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U.S. Nuclear Regulatory Commission
ATTN: Document Control Desk
Washington, D.C. 20555

Attention: Mr. Charles E. Rossi
Director, Division of Operational Events Assessment

Subject: Pressurizer Safety Valve Set Pressure Deviation

Dear Mr. Rossi:

Per your request, a copy of the information concerning the Pressurizer Safety Valve Set Pressure Deviation which was transmitted to all nuclear utilities with Westinghouse NSSS designs is attached.

Questions in regards to this topic are welcome, and should be directed to Carl Hirst, Manager, RCS Component Licensing, (412) 374-4311.

Very truly yours,

WESTINGHOUSE ELECTRIC CORPORATION

W.J. Johnson, Manager
Nuclear Safety Department

RVC/wh

Attachment

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0560A/RVC/1:10/20/1989

October 18, 1989

Pressurizer Safety Valve Set Pressure Deviation

This letter is to provide you with information related to a potential deviation of the pressurizer safety valve set pressure from the ASME Code and the plant technical specification requirements. This information is being provided for your evaluation following review by the Westinghouse Safety Review Committee (SRC). Based on an evaluation of the available information, the SRC concluded that this issue does not constitute a substantial safety hazard and, as such is not reportable by Westinghouse to the NRC under 10CFR Part 21. The SRC then evaluated the significance of this issue utilizing the criteria of 10CFR50.59. From this evaluation, the SRC concluded that the information should be communicated to various utilities for their evaluation.

SYNOPSIS

ASME Section III defines set pressure and provides an opening pressure tolerance that is specified in percent of the set pressure for pressures above 1000 psi. Typically, the set pressure for the pressurizer safety valves is 2485 psig +/-1% in plant Technical Specifications. Recent plant operating experience and test data indicate that the opening pressure changes by more than one percent from the original set pressure when the valve is installed at temperature conditions different from those used during the set pressure test. It has been observed that a shift of 4 to 8 percent can occur. This potentially places the plant in violation of Technical Specifications, ASME Code Sections III/XI requirements, and thus, outside the bounds of the plant licensing basis criteria.

IDENTIFICATION OF ISSUE

In 1989 two utilities, South Carolina Electric and Gas (SCE&G) and Pacific Gas and Electric (PG&E), conducted Crosby pressurizer safety valve testing at the Westinghouse Western Service Center (WSC). The valve testing included Crosby 6M6 forged body (V.C. Summer) and cast body (Diablo Canyon) valve designs. The set pressure tests were performed using a loop seal configuration. Test conditions included the control of ambient air temperature to simulate as-installed plant conditions and setting the valves to 2485 psig $\pm$1% using approximately 300 ^{o}F hot water in the loop. The loop seal was subsequently drained and the set pressure checked with steam. The valve set pressure dropped approximately 4% to 8%.

Based on the testing performed at the WSC, it has been determined that set pressure changes as a function of temperature. Plants setting their valves on steam and installing them on hot or cold water loop seals have a resultant set pressure higher than 2485 psig +1%. Since the trend is for the set pressure difference to increase as the temperature difference increases, setting valves on steam and installing them on a cold loop seal will result in the largest set pressure increase.

The FSAR licensing basis analyses were evaluated since pressurizer safety valve set points above the nominal 2500 psia ±1% value could have a potential adverse impact on the FSAR licensing basis criteria, where credit is taken for safety valve relief, specifically the Loss of Load/Turbine Trip, Feedline Break, Locked Rotor and RCCA Ejection analyses were examined.

Typically, in each of these analyses, the pressurizer safety valves (PSVs) are actuated and provide sufficient relief capacity which limits the peak pressure in the RCS to an acceptable value. Should the PSV set pressure be increased, the margin to the maximum allowed pressure for each of these events would be potentially reduced to a point where the licensing basis criteria would no longer be satisfied.

