*SAFETY ASSESSMENT*

# INCREASE OF MSIV LEAKAGE RATE AND DELETION OF LEAKAGE CONTROL SYSTEM

## Background

The Main Steam Lines (MSL) installed on current Boiling Water Reactor (BWR) plants are provided with dual quick-closing isolation valves. These valves function to isolate the reactor system in the event of a break in a steam line outside the primary containment, a design basis Loss-of Coolant Accident (LOCA), or other events requiring containment isolation. For a steam line break, the isolation valves would terminate the blowdown of reactor coolant in sufficient time to prevent an uncontrolled release of radioactivity from the reactor vessel to the environment. For the LOCA, the valves would isolate the reactor from the environment and prevent the direct release of fission products from the containment. Although the Main Steam Isolation Valves (MSIVs) are designed to provide a leak-tight barrier, industry operating experience has indicated that degradation has occurred in the leak-tightness of these valves.

As a result, Regulatory Guide 1.96, "Design of Main Steam Isolation Valve Leakage Control Systems for Boiling Water Reactor Nuclear Power Plants," Revision 0, May 1975 was issued and recommended the installation of a supplemental leakage control system (LCS) to ensure that the isolation function of the MSIVs complied with the specified Technical Specification (TS) leakage limits. To limit doses, a LCS has been installed on many BWR's to direct any leakage past the MSIV's during the LOCA to an area served by the Standby Gas Treatment System (SGTS). However, if the leakage rate through the MSIV's is greatly in excess of the technical specification value, the LCS may not be effective because of limitations in its design.

The BWR Owners' Group (BWROG) initially formed the MSIV Leakage Committee to determine the cause of and solution to MSIV failures of local leak rate testing by large margins. This Committee was subsequently re-formed into the MSIV Leakage Closure Committee to provide additional actions to resolve on-going, but less severe MSIV leakage problems and to address the limited capability of the LCS.

In accordance with the suggestions of NUREG-1169, "Technical Findings Related to Generic Issue C-8; Boiling Water Reactor Main Steam Isolation Valve Leakage and Leakage Treatment Method." this BWROG Committee generated typical generic licensing submittals which would significantly increase allowable MSIV leakage rates and, where applicable, eliminate the requirements for Leakage Control Systems. These submittals were documented in BWROG Report NEDC-31858P, Revision 2 entitled, "BWROG Report for Increasing MSIV Leakage Rate Limits and Elimination of Leakage Control System." This report concluded that the proposed increase of the MSIV leakage limit will reduce radiation exposure to maintenance personnel, reduce outage durations and extend the effective service life of the MSIV's. This report also concludes that the proposed elimination of the LCS will similarly reduce personnel exposure and outage durations, and that the

LCS can be replaced with an alternate method for MSIV leakage treatment using the main stem line and condenser.

This proposed alternate treatment method takes advantage of the large volume in the main steam lines and the main condenser to provide holdup and plateout of fission products that may leak through the closed MSIV's. This method uses the main steam drain lines to direct leakage to the main condenser.

Description of Changes

The proposed change would (Enclosure 1):

1. increase the allowable leakage rate specified in TS 3.6.1.2 from the current 11.5 standard cubic feet per hour (scfh) for any one MSIV, to 100 scfh for any one MSIV with a total maximum pathway leakage of 300 scfh through all four main steam lines;

2. add a new requirement to TS 3.6.1.2 related to the restoration of acceptable leak rates if any of the proposed limits are exceeded, such that if any MSIV exceeds 100 scfh, it will be repaired and retested to meet a leak rate limit of 11.5 scfh per valve;

3. modify TS 3.6.1.4, Tables 3.6.3-1 and 3.8.4.2.1-1, and Bases 3/4.6.1.4 to delete the MSIV Leakage Control System from TS; and,

4. administratively modify the Index, TS 3/4.6.1.4 and Bases 3/4.6.1.4 to reflect above requested changes.

