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RECIP.NAME RECIPIENT AFFILIATION
DENTON,H.R. Office of Nuclear Reactor Regulation, Director

SUBJECT: Forwards response to 810225 Generic Ltr 81-04 re station blackout event.Units can maintain reactor coolant sys inventory & provide decay heat removal w/only dc power available.

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BOWLING GREEN STATION
NEW YORK, N. Y. 10004

July 7, 1981
AEP:NCR:00537

Donald C. Cook Nuclear Plant Unit Nos. 1 and 2
Docket Nos. 50-315 and 50-316
License Nos. DPR-58 and DPR-74
Station Blackout; Generic Letter 81-04

Mr. Harold R. Denton, Director
Office of Nuclear Reactor Regulation
U. S. Nuclear Regulatory Commission
Washington, D. C. 20555

Dear Mr. Denton:

This letter provides our response to Mr. D. G. Eisenhut's Generic Letter 81-04 dated February 25, 1981. The response to the specific items requested in the Generic Letter is presented in the attachment to this letter.

We have reviewed our capability to mitigate a station blackout event at the Cook Plant and conclude that, within the scope of our assumptions, we can maintain the Reactor Coolant System (RCS) inventory and provide decay heat removal with only DC power available. This review considered the effects of loss of auxiliary systems on the equipment necessary for operation of the protection circuits and the RCS heat removal function. While total loss of AC power is not specifically a design basis event, the Cook Plant has substantial resistance to this event and even if it occurs, there is reasonable assurance that adequate core cooling can be maintained.

Current procedures provide the ability to maintain: a) the decay heat removal function with only DC power available by use of the Turbine-Driven Auxiliary Feedwater Pump (TDAFP) train and our demonstrated local shutdown system; and b) the integrity of the reactor coolant pressure boundary. The DC power requirement for the TDAFP train was stated in Question 040.8 and 040.13 of FSAR Appendix Q (Unit 2). In the response to Question 040.13 we stated that we would convert the trip and throttle steam admission valve to the TDAFP, and the four motor-operated feedwater supply valves from the pump to the steam generators, from AC to DC operation before the first Unit 2 fuel reloading. This change was accomplished in accordance with our

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Unit 2 Operating License Condition 3.k. This change was implemented in both Units of the Cook Plant and augments our local shutdown capability. An additional battery (train N) was installed in each Unit to be used with the TDAFP train as detailed in FSAR Amendment No. 84 (AEP:NRC:00176). The subsequent issuance of License Amendments No. 16 for Unit 2 and No. 35 for Unit 1 by the NRC documents the NRC's safety review of this matter.

Very truly yours,

R. S. Hunter
Vice President

/os

cc: John E. Dolan - Columbus
R. C. Callen
G. Charnoff
R. W. Jurgensen
D. V. Shaller - Bridgman
NRC Region III Resident Inspector - Bridgman
Joe Williams

STATE OF NEW YORK)
)
COUNTY OF NEW YORK)

R. S. Hunter being duly sworn, deposes and says that he is the Vice President of Licensee Indiana & Michigan Electric Company, that he has read the foregoing response to Generic Letter 81-04 and knows the contents thereof; and that said contents are true to the best of his knowledge and belief.

[signature]

Subscribed and sworn to before me this 7th day of July, 1981.

[signature]
Notary Public

KATHLEEN BARRY
NOTARY PUBLIC, State of New York
No. 41-4606792
Qualified in Queens County
Certificate filed in New York County
Commission Expires March 30, 1983

ATTACHMENT TO AEP:NRC:00537

Response to Item a:

The Auxiliary Feedwater System (AFS) flow design basis includes the Station Blackout event as described in our letter No. AEP:NRC:00300C dated November 3, 1980 responding to Enclosure 2 of Mr. Eisenhut's October 30, 1979 letter. The necessary equipment to maintain the reactor coolant inventory and heat removal function includes the redundant onsite safety related station batteries ("AB" and "CD"), vital bus static inverters, Turbine Driven Auxiliary Feedwater Pump (TDAFP) train which is DC powered by its own dedicated safety related battery (train "N"), necessary control room instrumentation for maintaining the plant in hot standby until AC power is restored, emergency lighting, emergency communication equipment, and equipment necessary for cooling the TDAFP. All of the above equipment operates independently of AC power.

