Tennessee Valley Authority, 1101 Market Street, Chattanooga, Tennessee 37402

CNL-14-218

April 6, 2015

10 CFR 50.90

U.S. Nuclear Regulatory Commission
ATTN: Document Control Desk
Washington, D.C. 20555-0001

Watts Bar Nuclear Plant Unit 1
Facility Operating License No. NPF-90
NRC Docket No. 50-390

Subject: **Application to Modify Watts Bar Nuclear Plant, Unit 1 Technical Specification 3.8.1 Regarding Diesel Generator Steady State Frequency (WBN-TS-13-08)**

References:

1. TVA Letter to NRC, “Watts Bar Nuclear Plant (WBN) Unit 2 – Diesel Generator Frequency – Response to NUREG 0847 Supplemental Safety Evaluation Report (SSER) 22, Open Item 32,” dated February 3, 2014 (ADAMS Accession Number ML14038A079)

2. NUREG-0847, “Supplemental Safety Evaluation Report 22,” dated February 2011, Appendix HH, Watts Bar Unit 2 Action Items Table (ADAMS Accession Number ML110390197)

3. NUREG-0847, “Supplemental Safety Evaluation Report 27,” dated January 2015, Appendix HH, Watts Bar Unit 2 Action Items Table (ADAMS Accession Number ML15033A041)

In accordance with the provisions of Title 10 of the *Code of Federal Regulations* (10 CFR) 50.90, "Application for amendment of license, construction permit, or early site permit," Tennessee Valley Authority (TVA) is submitting a request for an amendment to Facility Operating License No. NPF-90 for the Watts Bar Nuclear Plant (WBN) Unit 1.

The WBN Unit 1 license amendment request is based on the similar WBN Unit 2 submittal response to NUREG-0847, Supplemental Safety Evaluation Report (SSER) 22, Open Item 32 (Reference 1). The Nuclear Regulatory Commission (NRC) staff had questions (Reference 2) regarding the limits of the diesel generator (DG) voltage and frequency range as specified in the developmental revision Technical Specifications (TS) and requested additional details. In Reference 1, TVA stated that the DG steady state frequency would be revised from the values currently in the WBN Unit 1 TS to a frequency band of greater than or equal to (≥) 59.8 hertz (Hz) and less than or equal to (≤) 60.1 Hz. The stated steady state voltage band of ≥ 6800 volts (V) and ≤ 7260 V was acceptable and not changed. NUREG-0847, SSER 27 (Reference 3) documented the staff acceptance of the proposed changes and closure of NUREG-0847, SSER 22, Open Item 32 (Reference 2) consistent with NRC regulations and regulatory guidance.

In order to support WBN dual-unit operation once WBN Unit 2 receives an operating license, the DG voltage and frequency must be the same for both units. Accordingly, this license amendment request seeks to amend the WBN Unit 1 Technical Specifications by modifying the acceptance criteria for the DG steady state frequency range provided in TS Surveillance Requirements (SRs) 3.8.1.2, 3.8.1.7, 3.8.1.9, 3.8.1.11, 3.8.1.12, 3.8.1.15, 3.8.1.19, and 3.8.1.21. Currently, the acceptance criteria are ≥ 58.8 Hz and ≤ 61.2 Hz. TVA proposes to change the Diesel Generator steady state frequency acceptance criteria to ≥ 59.8 Hz and ≤ 60.1 Hz. The current Diesel Generator TS SR steady state voltage range, ≥ 6800 V and ≤ 7260 V, is still acceptable.

TVA has determined that the steady state frequency range acceptance criteria currently specified by TS SRs 3.8.1.2, 3.8.1.7, 3.8.1.9, 3.8.1.11, 3.8.1.12, 3.8.1.15, 3.8.1.19, and 3.8.1.21 are non-conservative. A problem evaluation report (PER) was initiated in accordance with the TVA Corrective Action Program. Subsequently, a prompt determination of operability (PDO), including administrative controls were established in accordance with NRC Administrative Letter 98-10, "Dispositioning of Technical Specifications That Are Insufficient to Assure Plant Safety," dated December 29, 1998. In conjunction with the PER and PDO, an apparent cause evaluation (ACE) was also initiated. As a result of the ACE, a number of immediate/interim and other corrective actions were identified, implemented, and completed. A review of historical DG test records for frequency and voltage supported the fact that the DGs were operable and supported the existing design basis analyses accidents. Administrative controls for DG frequency have been implemented in the applicable Surveillance Instructions to support continued DG operability.

