Nuclear Operating Company
South Texas Project Electric Generating Station P.O. Box 289 Wadsworth, Texas 77483

December 6, 2018
NOC-AE-18003602
10 CFR 50.90

U.S. Nuclear Regulatory Commission
Attention: Document Control Desk
Washington, DC 20555-0001

South Texas Project
Units 1 & 2
Docket No. STN 50-498, STN 50-499
Response to Request for Additional Information for
South Texas Project (STP) Units 1 & 2 License Amendment Request to
Revise Technical Specification 3.8.1.1 (A.C. Sources, Operating) (L-2018-LLA-0078)

References:

1. Letter; J. Connolly to USNRC Document Control Desk; "License Amendment Request to Revise Technical Specification 3.8.1.1 (A.C. Sources, Operating)"; March 27, 2018; (NOC-AE-17003529) (ML18086B761).
2. E-mail; L. Regner (NRC) to D. Richards (STP); "Final RAI – South Texas Standby DG TS change (L-2018-LLA-0078)"; October 10, 2018; (AE-NOC-18003142) (ML18283B952).

By Reference 1, STP Nuclear Operating Company (STPNOC) requested approval of a license amendment to Technical Specification 3.8.1.1 to revise certain minimum voltage and frequency acceptance criteria for steady-state standby diesel generator surveillance testing. By Reference 2, the NRC staff sent a request for additional information (RAI) to complete its review. STPNOC's responses to this RAI are provided in the Enclosure to this letter.

There are no commitments in this letter.

If there are any questions or if additional information is needed, please contact Drew Richards at (361) 972-7666 or me at (361) 972-7344.

I declare under penalty of perjury that the foregoing is true and correct.

Executed on December 6, 2018

James Connolly
Executive VP and CNO

amr/JWC

Enclosure: Responses to Request for Additional Information

STI: 34739061

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ENCLOSURE

Responses to Request for Additional Information

STP NUCLEAR OPERATING COMPANY
SOUTH TEXAS PROJECT ELECTRIC GENERATING STATION UNITS 1 AND 2
DOCKET NUMBERS 50-498 AND 50-499
REQUESTS FOR ADDITIONAL INFORMATION
REGARDING LICENSE AMENDMENT REQUEST TO REVISE
TECHNICAL SPECIFICATION 3.8.1.1 (A.C. SOURCES, OPERATING)

By application dated March 27, 2018 (ADAMS Accession Number ML18086B761), STP Nuclear Operating Company, the licensee, requested changes to the South Texas Project (STP) Unit 1 and Unit 2 Technical Specifications. The changes would restrict the steady-state voltage and frequency limits for standby diesel generator (SBDG) operation to ensure that accident mitigation equipment can perform as designed. The U.S. Nuclear Regulatory Commission (NRC) staff has determined the following requests for additional information (RAI) are needed in order to complete its review.

EEOB 1-1

Regulatory Requirements:

10 CFR, Appendix A of Part 50, General Design Criterion (GDC) 17, “Electric Power Systems,” requires, in part, that an onsite electric power system and an offsite electric power system be provided to permit functioning of structures, systems, and components (SSCs) important to safety. The safety function for each system (assuming the other system is not functioning) shall be to provide sufficient capacity and capability to assure that (1) specified acceptable fuel design limits and design conditions of the reactor coolant pressure boundary are not exceeded as a result of anticipated operational occurrences and (2) the core is cooled and containment integrity and other vital functions are maintained in the event of postulated accidents. The onsite electric power supplies shall have sufficient independence, redundancy, and testability to perform their safety functions assuming a single failure.

The licensee adopted WCAP-17308-NP-A, Revision 0, which states that the allowable range of frequency and voltage when incorporated directly into plant-specific TS SRs, imply that SSCs can function satisfactorily with a frequency variation of plus or minus (±) 0.25 percent of the 60 Hz nominal and ±5 percent variation in the 4160 V nominal voltage. Steady-state DG operation at the extremes of the allowable frequency and voltage limits will have an impact on system design bases, including:

- Performance of safety related systems
- DG loading calculations
- DG fuel oil consumption calculations
- MOV performance”

Issue:

The LAR states: “To maintain desired standby diesel generator (SBDG) operating parameters, the steady-state voltage range was also revised to 4160 ± 208 volts (± 5%). As a final corrective action, STPNOC is pursuing this license amendment request to ensure that the design basis is protected.” However, the licensee does not describe what methodology was used for evaluating the SBDG voltage tolerance. Further, the LAR does not include how the voltage tolerance was determined to ensure the functioning of SSCs.

Request:

Based on the above, provide a discussion of the methodology including the assumptions used for evaluating the SBDG voltage tolerance including how it demonstrates that the steady-state voltage values of ±5 percent of the nominal voltage (4160 ± 208 volts) provide sufficient capacity and capability to assure functioning of SSCs.

STPNOC response

STP used the methodology outlined in WCAP-17308 to address the issue of SBDG frequency and voltage variation in the STP safety analyses. The NRC found the WCAP methodology acceptable, as stated in the last sentence of the NRC Safety Evaluation: “Therefore, the NRC staff finds the proposed TR methodology acceptable, with noted limitations and conditions, for compliance with the NRC regulations.” By using the accepted methodology from WCAP-17308, STP has demonstrated compliance with the requirements of 10 CFR 50.36(c)(3), GDC 17, and GDC18. Additional information regarding voltage variation can be found below.