Westinghouse has performed sensitivity studies on the impact of increased PSV set pressures for each of the four potentially affected transients. The results of these analyses are contained in Attachment I.

Similarly, the effect of a lost loop seal during normal plant operation and Pressurizer Safety relief transient conditions have been reviewed for the case in which a Pressurizer Safety Valve has been set and is installed in a loop seal configuration.

If the loop seal is lost as a result of a transient lifting the PSV, the PSV is exposed to steam at the valve seat and a reduction in set pressure due to the increase in temperature is experienced. The reduction of the valve's set pressure from the nominal value of 2500 psia to the PORV set pressure and actuating at that point, does not affect the licensing basis criteria since no credit is taken for the PORVs in the licensing basis analysis. A further set pressure reduction to the maximum 8% below 2500 psia is not expected to violate the licensing criteria, however, confirmation would require plant specific analysis or evaluation.

If the loop seal is lost during normal plant operation, the PSV is exposed to steam at the valve seat and a reduction in set pressure due to the increase in temperature is experienced. The reduction of the valve's set pressure from the nominal value of 2500 psia to a level which opens during normal plant operation is bounded for one PSV as defined by the current analysis of an inadvertent opening of a PSV.

SAFETY ISSUE

The pressurizer safety valve is classified as a Safety Class 1 component and is required to prevent the pressure in the reactor coolant system from exceeding its design condition, typically 110 percent of 2485 psig (2500 psia). The deviation of the set pressure varies from 4 to 8 percent as seen under various loop seal conditions. This set pressure deviation is outside the bounds of ASME Code Section III and XI requirements and should be reviewed by each utility in conjunction with their Technical Specification. ASME Code Section III is not met since the set pressure of the pressurizer safety valves is outside the opening tolerance specified. Likewise, ASME Code Section XI for inservice testing requires valves not exceed the stamped set pressure criteria by more than 3%.

CONCLUSION

As a result of the tests conducted at the Westinghouse Western Service Center, it has been determined that the pressurizer safety valve set pressure will vary based on the methodology used in setting the valves. The variance occurs when the valve is set at conditions other than "as-installed". That is, when either the test media or ambient temperatures differ from the operating media and ambient temperatures a set pressure shift is possible. Crosby 6M6 design valves set with hot water and ambient air temperatures of approximately 300^{0}F and 130^{0}F, respectively, experienced a set pressure shift of 4% to 8% when the test media was changed to saturated steam. Thus, setting a valve at plant ambient air with steam as a media and installing it on a loop seal filled with 300^{0}F water can result in a set pressure 4% to 8% higher than anticipated.

Note that similar data does not exist for other safety valve sizes, designs, or other plant specific temperatures.

Crosby Valve and Gage Co. agrees that the valve set pressure should be established at temperatures representing as-installed media and ambient temperatures.

RECOMMENDATIONS

Utilities should review the existing methodologies that are currently in practice at their plants relative to setting and testing of pressurizer safety valves, their current FSAR analyses and the licensing bases for the plant to determine their compliance with safety valve set pressure tolerances as specified in their Technical Specification.

ATTACHMENT I

JUSTIFICATION FOR CONTINUED OPERATION

The FSAR licensing basis analyses were evaluated since pressurizer safety valve set points above the nominal 2500 psia ±1% value could have a potential adverse impact on the FSAR licensing basis criteria, where credit is taken for safety valve relief, specifically the Loss of Load/Turbine Trip, Feedline Break, Locked Rotor and RCCA Ejection analyses were examined.

Typically, in each of these analyses, the pressurizer safety valves (PSVs) are actuated and provide sufficient relief capacity which limits the peak pressure in the RCS to an acceptable value. Should the PSV set pressure be increased, the margin to the maximum allowed pressure for each of these events would be potentially reduced to a point where the licensing basis criteria would no longer be satisfied.

