nos. 1 and 2, in the event of a fire, was evaluated against the requirements of Sections III.G and III.L of Appendix R to 10 CFR Part 50.

Based on our review, we conclude that the Donald C. Cook Nuclear Plant alternate shutdown methods meet the performance goals for reactivity control, reactor coolant inventory makeup, reactor heat removal, monitoring of shutdown and support functions. Therefore, we conclude that the Donald C. Cook Nuclear Plant proposed alternative shutdown capability complies with the requirements of Sections III.G and III.L of Appendix R. However, since the proposed capability relies on shutdown procedures for coordinating the activities of two units, we require that the final procedures be submitted to the NRC for review and that the Technical Specifications for alternative shutdown capability be submitted to the NRC prior to completion of the plant modifications for approval. The schedule for you to complete required modifications is specified in 10 CFR 50.48(c)(4). Compliance with the Fire Protection Rule will be the subject of future Commission inspections.

Sincerely,

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Steven A. Varga, Chief
Operating Reactors Branch No. 1
Division of Licensing

Enclosure:
Safety Evaluation

cc w/enclosure:
See next page

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DATE			11/17/83	11/22/83	11/27/83		

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D. C. COOK NUCLEAR POWER PLANT, UNITS 1 & 2

SAFETY EVALUATION REPORT

ALTERNATIVE SHUTDOWN CAPABILITY

INTRODUCTION

On February 17, 1981, the fire protection rule for nuclear power plants, 10 CFR 50.48 and Appendix R to 10 CFR 50 became effective. This rule required all licensees of plants licensed prior to January 1, 1979, to submit by March 19, 1981: (1) plans and schedules for meeting the applicable requirements of Appendix R, (2) a design description of any modifications proposed to provide alternative safe shutdown capability pursuant to Section III.G.3 of Appendix R and (3) exemption requests for which the tolling provisions of Section 50.48(c)(6) were to be invoked. Section III.G of Appendix R, "Fire Protection of Safe Shutdown Capability" was retrofit to all pre-1979 plants regardless of previous SER positions and resolution.

By letter dated March 27, 1981, the licensee indicated that modifications were not required to provide alternative safe shutdown capability for the D. C. Cook plants. An NRC inspection of the plants identified a number of concerns with the safe shutdown capability. Subsequent to the inspection, the licenseee, by letter dated March 31, 1983 submitted the results of its reassessment of the safe shutdown capability to the requirements of

Section III.G of Appendix R and a description of proposed modifications to provide alternative shutdown capability. Additional information was provided by a letter dated August 22, 1983.

EVALUATION

A. Systems Used for Post-Fire Safe Shutdown

In the event of a fire concurrent with a loss of offsite power, the following systems are used to provide the shutdown capability for one unit. Reactor shutdown is initiated from the control room by a manual scram of the control rods, if an automatic scram has not occurred. Reactor coolant inventory and reactor shutdown reactivity are maintained by one of two centrifugal charging pumps taking suction from the refueling water storage tank. Primary system pressure is maintained by use of the pressurizer heaters. Overpressurization protection is provided by the pressurizer safety-relief valves.

For hot standby/shutdown, decay heat removal is accomplished by the auxiliary feedwater system supplying water to the steam generators from the condensate storage tanks. One of three auxiliary feedwater pumps is needed for decay heat removal. The essential service water system provides an

additional water source for the auxiliary feedwater system. The atmospheric dump valves or the code safety valves are used to remove heat from the steam generators. For cold shutdown, decay heat removal is accomplished by the residual heat removal (RHR) system in conjunction with the component cooling water system and the essential service water system. Cold shutdown can be achieved within 72 hours.

The above systems are supported by the component cooling water (CCW) system and the essential service water (ESW) system. The CCW system provides cooling for the charging pumps, the RHR pumps and heat exchangers and the reactor coolant pump thermal barrier heat exchangers. The CCW system for each unit consists of two trains, each with a pump and heat exchanger. A fifth CCW pump, a spare swing pump, is available to replace any CCW pump in either unit. The ESW system which is shared by the two units, consists of four pumps utilizing two main headers. The ESW system provides cooling to the CCW heat exchangers and the diesel generator heat exchangers. The diesel generators and associated electrical distribution system supply the essential power for the shutdown systems. There are two diesel generators for each unit. The above systems are normally controlled and monitored from the control room. In the event of a fire resulting in loss of the control room, alternative means of controlling and monitoring these systems are provided.