Per SBDG design specifications, under worst case conditions, the SBDG voltage regulator regulation accuracy is ± 0.5% of nominal voltage (4160 V). Equation 3 in WCAP-17308-NP-A calculates SBDG voltage uncertainty (U_V), which is a combination of regulator voltage control uncertainty (U_{Reg}) and regulator voltage setting uncertainty ($U_{Reg\text{-}Setting}$). Therefore, the worst case value for U_{Reg} is ± 0.5%. Rearranging Equation 3 to solve for regulator voltage setting uncertainty ($U_{Reg\text{-}Setting}$), if U_V equals 5% gives:

$$U_{Reg\text{-}Setting} = \sqrt{(5\%)^2 - (0.5\%)^2} = 4.975\%$$

Therefore, STP is allowing a ± 4.975% tolerance for regulator voltage setting uncertainty.

Reviewing the steady-state SBDG voltage readings in Table 1 and Table 2 below, the worst case deviation from the nominal SBDG steady-state voltage (4160 V) is approximately 3.03% (4034 V on 4/1/2018 for SBDG 22). Therefore, based on steady-state SBDG voltage readings from recent surveillances combined with the worst case ± 0.5% for regulation accuracy, the STP steady-state SBDG voltage allowance of ± 5% is acceptable.

Table 1 and Table 2 below provide steady-state voltage readings from recent surveillances performed on each SBDG and demonstrate that the SBDG voltage regulator does control voltage within the range of 4160 ± 208 V (± 5%). The maximum and minimum values for each SBDG are shaded for convenience.

Table 1 - Unit 1 Steady-State SBDG Voltage Readings					
SBDG # 11		**SBDG # 12**		**SBDG # 13**	
Date	**Steady State Voltage, V**	**Date**	**Steady State Voltage, V**	**Date**	**Steady State Voltage, V**
8/19/2018	4098	10/24/2018	4123	9/26/2018	4127
2/1/2018	4109.8	6/29/2018	4137	4/11/2018	4117
8/16/2017	4100	12/13/2017	4132	10/31/2017	4115.5
4/9/2017	4096	9/17/2017	4175	4/19/2017	4100
3/2/2017	4140	4/15/2017	4128.9	4/12/2017	4070

Table 2 - Unit 2 Steady-State SBDG Voltage Readings					
SBDG # 21		**SBDG # 22**		**SBDG # 23**	
Date	**Steady State Voltage, V**	**Date**	**Steady State Voltage, V**	**Date**	**Steady State Voltage, V**
9/18/2018	4146	4/1/2018	4034	4/17/2018	4130
4/17/2018	4091	3/31/2018	4089	4/16/2018	4090
4/17/2018	4099	2/16/2018	4151	12/26/2017	4138.4
10/17/2017	4190	9/27/2017	4129	7/13/2017	4231
5/2/2017	4128	3/18/2017	4123.5	1/25/2017	4120

EMIB 1-1

Background:

Insufficient net positive suction head (NPSH) margin can result in pump cavitation and pump performance degradation. Changes in pump frequency affect the available and required NPSH. Therefore, the proposed frequency tolerance might affect the available and required NPSH of the affected pumps. The licensee provided a list of the analyzed pumps in License Amendment Request (LAR) Section 3.0, subsection “IST pump curves.”

Issue:

The licensee did not provide information to describe how the proposed frequency tolerance affects available and required NPSH for the analyzed pumps.

Request:

In order to demonstrate that all pumps will continue to perform their design functions with the proposed SBDG frequency tolerance of 60 ± 0.3 Hertz (Hz) state whether or not there is sufficient margin between the required net positive suction head and available net positive suction head at 59.7 Hz and 60.3 Hz for all pumps evaluated for the LAR.

STPNOC response

Spent Fuel Pool Cooling and Cleanup pumps

The required NPSH for these pumps at 3,750 gpm (150% of design flow) is 18.75 feet. The NPSH available when operating in the normal cooling mode with suction from the spent fuel pool is 43.67 feet. The minimum NPSH available when operating in an abnormal mode with suction from the In-Containment Storage Area is 27.64 feet. By inspection, the effect of small voltage and frequency variations on NPSH margin is acceptable.

Residual Heat Removal pumps

Note that the Residual Heat Removal (RHR) pumps at STP do not have an emergency core cooling system function and operate with suction from the reactor coolant system hot legs. The required NPSH for these pumps at 3,400 gpm (normal cooling mode flow rate is controlled at 3,000 gpm) is 9.5 feet. The NPSH available when operating in an abnormal mode with the reactor coolant system fluid saturated due to total vacuum degassing at 150 °F is 14.2 feet. By inspection, the effect of small voltage and frequency variations on NPSH margin is acceptable.

Component Cooling Water pumps

During post-LOCA two-loop operation, which is the most conservative mode of operation for the Component Cooling Water pumps for NPSH margin, the required NPSH is 17 feet. The NPSH available when operating in this mode is 30.6 feet. By inspection, the effect of small voltage and frequency variations on NPSH margin is acceptable.

Chemical and Volume Control System Centrifugal Charging pumps

Note that the Chemical and Volume Control System Centrifugal Charging Pumps (CCP) at STP do not have an emergency core cooling system function. In the Safe Shutdown mode with suction from the boric acid tanks, which is the most limiting condition for NPSH margin, the required NPSH is 12.3 feet and the NPSH available is 19.23 feet. By inspection, the effect of small voltage and frequency variations on NPSH margin is acceptable.

