c. By verifying at least two suppression chamber water level indicators and at least sixteen surface water temperature indicators, at least one pair in each suppression pool sector, OPERABLE by performance of a:

1. CHANNEL CHECK at least once per 24 hours,
2. CHANNEL FUNCTIONAL TEST at least once per 31 days, and
3. CHANNEL CALIBRATION at least once per 18 months,

with the water level and temperature alarm setpoint for:

1. High water level ≤ 23'9",
2. Low water level ≥ 22'3", and
3. High water temperature:
   a) First setpoint, ≤ 90°F,
   b) Second setpoint, ≤ 105°F,
   c) Third setpoint, ≤ 110°F, and
   d) Fourth setpoint, ≤ 120°F.

d. ~~At least once per 18 months by~~ By conducting a drywell-to-suppression chamber bypass leak test at an initial differential pressure of at least 4.3 psi and verifying that the $A/\sqrt{k}$ calculated from the measured leakage is within the specified limit. If any drywell-to-suppression chamber bypass leak test fails to meet the specified limit, the test schedule for subsequent tests shall be reviewed and approved by the Commission. If two consecutive tests fail to meet the specified limit, a test shall be performed at least every 9 months until two consecutive tests meet the specified limit, at which time the ~~18-month~~ above test schedule may be resumed.

18

The bypass leak test shall be conducted at 40 ± 10 month intervals during shutdown, during each 10 year service period.

ADD

e. By conducting a leakage test on the drywell-to-suppression chamber vacuum breakers at a differential pressure of at least 4.3 psi and verifying that the total leakage area $A/(k)^{1/2}$ contributed by all vacuum breakers is less than or equal to 30% of the specified limit and the leakage area for an individual set of vacuum breakers is less than or equal to 12% of the specified limit. The vacuum breaker leakage test shall be conducted during each refueling outage for which the drywell-to-suppression chamber bypass leak test in Specification 4.6.2.1.d is not conducted.

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DEPRESSURIZATION SYSTEMS (Continued)

Because of the large volume and thermal capacity of the suppression pool, the volume and temperature normally changes very slowly and monitoring these parameters daily is sufficient to establish any temperature trends. By requiring the suppression pool temperature to be frequently recorded during periods of significant heat addition, the temperature trends will be closely followed so that appropriate action can be taken. The requirement for an external visual examination following any event where potentially high loadings could occur provides assurance that no significant damage was encountered. Particular attention should be focused on structural discontinuities in the vicinity of the relief valve discharge since these are expected to be the points of highest stress.

In addition to the limits on temperature of the suppression chamber pool water, operating procedures define the action to be taken in the event a safety-relief valve inadvertently opens or sticks open. As a minimum this action shall include: (1) use of all available means to close the valve, (2) initiate suppression pool water cooling, (3) initiate reactor shutdown, and (4) if other safety-relief valves are used to depressurize the reactor, their discharge shall be separated from that of the stuck-open safety relief valve to assure mixing and uniformity of energy insertion to the pool.

INSERT 'A'

3/4.6.3 PRIMARY CONTAINMENT ISOLATION VALVES

The OPERABILITY of the primary containment isolation valves ensures that the containment atmosphere will be isolated from the outside environment in the event of a release of radioactive material to the containment atmosphere or pressurization of the containment and is consistent with the requirements of GDC 54 through 57 of Appendix A to 10 CFR 50. Containment isolation within the time limits specified for those isolation valves designed to close automatically ensures that the release of radioactive material to the environment will be consistent with the assumptions used in the analyses for a LOCA.

3/4.6.4 VACUUM RELIEF

Vacuum relief breakers are provided to equalize the pressure between the suppression chamber and drywell. This system will maintain the structural integrity of the primary containment under conditions of large differential pressures.

The vacuum breakers between the suppression chamber and the drywell must not be inoperable in the open position since this would allow bypassing of the suppression pool in case of an accident. There are five pairs of valves to provide redundancy so that operation may continue for up to 72 hours with no more than one pair of vacuum breakers inoperable in the closed position.

INSERT 'A'

During a LOCA, potential leak paths between the drywell and suppression chamber airspace could result in excessive containment pressures, since the steam flow into the airspace would bypass the heat sink capabilities of the pool. Potential sources of bypass leakage are the suppression chamber-to-drywell vacuum breakers (VBs), penetrations in the diaphragm floor, and cracks in the diaphragm floor/liner plate and downcomers located in the suppression chamber airspace. The containment pressure response to the postulated bypass leakage can be mitigated by manually actuating the suppression chamber sprays. An analysis was performed for a design bypass leakage area of $A/(k)^{1/2}$ equal to 0.0535 ft^2 to verify that the operator has sufficient time to initiate the sprays prior to exceeding the containment design pressure of 53 psig. The limit of 10% of the design value of 0.0535 ft^2 ensures that the design basis for the steam bypass analysis is met.

The drywell-to-suppression chamber bypass test at a differential pressure of at least 4.3 psi verifies the overall bypass leakage area for simulated LOCA conditions is less than the specified limit. For those outages where the drywell-to-suppression chamber bypass leakage test is not conducted, the VB leakage test verifies that the VB leakage area is less than the bypass limit, with a 70% margin to the bypass limit to accommodate the remaining potential leakage area through the passive structural components. Previous drywell-to-suppression chamber bypass test data indicates that the bypass leakage through the passive structural components will be much less than the 70% margin. The VB leakage limit, combined with the negligible passive structural leakage area, ensures that the drywell-to-suppression chamber bypass leakage limit is met for those outages for which the drywell-to-suppression chamber bypass test is not scheduled.

c. By verifying at least two suppression chamber water level indicators and at least sixteen surface water temperature indicators, at least one pair in each suppression pool sector, OPERABLE by performance of a:

1. CHANNEL CHECK at least once per 24 hours,

2. CHANNEL FUNCTIONAL TEST at least once per 31 days, and

3. CHANNEL CALIBRATION at least once per 18 months,

with the water level and temperature alarm setpoint for:

