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 0 4

TITLE (4)

INDICATED VIOLATION OF F_Q POWER PEAKING LIMIT

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 3	2 1	8 4		0 0 9	0 0	0 7	0 9	8 4		0 5 0 0 0
										0 5 0 0 0

OPERATING MODE (9)	1	THIS REPORT IS SUBMITTED PURSUANT TO THE REQUIREMENTS OF 10 CFR §: (Check one or more of the following) (11)			
POWER LEVEL (10)	0 9 9	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)	X 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)	VOLUNTARY
		20.405(a)(1)(v)	50.73(a)(2)(iii)	50.73(a)(2)(x)	

LICENSEE CONTACT FOR THIS LER (12)

NAME	TELEPHONE NUMBER
WALLACE L. ZIMMERMANN, ENGINEER AMERICAN ELECTRIC POWER SERVICE CORPORATION	AREA CODE 6 1 2 — 2 2 3 - 2 0 5 8

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)

		EXPECTED SUBMISSION DATE (15)	MONTH	DAY	YEAR
YES (If yes, complete EXPECTED SUBMISSION DATE)	NO				

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

ON 03-21-84, AT 1400 HOURS, AND IN MODE 1 AT 99% RATED THERMAL POWER (RTP), A FLUX MAP WAS TAKEN WHICH INDICATED THAT TECHNICAL SPECIFICATION SURVEILLANCE REQUIREMENT 4.2.2.2.c FOR $F_Q^M(Z)$ WAS EXCEEDED.

REACTOR POWER WAS SUBSEQUENTLY REDUCED TO 96% RTP. THIS CIRCUMSTANCE OCCURRED DUE TO SELF-IMPOSED CONSERVATISMS RESULTING IN A DISCRETE DROP IN THE ALLOWABLE POWER LEVEL WHEN ROD CLUSTER CONTROL ASSEMBLY BANK D IS INSERTED INTO THE CORE AT OR BEYOND THE 217 STEP POSITION. FURTHER REVIEW SHOWED THAT THE SURVEILLANCE REQUIREMENT WAS NOT EXCEEDED. THIS DID NOT CONSTITUTE A CONDITION OUTSIDE OF UNIT 1 CYCLE 8 SAFETY ANALYSIS. IN THE INTEREST OF ADDRESSING THIS EVENT, THIS VOLUNTARY LER IS BEING SUBMITTED.

ON 03-21-84, AT 1400 HOURS, AND IN MODE 1 AT 99% RATED THERMAL POWER (RTP), A FLUX MAP WAS TAKEN WHICH INDICATED THAT TECHNICAL SPECIFICATION SURVEILLANCE REQUIREMENT 4.2.2.2.c FOR $F_Q^M(Z)$ WAS EXCEEDED. REACTOR POWER WAS SUBSEQUENTLY REDUCED TO 96% RTP. THIS CIRCUMSTANCE OCCURRED DUE TO SELF-IMPOSED CONSERVATISMS RESULTING IN A DISCRETE DROP IN THE ALLOWABLE POWER LEVEL WHEN ROD CLUSTER CONTROL ASSEMBLY BANK D IS INSERTED INTO THE CORE AT OR BEYOND THE 217 STEP POSITION. FURTHER REVIEW SHOWED THAT THE SURVEILLANCE REQUIREMENT WAS NOT EXCEEDED. THIS DID NOT CONSTITUTE A CONDITION OUTSIDE OF UNIT 1 CYCLE 8 SAFETY ANALYSIS.

WESTINGHOUSE GENERATES THEORETICAL FACTORS WHICH ARE USED AS INPUT TO THE DETECTOR (THE FLUX MAP ANALYSIS PROGRAM CODE). THESE THEORETICAL FACTORS ARE THEN COMBINED WITH MEASURED FLUX MAP DATA TO PRODUCE A BEST ESTIMATE OF ASSEMBLY AND 'HOT ROD' POWERS. THE RESULTS FROM DETECTOR (COMPONENT FUNCTION IDENTIFIER=CPU) ARE THEN USED TO DETERMINE COMPLIANCE OR NON-COMPLIANCE WITH TECHNICAL SPECIFICATIONS.