Essential Cooling Water pumps

The more limiting parameter for the open well, vertical turbine, essential cooling water pumps is submergence. The required submergence for the essential cooling water pumps is 6.3 feet at 20,610 gpm (maximum rated flow rate). The minimum available submergence during the design case for the minimum level in the Ultimate Heat Sink is 10.0 feet. By inspection, the effect of small voltage and frequency variations on submergence margin is acceptable.

Essential Chilled Water pumps

The required NPSH for the Essential Chilled Water pumps is 18 feet. During normal operation, pressure of the nitrogen cover gas in the Essential Chilled Water expansion tank is kept between 26 and 30 psig. Even with a complete loss of expansion tank cover gas pressure, the NPSH available at Essential Chilled Water pumps is 47.4 feet. By inspection, the effect of small voltage and frequency variations on NPSH margin is acceptable.

Motor Driven Auxiliary Feedwater pumps

A safety-related control valve automatically maintains AFW pump flow between 550 and less than 675 gpm and limits flow to less than 675 gpm when being manually controlled from the Control Room. Because of this control function, small voltage and frequency variations will not cause the pumps to operate at a higher flow rate and there is no significant effect on NPSH margin.

Emergency Core Cooling System - LHSI Pumps

The IST upper limits ensure that with combined test uncertainty and uncertainty due to SBDG voltage and frequency, the highest LHSI pump flow rate with the RCS depressurized to 0 psig and in the injection mode with the minimum flow path to the RWST open is less than 2,900 gpm. The most limiting conditions for LHSI pump NPSH margin are during the containment sump recirculation mode. Two cases for LHSI pump required NPSH are considered: 1) at the center line of the first stage impeller, and 2) at the center line of the pump suction nozzle located at the top of the pump barrel. The manufacturer's test reports show required NPSH at the first stage for these pumps at a test flow of 2,944 gpm (well above the 2,900 maximum pump flow during RWST injection ensured by the IST limits) is 12.9 feet. The pump design has a distance of 15 feet in the barrel between the pump suction nozzle center line and the first stage impeller center line, ensuring a required head of 13 feet will always be met.

The required NPSH at the center line of the pump suction nozzle is determined by:

$$NPSH_{Required} = \frac{1}{2} * ID + \frac{V^2}{2g} \quad \text{where,}$$

g is gravitational acceleration, 32.13 ft/sec^2,
V is the flow velocity in the pump suction piping in ft/sec, and
ID is the inner diameter of the pump suction piping in feet.

At 2,900 gpm, the required NPSH at the center line of the pump suction nozzle is 1.55 feet. The lowest NPSH available from the containment sump is 7.5 feet at the suction nozzle center line, not including debris head loss across the sump strainer. The limiting combination of total strainer head loss and available NPSH occurs at a sump temperature of 212 °F when the margin above the required NPSH is 0.7 feet. The IST acceptance criteria, which include combined test uncertainty and uncertainty due to SBDG voltage and frequency, ensure this minimum margin is exceeded for all of the LHSI pumps.

Emergency Core Cooling System - HHSI Pumps

The IST upper limits ensure that with combined test uncertainty and uncertainty due to SBDG voltage and frequency, the highest HHSI pump flow rate with the RCS depressurized to 0 psig and in the injection mode with the minimum flow path to the RWST open is 1,620 gpm. The most limiting conditions for HHSI pump NPSH margin are during the containment sump recirculation mode. Two cases for HHSI pump required NPSH are considered: 1) at the center line of the first stage impeller, and 2) at the center line of the pump suction nozzle located at the top of the pump barrel. The manufacturer's pump performance curve shows required NPSH at the first stage for these pumps at 1,620 gpm is 11 feet. The pump design has a vertical distance of 15 feet in the barrel between the pump suction nozzle center line and the first stage impeller center line, ensuring a required head of 11 feet will always be met.

The required NPSH at the center line of the pump suction nozzle is determined by:

$$NPSH_{Required} = \frac{1}{2} * ID + \frac{V^2}{2g} \quad \text{where,}$$

g is gravitational acceleration, 32.13 ft/sec^2,
V is the flow velocity in the pump suction piping in ft/sec, and
ID is the inner diameter of the pump suction piping in feet

At 1,620 gpm, the required NPSH at the center line of the pump suction nozzle is 1.1 feet. The lowest NPSH available from the containment sump is 7.4 feet at the suction nozzle center line, not including debris head loss across the sump strainer. The limiting combination of total strainer head loss and available NPSH occurs at a sump temperature of 212 °F when the margin above the required NPSH is 1.2 feet. The IST acceptance criteria, which include combined test uncertainty and uncertainty due to SBDG voltage and frequency, ensure this minimum margin is maintained for all of the HHSI pumps.

Conclusion

Compliance with Technical Specification requirements, as applicable, ensures that design basis input values are protected. Also, the development and use of IST pump performance curves protects the design bases input values. This position is validated in WCAP-17308, Section 2.1, with the following statements in regard to development of IST pump performance curves:

> "The term IST pump curves (as used in this document) are the limiting pump curves that are based on performance requirements consistent with the plant design and licensing basis. … Therefore, flow variability due to measurement uncertainties and the effects of frequency and voltage on pump speed are statistically factored into the pump head uncertainty."

The NRC found the WCAP methodology acceptable, as stated in the last sentence of the NRC Safety Evaluation: "Therefore, the NRC staff finds the proposed TR methodology acceptable, with noted limitations and conditions, for compliance with the NRC regulations." By using the accepted methodology from WCAP-17308, STP has demonstrated compliance with the requirements of 10 CFR 50.36(c)(3), GDC 17, and GDC18, and that adequate margin exists between the required and available net positive suction head for all pumps evaluated in the STP LAR.

