

EVALUATION OF ADLPIPE ERROR
IN TEE ELEMENT
RELATING TO
DEFECT AND NON-COMPLIANCE EVALUATION REPORT
NO. 83-01

Washington Public Power Supply System
Nuclear Power Plant #2

March 28, 1983

Prepared by: *A. Chu*
A. Chu

Reviewed by: *Z. Studnicka*
Z. Studnicka

Approved by: *O. Michejda*
O. Michejda

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PDR ADOCK 05000397
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INTRODUCTION

This study is in response to a letter from B. C. Hanley of DIS/ADLPIPE to H. Boyd of United Information Services, dated 9/28/82, stating that for Class 2, 1972 analysis the section modulus used for reduced outlet branches was actually that of the run and not that of the branch. The letter was included as an attachment in a memo, #CS9182 Ref. (1) to O. Michejda, dated 12/2/82. After an inquiry to DIS/ADLPIPE, Burns & Roe was informed on 12/20/82 that an error definitely exists in the in-house version of ADLPIPE, Ref. (2). The Piping Engineering Department immediately formulated a correction procedure and started to review all the calculations in the Washington Public Power Supply System Nuclear Power Plant #2 project. The applicable codes for the project are ASME Section III, 1971 edition through 1973 Winter addenda and ANSI B31.1 1973 edition, Ref. (3). WNP-2 project used the ADLPIPE program containing the above mentioned error with some few exceptions where the 1974 ASME Class 2 code was used which is more conservative than the 1972 Code.

As stated in Ref. (1), the calculations would contain an error if the following conditions occurred concurrently:

- 1) The piping system had reduced branches,
- 2) The fittings were modeled with TEE, 1T, 2T or BRANCH cards,
- 3) ASME Class 2, 1972 code was used.

The review of all calculations showed incorrect stresses at sixty seven nodal points. A procedure was prepared to assess the effects of the error on the calculated stresses at the identified locations.

PROCEDURES

Correction factors for stress evaluation were calculated from the dimensions of the fittings to account for the incorrect calculation of the branch section modulus in accordance with Article NC3652.4 of ASME B&PV Code Section III (Ref. 4)

$$\text{Correction Factor } \frac{Z_r}{Z_b} = \frac{r_R^2 t_R}{r_b^2 t_e}$$

Where:

r_R = nominal mean cross-section radius of pipe connected to the run portion of the tee

r_b = nominal mean cross-section radius of pipe connected to the branch portion of the tee

Z_r = section modulus of the run portion of the tee

Z_b = section modulus of the branch portion of the tee

t_R = thickness of pipe connected to the run portion of the tee

t_e = effective branch wall thickness, lesser of t_R or $i \times t_b$

t_b = thickness of pipe connected to the branch portion of the
tee

i = stress intensification factor for tee

The erroneous ADLPIPE stresses were multiplied by the above correction factors. Later the procedure was confirmed by a letter from I. W. Dingwell of DIS/ADLPIPE to T. Butler of Burns & Roe, dated 1/10/83 (Attachment A). The results including ADLPIPE output stress, corrected stress and allowable stress are summarized in the Calculation No. 8.90.38 Book No. 8.90.16.

The ADLPIPE stresses for equations 8 and 9 consist of two terms; stress due to pressure and stress due to moment. Only the stress due to moment was affected by the incorrect section modulus in the ADLPIPE program. In the process of correcting the ADLPIPE stresses, correction factors were applied to the printed stresses as indicated in Attachment A. This results a conservative stress values. If overstressed condition was found, the printed stress was broken down into two parts and then stress due to moment only was multiplied by the correction factor resulting in actual stress values.

CONCLUSION

All corrected stresses were compared with the allowable limits.

No overstressed condition was found. The original calculations are being revised to correct the stress values at the affected locations.

REFERENCES

1. Memo, T. Butler to O. Michejda/A. Dajani, dated 12/2/82, CS9182, UIS System ADLPIPE Errors.
2. Memo, T. Butler to O. Michejda/P. Chan/H. Brandmaier, dated 12/20/82, CS10982, Possible Tee Errors in ADLPIPE.
3. Piping Design Guide for Washington Public Power Supply System Nuclear Project No. 2.
4. ASME B&PV Code, Division I, Section III, 1972 Winter Addenda.

