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SAFETY REVIEW FOR LASALLE COUNTY STATION UNIT 1 AND 2 SAFETY/RELIEF VALVES REDUCTION AND SETPOINT TOLERANCE RELAXATION ANALYSES

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TO: G. BENES
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SUBJECT: Addenda to GE-NE-B13-01760 "Safety Review for LaSalle County Station Unit 1 and 2 Safety/Relief Valves Reduction and Setpoint Tolerance Relaxation", March 1995.

The purpose of this addenda is to provide the following changes and clarifications to the subject report.

Page 3-3, Table 3-1
For the MSIV Flux Scram case at nominal + 3%, 10 SRVs, the peak steamline pressure should be 1316 psig instead of 1317 psig as currently stated.

Pages 4-11 and 4-12, Section 4.3.1, 4.3.2 and 4.3.3
LSCS does not allow two-pump operation for the SLCS during an ATWS condition (Section 4.3.2). In addition, the nominal flow rate for SLCS should be changed in Section 4.3.1, 4.3.2 and 4.3.3 to reflect the minimum Technical Specification value of 41.2 gpm. These changes do not affect the conclusion for the SLCS performance as these data were not used in the justification.

Page 5,-1, Section 5.1.1
For LSCS, the limiting DBA LOCA for containment temperature response is the double-ended guillotine break of a main steam line. For the peak containment pressure and peak suppression pool temperature response, the limiting DBA LOCA is a recirculation line break. The SRV setpoint tolerance relaxation has no effects on these events because the vessel depressurizes without any SRVs actuations.

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SUMMARY

This report documents the analyses performed for LaSalle County Station (LSCS) Unit 1 and 2 in support of Commonwealth Edison's (ComEd) effort to reduce the number of Safety/Relief Valves (SRVs) currently installed at the LSCS units. In addition, the analyses also provide the technical justifications to support the relaxation of the SRV safety mode setpoint tolerance from the current + 1% value to + 3%. The GE evaluation addresses some of the safety concerns associated with these proposed changes and will be used as part of or as reference by ComEd in its licensing change submittal. In the event that ComEd decides to implement only the SRV setpoint tolerance relaxation, the reduced number of SRVs assumed in the various safety evaluations is then considered bounding.

The analyses results show that along with the setpoint tolerance relaxed to +3%, up to 5 SRVs can be eliminated from the current SRV configuration at the LSCS units without adversely impacting the safety of plant operation.

The limiting transient event for vessel overpressure protection was re-analyzed for LSCS Unit 2 Cycle 7 at the + 3% safety mode valves opening setpoints in conjunction with a reduction in number of SRVs. The results show that with the tolerance setpoint relaxation and SRVs inoperable, the maximum vessel pressure still remain within the ASME Upset Code limit of 1375 psig.

The containment LOCA and the suppression pool boundary loads responses, the Anticipated Transient Without Scram (ATWS) and the high pressure make-up system performance were also evaluated to justify operation with the increase valves setpoint opening and valves reduction. Results of the evaluation reported herein show that there is no impact on those areas.

1.0 INTRODUCTION

1.1 PURPOSE

The purpose of this report is to present the results of an evaluation of the LaSalle County Station (LSCS) Unit 1 and 2 Safety/Relief Valves (SRVs) performance requirements. With the current excess steam relief capacity at the LSCS units, the total number of SRVs can be reduced and yet the remaining configuration would still achieve the design basis requirement to support safe plant operation. In addition, the SRVs safety mode opening setpoint tolerance are relaxed from +1%/-3% to ±3% to minimize the impact on plant operations from potential pressure relief system related problems due to SRV opening setpoint drift. Commonwealth Edison (ComEd) has requested that these SRV performance changes be evaluated to support the following pressure relief system performance requirements:

(1) Relaxation of the LSCS surveillance requirement tolerance from current +1% to ±3% for the SRVs opening setpoint in the safety mode. There is no change to the current performance requirements for the SRVs opening setpoint in the relief mode.

(2) Justification for continuous plant operation with a reduction in the current number of SRVs.

The current performance requirements for the LSCS SRVs are discussed in Section 1.3. Each of the present performance requirements pertinent to this analysis is identified, as well as, the associated limitation and the remedial actions for exceeding the limit. Section 1.4 discusses the proposed performance requirement changes, the associated limits and the analyses required to support each proposed change. A comparison of the present and proposed performance requirements is shown in Table 1-1.

The analysis approach and the listing of the type of analyses performed to support the proposed changes are described in Section 2.0. In the event that ComEd decides to implement only the SRV setpoint tolerance relaxation portion of the proposed changes, then the reduction in the number of SRVs assumed in the various safety evaluation is considered a bounding input assumption.

1.2 BACKGROUND

The nuclear pressure relief system at the LSCS units consists of Crosby dual mode SRVs located on the main steam lines between the reactor vessel and the first isolation valve within the drywell. The SRVs provide three main protection functions:

(1) Overpressure relief operation. The SRVs open automatically to limit the vessel pressure excursion during a postulated pressurization transient event.

(2) Overpressure safety function (spring safety mode). The SRVs, functioning in the self-actuated safety mode, open to prevent the reactor vessel overpressurization.

(3) Depressurization operation. The Automatic Depressurization System (ADS) function is performed by selected SRVs and these valves open automatically as part of the Emergency Core Cooling System (ECCS) for events involving small breaks in the reactor vessel process barrier.

1.3 PRESENT PERFORMANCE REQUIREMENTS

1.3.1 SRVs Setpoint Tolerance

From Reference 1, the current SRVs configuration and nominal opening setpoint for LSCS is as follows:

	Relief Mode, psig		Safety Mode, psig	
Number of SRVs	Nominal	Analytical	Nominal	Analytical
2	1076.	1091.	1150.	1162.
4	1086.	1101.	1175.	1187.
4	1096	1111	1185.	1197.
4	1106.	1121.	1195.	1207.
4	1116.	1131.	1205.	1217.

