

From: David Terao
To: Joseph Colaccino
Date: 9/3/04 9:21AM
Subject: AP1000 GAPPIPE letter

Joe,

I reviewed the NRC letter dated April 11, 1995 from B. Sheron to R.L. Cloud containing the staff's safety evaluation of the R.L. Cloud topical report on the use of a computer program, GAPPIPE, for limit stop pipe supports. The NRC letter is referenced in Section 3.12.6.5 of the AP1000 final SER. The NRC letter and safety evaluation do not contain any technical information that is proprietary in nature. The letter and safety evaluation should be made publicly available since it does contain several conditions on the use of the topical report.

CC: John Segala

April 11, 1995

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Mr. Robert L. Cloud, President
Robert L. Cloud & Associates, Inc.
2150 Shattuck Avenue, Suite 1200
Berkeley, California 94704-1306

SUBJECT: TOPICAL REPORT REVIEW OF RLCA REPORT "A TOPICAL REPORT ON THE METHODOLOGY, VERIFICATION AND APPLICATIONS OF COMPUTER PROGRAM GAPPIPE," RLCA/P94/04-94/009, JUNE 1, 1994.

- References:
1. Letter of July 22, 1994, from J. S. M. Leung, Robert L. Cloud and Associates (RLCA), to USNRC Document Control Desk, with enclosed subject topical report.
 2. Letter of January 17, 1995, from R. L. Cloud, RLCA, to W. Russell, USNRC.
 3. Letter of March 15, 1995, from R. L. Cloud, RLCA, to W. Russell, USNRC.

Dear Mr. Cloud:

This provides the staff review of the subject topical report submitted on July 22, 1994 (Reference 1). The Office of the Controller is responding separately to References 2 and 3, in which you requested a waiver of the fee requirements of 10 CFR 170.21 for the staff review of the subject topical report.

The staff has completed its review of the topical report. A topical report evaluation, and conditions for applicability of GAPPIPE and limit stops, are provided in the enclosure to this letter. We find the report acceptable for referencing in future licensing actions or licensee modifications made pursuant to 10 CFR 50.59. The associated topical report evaluation should also be referenced along with the topical report.

OFFICIAL SIGNED BY
BRIAN W. SHERON
Brian W. Sheron, Director
Division of Engineering
Office of Nuclear Reactor Regulation

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Enclosure

Topical Report Evaluation

Mechanical Engineering Branch
Division of Engineering
Office of Nuclear Reactor Regulation

Title: "A Topical Report on the Methodology, Verification and Applications of Computer Program GAPPIPE." RLCA/P94/04-94/009, June 1, 1994.

Organization: Robert L. Cloud and Associates, Inc. (RLCA)

1.0 BACKGROUND

RLCA has developed a proprietary device known as "Limit Stop," to be used for restraining piping systems during seismic events. This device is equivalent to a support with large gaps. It permits free thermal expansion during normal plant operation; however, during a seismic event the pipe impacts the support with the limit stop, thus limiting the pipe displacements and stresses to acceptable values. The report asserts that the use of these devices should improve the reliability of piping systems.

Concurrently with the development of this device, RLCA has also developed the proprietary computer program GAPPIPE for the analysis of piping systems containing these devices. Since these devices contain gaps, they are non-linear in nature. For ASME Section III, Service Levels B, C and D loading conditions, piping systems are also permitted to experience inelastic deformation. The non-linear analysis of such piping systems is highly complex, requires competent analysts, and is usually considered expensive and impractical for production analysis.

The seismic analysis of piping systems under all loading conditions is ordinarily performed on an elastic basis, using either time-history or response spectrum methodology. RLCA has adopted an equivalent linearization procedure found in the literature for analyzing elastic structures with finite gaps, which permits the inclusion of gapped supports in standard linear elastic analysis of piping under seismic loading. This procedure forms the basis for GAPPIPE. However, the analysis of piping systems with limit stops may be performed with any computer program that has the capability to model and analyze the non-linear behavior of the stops.

The device is being proposed as a replacement for snubbers in nuclear power plants. The report provides the analytic methodology for the evaluation of piping systems that rely on limit stops in place of snubbers. A number of licensees have expressed an interest in installing limit stops in their plants, and such stops have, in fact, been installed in three U.S. nuclear power plants.

2.0 EVALUATION

The Mechanical Engineering Branch has reviewed the subject topical report. It contains a detailed description of the linearization procedure in GAPPIPE, and a section on the application of GAPPIPE to systems where snubbers were replaced with limit stops.

Sections 2.0 and 3.0 of the topical report describe the linearization procedure and its verification. This material was previously reviewed by the staff and its contractor, the Brookhaven National Laboratory, in a safety evaluation report (References 1 and 2) and was found to be acceptable, subject to the following conditions:

1. The damping used with the Uniform Support Motion response spectrum analysis method shall not exceed that specified in ASME Section III Code Case N-411 (Reference 3);
2. The application of ASME Section III Code Case N-411 shall conform with the limitations stipulated for this code case in Regulatory Guide 1.84 (Reference 4);
3. The Independent Support Motion method, based on response spectrum analysis or acceleration time-history analysis, shall conform with the conditions for application stated on pp. 2-2, 2-3 of Reference 5.