B. Associated Circuit Protection

To assure the availability of the above systems following a fire, the licensee identified associated circuits that could prevent operation or cause maloperation of shutdown systems and equipment. For identified associated circuits, protection for the safe shutdown systems was provided in accordance with NRC guidelines as outlined in the following paragraphs.

1. Power Source Case - The licensee indicated that all circuits in the emergency power system (diesel generators) were reviewed to assure proper coordination of protective breakers and fault interrupting devices. The emergency power system is utilized to supply the essential power for the post-fire shutdown systems. Coordination of circuit protective devices was part of the original electrical system design of the D. C. Cook plants. Thus, by design of the plant, associated circuits of this type should not exist. Additionally, the licensee will verify coordination for the safe shutdown power supply system.

2. Spurious Signal Case - The licensee identified a number of circuits where fire-induced failures may adversely affect the safe shutdown capability. In identifying

associated circuits of concern, the licensee reviewed control circuit electrical interlocks between shutdown circuits and other circuits. A Failure Mode and Effects Analysis (FMEA) was then performed to determine if fire-induced failures of these interlocks could adversely impact safe shutdown. Further, the licensee reviewed plant systems to identify any component which had the potential for adversely affecting safe shutdown. A FMEA was performed on these components to determine if fire-induced circuit failures could result in the component being in an unacceptable state. Unacceptable in the sense that it adversely impacts shutdown. The licensee eliminated some failure modes from consideration, based on their low probability of occurrence as discussed in the following paragraphs.

The licensee did not consider three-phase ac power circuit cable to cable faults, two wire ungrounded dc power circuit cable to cable fault (250V); two wire ungrounded dc control curcuit cable to cable faults (250V), and one phase ungrounded ac control circuit cable to cable faults (220V). For the case of the three phase circuits, the licensee indicated that two power circuits, one of which is energized and the other in nonenergized, would

need to be damaged by the fire such that power would be supplied to the nonenergized circuit. The licensee indicated that for three phase circuits, this failure was unlikely. For the case of the two wire dc power circuits, two power circuits, one of which is energized and the other is nonenergized would need to be damaged by the fire such that power would be supplied to the nonenergized circuit. Since the dc power system is a nongrounded system, the short of the two circuits would have to occur prior to one of the circuits being shorted to ground. For the cases of the two wire ungrounded dc control circuit and the one phase ungrounded ac control circuits similar conditions exist. For the dc or ac circuits supplied from different sources at least two electrically independent cable to cable shorts without grounding must occur. For the dc or ac circuits supplied from the same source, two independent cable to cable shorts without grounding must occur because of the Cook design which requires that the control switch and relay contacts "double break" the positive and negative control leads for components whose spurious operation could affect safe shutdown. Therefore, the above failure modes were not considered based on their low probability of occurrence.

For the identified associated circuits of concern the licensee proposed methods for protecting the safe shutdown capability consistent with the severity of the problem. For example, for spurious operation of components which could divert auxiliary feedwater flow, the licensee proposed removing power to those components by operating the plant with the appropriate circuit breaker open. For other components, the shutdown procedures will require isolation of the components; thus, limiting the impact of spurious operations. For cold shutdown, procedures will verify proper alignment to correct any spurious operations. Further, for prevention of a possible fire induced LOCA, the power for one of the redundant electrically controlled valves at the high/low pressure interface of the reactor coolant system and the RHR pump suction line, will be removed by opening the breaker for either valve during normal operation.

3. Common Enclosure Case - The licensee indicated that electrical circuit fault protection was provided by protective relaying, circuit breakers and fuses as part of the original plant design of the electrical system. These circuit fault protective devices prevent cable

removal, process monitoring and support for the above functions: 6N, 6S, 14, 20, 40A, 40B, 41, 42A through D, 44N, 44S, 45, 46A through D, 47A, 47B, and 53 through 60. These fire zones of both units include the control rooms, the cable vault areas, the switchgear cable vaults, the switchgear and motor control rooms and the transformer rooms.

For the reactivity control function, the charging systems of the two units will be connected by a four-inch line between the centrifugal pump discharge headers. Each unit's charging system consists of two high-head centrifugal pumps with only one pump needed for a unit's post-fire shutdown. The piping connections between the units' systems will be normally isolated by two manual valves. The alternative shutdown capability will also utilize the crossties between charging systems for the reactor coolant makeup function. For primary side pressure control, the alternative shutdown capability will utilize repairs to establish pressurizer heaters. Repairs to the pressurizer heaters power cables provides operational flexibility to operators. The pressurizer heaters are not required for shutdown. The plant

will have the capability of proceeding to cold shutdown as the plant depressurizes. Use of the heater extends the time before depressurization.