The margin for the relief mode opening setpoint between the nominal trip and the analytical limit for LSCS is based on plant-specific setpoint methodology calculations which

took into account the uncertainty, calibration and drift characteristics of the pressure switches.

A narrow +1% tolerance band on the safety mode opening setpoint of the SRVs stems from an acceptance criterion defined by the American Society of Mechanical Engineers (ASME) for vessel overpressure protection. Section 3/4.4.2 of the current Technical Specifications for LSCS states that the allowable opening setpoint errors for each SRV in the safety mode shall be +1%.

The ASME has since revised the criterion for demonstrating valve operational readiness from 1% to 3% (Reference 2) within the plant's design basis. The 1% tolerance applies to several limitations which have to be addressed if these tolerances are exceeded. These limitations are as follows:

(1) The LSCS Technical Specification 3/4.4.2 delineates that the SRVs in safety mode are operable within +1% of the nominal setpoint.

(2) Licensing basis analyses for vessel overpressurization have been performed assuming the valves opening pressures are +1% above the nominal setpoints. If the SRVs safety mode opening pressures are greater than 1% above the nominal setpoint, then the plant could potentially operate in an unanalyzed condition. Such a condition warrants a review for a Licensee Event Report (LER) and a safety evaluation.

(3) Valve refurbishment and the removal of additional valves from the plant for testing are necessary if valve opening pressures are demonstrated to be beyond the limiting condition for operation 3/4.4.2 (+ 1%/-3% of the nominal SRV safety mode settings).

(4) If surveillance testing demonstrates that the safety mode opening pressures are beyond +1% of the nominal setpoint, setpoint adjustment to the +1% tolerance is required prior to returning the valves to service.

Consequently, valves opening setpoint drift to > +1% above the nominal setpoint causes each of the remedial actions above to be taken, thereby increasing valves surveillance testing costs, adding to the number of reportable events and consuming utility manpower. Although the +1% tolerance is specified in the LSCS Technical Specifications and has been used in plant safety evaluations, it does not represent the limiting setpoint required to ensure plant safety. Several

limitations. Each time, safety evaluations were performed on a cycle specific basis demonstrating that setpoint drift did not compromise plant safety. The consequences of valves opening setpoint drift can be minimized by increasing the setpoint tolerance assumed in licensing analyses and resultant plant operating limits.

1.3.2 SRVs Reduction

The current reload licensing basis for LSCS assumes one SRV declared OOS for minimum critical power ratio (MCPR) and vessel overpressure protection calculations.

1.4 PROPOSED PERFORMANCE REQUIREMENT CHANGES

This section discusses the effect of each set of the proposed performance requirement change on LSCS and the analyses necessary to support the changes. The present and proposed SRV performance requirements are shown in Table 1-1.

1.4.1 SRVs Safety Mode Tolerance Setpoint Relaxation

The ASME has expanded the acceptance criterion for SRV performance testing from +1% to +3% per Reference 2. Consequently, as long as the maximum valve opening pressure remains below the nominal + 3% range, the plant is still within analyzed conditions and the valves are considered capable of performing their relief function.

The acceptance criterion defines the range of expected in-service performance of a valve. Beyond this criterion, valve refurbishment is required and additional valves must be removed from the plant for testing. The increased tolerance on the acceptance criterion potentially reduces the number of valves that will exceed the in-service performance testing requirements, thus reducing the cost of valves surveillance testing.

Prior to placing new or refurbished valves in service, the valves setpoints are adjusted to within +1% of the nominal settings. Installation of the valves within a +1% tolerance ensures that there is margin to the +3% in-service testing criterion for opening pressure. In this manner, valve integrity and the benefits of the increased surveillance requirement tolerance are maintained from cycle to cycle.

The safety concerns affected by the SRV setpoint tolerance relaxation are defined in the They include vessel overpressure protection, ECCS/LOCA performance, fuel thermal limits, containment loads and high pressure system performance (High Pressure Coolant System, Reactor Core Isolation Cooling System, and Standby Liquid Control System). The Anticipated Transient Without Scram (ATWS) performance is also reevaluated for this proposed setpoint tolerance change.

The GE work scope consists of the tasks identified above, with the exception of the ECCS/LOCA performance, fuel thermal limits impact and main steam piping loads which are ComEd's responsibility and thus are not part of this report.

1.4.2 SRV(s) Reduction

To take advantage of the current over-designed steam relief capacity at LSCS, it is proposed to reduce the number of SRVs from the current eighteen-valve configuration to a smaller number based on the safety analyses results. For LSCS, the proposed changes include justifying continued plant operation with less than eighteen SRVs available. However, the SRVs available for potential elimination cannot be part of those required to perform the Automatic Depressurization System (ADS) and the Low-Low-Set (LLS) Logic function.

The potential consequences from the SRV reduction will be evaluated. The final number of SRVs available for permanent removal will be based on the maximum number of SRVs required to comply to the reactor vessel overpressure protection (during normal transient as well as ATWS event), ECCS/LOCA performance, fuel thermal limits, containment and main steam piping loads, high pressure system performance and Emergency Procedures Guidelines (EPGs).

The GE work scope consists of the tasks identified above, with the exception of the ECCS/LOCA performance, fuel thermal limits impact, main steam piping loads and EPGs which are ComEd's responsibility and thus are not part of this report.