Assuming loss of all AC power, the TDAFP train is automatically actuated by the reactor coolant pump bus undervoltage signal or by the low-low steam generator water level signal in any two of four steam generators, and supplies emergency feedwater to cool the tripped reactor. These actions are initiated by the protection system, occur without a dependency on AC power, and are sufficient to enable the plant to remain in a safe hot standby condition with natural circulation cooling. Core heat is removed via the steam generators through their safety valves or their power-operated relief valves (PORVs). The PORVs include provisions for remote manual operation as part of our local shutdown system. The monitoring of critical plant parameters can be accomplished from the control room since the vital instrument buses and protection circuits are not dependent on AC power.

The ventilation systems for the TDAFP rooms, vital bus static inverter rooms and main control room are AC-powered. The TDAFP manufacturer has not been able to evaluate the performance of the pump when ventilation is not available. Operability of the TDAFP bearing depends on the bearing lubricating oil properties. However, if the temperature increase in the TDAFP room excessively shortens the pump bearing life, then a cooling water source that is not dependent on AC power can be provided. In addition, the TDAFP overspeed trip control is sensitive to excessive temperature increases above its design rated temperature, as would be typical of an extended loss of ventilation. A guideline can be instituted once the Westinghouse Owners' Group guidelines for Station Blackout are issued to allow this trip to be disabled at the indication of excessively high room temperature.

The Plant emergency lighting is powered either from the station batteries or by individual eight-hour battery packs. The Plant has available portable radios to maintain emergency communications.

The four vital bus static inverters will operate to supply power from the station batteries to the control room instrumentation. As a result of the assumed normal electrical load on the inverters, a certain heat load will be generated in the static inverter room and control room. Using the maximum heat loads for the two full instrumentation trains and worst case summer weather data for the Cook Plant area, a conservative analysis was performed to derive the temperature transient which will occur in the static inverter room and the control room without their ventilation systems functioning. The results of this analysis show that the room temperatures will eventually exceed the continuous rating temperature of the electrical equipment located in the rooms. Thus, an extended loss of AC power could create a situation where the design life of monitoring instrumentation and/or its power supply (static inverter) will be shortened, or perhaps will eventually cause equipment failure. Instrumentation devices in the control room that are not needed for continuous monitoring of safety parameters can be turned off thereby decreasing the heat load in both the control room and the inverter room. In addition, since only one train of monitoring equipment (or a portion of one train) is all that is necessary, the redundant train can be shut down temporarily to allow it and its inverter room to cool down. The shut off train can then be re-energized and the other train can be shut down for a cooling period thereby not allowing any of the equipment to exceed its continuous rating temperature. This switching action between redundant trains or the necessary portions thereof can be accomplished from the control room and could eliminate the need to provide forced air cooling in the rooms. Room air temperature will have to be monitored and communicated back to the control room until offsite or onsite AC power is restored. The proposed course of action will further extend the battery capacity as well as reduce the heat loads.

The effect of losing Component Cooling Water (CCW) to the Reactor Coolant Pump (RCP) thermal barrier and losing seal injection has also been evaluated in conjunction with a loss of all AC power. Operating procedures for the RCP for loss of all AC power are incorporated in the D. C. Cook Plant procedures. These procedures conform, in general, to the procedures outlined in the "Westinghouse Instruction and Operating Book" for the Reactor Coolant Pumps, which outline necessary actions upon loss of seal injection water and how to return the pump to operation (the latter is discussed in the response to Item g). The D. C. Cook Plant procedures require that the number one seal leak-off valves (QRV-10, -20, -30, -40) be closed immediately upon loss of AC power. These fail-open air-operated valves may reopen a short time later as the air pressure decreases due to the loss of AC power. It would therefore be necessary to manually close either QCM-350, CS-357, or CS-361 from the Auxiliary Building before the air supply is greatly reduced. The maximum flow rate through the RCP seals following loss of all AC power should be 5 gpm per pump. Utilization of the above valve lineup keeps the number two seal in direct service, reducing the flow below 5 gpm. The flow rate of 5 gpm can be used as a conservative figure for estimating the time to empty the pressurizer and the onset of the transition from water-solid natural circulation to a reflux cooling mode. However, it is highly unlikely that all four pumps would have a flow rate of 5 gpm; several of the pumps can be expected to have lower flows.