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ATTACHMENT A

January 10, 1983

Via Federal Express

Mr. Thomas Butler
BURNS & ROE, INC.
650 Winters Avenue
Paramus, NJ 07652

Dear Mr. Butler:

The purpose of this letter is to provide you with information concerning a forthcoming change in ADLPIPE, and to advise you that if previous revisions of ADLPIPE were used in the design of a nuclear reactor under specific circumstances, an evaluation under 10 CFR Part 21 may be required.

The May 1974 release introduced into ADLPIPE the requirements of ASME Section III (Nuclear Power Plant Components) for Class 2 piping (Subsection NC, 1972 Winter Addenda). New editions of Subsection NC were published by the ASME in 1974 and 1977. The requirements of these codes were implemented into ADLPIPE in April 1976 and November 1981 respectively.

An error has recently been discovered in the May 1974 release of ADLPIPE and all subsequent versions related to reduced outlet branch tee fittings whose stress was evaluated under Class 2, 1972 Winter Addenda. This error does not affect calculations under the 1974 and 1977 editions of Subsection NC.

For evaluations under the Class 2, 1972 Winter Addenda, the calculation of the section modulus of the reduced outlet branch (Paragraph NC-3652.4(c)) incorrectly substituted the run section modulus for the branch section modulus.

It is suggested that all Class 2, 1972 Winter Addenda stress calculations for the reduced outlet branch be reviewed. The following factor should be applied to the printed stress at the intersection of the run and reduced outlet portions of a tee:

DISADLPIPE, Inc.

January 10, 1983

-2-

ATTACHMENT A

Mr. Thomas Butler
BURNS & ROE, INC.

(a) for cases where $t_r < it_b$

$$\text{factor} = \frac{r^2}{r_b^2}$$

(b) for cases where $t_r > it_b$

$$\text{factor} = \frac{r^2}{r_b^2} \times \frac{t_r}{it_b}$$

where:

r = nominal mean cross-section radius of pipe connected to the run portion of the tee

r_b = nominal mean cross-section radius of pipe connected to the branch (reduced outlet) portion of the tee

t_r = thickness of pipe connected to the run portion of the tee

t_b = thickness of pipe connected to the branch portion of the tee

i = stress intensification factor for tee (printed out in Class 2 Stress Report).

The above factors apply for reduced outlets for TEE, 1T, 2T and BRANCH connections.

This correction will be made in a future change to ADLPIPE.

If the ADLPIPE code was used in the design of a facility licensed by the United States Nuclear Regulatory Commission (NRC) under circumstances where the foregoing change is pertinent, we request that the user perform an evaluation to ascertain whether such use could create a "substantial safety hazard," as defined in 10 CFR Part 21. If a substantial safety hazard could be created, we further request that the NRC be notified in accordance with the requirements of Part 21 and that we be advised of such notification.

Very truly yours,

I. W. Dingwell
President

MEMORANDUM

BURNS and ROE, Inc.

DATE 4/8/83

COPIES TO:

J. DeLooper
db

TO E. R. Kummerle
FROM O. Michejda ✓
SUBJECT Potentially Reportable Deficiencies No. 82-12
and 83-1

The errors in ADLPIPE program identified by the Potentially Reportable Deficiencies:

No. 82-12 - Bellows Skew Card and
No. 83-1 - Branch Tee Section Modulus

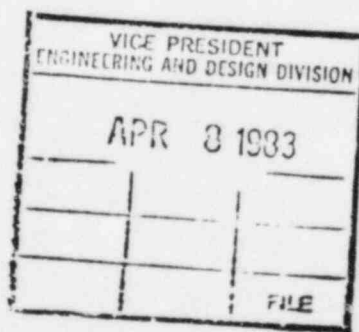
have been evaluated for all the nuclear projects within Burns and Roe, Inc. Two reports, one for each deficiency, have been submitted previously for Washington Public Power Supply System Project, WNP-2.