Safety Analysis

**Analysis**

The Boiling Water Reactor Owners' Group has evaluated the availability of main steam system piping and main condenser alternate pathways for processing Main Steam Isolation Valve leakage, and has determined that the probability of a near coincident Loss of Coolant Accident and a seismic event is much smaller than for other plant safety risks. Accordingly, this alternate MSIV leakage treatment pathway will be available during and after a LOCA. Nevertheless, the BWROG has also determined that main steam piping and main condenser designs are extremely rugged, and that the design requirements applied to the Susquehanna Steam Electric Station (SSES), Unit 1 and Unit 2 main steam system piping and main condenser contain substantial margin, based on the original design requirements.

In order to further justify the capability of the main steam piping and main condenser alternate treatment pathway, the BWROG has reviewed limited earthquake experience data on the performance of non-seismically designed piping and condensers during past earthquakes. As summarized in General Electric (GE) Report, "BWROG Report for Increasing MSIV Leakage Rate Limits and Elimination of Leakage Control System," NEDC 31858P, Revision 2, submitted

to the NRC by BWROG letter dated October 4, 1993, this study concluded that the possibility of a failure which would cause a loss of steam or condensate in BWR main steam piping or condensers in the event of a design basis (i.e., safe shutdown) earthquake is highly unlikely, and that such a failure would also be contrary to a large body of historical earthquake experience data, and thus unprecedented.

We have evaluated the seismic adequacy of the Unit 1 and Unit 2 main steam piping and main condenser with the guidelines discussed in Section 6.7 of NEDC-31858P, Revision 2 to provide reasonable assurance of the structural integrity of these components. This evaluation, "MSIV Leakage Alternate Treatment Method Seismic Evaluation, for SSES Unit 1 and Unit 2," dated October 19, 1994 is attached (Enclosure 2). The results of the evaluation clearly demonstrate that the MSIV Leakage Alternate Treatment Method meets the intent of 10CFR100 Appendix A, with regard to seismic qualification. Except for the requirement to establish a proper flow path from the MSIVs to the condenser, the proposed method is passive and does not require any additional logic control and interlocks. The method proposed for MSIV leakage treatment is consistent with the philosophy of protection by multiple barriers used in containment design for limiting fission product release to the environment.

A plant-specific radiological analysis has been performed in accordance with NEDC-31858P, Revision 2 to assess the effects of the proposed increase to the allowable MSIV leakage rate in terms of Control Room and off-site doses following a postulated design basis LOCA. This analysis utilizes the hold-up volumes of the main steam piping and condenser as an alternate method for treating the MSIV leakage. As discussed earlier, there is reasonable assurance that the main steam piping and condenser will remain intact following a design basis earthquake. The radiological analysis uses standard conservative assumptions for the radiological source term consistent with Regulatory Guide (RG) 1.3, "Assumptions Used for Evaluating the Potential Radiological Consequences of a Loss-Of-Coolant Accident for Boiling Water Reactor." Revision 2 dated April 1974. The analysis results demonstrate that dose contributors from the proposed MSIV leakage rate limit of 100 scfh per steam line, not to exceed a total of 300 scfh for all four main steam lines, along with the proposed deletion of the Leakage Control System (LCS), result in an insignificant increase to the LOCA doses previously evaluated against the regulatory limits for the off-site doses and control room doses contained in 10CFR100 and 10CFR50, Appendix A, General Design Criterion (GDC) 19, respectively. The off-site and control room doses resulting from a LOCA are discussed in Section 15.6.5 of the FSAR.. The off-site and control room doses resulting from a LOCA associated with the proposed changes are the sum of the LOCA doses evaluated in the power uprate revision to the design basis DBA-LOCA calculation (EC-RADN-1009) and the additional doses calculated using the alternate MSIV leakage treatment method. Enclosure 3 summarizes the off-site and control room doses and compares the alternate treatment method doses to the original MSIV-LCS treatment method doses.