The enclosure provides a description, technical evaluation, regulatory evaluation, and environmental consideration of the proposed changes. Attachments 2 and 3 to the enclosure provide the existing TS and Bases pages marked-up to show the proposed changes. Attachments 4 and 5 to the enclosure provide the existing TS and Bases pages retyped to show the proposed changes.

TVA requests that the NRC approve this amendment by June 1, 2015 with implementation within 60 days of issuance.

TVA has determined that there are no significant hazard considerations associated with the proposed change and that the change qualifies for a categorical exclusion from environmental review pursuant to the provisions of 10 CFR 51.22(c)(9).

The WBN Plant Operations Review Committee and the WBN Nuclear Safety Review Board have reviewed this proposed change and determined that operation of WBN Unit 1 in accordance with the proposed change will not endanger the health and safety of the public.

Additionally, in accordance with 10 CFR 50.91(b)(1), TVA is sending a copy of this letter and the enclosure to the Tennessee Department of Environment and Conservation.

There are two regulatory commitments associated with this submittal as detailed in Attachment 1 of the enclosure to this letter. If you have any questions, please contact Gordon Arent at (423) 365-2004.

I declare under penalty of perjury that the foregoing is true and correct. Executed on this 6th day of April 2015.

Respectfully,

for JW Shea

J. W. Shea
Vice President, Nuclear Licensing

Enclosure: Application to Modify Watts Bar Nuclear Plant Unit 1 Technical Specification 3.8.1 Regarding Diesel Generator Steady State Frequency (WBN-TS-13-08) cc (Enclosure):

NRC Regional Administrator – Region II
NRC Senior Resident Inspector – Watts Bar Nuclear Plant, Unit 1
NRC Project Manager – Watts Bar Nuclear Plant, Unit 1
Director, Division of Radiological Health – Tennessee State Department of Environment and Conservation

ENCLOSURE

TENNESSEE VALLEY AUTHORITY
WATTS BAR NUCLEAR PLANT
UNIT 1

EVALUATION OF PROPOSED CHANGE

Subject: **Application to Modify Watts Bar Nuclear Plant Unit 1 Technical Specification 3.8.1 Regarding Diesel Generator Steady State Frequency (WBN-TS-13-08)**

3. Proposed TS Bases Changes (Mark-Ups) for WBN Unit 1 (For Information Only)

4. Proposed TS Changes (Final Typed) for WBN Unit 1

5. Proposed TS Bases Changes (Final Typed) for WBN Unit 1 (For Information Only)

1.0 SUMMARY DESCRIPTION

In order to support Tennessee Valley Authority's (TVA) Watts Bar Nuclear Plant (WBN) dual-unit operation, once WBN Unit 2 receives an operating license, the diesel generator (DG) voltage and frequency must be the same for both units. Accordingly, this license amendment request seeks to amend the WBN Unit 1 Technical Specifications (TS) by modifying the acceptance criteria for the DG steady state frequency range provided in TS Surveillance Requirements (SRs) in order to make them the same as WBN Unit 2.

The WBN Unit 1 license amendment request is based on the similar WBN Unit 2 submittal response to NUREG-0847, Supplemental Safety Evaluation Report (SSER) 22, Open Item 32 (Reference 13). The Nuclear Regulatory Commission (NRC) staff had questions (Reference 16) regarding the limits of the diesel generator voltage and frequency range as specified in the developmental revision Technical Specifications. In Reference 13, TVA stated that the DG steady state frequency would be revised from the values currently in the WBN Unit 1 TS to a frequency band of greater than or equal to (≥) 59.8 hertz (Hz) and less than or equal to (≤) 60.1 Hz. The stated steady state voltage band of ≥ 6800 volts (V) and ≤ 7260 V was acceptable and not changed. NUREG-0847, SSER 27 (Reference 15) documented the staff acceptance of the proposed changes and closure of NUREG-0847, SSER 22, Open Item 32 consistent with NRC regulations and regulatory guidance.