The other projects have been evaluated and the results submitted in documents attached to this memo. The table below relates the copies of the attached documents to the two reports and the projects.

	<u>Rep. 82-12</u>	<u>Rep. 83-1</u>
Cooper Station	Att. 1	Att. 1
Oyster Creek	Att. 2	Att. 3
TMI II	Att. 2	Att. 3 and 4
Phil. Nuc. Plant	Att. 2	Att. 3
PSE&G	Att. 5	Att. 5
CRBRP	Att. 6	Att. 7

O. Michejda
O. Michejda

OM/kas
attachments



BURNS and ROE, Inc.**DATE** 3/16/83

Revised 3/31/83

IGabel

PF

db

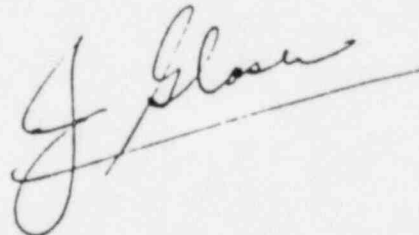
TO O. Michejda**FROM** J. Glaser**SUBJECT** Nebraska Public Power District
Cooper Nuclear Station
Brownville, Nebraska
Errors Discovered in "ADLPIPE" Calculations

1. Skewed Bellows (82-12)
2. Reduced outlet tee fitting (83-1)

The 2 "ADLPIPE" errors recently discovered had no effect on the subject nuclear plant. "ADLPIPE" was never used during the design and licensing of the subject plant. The BRI Computer Program was used for "thermal" calculations and EDS was contracted to perform the seismic calculations utilizing their own program.

Investigation also showed that during the NRC 79-02 and 79-14 review of the pipe supports in the subject plant, the 2 "ADLPIPE" errors had no effect on the results. The skewed "bellows" and "flexible" input cards (subject error #1) and the affected versions of ADLPIPE (subject error #2) were never used in the review calculations.

/cd



BURNS and ROE, Inc.

DATE 3/31/83

COPIES TO:

A.G. Dam
R. Gagliardo
T. Butler
J. Sudol
L.A. Zuchowski
pf(2) 10.02A
75.50

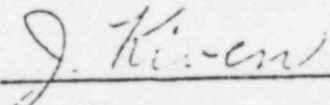
TO O. Michejda
FROM J. Kiven
SUBJECT W.O. 3344
Westinghouse Electric Corporation
Philippine Nuclear Power Plant Unit No.1
Error in ADLPIPE coding-Bellows-preceded
by Skew card

Reference Letter: Dingwell (Disadpipe Inc.) to Butler
(B&R) dated October 22, 1982.

The reference letter states that a problem exists with
the Bellows card in the IBM version of ADLPIPE only.

Until the time when ADLPIPE was adapted to the Burns and
Roe machine, which is a rather recent development, the CDC
version of ADLPIPE was used at Burns and Roe either through
CDC - Minneapolis or through The CDC machine at Grumman.
This period covers all work done for TMI-2, and those
calculations are not affected by this problem.

Work done more recently for The Philippines Project and
for Oyster Creek has been reviewed and no use of the in-
valid coding has been found.


J. Kiven

JK/kr

BURNS and ROE, Inc.

DATE 3/1/83

COPIES TO:

TO O. Michejda

FROM J. Kiven

SUBJECT W.O. 3344
Westinghouse Electric Corporation
Philippine Nuclear Power Plant Unit No. 1
TEE Errors in ADLPIPE

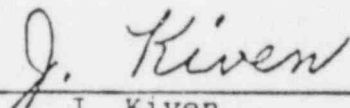
ASDam
RGagliardo
TButler
JSudol
LAZuchowski
pf (2) 10.02A
75.50

Ref. 1. Memo T.B. to O. Michejda/P. Chan
H. Brandmaier dated 12/20/82, Same Subject

Ref. 2. Letter B. Hanley, (DIS/ADLPIPE) Inc. to
Tom Butler, (B&R) dated 1/10/83

References 1 and 2 state a tee calculation error exists in ADLPIPE for the calculation version based on ASME Section III Subsection NC for Class II piping as issued in the 1972 Winter Addenda and brought out by ADLPIPE in May 1974. However, other calculation options exist in ADLPIPE for Class II piping which are correctly coded.

