BROOKHAVEN NATIONAL LABORATORY
TECHNICAL EVALUATION REPORT FOR

U.S. NUCLEAR REGULATORY COMMISSION
OFFICE OF NUCLEAR REACTOR REGULATION
PWR DIVISION OF LICENSING - GROUP A
PLANT SYSTEMS BRANCH

REVIEW OF APPENDIX R PROCEDURES FOR POST-FIRE REMOTE EMERGENCY SHUTDOWN OUTSIDE THE CONTROL ROOM

LICENSEE: Indiana & Michigan Electric Company

FACILITY: D.C. Cook Nuclear Plant, Units 1 & 2

REVIEW CONDUCTED: October 27-29, 1986

NRC REVIEWERS: A. Singh, NRR
D. Wigginton, NRR

BNL TECHNICAL SPECIALIST: Anthony Fresco 11/6/86
Anthony Fresco (Mechanical Systems) Date

BROOKHAVEN NATIONAL LABORATORY
ASSOCIATED UNIVERSITIES, INC.

CONTENTS

1. GENERAL SUMMARY

During the time period of October 27-29, 1986, a team of NRC personnel from the Office of Nuclear Reactor Regulation, Plant Systems Branch and the Division of Licensing personnel and A. Fresco of BNL conducted a special review and walkdown of the emergency remote shutdown and associated repair procedures as required by the November 22, 1983 Safety Evaluation Report for the Alternate Shutdown Capability at the D.C. Cook Nuclear Power Plant, Units 1 & 2. The team members were assisted in the walkdown by the Senior Resident Inspector. The results of this review will be transmitted to Region III Headquarters. The review was not intended to address other Appendix R issues, such as separation of components required for safe shutdown, associated circuits, or fire protection features.

In general, the licensee's procedures were found to be workable but certain steps require reorganization, revision, or amplification to provide additional guidance to the operators. A potentially serious problem was identified to the licensee in a post-review conference call on November 5, 1986 concerning Attachment Nos. 3 and 7 which relate to local manual de-energization of breakers in the Switch Gear Rooms to prevent spurious operation of pumps and valves. If a fire occurred in the Switch Gear Room, the alternative local operations were not described in the procedure, and upon discussion with the licensee, appeared to involve pneumatic or electrical jumpering during Hot Standby or Hot Shutdown conditions. See Section 5.1.1(d) for further discussion. Possible problems were also identified with emergency lighting.

The arrangement and usage of the cross-ties and opposite unit equipment to achieve safe shutdown in the affected unit required clarification and an overall analysis to justify the actions taken in the procedures to achieve the performance goals of Appendix R, e.g., isolation of letdown flow, usage requirements for pressurizer PORVs and heaters, etc. was not available during the review.

It was also recommended that the licensee provide a chart indicating the assignment of the personnel required to implement the procedure. The licensee was advised that if any local operator actions are required to be performed in the yard area, e.g., verification that the flow path is available and there is a sufficient high pressure nitrogen supply for steam generator power-operated relief valve operation, that 8-hour battery powered emergency lighting is required for the access path or else an exemption request should be filed.

Finally, the team provided guidance to the licensee on the conduct of a full scope Appendix R audit.

2. PERSONS CONTACTED

NAME	TITLE	COMPANY
W. G. Smith, Jr.	Plant Manager	Indiana & Michigan Electric Co.
J.E. Rutkowski	Ass't Plant Mgr.	I&M
P. Jacques	Quality Control/ Fire Protection Coord.	I&M
K.R. Baker	Operations	I&M
M. Onken	Operations	I&M
R. Heathcote	Operations	I&M
W. Nelson	Operations	I&M
D. Rumpf	Operations	I&M
H. Rumser	Operations	I&M
G. Tollas	Operations	I&M
J. St. Amand	Operations	I&M
J. Conrad	Operations	I&M
J. Stubblefield	Training	I&M
C. Miles	I&C Planning	I&M
J. Feinstein	Mgr. - Nuclear Safety Licensing	American Electric Power Service Corp.
A. Auvil	NS&L	AEPSC
R.L. Shoberg	Asst. Section Mgr.-I&C	AEPSC
W.G. Sotos	I&C	AEPSC
E. Brown	Electrical Engineer	AEPSC
G. Weber	Section Manager	Impell Corp.
B. Jorgensen	Senior Resident Inspect.	USNRC

3. DOCUMENTS REVIEWED

3.1 NRC Correspondence

1. Letter to J.E. Dolan, Indiana and Michigan Electric Company (I&M) from Mr. C.E. Norelius, NRC Region III, dated September 22, 1982 transmitting the results of Appendix R audit conducted April 12-16, May 14, June 10, 1982 at D.C. Cook.

