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Ref: NR84051

May 24, 1984

Dr. Thomas E. Murley
Regional Administrator
USNRC Office of Inspection and Enforcement
651 Park Avenue
King of Prussia, Penn. 19406

Dear Dr. Murley:

This letter with attachments constitutes a written notification of a potential 10CFR21 item, requiring "Reporting of Defects and Noncompliance."

The item involves a bug introduced in an August 1983 modification to the DETECTOR computer code. The result of the bug is that technical specification limits for the enthalpy rise peaking factor, $F_{\Delta H}$, may be incorrectly calculated.

DETECTOR is a component code of the CORE computer package (Codes for Operating Reactor Evaluation). The purpose of DETECTOR is to reduce measured results from incore detectors (miniature fission chambers) in Westinghouse PWR reactors, and combine these data with calculated values for fuel pin power distribution and detector response distribution, resulting in the best estimate for the actual power distribution in the operating reactor core.

While there is no regulatory requirement that codes such as DETECTOR perform a technical specification compliance analysis, this feature has been incorporated into DETECTOR, and is of obvious benefit to the utility company users.

In August '83 the Tech. Spec. compliance analysis was extended to allow fuel technical specifications which can vary with fuel type. In particular to cover a specification for a mixed core with both Westinghouse and Exxon Nuclear Co. fuel. Prior versions of DETECTOR, as well as use of the Aug '83 version with a single set of Tech. Spec. parameters, are not affected by the bug discussed in this notification.

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In practice the effect of the bug was trivial. All flux maps in which the Aug '83 version of DETECTOR was utilized have been reanalyzed. No violations of technical specification parameters occurred, and no hazards to personnel health or safety were involved.

The bug has been corrected and responsible parties have been notified. The purpose of this notification is solely to conform to the regulatory requirements of 10CFR21.

The Aug '83 version of DETECTOR was utilized for only one nuclear unit, the Donald C. Cook Unit 1 Nuclear Power Plant, during Cycle 8 operation. This plant is operated by the American Electric Power Company and their engineering support group is the American Electric Power Service Corporation (AEPSC). For D. C. Cook Unit 2 AEPSC utilized an earlier version of DETECTOR.

The only other utility company which has a DETECTOR code with the Aug '83 bug is Duke Power Company (DUKE). DUKE utilizes an earlier version of DETECTOR for current operational analysis of their McGuire Unit 1 and Unit 2 plants.

Earlier versions of DETECTOR have been provided to the Exxon Nuclear Company, Northern States Power Company, and the Union Electric Company. DETECTOR may also be accessed on the UCC and CDC computer service networks.

The CORE including DETECTOR code was written, is maintained, and is supplied by Shanstrom Nuclear Associates (SNA).

Pursuant to the requirements of 10CFR21, the following notifications have been made:

(1) Telephone call from AEPSC to SNA informing SNA of the apparent bug as discovered by AEPSC. Confirmation of the bug by SNA and proposed correction by SNA in the same call, apx. 11 AM May 22, 1984;

(2) Correction of the SNA version of DETECTOR and completion of sample run to verify the proposed correction, apx. 1 PM, May 22;

(3) Telephone call to DUKE to notify them of the bug and required correction, apx. 3 PM, May 23;

(4) Telephone call to Dan Fieno, Richard Lobel, and Marv Dunenfeld of the NRC, Core Performance Branch to discuss the issue, apx. 9 AM, May 24;

(5) Telephone call for initial notification to Dr. Shanbaky, NRC Office of Inspection and Enforcement, Region 1, apx. 10 AM, May 24;

(6) Return telephone call from Dr. Shanbaky giving address for written notification, apx. 2 PM May 24;

(7) This written notification dated May 24, 1984 and sent at apx. 9 AM May 25 to:

a) Dr. Thomas E. Murley, NRC Region 1, Attn: Dr. Shanbaky

b) Director, Division of Licensing, NRC, Attn: Mr. Richard Lobel, Core Performance Branch

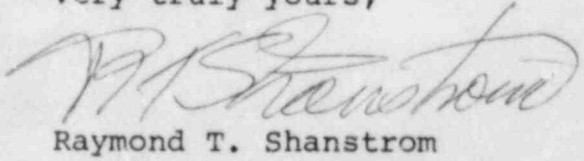
c) Mr. Milton Alexich, AEPSC, Attn: Mr. George John

d) Mr. K. S. Canady, DUKE, Attn: Mr. Raymond P. Wood.