## Conclusion

In summary, the proposed changes do not result in a significant increase in the radiological consequences of a LOCA when the same assumptions and methods specified in the FSAR are used, recognizing that radiological consequences calculated in the FSAR and for these proposed changes are significantly higher than those using more realistic assumptions and methods. The calculated off-site and control room doses resulting from a LOCA remain well below the regulatory limits.

## NO SIGNIFICANT HAZARDS CONSIDERATIONS

The proposed changes do not:

I. Involve a significant increase in the probability or consequences of an accident previously evaluated.

The proposed changes to TS Section 3.6.1.2 do not involve a change to structures, components, or systems that would affect the probability of an accident previously evaluated. The TS limits for MSIVs are increased from 46 scf per hour for all four main steam lines to ≤100 scf per hour for any one MSIV and a combined maximum pathway leakage rate of ≤300 scf per hour for all four main steam lines. The consequences of an accident are affected as discussed in this section.

The proposed changes to TS Section 3.6.1.4 eliminate the Main Steam Isolation Valves (MSIVs) Leakage Control System (LCS) requirements from the TS. As described in Section 6.7 of the FSAR, the LCS is manually initiated in about 20 minutes following a design basis Loss of Coolant Accident (LOCA). Since the LCS is operated only after an accident has occurred, these proposed changes have no effect on the probability of an accident.

Since MSIV leakage and operation of the LCS are included in the radiological analysis for the design basis LOCA as described in Section 15.6.5 of the FSAR, the proposed changes do not affect the precursors of other analyzed accidents. Analysis of the effects of the proposed changes do, however, result in acceptable radiological consequences for the design basis LOCA previously evaluated in Section 15.6.5 of the FSAR.

SSES, Units 1 and 2 have an inherent MSIV leakage treatment capability as discussed below. We propose to use the drain lines associated with the main steam lines and main turbine condenser as an alternative to the guidance in Regulatory Guide 1.96, "Design of Main Steam Isolation Valve Leakage Control System For Boiling Water Nuclear Power Plants", Revision 0, May 1975, for MSIV leakage treatment. If approved, we will incorporate this alternate method in the appropriate operational procedures and Emergency Operating Procedures.

The Boiling Water Reactor Owners' Group (BWROG) has evaluated the availability of main steam system piping and main condenser alternate pathways for processing MSIV leakage, and has determined that the probability of a near coincident LOCA and a seismic event is much smaller than for other plant safety risks. Accordingly, this alternate MSIV leakage treatment pathway is available during and after a LOCA. Nevertheless, the BWROG has also determined that main steam piping and main condenser design are extremely rugged, and the design requirements applied to SSES Unit 1 and Unit 2 main steam system piping and main condenser contain substantial margin, based on the original design requirements. Therefore, the alternate treatment method has been evaluated for its capability to mitigate the consequences of a LOCA, and has been evaluated to assure its availability considering a seismic event.

In order to determine the capability of the main steam piping and main condenser alternate treatment pathway, the BWROG has reviewed earthquake experience data on the performance of non-seismically designed piping and condensers during past earthquakes. The data is summarized in General Electric (GE) Report, "BWROG Report for Increasing MSIV Leakage Rate Limits and Elimination of Leakage Control Systems," NEDC 31858P, Revision 2, submitted to the NRC by BWROG letter dated October 4, 1993. This study concluded that the possibility of a failure that could cause a loss of steam or condensate in Boiling Water Reactor (BWR) main steam piping or condensers in the event of a design basis (i.e., safe shutdown) earthquake is highly unlikely, and that such a failure would also be contrary to a large body of historical earthquake experience data, and thus unprecedented.

