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SUBJECT: Forwards response to request for addl info from standby
 liquid control sys enforcement conference re NRC insp repts
 50-387/97-07 & 50-388/97-07.

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**SUSQUEHANNA STEAM ELECTRIC STATION
INFORMATION REQUESTED AT STANDBY LIQUID CONTROL
SYSTEM ENFORCEMENT CONFERENCE
PLA-4917**

FILE R41-2

Docket No. 50-387

References: 1) NRC Inspection Report 50-387/97-07, 50-388/97-07 and Notice of Violation, October 30, 1997.

On May 5, 1998, NRC held an Enforcement Conference with PP&L to discuss apparent violations related to the Standby Liquid Control System (SLCS) accumulators. Near the end of the meeting, the NRC asked that PP&L document responses to several additional questions. This letter provides PP&L's responses. The detailed responses are provided in the Attachment.

In general, PP&L took prompt and conservative actions in response to the issues raised. Specifically, when the NRC called SLCS operability into question, PP&L ensured that SLCS was promptly placed into a known operable condition and actions were taken to prevent repeat occurrences. In addition, until completion of all engineering reviews, PP&L acted as if the accumulators were needed for SLCS operability. This approach assured the plant was operated in a safe and conservative manner while Engineering performed the necessary research to review and confirm the impact of the accumulators on SLCS requirements. Engineering has now completed their review and determined that the accumulators are neither required for SLCS operability nor to meet ATWS rule requirements (10 CFR 50.62). This judgment is supported by information and test data obtained from the General Electric Company.

The operations and maintenance personnel considered the accumulators not to be required for SLCS operability until the NRC raised the question on September 9, 1997. PP&L's initial position was well established, but not clearly documented, during the initial licensing and startup of Susquehanna. Based on a review of the various communications generated by PP&L and the NRC, on or shortly after September 9, 1997, the NRC was aware that operations and maintenance did not consider the SLCS inoperable when the accumulators were outside the specified pressure range. In addition, since the operability question was raised, PP&L believes there have been frequent communications with the NRC to keep them informed of the status of our evaluations.

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We believe there were shortcomings in our original documentation of the basis for the accumulators and their relationship to SLCS operability. This shortcoming lead to uncertainty and formed the basis for NRC Violation 387/97-07-06 (Reference 1), wherein PP&L was cited for being in an unanalyzed condition. PP&L has accepted that violation and has improved the documentation of the basis for the SLCS requirements. PP&L continues to look for design basis documentation weaknesses for other systems as part of our Current Licensing Basis (CLB) and Design Basis Documentation (DBD) projects.

Perhaps most important, PP&L believes that the safety significance of any non-compliance resulting from this issue should be considered minor, given that the accumulators are neither required for SLCS operability nor to meet the requirements of the ATWS rule.

Any questions regarding this request should be directed to Mr. A. J. Roscioli at (610) 774-4019.

Sincerely,



R. G. Byram

copy: NRC Region I
Mr. V. Nerses, NRC Sr. Project Manager - OWFN
Mr. K. M. Jenison, NRC Sr. Resident Inspector - SSES
Mr. K. Kerns, PA DEP

ATTACHMENT
RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION
FROM SLCS ENFORCEMENT CONFERENCE

1. Document the discussion given at the Enforcement Conference regarding the historic treatment of the accumulators at Susquehanna and how PP&L responded once the operability question was raised. This response should include discussion as to why we took such conservative actions in light of the strong feelings at the plant that the accumulators were not required for operability.

PP&L Response

During the original licensing and startup of Susquehanna, the accumulators were not required for Standby Liquid Control System (SLCS) operability. The operator training information and the maintenance procedures were developed on that basis. However, the information did not clearly document that the accumulators were not needed. By omission of the accumulators from the list of important attributes of SLCS, the operations and maintenance personnel were led to believe that they were not required for operability. This is also consistent with the fact that the accumulators are not discussed in any of the following documents: Susquehanna FSAR, the NRC Safety Evaluation Report for Susquehanna (NUREG-0776), the Susquehanna Technical Specifications, and the Technical Specification Bases.