A review of ADLPIPE stress calculations for projects under my cognizance has been made in accordance with your request to determine whether our analysis has ever used the Class II 1972 option. It appears that this version was never used and no errors have been introduced. The project calculations reviewed were TMI-2, Oyster Creek and Philippines Unit I. In TMI-2, considering the very large number of calculations, a 10% sampling was made with the effective conclusion as stated. In the other projects 100% of the calculations were checked.



J. Kiven

JK/dm

BURNS and ROE, Inc.

DATE 4/5/83

COPIES TO:

A.S. Dunn
A. Asarpota
M. Maher
T. Butler
pf(2)

TO O. Michejda / R. Gagliardo

FROM J. Kiven

SUBJECT W.O. 3775-04
G.P.U. Nuclear Corp.
Three Mile Island Unit #2
TEE Errors in ADLPIPE

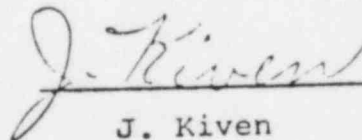
Reference: Memo Kiven to Michejda same Subject, dated 3/1/83

The reference memo states a review of 10% of the approximately 700 TMI-2 pipe stress calculations indicated that the incorrectly coded ASME Class II Winter 1972 option was not used. The option that was used referenced the B31.1 code which is equivalent to ASME Section III Subsection NC which covers Class II piping.

However in those piping configurations to be analyzed that were partly Nuclear Class I and partly Nuclear Class II, the B31.1 option was not available. In these cases the coding had to reference the 1972 ASME code where the validity of the procedure for calculating stresses in Tees is in question.

A study of appropriate flow diagrams determined that a maximum of 6 "mixed" Class runs existed.

A detailed review of existing analyses for the 6 configurations indicated that all of the designs are acceptable.


J. Kiven

JK/kr

MEMORANDUM

ATTACHMENT 5

COPIES TO:

BURNS and ROE, Inc.

DATE 3/31/83

JDeLooper
DGoldner
pf

TO O. Michejda

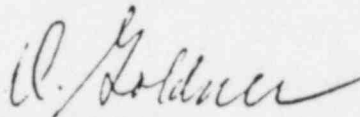
FROM D. Goldner

SUBJECT Public Service Electric & Gas Co.
Computer Program

This is to inform you that errors in the ADL Pipe Computer Program have not affected Burns and Roe calculations for PSE&G's Salem 1 and 2 piping systems.

This is due to the fact that these calculations were performed using the PIPDYN II computer program. This program was developed by Franklin Institute for PSE&G's use on the Salem projects.

DG/gg


D. Goldner

BURNS and ROE, Inc.

QA-364-82

DATE 11/4/82

TO Messrs. K. A. Roe (via O.O.P), S. Baron,
W. H. Young

FROM E. J. Corrigan *E. J. Corrigan*

SUBJECT 10CFR21/10CFR50.55(e) Evaluation
of ADLPIPE Program Problem

REFERENCE: BRD-L-2.3, Reporting of Defects and
Noncompliances

Review Committee:

- . M. C. Ascher
- . F. Corrigan
- . A. Dajani
- . J. Ellwanger
- . P. Timar

*Licensing:

- . A. Lageraen
(WPPSS WNP-2,
Woodbury)
- . W. Conn (WPPSS
WNP-2, Richlan)
- . F. Patti (all
other BR Nucle
Projects)

*W. P. Rausch

*pf: 1.1, 2.8, 6.6,
101.11

sc

*W/Attach. 1 only

Attachments 1 and 2 are provided as required by
the referenced procedure.

The attachments describe the evaluation that was
performed by the Breeder Reactor Division for the
Clinch River Breeder Reactor Plant to determine re-
portability under the law for the ADLPIPE Program
problem.