EMIB 1-2

Background:

The lube oil pump, jacket water pump, and fuel oil primary booster pump are mounted on the SBDG skid and are driven by the SBDG, therefore, these pumps are affected by the proposed frequency tolerance.

Issue:

The licensee did not provide information that addresses how the proposed SBDG frequency tolerance affects the performance of the SBDG lube oil pump, jacket water pump, and fuel oil primary booster pump.

Request:

In order to demonstrate that the SBDG lube oil pump, jacket water pump, and fuel oil primary booster pump will continue to perform their design functions with the proposed SBDG frequency tolerance of 60 ± 0.3 Hertz (Hz) state whether or not there is sufficient margin for SBDG operation: (1) for the flow rate at 59.7 Hz and 60.3 Hz; (2) for the discharge pressure at 59.7 Hz and 60.3 Hz; and (3) between the required net positive suction head and available net positive suction head at 59.7 Hz and 60.3 Hz.

STPNOC response

Because the SBDG lube oil pumps, jacket water pumps, and fuel oil primary booster pump are tested as part of the overall diesel generator unit, these pumps are not part of the pump IST program and the methodologies of WCAP-17308-NP-A are not directly applicable. The engine-mounted lubrication system piping and components meet the guidelines described by the Diesel Engine Manufacturers Association (DEMA) standards. From DEMA Standard Practices for Low and Medium Speed Stationary Diesel and Gas Engines, Sixth Edition, 1972, an engine-driven pump "must have sufficient capacity to maintain the minimum allowable pressure when the engine is operated at reduced speeds." This results in auxiliary pumps which may have substantial excess capacity at rated speed. Functional performance of these pumps is verified during SBDG load sequencer surveillance testing with frequency variations larger than the 59.7 Hz to 60.3 Hz steady state tolerance. Additionally, as part of the loading sequence during monthly SBDG operational testing, the governor is manually cycled between 59.5 Hz and 60.5 Hz. Operational problems are not noted when operating the SBDG through this range of engine speeds and output frequency.

SBDG Jacket Water pumps

Performance of both the engine-driven jacket water pump and the redundant motor-driven jacket water pump will vary with engine speed and frequency. The engine-driven jacket water pump, however, will not change with changes in SBDG voltage. Using the methods of WCAP-17308-NP-A, the standby motor-driven jacket water pump speed uncertainty will be 14.5 rpm, or 0.82% of the 1,770 rpm rated running speed. Performance of the jacket water pumps, therefore, is bounded using a speed variation of 0.82%. Using the pump affinity laws for centrifugal pumps, pump flow will change proportionally with pump speed changes and pump discharge head will change with the square of pump speed changes.

The jacket water pump flow change with the 0.82% bounding pump speed change is 11 gpm from the rated operating point of 1,350 gpm. Pump developed head will change by about 1.2 feet from the rated operating point of 70 feet. Because the jacket water system is a closed loop system, the system resistance curve is dominated by dynamic flow resistance. The expected jacket water flow rate change with this pump speed change is approximately 11 gpm. With normal jacket water cooler conditions, a thermostatic valve bypasses part of the jacket water flow around the jacket water cooler to maintain jacket water temperature. Even assuming no thermostatic valve bypass flow, the jacket water cooler outlet temperature will not change by more than 0.1 °F with an 11 gpm change in jacket water flow. The jacket water high temperature trip setpoint is 205 °F, there is a high temperature alarm at 190 °F, and the design jacket water temperature is 170 °F (the jacket water high temperature engine trip is bypassed when the engine is operating in emergency mode). By inspection, the effect of small voltage and frequency variations on the jacket water performance margin is acceptable.

Normal jacket water pump discharge pressure is about 20 psig while jacket water pressure at the engine is about 9 psig. If jacket water pressure at the engine falls to 6 psig, the motor-driven standby jacket water pump will start. A reduction of about 1.2 feet of pump head will not significantly affect the margin to the standby jacket water pump auto-start.

Normal jacket water standpipe level ensures adequate suction head to the jacket water pumps. The small flow change associated with voltage and frequency variations is acceptable to the NPSH margin.

SBDG Lube Oil pumps

Performance of both the engine-driven lube oil pump and the redundant standby motor-driven lube oil pump will vary with engine speed and frequency. The engine-driven lube oil pump, however, will not change with changes in SBDG voltage. Both oil pumps are positive displacement pumps rated at 670 gpm. Using the methods of WCAP-17308-NP-A, the standby motor-driven lube oil pump speed uncertainty will be 13.9 rpm, or 0.78% of the 1,775 rpm nominal running speed. Performance of the lube oil pumps, therefore, is bounded using a speed variation of 0.78%. Because both pumps are positive displacement pumps, the pump flow rate will vary directly with pump speed changes, or about 5.2 gpm from the nominal 670 gpm pump capacity.

A pressure relief valve on the engine-driven pump discharge maintains header pressure by circulating a portion of the pump flow back to the sump. A pressure regulator valve in the supply to the engine turbocharger maintains turbocharger oil supply pressure at about 35 psig. On decreasing SBDG engine lube oil pressure, the standby motor-driven lube oil pump will automatically start at about 35 psig. At about 30 psig at either the engine lube oil supply or the turbocharger oil supply, redundant pressure switches actuate to trip the engine. Normal engine oil header pressure is about 50 psig. By inspection, a pump output change of about 5.2 gpm from the normal 670 gpm pump lube oil output, will not significantly affect the margin from normal header pressure to the 35 psig standby oil pump auto-start or the 30 psig engine trip point.

