LOFT TECHNICAL REPORT LTR 1115-40

RE&C REPORT NUMBER RE-A-78-076

JULY 7, 1978

MASTER

FAULTED STRESS ANALYSIS
OF THE LOFT REACTOR VESSEL
FILLER ASSEMBLY

D. P. Finicle

NOTICE

NO ONLY

PORTIONS OF THIS REPORT ARE ILLEGIBLE. It
has been reproduced from the best available
copy to permit the broadest possible avail-
ability.

EG&G Idaho, Inc.

IDAHO NATIONAL ENGINEERING LABORATORY

DEPARTMENT OF ENERGY

IDAHO OPERATIONS OFFICE UNDER CONTRACT EY-76-C-07-1570

DISTRIBUTION OF THIS DOCUMENT IS UNLIMITED

DISCLAIMER

This report was prepared as an account of work sponsored by an agency of the United States Government. Neither the United States Government nor any agency Thereof, nor any of their employees, makes any warranty, express or implied, or assumes any legal liability or responsibility for the accuracy, completeness, or usefulness of any information, apparatus, product, or process disclosed, or represents that its use would not infringe privately owned rights. Reference herein to any specific commercial product, process, or service by trade name, trademark, manufacturer, or otherwise does not necessarily constitute or imply its endorsement, recommendation, or favoring by the United States Government or any agency thereof. The views and opinions of authors expressed herein do not necessarily state or reflect those of the United States Government or any agency thereof.

DISCLAIMER

Portions of this document may be illegible in electronic image products. Images are produced from the best available original document.

LTR NO. 1115-40
RE&C Report # RE-A-78-076
DATE July 7, 1978
WORK REQUEST NO.

RESEARCH, ENGINEERING AND CONSTRUCTION REPORT ENGINEERING ANALYSIS DIVISION

APPLIED MECHANICS BRANCH

FAULTED STRESS ANALYSIS
OF THE LOFT REACTOR VESSEL
FILLER ASSEMBLY

NOTICE
This report was prepared as an account of work sponsored by the United States Government. Neither the United States nor the United States Department of Energy, nor any of their employees, nor any of their contractors, subcontractors, or their employees, makes any warranty, express or implied, or assumes any legal liability or responsibility for the accuracy, completeness or usefulness of any information, apparatus, product or process disclosed, or represents that its use would not infringe privately owned rights.

D. P. Finicle
D. P. Finicle AUTHOR

CHECKED BY: R. G. Rahl APPROVED BY: C. A. Moore
R. G. Rahl C. A. Moore

~~THIS DOCUMENT HAS NOT RECEIVED PATENT CLEARANCE AND IS NOT TO BE TRANSMITTED TO THE PUBLIC DOMAIN.~~

cc: D. P. Finicle
R. C. Guenzler *ms*
M. A. Illover
C. A. Moore
R. G. Rahl
H. Rau
S. M. Gardner (3)
AM File (5)

DISTRIBUTION OF THIS DOCUMENT IS UNLIMITED *EB*

**LOFT TECHNICAL REPORT
LOFT PROGRAM**FORM EG&G-229
(Rev. 12-76)

TITLE Faulted Stress Analysis of the LOFT Reactor Vessel Filler		REPORT NO. LTR 1115-40
Assembly		RE-A-78-076
AUTHOR D. P. Finicle		GWA NO.
PERFORMING ORGANIZATION Applied Mechanics Branch <i>LA Moore 4-29-78</i>		DATE July 7, 1977
LOFT APPROVAL <i>R. P. [signature] 6-28-78</i> <i>MA Hoover 6-28-78</i> <i>H. [signature] 4-29-78</i> <i>[signature]</i>		
LD&DB Mgr.	F&REP Supvr.	FE&OB Mgr.
<i>ELC</i> RSB Mgr.	<i>[signature]</i> P&CSB Mgr.	LESD Mgr.
		PSB Mgr.

SUMMARY

A faulted analysis of the Reactor Vessel filler blocks has been completed. The faulted loads were the sum of LOCA (Loss of Coolant Accident) plus SSE (Safe Shutdown Earthquake). The analysis showed the filler blocks to be structurally adequate for the faulted loading.

ANALYSIS

The analysis consisted of obtaining LOCA loads from G. Miller, LTR 1115-34, Supp. 1, Reference 1, and SSE loads from T. Thompson, Reference 4. These loads were combined and then compared with the loading used in the LOCE analysis contained in LTR 1115-11, Rev. A., Reference 2. Due to a change in the support of the vessel fillers, the LOCA + SSE loading is lower than the LOCE loads that were analyzed for in LTR 1115-11, Rev. A. Since the ASME Section III allowables are higher for faulted conditions than for operating conditions (LOCE), no additional analysis was needed. The LOCA's used are documented in Reference 6.

REFERENCES

1. LTR 1115-34, Supplement 1, "Mechanical Analysis of LOFT Reactor Internals Due to Loss of Coolant Accidents," Greg Miller, to be released.
2. LTR 1115-11, Rev. A, "Analysis of the LOFT Reactor Vessel Filler Fasteners," B. F. Saffell, December 4, 1972.
3. LTR 1115-34, "Mechanical Analysis of LOFT Reactor Internals Due to Loss of Coolant Experiments," T. R. Thompson, April 28, 1977.
4. LTR 1115-31, "Seismic Analysis of LOFT Reactor Internals," T. R. Thompson, July 8, 1976.
5. ASME Boiler and Pressure Vessel Code, "Nuclear Components," Section III, 1977.
6. V. T. Berta, "LOFT LOCA-WHAM6 Model and Code Application", LOFT Technical Report LTR 114-100 (to be published).

