INDIANA & MICHIGAN ELECTRIC COMPANY

P.O. BOX 16631
COLUMBUS, OHIO 43216

May 25, 1984
NMFM 84-0238

Donald C. Cook Nuclear Plant Unit Nos. 1 and 2
Docket Nos. 50-315 and 50-316
License Nos. DPR-58 and DPR-74

Mr. Richard C. DeYoung, Director
Office of Inspection and Enforcement
U.S. Nuclear Regulatory Commission
1717 H Street
Washington, D.C. 20555

Subject: Programming Error in the DETECTOR Code Supplied by Shanstrom Nuclear Associates, Incorporated

Dear Mr. DeYoung:

This letter is to confirm the telephone conversation of May 23, 1984 between American Electric Power Service Corporation and Mr. D. Wigginton, Project Manager, NRC, regarding notification made pursuant to Title 10 CFR Part 21.

In the process of modifying our code DETECTOR, which is supplied by Shanstrom Nuclear Associates, Inc., an error was found in the coding. Our review showed that the coding error did not constitute a significant safety problem in its application at the Donald C. Cook Nuclear Plant. Nevertheless, notification has been made to Shanstrom Nuclear Associates, Inc. and the NRC. It is our understanding that other users of the code have been notified. Additional details on this event are included in the enclosed attachment.

If you require further information please call J.M. Cleveland (614/223-2050) of my staff.

Very truly yours,

M.P. Alexich
Vice President

cc: Harold R. Denton, Director, NRC
D. Wigginton - NRC
J. Keppler - NRC, Region III
John E. Dolan
W.G. Smith, Jr
R.C. Callen
G. Charnoff
E.R. Swanson, NRC Resident Inspector - Bridgman
R.T. Shanstrom

IE19

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NRC Form 366 (9-83)

U.S. NUCLEAR REGULATORY COMMISSION

APPROVED OMB NO. 3150-0104
EXPIRES: 8/31/85

LICENSEE EVENT REPORT (LER)

FACILITY NAME (1)	DOCKET NUMBER (2)	PAGE (3)
Donald C. Cook Nuclear Plant Unit 1	0 5 0 0 0 3 1 5	1 OF 1

TITLE (4)
Discovery of Error in DETECTOR Code

EVENT DATE (5)			LER NUMBER (6)			REPORT DATE (7)			OTHER FACILITIES INVOLVED (8)	
MONTH	DAY	YEAR	YEAR	SEQUENTIAL NUMBER	REVISION NUMBER	MONTH	DAY	YEAR	FACILITY NAMES	DOCKET NUMBER(S)
0 5	2 2	8 4	8 4	—	— 0 0			8 4		0 5 0 0 0
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OPERATING MODE (9)	THIS REPORT IS SUBMITTED PURSUANT TO THE REQUIREMENTS OF 10 CFR §: (Check one or more of the following) (11)			
POWER LEVEL (10) 1 0 0	20.402(b)	20.405(c)	50.73(a)(2)(iv)	73.71(b)
	20.405(a)(1)(i)	50.36(c)(1)	50.73(a)(2)(v)	73.71(c)
	20.405(a)(1)(ii)	50.36(c)(2)	50.73(a)(2)(vii)	OTHER (Specify in Abstract below and in Text, NRC Form 366A)
	20.405(a)(1)(iii)	50.73(a)(2)(i)	50.73(a)(2)(viii)(A)	
	20.405(a)(1)(iv)	50.73(a)(2)(ii)	50.73(a)(2)(viii)(B)	
	20.405(a)(1)(v)	50.73(a)(2)(iii)	50.73(a)(2)(x)	

LICENSEE CONTACT FOR THIS LER (12)

NAME	TELEPHONE NUMBER
Michael A. Saum American Electric Power Service Corporation	AREA CODE 6 1 4 — 2 1 3 1 - 1 2 1 0 5 1 7

COMPLETE ONE LINE FOR EACH COMPONENT FAILURE DESCRIBED IN THIS REPORT (13)

CAUSE	SYSTEM	COMPONENT	MANUFACTURER	REPORTABLE TO NPRDS		CAUSE	SYSTEM	COMPONENT	MANUFACTURER	REPORTABLE TO NPRDS	

SUPPLEMENTAL REPORT EXPECTED (14)

☐ YES (If yes, complete EXPECTED SUBMISSION DATE) ☐ NO

EXPECTED SUBMISSION DATE (15): MONTH ___ DAY ___ YEAR ___

ABSTRACT (Limit to 1400 spaces, i.e., approximately fifteen single-space typewritten lines) (16)

This is submitted as a voluntary LER

During the process of modifying the DETECTOR code, which analyzes raw flux map data to determine compliance with Power Distribution Technical Specifications, an error was discovered in the calculational logic. This error was present in DETECTOR version 23, which was used in analyzing the first 47 flux maps taken during Unit 1 Cycle 8. These changes were made in August, 1983 in accordance with Nuclear Materials and Fuel Management (NMFM) Procedure No. 7, Changes to the DETECTOR Code. Testing of this version of DETECTOR, which was carried out at the time the changes were made, did not indicate that this error was present. All 47 flux maps were reviewed and it was determined that no Technical Specifications were violated. Discussion of this conclusion appears in the LER text.