1. High water level ≤ 23'9",

2. Low water level ≥ 22'3", and

3. High water temperature:

   a) First setpoint, ≤ 90°F,
   b) Second setpoint, ≤ 105°F,
   c) Third setpoint, ≤ 110°F, and
   d) Fourth setpoint, ≤ 120°F.

d. ~~At least once per 18 months by~~ By conducting a drywell-to-suppression chamber bypass leak test at an initial differential pressure of at least 4.3 psi and verifying that the $A/\sqrt{k}$ calculated from the measured leakage is within the specified limit. If any drywell-to-suppression chamber bypass leak test fails to meet the specified limit, the test schedule for subsequent tests shall be reviewed and approved by the Commission. If two consecutive tests fail to meet the specified limit, a test shall be performed at least every ~~9~~ 18 months until two consecutive tests meet the specified limit, at which time the ~~18 month~~ above test schedule may be resumed.

The bypass leak test shall be conducted at 40±10 month intervals during shutdown, during each 10-year service period.

ADD

e. By conducting a leakage test on the drywell-to-suppression chamber vacuum breakers at a differential pressure of at least 4.3 psi and verifying that the total leakage area $A/(k)^{1/2}$ contributed by all vacuum breakers is less than or equal to 30% of the specified limit and the leakage area for an individual set of vacuum breakers is less than or equal to 12% of the specified limit. The vacuum breaker leakage test shall be conducted during each refueling outage for which the drywell-to-suppression chamber bypass leak test in Specification 4.6.2.1.d is not conducted.

DEPRESSURIZATION SYSTEMS (Continued)

Because of the large volume and thermal capacity of the suppression pool, the volume and temperature normally changes very slowly and monitoring these parameters daily is sufficient to establish any temperature trends. By requiring the suppression pool temperature to be frequently recorded during periods of significant heat addition, the temperature trends will be closely followed so that appropriate action can be taken. The requirement for an external visual examination following any event where potentially high loadings could occur provides assurance that no significant damage was encountered. Particular attention should be focused on structural discontinuities in the vicinity of the relief valve discharge since these are expected to be the points of highest stress.

In addition to the limits on temperature of the suppression chamber pool water, operating procedures define the action to be taken in the event a safety-relief valve inadvertently opens or sticks open. As a minimum this action shall include: (1) use of all available means to close the valve, (2) initiate suppression pool water cooling, (3) initiate reactor shutdown, and (4) if other safety-relief valves are used to depressurize the reactor, their discharge shall be separated from that of the stuck-open safety relief valve to assure mixing and uniformity of energy insertion to the pool.

INSERT 'A'

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3/4.6.4 VACUUM RELIEF

Vacuum relief breakers are provided to equalize the pressure between the suppression chamber and drywell. This system will maintain the structural integrity of the primary containment under conditions of large differential pressures.

The vacuum breakers between the suppression chamber and the drywell must not be inoperable in the open position since this would allow bypassing of the suppression pool in case of an accident. There are five pairs of valves to provide redundancy so that operation may continue for up to 72 hours with no more than one pair of vacuum breakers inoperable in the closed position.

INSERT 'A'

During a LOCA, potential leak paths between the drywell and suppression chamber airspace could result in excessive containment pressures, since the steam flow into the airspace would bypass the heat sink capabilities of the pool. Potential sources of bypass leakage are the suppression chamber-to-drywell vacuum breakers (VBs), penetrations in the diaphragm floor, and cracks in the diaphragm floor/liner plate and downcomers located in the suppression chamber airspace. The containment pressure response to the postulated bypass leakage can be mitigated by manually actuating the suppression chamber sprays. An analysis was performed for a design bypass leakage area of $A/(k)^{1/2}$ equal to 0.0535 ft^2 to verify that the operator has sufficient time to initiate the sprays prior to exceeding the containment design pressure of 53 psig. The limit of 10% of the design value of 0.0535 ft^2 ensures that the design basis for the steam bypass analysis is met.

The drywell-to-suppression chamber bypass test at a differential pressure of at least 4.3 psi verifies the overall bypass leakage area for simulated LOCA conditions is less than the specified limit. For those outages where the drywell-to-suppression chamber bypass leakage test is not conducted, the VB leakage test verifies that the VB leakage area is less than the bypass limit, with a 70% margin to the bypass limit to accommodate the remaining potential leakage area through the passive structural components. Previous drywell-to-suppression chamber bypass test data indicates that the bypass leakage through the passive structural components will be much less than the 70% margin. The VB leakage limit, combined with the negligible passive structural leakage area, ensures that the drywell-to-suppression chamber bypass leakage limit is met for those outages for which the drywell-to-suppression chamber bypass test is not scheduled.

Enclosure to PLA-3968:

SAFETY ANALYSIS OF PROPOSED AMENDMENT TO TECHNICAL SPECIFICATION 4.6.2.1

Abstract

The current Technical Specifications specify that a drywell-to-suppression chamber bypass test be conducted at least once per 18 months to verify an acceptable bypass leakage area, $A/(k)^{1/2}$. Potential Sources of bypass leakage that are included in the drywell-to-suppression chamber bypass test include the suppression chamber-to-drywell vacuum breakers, penetrations in the diaphragm floor, and cracks in the diaphragm floor/liner plate and downcomers located in the suppression chamber airspace. FSAR Section 6.2.6.5.1.2 discusses the potential for decreasing the bypass leakage test frequency once significant experience with SSES or other Mark II containments has demonstrated adequate bypass integrity. The proposed TS change:

1. decreases the test frequency of the drywell-to-suppression chamber bypass test to coincide with the test frequency for the Type A Integrated Leak Rate Test (ILRT). The revised test frequency would require that three low pressure bypass tests be conducted at 40 $\pm$ 10 month intervals during each 10-year service period, and

2. requires an additional surveillance test to measure the VB leakage area, $A/(k)^{1/2}$, for those outages for which the drywell-to-suppression chamber bypass test is not scheduled.