In summary, we believe that the inherent design of the Plant, plus our existing procedures and training, would allow us to maintain the reactor in a safe shutdown condition on natural circulation cooling for a certain length of time until a source of AC power is restored.

Response to Item b:

During a station blackout event, decay heat removal is maintained by use of the TDAFP train, which does not require AC power to operate. Therefore, the time available to restore AC power is limited by the capacity of the station batteries to supply DC power for the necessary monitoring instrumentation. This time is conservatively estimated to be three hours assuming full normal battery loads and is based on conservative design requirements for the length of time each respective instrumentation device must be available. If any device is used for a period of time less than the assumed design value, battery capacity will be available for a period longer than three hours. In addition, the switching action between redundant trains of instrumentation discussed in item (a) above will further extend battery life for longer than three hours.

Response to Item c:

AEP's System Operations Department is preparing procedures for restoration of the electrical grid, giving the Cook Plant priority in the process.

Once the grid has been restored, restoration of AC power to the safety buses can be accomplished through the Preferred Offsite power source, the Alternate (emergency) Offsite power source, and the Normal Auxiliary power source as described below. In all cases, power would be re-established by sequentially energizing transformers and buses from the power source to the load.

1. Restoring AC Offsite Power Through the Preferred Offsite Power Source

   This source consists of two parallel paths for feeding power to the auxiliary buses. Redundant devices exist from the 765/345 kV substations to the 4 kV safety buses (transformers, feeders and circuit breakers) such that any single failure cannot eliminate power to both plant safety trains. Furthermore, switching arrangements and installed emergency ties (at the 34.5 kV level) facilitate restoration of the safety train that may have been temporarily lost.

2. Restoring AC Offsite Power Through the 69 kV Alternate Offsite (Emergency) Power Source

   During the event the operator would verify that the 4 kV Recloser circuit breaker at the 69/4 kV substation is closed and then proceed to close the safety bus emergency power supply breakers in the plant.

3. Restoring AC Offsite Power Through the Normal 26 kV Auxiliary Power Source

Actions to be taken in this case would be to remove the generator links and backfeed the auxiliary buses from the 345 kV substation through the 345/26 kV step-up transformer and 26/4 kV normal auxiliary power transformers.

Response to Item d:

There are several routes through which offsite AC power may be provided to the safety buses when onsite power is lost. For each route, there are various devices whose failure may interrupt power to the safety buses through that particular route.

1. Failure of Preferred Offsite Reserve Power Source

No single failure can disable this power source to both plant safety trains. If the main reserve power Transformer Bank #4 (765/345/34.5 kV) or a power cable are lost, automatic switching will isolate the faulted device. Manual switching will reconnect the auxiliary buses to the alternate transformer source (345/34.5 kV Transformer Bank #5) and then to the Preferred Offsite power source. Likewise, if a 34.5 kV circuit breaker fails, automatic switching will isolate the faulted device and manual switching will make an alternate route available.

If a 34.5/4 kV power transformer on one of the two trains fails, the other reserve power source train will still be available. One or more of the alternate routes discussed in item (c) above, and the emergency onsite AC power sources (trains AB and CD diesel generators) may also be available. In the meantime, the faulted transformer can be repaired. Also, an existing onsite 34.5/4 kV spare transformer can be used to replace the faulted transformer. Alternatively, a portable transformer of sufficient capacity can be installed and the faulted transformer by-passed. If a 4 kV feeder breaker or a 4 kV feeder cable connecting the respective 34.5/4 kV power transformer to the feeder breaker fails, the second path to the auxiliary buses on the same train is momentarily disabled. Power to safety buses can be supplied from the 69/4 kV Alternate Offsite (emergency) power source. The faulted device can be isolated, repaired, or replaced. The power source for the other train is left intact.