Section 4.0 of the report describes applications of limit stops and GAPPIPE. Limit stops were installed on a pilot basis in the Byron 2 plant. In its safety evaluation concerning the use of these limit stops at Byron (Reference 1), the staff stated that limit stops should be inspected after one cycle of operation. The licensee for Byron 2 has not yet reported the results of that inspection.

Section 4.0 also describes the installation of limit stops at the McGuire Nuclear Station and the Wolf Creek Nuclear Station under "direct replacement without analysis" programs. The subject topical report states that, under these programs, snubbers are replaced on a one-for-one basis without reanalysis. The justification for this is that the snubbers were designed under seismic loads using lower damping than the values in ASME Code Case N-411, which provides a certain amount of margin as compared to calculations based on the Code Case damping. The topical report also addresses conditions under which the replacement of certain snubbers will require analysis. The staff had previously accepted similar conditions for replacement in Reference 6. Based on the information provided by Duke Power Company (Ref. 6) in support of snubber replacements with limit stops at McGuire using 10 CFR 50.59, and based on the review of Section 4.0 of the topical report, the staff finds the application and installation of limit stops under a "direct replacement without analysis" program acceptable, subject to the same conditions referenced in the McGuire program and stated below:

1. Snubbers on a piping system may be replaced on a one-for-one basis without reanalysis if:

- a. the existing snubber configuration has not been optimized;
 - b. the existing snubbers account for 50% or less of the total number of dynamic supports of the system;
 - c. the seismic analysis of the system with the existing snubbers was based on Regulatory Guide 1.61 (Reference 7), or lower, damping.
2. Systems where the existing snubbers account for more than 50% of the dynamic supports shall be reanalyzed using damping no greater than that stated in Reference 3.
3. The following snubbers shall not be replaced with limit stops without reanalysis:
- a. snubbers which act as immediate dynamic supports to equipment nozzles in any transverse direction;
 - b. snubbers attached to valve operators;
 - c. snubbers which are the only dynamic supports acting to restrain the longitudinal direction of a pipe run between anchors and/or branch connections.

The topical report does not address inservice examination requirements. Limit stops fall within the scope of ASME Section XI, Article IWF-1000, Section IWF-1210, Subsection C, "Component Standard Supports" (Reference 8). Limit stops shall therefore be examined under the applicable provisions of ASME Section XI, 1989 Edition, Article IWF-2000, Sections IWF-2410 and IWF-2510. The method of examination shall conform with Section IWF-2520, subject to the relevant acceptance criteria stated in Section IWF-3400. Limit stops may also be examined under the alternate rules for examination stated in ASME Section XI Code Case N-491 (Reference 9) which has been approved by the NRC in Reference 10.

3.0 CONCLUSION

Based on its review, the staff finds this topical report acceptable for reference in licensing applications subject to the conditions stated above. This concludes our review of the subject topical report.

4.0 REFERENCES

1. Letter of May 21, 1990, from P. Shemanski, USNRC, to T. J. Kevatch, Commonwealth Edison Company, with enclosed safety evaluation report.
2. NRC Memorandum for A. H. Hsia, PDIII-2, from J. A. Norberg, Chief, EMEB, dated December 5, 1991. -

3. ASME Boiler and Pressure Vessel Code, Code Case N-411-1, "Alternative Damping Values for Response Spectra Analysis of Classes 1, 2, 3 Piping, Section III, Division 1," dated February 20, 1986.
4. USNRC Regulatory Guide 1.84, "Design and Fabrication Code Case Acceptability, ASME Section III Division 1," Revision 30, October 1994.
5. NUREG 1061, Volume 4, "Report of the US Nuclear Regulatory Commission Piping Review Committee, Evaluation of Other Dynamic Loads and Load Combinations," December 1984.
6. USNRC Summary of a Meeting with Duke Power on Snubber Replacement at McGuire Nuclear Station, dated December 21, 1992.
7. US Atomic Energy Commission Regulatory Guide 1.61, "Damping Values for Seismic Design of Nuclear Power Plants," October 1973.
8. ASME Boiler and Pressure Vessel Code, Section XI, "Rules for Inservice Inspection of Nuclear Power Plant Components," 1989 Edition.
9. ASME Boiler and Pressure Vessel Code, Code Case N-491, "Alternative Rules for Examination of Class 1, 2, 3, and MC Component Supports of Light Water-Cooled Power Plants," Section XI, Division 1, March 14, 1991.
10. USNRC Regulatory Guide 1.147, "Inservice Inspection Code Case Acceptability, ASME Section XI, Division 1," Revision 11, October 1994.