This report provides the Safety Analysis for the above TS changes and demonstrates that the steam bypass capability and structural integrity of the Susquehanna SES containment will not be adversely affected by the proposed change.

1.0 INTRODUCTION

SSES incorporates a Mark II containment with the drywell located over the suppression chamber and separated by a diaphragm slab (see Figure 1). The suppression chamber contains a pool of water with a depth that varies between 22' and 24' during normal operation. Eighty-seven downcomers and sixteen main steam safety/relief (SRV) discharge lines penetrate the diaphragm slab and terminate at a pre-designed submergence within the pool. During a LOCA, the containment design directs steam from the drywell to the suppression pool via the downcomers to limit the maximum containment pressure response to less than the design pressure of 53 psig. The effectiveness of the SSES containment design requires that the leak path from the drywell to the suppression chamber airspace be minimized. Steam that enters the suppression pool airspace through these potential leak paths will bypass the suppression pool and can result in a rapid increase in containment pressure depending on the size of the bypass flow area.

Technical Specification 3.6.2.1.b requires that the drywell-to-suppression chamber bypass leakage be less than or equal to 10% of the acceptable $A/(k)^{1/2}$ design value of 0.0535 ft^2. The acceptable bypass area provides sufficient time for the operator to initiate the suppression chamber airspace sprays and prevent the containment pressure from exceeding the containment design pressure of 53 psig. TS 4.6.2.1.d stipulates that a low pressure drywell-to-suppression chamber airspace bypass leak test be conducted at least once per 18 months to verify the measured bypass leakage area is in compliance with TS 3.6.2.1.b.

A change to the SSES Technical Specification (4.6.2.1.d) is proposed to decrease the test frequency of the low pressure drywell-to-suppression chamber bypass leak test to coincide with the test frequency for the Type A Integrated Leak Rate Test (ILRT).

The safety significance of altering the test frequency is addressed in this report. Technical justifications are provided to show that the containment integrity is not adversely affected by the proposed change.

2.0 PROPOSED TECHNICAL SPECIFICATION CHANGE

2.1 Current Technical Specification

Technical Specification 4.6.2.1.d states that:

"The suppression chamber shall be demonstrated OPERABLE:

d. At least once per 18 months by conducting a drywell-to-suppression chamber bypass leak test at an initial differential pressure of at least 4.3 psi and verifying that the $A/(k)^{1/2}$ calculated from the measured leakage is within the specified limit [10% of 0.0535 ft^2]. If any drywell-to-suppression chamber bypass leak test fails to meet the specified limit, the test schedule for subsequent tests shall be reviewed and approved by the Commission. If two consecutive tests fail to meet the specified limit, a test shall be performed at least every 9 months until two consecutive tests meet the specified limit, at which time the 18 month test schedule may be resumed."

2.2 Proposed Technical Specification Change

The proposed revision to TS 4.6.2.1.d is stated below (revisions are bolded):

"The suppression chamber shall be demonstrated OPERABLE:

d. By conducting a drywell-to-suppression chamber bypass leak test at an initial differential pressure of at least 4.3 psi and verifying that the $A/(k)^{1/2}$ calculated from the measured leakage is within the specified limit. ***The bypass leak test shall be conducted at 40 ± 10 month intervals during shutdown, during each 10-year service period.*** If any drywell-to-suppression chamber bypass leak test fails to meet the specified limit, the test schedule for subsequent tests shall be reviewed and approved by the Commission. If two consecutive tests fail to meet the specified limit, a test shall be performed at least every ***18*** months until two consecutive tests meet the specified limit, at which time the ***above*** test schedule may be resumed."

e. By conducting a leakage test on the drywell-to-suppression chamber vacuum breakers at a differential pressure of at least 4.3 psi and verifying that the total leakage area $A/(k)^{1/2}$ contributed by all vacuum breakers is less than or equal to 30% of the specified limit and the leakage area for an individual set of vacuum breakers is less than or equal to 12% of the specified limit. The vacuum breaker leakage test shall be conducted during each refueling outage for which the drywell-to-suppression chamber bypass leak test in Specification 4.6.2.1.d is not conducted.

3.0 SAFETY IMPACT ASSESSMENT

3.1 Steam Bypass Design Basis

During a LOCA, potential leak paths between the drywell and suppression chamber airspace could result in excessive containment pressures, since the steam flow into the airspace would bypass the heat sink capabilities of the pool. Potential sources of bypass leakage are the suppression chamber-to-drywell vacuum breakers (VBs), penetrations in the diaphragm floor, and cracks in the diaphragm floor/liner plate and downcomers located in the suppression chamber airspace (see attached Figure 1). The containment pressure response to the postulated bypass leakage can be mitigated by manually actuating the suppression chamber sprays. However, since the sprays are manually actuated, an analysis was performed to show that the operator has sufficient time to initiate the sprays prior to exceeding the containment design pressure of 53 psig.

Reference 1 calculated the containment pressure response based on a conservative design bypass flow area of $A/(k)^{1/2}$ equal to 0.0535 ft^2. The analysis assumed a small break LOCA with a differential pressure between the drywell and suppression chamber airspace equal to the downcomer submergence. The analysis showed that it takes approximately 27 minutes from the onset of the LOCA to reach the

containment design pressure of 53 psig. The steam bypass analysis results were submitted to the NRC in PLA-923 (Reference 2).

Supplement No. 3 to the SSES Safety Evaluation Report (SER) documents the NRC's review and approval of the steam bypass analysis for the SSES containment. The bases for their review were the requirements stipulated in the Standard Review Plan (SRP), Appendix I of Section 6.2.1.1.c, "Steam Bypass for Mark II Containments." The NRC concluded that SSES's steam bypass capability is adequate, since the operator has sufficient time to actuate the suppression chamber sprays prior to reaching the containment design pressure based on a design bypass area equal to 0.0535 ft^2.