This evaluation supports a request to amend the WBN Unit 1, Facility Operating License Number NPF-90. The proposed change will modify WBN Unit 1, Technical Specification 3.8.1, "AC Sources - Operating," by revising the acceptance criteria for the DG steady state frequency range provided in Surveillance Requirements 3.8.1.2, 3.8.1.7, 3.8.1.9, 3.8.1.11, 3.8.1.12, 3.8.1.15, 3.8.1.19, and 3.8.1.21. Currently, the DG SR steady state acceptance criteria are ≥ 58.8 Hz and ≤ 61.2 Hz. The proposed change to SR 3.8.1.2 will result in a 60 Hz nominal frequency. The frequency will be changed from ≥ 58.8 Hz and ≤ 61.2 Hz to ≥ 59.8 Hz and ≤ 60.1 Hz for SRs 3.8.1.7, 3.8.1.9, 3.8.1.11, 3.8.1.12, 3.8.1.15, 3.8.1.19, and 3.8.1.21. The current DG TS SR steady state voltage range, ≥ 6800 V and ≤ 7260 V, is still acceptable (Reference 11).

This proposed change also affects SR 3.8.1.3, because it requires successful performance of SR 3.8.1.2 or 3.8.1.7. TS 3.8.2, "AC Sources - Shutdown," is also affected because SR 3.8.2.1 requires the following TS 3.8.1 SRs affected by the change to be met: SR 3.8.1.2, SR 3.8.1.7, SR 3.8.1.9, SR 3.8.1.11, SR 3.8.1.12, SR 3.8.1.15, and SR 3.8.1.19.

2.0 DETAILED DESCRIPTION

2.1 Proposed Changes

Currently, the acceptance criteria for DG steady state frequency specified in WBN Unit 1, TS SRs 3.8.1.2, 3.8.1.7, 3.8.1.9, 3.8.1.11, 3.8.1.12, 3.8.1.15, 3.8.1.19, and 3.8.1.21 are ≥ 58.8 Hz and ≤ 61.2 Hz. TVA proposes to change the SR 3.8.1.2 range to a 60 Hz nominal frequency. TVA proposes to conservatively 'narrow' the DG frequency range by increasing the current DG frequency lower limit of ≥ 58.8 Hz to ≥ 59.8 Hz and decreasing the current upper limit from the existing ≤ 61.2 Hz to ≤ 60.1 Hz in the WBN Unit 1 TS (i.e., SRs 3.8.1.7, 3.8.1.9, 3.8.1.11, 3.8.1.12, 3.8.1.15, 3.8.1.19, and 3.8.1.21) and TS Bases 3.8.1. The proposed WBN Unit 1 DG frequency and voltage steady state operating ranges only apply to the steady state condition of DG operation, and are summarized below in Table 1.

Table 1 - Technical Specification DG Steady-State Operating Range	
Parameter	**Range**
Frequency	≥ 59.8 Hz to ≤ 60.1 Hz
Voltage	≥ 6800 V to ≤ 7260 V

This change will be implemented in the surveillances performed at 184 days, 18 months, and ten (10) years when maintenance & test equipment (M&TE) is installed on the DG per the surveillance instructions.

With respect to the monthly surveillance performed on the DG, TVA will revise this surveillance (i.e., SR 3.8.1.2) to confirm that the nominal frequency value of 60 Hz is achieved. During the monthly testing, the DG is not in accident mode and is, therefore, controlled by the operator rather than the DG governor's accident speed reference.

The DG voltage limits as described in the Technical Specification are correct as validated by these analyses.

Attachment 1 to this enclosure provides a list of regulatory commitments made by TVA in this submittal. Attachments 2 and 3 to this enclosure provide the existing WBN Unit 1 TS and Bases pages marked-up to show the proposed changes. Attachments 4 and 5 to this enclosure provide the existing TS and Bases pages retyped to show the proposed changes.

The proposed Bases changes are provided to the NRC for information only.