With normal lube oil cooler conditions, a thermostatic valve bypasses part of the lube oil flow around the lube oil cooler to maintain engine oil temperature. Even assuming no thermostatic valve bypass flow, the oil cooler outlet temperature will not change by more than 0.2 °F with a 5.2 gpm change in lube oil pump flow. The lube oil high temperature trip setpoint is 195 °F, there is a high temperature alarm at 185 °F, and the design engine oil temperature is 165 °F (the engine oil high temperature engine trip is bypassed when the engine is operating in emergency mode). By inspection, the effect of small voltage and frequency variations on the lube oil performance margin is acceptable.

SBDG Fuel Oil Booster pumps

Performance of both the engine-driven fuel oil booster pump and the redundant motor-driven fuel oil booster pump will vary with engine speed and frequency. The engine-driven fuel oil booster pump, however, will not change with changes in SBDG voltage. Both fuel oil pumps are positive displacement pumps with the engine-driven pump rated at 11 gpm and the motor-driven pump rated at 10 gpm. The engine uses about 6 gpm of fuel, with the remaining fuel oil returning to the fuel oil storage tank through a relief valve. By inspection, small changes in voltage and frequency will not significantly affect the margin of these pumps.

EMIB 1-3

Background:

The lower discharge pressures resulting from the proposed lower-end frequency tolerance (59.7 Hz) could cause low pressure switches to trip. Similarly, the higher discharge pressure resulting from the proposed higher-end frequency tolerance (60.3 Hz) could cause relief valves to lift on affected discharge piping.

Issue:

The licensee did not provide information that addresses whether the proposed SBDG frequency tolerance will cause low pressure switches associated with skid mounted pumps for the SBDG to trip or relief valves located on the discharge piping of the ECCS pumps and SBDG skid mounted pumps to lift.

Request:

Discuss whether or not any low pressure switches associated with skid mounted pumps for the SBDG will trip or whether any relief valves located on the discharge piping of the ECCS pumps and SBDG skid mounted pumps will lift due to the pressures at the low-end (59.7 Hz) and high-end (60.3 Hz) proposed SBDG frequency tolerance. If a low pressure switch will trip or a relief valve will lift, explain how the affected pumps will continue to perform their design functions.

STPNOC response

Emergency Core Cooling System - LHSI Pumps

At STP, the LHSI pumps have no low pressure pump trips. During the quarterly pump IST, the pumps are operated with flow only through the minimum flow path. This mode of operation is the most limiting with regard to margin to relief valve lift setpoints. The highest pump discharge pressure recorded during these tests is less than 340 psig. The nominal setpoint of the relief valve on the discharge of the LHSI pumps is 600 psig. Because this relief is at a higher elevation than the LHSI pump discharge pressure gauge, by inspection the relief valve will not be challenged by operation at the high-end (60.3 Hz) SBDG frequency tolerance.

Emergency Core Cooling System - HHSI Pumps

At STP, the HHSI pumps have no low pressure pump trips. During the quarterly pump IST, the pumps are operated with flow only through the minimum flow path. This mode of operation is the most limiting with regard to margin to the relief valve lift setpoint. The highest pump discharge pressure recorded during these tests is 1,680 psig. The nominal setpoint of the relief valve on the discharge of the LHSI pumps is 1,750 psig, with a lower allowable lift point of about 1,730 psig for setting tolerance. Because this relief is at a higher elevation than the HHSI pump discharge pressure gauge, pressure at the relief valve will be about 22 psi less than pressure at the pump discharge pressure gauge. This difference, combined with allowances for instrument accuracy, allows approximately 60 psi margin between the highest recorded discharge pressure during quarterly pump testing (1,680 psig) and the relief valve lower allowed lift point (1,730 psig). HHSI pump delta-pressure when operating on the minimum flow path is less than 1,660 psid. Using the pump affinity laws, pump head will change with the square of the change in pump speed and a 0.5% increase in pump speed due to operation at 60.3 Hz will result in about a 1.0% change in pump head. At 1,660 psid, the 1.0% increase in pump head would be 16.6 psi. Compared to the 60 psi margin from the relief valve lift valve lower allowed lift point, the HHSI relief valve should not lift during HHSI operation on minimum flow. Note that the HHSI pump will operate on minimum flow only as long as the RCS pressure remains above pressure in the HHSI pump discharge header.

SBDG Skid Mounted Pumps

The SBDG jacket cooling water system is a closed system with a vented standpipe. The jacket water cooling system does not have any relief valves. Pressure in the system is maintained by standpipe level.

The SBDG lube oil system and fuel oil system use positive displacement pumps which have pressure relief valves and regulator valves to control system pressure. Pressure relief valve discharges are returned to the system. Operation of these pressure control devices is expected and does not adversely affect system inventory. Refer to the discussion in the STP response to EMIB 1-2 which shows substantial margin to the lube oil low pressure switch trip pressures.

SRXB 1-1

Identify the large- and small-break loss-of-coolant accidents (LOCA), and non-LOCA events in Chapter 15 of the Updated Final Safety Analysis Report (UFSAR) that have analyses crediting the equipment, systems or components that are powered by the SBDG for operation.