Table 1-1
COMPARISON OF PRESENT TO PROPOSED PERFORMANCE REQUIREMENTS

Performance Requirement	Present Limit	New Limit
1. Opening pressure (relief mode) up to which the SRVs are capable of performing their intended function (operable).	± 15 psi	±15 psi
2. Opening pressure (safety mode)up to which the the SRVs are capable of performing their intended function (operable), Technical Specification 3/4.4.2	+ 1%/-3%	±3%
3. Opening pressure up to which licensing basis analyses have been performed.	+ 1.%	+ 3%
4. Tolerance beyond which valve refurbishment and additional valve testing is required as demonstrated by surveillance testing,	+ 1%/-3%	± 3%
5. Tolerance on the as-left SRV setting prior to the valve being returned to service.	± 1%	± 1%
6. Number of SRVs assumed OOS	1	1

2.0 ANALYSIS APPROACH

This section identifies the areas which may be affected by the proposed SRVs performance requirement changes shown in Table 1-1. The following safety and regulatory concerns are identified as potentially being affected as a result of the SRV safety mode opening setpoint tolerance increase to +3% and/or operation with a reduction in the number of SRVs:

1. Vessel overpressurization.
2. Thermal limits during anticipated operational occurrences (AOOs).
3. Emergency Core Cooling System (ECCS) performance during postulated LOCA.
4. Anticipated Transients Without Scram (ATWS).
5. High pressure system performance.
6. Containment LOCA responses and suppression pool boundary dynamic loads.
7. Main steam piping loads, including loads on attached SRV discharge lines.
8. Emergency Procedure Guidelines.
9. SRV availability.

The GE's scope of work includes item 1, 4, 5, 6 and 9 and ComEd or its Architect-Engineer (Sargent and Lundy) is responsible for the remaining tasks. Although GE does not have the updated main steam piping analyses of the LSCS units as performed by Sargent and Lundy, the GE scope of work does not require the availability of this information.

For the scope of work performed by GE and documented in this report, the SRVs safety mode tolerance setpoint increase from + 1%/- 3% to ± 3% in conjunction with a reduction in the number of SRVs. Due to the different applicable criteria applicable, the number of SRVs available for elimination will be specific to each tasks and the smallest value will be recommended for subsequent implementation. In the event that ComEd chooses to implement only the SRV setpoint tolerance relaxation portion, then the reduced number of SRVs assumed in the various safety evaluations is considered as a conservative assumption.

3.0 VESSEL OVERPRESSURE ANALYSIS

The ASME Code requires peak vessel pressures to be less than the upset transient limit of 1375 psig during transient events. The limiting overpressure event for the LSCS units is the Main Steam Isolation Valve (MSIV) closure with flux scram event (Reference 3). The reactor is shutdown by the backup, indirect high neutron flux scram due to the vessel pressurization and the following collapse of voids.

The greatest challenge to the ASME Upset code limit is provided by assuming that all the SRVs safety mode setpoint have drifted upward to +3% above the nominal trip setpoint, coincident with a reduction in the number of SRVs.

3.1 OVERPRESSURE ANALYSIS ASSUMPTIONS

The following assumptions and initial conditions were used in analyzing the MSIV closure with flux scram for LSCS Unit 2:

(1) Initial core thermal power at 102% of rated.

(2) Initial core flow at 105% of rated.

(3)

(4) Reduction in the number of SRVs such that the ASME overpressurization criteria (peak vessel pressure less than 1375 psig) is maintained.

(5) Credit taken for the available SRVs in the safety mode.

3.2 OVERPRESSURE ANALYSIS RESULTS

The overpressure analysis results are applicable to LSCS Unit 2 Cycle 7 reload application. The reactor response with the SRVs safety mode opening setpoint at +3% above the nominal is shown in Figure 3-1.

With only 10 SRVs available out of a total of 18, the calculated peak vessel pressure at the bottom of the reactor vessel is 1341 psig, thus providing significant margin to the ASME Upset code limit of 1375 psig. Since the current reload licensing basis for the LSCS units is to assume one SRV-OOS, the net number of SRVs available for elimination based on the ASME overpressure upset criteria would be seven valves.

Table 3-1 shows the resultant peak vessel pressures for the MSIV closure flux scram event analyzed and Figure 3-1 shows the time histories of key parameters during this transient event. The Cycle 7 reload licensing analyses results (Reference 3), with 17 out of 18 SRVs available and with a setpoint tolerance of -3%/+1%, are also included in Table 3-1 for comparison purpose.

Table 3-1

MSIV CLOSURE FLUX SCRAM EVENT ANALYSIS RESULTS

Power/Flow	SRV Configuration	Peak Neutron Flux (% NBR)	Peak Heat Flux (% NBR)	Peak Steamline Pressure psig	Peak Vessel Bottom Pressure psig
102/105(1)	Nom. + 1%, 17 SRVs	486	132	1240	1275
102/105	Nom + 3% 10 SRVs	486	132	1317	1341

Note: (1) LSCS Unit 2 Cycle 7 reload analysis (Reference 3), with -3%/+1% setpoint tolerance range.