2.2 Need for Proposed Changes

Plant safety analyses make specific assumptions regarding the Emergency Core Cooling System (ECCS) flow to provide the core cooling function following any event that requires safety injection (SI) to mitigate the event. For the events that assume a loss of offsite power (LOOP), the DGs provide power to the ECCS pumps. Following a LOOP, each DG starts and ties to an Engineered Safety Feature (ESF) bus, and essential loads, including the ECCS pumps, are sequentially connected to the ESF bus by individual timers for each load sequence. The calculated ECCS flow rates assume that the steady state DG frequency is 60 Hz (i.e., after the DG starting and loading transients).

Once the DG starting and loading sequences are complete, the DG governor maintains the frequency at 60 Hz within a specified tolerance, which is based on the governor manufacturer/model.

The ECCS flow provided by the ECCS pumps is affected by the pump speed, which in turn is a function of the DG frequency. Historically, the DG frequency tolerances associated with the governor were not considered in the development of the ECCS, Containment Spray System (CSS), and Auxiliary Feedwater (AFW) flow rates. The primary effect of changes in DG frequency on the ECCS safety functions is an increase or decrease in the speed of safety-related motors that are powered by the DG. The increase or decrease in the speed of the motors affects pump performance, motor operated valve (MOV) stroke times, cooling fan performance, and DG loading, among other factors.

The minimum and maximum frequency values of 58.8 Hz and 61.2 Hz contained in plant-specific TS SRs are equal to ± 2% of the 60 Hz nominal frequency (i.e., the TS specified plant specific transient range). However, the ± 2% frequency tolerance is only applicable to DG starting and loading transients, and does not apply to steady state operation as discussed in Regulatory Guide 1.9, Revision 3, "Selection, Design, Qualification, and Testing of Emergency Diesel Generator Units Used as Class 1E Onsite Electrical Power Systems at Nuclear Power Plants" (Reference 1).

Because the safety analyses did not consider the effects of operating at the extremes of the steady state frequency range specified in TS SRs 3.8.1.2, 3.8.1.7, 3.8.1.9, 3.8.1.11, 3.8.1.12, 3.8.1.15, 3.8.1.19, and 3.8.1.21, TVA has determined that the current WBN Unit 1 TS SR acceptance criteria for steady state DG frequency are non-conservative. The non-conservative acceptance criteria were addressed within the TVA corrective action program (CAP) and administrative controls were established in accordance with NRC Administrative Letter 98-10, "Dispositioning of Technical Specifications That Are Insufficient to Assure Plant Safety," dated December 29, 1998 (Reference 2). To address the non-conservative TS, TVA is proposing a change to TS SRs 3.8.1.2, 3.8.1.7, 3.8.1.9, 3.8.1.11, 3.8.1.12, 3.8.1.15, 3.8.1.19, and 3.8.1.21 to revise the DG SR steady state acceptance criteria to a nominal frequency of 60 Hz (SR 3.8.1.2), and to ≥ 59.8 Hz and ≤ 60.1 Hz for the remaining SRs.

As part of the operating license application for WBN, Unit 2; the NRC issued Open Item 32 in Appendix HH, "Watts Bar Unit 2 Action Items Table," of Supplemental Safety Evaluation Report (SSER) 22 (Reference 16) related, in part, to administrative limits applied to DG voltage and frequency. In Reference 13, TVA stated that the DG steady state speed would be revised to a frequency band of ≥ 59.8 Hz and ≤ 60.1 Hz, and the steady state voltage band to ≥ 6800 V and ≤ 7260 V. NUREG-0847, SSER 27 (Reference 15) documented the staff acceptance of the proposed changes and closure of NUREG-0847, SSER 22, Open Item 32 consistent with NRC regulations and regulatory guidance.

Westinghouse performed an evaluation of the emergency core cooling system (ECCS) pumps. Westinghouse utilized 6600 V for the ECCS motor terminal voltage and a nominal frequency of 60 Hz for the analysis. A sensitivity analysis was performed to determine that a ± 0.3% motor speed variation (i.e., 60 ± 0.2 Hz effective frequency at 6600 V) would be acceptable. The composite effect of the voltage and frequency bands ensures that the ECCS pump speeds do not deviate more than 0.3% of rated values at rated horse power.