STPNOC response

The large-break LOCA (LBLOCA), small-break LOCA (SBLOCA), and non-LOCA events are discussed in UFSAR Chapter 15. The following events credit equipment powered by the SBDG:

- Steam System Piping Failure (UFSAR Section 15.1.5)
- Loss of Non-Emergency AC Power to the Station Auxiliaries (Loss of Offsite Power) (UFSAR Section 15.2.6)
- Loss of Normal Feedwater Flow (UFSAR Section 15.2.7)
- Feedwater System Pipe Break (UFSAR Section 15.2.8)
- Inadvertent Operation of the Emergency Core Cooling System During Power Operation (UFSAR Section 15.5.1)
- Steam Generator Tube Rupture (UFSAR Section 15.6.3)
- Large-Break LOCA (LBLOCA) (UFSAR Section 15.6.5)
- Small-Break LOCA (SBLOCA) (UFSAR Section 15.6.5)

The safety-grade components powered by the SBDG that are credited in accident analyses are:

- Low-Head and High-Head Safety Injection (LHSI, HHSI) pumps,
- Auxiliary Feedwater (AFW) pumps,
- Control Room Makeup and Cleanup Filtration System fans,
- Containment Spray System (CSS) pumps, and
- Reactor Containment Fan Coolers (RCFCs).

The following components powered by SBDG are assumed to perform their functions when required:

- Component Cooling Water (CCW) pumps,
- Essential Cooling Water (ECW) pumps,
- Residual Heat Removal (RHR) pumps,
- Spent Fuel Pool (SFP) cooling pumps,
- Centrifugal Charging pumps (CCP),
- Essential Chilled Water (CHW) chillers and pumps, and
- Boric Acid Transfer pumps.

SRXB 1-2

For each of the events identified in above item 1, identify the equipment, systems, or components (such as the safety isolation valves, pumps and fans for safety injection (SI), auxiliary feedwater (AFW), containment fan coolers (CFC), and containment spray (CS), etc.) that are powered by the SBDG and credited in the UFSAR Analysis of Record (AOR). The information should include the values (such as flow rates of emergency core cooling system (ECCS) pumps, AFW pumps, CFC pumps, and CS pumps; as well as the safety isolation valve closure time, and power-operated-relief valve (PORV) lifting and closure times, etc.) assumed in the AOR, representing the performance characteristics of the identified equipment, systems or components.

SRXB 1-3

For the input values assumed in the AOR identified in above item 2, provide information to show how those values are impacted by the proposed SBDG voltage and frequency limits conditions. The information should include: (a) the limiting input values representing the performance characteristics of the equipment, systems, or components that are powered by the SBDG based on the revised TS voltage and frequency limits; [(b)] a discussion of the methodology used to determine the input values, including the flow rates of the ECCS pumps, AFW pumps, CFC pumps, and CS pumps; as well as the safety isolation valve closure time, PORV lifting and closure times, etc., and (c) the impact of any changes on the AOR.

STPNOC response (combined response to SRXB 1-2 and SRXB 1-3)

The following components that are powered by the SBDG and credited in the UFSAR AOR were identified in the STP LAR:

- Spent Fuel Pool (SFP) Cooling and Cleanup System (SFPCCS) pumps
- Residual Heat Removal (RHR) pumps
- Component Cooling Water (CCW) pumps
- Chemical Volume and Control System (CVCS) centrifugal charging pumps (CCPs)
- Essential Cooling Water (ECW) pumps
- Motor-driven Auxiliary Feedwater (MDAFW) pumps
- Emergency Core Cooling System (ECCS):
  - Low Head Safety Injection (LHSI) pumps
  - High Head Safety Injection (HHSI) pumps
- Essential Chilled Water pumps
- Essential Chilled Water chillers
- Motor Operated Valves (MOVs)
- Control Room Makeup and Cleanup Filtration System fans
- Non-motorized loads

For these components, the applicable limiting design conditions were discussed in the LAR. For the components that are part of the IST program, compliance with the program ensures that design basis input values are protected.

The following components that are powered by the SBDG and credited in the UFSAR AOR were **not** identified in the STP LAR; further discussion of the performance of these components is provide below:

- Containment Spray System (CSS) pumps
- Boric acid transfer pumps
- Refueling Water Storage Tank

The **Containment Spray System** (CSS) pumps provide borated water spray flow to reactor containment following a high-energy line break inside containment. The minimum total flow required to be delivered to the reactor containment to meet the design bases for each particular accident condition depends on reactor power level and break size. The flow delivered into the containment atmosphere by the CSS pumps depends on: (1) the arrangement and flow resistance of the spray ring headers, (2) the number of CSS pumps assumed to operate, and (3) the flow and developed head characteristics of the CSS pumps. Therefore, the effectiveness of the CSS pumps is not directly determined from any single parameter but from the interaction of several system design parameters.

The STP Surveillance Frequency Control Program tests the CSS pumps by recirculating Refueling Water Storage Tank fluid to meet the Technical Specification Surveillance Requirement 4.6.2.1.b. that each pump develop ≥ 283 psid on recirculation flow. The most recent surveillance test performance test data for each CSS pump is provided below to show differential pressure margin.

CSS pump	Measured differential pressure, psid	Margin, psid
Unit 1, Train A	292.5	9.5
Unit 1, Train B	289.0	6.0
Unit 1, Train C	288.5	5.5
Unit 2, Train A	293.4	10.4
Unit 2, Train B	294.2	11.2
Unit 2, Train C	302.0	19.0

Therefore, STP has confidence that the CSS pumps will operate within allowable operating parameters, including uncertainties associated with SBDG voltage and frequency tolerances. This confirms that adequate NPSH will be available for the CSS pumps.