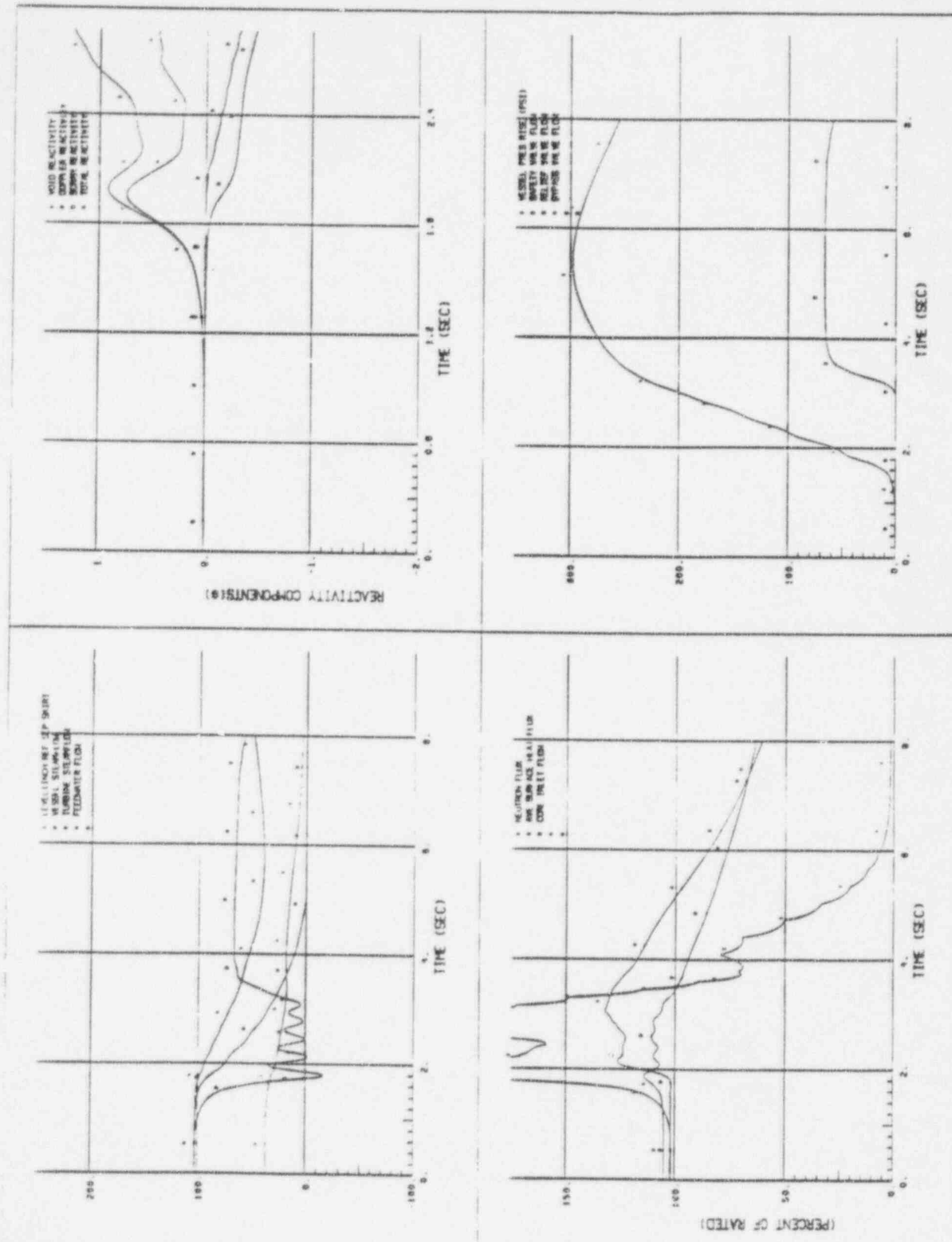

Figure 3-1 MSIV Closure Flux Scram Event, 102P/105F, Nominal + 3%, 8 SRVs OOS

4.0 HIGH PRESSURE SYSTEM PERFORMANCE

The purpose of this section is to evaluate the impact of the SRVs safety mode opening setpoint tolerance change and the SRV reduction on the high pressure make-up system performance at LSCS. The following system are included in the evaluation:

- High Pressure Core Spray (HPCS)
- Reactor Core Isolation Cooling (RCIC)
- Standby Liquid Control System (SLCS)

4.1 HIGH PRESSURE CORE SPRAY SYSTEM EVALUATION

The most significant impact of the SRV setpoint tolerance relaxation and SRV reduction program on the HPCS system is the resulting higher reactor pressure due to the increase in the SRV upper analytical opening setpoint. For LSCS, the HPCS system was originally designed to provide injection into the reactor pressure vessel up to at least 1% above the lowest safety setpoint of the SRVs, which corresponds to a reactor pressure of 1162 psig. With the setpoint tolerance relaxation program, the SRV safety setpoint tolerance is being increased from 1% to 3%. This change increases the maximum reactor pressure for HPCS system injection by 23 psi, to 1185 psig.

4.1.1 System Function and Requirements

The HPCS system, an ECCS component, is designed to provide sufficient core cooling and prevent excessive fuel cladding temperature in the event of a LOCA. The HPCS system accomplishes this function by injecting coolant makeup water into the pressure vessel to cool the reactor core when coolant is lost through any design basis break of the nuclear system process barrier. The HPCS also supplies makeup water to the reactor vessel in the event of a transient which results in the loss of all feedwater flow or reactor isolation and a failure of the RCIC system. The HPCS system is designed to deliver water to the reactor vessel at a rate equal or greater than 516 gpm, with the reactor vessel pressure 1160 psi above the pressure at the source of suction (suppression pool).

4.1.2 Inputs and Assumptions

The following values constitute the present high pressure design point for the HPCS system:

System Flow Rate	=	516 gpm
Pump Flow Rate	=	1156 gpm
Reactor Operating Pressure	=	1160 psig

The HPCS system changes required by the SRV setpoint tolerance relaxation and SRV reduction program will be based upon maintaining the same system flow rate and injection time at the new maximum system operating pressure. The HPCS system requires that the current setpoint for the lowest group of SRV s must be maintained in order for the system to meet its design basis requirements. Table 4-1 lists the parameters used to evaluate the effect of the SRV setpoint tolerance relaxation and SRV reduction upon the HPCS system performance.

4.1.3 System Evaluation

4.1.4 Component Evaluation

System components were evaluated by comparing the system's current operating and design temperatures and pressures with the expected system operating temperatures and pressures associated with the increased SRV setpoint tolerance. This examination demonstrated that the current operating values as well as the projected operating values are bounded by the current design. Therefore, the individual system components will be subjected to temperatures and pressures that are within the current design.