TS 3.6.2.1.b conservatively specifies a maximum allowable bypass area of 10% of the design value of 0.0535 ft^2. The TS limit provides an additional 10 factor of safety above the conservatisms taken in the steam bypass analysis. The drywell-to-suppression chamber bypass test required by TS 4.6.2.1.d verifies that the actual bypass flow area is less than or equal to the TS limit. The bypass leakage test ensures that degradation in the measured bypass area is identified and corrected to ensure containment integrity during LOCA events.

3.2 Technical Justification for Decreasing The Drywell-To-Suppression Chamber Bypass Test Frequency

The proposed TS change decreases the test frequency for the drywell-to-suppression chamber bypass test from the current 18 month interval to coincide with the test frequency for the Type A ILRT. This essentially decreases the test frequency from every outage to every other outage. The safety significance of this change can be addressed by evaluating whether there is a reduction in the ability to detect an adverse bypass flow condition due to the increased time duration between bypass tests allowed by the change.

Potential bypass leakage originates from two flow paths (see attached Figure 1):

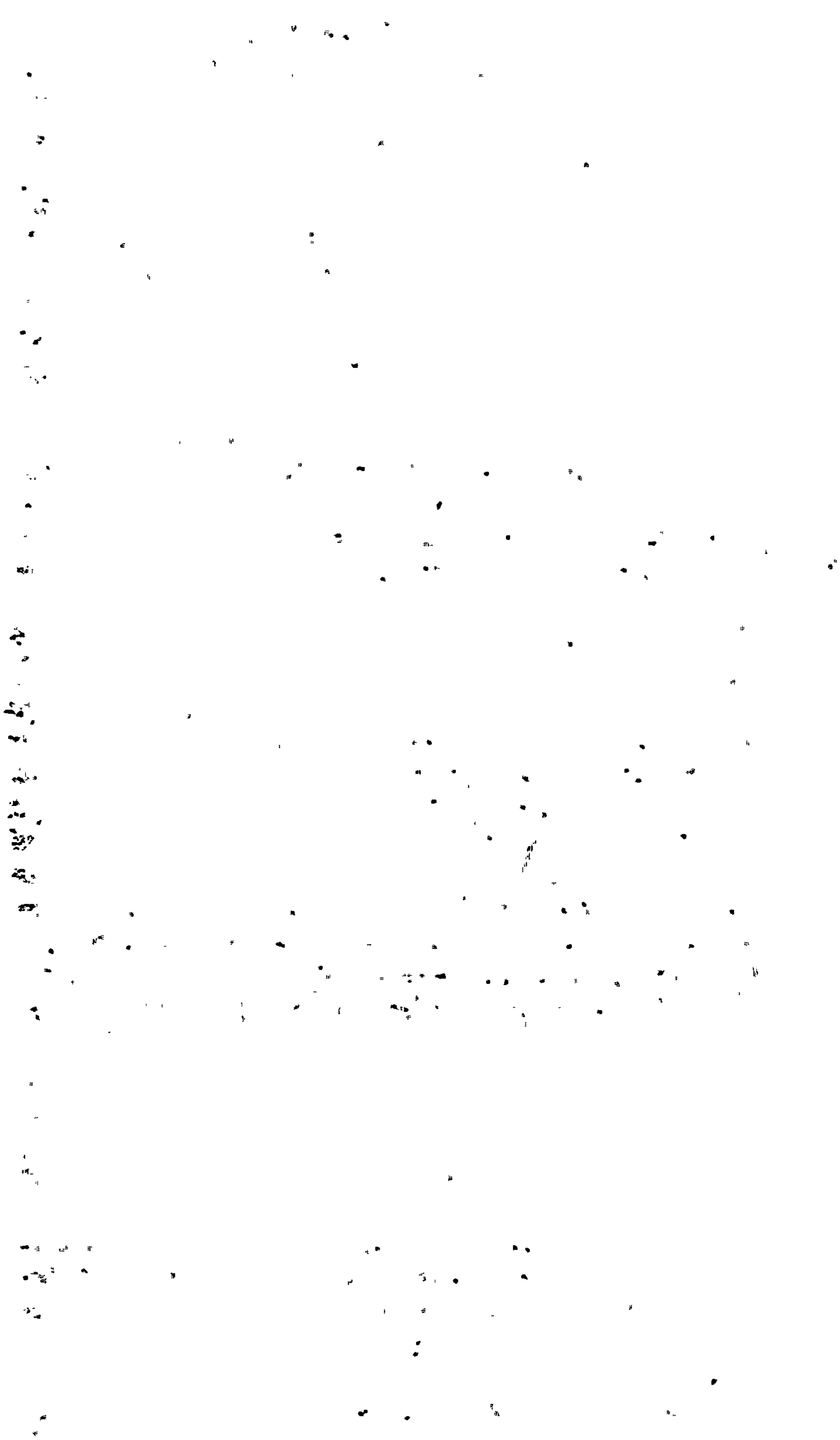
1. Non-VB sources such as leakage through the diaphragm floor penetrations (SRV discharge line and downcomers), cracks in the diaphragm floor/liner plate and cracks in the downcomers that pass through the suppression pool airspace.

2. The five sets of drywell-to-suppression chamber containment VBs.

Each potential flow path is evaluated for the proposed TS change.

3.2.1 Non-VB Bypass Area

Several plant design features and the low pressure bypass test data measured to date confirm that the non-VB bypass leakage is negligible and will continue to be negligible for the increased duration between bypass tests as described below:



1. Diaphragm Floor

The diaphragm floor is a reinforced concrete slab approximately 3.5' thick. The drywell side surface of the diaphragm slab is capped with a 1/4" thick carbon steel liner plate. The liner plate is constructed of carbon steel plates welded together to form a continuous steel membrane. Non-destructive testing and vacuum box testing were performed on the welds at the liner plate seams to verify acceptable weld quality, structural integrity and leaktightness. The liner plate is protected against corrosion and deterioration by a safety-related epoxy coating. The diaphragm slab and liner plate provide a barrier against the potential for current and future bypass leakage from the drywell to the suppression pool airspace via the diaphragm floor.