The **boric acid transfer** pumps inject concentrated boric acid into the suction of the CCPs from the boric acid storage tank to provide reactor coolant system boration control for safe shutdown. There are two pumps in each unit and they are supplied from independent safety-related buses. The pumps are capable of being manually loaded, as required, onto the SBDGs on a selective-load basis. Flow requirements are tested to meet Technical Requirements Manual Surveillance Requirement 4.1.2.2.d. that the normal and emergency boration flow paths deliver ≥ 30 gpm to the reactor coolant system. The most recent surveillance test performance data is provided below to show boration flow rate margin.

Boric Acid transfer pump	Measured normal boration flow rate, gpm	Normal boration flow rate margin, gpm	Measured emergency boration flow rate, gpm	Emergency boration flow rate margin, gpm
Unit 1, Train A	50	20	135	105
Unit 1, Train B	50	20	120	90
Unit 2, Train A	46	16	90	60
Unit 2, Train B	45	15	95	65

Therefore, based on the large amount of margin, STP has confidence that the boric acid transfer pumps will operate within allowable operating parameters, including uncertainties associated with SBDG voltage and frequency tolerances.

The post-LOCA **Refueling Water Storage Tank** switchover volume was evaluated. As outlined in the STP LAR and above, the ECCS and CSS pumps will continue to operate within allowable flow bands when SBDG voltage and frequency uncertainties are considered. Therefore, adequate NPSH will be available for the ECCS and CSS pumps.

Conclusion

Compliance with Technical Specification requirements, as applicable, ensures that design basis input values are protected. Also, the development and use of IST pump performance curves protects the design bases input values. This position is validated in WCAP-17308, Section 2.1, with the following statements in regard to development of IST pump performance curves:

> “The term IST pump curves (as used in this document) are the limiting pump curves that are based on performance requirements consistent with the plant design and licensing basis. … Therefore, flow variability due to measurement uncertainties and the effects of frequency and voltage on pump speed are statistically factored into the pump head uncertainty.”

The NRC found the WCAP methodology acceptable, as stated in the last sentence of the NRC Safety Evaluation: “Therefore, the NRC staff finds the proposed TR methodology acceptable, with noted limitations and conditions, for compliance with the NRC regulations.” STP used the accepted methodology from WCAP-17308 to demonstrate that STP remains in compliance with the requirements of 10 CFR 50.36(c)(3), GDC 17, and GDC18.

STSB 1-1

Requirements:

The NRC's regulatory requirements related to the content of the TS are contained in Title 10 of the *Code of Federal Regulations* (10 CFR) at 10 CFR 50.36. Surveillance requirements (SRs) are located at 10 CFR 50.36(c)(3). Per 10 CFR 50.36(c)(3), SRs "…are requirements relating to test, calibration, or inspection to assure that the necessary quality of systems and components is maintained, that facility operation will be within safety limits, and that the limiting conditions for operation will be met."

Applicable regulatory guidance is contained in Standard Technical Specifications (STS) for Westinghouse Plants, NUREG-1431, Revision 4 (ADAMS Accession No. ML12100A222).

Additionally as stated on Page 4 of 18 of the enclosure to the LAR STPNOC used WCAP-17308 in conjunction with the NRC Safety Evaluation (ADAMS Accession No. ML17074A112). In STPNOC UFSAR Table 3.12-1 it states that STP complies with Regulatory Guides 1.9, Rev. 2 (ADAMS Accession No. ML12305A253), with an exception identified in UFSAR paragraph 8.3.1.2.3.

Background

In the STPNOC proposed markups of LAR Enclosure Attachment (1) both existing SR 4.8.1.1.2.a.2 and proposed SR 4.8.1.1.2.a.5 retain the former voltage and frequency tolerance bands of 4160 +/- 416 volts and 60 +/- 1.2 Hz. Neither SR requires DG loading therefore the larger bands sometimes assumed for loading do not apply. SR 4.8.1.1.2.a.2 only contains the old criteria. In WCAP-17308 the voltage and frequency tolerance bands were proposed to be deleted from STS SR 3.8.1.2. While the NRC stated that STS SR 3.8.1.2 was outside the scope of WCAP-17308 it also stated that the existing STS criteria would apply meaning that a voltage and frequency band in agreement with the licensee's accident analysis should still be used.

Request:

Explain for each SR in which the previous voltage and frequency band is retained, how testing to the former criteria (i.e., determined to be non-conservative) demonstrates assurance "that the necessary quality of systems and components [the SBDGs] is maintained, that facility operation will be within safety limits, and that the limiting conditions for operation will be met."

STPNOC response

The current STP Standby Diesel Generator (SBDG) acceptance criteria were determined to be non-conservative based on the *steady-state* voltage and frequency bands (i.e., the broader voltage and frequency bands were not determined to be non-conservative). Thus, in accordance with WCAP-17308, proposed changes have been requested with regard to steady-state voltage and frequency bands only.