4.1.5 Interfacing Systems Evaluation

Systems interfacing with the HPCS with potential interface changes are identified in this section. The Primary Containment, Condensate Storage System, Reactor Vessel System, Service Air System, Residual Heat Removal System, Radwaste System and Leak Detection System interface with the HPCS System, but do not have significant changes to the system interfaces.

4.1.6 Conclusion

The HPCS system was found to have the capability to deliver the required flow of 516 gpm at the increased reactor pressure resulting from relaxation of the SRV setpoint tolerances. The higher reactor pressure with the SRV tolerance relaxation program does not impact the design of those system components directly impacted by the increased reactor pressure, including the valves, because the system was designed to operate at the higher pressures expected during system operation at shutoff head conditions (no flow to the reactor vessel).

However, for the SRV reduction program, the HPCS design performance imposes a restriction on the SRVs selected for potential removal, such that the lowest opening setpoint SRV group must be maintained.

4.2 REACTOR CORE ISOLATION COOLING SYSTEM EVALUATION

The most significant impact of the SRV setpoint tolerance relaxation and SRV reduction program on the RCIC system is the resulting higher reactor operating pressure due to the increase in the SRV upper analytical opening setpoint. For LSCS, the RCIC system is originally designed to provide injection into the reactor pressure vessel up to at least 1% above the lowest safety

setpoint (analytical limit) of the SRVs, which corresponds to a reactor pressure of 1162 psig. With the SRV setpoint tolerance relaxation, the SRV safety setpoint tolerance is being increased from 1% to 3%. This increases the maximum reactor pressure for RCIC system injection by 23 psi, to 1185 psig.

4.2.1 System Function and Requirements

The RCIC System, classified as a Power Generation System, is designed to maintain the reactor vessel water level above Level 1 in the event of a transient occurrence which results in the loss of all feedwater flow or reactor isolation. The system is also designed to allow for complete shutdown by maintaining sufficient water inventory until the reactor is depressurized to a level where the shutdown cooling mode of the Residual Heat Removal (RHR) system can be placed into operation. The RCIC system accomplishes this function by injecting coolant makeup water into the reactor pressure vessel with a turbine driven pump.

The system design basis requirement for the RCIC is a developed head of 2890 ft at a reactor pressure of 1158 psig (high reactor pressure operating mode).

4.2.2 Inputs and Assumptions

The following values constitute the present high pressure design point for the RCIC system:

System Developed Head	= 2890 ft
Reactor Operating Pressure	= 1158 psig
Pump Speed	= 4530 rpm
Pump Shut-Off Head	= 1476 psig

The RCIC system changes required by the SRV setpoint tolerance relaxation and SRV reduction program will be based upon maintaining the same system design requirement capability at the new reactor operating pressure. The RCIC system changes will also take into consideration any limitations on the program imposed by other systems. The HPCS system requires that the current setpoint for the lowest group of SRVs must be maintained in order for the system to meet its design basis requirements. Consequently the RCIC system changes will be based on changing the SRV setpoint tolerance for the lowest group of SRVs. Table 4-3 lists

the parameters used to evaluate the effect of the SRV setpoint tolerance and SRV reduction upon RCIC system performance.

4.2.3 System Evaluation

System Injection Time

The RCIC system design basis injection time is 30 seconds from onset of the reactor water low level condition, until the injection rate into the reactor reaches its design value. The additional time required for the turbine to reach the higher rated speed because of the SRV opening setpoint increase is not considered to be significant. This is because the turbine speed is on the control ramp during the final acceleration to rated speed. At a typical ramp speed rate of 280 rpm per second, the extra time needed to reach the new rated speed is about 0.2 second. Since turbine startup tests typically indicate that there is a minimum of 1 to 2 seconds margin in the system injection time, this small additional time to reach the new higher rated speed will not be a concern.

4.2.4 Component Evaluation

4.2.5 Interfacing Systems Evaluation

Systems interfacing with the RCIC with potential interface changes are identified in this section. The Primary Containment, Condensate and Condenser, Reactor Water Cleanup, and Radwaste systems interface with the RCIC system, but do not have significant changes to the system interfaces.

4.2.6 Conclusion

The RCIC system was found to have the capability to deliver its design rated flow of 600 gpm at the increased reactor pressure resulting from relaxation of the SRV setpoint tolerances. This capability was achieved by increasing the turbine/pump maximum rated operating speed to obtain an increase in the pump developed head while maintaining the original system design margins.

The RCIC turbine has the capacity to develop the horsepower and speed required by the pump to meet its new discharge pressure requirements while continuing to use the original

system design margins. The change in the system design point requires a new pump and turbine rated speed of 4580 rpm. This speed is below the maximum continuous operating speed specified by the pump and turbine manufacturers. The increased turbine rated speed requires the acceptance of a reduced overspeed trip margin since the maximum trip speed cannot be raised above the specified manufacturers limit.

The steam supply isolation setpoint of 300% of steady state flow for steam line leak detection will need to be re-evaluated as defined in GE SIL 475 (RCIC and HPCI High Steam Flow Analytical Limit) for the 3.8% higher steam flow rates.

The RCIC System valves that are impacted by the increase in reactor pressure will require re-evaluation for operability at the increased operating pressures. The specified full differential pressure values for the RCIC steam supply and pump discharge valves should be adjusted accordingly to reflect the effect of the new SRV setpoint tolerances.

The impact of the SRV setpoint relaxation program on the remainder of the system components was determined to be negligible because of the very small increase in operating pressure and/or temperature.