2. Letter to Mr. J.E. Dolan, I&M, from Mr. S.A. Varga, Operating Reactors Branch No. 1, Division of Licensing, dated November 22, 1983 transmitting the Safety Evaluation Report on Alternative Shutdown Capability at D.C. Cook.

3.2 Licensee Documents

1. Indiana & Michigan Electric Company, "Nuclear Regulatory Commission - Appendix R Audit - October 27, 1986 - Alternate Shutdown Capability - Donald C. Cook Nuclear Plant - Bridgman, Michigan."

3.3 Procedures

	ID No.	Title	Rev.	Effective Date
1.	**12-OHP 4023.100.001	Unit 1 Emergency Remote Shutdown	0	6/10/86
2.	**1MHP2140.082.001	Maintenance Procedure for Repowering an RHR Pump	1	10/23/86
3.	**1MHP2140.082.003	Maintenance Procedure for Repowering Pressurizer Backup Heaters	1	10/23/86
4.	**1MHP2140.082.005	Maintenance Procedure for Repowering Containment Valves	2	10/23/86
5.	**1 THP 6030 IMP.304	Pressurizer PORV Cable Repair	1	8/14/86
6.	**1 THP 6030 IMP.305	Appendix R Post-Fire Repowering of In-Containment Valves	1	10/23/86

4. POST FIRE SAFE SHUTDOWN

4.1 Systems Required for Safe Shutdown

The licensee provided a brief presentation of the systems required for safe shutdown. The team reviewed this within the time available as background information justifying the actions to be taken in the procedures.

4.1.1 Reactivity Control

Initial reactivity control is provided by tripping the reactor control rods using the scram switches in the main control room. The reactor can also be scrammed by tripping the turbine at the front standard and also at other unspecified locations. Additional negative reactivity to achieve the required boration margin is provided by the borated water in the Refueling Water Storage Tank utilizing the opposite unit's charging pumps discharging into the reactor coolant pump seal injection lines. The licensee was advised to have available, for the full scope Appendix R audit, an analysis showing that the RWST alone does provide sufficient negative reactivity capability to achieve and maintain cold shutdown.

4.1.2 Reactor Coolant Makeup (Inventory and Pressure Control)

Inventory control of the reactor coolant system is provided by the reactor coolant pump seal injection lines and charging system. For alternative shutdown outside of the affected unit's control room, seal injection is provided by the opposite unit's charging pump via a discharge header unit crosstie to RCP seals. Charging through the normal charging line can be provided by the opposite unit's Boron Injection flow path. The system alignments are summarized in the licensee's introductory presentation on alternate shutdown capability (Ref. 3.2-1) as follows:

Borated Cooling Water Source:	Opposite Unit's RWST or Affected Unit's RWST (via unit crosstie) Opposite Unit's CVCS
Auxiliary Systems:	Opposite Unit's Emergency Power System Opposite Unit's HVAC Opposite Unit's CCW
Control:	Normal valve and pump control on opposite unit Local manual control of valves on affected unit
Instrumentation:	Local shutdown panel powered from opposite unit Other local self-powered indictors

Pressurizer level is controlled by supplying sufficient volume flow to support a 25°F/hour cooldown rate. The licensee's position on pressurizer pressure and use of the pressurizer PORVs during hot standby and hot shutdown is that the heat losses from the pressurizer are such that pressure will be reduced within a 72 hour period to allow use of the residual heat removal (RHR) system without use of the pressurizer PORVs and that the PORVs are not required to maintain hot shutdown. The licensee did not provide the analysis to justify this but was advised that the analysis should be available for the full scope Appendix R audit. The cables to the PORVs can be repaired to allow pressure control during the transition to cold shutdown.

4.1.3 Decay Heat Removal

For loss of offsite power conditions, natural circulation is established by dumping steam from at least two of the four steam generators via the atmospheric steam generator PORVs with makeup to the steam generators provided by the Auxiliary Feedwater System from the Condensate Storage Tank to support a 25°F/hour cooldown rate. Ref. 3.2-1 describes the system alignments as follows:

Auxiliary Feedwater is provided by either the affected Unit's turbine-driven pump via the normal flow path or either of the opposite Unit's motor-driven pumps via a discharge header unit crosstie to the normal flow path.