For hot standby/shutdown, the alternative shutdown capability will utilize the existing crossties between the motor-driven pumps of each unit's auxiliary feedwater system, for decay heat removal. The connections between the two units' system are normally isolated by manual valves. Flow to the steam generator will be controlled by manual control of the affected unit's steam generator inlet valves. For heat removal from the steam generators, the alternative shutdown capability will utilize manual operation of the atmospheric dump valves from local control stations. Control will be provided by pneumatic valve loading control with backup motive power from the plant N_2 distribution header. For cold shutdown, repairs to the power cables for one residual heat removal pump of the fire affected unit will be used to provide alternative shutdown capability.

For the process monitoring function for each unit's alternative shutdown capability, the licensee proposes use of four instrument panels. Each of the instrument panels will have

the capability of being powered from either unit's emergency power system. Two panels are located adjacent to the local controls for the steam generator inlet valves and the atmospheric dump valves. These two panels provide monitoring for reactor coolant hot and cold leg temperatures and steam generator pressures and levels for their respective loops. The additional two panels are centrally located and will be used for coordination of shutdown activities. One panel provides monitoring for reactor coolant pressure, pressurizer level, charging flow and letdown flow. The other panel provides monitoring for reactor coolant hot and cold leg temperatures and steam generator pressures and levels for each of the four loops and source range neutron flux. Additionally, monitoring of the unaffected unit's equipment is provided from the unaffected unit's control room.

The alternative shutdown capability will utilize the unaffected unit's component cooling water (CCW) system, essential service water system and emergency power system (EPS) to provide the necessary support functions. For hot shutdown, the CCW system, the ESW system and the EPS provide support to the unaffected unit's equipment which is being used for alternative shutdown. Additionally, the EPS is capable of

powering the fire-affected unit's four alternative instrument panels. For cold shutdown, the CCW and the ESW systems of the unaffected unit will be manually aligned to provide cooling for one residual heat removal (RHR) pump and heat exchanger of the fire-affected unit. Additionally, the RHR pump will be re-powered from the unaffected unit's EPS.

The licensee has committed to provide a shutdown procedure describing use of the alternative shutdown capability. The shutdown procedure involves use of three operators from the fire-affected unit and some operator functions from the unaffected unit's control room. The three operators will initially manually isolate the primary and secondary systems and manually align the cross-ties for the charging and auxiliary feedwater systems. The control room operators of the unaffected unit will start the unaffected unit's motor-driven auxiliary feedwater pump and maintain operation of the unaffected unit's equipment being used (CCW, ESW, charging system and EPS). The three operators of the fire-affected unit will control charging and auxiliary feedwater flow to achieve and maintain hot standby. The procedure will also describe the operation necessary to achieve cold shutdown.

The alternative shutdown capability will utilize two repair activities for safe shutdown. As described above, repair of the pressurizer heaters is used to provide operational flexibility. Permanently installed power cabling between the pressurizer heater containment penetration area and a 480V MCC cubicle powered from the alternate unit will be provided. The post-fire repair will consist of disconnecting the damaged cabling and connecting the repair cable from the penetration area. The pressurizer heaters would then be powered from the alternate unit. All tools and procedures needed for the repair activity will be stored with the cabling in the penetration area. Repair of the power source for one RHR pump is utilized to achieve and maintain cold shutdown. The repair consists of interrupting the power supply to one of the unaffected unit's RHR pump and rerouting the power supply to the fire-affected unit's RHR pump. The rerouting of power cabling will result in one RHR pump from each unit being powered from the unaffected unit's emergency power system. The material, tools and procedures for the repairs will be stored onsite.

Method 2 - For the following fire zones of Units 1 and 2, the alternative shutdown capability utilizes the proposed crosstie between the two units charging systems to provide the shutdown functions of reactivity control and reactor coolant makeup: 62A through C and 63A through C. These fire zones are the respective charging pump areas for each unit. As described above, the charging systems of the two units will be connected by a four-inch line between the centrifugal pump discharge headers. Thus, in the event of a fire causing loss of one unit's charging pumps, one pump from the unaffected unit will supply the reactivity control and reactor coolant makeup functions via the crosstie. All other shutdown functions are unaffected by a fire in these areas. Safe shutdown will be controlled from the control room.