The diaphragm floor liner plate is designed, constructed and coated to safety-related quality assurance requirements. In addition, it is designed for all postulated loading conditions, including seismic, hydrodynamic, pressure, temperature and other loads. References 3 and 4 provide the design and construction requirements for the diaphragm floor liner plate.

2. Diaphragm Floor Penetrations

The downcomers and SRV discharge lines penetrate through the diaphragm slab and terminate in the suppression pool. The downcomers are 24" diameter, seamless carbon steel, galvanized pipes with 3/8" wall thickness. A 42" diameter steel ring plate is welded to the outside of the downcomers. The downcomer/ring plate assemblies are embedded in the diaphragm slab with the top surface of the ring plate flush with the drywell side diaphragm slab. The diaphragm floor liner plate is installed to provide a minimum 1" overlap around the ring plate. All connections are welded to form a continuous steel membrane between the liner plate and downcomer penetrations.

The SRV discharge lines are routed through welded flued heads at the diaphragm floor. The flued head design and construction are similar to the downcomer penetrations and also provide a continuous steel barrier between the liner plate and SRV discharge line flued heads.

Both the downcomer penetration assemblies and SRV discharge line flued heads are designed and constructed to safety-related quality assurance requirements. In addition, they are designed for all postulated loading conditions, including seismic, hydrodynamic, pressure, temperature and other loads. References 4 and 5 provide the design and construction requirements for the diaphragm floor penetrations.

3. Downcomers Located in the Suppression Pool Airspace

The downcomers are constructed of 24" diameter seamless piping with a 3/8" wall thickness. The downcomers have been designed to the requirements of ASME Section III, NB-3600 for all postulated loading conditions, including seismic, hydrodynamic, pressure, temperature and other loads. In addition, although not required by the ASME code, a fatigue analysis was performed for the portion of the downcomers located in the suppression chamber airspace. The fatigue analysis was completed to address the NRC's concern for potential bypass leakage due to fatigue induced downcomer failures in the suppression pool airspace. The fatigue analysis includes a conservative number of SRV and LOCA chugging load cycles. The fatigue analysis confirms that the downcomers will maintain their structural integrity for all postulated loading conditions. These conservative design requirements ensure that the downcomers will not contribute to the non-VB bypass leakage

4. Diaphragm Floor Structural Integrity Test

During the pre-operational test program, a structural integrity test was conducted to verify the structural integrity of the diaphragm floor and penetrations. The drywell was pressurized to a drywell-to-suppression chamber differential pressure of approximately 30 psig, which envelops the maximum differential pressure during LOCA conditions. The test conditions were maintained for a sufficient time period to verify the structural integrity of the diaphragm floor and penetrations.

5. Low Pressure Bypass Test Data

To date, eight Unit 1 and seven Unit 2 low pressure drywell-to-suppression chamber bypass tests have been completed as required by TS 4.6.2.1.d. These tests were conducted at a drywell-to-suppression chamber differential pressure of approximately 4.3 psi to simulate the differential pressure during the steam blowdown phase of a LOCA. The measured leakage area includes leakage from both the VB and non-VB sources. However, the tests were conducted following maintenance to the VBs and are more indicative of the long-term leakage integrity for the non-VB sources, since it is expected that the as-left VB leakage is minimal.

Attachment 1 compares the measured Unit 1 and 2 leakage areas with the TS (0.77 in^2) and design limits (7.7 in^2). In all cases, the measured leakage areas are significantly less than the TS and design limits. The maximum measured leakage areas are 0.037 in^2 and 0.009 in^2 for Units 1 and 2, respectively; or 4.81% and 1.17% of the TS limit. The average measured leakage areas are 0.00950 in^2 and 0.005 in^2 for Unit

1 and 2, respectively; or 1.23% and .69% of the TS limit and 0.12% and 0.07% of the design limit. The minimum measured leakage areas are 0.001 in^2 and 0.002 in^2 for Unit 1 and 2, respectively; or 0.13% and 0.26% of the TS limit and 0.013% and 0.039% of the design limit. Clearly, the test data confirms that the bypass leakage measured to date at Susquehanna SES has been negligible.

In addition, PP&L has obtained the bypass leakage data for thirteen drywell-to-suppression chamber bypass tests from two plants which incorporate a Mark II containment and Anderson Greenwood VBs (same as PP&L), and therefore the data is directly applicable to the SSES containment design and the proposed TS change. One plant's minimum and maximum measured leakage areas are 0.0% (3 tests) and 17.6% of the TS limit; with an average bypass leakage area of 5.8% of the TS limit. The other plant's minimum and maximum measured leakage areas are 1.03% and 5.6% of the TS limit; with an average bypass leakage area of 2.4% of the TS limit. All tests were completed at the end of the outage and represent as-left bypass leakage.

Approximately 20 reactor years of operation at Susquehanna SES substantiate the fact that the non-VB flow areas are negligible compared to the TS and design leakage areas. The bypass leakage area varies randomly at extremely low leakage areas and confirms the structural integrity and leaktightness of the non-VB sources. No adverse trend in measured bypass leakage area can be seen in the test data. This is expected since the plant design incorporates design features to minimize the non-VB bypass flow area. Furthermore, the proposed test frequency is judged to be acceptable based on the risk to the structural integrity of non-VB leak sources being essentially equivalent to that of the rest of the primary containment structure, which is tested on the same frequency during ILRTs.

It is expected that future testing, performed at a reduced test frequency proposed by the TS change, will continue to measure negligible bypass flow areas. In addition, the non-SSES bypass test data substantiate the above conclusion for other Mark II plants.

Therefore, the proposed TS change has no safety significance relative to the potential for not being able to detect adverse non-VB bypass leakage sources due to the reduced bypass test frequency.