In summary, no violations of technical specification requirements have occurred. AEPSC utilized the Aug '83 version of DETECTOR for the analysis of forty-seven flux maps for Cycle 8 of the Donald C. Cook Unit 1 Nuclear Power Plant. Except for two low power flux maps the code identified the proper limiting fuel pin. Reanalysis of all flux maps, including the two taken at low powers, showed that no technical specification violations occurred. Responsible parties have been informed and corrections to the DETECTOR code have been effected.

Should you wish more information please call Dr. Raymond T. Shanstrom at (203) 655-9400.

Very truly yours,



Raymond T. Shanstrom

Attachments

Att. 1. Modification to August 1983 Version of DETECTOR to Correct Bug in Calculation of Limiting $F_{\Delta H}$ Values.

Subroutine S1234 (Bug is in location of Statement No. 21370)

Aug '83 Modification

```
      RBFCT = 1. - RBFCT
      FSHTS = FSHTSX(K)
21370 TSFSH = FSHTS * RBFCT
      TSDIF = TSFSH - FSUBH
```

Correction

```
      RBFCT = 1. - RBFCT
21370 FSHTS = FSHTSX(K)
      TSFSH = FSHTS * RBFCT
      TSDIF = TSFSH - FSUBH
```

Discussion:

Statement Number 21370 is an entry point if calculation of the rod-bow penalty (RBFCT) is bypassed. FSHTSX(K) is the constant multiplier (see "CONST. MULT." in Att. 2.) in the technical specification limit for $F_{\Delta H}$. For example,

$$FSHTSX(K) = a_k * (1. + b_k*(1.-P))$$

where, a_k and b_k are constants for technical specification parameter set k, and P is the core power relative to rated power. The error caused FSHTS to always be set to FSHTSX(KMAX), the values for the last technical specification parameter set. This error only occurs if the calculation of the rod-bow penalty is bypassed.

Att. 2. Sample Edit of $F_{\Delta H}$ Technical Specification Parameters

105029 97% POWER, CIDAEPE + SOME PHONY TECH SPECS FOR SET 2
AEP - THIMBLE DATA

CONSTANT FACTOR INCLUDED IN THE CALCULATION OF ACTUAL ENTHALPY RISE, FSUBH
MEASUREMENT UNCERTAINTY FACTOR, FSUBHU = 1.0400