Westinghouse has performed sensitivity studies on the impact of increased PSV set pressures for each of the four potentially affected transients. The following sensitivity studies were performed on the impact of increased PSV set pressures for each of the four potentially affected transients:

Loss of Load/Turbine Trip

For the loss of load/turbine trip analysis, sensitivity studies show that with no credit taken for any relief capacity from either the PSVs or the PORVs, the peak RCS pressure exceeds 110% of design (the licensing basis limit for this Condition II event). However, the pressure remains below 120% of design and thus, the peak RCS pressure does not cause stresses to exceed the faulted condition stress limits. This analysis is based upon the analysis documented in the FSAR, and all of the conservative bounding assumptions are applied.

Feedline Break

For the feedline break event, Westinghouse has performed analyses which demonstrate that with a 10% increase in the PSV set pressure, from 2500 psia to 2750 psia, the maximum RCS pressure remains below 120% of design. In addition, the core remains covered throughout the transient and no overpressurization of the secondary side occurs. This analysis does not take credit for best estimate operation or PORVs, and retains the conservative assumptions which are presented in the FSAR. Thus, the peak RCS pressure does not cause stresses to exceed the faulted condition stress limits.

Locked Rotor

Westinghouse has performed locked rotor analyses for a typical 2 loop plant, which bounds 3 and 4 loop plants. This analysis makes similar conservative assumptions to those found in the FSAR analysis. No credit was taken for any relief capacity from the PSVs or PORVs. The maximum RCS pressure remains below 120% of design. Thus, the peak RCS pressure does not cause stresses to exceed the faulted condition stress limits. There is no adverse impact upon the rods-in-DNB or the peak clad temperature analyses documented in the FSAR.

RCCA Ejection

Westinghouse has performed a bounding overpressurization analysis for the RCCA ejection event which is documented in WCAP-7588. This analysis is performed under BOL HFP conditions and makes extremely conservative assumptions regarding ejected rod worth. The PSVs are assumed operable with a set pressure of 2500 psia. The peak pressure is calculated to be less than 2800 psia. A 10% increase (250 psi) in the PSV set pressure would increase the peak pressure by no more than 250 psi, resulting in a peak RCS pressure of 3050 psia. This is greater than 120% of design pressure. However, as discussed in WCAP-7588, a more detailed, but still conservative analysis, using 3D methodology calculated a peak RCS pressure less than 2600 psia. Thus, even with the additional 250 psi bias due to the 10% setpoint shift, the pressure will remain less than 2850 psia which is below 120% of design. In addition, this analysis used an extremely conservative ejected rod worth estimated at 2 to 3 times greater than the conservative values typically presented in the FSAR. Lower, but still conservative, ejected rod worths would yield lower RCS pressures. Thus, even under conservative assumptions, the peak RCS pressure will not exceed that which would cause stresses to exceed the faulted condition stress limits.

Based on the results of these sensitivity studies, the calculated pressure spikes for these transients do not challenge the pressure integrity of the primary system components.

Similarly, the effect of a lost loop seal during normal plant operation and Pressurizer Safety relief transient conditions have been reviewed for the case in which a Pressurizer Safety Valve has been set and is installed in a loop seal configuration.

If the loop seal is lost as a result of a transient lifting the PSV, the PSV is exposed to steam at the valve seat and a reduction in set pressure due to the increase in temperature is experienced. The reduction of the valve's set pressure from the nominal value of 2500 psia to the PORV set pressure and actuating at that point, does not affect the licensing basis criteria since no credit is taken for the PORVs in the licensing basis analysis. A further set pressure reduction to the maximum 8% below 2500 psia is not expected to violate the licensing criteria, however, confirmation would require plant specific analysis or evaluation.

If the loop seal is lost during normal plant operation, the PSV is exposed to steam at the valve seat and a reduction in set pressure due to the increase in temperature is experienced. The reduction of the valve's set pressure from the nominal value of 2500 psia to a level which opens during normal plant operation is bounded for one PSV as defined by the current analysis of an inadvertent opening of a PSV.