A verification has been performed of the seismic adequacy of the Unit 1 and Unit 2 main steam piping and main condenser consistent with the guidelines discussed in Section 6.7 of NEDC-31858P, Revision 2, to provide reasonable assurance of the structural integrity of these components. An evaluation, including the walkdown report outliers, "MSIV Leakage Alternate Treatment Method Seismic Evaluation," for Unit 1 and Unit 2, is attached. The results of the evaluation clearly demonstrate that the MSIV Leakage Alternate Treatment Method meets the intent of 10CFR100 Appendix A, with regards to seismic qualification. Except for the requirement to establish a proper flow path from the MSIVs to the condenser, the proposed method is passive and does not require any additional logic control and interlocks. The method proposed for MSIV leakage treatment is consistent with the philosophy of protection by multiple barriers used in containment design for limiting fission product release to the environment.

A plant-specific radiological analysis has been performed in accordance with NEDC-31858P, Revision 2, to assess the effects of the proposed increase to the allowable MSIV leakage rate in terms of control room and off-site doses following a postulated design basis LOCA. This analysis utilizes the hold-up volumes of the main steam piping and condenser as an alternate method for treating the MSIV leakage. As discussed earlier, there is reasonable assurance that the main steam piping and condenser remain intact following a design basis earthquake. The radiological analysis uses standard conservative assumptions for the radiological source term consistent with Regulatory

Guide (RG) 1.3, Assumptions Used for Evaluating the Potential Radiological Consequences of a Loss-Of-Coolant Accident for Boiling Water Reactor, Revision 2, dated April 1974.

The analysis results demonstrate that dose contributions from the proposed MSIV leakage rate limit of 100 scfh per steam line, not to exceed a total of 300 scfh for all four main steam lines, and from the proposed deletion of the LCS, result in an insignificant increase to the LOCA doses previously evaluated against the regulatory limits for the off-site doses and control room doses contained in 10CFR100 and 10CFR50, Appendix A, General Design Criterion (GDC) 19, respectively. The off-site and control room doses resulting from a LOCA are discussed in Section 15.6.5 of the FSAR. The off-site and control room doses resulting from a LOCA associated with the proposed changes are the sum of LOCA doses evaluated in the power uprate revision to the design basis DBA-LOCA calculation (EC-RADN-1009) and the additional doses calculated using the alternate MSIV leakage treatment method. Enclosure 3 summarizes the off-site and control room doses and compares the alternate treatment method doses to the original MSIV-LCS treatment method doses.

The 30-day whole body doses at the Low Population Zone (LPZ) did not change and remained at .37 rem for the alternate treatment method. The 30-day control room whole body doses increased slightly from .38 rem to .76 rem for the alternate treatment method. The increase in control room dose is not significant since the revised doses are well below the regulatory limits, i.e., .76 rem calculated versus the limit of 5 rem in the control room. The two-hour whole body dose at the Exclusion Area Boundary (EAB) decreased slightly from 2.47 rem to 2.217 rem.

The 30-day thyroid dose at the LPZ increased from 30.4 rem for the MSIV-LCS treatment method to 41.74 rem for the alternate treatment method. This increase is not significant since the revised dose of 41.74 rem is well within the regulatory limit of 300 rem. The two-hour thyroid dose at the EAB decreased slightly from 127.8 rem to 125.61 rem. The 30-day control room thyroid dose increased from 14.19 rem for the MSIV-LCS treatment method to 18.55 rem for the alternate treatment method. The increased control room thyroid dose is not significant since the revised dose remains well below the regulatory limit of 30 rem.

The 30-day control room beta dose increased insignificantly from 12 rem for the MSIV-LCS treatment method to 12.17 rem for the alternate treatment method, remaining a small fraction relative to the limit of 75 rem.

In summary, the proposed changes discussed above do not result in a significant increase in the radiological consequences of a LOCA when the same assumptions and methods specified in the FSAR are used, recognizing that radiological consequences calculated in the FSAR and for these proposed changes are significantly higher than those using more realistic assumptions and methods. Nevertheless, the calculated off-site and control room doses resulting from a LOCA remain well below the regulatory limits.

