

WCAP-9561-NP-A

Addendum 2

ADDENDUM TO
BART-A1: A COMPUTER CODE
FOR THE BEST ESTIMATE ANALYSIS
OF REFLOOD TRANSIENTS
(SPECIAL REPORT: NS-NRC-85-3025-A)

B. A. McINTYRE

JULY 1985

Westinghouse Electric Corporation
Nuclear Energy System
P.O. Box 355
Pittsburgh, Pennsylvania 15230

8508280208 850814
PDR TOPRP EMVWEST
C PDR



UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D. C. 20555

MAY 9 1985

Mr. E. P. Rahe, Jr., Manager
Nuclear Safety Department
Westinghouse Electric Corporation
Box 355
Pittsburgh, Pennsylvania 15230

Dear Mr. Rahe:

SUBJECT: ACCEPTANCE FOR REFERENCING OF SPECIAL REPORT NS-NRC-85-3025 (NP),
"BART-WREFLOOD INPIIT REVISION"

We have completed our review of the subject special report submitted March 22, 1985 by Westinghouse Electric Corporation letter. This special report revises the methodology for inputting WREFLOOD data to BART as described in WCAP 9561(P), "BART A1: A Computer Code for the Best Estimate Analysis of Reflood Transients." We find the report to be acceptable for referencing in license applications to the extent specified and under the limitations delineated in the report and the associated NRC evaluation, which is enclosed. The evaluation defines the basis for acceptance of the report.

We do not intend to repeat our review of the matters described in the report and found acceptable when the report appears as a reference in license applications, except to assure that the material presented is applicable to the specific plant involved. Our acceptance applies only to the matters described in the report.

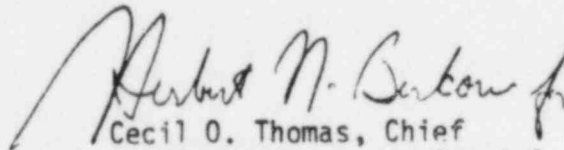
In accordance with procedures established in NUREG-0390, it is requested that Westinghouse publish an accepted version of this report, within three months of receipt of this letter. The accepted version shall incorporate this letter and the enclosed evaluation between the title page and the abstract. The accepted version shall include an -A (designating accepted) following the report identification symbol. When WCAP 9561 is revised, the appropriate text of special report NS-NRC-85-3025 is to be incorporated in that revision, and this acceptance letter, together with the enclosed SER are to be incorporated in the accepted version of that revision, between the title page and the abstract.

E. P. Rahe, Jr.

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Should our criteria or regulations change such that our conclusions as to the acceptability of the report are invalidated, Westinghouse and/or the applicants referencing the topical report will be expected to revise and resubmit their respective documentation, or submit justification for the continued effective applicability of the topical report without revision of their respective documentation.

Sincerely,

A handwritten signature in dark ink, appearing to read "Cecil O. Thomas". The signature is fluid and cursive, with a large initial "C" and "T".

Cecil O. Thomas, Chief
Standardization and Special
Projects Branch
Division of Licensing

Enclosure:
As stated

SSER ON BART-A1 COMPUTER
CODE INPUT METHODOLOGY MODIFICATION

Reference 1 is the acceptance copy of the topical report describing BART-A1. The NRC staff SER is included in that document. BART-A1 is used to calculate reflood heat transfer during a large break LOCA. This code, developed by Westinghouse replaces the FLECHT correlation. It is based on more mechanistic principles and is less empirical than FLECHT. In general, the staff supports approaches such as used in BART-A1.

The purpose of this SSER is to address the change in input methodology for the BART computer code as reported to the Turkey Point Board on March 18, 1985. In consideration of that issue some changes are made in the Turkey Point SER (reference 2).

In reference 3, the NRC staff was informed by Westinghouse Electric Corporation of an input methodology problem for the BART computer program. BART is one of the programs in the Westinghouse Emergency Core Cooling System (ECCS) evaluation model used to demonstrate compliance with 10 CFR 50.46 and Appendix K to 10 CFR 50.

Core inlet flooding rate (V_{in}) calculated as a function of time in the WREFLOOD computer code is used as input to the BART code. However, only a limited number of V_{in} points are made available from WREFLOOD. During the first few seconds of the core reflooding transient, the change in V_{in} as a function of

time is oscillatory. Therefore, using a limited number of points from WREFLOOD did not allow an accurate representation of V_{in} or the integral of V_{in} used in BART. In partical the integrál of V_{in} and consequently the water level in the core was too high as used in BART.

Westinghouse modified the data transfer procedure so that good agreement now exists between WREFLOOD and BART. The analysis procedure also instructs the analyst to assure that for all times during reflood the integrated value of V_{in} used in BART is equal to or less than that calculated by WREFLOOD. A reanalysis of the Turkey Point Units 3 and 4 was performed using the new methodology.