Subsequent to original licensing, changes were made to the SLCS to incorporate the ATWS rule requirements (10 CFR 50.62) and power uprate. These changes resulted in increased system pressure, but the margins were found to be acceptable. Licensing and engineering documentation (e.g., FSAR changes, NRC submittals, calculations) regarding a change in the function of the accumulators were not generated at that time. As a result, no change to the operator training information or maintenance procedures was considered necessary.

Prior to September 9, 1997, the accumulators were occasionally found outside their specified pressure range. In accordance with approved procedures, maintenance would fix any leaking components (e.g., the charging valve) and recharge the accumulators. Operations did not consider the SLCS system inoperable while the accumulators were outside the specified pressure range. SLCS accumulator upgrades were made in 1991 to make it easier to maintain the accumulators.

On September 9, 1997 the Unit 1 B SLCS pump was out of service for maintenance and a 7 day LCO was in effect. In preparation for the quarterly flow surveillance to be run later that day, Maintenance was checking the precharge in the SLCS accumulators. The precharge in the A accumulator was found to be within the allowable range; however, when the test gauge was removed the schrader valve began leaking and the leakage could not be stopped. The Maintenance personnel called the control room and asked if they could depressurize the accumulator and replace the schrader valve. After considering the effects and concluding the operability of the A pump would not be impacted, the control room gave permission to the Maintenance crew to replace the valve. It was during this activity that the NRC resident inspector questioned the effect on pump operability and whether the 8 hour LCO should have been entered. The control room responded to the resident inspector that pump operability was not affected and the 7 day LCO was appropriate.

System Engineering was essentially asked the same question by the NRC resident inspector later in the morning on September 9, 1997. System Engineering's initial response was that the accumulators served to dampen the pressure pulsations in the system to reduce vibration. It was stated the accumulators were historically not treated as necessary for operability but that the issue would be investigated further

System Engineering contacted GE to discuss the original design purpose for the accumulators and their impact on SLCS operability. GE provided an overview of the design evolution of the SLC system and stated the accumulators were added to all SLC systems after a sparger failure at a foreign plant but emphasized that lack of an accumulator was probably not the cause of the sparger failure (other system design changes addressed the sparger failure). GE also stated that since then, some older BWRs have removed their accumulators based on plant testing (i.e., recording peak pressures during pump runs with a depressurized accumulator). PP&L realized that the issue of concern when accumulators are depressurized is not the integrity of the piping system (i.e., vibration) but rather excess pressure ripple on the pump discharge to the point that the relief valve would begin to chatter and/or leak. GE and PP&L next discussed the specific Susquehanna test pressures and relief valve setpoints and acknowledged the small margin between the two. GE stated that a review of plant specific documentation would need to be performed to determine if the accumulator was required for SLCS operability or not.

Further review narrowed the area of concern to be the small margin between the ATWS test pressure and pump discharge relief valve setpoint (1319 psig vs. 1400 psig, respectively). As a result of the consultation with GE and due to the lack of clear documentation on whether the accumulators were needed to prevent inadvertent lifting of the relief valves, System Engineering determined that the need for the accumulators for SLCS operability was indeterminate and conservatively assumed that the accumulators were necessary for pump operability until further investigation could be performed.

As a result, PP&L took actions to ensure the accumulators were maintained in a known operable condition and to assure that appropriate LCOs were entered if the accumulators were found outside its specified pressure range. At the same time Nuclear Technology initiated a study to determine the need for the accumulators for SLCS operability.

On November 25, 1997, during the first monthly accumulator pressure check on Unit 1 (performed due to PP&L's actions to treat the accumulators as if they are needed for operability), PP&L found the accumulators at low pressure. The low pressure conditions were found and pressure was restored one accumulator at a time. The appropriate LCOs were entered. PP&L performed extensive follow-up root cause investigations and actions, including plant modifications, to mitigate the possibility of repeat depressurization events. The specific actions are enumerated in PP&L Letter PLA-4870 (March 13, 1998) and were summarized at the Enforcement Conference.

Shortly after the November 25, 1997 event, Nuclear Technology reached a preliminary conclusion regarding the need for the accumulators for SLCS operability. PP&L arrived at this conclusion that the accumulators are needed for SLCS operability based on a conservative study. This study only considered the effect of the pump to produce the pressure pulsations and did not consider the system dynamics.