The following modifications/setpoint changes are required for the RCIC System to perform at the new design point:

1. Turbine control system adjusted for a rated speed of 4580 rpm
2. Steam supply line isolation differential pressure setpoint re-evaluated
3. Valve operability confirmed for higher differential pressures

4.3 STANDBY LIQUID CONTROL SYSTEM EVALUATION

The SRV setpoint tolerance relaxation and SRV reduction program does not impact the performance of the SLCS. The SLCS was originally designed to provide injection into the reactor pressure vessel from zero pressure up to a maximum reactor pressure of 1150 psig at the point of injection. The performance of the SLCS was conservatively based on the SRV relief setpoint pressure (with 1% setpoint tolerance) for the highest valve group. Since the SRV setpoint tolerance relaxation program increases the SRV spring safety setpoint tolerance from 1 to 3% without impacting the SRV relief function setpoint tolerance, the operation of the SLCS

will not be impacted. The removal of SRVs under the SRV reduction program will not impact the performance of the SLCS since the maximum syst..n injection pressure is based on the upper analytical pressure for highest valve group.

Since the calculations for maximum pressure at the discharge of the SLCS pumps were completed by the utility for implementation of ATWS, this report will not include an assessment of SLCS operation.

The ability of the SLCS pump to inject its design flow rate into the reactor vessel is not directly affected by this analysis since there was no change in the reactor pressure for system operation.

4.3.1 System Functions and Requirements

The Standby Liquid Control System (SLCS) is a redundant reactivity control system capable of shutting down the reactor from rated power condition to cold shutdown in the postulated condition that all or some of the control rods cannot be inserted. It is a manually operated system that will pump a sodium pentaborate solution into the vessel in order to provide neutron absorption and achieve a subcritical reactor condition.

Since this analysis does not change the reactor power level or shutdown margin requirements, it has no impact on the SLCS shutdown capability. The proposed change in SRV setpoint tolerances increases the maximum reactor pressure during injection, thus increasing the pump discharge pressure for injection.

The design criterion for this system is to provide a prescribed boron concentration in solution into the reactor (660 ppm). Technical Specification limits are placed on this system to assure adequate reactor shutdown margin. These limits are expressed in terms of acceptable solution volume and concentration operating regions. The operation of a single SLCS pump at a nominal flow rate of 43 gpm, meets the boron injection rate requirements for continued decreasing reactivity as the core cools down.

The maximum reactor pressure at which the SLCS pumps could be called upon to inject sodium pentaborate into the reactor is determined by the upper analytical pressure for the highest group of SRVs operating in the relief mode. The maximum pressure at the discharge of the

SLCS pumps is therefore the SRV setpoint pressure plus the head of water in the reactor and the pump discharge system flow and head losses with the operation of either one or both pumps in operation.

4.3.2 Inputs and Assumptions

The following values constitute the present design of the SLCS :

Pump Nominal Flow Rate	=	43.0 gpm (each)
ATWS Injection Rate (2 pumps)	=	86.0 gpm
Reactor Operating Pressure Range	=	0 to 1150 psig
Injection Rate (Boron)	=	6 to 25 ppm/min
Reactor Boron Concentration	=	660 ppm
Pump relief valve nominal setpoint	=	1400 psig

4.3.3 System Evaluation

4.3.5 Conclusions

The SLCS for LSCS was designed to inject the neutron absorber solution at a maximum reactor pressure of 1150 psig measured at the outlet of the control sparger. The results of the evaluation found that SRV setpoint tolerance relaxation and SRV reduction program does not impact the system capability to deliver the required flowrate of neutron absorber solution to the reactor pressure vessel at the higher reactor pressures.

The impact of this program on the remainder of the system components was determined to be negligible because the system operating pressures do not change.

No modifications or setpoint changes are required for the SLCS as a result of this program.

Table 4-1
HPCS SYSTEM PERFORMANCE COMPARISON

SRV Setpoint Tolerance	± 1%	± 3%
Reactor Pressure, psig (above suction source)	1160	1185
Required System Injection Rate, gpm	516	516
Minimum Flow Line Rate, gpm	640	640
Total Required Pump Flow Rate, gpm	1156	1156
Required TDH, feet	2908.3	2967.0
Pump Characteristics		
Pump Total Dynamic Head Required, ft	3000	3000
Pump Flow Rate, gpm	1156	1156
Margin, ft	91.7	33.0

Table 4-2

HPCS PUMP HEAD DESIGN REQUIREMENTS

Design:

SRV Group	AL(+1%) (psig)	SYSTEM REQD. TDH (feet)	AVAILABLE PUMP TDH (feet)	DESIGN MARGIN (feet)	DESIGN MARGIN (psig)
1	1160	2908.3	3000	91.7	39.1

Proposal:

SRV Group	AL(+3%) (psig)	SYSTEM REQD. TDH (feet)	AVAILABLE PUMP TDH (feet)	DESIGN MARGIN (feet)	DESIGN MARGIN (psig)
1	1184.5	2965.8	3000	34.2	14.6
2	1201.2	3026.1	3000	-26.1	n/a
3	1220.6	3050.5	3000	-50.5	n/a

Table 4-3

RCIC SYSTEM PERFORMANCE COMPARISON

SRV Setpoint Tolerance	± 1%	± 3%
System Flow Rate, gpm	600	600
<u>Pump Characteristics</u>		
Total Dynamic Head, ft	2890	2960
Pump Flow Rate, gpm	625	625
Shaft Speed, RPM	4530	4580
Brake Horsepower, HP	702	730
<u>Turbine Characteristics</u>		
Turbine Steam Supply Press., psig	1158	1185
Inlet Pressure (minimum required), psig	410	420
Steam Flow Rate, lbm/hr	28,250	29,330
Design Rated Speed, RPM	4530	4580*
Nominal Overspeed Trip Speed, RPM	5625	5625*
Maximum Overspeed Trip Speed, RPM	5740	5740
Overspeed Trip Setpoint Margin percent speed**	124.2	122.8

* Suggested speed values

** Based on rated and nominal trip speeds

5.0 CONTAINMENT DYNAMIC LOADS

The Safety Relief Valve (SRV) safety mode setpoint tolerance relaxation to 3% was assessed for potential impact on the containment hydrodynamic loads. The results of this assessment also considers plant operation with a reduction of up to 5 SRVs out of a total of 18 SRVs currently available.