The proposed change to TS Table 3.6.3-1 deletes the LCS valves from the list of primary containment isolation valves. This proposed change is consistent with the proposed deletion of the LCS. The LCS lines that are connected to the main steam piping are welded and/or capped closed to assure primary containment integrity is maintained. The welding and post weld examination procedures will be in accordance with American Society of Mechanical Engineers (ASME) Code, Section III requirements. These welds and/or caps will be periodically tested as part of the Containment Integrated Leak Rate Test (CILRT). This proposed change does not involve an increase in the probability of equipment malfunction previously evaluated in the FSAR. In fact, this proposed change reduces the probability of equipment malfunction since, upon implementation of these proposed changes, the plant will be operated with less primary containment isolation valves subjected to postulated failure. This proposed change has no effect on the consequences of an accident since the LCS lines will be welded and/or cap closed, thus assuring that the containment integrity, isolation and leak test capability are not compromised.

The proposed change to TS Table 3.8.4.2.1-1 deletes the LCS motor operated valves from the list of "Motor Operated Valves Thermal Overload Protection - Continuous." The proposed change has no effect on the probability or consequences of an accident since the valves are eliminated and not performing a safety function.

Therefore, as discussed above, the proposed changes do not involve a significant increase in the probability or consequences from any accident previously evaluated.

II. Create the possibility of a new or different kind of accident from any accident previously evaluated.

As stated in Section I, the proposed changes do not involve a change to structures, components, or systems that would affect the probability of an accident previously evaluated , nor would these changes create any new or different kind of accident from any previously evaluated. The proposed changes will introduce and take credit for a new level of operational performance for existing plant systems and components to mitigate the consequences of the accident. The effect on this equipment has been evaluated and found to provide an acceptable level of reliability resulting in the required level of protection. This conclusion is based on the evaluation performed in NEDC 31858P, Revision 2, and the plant specific seismic evaluation provided in the Enclosure 2, "MSIV Leakage Alternate Treatment Method Seismic Evaluation." The Leakage Control System has been installed to direct any leakage past the MSIVs during the LOCA; acting after the accident has occurred. The resulting consequences of the evaluated accidents have been affected as discussed in Section I resulting in no significant increase in the probability or consequences of said accident. Therefore, reliance on different equipment than previously assumed to mitigate the consequences of an accident does not create the possibility of a new or different kind of accident from any accident previously evaluated.

The BWROG evaluated MSIV performance and concluded that MSIV leakage rates up to 200 scfh per valve will not inhibit the capability and isolation performance of the MSIVs to effectively isolate the primary containment. Implementation of the proposed changes does not result in modifications which could adversely impact the operability of the MSIVs. The LOCA has been analyzed using the main steam piping and main condenser as a treatment method to process MSIV leakage at the proposed maximum rate of 100 scfh per main steam line, not to exceed 300 scfh total for all four main steam lines. Therefore, the proposed TS Section 3.6.1.2 change to increase the allowed MSIV leakage rate does not create any new or different kind of accident from any accident previously evaluated.

The proposed TS Section 3.6.1.4 change to eliminate the LCS does not create the possibility of a new or different kind of accident from any accident previously evaluated because the removal of the LCS does not affect any of the remaining SSES Unit 1 and Unit 2 systems, and the LOCA has been re-analyzed using the proposed alternate method to process MSIV leakage. The associated proposed change to delete the LCS isolation valves from TS Table 3.6.3-1 and Table 3.8.4.2.1-1 does not create the possibility of a new or different kind of accident. The affected main steam piping will be welded and/or capped closed to assure that the primary containment integrity, isolation, and leak testing capability are not compromised. The affected LCS motor operated valves will be eliminated so their thermal overloads will not need to be bypassed.

Therefore, as discussed above, the proposed changes do not create the possibility for any new or different kind of accident from any accident previously evaluated.