Engineering continued to study the SLC system to understand the system dynamics in an attempt to more accurately determine the role of the accumulators for the SLCS operability. As part of this evaluation, PP&L reviewed the generic licensing documentation related to BWR compliance with the ATWS rule. PP&L again contacted GE for assistance in determining the basis of the approach for evaluating the Susquehanna specific relief valve setpoint margin. GE provided their assessment of the required setpoint margin based on test data and analysis. This information was used in a study which concluded that the accumulators were not required for SLCS operability or to meet the ATWS rule requirements. A discussion of the basis for this conclusion and the applicability of the information for Susquehanna is provided in response to request 3 below.

In general, PP&L believes it has responded with prompt and conservative actions to the questions raised by the NRC Resident Inspector in September 1997. Once identified as a potential issue, PP&L ensured that the system was promptly placed into a known operable condition and actions were taken to prevent repeat occurrences. This approach assured the plant was operated in a safe and conservative manner while Engineering performed the necessary research to review and confirm the impact of the accumulators on SLCS requirements.



2. Why wasn't it communicated to the NRC that prior to September 9, 1997 it was "common knowledge" that the accumulators were not required for operability?

PP&L Response

When the NRC resident inspector questioned the operability of the SLCS A pump with the accumulator depressurized, Maintenance personnel called the control room. The control room responded to the NRC resident inspector that pump operability was not affected. NRC Inspection Report 50-387/97-07, 50-388/97-07, issued on October 30, 1997, stated that the maintenance procedures controlling the work activities did not contain precautions or notes regarding the impact on SLCS operability. Violation 387/97-07-06 identified that the SLCS maintenance procedures were inadequate to control SLCS maintenance activities such that the system remained in an analyzed condition. Further discussion in the NRC Inspection Report stated: "... this activity had been done the same way for a very long time and was not previously considered to have an operability impact." Therefore, the NRC was aware that operations and maintenance personnel did not consider that the accumulators were required for operability of the SLCS system.

In PP&L letter PLA-4807 (December 1, 1997), PP&L accepted the violation and corrective steps were taken to ensure the operations and maintenance personnel considered the accumulators required for operability. PP&L also committed to perform an evaluation to determine the design basis for the SLCS pump accumulators. It was stated in PLA-4807 that the evaluation would be used to determine the necessity of the accumulators for pump operability.

On December 2, 1998 PP&L initiated a 4-hour report to the NRC based on the November 25, 1997 event in which both trains of the SLCS may have been inoperable at the same time due to a common cause maintenance practice of overtightening the schrader valve caps on the accumulators. This report demonstrated that PP&L considered that the accumulators were required for operability at that time, per the commitments made in PLA-4807. LER 50-387/97-025-00 documenting the November 25, 1997 event was submitted on January 2, 1998 (PLA-0004830).

On February 4, 1998, NRC issued Inspection Report 50-387/97-10, 50-388/97-10 which discussed the SLCS issue. The report indicated that the SLCS issue would be considered unresolved pending additional information from PP&L regarding an analysis to determine if the depressurized accumulators would have prevented the SLC system from performing its safety related function. The Inspection Report requested that PP&L complete its evaluation in 20 days.

On February 24, 1998, PP&L held a meeting with the NRC Resident Inspector to discuss PP&L's engineering analyses. At this time PP&L indicated that we believed the accumulators were needed, but that the actual relief valve setpoints (which would be

obtained in the 'U1 10RIO) were needed before completing our evaluations. PP&L also indicated that our goal was to be able to show the accumulators are not required for SLCS operability, but we were not sure that this goal could be attained.

On March 13, 1998, PP&L submitted a letter (PLA-4870) providing an initial response to the unresolved item from the NRC Inspection Report 50-387/97-10, 50-388/97-10. The letter stated that PP&L's on-going investigations indicate that even if the accumulators were not pressurized, one SLCS pump is expected to be capable of injecting full flow and the other pump may be capable of injecting partial flow. Conservatively assuming only one pump operation, the ATWS analysis shows the ATWS fuel and containment criteria were met. This letter indicated that PP&L was continuing to analyze to determine the SLCS accumulator design requirements.