IN PREVIOUS CYCLES, WESTINGHOUSE HAD PROVIDED US WITH TWO SETS OF THEORETICAL FACTORS; ONE SET ASSUMING ALL RODS WERE OUT OF THE CORE (ARO) AND THE OTHER SET ASSUMING THE D-BANK WAS FULLY INSERTED (DIN). SINCE THE FUEL ASSEMBLY PROPERTIES WERE UNIFORM ALONG THE LENGTH OF THE FUEL ASSEMBLY, WESTINGHOUSE WAS ABLE TO GENERATE THESE SETS UTILIZING TWO-DIMENSIONAL (2D) PLANAR GEOMETRY ASSUMPTIONS. DETECTOR WOULD THEN UTILIZE THE DIN SET FOR THE RODDED FRACTION OF THE CORE AND THE ARO SET FOR UNRODDED FRACTION OF THE CORE IN ITS ANALYSIS OF THE FLUX MAP DATA.

UNIT 1 CYCLE 8 WESTINGHOUSE FUEL DIFFERS FROM PREVIOUS FUEL IN THAT THE FUEL ASSEMBLY PROPERTIES ARE NOT UNIFORM ALONG THE LENGTH OF THE FUEL ASSEMBLY. THIS IS DUE TO THE PRESENCE OF PART LENGTH WET ANNULAR BURNABLE ABSORBER (WABA) RODS WHICH DO NOT COVER THE FULL ACTIVE FUEL LENGTH. IT WAS DETERMINED BY AMERICAN ELECTRIC POWER SERVICE CORPORATION (AEPSC) THAT WESTINGHOUSE COULD NOT MAKE THE 2D ASSUMPTIONS IN GENERATING THE THEORETICAL FACTORS; RATHER, THEY WOULD HAVE TO GENERATE THE THEORECTICAL FACTORS UTILIZING THREE-DIMENSIONAL (3D) GEOMETRY ASSUMPTIONS. THUS, WESTINGHOUSE PROVIDED US WITH THREE SETS OF THEORETICAL FACTORS; TWO SETS COVERING THE TOP AND BOTTOM REGIONS WITH PART LENGTH WABA PRESENT. NOTE THAT THE 3D SETS ASSUMED ARO. IN ADDITION TO THESE 3D FACTORS, WESTINGHOUSE PROVIDED US WITH THE USUAL 2D THEORETICAL FACTOR AS DISCUSSED ABOVE. IF FOR SOME REASON, IT BECAME NECESSARY TO USE THESE 2D FACTORS, WESTINGHOUSE RECOMMENDED A PENALTY FUNCTION (TO BE DESCRIBED LATER) TO BE USED TO ACCOUNT FOR THE AXIAL NON-UNIFORMITY OF THE FUEL.

AEPSC REALIZED THAT WHEN D-BANK WAS SIGNIFICANTLY INSERTED AND THE 3D THEORETICAL FACTOR SETS WERE USED, THE RELATIVE ERRORS BETWEEN DETECTOR AND THEORETICAL RESPONSES BECAME LARGE IN THE TOP REGION WHERE NO WABA

ARE PRESENT, THUS REDUCING CONFIDENCE IN THE DETECTOR ANALYSIS OF THE CORE IN THAT REGION.

BASED ON ANALYSIS OF THE RELATIVE MEASURED VERSUS PREDICTED ERRORS AS A FUNCTION OF D-BANK ROD POSITION, AEPSC RECOMMENDED TO THE COOK PLANT THAT WHEN D-BANK WAS AT 217 STEPS OR BELOW, THE 2D THEORETICAL FACTOR SET, ALONG WITH ITS PENALTY FUNCTION, SHOULD BE USED WITH DETECTOR TO CONSERVATIVELY ACCOUNT FOR THE EFFECT OF CONTROL RODS ON THE CORE POWERS IN THE TOP REGION. IF D-BANK WAS POSITIONED GREATER THAN 217 STEPS, THEN 3D THEORETICAL FACTOR SET WAS TO BE USED.