~~EC 22~~

NRC Form 366 (9-83)

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NRC Form 366A
(9-83)

LICENSEE EVENT REPORT (LER) TEXT CONTINUATION

U.S. NUCLEAR REGULATORY COMMISSION
APPROVED OMB NO. 3150-0104
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TEXT (If more space is required, use additional NRC Form 366A) (17)

See attached unformatted page for suggested text.

DETECTOR CODING ERROR - LER

Background

In August of 1983, modifications were made to the DETECTOR code to allow comparison to Technical Specification parameters which varied with Fuel Type. These modifications were made by Shanstrom Nuclear Associates, who in fact, was the original author of the code.

The modified code was tested by making runs on old data sets, was debugged and put into production for Unit 1 Cycle 8. The changes to DETECTOR were carried out in accordance with NMFM Procedure No. 7, Changes to the DETECTOR Code.

Discovery of Error

An effort was begun in May of 1984 to modify the DETECTOR code in house to incorporate the ability to monitor a modified $F^N_{\Delta H}$ Technical Specification required for Unit 2 Cycle 5. The modifications involved incorporating into the code two $F^N_{\Delta H}$ limits, one related to DNB (the current $F^N_{\Delta H}$ limit), and a new, LOCA related $F^N_{\Delta H}$ limit. During this process, an error was discovered in the logic of the way in which DETECTOR compares measured $F^N_{\Delta H}$ to the Technical Specification $F^N_{\Delta H}$ limit. This logic error first occurred in the August, 1983 version of DETECTOR and thus was present in the analysis of the first 47 flux maps taken for Unit 1 Cycle 8.

Nature of Error

The DETECTOR code requires that the input data include Technical Specification limits for each fuel type. With the August 1983 modification to the DETECTOR code, it was intended that the relative power of each fuel pin (assemblage) be compared to the limit appropriate for its fuel type. However, an error was made in the coding such that the relative power of each pin was always compared to the limits of the last fuel type in the input data set. Therefore, the DETECTOR output would not indicate the correct margin between $F^N_{\Delta H}$ and its Technical Specification limit for the first fuel type.

It should be noted, that the error affected only one page in the DETECTOR output. Review of other pages could potentially lead to identifying discrepancies in the data. The specific error was that a transfer was made to the wrong line of code.

Impact on Unit 1 Cycle 8

The coding error in DETECTOR did not cause a Technical Specification violation during Unit 1 Cycle 8 operation. To justify this statement, one must look at the input going into DETECTOR for Unit 1 Cycle 8 flux map analysis.

There were two sets of Technical Specifications which were applicable for Unit 1 Cycle 8. Technical Specification set 1 was applicable to Exxon Nuclear Company (ENC) fabricated fuel, which applied to once and twice burned fuel assemblies present in the core. Technical Specification set 2 was applicable to Westinghouse fuel which was fresh at the start of Unit 1 Cycle 8. The corresponding Technical Specifications limits for $F^N_{\Delta H}$ input into DETECTOR were:

Technical Specification Set 1: $F^N_{\Delta H}(1) \leq 1.45[1 + 0.2\ (1-P)]$

Technical Specification Set 2: $F^N_{\Delta H}(2) \leq 1.49[1 + 0.3\ (1-P)]$

where P is the ratio of actual thermal power to rated thermal power (RTP).

In all cases DETECTOR compared $F^N_{\Delta H}$ to the Technical Specification limit for Technical Specification set 2 (Westinghouse) regardless of whether the $F^N_{\Delta H}$ was associated with an ENC (Technical Specification set 1) or a Westinghouse (Technical Specification set 2) fuel assembly. Thus if a $F^N_{\Delta H}$ greater than $1.45[1 + 0.2(1-P)]$ occurred in an ENC fuel assembly it might not have been indicated as a violation of the Technical Specification limit by DETECTOR.