Method 3 - For the following fire zones of Units 1 and 2, the alternative shutdown capability utilizes the shared features of the essential service water (ESW) system to provide the necessary support function for safe shutdown: 29A through F. These fire zones are the respective service pump areas for each unit. The ESW system which is shared by the two units consist of four pumps utilizing two main headers. Two operable pumps are sufficient for heat removal loads of two

units. The licensee proposed cable rerouting and installation of isolation relays to assure separation of the two units' pumps. Thus, in the event of a fire causing loss of one unit's service water pumps, the unaffected unit's pumps will supply the cooling for both units. All other shutdown functions are unaffected by a fire in these areas. Safe shutdown will be controlled from the control room.

Method 4.- For the following fire zones of Units 1 and 2, the alternative shutdown capability utilizes local control of the atmospheric dump valves to provide the decay heat removal function: 15, 18, 33, 34, 38, 39 and 52. A fire in these areas could result in either loss of the atmospheric dump valves control circuit or loss of emergency power supply for the atmospheric dump valves. Alternative control will be provided at local panels by pneumatic valve loading control with backup motive power from the plant N_2 distribution system. The valves could also be operated by existing manual handwheels. All other shutdown functions are unaffected by a fire in these zones except for zones 15, 18, 38 and 39. For these four zone portions of the shutdown monitoring function could also be damaged by a fire. The alternative capability for these zones is described in the following paragraphs.

Method 5 - For the following fire zones of Units 1 and 2, the alternative shutdown capability utilizes alternative instrument panels to provide portions of the process monitoring function: 10, 15, 18, 24, 38, 39, 66, 67, 74, 75, 120 through 123. A fire in these areas could result in loss of reactor coolant hot and cold leg temperature instrumentation cables or the power supply for the instrumentation. As described above, the licensee will install instrument panels for each unit which will provide monitoring for reactor coolant hot and cold leg temperatures and steam generator pressures and levels for each of the four loops. The instrumentation circuits for the remote panels will be separated from the present reactor coolant temperature instrumentation circuits in accordance with the separation criteria of Appendix R. All other shutdown functions are unaffected by a fire in these zones except as previously identified.

E. Technical Specifications

The alternative shutdown capability of one unit relies on the equipment of the opposite unit. Therefore, the technical specifications (T.S.) covering the alternative equipment for both units must be coordinated to assure availability of alternative equipment when one unit is operating. The

licensee's review of its T.S. indicated that only for operating modes 4, 5 and 6 (shutdown modes) some equipment availability is not covered by T.S. The equipment not completely covered by T.S. includes the charging system, the motor-driven auxiliary feedwater pumps, the component cooling water system and the essential service water system.

The licensee proposed the following guidelines for modifying its T.S. Whenever one unit is in operating modes 4, 5 or 6 and the opposite unit is in operating modes 1, 2 or 3, the unit must maintain sufficient equipment available to support its operating mode and the alternative shutdown capability of the opposite unit. With insufficient equipment available, the minimum capability must be restored within 72 hours or establish a daily fire inspection of the opposite unit's areas which require alternative shutdown capability and verify operability of the fire detection and suppression equipment for those areas. If the minimum capability can not be restored within 30 days, the licensee must report the event and outline proposed corrective actions.

We have reviewed the licensee's proposed guidelines and it is our position that the guidelines for T.S. may allow seven days to restore the minimum capability; however; we

recommend a fire inspection of the opposite unit's areas once every shift. Additionally, the plant must restore the minimum capability or bring the opposite unit to cold shutdown within 30 days.

CONCLUSION

Based on our review, we conclude that the licensee has adequately identified the systems needed for post-fire safe shutdown and analyzed associated circuits to assure availability of the post-fire shutdown systems. Additionally, we conclude that the alternative shutdown methods proposed for various fire zones of Units 1 and 2 meet the performance goals for reactivity control, reactor coolant inventory makeup, reactor heat removal, monitoring of shutdown and support functions. Therefore, we conclude that the design of the alternative shutdown capability complies with the requirements of Sections III.G and III.L of Appendix R. However, since the alternative shutdown relies on shutdown procedures for coordinating the activities of two units, we will require the licensee to submit the final procedures for NRC review. Additionally, we will require technical specifications for the alternative shutdown capability be submitted prior to completion of the plant modifications. We will provide separate evaluations for both the procedures and the technical specification.