UNIT 1 CYCLE 8 FLUX NUMBER 35, TAKEN AT ABOUT 10 A.M., MARCH 21, WITH D-BANK AT 216.5 STEPS, INDICATED A VIOLATION OF TECHNICAL SPECIFICATION SURVEILLANCE REQUIREMENT 4.2.2.2.c, WHICH STATES, IN EFFECT,

$$F_Q^M(Z) \leq \frac{1.97}{P} \quad \frac{K(Z)}{V(Z)}$$

IN ASSEMBLY P9, AND ITS SYMMETRIC COUNTERPARTS IN THE CORE, THE F_Q AT AXIAL LOCATION 29 (5.8 FEET HIGH IN A 12 FEET CORE) WAS MEASURED TO BE 1.6182. APPLYING 5% UNCERTAINTY FOR MEASUREMENT AND 3% UNCERTAINTY FOR MANUFACTURING TOLERANCES (ENGINEERING FACTOR),

$$F_Q^M(Z=29) = 1.7501$$

POWER WAS AT 98.94%, AND AXIAL LOCATION 29, V(Z) = 1.131 AND K(Z)=.9901.

THEREFORE, THE LIMIT WAS

$$\frac{1.97}{.9894} \times \frac{.9901}{1.131} = 1.7431$$

INDICATIONS OF VIOLATION WERE ALSO RECEIVED FOR AXIAL LOCATIONS 27, 28 AND 30 IN THE SAME ASSEMBLIES. HOWEVER, THE VIOLATIONS IN THESE LOCATIONS WERE NOT AS GREAT. FOLLOWING THIS RESULT, POWER WAS REDUCED TO 96% AND MAINTAINED AT THAT LEVEL OR BELOW UNTIL A SUBSEQUENT FLUX MAP INDICATED A RETURN TO 100% POWER WAS ALLOWABLE.

THERE ARE THREE MITIGATING ASPECTS TO NOTE, HOWEVER. EACH OF THESE ASPECTS BY ITSELF IS SUFFICIENT TO SHOW THAT THE UNIT WAS WITHIN ANALYZED CONDITIONS DURING THIS APPARENT VIOLATION.

FOR THE FIRST ASPECT, THE USE OF K(Z) VALUE OF 0.9901 SHOULD BE EXPLAINED. THIS K(Z) INCLUDES THE PENALTY FUNCTION CITED ABOVE, WHICH IN THE MIDDLE OF THE CORE (AXIALLY SPEAKING), HAS A VALUE OF ONE PERCENT. THIS PENALTY IS ASSUMED WHEN MONITORING THE MARGIN TO PEAKING LIMITS WITH 2D THEORETICAL FACTORS AS DISCUSSED IN LETTER AEP:NRC:0745J, DATED DECEMBER 1, 1983. IN THE 0745J LETTER, THE NEED FOR 3D THEORETICAL FACTORS IN THE PRESENCE OF PART-LENGTH BURNABLE ABSORBERS WAS DEMONSTRATED. IN THE EVENT THAT 3D THEORETICAL FACTORS CANNOT BE USED, AN AXIAL-POSITION-DEPENDENT PENALTY FUNCTION IS ASSIGNED FOR ACCEPTABLY CONSERVATIVE USE