2. Failure of the 69 kV Alternate Offsite (Emergency) Power Source

Loss of this source may be a consequence of the loss of the cable connection between the substation and the safety bus feeder breakers or because one or more of these feeder breakers have failed. In the event of such a failure, some other route for feeding the safety buses should be used (eg., the normal or preferred routes). If no other routes are available and the emergency onsite diesel generators are not available, the faulted cable can be replaced to restore power to the safety buses. The faulted breakers can also be pulled and replaced with operable breaker elements from neighboring breaker cabinets.

Response to Item e:

Under blackout conditions all safety bus breakers trip, including the safety bus feeder breakers. Starting (or re-starting) the diesel generator results in closing of the safety bus diesel generator feeder breaker and sequential loading of the safety bus.

If there is a diesel generator start failure or failure to accept load, the source of the problem would be identified and rectified. The diesel generator would then be re-started and loaded through existing circuitry. Our design permits both manual and automatic starting and control of the diesel generator and its load. This operation can be accomplished from the control room or locally from the diesel generator room subpanel. Emergency lighting (eight-hour battery packs) and communications are available to perform this function locally. The capability exists for multiple diesel generator starts in either train.

Response to Item f:

The plant control room is equipped with 250 volt DC emergency lighting fed from the safety-related plant batteries. Furthermore, all essential areas of the plant (switchgear rooms, MCC rooms, diesel generator rooms, auxiliary feedpump rooms, access and egress routes, etc.) are equipped with eight-hour battery pack lighting. Both emergency lighting and battery pack lighting are automatically established after blackout conditions.

Response to Item g:

The D. C. Cook Plant procedures incorporate instructions that prevent thermal shocking of the RCP shafts. The procedures require that if CCW and seal injection are not available for more than five minutes, the seal injection should be valved out at the seal injection filters. In addition, seal injection is not re-started until at least one half hour after the CCW to the thermal barrier has been re-established. This allows the pump shaft to be cooled down prior to coming in contact with relatively cold water, and prevents the potential for bowing of the shaft. Procedures also require that the pump shaft be manually rotated prior to re-starting the pump with AC power.

The operators will have sufficient time to monitor ESF system and containment parameters and to disable ESF system functions, if necessary, prior to the restoration of AC power to avoid possible unwanted ECCS actuation and/or containment spray.

Consideration of Emergency Procedures and Simulator Exercises for the Annual Requalification Training Program

The annual requalification training program includes an annual review of all abnormal and emergency operating procedures. In addition, special training sessions have been conducted to review the emergency procedures revisions resulting from the Westinghouse Owners' Group post-TMI analysis efforts. Most of the procedural changes were to make accident mitigation more symptom-oriented as opposed to the perfunctory performance of procedural steps. We have also contracted with Westinghouse to conduct a "Mitigating Core Damage Course" to train Operations personnel how to readily recognize potentially hazardous operating conditions and best utilize installed equipment and systems to control or mitigate core damage. This training will be accomplished during July and August, 1981.

The requalification program includes annual simulator training sessions. The simulator training exercises have included loss of offsite AC power with decay heat removal accomplished by natural circulation and the auxiliary feedwater system. We will pursue with our simulator training contractor and the Westinghouse Owners' Group the possibility of including simulator exercises involving loss of all AC power (station blackout) with decay heat removal by natural circulation and the use of the AFS with only the turbine driven auxiliary feedwater pump.

Our review of Mr. Eisenhut's letter has shown us that several possible mitigating actions will require procedural modifications and further analysis of the behavior of the RCS during a total loss of AC power. However, we will postpone a further review and analysis of the behavior of the Cook Plant under a total loss of AC power event until the Westinghouse Owners' Group analysis and guidelines have been issued. This effort is currently expected to be completed by approximately October, 1981. Total loss of AC power constitutes an unlikely event at the Cook Plant, well outside of its licensing basis. We believe that this fact, when coupled with the complexity of the issue involved, advises us to perform further analysis and procedural modifications only when the above mentioned Westinghouse Owners' Group work is completed.