We have reviewed the information submitted by Westinghouse and find the new methodology satisfactory and meets the requirements of Appendix K to 10 CFR 50. An SER addressing this subject on a plant specific basis for Turkey Point Units 3 and 4 and other plant specific SERs will be supplied for those plants that have referenced BART prior to this evaluation approving the modified data transfer procedure on a generic basis.

Principal Contributor:

N. Lauben

REFERENCES

1. BART-A1: A Computer Code for the Best Estimate Analysis of Reflood Transients, WCAP-9561-P-A, March 1984.
2. Letter to Robert E. Uhing (FP&L) from Dan McDonald (NRC) on "Technical Specification Amendments to Support the Integrated Program for Vessel Flux Reduction and Operation with New Steam Generators," (Enclosure 3) dated December 23, 1983.
3. Letter from E. P. Rahe, (Westinghouse) to D. G. Eisenhut (NRC) on "BART-WREFLOOD Input Revision," dated March 22, 1985.



Westinghouse
Electric Corporation

Water Reactor
Divisions

Box 355
Pittsburgh Pennsylvania 15230

March 22, 1985

NS-NRC-85-3025

Mr. D. G. Eisenhut

Office of Nuclear Reactor Regulation
U.S. Nuclear Regulatory Commission
Phillips Building
7920 Norfolk Avenue
Bethesda, MD 20014

Subject: BART-WREFLOOD Input Revision

Dear Mr. Eisenhut:

The purpose of this letter is to inform you of an input methodology revision in the interface between two computer codes used in the Westinghouse Emergency Core Cooling System (ECCS) evaluation model which is used to demonstrate compliance with Appendix K to 10CFR50.46. Specifically, the input methodology revision applies the way input to the BART code is determined from the WREFLOOD code in the large break loss-of-coolant-accident (LOCA) analyses. The revision in the input methodology may result in an increase in calculated peak cladding temperature for analyses which have used the BART computer code. This problem has been discussed with Dr. Brian Sheron and Mr. Norman Lauben of your staff. Additional details regarding this problem may be found in the attachment.

Westinghouse has reviewed the LOCA analyses which have been performed with the Westinghouse ECCS evaluation model which incorporates the BART code and WREFLOOD code interface and determined that the effect of the input methodology revision would not result in any of the analyses exceeding the 2200°F regulatory limit on peak cladding temperature. Reanalyses of Turkey Point units 3 and 4 have been completed as reflected in the attachment and reanalyses of the other affected plants is in progress.

If you have any questions concerning these modifications, please contact Mr. Brian McIntyre of my staff at (412)374-5506.

Sincerely,
Westinghouse Electric Corporation

E. P. Rahe, Jr.
E. P. Rahe, Jr., Manager
Nuclear Safety Department

cc: B. Sheron
N. Lauben

BART Vin ISSUE SUMMARY

BACKGROUND

In the course of performing work unrelated to the Florida Power and Light Company analyses for Turkey Point Units 3 and 4 it was determined that it was necessary to revise the approved procedure by which the flooding rate information generated by the WREFLOOD code was transferred to the BART code. The core inlet flooding rate (Vin) is transferred by hand from the WREFLOOD code output to the BART code input. Examination of a typical flooding rate curve shows that it is divided into two phases; an initial surge which takes place in approximately the first seven seconds, reaching values on the order of 15 in/sec or more, and the remainder of the transient which is characterized by relatively slowly varying inlet velocities on the order of one inch per second. The transient response is dependent on the integrated value of the inlet velocity.

A limited number of instantaneous values of Vin are available to the analyst for replicating the Vin curve as a part of the BART input. Use of all available Vin values in the initial surge portion of the transient does not necessarily produce good integrated agreement at the start of the second portion of the transient. Connecting the discrete input points can result in more water in the core than the WREFLOOD code calculates.

A representative example of WREFLOOD output and BART input is presented in figure 1. It can be seen that the area under the BART input Vin curve is greater than under the WREFLOOD output Vin curve. The BART points are the WREFLOOD values normally available to the analyst.

As a result the integrated value of water in the core may be higher in BART than in the WREFLOOD code. This higher water level provides an earlier onset of entrainment which results in an earlier initiation of steam cooling in the upper regions of the core. This earlier initiation of steam cooling gives a lower calculated PCT than would be calculated if the integrated value of the Vin curve from WREFLOOD had been matched exactly.

The WREFLOOD integrated Vin curve and the BART integrated Vin curve for a representative plant are presented in figure 2.

CORRECTIVE ACTION

A data transfer procedure, utilizing the available WREFLOOD Vin output, has been developed and implemented that results in good agreement between the WREFLOOD calculated value of the integrated flooding rate and the BART calculated value of the integrated flooding rate. This procedure also cautions the analysis reviewer to verify the similarity of the integrated Vin curves between the two codes and provides a standard method for comparing the two curves.