RATIO OF ACTUAL POWER TO RATED POWER, P = .9653

T.S. SET	FLOW FACTOR	TEMP FACTOR	F & T FACTOR	CONST. MULT.
1	0.0000	0.0000	1.0000	1.5205
2	0.0000	0.0000	1.0000	1.5114

* INDICATES VIOLATION OF TECH SPECS

20 LOWEST FRACTIONAL MARGINS FOR ENTHALPY RISE FACTORS

ORD	FT	SET	FUEL ASM.	F.A. LOC.	FSUBHN	ROD BOW FACTOR	TECH SP. FSUBH	ACTUAL FSUBH	TECH SPEC DIFF.	MARGIN FRACT.	VIOL.
1	7	2	232	3 -N	1.3774	.9998	1.5111	1.4325	.0786	.0549	
2	7	2	250	3 -C	1.3774	.9998	1.5111	1.4325	.0786	.0549	
3	7	2	511	13-N	1.3774	.9998	1.5111	1.4325	.0786	.0549	
4	7	2	529	13-C	1.3774	.9998	1.5111	1.4325	.0786	.0549	
5	6	1	309	6 -L	1.3672	1.0000	1.5205	1.4219	.0986	.0694	
6	6	1	321	6 -E	1.3672	1.0000	1.5205	1.4219	.0986	.0694	
7	6	1	441	10-L	1.3672	1.0000	1.5205	1.4219	.0986	.0694	
8	6	1	453	10-E	1.3672	1.0000	1.5205	1.4219	.0986	.0694	
9	6	1	308	6 -L	1.3670	1.0000	1.5205	1.4217	.0988	.0695	
10	6	1	320	6 -E	1.3670	1.0000	1.5205	1.4217	.0988	.0695	
11	6	1	440	10-L	1.3670	1.0000	1.5205	1.4217	.0988	.0695	
12	6	1	452	10-E	1.3670	1.0000	1.5205	1.4217	.0988	.0695	
13	6	1	280	5 -K	1.3668	1.0000	1.5205	1.4215	.0990	.0696	
14	6	1	289	5 -F	1.3668	1.0000	1.5205	1.4215	.0990	.0696	
15	6	1	471	11-K	1.3668	1.0000	1.5205	1.4215	.0990	.0696	
16	6	1	480	11-F	1.3668	1.0000	1.5205	1.4215	.0990	.0696	
17	6	1	281	5 -K	1.3651	1.0000	1.5205	1.4197	.1007	.0710	
18	6	1	290	5 -F	1.3651	1.0000	1.5205	1.4197	.1007	.0710	
19	6	1	472	11-K	1.3651	1.0000	1.5205	1.4197	.1007	.0710	
20	6	1	481	11-F	1.3651	1.0000	1.5205	1.4197	.1007	.0710	

Discussion:

This is a copy of a sample run output used to test the Aug '83 Version of DETECTOR. Phony Tech. Spec. parameters were used for Fuel Type 7, TS Set 2, to test the rod-bow penalty calculation and to cause FT 7 fuel pins to appear in the edit values. The "CONST. MULT." is FSHTSX(K), see Att. 1. This edit is always correct even in the Aug '83

Att. 2. Discussion (cont'd.)

version. The "TECH SP. FSUBH" is TSFSH of Att. 1, ie FSHTS times the "ROD BOW FACTOR." The values in the edit of Att. 2 are correct since the calculation of rod bow factor was not bypassed (even if unity). If this factor had been bypassed values for "TECH SP. FSUBH" for Fuel Type 6, Tech. Spec. Set 1, would have incorrectly been edited as 1.5114. (This bypass was utilized by AEPSC). In fact the technical specification for Unit 1 does not require a "ROD BOW FACTOR" nor does it require a "FLOW FACTOR" or a "TEMP FACTOR."

The values "FSUBHN", $F^N_{\Delta H}$, are the best estimates from the DETECTOR code for the enthalpy rise peaking factors. These values are correct even in the Aug '83 modification. The "ACTUAL FSUBH" values are "FSUBHN" times the measurement uncertainty factor "FSUBHU", F_U. The key technical specification requirement is that "ACTUAL FSUBH" values not exceed "TECH SP. FSUBH." This requirement was fulfilled in all the maps that utilized the Aug '83 version of DETECTOR.

Att. 3. Recommended Additional Surveillance

Current Surveillance:

(1) SNA verification.

(2) DETECTOR Training & QA Course

Both AEPSC and Duke personnel have completed this course. In this training hand-calculational verifications are performed for all the DETECTOR results, starting with raw detector data and progressing to technical specification compliance, for the limiting fuel pin locations for F_Q, $F_{\Delta H}$, and F_{PDC} (F_Q surveillance).

Recommended Additional Surveillance:

(1) Increase the size of the edits for $F_{\Delta H}$ and F_Q technical specification edits (eg from 20 to the maximum code allowance of 100). This would have clearly identified this particular bug since the "TECH SP. FSUBH" for TS Set 1 would have incorrectly been listed as the "CONST. MULT." for TS Set 2.

(2) For each change in DETECTOR versions and for any change in input values for calculational options, the user should verify, via hand calculations, that the DETECTOR results for limiting technical specification are valid for <u>each fuel type</u>. (The SNA verification and the DETECTOR training include hand-calculation verification of results for all <u>expected</u> options).

Att. 4. List of Addresses for Responsible Parties

Official Notification:

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