Cooling Water Source:	Opposite Unit's CST Affected Unit's CST Lake Michigan via opposite Unit's essential service water
Auxiliary Systems:	Opposite Unit's Emergency Power System (MDAFP use) Opposite Unit's HVAC (applies only to one of the opposite Unit's MDAFP)
Control:	Local control panel for TDAFP Normal valve and pump control for opposite Unit's MDAFPs Local manual control of valves on affected unit
Instrumentation:	Local TDAFP Panel (Turbine Speed)

The steam generator PORVs are powered from the alternate source which is the backup nitrogen supply located in the yard area. Control is at either local control panels or as a back-up by local manual operation of the valves' handwheels. Instrumentation is at a local shutdown panel powered from the opposite unit and at other local self powered indicators for the N_2 supply.

4.1.4 Support Systems and Process Monitoring Instrumentation

The front-line systems are supported by the systems described in 4.1.1 to 4.1.3 while process monitoring is provided at local control panels within the plant. Neither of these aspects were reviewed in any detail due to time constraints.

4.1.5 Cold Shutdown

The RHR system is used to achieve and maintain cold shutdown. RHR is provided by either train of normal RHR powered from the opposite unit. Ref. 3.2-1 describes the system alignments as follows:

Auxiliary Systems:	Opposite Unit's Emergency Power System Opposite Unit's ESW (via unit crosstie) Opposite Unit's CCW (via unit crosstie)
Control:	Temporary RHR pump control from opposite unit, Normal ESW and CCW pump and valve control from opposite unit
	Local manual control of RHR, ESW, and CCW valves on affected unit
Instrumentation:	RHR pump load from temporary RHR pump control station in opposite Unit's control room (Valve operation coordinated with indications provided at local shutdown panel at another location)

The licensee has developed repair procedures for repowering an RHR pump, pressurizer backup heaters, pressurizer PORV cables, and in-containment valves. Only repair of the RHR pumps and pressurizer heaters was discussed in the Safety Evaluation Report (Ref. 3.1-2). No mention is made in the SER concerning the use of the pressurizer PORVs. It was suggested to the licensee that their use be clarified for the full-scope audit as mentioned in 4.1.2 above.

4.2 Areas Requiring Alternative Shutdown

There are four areas in each unit which require implementation of the remote shutdown procedure in the event of a fire:

- Control Room Cable Vault
- Auxiliary Cable Vault
- Switch Gear Room
- Control Room

Since there is a 3-hour rated fire barrier between each unit's control room and there is significant crosstie capability between systems required for safe shutdown, the Shift Supervisor directs operations from the opposite unit's control room. The hot shutdown panels located within each control room were not designed to meet the demands of a fire as postulated by Appendix R.

5. PROCEDURES

The procedure reviewed in detail and walked though during this plant visit was:

** 12-OHP 4023.100.001, "Unit 1 Emergency Remote Shutdown," Rev. 0, 6/10/86

This procedure is structured with a main body and eight attachments. Attachment No. 1 relates to the establishment of the charging header crosstie from the opposite unit while No. 2 provides for the initiation of Auxiliary Feedwater flow. Attachment No. 3 concerns isolation of the Reactor Coolant System and the steam generators and No. 4 pertains to control of the steam generator PORVs. Attachment Nos. 5 & 6 describe the steps to provide RHR cooling using Unit 2 Essential Service Water and Component Cooling Water Pumps. Attachment No. 7 instructs the de-energization of equipment from the switch gear rooms to prevent spurious actuations and No. 8 provides for the restoration of offsite power. The repair procedures were also reviewed but in less detail.

5.1 Procedure for Unit 1 Remote Emergency Shutdown

The licensee personnel explained, by means of a hand-drawn chart, the reassignment of the normal plant operating staff to form the fire brigade and to implement the procedure. The results was that four operations personnel are required to implement the procedure, three from the affected unit and one from the unaffected unit. The licensee was advised to provide a simplified staffing assignment chart for the full scope Appendix R audit.

Comments generated during the review and walkthrough will be provided separately below:

5.1.1 Review

a) Main Portion

Step 4.2.2 - It was recommended that this step, which directs the operator to locally trip the reactor, include the locations of other means of tripping the reactor outside the control room. These other locations should be reviewed to determine their suitability under the conditions of a fire requiring control room evacuation. It was also recommended that the step include a statement instructing the operator to verify the control rod positions, if at all possible, before evacuating the control room.