III. Involve a significant reduction in a margin of safety.

The proposed change to TS Section 3.6.1.2 to increase the MSIV allowable leakage does not involve a significant reduction in the margin of safety. As discussed in the current Bases for TS Section 3/4.6.1.2, the allowable leak rate limit specified for the MSIVs is used to quantify a maximum amount of leakage assumed to bypass primary containment in the LOCA radiological analysis. Accordingly, results of the re-analysis supporting these proposed changes are evaluated against the dose limits contained in 10CFR100 for the off-site doses, and 10CFR50, Appendix A, GDC 19, for the control room doses. As discussed above, sufficient margin relative to the regulatory limits is maintained even when assumptions and methods (e.g., RG 1.3) that are considered highly conservative relative to more realistic assumptions and methods are used in the analysis.

Results of the radiological analysis demonstrate that the proposed changes do not involve a significant reduction in the margin of safety. Whole body doses, in terms of margin of safety, are insignificantly reduced by .38 rem in the control room. The margin of safety remains constant for the LPZ whole body dose or actually increases by .253 rem for the EAB whole body dose . The margin of safety for thyroid dose category is reduced by 11.34 rem at the LPZ and 4.36 rem in the control room. The margin of safety is found to

increase for the EAB thyroid dose by 2.19 rem. The margin of safety for beta dose is insignificantly reduced by .17 rem in the control room. The reductions in the margin of safety are not significant since the revised calculated doses are highly conservative yet remain well below the regulatory limits, and therefore, a substantial margin to the regulatory limits is maintained.

The proposed change to eliminate the LCS from TS Section 3.6.1.4 does not reduce the margin of safety, in fact, the overall margin of safety is increased. The function of the LCS for MSIV leakage treatment will be replaced by alternate main steam drain lines and condenser equipment. This treatment method is effective in reducing the dose consequences of MSIV leakage over an expanded operating range compared to the capability of the LCS and will, thereby, resolve the safety concern that the LCS will not function at MSIV leakage rates higher than the LCS design capacity. Except for the requirement to establish a proper flow path from the MSIVs to the condenser, the proposed method is passive and does not require any new logic control and interlocks. This proposed method is consistent with the philosophy of protection by multiple barriers used in containment design for limiting fission product release to the environment. Furthermore, as previously identified, based on the evaluations discussed in NEDC-31858P, Revision 2, and the seismic evaluation provided in the Enclosure 2 report, "MSIV Leakage Alternate Treatment Method Seismic Evaluation," the design of the MSIV leakage alternate drain pathway, meets the intent of the 10CFR100, Appendix A requirement for seismic qualification. Therefore, the proposed method is highly reliable and effective for MSIV leakage treatment.

The revised calculated LOCA doses remain within the regulatory limits for the off-site and the control room. Therefore, the proposed method maintains a margin of safety for mitigating the radiological consequences of MSIV leakage for the proposed TS leakage rate limit of 100 scfh per main steam line, not to exceed a total of 300 scfh for all four main steam lines.

The proposed change to delete LCS isolation valves from TS Table 3.6.3-1 and Table 3.8.4.2.1-1 does not reduce the margin of safety. Welded and/or capped closure of the LCS lines assures that the primary containment integrity and leak testing capability are not compromised. These welds and/or caps will be periodically leak tested as part of the CILRT. The LCS motor operated valves will be eliminated so their thermal overloads will not need to be bypassed. Therefore, the proposed deletion of the LCS isolation valves does not involve a reduction in the margin of safety.

## ENVIRONMENTAL CONSEQUENCES

This request is consistent with the Susquehanna design basis, in that the proposed changes of increasing allowable MSIV leakage rate and replacing the MSIV/LCS with an alternate treatment method will result in no significant changes to the LOCA radiological analysis while continuing to reduce dose consequences associated with MSIV leakage over an expanded operating range.

Therefore, no environmental consequences that have not been previously considered are anticipated.

## IMPLEMENTATION

The modifications associated with this proposed change are currently scheduled to be performed during the Unit 2 7th, and the Unit 1 9th Refueling and Inspection Outages. As a result, we request NRC to complete its review no later than May 26, 1995, with the condition that the amendment become effective upon unit restart.