FIGURE 1

⊖ # NODE #
 ⊖ # BEAM ELEMENT #

VESSEL FILLER BLOCKS from fig 1.

~FIGURE 2~

CALCULATION WORK SHEET Page 1 of PagesSubject REACTOR VESSEL FILLER FAULTED ANALYSIS Date Prepared By D. P. FINICLE Checked Work Request

INTRODUCTION: The LOFT REACTOR VESSEL FILLER BLOCKS will be analyzed for LOCA+SSE loading conditions which are considered as a faulted loading condition. The LOCA loading is obtained from LTR 1115-34, ~~ref. 1~~, ref. 1. The basic computer model used in ref. 1, was developed in ref. 3, LTR 1115-34, by T. R. Thompson. The model is shown in figures 1 & 2 of this report.

The ^{LOCA} loading for this model is obtained from ref. 1, which contains Hot and Cold leg LOCA (LOCA 2 and LOCA 1) computer runs.

LTR 1115 40

FORM EG&G-1592
(Rev. 5-77)

Page 13 of Pages

Subject _____ **Date** _____

Prepared By D P FINICLE Checked _____ Work Request _____

beam #	V2(I)	M3(I)	V2(J)	M3(J)
23	2.47×10^5	1.89×10^6	2.47×10^5	4.06×10^6
24	2.20×10^5	1.88×10^6	2.20×10^5	1.88×10^6
25	1.81×10^5	3.13×10^6	1.81×10^5	1.88×10^6
26	1.44×10^5	3.93×10^6	1.44×10^5	3.13×10^6

The remaining values are still less than those for the HOT LEG BREAK.

CALCULATION WORK SHEET

Page 4 of Pages

Subject _____ **Date** _____

Prepared By D P FINICLE Checked _____ Work Request _____

The maximum LOCA moments & shears occur during the HOT LEG BREAK and are

$$V_{MAX} = 3.61 \times 10^5 \text{ lb.}$$

$$M_{\text{max}} = 1.69 \times 10^7 \text{ " lb.}$$

These LOCA loads must be added to loads from an SSE. A seismic analysis using the computer model shown in figures 1 & 2, is contained in LTR 1115-31, By T.R. Thompson. Stress levels in the Vessel Fillers were reported in LTR 1115-31, ref 4, but loads were obtained from T. R. Thompson.

The seismic loadings are listed on the next page. These loads were pulled from computer output that was generated in LTR 1115-31

Page 5 of Pages

Subject _____ **Date** _____

Prepared By D P FINICLE Checked _____ Work Request _____

From inspection of the above loading, it can be seen that the maximum loads occur for the X-Z earthquake and they occur at top of the Reactor Vessel Fillers

CALCULATION WORK SHEET

Subject _____ Page 6 of _____ Pages
 Date _____
 Prepared By D. P. FINICLE Checked _____ Work Request _____

Combined LOCA + SSE LOADING

AT Beam Element # 23.

$$\begin{aligned}
 V &= 3.61 \times 10^5 + 1.28 \times 10^4 = 3.74 \times 10^5 \text{ lb} \\
 M_{\text{MAX}} &= 1.44 \times 10^7 + 1.21 \times 10^6 = 1.56 \times 10^7 \text{ " #} \\
 P_{\text{MAX}} &= 9.77 \times 10^3
 \end{aligned}$$

AT BEAM ELEMENT # 31

$$\begin{aligned}
 V &= 3.15 \times 10^5 \text{ lb.} \\
 M &= 1.71 \times 10^7 \text{ " #} \\
 P &= 6.52 \times 10^3 \text{ lb.}
 \end{aligned}$$

of the two highest loaded elements, the maximum forces & moments are

$$\left. \begin{aligned}
 V &= 3.74 \times 10^5 \text{ #} \\
 M &= 1.71 \times 10^7 \text{ " #} \\
 P &= 9.77 \times 10^3 \text{ #}
 \end{aligned} \right\} \text{ LOCA + SSE Loads}$$

Although these ^{maximum} forces and moments do not occur on the same element, the vessel fillers will be analyzed as if they did. This is a conservative approach which will shorten the analysis required.

Subject

Date _____

Prepared By D.P. FINIGAN Checked _____ Work Request _____

Checked

Work Request

The forces and moments used by B.F. Saffell in LTR 115-115 Ref 2, are shown below. These are HOCE or operating loads.

CALCULATION WORK SHEET

Page 8 of Pages

Subject _____ Date _____

Prepared By D. P. FINICLE Checked _____ Work Request _____

A maximum $V \cong 14 \times 10^5$ lbs and $M \cong 2.0 \times 10^7$ in-lbs was used at the top of the vessel filler, by B. F. Saffel in LTR 1115-11, Rev A.

The WOCE loads are larger than the WOCA+SSE loads given on page 6. The reason for this is that the support for the vessel filler was changed after LTR 1115-11 Rev A, was issued.

(faulted condition)

The allowables for LOCA+SSEA are larger than the allowables used in LTR 1115-11, which were for an operating condition. Since the faulted loads are less, and the allowables are larger, than the previous analysis of the vessel filler and fastener, no additional analysis is needed.

∴ The LOFT REACTOR VESSEL FILLER is OK.
for Faulted Loading (LOCA + SSE)