Step 4.2.3 - This step directs the personnel to rapidly accomplish certain of the attachments with priority being given to Attachment Nos. 1 and 2. Since Attachment No. 1 concerns establishment of RCP seal injection flow to cool the seals and also to provide makeup to the RCS, the time available to perform these actions is typically at least one hour unless a pressurizer PORV has spuriously opened. There are typically only 30 minutes available to provide AFW flow to the steam generators before boil-dry so that performance of Attachment No. 2 is usually more time limited. It was recommended that this be indicated in the procedure.

Note prior to Step 5.3.5 — This note states that pressurizer PORV use is limited by the air bottle (N_2) backup capability and that the Pressurizer Relief Tank (PRT) has no quench or drain capability and has been receiving RCP seal leakoff. Further, it tells the operator to "Plan it carefully." Upon discussion with licensee personnel, it was stated that there is adequate N_2 supply to provide over 70 operations of the PORVs and that rupture of the PRT rupture disks is not of concern except that extensive cleanup of the containment would be required. Again, it was recommended to the licensee that an analysis justifying the N_2 supply, the number of PORV operations required to depressurize, the assumptions regarding the rupture disk, and the overall usage of the PORVs be available for the full scope Appendix R audit. The licensee was also advised that if local operator actions are required in the yard area to assure adequate N_2 supply to the PORVs that 8-hour emergency lights be provided for the access path or an exemption request should be filed. The licensee agreed with the team's concern over the use of the term "Plan it carefully", and indicated that the procedure would be revised accordingly to provide clearer instructions to the operator.

b) Attachment No. 1

There were no significant comments during the review process.

c) Attachment No. 2

Caution - The caution states "Since core cooling mode is natural circulation, do not overfeed or oversteam." The team expressed the concern that this appears to provide a rigid mindset to the operators that the procedure is only applicable for loss of offsite power. There is a separate procedure for remote shutdown in the event of a fire with offsite power available. However, there is no direct provision for the operator to return to that procedure in the event that offsite power is restored without onsite operator actions. The licensee agreed to revise the procedure to address this concern.

Steps 2.6, 3.6 & 4.5- These steps instruct the operators to manually operate the handwheels on the AFW pump discharge lines to establish and maintain level in the steam generators without indicating a minimum recommended level. The team recommended that the licensee revise the procedure to recommend maintaining level at a point providing sufficient contingency.

d) Attachment Nos. 3 and 7

There were no significant comments on these attachments during the review but they were the subject of a conference call between the review team and the licensee on November 5, 1986. Specifically, No. 3 concerns electrical isolation of the Reactor Coolant System and the Steam Generators to prevent spurious

operation and No. 7 electrical isolation of pumps and valves from the Switch Gear Rooms. BNL expressed the concern that the actions described in the Switch Gear Rooms, such as manually tripping the breakers, could not be performed if the postulated fire occurred in the Switch Gear Rooms. The licensee's response was that the situation of a fire in the Switch Gear Room is covered by another procedure for remote emergency shutdown when offsite power is available. This alternate procedure was not cross referenced nor was it reviewed by the team. Upon further discussion, it appeared that it calls for jumpering of valves and/or breakers during the hot standby or hot shutdown conditions to prevent spurious operations. The licensee was strongly advised that any jumpering is considered a repair and as such is not allowed during hot standby or hot shutdown conditions. Also, it can not be stated that the two procedures are in parallel since the procedure under review, i.e., for the case of loss of offsite power, does not cover a fire in the Switch Gear Rooms, which requires evacuation of the affected units control room. Adequate and proper cross referencing, which the team felt is essential, did not exist in the reviewed procedure. The licensee agreed to review the procedural response and methodology accordingly in preparation for a full scope Appendix R audit.

e) Attachment Nos. 4, 5, 6, and 8

There were no significant comments during the review phase except for any actions to be taken in the yard area to assure N_2 supply and the provision of emergency lighting, as previously noted in (a) above (pertaining to Attachment No. 4).

5.1.2 Walkdown

a) Main Portion

Some of the team members found the quality of the operators communications skills to be poor at times. It should also be noted that hand-held radios are the only communications means available under loss of offsite power. In addition, there are only two channels available, F-1 and F-2, and only one of those channels, F-1, is backed up by a repeater station. The repeater station is located in the Unit 2 Switchgear Room so that in the event of a fire in that Switch Gear Room, only the F-2 channel is available, which the licensee conceded has some difficult areas between which the communication is poor or non-existent.

There were no other significant comments noted during the walkdown.

b) Attachment No. 1

Step 1.1 - There appeared to be inadequate emergency lighting for the operator to check closed valves 1-CS-536 and 1-CS-534.