IMPACT ON TURKEY POINT UNITS 3 AND 4

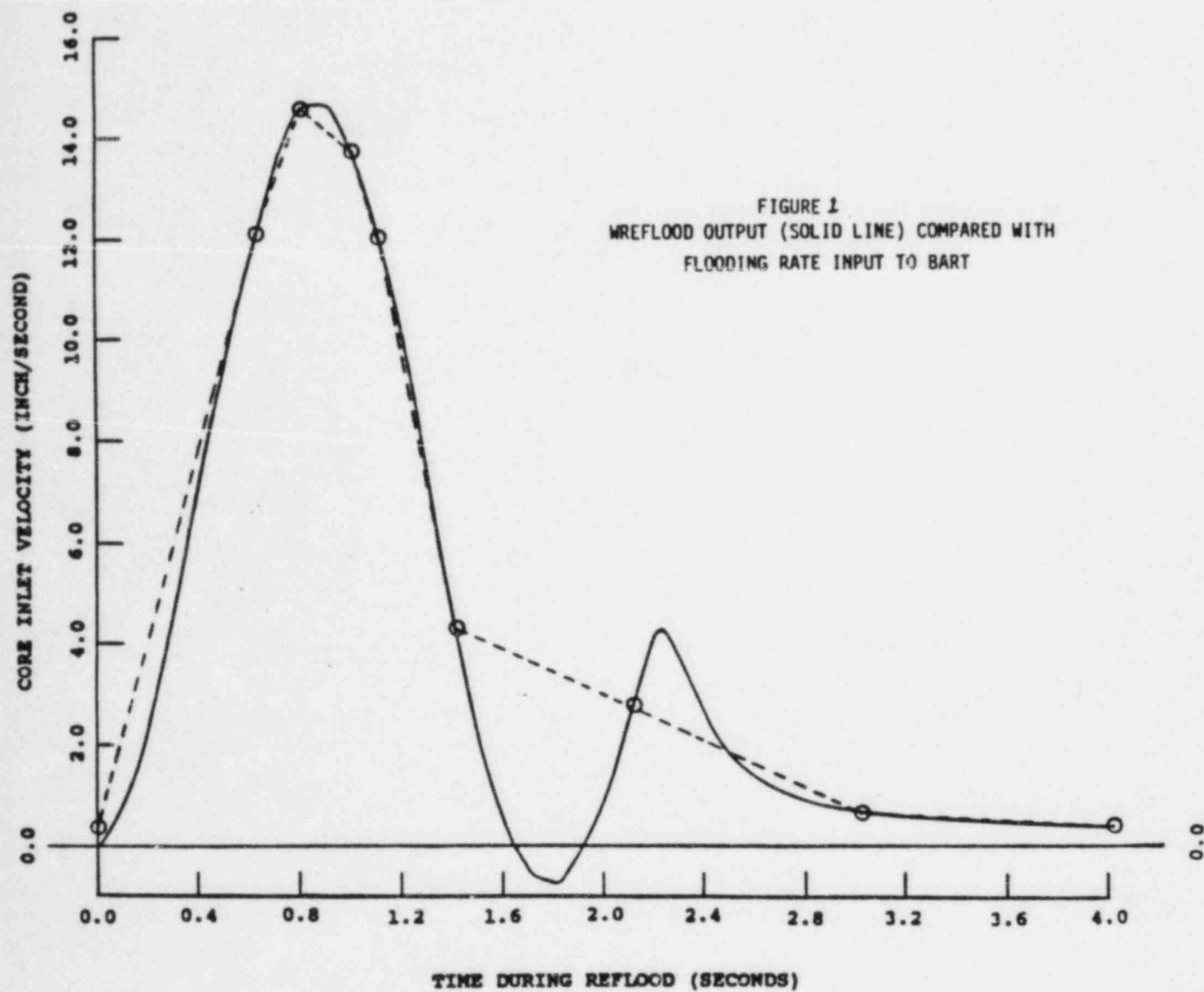
A reanalysis of the Turkey Point Units 3 and 4 was performed using this new methodology. The results of this reanalysis indicated that the calculated PCT increased 79 F to 2051 F from the original analysis value of 1972 F.

The revised calculated peak cladding temperature is well below the 2200 F limit of 10CFR50.46.

OTHER AFFECTED PLANTS

ZION 1&2
DC COOK 1
MCGUIRE 1&2

An evaluation of the BART results for these plants indicates that in no case will the 2200 F limit of 10CFR50.46 be exceeded. More detailed analyses will be performed for these plants in the next two weeks.



COMPARISON OF INTEGRATED CORE INLET FLOW
FIGURE 2