The following proposed STP Technical Specification Surveillance Requirements [SRs] contain requirements for verifying *non-steady-state* voltage and frequency bands within the current wider bands. (Current surveillance frequencies from the STP Surveillance Frequency Control Program are included in [brackets].):

A)	4.8.1.1.2.a.2)	[monthly surveillance frequency]	**“idle start”**
B)	4.8.1.1.2.a.5)	[semi-annual surveillance frequency]	**“rated start”**

Currently, STP Technical Specification SR 4.8.1.1.2.a.2) is applied to both “idle” SBDG starts and “rated” SBDG starts. SPECIFICATION NOTATION (3) is used to specifically state that an idle SBDG start may be a modified start involving reduced fuel and/or idling and gradual acceleration to synchronous speed. In the License Amendment Request (LAR), STP is proposing to retain 4.8.1.1.2.a.2) as the SR for idle SBDG starts and create a new SR 4.8.1.1.2.a.5) for rated SBDG starts.

STP procedures for idle SBDG starts [proposed SR 4.8.1.1.2.a.2)] do not require measurement of steady-state voltage and frequency values (i.e., there are no acceptance criteria for steady-state values). The equivalent Westinghouse SR 3.8.1.2 provided in WCAP-17308 does require measurement of steady-state voltage and frequency. STP, however, is not proposing to change how idle SBDG starts are surveilled and acceptance criteria for idle SBDG starts will not change. As noted in the STP LAR, the NRC Safety Evaluation on WCAP-17308 states that Westinghouse SR 3.8.1.2 is outside the scope of the WCAP.

To demonstrate that the necessary quality of the SBDGs is maintained; facility operation will be within safety limits; and that Limiting Conditions for Operation will be met, STP reviewed performance data for a total of 258 SBDG surveillances that included a majority of the past ten performances of the following surveillance tests:

- rated starts,
- 24-hour runs,
- load rejections,
- LOOP [loss of offsite power] tests, and
- LOOP with Safety Injection tests.

The performance data were evaluated against the proposed narrower voltage and frequency bands. In five instances, SBDG voltage and frequency were outside of the proposed narrow bands:

- SBDG 11 (11/19/2012): frequency of 59.63 Hz
- SBDG 21 (05/05/2013): frequency of 60.38 Hz
- SBDG 21 (11/19/2013): frequency of 60.4 Hz
- SBDG 13 (04/19/2008): frequency of 59.2 Hz (this issue was documented as a potential hand switch issue where the switch was not placed back into the optimal position following speed adjustment)
- SBDG 22 (04/27/2010): voltage of 4463 volts (conservative data was recorded due to not obtaining the strip chart data – SBDG output was known to be between 4079 volts and 4463 volts; 4463 volts was recorded as a conservative value)

This represents approximately 1.9% of the surveillance tests that were evaluated. If these events had occurred with the narrower bands in effect, then the SBDG would have been declared inoperable and adjustments would have been made or corrective maintenance activities performed to restore operability.

Note that proposed SR 4.8.1.1.2.a.5) for rated starts is consistent with Westinghouse SR 3.8.1.7 with respect to verifying that non-steady-state SBDG voltage and frequency within the wider bands is achieved within 10 seconds, followed by verification of steady-state voltage and frequency within the narrow bands.

C) 4.8.1.1.2.e.2) [refueling outage surveillance frequency] **load rejection**

STP is not proposing any changes to this SR. This SR does not measure steady-state voltage and frequency (i.e., the current non-steady-state SR values were not found to be non-conservative) and it is consistent with Westinghouse SR 3.8.1.9, which retains wider bands for non-steady-state voltage and frequency.

D) 4.8.1.1.2.e.5) [refueling outage surveillance frequency] **Safety Injection auto-start**

The current SR is proposed to retain the wide bands for non-steady-state voltage and frequency within the first 10 seconds following the autostart signal and to use the narrow bands for steady-state voltage and frequency. This is consistent with Westinghouse SR 3.8.1.12.

E) 4.8.1.1.2.f [10-year surveillance frequency] **interdependence test**

The current SR does not contain verification of any voltage and frequency values. The proposed SR would verify that the non-steady-voltage and frequency are within the wide bands within 10 seconds after the start signal and that steady-state voltage and frequency is within the narrow bands. This is consistent with Westinghouse SR 3.8.1.20.

Conclusion

Based on the STP LAR and the information provided above, STP has determined that the proposed STP SBDG SRs demonstrate assurance that the necessary quality of the SBDGs is maintained, that facility operation will be within safety limits, and that the Limiting Conditions for Operation will be met.

STSB 1-2

[Requirements and Background are the same as STSB 1-1]

Request:

STPNOC proposed a new SR 4.8.1.1.2.a.5 be added. In the LAR STPNOC states (via Table 1) that the current surveillance requirement SR 4.8.1.1.2.a.2 is meant to be equivalent to STS SR 3.8.1.2 (i.e. more frequent or “monthly” SR, with a modified start allowed by note 3) and that SR 4.8.1.1.2.a.5 is meant to be equivalent to STS 3.8.1.7. However the proposed changes to TS 3.8.1.1, Actions b and c (each comparable to STS 3.8.1, Required Action B.3.2) would appear to indicate that the opposite is true (i.e. SR 4.8.1.1.2.a.5 is meant to be equivalent to STS SR 3.8.1.2). Please explain the apparent discrepancy.

STPNOC response

The equivalence referenced in Table 1 of the LAR is only intended to show that STP SR 4.8.1.1.2.a.2) is equivalent to Westinghouse SR 3.8.1.2 for idle SBDG starts and STP SR 4.8.1.1.2.a.5) is equivalent to Westinghouse SR 3.8.1.7 for rated SBDG starts. As noted in the NRC request above, the Westinghouse STS requires an idle start surveillance to check for a common cause failure in other SBDGs. STP performs a rated start surveillance, which verifies steady-state voltage and frequency are within the narrow bands.