OF 2D THEORETICAL FACTORS IN MONITORING MARGINS TO PEAKING LIMITS. FURTHER, LETTER 0745J MENTIONS THAT 2D FACTORS ARE USED WHEN THE ROD CLUSTER CONTROL ASSEMBLY BANK D IS SIGNIFICATNLY INSERTED. IN AN ANALYSIS PERFORMED AND APPROVED (WITHIN AEPSC) PRIOR TO FLUX MAP NUMBER 35, THE BANK D POSITION AT WHICH 2D THEORETICAL FACTORS SHOULD BE USED WAS SET AT 217 STEPS AND BELOW. MAP 35 WAS TAKEN WITH BANK D AT 216.5 STEPS, AND THEREFORE WAS ANALYZED WITH 2D FACTORS AND WITH THE PENALTY DUE TO THE USE OF 2D FACTORS. HOWEVER, THE REASON FOR CHANGING FROM 3D TO 2D FACTORS IS THE INABILITY OF 3D FACTORS TO CORRECTLY REPRESENT THE TOP OF THE CORE WHEN THE RODS ARE SIGNIFICANTLY INSERTED. AN INFORMATION-ONLY REANALYSIS OF THIS MAP WITH 3D FACTORS PRODUCED RESULTS IN THE AREA OF THE APPARENT VIOLATION NEARLY IDENTICAL TO THE RESULTS PRODUCED BY THE 2D FACTORS BEFORE APPLICATION OF THE PENALTY. THIS SHOWS THAT, AT LEAST FOR THIS MAP, THE ONE PERCENT PENALTY WAS UNNECESSARY. WITHOUT THIS UNNECESSARY PENALTY, THERE WOULD HAVE BEEN NO VIOLATION FLAGGED.

FOR THE SECOND ASPECT, THE USE OF THE V(Z) VALUE OF 1.131 SHOULD BE CONSIDERED. THIS VALUE CAME FROM A CYCLE-LONG V(Z) FUNCTION, WHICH IS A CONSERVATIVE BOUND OF V(Z) FUNCTIONS CALCULATED FOR EACH INDIVIDUAL BURNUP PERIOD. PRIOR TO TAKING THIS MAP, WE HAD SUBMITTED, IN LETTER AEP:NRC:0745L, DATED MARCH 20, 1984, OUR INTENT TO USE THESE EXISTING BURNUP-DEPENDENT V(Z) VALUES. ON MARCH 23, 1984, WE WERE TOLD THAT, BASED ON OUR 10 CFR 50.59 REVIEW, USE OF THE BURNUP-DEPENDENT V(Z) WAS ACCEPTABLE. WITH THE BURNUP DEPENDENT VALUES, V(Z=29) IS 1.082. USE OF THIS BURNUP DEPENDENT V(Z) IN MAP 35 WOULD NOT HAVE CREATED A VIOLATION.

FOR THE THIRD ASPECT, ONE MAY NOTE THAT MAP 35 WAS TAKEN DURING STEADY STATE OPERATION, WITHOUT ANY LOAD FOLLOW MANEUVERS. AS SUCH, THE APPLICATION OF V(Z), RESULTING IN A VIOLATION, DOES NOT INDICATE A TRUE F_Q MEASUREMENT IN EXCESS OF LIMITS. RATHER THIS ONLY INDICATES THAT UNMONITORED LOAD FOLLOW MANEUVERS FROM THIS BASE SITUATION COULD RESULT IN EXCEEDING THE F_Q LIMIT SET BY ANALYSIS.

FOR THESE REASONS, WE CONCLUDE THAT THIS INDICATED VIOLATION DID NOT REPRESENT THE CORE BEING IN A CONDITION OUT OF THE BOUNDS SET BY THE APPLICABLE SAFETY ANALYSES. IN THE INTEREST OF ADDRESSING THIS EVENT, HOWEVER, WE SUBMIT THIS AS A VOLUNTARY LICENSEE EVENT REPORT.

American Electric Power System
INDIANA & MICHIGAN ELECTRIC COMPANY
DONALD C. COOK NUCLEAR PLANT
P.O. Box 458, Bridgman, Michigan 49106
(616) 465-5901

July 9, 1984

United States Nuclear Regulatory Commission
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Document Control Manager:

In accordance with the criteria established by 10CFR50.73 entitled Licensee Event Reporting System, the following report/s are being submitted:

RO 84-009-0

Sincerely,

W.G. Smith, Jr.
Plant Manager

/cbm

Attachment

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