On April 9, 1998, the NRC Issued Inspection Report 50-387/98-01, 50-388/98-01 which announced the predecisional enforcement conference related to the SLCS issues.

In late April 1998, in parallel with our preparations for the enforcement conference, GE identified to PP&L the basis for the evaluation of the acceptability of the SLCS relief valve setpoint margin. This basis included test data from Oyster Creek and evaluations to apply the data to the Susquehanna plant. The evaluation concluded that the Susquehanna accumulators were not required for SLCS operability or to meet the requirements of the ATWS rule. A more detailed discussion of this evaluation is provided in the response to request #3 below.

On May 5, 1998, PP&L and the NRC met at the enforcement conference to discuss the SLCS issues.

On May 7, 1998, PP&L submitted a letter (PLA-0004894) withdrawing LER 50-387/97-025-00.

In general, the various communications summarized above indicate that there was substantial interaction between PP&L and the NRC related to the SLCS issue. Many other informal and undocumented conversations were held since September 9, 1997 in addition to those identified above.

3. **Submit the information used to conclude that the accumulators are not required. Include a discussion of all calculations used to arrive at this conclusion. Discuss the influence any calculation performed to date has on the conclusion (e.g., calculation describing a 6% pressure pulse for a triplex positive displacement pump).**

PP&L Response

The attached calculations document the calculational history associated with PP&L's efforts to determine the contribution of the Standby Liquid Control (SLC) accumulators to the operability of the SLC system. The calculation that initially determined that the accumulators were required for Standby Liquid Control System (SLCS) operability is EC-053-1001, revision 0. The calculation that supports PP&L's current conclusion that the SLC accumulators are not required for SLCS operability is EC-053-1003, revision 2. The intervening calculations (EC-053-1003, revisions 0 & 1) are provided for completeness to show the thought process in transitioning from the accumulators being required to not required for SLCS operability. These intervening calculations also provide information regarding the magnitude of pressure pulsations for an "ideal" pump, and for determining the effectiveness of a bladder accumulator in mitigating pressure pulsations.

The basis for the current conclusion regarding the SLC accumulators not being required for SLCS operability is summarized as follows:

- The Oyster Creek Test established that there was no change in the magnitude of the pressure pulsations with or without the accumulators. [Note: Subsequent to the issuance of the calculations, PP&L discovered that the vibration test actually measured pressure pulsations in the piping.]
- The differences that may exist between Susquehanna and Oyster Creek in terms of the piping layout (length of pipe, # of bends/fittings) to the test tank would have a negligible effect since the pressure drop is overwhelmingly dominated by the orifices and throttle valve.
- Both systems utilize triplex pumps with accumulators located near the pump discharge.
- Since there is no change in the magnitude of the pulsations to the test tank with or without the accumulator, if the relief valve does not lift with an accumulator, it would not lift without an accumulator.
- The piping configuration to the reactor vessel would act to smooth out the pressure pulse more than the configuration to the test tank. This is based on the length of pipe, the number of bends, the constant back pressure imposed by the reactor, and the fact that the reactor will also act like an accumulator. [Note: subsequent to the issuance of this calculation, GE told PP&L that the testing at Oyster Creek included an injection to the



reactor (w/demineralized water) at high pressure conditions. GE reported that the vibration levels were significantly less than those found to the test tank, however, the values were not recorded.]

- The ATWS Licensing Topical Report (NEDE-31096-P) identified a margin between the relief valve and 2 pump operating pressure that included an allowance for pressure pulsations (30 psig). PP&L testing showed that this pressure margin was satisfied.
- Similarly, the Power Uprate evaluation include the same pressure pulse allowance as the ATWS LTR and concluded that adequate margin existed.

For additional detail regarding these conclusions refer to calculation EC-053-1003, revision 2. In conclusion, the Oyster Creek test demonstrated that the magnitude of the of the pressure pulsations in the test loop did not increase without the accumulators. The magnitude of the pressure pulses to the RPV would be less than those to the test tank due to the favorable piping configuration and the fact that the RPV would also act as an accumulator. GE included an allowance of approximately 30 psig in the Power Uprate evaluation for pressure pulsations and showed that sufficient margin existed to the relief valve setpoint for Susquehanna.