5.1 LOCA CONTAINMENT RESPONSE

5.1.1 Containment Pressure and Temperature

The effect on the peak containment pressure and temperature response and on the peak suppression pool temperature for the respective limiting events were considered. The most limiting event in terms of peak containment pressure and temperature and peak suppression pool temperature is the design basis accident (DBA) LOCA , a double-ended guillotine break of the steam line. Relaxation of the SRV setpoint tolerance has no effect on this event because the vessel depressurizes without any SRV actuations. Therefore, there is no impact on the DBA-LOCA peak containment pressure and temperature and on the peak DBA-LOCA suppression pool temperature.

5.1.2 LOCA Hydrodynamic Load

5.2 SAFETY/RELIEF VALVE DYNAMIC LOADS

The SRV dynamic loads defined for LSCS Unit 1 and 2 were reviewed to determine the effect of a relaxation of the SRV safety open setpoint tolerance to 3%. The purpose of the review was to determine if sufficient conservatism and margins in the LSCS defined SRV loads are available to offset the effects of an increase in the SRV opening pressure of 3%.

SRVs provide pressure relief during reactor transients. Steam discharged from the SRVs is routed through the SRV discharge lines (SRVDLs) and through the SRVDL quencher into the suppression pool. Actuation of SRVs introduces high pressure steam in the SRVDL which quickly pressurizes the SRVDL resulting in the forced expulsion of the waterleg initially in the SRVDL and subsequently the air in the SRVDL. The SRV loads resulting from SRV operation include the reaction and thrust loads acting on the SRVDL and quencher and the air-bubble loads which are transmitted to the submerged boundaries and structures. These loads and the basis for these loads as applied to LSCS are summarized in the LSCS Design Assessment Report (Reference 7).

An increase in the SRV safety open setpoint tolerance to 3% from the current value of 1% will result in an increase in the SRV opening discharge flow rate into the SRV discharge line. This in turn results in an increase in the loads associated with SRV openings. Therefore to support operation with the SRV safety open set point tolerance relaxed to 3% an evaluation of the impact on the SRV loads was performed. The evaluation identified conservatism and/or margins in the design loads which can be used to show that an increase in the SRV loads due to a relaxation of the SRV setpoint tolerance does not result in allowable stresses being exceeded.

The SRV loads evaluation was divided into two parts: 1) the loads on the SRVDL and quencher and, 2) the loads on the submerged suppression pool boundary and on the submerged structures in the suppression pool.

5.2.1 SRVDL and Quencher Loads

This task is not part of the GE scope of work and the results will be provided by ComEd or Sargent and Lundy.

5.2.2. Submerged Pool Boundary and Submerged Structure Loads

The loads on the submerged boundary and on submerged structures are based on the peak bubble pressures determined with the generic methods described in References 7 and 8. The conservatism in the generic methods were reviewed to address load increases due to the set point tolerance relaxation.

Submerged Pool Boundary Load

LSCS uses the KWU T-Quencher at the end of the SRV discharge line, therefore the design pool boundary loads for the LSCS units are based on the KWU T-Quencher methodology. According to Reference 7, the LSCS T-Quencher load uses the KWU T-Quencher methodology which is also described in Reference 8 and is identified as the "Alternative Methodology" for defining the T-Quencher design load. According to Reference 8, the basis for the "Alternative

Submerged Structure Loads.

According to Section 3.2.2.4 of Reference 7, the submerged structure SRV loads for the LSCS units are based on the pool boundary pressures for first and subsequent actuations calculated with the GE correlation for X-Quenchers given in Reference 9. Therefore the expected

5.3 CONCLUSION

Due to the significant conservatism and margins available in the SRV loads, an increase in the LSCS SRV safety opening setpoint tolerance to 3% will not adversely impact the current design basis SRV hydrodynamic loads analyses results.

6.0 ATWS MITIGATION CAPABILITY

The potential impact of the SRV tolerance setpoint relaxation and SRV reduction program on the LSCS Anticipated Transient Without Scram (ATWS) performance is the compliance to vessel overpressure criteria of 1500 psig (Emergency Condition). The limiting event for this ATWS condition is the main steam isolation valve closure (MSIVC) transient. For such an event, it is conservatively assumed that the reactor scram does not take place on any reactor protection system signals. Thus, the eventual shutdown of the plant for this postulated event is by the use of the Standby Liquid Control System (SLCS). The initial reduction in power occurs by the use of the ATWS high dome pressure recirculation pump trip (RPT) signal. After the ATWS RPT function is actuated by its upper analytical limit and following the actuation of the SRVs, the event is terminated. The following assumptions were used to study the effect of SRV setpoint relaxation and SRV reduction on this ATWS event:

1. The reactor is operating at 100% power/105% flow.
2. The MSIVs are assumed to close within 4 seconds.
3. The SRV relief mode and safety mode opening setpoints are increased by + 3%. over the current nominal values (conservative assumption for the relief mode).
4. The number of SRVs is reduced such that the 1500 psig criteria is still met.
5. ATWS RPT high pressure upper analytical trip setpoint of 1165 psig.

For this MSIV Closure with No Scram event analyzed with 13 SRVs available (out of the total number of 18 SRVs), the peak reactor vessel bottom pressure was calculated to be 1457 psig, which is less than the ASME service level C (Emergency) value of 1500 psig. The available margin to the limit is reserved for potential variations during future operating cycles. The transient peak values are summarized in Table 6-1 and key parameters time histories are presented in Figure 6-1.

Therefore, it is concluded that the SRV performance requirements of + 3% setpoint tolerance relaxation in conjunction with a reduction of five SRVs from the current 18-valve configuration do not adversely impact the vessel overpressurization criteria for the limiting ATWS event.