To verify that this did not occur, Flux Maps 1 - 47 for Unit 1 Cycle 8 were analyzed to determine whether any $F^N_{\Delta H}$ for ENC fuel was greater than 1.45 (the most limiting $F^N_{\Delta H}$ for ENC fuel with P = 1.0). No maps were identified where $F^N_{\Delta H}$ (ENC) was greater than the Technical Specification $F^N_{\Delta H}$ limit for ENC fuel, and therefore there were no Technical Specification violations.

Once satisfied that no Technical Specification violations had occurred, the possibility that the most limiting Technical Specification margin edit did not contain completely accurate information was investigated. Specifically, the possibility existed that an ENC $F^N_{\Delta H}$ was closer to its Technical Specification limit than the most limiting Technical Specification margins printed out for the Westinghouse fuel. Since the $F^N_{\Delta H}$ for ENC fuel would be compared to the Westinghouse limit, which is higher than the ENC limit, this ENC fuel assembly (or pin) might not be included in the most limiting Technical Specification margins edit.

This in fact did occur on two flux maps, 108-04 and 108-05. However, these maps were taken at BOC, < 50% RTP, with the Technical Specification margin for the most limiting pins approximately equal to 0.20. Therefore, the fact that ENC fuel assemblages were not listed on the most limiting $F^N_{\Delta H}$ edits does not appear on the basis of engineering judgement to be significant.

One should note also that from a core analysis of the Unit 1 Cycle 8 core, the hot spots $F^N_{\Delta H}$ and F_Q (Z,1) will occur in fresh fuel assemblies once equilibrium HFP core conditions are reached. This was confirmed by the analysis of all Unit 1 Cycle 8 flux maps.

Possible Impact on Unit 2 Cycle 5

It is difficult to postulate whether the error would have been discovered if the Unit 2 Cycle 5 Technical Specifications had not required modification to include the addition of LOCA based $F^N_{\Delta H}$ limitations. If we assume that the error would not have been discovered, we can look at the two cases and see the potential outcome. In either case the applicable $F^N_{\Delta H}$ Tech Spec Limits for the two different fuel types are:

Exxon Fuel: $F^N_{\Delta H} \leq 1.49\ [1.0 + 0.2\ (1-P)]$

Westinghouse Fuel: $F^N_{\Delta H} \leq 1.48\ [1.0 + 0.2\ (1-P)]$

Case 1

In this case Exxon Fuel would be assigned to Technical Specification set 1 and Westinghouse Fuel to Technical Specification set 2. One should note that the Unit 2 Cycle 5 core consists of one region (twice burned) of Westinghouse fuel and 2 regions (once burned and fresh) of ENC fuel. In this case, the peak $F^N_{\Delta H}$, occurring in the ENC fuel, would have been compared to the Technical Specification limit for Westinghouse Fuel. However, the $F^N_{\Delta H}$ Technical Specification limit for Westinghouse is more conservative than the $F^N_{\Delta H}$ Technical Specification limit for ENC, therefore this would not have been a problem. Furthermore, it is believed that this problem would have been identified immediately upon analysis of the most limiting pins on the $F^N_{\Delta H}$ lowest Technical Specification margin edit.

Case 2

In this case Westinghouse Fuel would be assigned to Technical Specification set 1 and ENC Fuel to Technical Specification set 2. This case is similar to what actually occurred in Unit 1 Cycle 8 in that the fresh fuel Technical Specifications were input as the second Technical Specification set. The fresh fuel Technical Specification limit would be applied to all fuel. This is a nonconservative comparison for the Westinghouse fuel. However, since the Westinghouse fuel is twice burned and consequently operates at low power, it is highly unlikely that this fuel would reach an $F^N_{\Delta H}$ as high as its own limit or the marginally higher Exxon limit.

Corrective Action

The coding error will be corrected in conjunction with the other DETECTOR modifications being made for Unit 2 Cycle 5.

The two flux maps that indicated the wrong most limiting pins on $F^N_{\Delta H}$, Unit 1 Cycle 8 maps 108-04 and 108-05, will be rerun with the corrected DETECTOR version.

AEPSC has changed their SOURCE library disk file management system on the corporation computer system from SOURCE to LIBRARIAN. LIBRARIAN offers a much more thorough method of maintaining an accurate audit trail of changes made to a program than previously existed with SOURCE. It is believed that this software enhancement, will reduce the possibility of future code modifications being in error.

It was determined prior to this event that the procedure which controls changes to the DETECTOR code, NMFM Procedure No. 7, Changes to the DETECTOR Code, should be revised to assure that not only are test cases run, but that an independent line by line review of the coding is performed. This procedure will be revised by December 31, 1984.