3.2.2 Containment Vacuum Breaker (VB) Flow Area

The remaining and most likely source of potential bypass leakage are the five sets of containment VBs. Each set consists of two VBs in series, flange mounted to a Tee off the downcomers in the suppression chamber airspace. The VBs incorporate several design features to minimize bypass leakage:

1. An elastomer diaphragm is installed in the valve body seat to enhance the leaktightness at the disk/valve body interface (Reference 6).

2. The actual VB seat design is pressure boosted so that the higher drywell pressure creates a differential pressure between sections of the diaphragm that assists in maintaining the disk/body seal (Reference 6).

3. The closing direction of the VB swing disk allows the drywell-to-suppression chamber differential pressure during a LOCA to apply a closing force to the valve disk (1600# minimum force) to provide better valve seating.

4. Two VBs are installed in series, so that both valves in series would have to leak to have a bypass leakage path.

5. The VBs incorporate a sensitive valve disk position indication system. The position indication system design and calibration provides an open valve indication in the control room when the VB disk is open to an equivalent bypass area of less than the design $A/(k)^{1/2}$ (7.7 in^2). This ensures that an adverse VB position will be detected during plant operation and corrected.

The drywell-to-suppression chamber bypass test per TS 4.6.2.1.d is completed at the end of each refueling outage and is used to verify that the total bypass area, including the VBs, meets the TS limit. If maintenance has been performed on the VBs, the test also provides a post-maintenance VB leakage area test. The proposed TS change decreases the test frequency for the bypass test. As a result, another means of performing post-maintenance VB leakage is required for those outages for which the TS bypass test is not scheduled. In addition, although the VB design ensures leaktightness, they contain active components and their susceptibility to leakage is greater than the passive structural components described in 3.1.1. The bypass test data described in Section 3.2.1 was obtained following maintenance to the VBs and therefore cannot be utilized to determine the VB leakage reliability over two cycles of operation.

To address this concern and collect additional data on VB leakage, the proposed Technical Specification change includes an additional Surveillance Requirement (see Section 2.2.) to conduct a vacuum breaker leakage test as described below:

1. The leakage test will be conducted on each set of VBs (five VB sets per unit) during each refueling outage for which the TS bypass test is not scheduled. If maintenance is performed on the VBs, the VB leakage test will be conducted post-maintenance to verify that the as-left leakage is acceptable. The VB leakage test will be conducted at a drywell-to-suppression chamber differential pressure of 4.3 +0.7, -0.0 psid (same as TS bypass test) by either pressurizing the drywell side of the VBs or inducing a vacuum on the suppression chamber side of the VBs. Attachment 2 summarizes the theoretical basis for calculating the leakage area from the test data. The Attachment 2 methodology has been prepared and approved in PP&L Calculation M-CNT-004 (Reference 7).

2. The acceptance criteria for the VB leakage tests will be as follows:

   a. The total VB leakage area for all five sets of VBs will be less than or equal to 30% of the TS limit ($0.3 \times .77 = 0.231$ in^2). The acceptable VB leakage area provides a 70% margin to the TS limit to account for the non-VB sources of leakage, since the proposed TS change does not require a drywell-to-suppression chamber bypass test for the outage during which the VB test is conducted. As described in Section 3.2.1, previous SSES bypass testing measured a maximum bypass leakage area of 4.8% of the TS limit, while the majority of the tests measured significantly lower bypass areas. The 70% margin to the TS limit is sufficiently high to accommodate the expected non-VB leakage sources. It should be noted that there is a factor of 10 margin between the TS limit and design limits.

   Attachment 3 provides the expected leakage through the VBs based on the acceptance criteria of 30% of the TS limit (0.231 in^2). The spreadsheet solves Eq. (3) of Attachment 2 for hypothetical VB test conditions and calculates an acceptable total VB leakage of 1,580,000 [1]SCCM or 55.8 [2]SCFM.

[1] Standard Cubic Centimeters per Minute (SCCM)

[2] Standard Cubic Feet per Minute (SCFM)

b. Each individual set of VBs will have a leakage area of less than or equal to twice the acceptable VB leakage from a. above assuming the leakage area is evenly distributed among the five sets of VBs (12% of TS limit). This allows a leakage area of less than or equal to 0.0924 in^2 (0.231/5 x 2 = 0.0924 in^2) for an individual set of VBs. The criteria is stipulated to identify individual sets of VBs with higher leakage area.

   Based on Attachment 3, the allowable leakage flow rate would be 632,000 SCCM (2 x 316,000 = 632,000) or 22.3 SCFM for an individual VB set.

3. Failure to meet the total leakage area criteria in 2a. or 2b. above will require corrective action to reduce the VB leakage area to below the acceptance criteria. If either acceptance criteria in 2a. or 2b. is exceeded, then a root cause evaluation will be conducted to determine why the VB leakage area exceeded the criteria.

   The additional Surveillance Requirement ensures an acceptable VB leakage area for those outages where the drywell-to-suppression chamber bypass test will not be performed. An acceptable VB leakage area, combined with the negligible non-VB leakage area, provides an equivalent level of assurance as the current TSs that the containment design basis for steam bypass will be met.

4.0 CONCLUSIONS

The current TS requirement for an 18-month surveillance frequency reflects the NRC's concern with the Licensee's ability to detect an adverse bypass leakage condition prior to a LOCA and uncertainties in the increase in future bypass leakage. The bypass leakage test data collected at SSES indicates conformance by a large margin with the Technical Specification and design leakage requirements. In fact, the measured leakage data confirms that there is minimal risk that the bypass leakage will adversely change in future years. As a result, technical justification exists for changing the test frequency from 18-months to coincide with the test frequency for the Type A Integrated Leak Rate test. Furthermore, the proposed test frequency is judged to be acceptable based on the risk to the structural integrity of non-VB leak sources being essentially equivalent to that of the rest of the primary containment structure, which is tested on the ILRT frequency. A VB leakage test will be developed and conducted to verify acceptable VB bypass area for those outages during which the TS bypass test will not be conducted. The VB leakage test and stringent acceptance criteria, combined with the negligible non-VB leakage area, provide an equivalent level of assurance as the current TS requirements that the drywell-to-suppression chamber bypass leakage can be measured and an adverse condition detected prior to a LOCA. Therefore, containment integrity during a LOCA will be maintained for the proposed TS change.

