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REGULATORY GUIDE

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INSTALLATION OF OVERPRESSURE PROTECTION DEVICES

A. INTRODUCTION

General Design Criterion 1, "Quality Standards and Records," of Appendix A, "General Design Criteria for Nuclear Power Plants," to 10 CFR Part 50, "Licensing of Production and Utilization Facilities," requires that structures, systems, and components important to safety be designed, fabricated, erected, and tested to quality standards commensurate with the importance of the safety functions to be performed. This Regulatory Guide describes a method acceptable to the AEC Regulatory staff for implementing this criterion with regard to the design of piping for safety valve and relief valve stations which have open discharge systems with limited discharge pipes and which have inlet piping that neither contains a water seal nor is subject to slug flow of water upon discharge of the valves. This guide applies to light-water-cooled reactors. The Advisory Committee on Reactor Safeguards has been consulted concerning this guide and has concurred in the regulatory position.

B. DISCUSSION

Pressure relief valves are required to be installed on the reactor coolant system pressure boundary of nuclear power plants to provide overpressure protection. Failure of the valve or piping to the valve, however, can constitute the equivalent of an open-ended rupture of the piping.

The Working Group on Piping of the ASME Boiler and Pressure Vessel Code, Section III,[1] has developed a Code Case which includes requirements and guidance for the design of piping for pressure relief valve stations. This Case was approved on March 3, 1973, as Case 1569, Interpretations of the ASME Boiler and Pressure Vessel Code.

For those pressure relief valve stations within its scope, ASME Code Case 1569, "Design of Piping for Pressure Relief Valve Station," provides guidance that may be used in the design and analysis of piping for a pressure relief/safety valve station. However, because of the limited scope of the code case, the following additional guidelines should be employed:

1. Appendix B, "Owner's Design Specifications," of Section III of the Code indicates in paragraph B-1223.2 that the Design Specification should stipulate the loads, the effect of which must be combined with the design pressure effects for comparison with the several primary stress-intensity limits at the design temperature. Code Case 1569 requires inclusion of the reaction force (including dynamic effects) among those loads to be compared to the primary stress-intensity limits. Therefore, the magnitude of the reaction forces should be stipulated in the Owner's Design Specification, including the anticipated transient behavior of the forces.

2. Subarticles NB-7300, "Overpressure Protection Report," and NC-7300, "Overpressure Protection Analysis," of the Code require submission of a documented analysis of the transient conditions and operating conditions that give rise to the maximum relieving requirements. Therefore, for those systems where an overpressure report or analysis is required, the individuals preparing these documents should also evaluate, stipulate, and, where certification is required, certify the magnitude of the reaction force anticipated from discharge of the valves. They should also stipulate the anticipated transient behavior of this force.

3. Experience seems to indicate that the discharge of one valve in a multiple-valve installation on a single run pipe could lead to premature discharge of the other valves due to mechanical or hydraulic shock transmitted through the common piping or due to other types of interaction. Because of this potential for simultaneous

[1] American Society of Mechanical Engineers Boiler and Pressure Vessel Code, Section III, "Nuclear Power Plant Components," hereinafter referred to as the Code.

discharge, a reasonable position to assure adequate strength is to require consideration of the most severe potential sequence of discharges; e.g., either the simultaneous discharge of all the relief valves on any single run pipe in a multiple-valve installation and the resultant combined dynamic load or, where forces may counteract each other, a sequence of discharges such that the dynamic effects combine in that phase relation which is estimated to induce the maximum effect at any point. Multiple discharge reaction forces which act to induce forces or moments in directions opposite to each other should not be considered to act with their Dynamic Load Factor (DLF) applied simultaneously.

4. The requirements of Code Case 1569 do not clearly state that the reaction forces and moments are to be included in evaluation of stresses for all components and all connecting welds of the pressure relief station and the run pipe. Also, the Code Case does not clearly state that maximum instantaneous values of forces and moments should be used in the calculation of both primary stresses and secondary stresses. The maximum instantaneous value should be determined either by applying a Dynamic Load Factor to the steady-state forces and moments or by performing a dynamic hydraulic/structural system analysis, as stated in the Code Case. Regulatory Positions C.3. and C.4. are included to clarify these requirements. A Dynamic Load Factor of 2.0 may be used in lieu of a dynamic analysis to determine the DLF.

5. Code Case 1569 indicates in Category 4 that detailed rules are under consideration for the design of piping of a pressure relief valve installation with closed discharge systems, open discharge systems with a long discharge pipe, and systems with slug flow as from a water seal. The scope of this regulatory guide does not include such systems.

C. REGULATORY POSITION

For those pressure relief valve stations[2] within its scope, ASME Code Case 1569, "Design of Piping for Pressure Relief Valve Station," should be used in the design and evaluation of the structural and pressure boundary integrity of piping subjected to the reaction forces associated with pressure relief valve discharges, supplemented by the following:

1. The magnitude of the reaction force resulting from discharge of the pressure relief valve, the anticipated transient behavior of this force, and the basis for the determination of the specified magnitude should be set forth in the Report on Overpressure Protection or Analysis on Overpressure Protection and in the Owner's Design Specication, for cases where such reports are required by the Code.[1]

2. Where more than one valve is installed on the same run pipe, the sequence of valve openings to be assumed in analyzing for the stress at any piping location should be that sequence which is estimated to induce the maximum instantaneous value of stress at that location, unless another sequence is specified in the Design Specification based on justification delineated in the Report on Overpressure Protection or Analysis on Overpressure Protection.

3. Stresses should be evaluated, and applicable stress limits as cited in Code Case 1569 should be satisfied for all components of the run pipe and connecting systems and the pressure relief valve station including supports and all connecting welds between these components.

4. In meeting the requirements of paragraph C.3. above, the contribution from the reaction force and the moments resulting from that force should include the effects of the Dynamic Load Factor or should use the maximum instantaneous values of forces and moments for that location as determined by the dynamic hydraulic/structural system analysis. This requirement should be satisfied in demonstrating satisfaction of all design limits at all locations of the run pipe and the pressure relief valve station for Class 1, 2, and 3 piping. A Dynamic Load Factor (DLF) of 2.0 may be used in lieu of a dynamic analysis to determine the DLF.

[2] These requirements should also be considered for application to blowdown valves whose discharge pipe geometry meets the requirements of Code Case 1569.