The attachments reflect the decision that the pro-
blem described therein is not reportable under either
10CFR21 or 10CFR50.55(e).

EJC:ic

Attachment 1 - 10CFR21/10CFR50.55(e) Evaluation
Report dated 11/4/82

Attachment 2 - 10CFR21/10CFR50.55(e) Evaluation
Review Committee Meeting Minutes

Burns and Roe, Inc.
700 Kinderkamack Road
Oradell, N. J. 07649

PROJECT: Clinch River Breeder Reactor Plant EVALUATION REPORT # BRD-82-1
WORK ORDER: 3067 & 3070 DATE: November 4, 1982
SPECIFIC AREA OF CONCERN: IBM Version of ADLPIPE Computer Program - 2C, 2D2 and 2D12
OUTSIDE CONTRACTOR INVOLVED: DIS/ADLPIPE, INC., 55 Wheeler Street,
Cambridge, Ma. 02138

1. DESCRIPTION OF POTENTIAL DEFECT OR NONCOMPLIANCE: Discrepancy between piping support loads calculated using the ADLPIPE IBM version of the program (2C, 2D2 and 2D12) when compared to the CDC version of the program when spring stiffness $\geq 10^6$ were used in modeling a skewed support as a bellow element.
2. DATE AND METHOD OF DISCOVERY: BR Corp. QA meeting report received 10/26/82.
3. ANALYSIS OF SAFETY IMPLICATION: All stress calculations in safety related systems were reviewed to determine whether the subject program had been utilized. Only four calculations were identified as having used the program. None of the calculations had proceeded to the approval stage for incorporation into the design of a facility, component or activity related to the project. Further, none of the calculations included the conditions (stiffness values) which could have resulted in a safety hazard.

The defect was not the result of a failure to comply with any applicable rule, regulation, order or license issued by the Nuclear Regulatory Commission.

Accordingly, the defect is not reportable by the criteria of 10CFR21. Based on the licensing phase of construction (i.e. non-safety related site preparation activities) a potential 10CFR50.55(e) deficiency does not exist.

4. OTHER FACILITIES WHICH MAY BE AFFECTED: Program Users being identified by outside contractor DIS/ADLPIPE, Inc.
5. CORRECTIVE ACTION (TAKEN/PROPOSED): DIS/ADLPIPE, Inc. has issued a corrected program (Change 469) and is notifying users of the IBM version of the program of the potential problem.

6. REQUIRED REVIEW AND INDIVIDUAL DETERMINATION:

	Signature/Date	Reportable	Not Reportable	Eng. Study Required
Project Manager	<i>McBreen</i> 11/4/82		X	
QA Manager	<i>E. Corrigan</i> 11/4/82		X	
Asst. P.M. Engr. & Des. Ser.	<i>P. T. Dajani</i> 11/4/82		X	
Cog. Section Manager	<i>Peter J. ...</i> 11/4/82		X	
Lic. & Environmental Mgr.	<i>...</i> 11/4/82		X	
Initiating Employee	Not Applicable			

7. EVALUATION BY BRD VICE-PRESIDENT: Not required.

8. ACTION TAKEN: No Burns and Roe, Inc. action required on Clinch River Project.

E. J. Corrigan 11/4/82 13:30
QA Manager Date Time

MEMORANDUM

5A-030-83

COPIES TO:

BURNS and ROE, Inc.

DATE 4/7/83

TO A. T. Dajani,
W. H. Gibson
FROM W. H. Gibson

JArcher
OMichejda
ECorrigan
PTimar
pf 1.1
sc

SUBJECT ADLPIPE TEE Errors

I called Dr. P. W. Chan on Friday, April 1, 1983 and asked him whether a review of CRBRP stress analyses was performed relative to the ADLPIPE reduced branch TEE problem. He replied that such a review had been performed and that no analyses were made using the 1972 Version (Section III, Winter Addenda 1972). As a counter check I reviewed some of our existing calculations and found this to be true.

CRBRP therefore has no further required action on this point.

WHG/lv