Step 2.1 - The sequence of actions to de-energize the breakers at MCC 1-AZV-A and 1-AM-D appeared to be reversed. That is, it was more time efficient for the operator to perform the actions required at MCC 1-AM-D before MCC 1-AZV-A particularly since they are at different elevations.

Step 2.2 - A similar problems exists in Step 2.2 in that it is easier to isolate control air to 1-RV-251, 1-RV-252, and 1-RV-255 near the Batch Tank before entering the Boron Injection Tank (BIT) Room to verify 1-IMO-255 and 1-IMO-256 closed so that it appears the order of the steps should be reversed. Emergency lighting at the Batch Tank area was not available to perform the required functions while the emergency lighting in the BIT Room was inadequate being on only one side of the BIT, which is a very large and tall tank, while actions are required on both sides of the tank.

Step 2.3 - Since entry into the BIT Room, as required by Step 2.2, and into the BIT Outlet Valve Room, as required by Step 2.3, necessitates the use of anti-contamination clothing, it is much less time consuming if the procedure included a note directing the operator to gather an extra set of anti-C's when performing Step 2.2 in preparation for Step 2.3.

In summary, allowing for the inherent difficulties of performing this attachment with an inspector tagging along, it appears that the implementation is excessively long and can be streamlined.

c) Attachment No. 2

This attachment, which provides for initiation of Auxiliary Feedwater flow, was walked through by the Senior Resident Inspector whose comments follow:

General Comments.

1. The licensee should walk through each person on each intended function.

2. The licensee should assure independence of activities by various agents, i.e., which steps require prior communication and authorization.

Step 2.0 - In the event that the affected units turbine-driven AFW pump (TDAFP) should fail to start or fail to run after starting, it required approximately 10 minutes to simulate the initiation of AFW flow using the opposite unit's motor-driven AFW pumps. The licensee should determine if this time interval can be reduced.

Steps 2.6, 3.6, and 4.5 - The procedure should specify a quantitative throttle position for the operator to locally manually operate the handwheels of the AFW pump discharge control valves to maintain steam generator levels. (This comment is similar to the comment by the team on this step noted during the review process.)

5.2 Repair Procedures Required to Achieve Cold Shutdown

The procedures listed in Section 3.3, Nos. 2 through 6 were briefly reviewed and appeared to be substantially detailed to facilitate implementation. No

walkthrough was conducted but a check was made of whether the tools and equipment required to implement the procedures were available onsite. This equipment was found to be in separately stored and labeled containers in areas readily accessible to plant maintenance personnel.

January 27, 1987.

DISTRIBUTION:
Docket File
LocalPDR
NRC PDR
PWR#4 Reading
BJYoungblood Reading
MDuncan
DWigginton
ACRS(10)
NThompson
EJordan
JPartlow
BGrimes

DOCKET NO(S). 50-315 and 50-316

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

SUBJECT: D.C. Cook Nuclear Plant, Units 1 and 2

The following documents concerning our review of the subject facility are transmitted for your information.

- ☐ Notice of Receipt of Application, dated _____.
- ☐ Draft/Final Environmental Statement, dated _____.
- ☐ Notice of Availability of Draft/Final Environmental Statement, dated _____.
- ☐ Safety Evaluation Report, or Supplement No._____ dated _____.
- ☐ Environmental Assessment and Finding of No Significant Impact, dated _____.
- ☐ Notice of Consideration of Issuance of Facility Operating License or Amendment to Facility Operating License, dated _____.
- ☒ Bi-Weekly Notice; Applications and Amendments to Operating Licenses Involving No Significant Hazards Considerations, dated 1/14/876 [*see page(s)*] 1555, 1556, and 1561
- ☐ Exemption, dated _____.
- ☐ Construction Permit No. CPPR-_____, Amendment No. _____ dated _____.
- ☐ Facility Operating License No. _____, Amendment No. _____ dated _____.
- ☐ Order Extending Construction Completion Date, dated _____.
- ☐ Monthly Operating Report for _____ transmitted by letter dated _____.
- ☐ Annual/Semi-Annual Report- _____ _____ transmitted by letter dated _____.

Office of Nuclear Reactor Regulation

Enclosures:
As stated

cc:
See next page

OFFICE	PWR#4/DPWR-A		PWR#4/DPWR-A				
SURNAME	MDuncan/rad		DWigginton				
DATE	01/16/87		01/27/87				

NRC FORM 318 (10/80) NRCM 0240

OFFICIAL RECORD COPY