Table 6-1

MSIV CLOSURE (NO SCRAM)
TRANSIENT RESPONSES

	Peak Heat Flux (% NBR)	Peak Neutron Flux (%NBR)	Peak Steamline Press. (psig)	Peak Vessel Press. (psig)
MSIV Closure (No Scram) Event, 102P/105F, +3%, 13 SRVs in-service	154	565	1442	1457

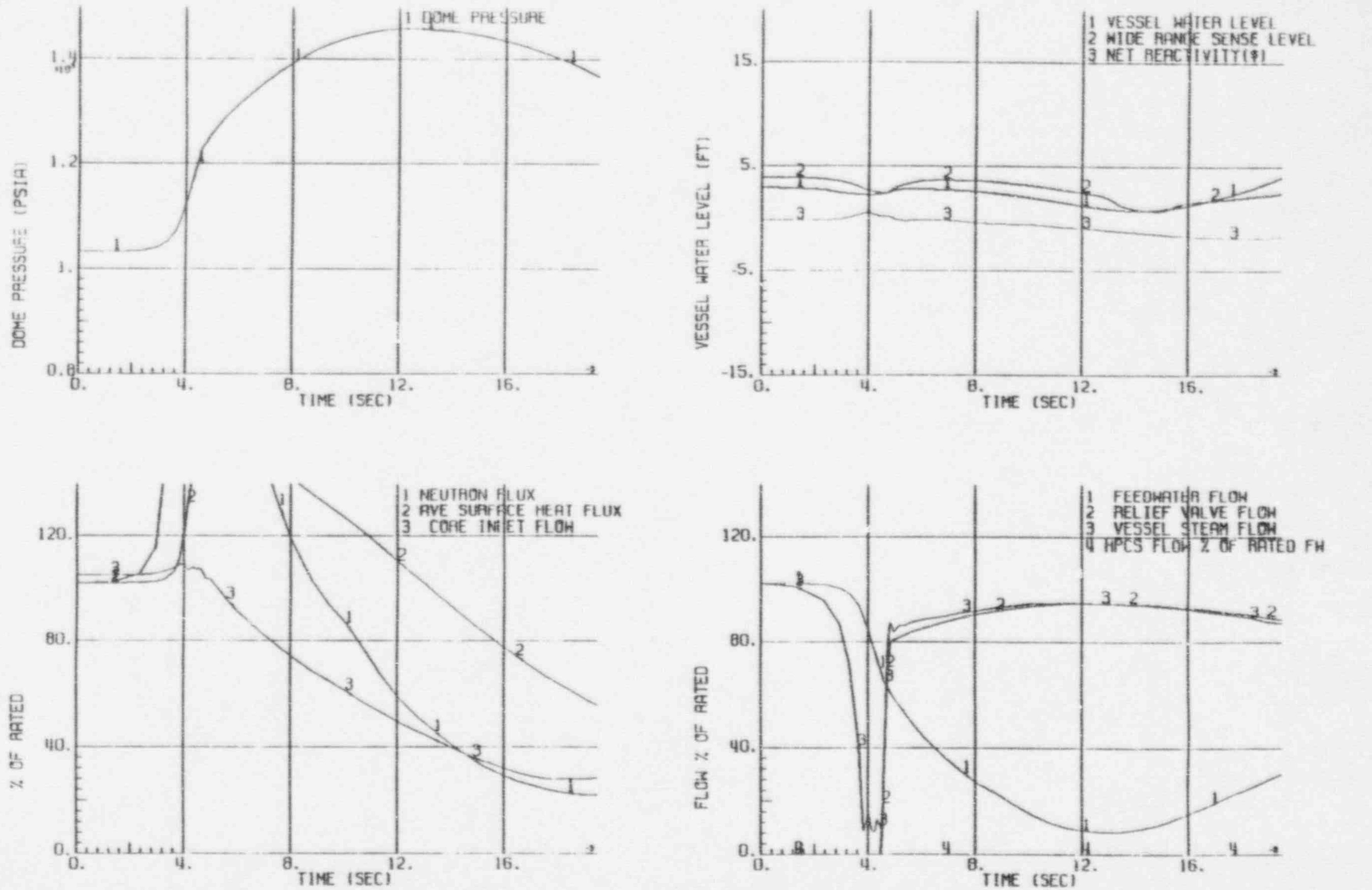

Figure 6-1 MSIV Closure No Scram Event, 102P/105F, Nominal + 3%, 5 SRVs OOS

7.0 SRV AVAILABILITY

This evaluation is required only to support the proposed reduction in the number of SRVs at the LSCS units. The SRV setpoint tolerance relaxation has no adverse impact on the current SRV availability. The results of this SRV availability study will be provided at a later date, should ComEd decide to implement the SRVs reduction portion of this analysis.

8.0 CONCLUSIONS

Based on the GE valuations described herein, the proposed SRV performance requirement changes for LSCS Unit 1 and 2 as depicted in Table 1-1 have no significant safety impact on ECCS/LOCA performance, high pressure system (HPCS, RCIC and SLCS) performance, containment structural integrity, and ATWS analysis results.

Additionally, this analysis examined cycle dependent safety concerns, such as vessel overpressure margin and thermal limits, demonstrating that the SRV safety mode tolerance setpoint relaxation up to ± 3% above the nominal setpoint combined with up to 5 SRVs OOS has no significant impact upon plant safety. For future cycles, it is recommended that the LSCS reload licensing evaluations verify the cycle specific applicability of the vessel overpressure analysis conclusion.

9.0 REFERENCES

2. ANSI/ASME OM-1-1981, as referenced in Subsection IWV-3500 of the ASME Code, Section XI, 1986 Edition.
3. General Electric Company, "LaSalle County Nuclear Station Reload 6 Cycle 7 Reload Licensing Submittal", 24A5162, Revision 0, December 1994.