5.0 REFERENCES

1. Bechtel Calculation 200-0217, Containment Steam Bypass Leakage, August 1981.

2. PLA-923, Steam Bypass of Suppression Pool - SER Outstanding Issue #25, September 3, 1981

3. Drawing C-293, Reactor Building Units 1 & 2 Liner Plate Diaphragm Floor - Plan & Details

4. Specification 8856-C-50, Technical Specification for Furnishing, Detailing, Fabricating, Delivering and Erecting the Primary Containment Liner Plate and Accessory Steel, Revision 10, March 18, 1983

5. Drawing C-372, Reactor Building Units 1 & 2 Primary Containment Vent Pipe - Details, Sheet 1

6. IOM 166, Operation and Maintenance Manual for Vacuum Relief Valve, Type CV1-L, 24-Inch and Auxiliaries, Revision 8, January 1990.

7. PP&L Calculation M-CNT-004, $A/(k)^{1/2}$ Calculation for Vacuum Breaker Leakage Testing, April 1993.

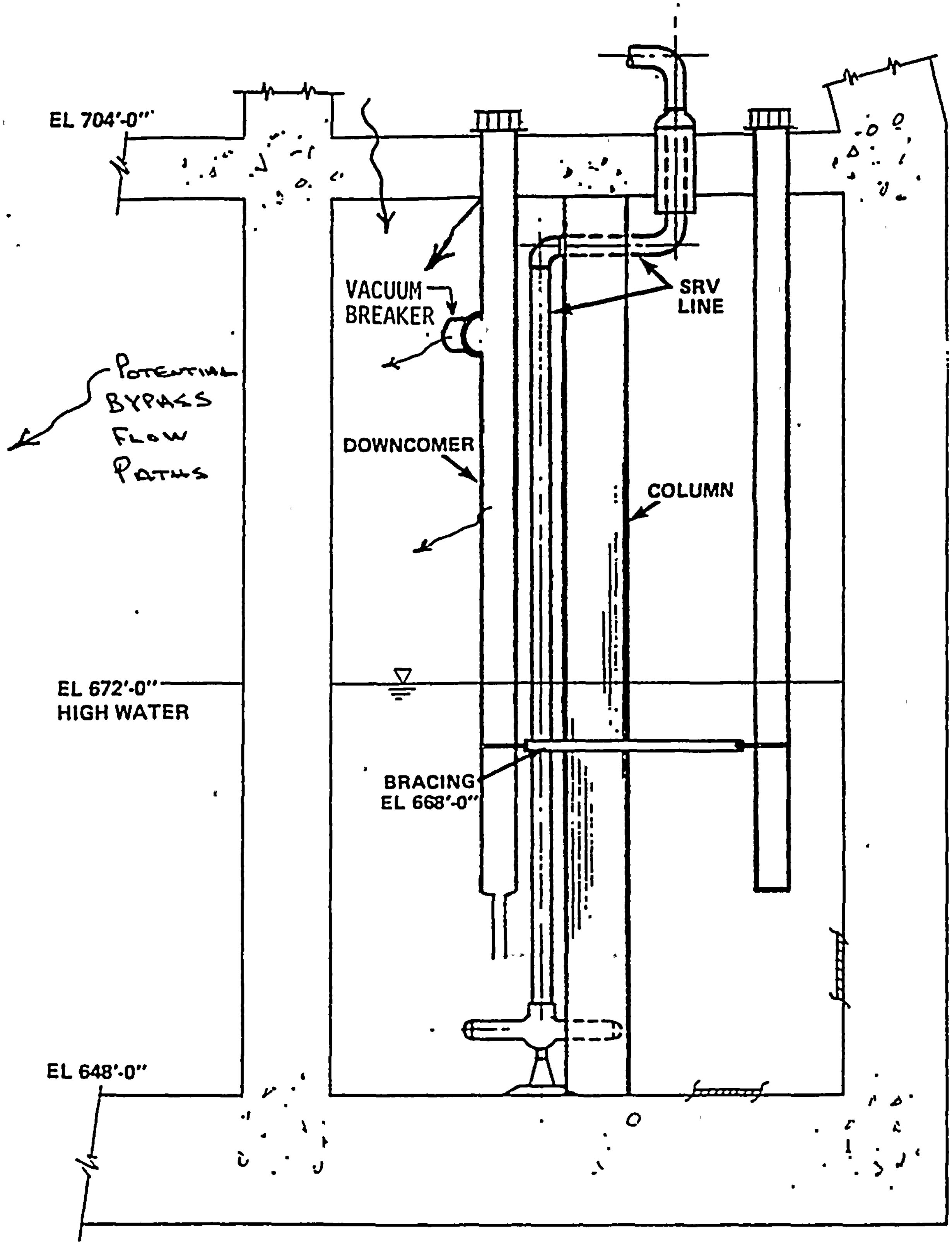


FIGURE 1: POTENTIAL BYPASS FLOW AREAS

SSES UNIT 1

LOW PRESSURE BYPASS TEST DATA

COMPARISON OF MEASURED BYPASS FLOW AREA WITH TECHNICAL SPECIFICATION AND DESIGN BYPASS AREA

OUTAGE	DATE	MEASURED AREA (IN^2)	TECHNICAL SPECIFICATION LIMIT (IN^2)	DESIGN AREA (IN^2)	PERCENTAGE OF TECH SPEC AREA (NOTE 1)	PERCENTAGE OF DESIGN AREA (NOTE 2)
Pre-OP	05/24/82	0.012	0.77	7.7	1.56%	0.16%
Pre-Comm.	05/06/83	0.001	0.77	7.7	0.13%	0.01%
1st Refuel	06/02/85	0.007	0.77	7.7	0.91%	0.09%
2nd Refuel	04/13/86	0.002	0.77	7.7	0.26%	0.03%
3rd Refuel	11/09/87	0.003	0.77	7.7	0.39%	0.04%
4th Refuel	05/31/89	0.037	0.77	7.7	4.81%	0.48%
5th Refuel	11/4/90	0.006	0.77	7.7	0.78%	0.08%
6th Refuel	05/06/92	0.008	0.77	7.7	1.04%	0.10%
AVERAGE		0.00950			1.23%	0.12%