4. What is the quality status of the components of the Standby Liquid Control System? Be precise (e.g., Q pressure boundary only). What components in the accumulator are on the Q list?

PP&L Response

Quality Classification for SLC System

The Standby Liquid Control System (SLCS) is an independent, diverse backup system to the Control Rod Drive (CRD) System. The SLCS shuts down the reactor by injecting a neutron absorbing solution into the primary reactor coolant, which is circulated through the core. The function of the SLCS is to inject a neutron absorbing solution into the reactor to achieve and maintain sub-criticality in the event that control rods cannot be manually inserted. The neutron absorber used in the SLCS is an aqueous solution of sodium pentaborate decahydrate, $\text{Na}_2\text{B}_{10}\text{O}_{16} \cdot 10\text{H}_2\text{O}$. Sufficient solution is injected such that the reactor will be brought from maximum rated power conditions to cold subcritical over the entire reactor temperature range from maximum operating to cold shutdown conditions. There is no requirement for the SLCS to be capable of operation when the reactor is shutdown by the CRD System.

The SLCS was classified by GE as a "Special Capability System" (a subset of the non-safety-related classification), designed with the ability to shutdown the reactor and bring the reactor to the cold shutdown condition independent of the control rods. Because the SLCS is not required to respond and mitigate the consequences of a DBA, the SLCS is not required to meet all safety design basis requirements of Engineered Safety Feature Systems. However, in order for the system to have a high degree of reliability, the system was designed with many safety-related system features (e.g., components required for injection are designed to safety-related criteria).

Consistent with the above, SLCS is listed as a Nuclear Steam Supply System, and based on Regulatory Guide 1.70, is identified as a safe shutdown system having a safety-related classification. Safety-related systems provide the actions necessary to assure safe shutdown of the reactor, to protect the integrity of radioactive material barriers, and/or to prevent the release of radioactive material in excess of allowable dose limits. Additionally, the system is designed to Seismic Category I criteria and is powered from a IEEE Class 1E power source; however, it is not designed to be single-failure proof.

Therefore, since safe shutdown of the reactor is classified as a nuclear safety function, the SLCS is classified as having a safety-related function with those SLCS components critical to the system meeting its injection function requirements classified as safety-related. Consequently, the SLC System has a PP&L quality classification of "Q", which equates to safety-related.

Accumulator Quality Classification

The SLC accumulator shell is an ASME Section III, Class 3 component and accordingly is classified as "Q" within PP&L's quality classification system. This is consistent with the need for the accumulator shell to maintain SLCS pressure boundary integrity to assure that the system can fulfill its safety function. The accumulator bladder and gas valve were originally supplied as a single unit, and were similarly classified by PP&L as "Q" (safety-related) on the same basis as the accumulator shell, i.e., pressure boundary integrity. However, while PP&L considered the bladder and gas valve to be Q, GE provided these as non-Q, commercial grade items. This was consistent with GE's position that the accumulators were not required for SLCS to perform its safety function.

PP&L's quality classification for the SLC accumulator bladder and gas valve was changed from Q, pressure retaining to non-Q, commercial grade in November 1985 to be consistent with GE specifications. This was based on PP&L engineering's understanding of the role of the accumulators at that time. However, the quality classification of the bladder and gas valve was subsequently changed back to Q, safety related in April of 1991. This was done in response to a change which replaced the original style bladder/gas valve unit with separate components (i.e., a bladder with a removable gas valve). At this time PP&L also concluded that the bladder and gas valve should be classified as Q components based on a safety function of dampening vibration. As such, the components were purchased as non-Q, commercial grade and "dedicated" as Q components. The basis for the quality designation is contained in the Dedication Document.

The quality classification identified in April of 1991 has remained in effect up through the present. Consequently, the SLCS bladder and gas valve (schrader valve) are currently designated on PP&L's Q-List as "Q" safety-related components whose safety function is to dampen the vibrations from the SLCS pumps.

Consistent with PP&L's studies showing that the accumulators are not required for SLCS operability, the quality classification and supporting documentation will be revised, as necessary.