NOTE 1: (MEASURED FLOW AREA)/(TS AREA) X 100

NOTE 2: (MEASURED FLOW AREA)/(DESIGN AREA) X 100

SSES UNIT 2

LOW PRESSURE BYPASS TEST DATA

COMPARISON OF MEASURED BYPASS AREA WITH TECHNICAL SPECIFICATION AND DESIGN AREA

OUTAGE	DATE	MEASURED AREA (IN^2)	TECHNICAL SPECIFICATION LIMIT (IN^2)	DESIGN AREA (IN^2)	PERCENTAGE OF TECH SPEC AREA	PERCENTAGE OF DESIGN AREA
Pre-OP	11/03/83	0.002	0.77	7.7	0.26%	0.03%
Pre-Comm.	12/15/84	0.004	0.77	7.7	0.52%	0.05%
1st Refuel	06/11/86	0.008	0.77	7.7	1.04%	0.10%
2nd Refuel	06/12/88	0.003	0.77	7.7	0.39%	0.04%
3rt Refuel	11/05/89	0.007	0.77	7.7	0.91%	0.09%
4th Refuel	04/30/91	0.009	0.77	7.7	1.17%	0.12%
5th Refuel	11/02/92	0.004	0.77	7.7	0.52%	0.05%
AVERAGE		0.005			0.69%	0.07%

NOTE 1: (MEASURED FLOW AREA)/(TECHNICAL SPECIFICATION AREA) X 100

NOTE 2: (MEASURED FLOW AREA)/(DESIGN FLOW AREA) X 100

VACUUM BREAKER (VB) BYPASS AREA CALCULATION

A. Test Approach

The VB leakage test will be conducted at a drywell-to-suppression chamber differential pressure of 4.3 +0.7, -0.0 psid (same as TS bypass test) by either pressurizing the drywell side of the VBs or inducing a vacuum on the suppression chamber side of the VBs. Both VBs in-series will be closed during the test. The VB leakage flow rate, upstream and downstream pressures and drywell air temperature are measured and used to calculate the equivalent leakage area, $A/(k)^{1/2}$.

B. Assumptions

1. Calculations are based on equivalent leakage through an orifice.

2. The bypass area, $A/(k)^{1/2}$ is derived from flow equations based on sub-critical flow. For air with k = 1.4, the critical flow ratio is 0.528. Therefore, the bypass flow area calculation methodology described below is valid for a downstream pressure no lower than 0.528 x the drywell pressure (Pd). For example, if Pd = 14.7 psia, then the downstream pressure can be no lower than (0.528)(14.7) = 7.7 psia.

C. Formulas

The VB bypass area, $A/(k)^{1/2}$ is derived from the following formula (Reference 1; page 5-14):

$$W = \frac{A}{\sqrt{k}} \frac{(2.05)(Pd)}{\sqrt{Td}} \sqrt{\left[\left(\frac{Pw}{Pd}\right)^{1.43} - \left(\frac{Pw}{Pd}\right)^{1.71}\right]} \tag{1}$$

where:

W = VB leakage mass flow rate (lb/sec)

Td = Drywell air temperature (°R)

Pd = Upstream/Drywell side pressure (psia)

Pw = Downstream/Suppression chamber side pressure (psia)

VB BYPASS AREA CALCULATION

$\frac{A}{\sqrt{k}}$ = *VB leakage area, inches*^{2}

But:

W = [(Q)(S)]/[(60)(28,317 cc/ft^3)] (2)

where:

Q = VB leakage measured by flow device (standard cubic cent./min (sccm))

S = air density at standard conditions (0.0763 lb/ft^3)

Substituting equation (2) into equation (1) and rearranging:

$$\frac{A}{\sqrt{k}} = \frac{(S)(Q)\sqrt{Td}}{(2.05)(Pd)(60)(28{,}317)} \left[\left(\frac{Pw}{Pd}\right)^{1.43} - \left(\frac{Pw}{Pd}\right)^{1.71}\right]^{-0.5} \qquad (3)$$

D. References

1. C.W. Gibbs - Editor, New Compressed Air and Gas Data, Ingersoll-Rand Company, Second Edition, 1971.

CALCULATION OF VACUUM BREAKER (VB) LEAKAGE AREA FOR

ALLOWABLE LEAKAGE OF 30% OF TS LIMIT (0.231 IN^2)

VACUUM BREAKER SET	*VB LEAKAGE FLOW (SCC/MIN)*	DRYWELL TEMP (F)	DRYWELL PRESS (PSIA)	WETWELL VACUUM (PSIA)	AIR DENSITY (LBM/FT^3)	VB LEAKAGE AREA (IN^2) (NOTE 1)
VB A	316000	80	14.7	10.4	0.076	0.04612
VB B	316000	80	14.7	10.4	0.076	0.04612
VB C	316000	80	14.7	10.4	0.076	0.04612
VB D	316000	80	14.7	10.4	0.076	0.04612
VB E	316000	80	14.7	10.4	0.076	0.04612
TOTAL	1580000					0.231

NOTE 1: ASSUMES THAT LEAKAGE IS EVENLY DISTRIBUTED AMONG EACH SET OF VBS