The four WBN DGs are shared between WBN Units 1 and 2, as described below in Section 3.1, and the SR requirements for all four DGs are specified in the WBN Unit 1, TSs. Therefore, the proposed SR steady state frequency acceptance criteria of ≥ 59.8 Hz and ≤ 60.1 Hz would apply to both DGs on both units.

2.3 Implementation

The TVA process governing the preparation and submittal of TS changes and License Amendment Requests (LAR) requires that the appropriate organizations (e.g., Operations, Training, Engineering, Maintenance, Chemistry, Radiation Protection, and Work Control) identify the documents that are affected by each proposed change to the TSs and Operating Licenses. Among the items that are considered are training, plant modifications, procedures, special implementation constraints, design documents, and surveillance instructions associated with TS SRs, Technical Requirements Manual, TS Bases, and the Updated Final Safety Analysis Report (UFSAR). The process requires that procedures and design document changes necessary to support TS Operability are approved prior to implementation of an NRC approved license amendment. The process also provides assurance that the remaining changes, if any, are scheduled and tracked for configuration control.

3.0 TECHNICAL EVALUATION

3.1 System Description

The onsite Class 1E alternating current (ac) standby system is described in WBN UFSAR Section 8.3, "Onsite (Standby) Power System" (Reference 3).

The ac standby system supplies electrical power to four power trains, shared between the two units, with each train powered by an independent Class 1E 6.9 kilo-volt (kV) shutdown board. Power trains 1A and 2A comprise load group A, and power trains 1B and 2B comprise load group B. Two DGs associated with one load group can provide all safety related functions to mitigate a loss-of-coolant accident (LOCA) in one unit and achieve hot standby in the opposite unit. Each 6.9 kV shutdown board has two separate and independent offsite sources of power as well as a dedicated onsite DG source. Each A and B train ESF system provides for the minimum safety functions necessary to shut down the plant and maintain it in a safe shutdown condition.

The safety function of the ac standby power system is to supply power to permit functioning of components and systems required to assure that: (1) fuel design limits and reactor coolant pressure boundary design conditions are not exceeded due to anticipated operational occurrences, and (2) the core is cooled and vital functions are maintained in the event of a postulated accident, subject to loss of the preferred power system and subject to any single failure in the standby power system.

Specifically, the ac standby power system consists of the following:

- four Class 1E DGs
- four 6.9 kV shutdown boards and 6.9 kV shutdown relay panels
- associated 6.9 kV / 480 V transformers and 480 V shutdown boards
- motor control centers supplied by the 480 V shutdown boards

The ac standby power system is divided into two redundant load groups. The 6.9 kV shutdown boards are arranged electrically into four power trains (two per unit) with two boards associated with each load group and each unit. The boards comprising load group A are located in the WBN Unit 1 area and the boards associated with load group B are located in the WBN Unit 2 area. When the preferred (offsite) power system is not available, each shutdown board is energized from a separate standby DG.

A loss of voltage on the 6.9 kV shutdown board starts the associated DG and initiates logic that trips the supply feeder breakers, all 6.9 kV loads (except the 480 V shutdown board transformers), and the major 480 V loads. The bypass breaker for the 480 V shutdown board's current-limiting inductive reactor is also closed as part of this logic. When the DG has reached rated speed and voltage, the generator is automatically connected to the 6.9 kV shutdown board. This return of voltage to the 6.9 kV shutdown board initiates logic which connects the required loads in sequence. The standby (onsite) power system's automatic sequencing logic is designed to automatically connect the required loads in proper sequence should the logic receive an accident signal prior to, concurrent with, or following a loss of all nuclear unit and preferred (offsite) power.

There are two loading sequences: (1) which is applied in the absence of a "safety injection signal (SIS)" (i.e., the "non-accident condition"), and (2) the other which is applied when an SIS is received prior to or coincident with a sustained loss of voltage on the 6.9 kV shutdown board (i.e., the "accident condition"). A loss of offsite power coincident with an SIS is the design basis event; however, an SIS received during the course of a non-accident shutdown loading sequence will cause the actions described below.

- Loads already sequentially connected that are not required for an accident will be disconnected.
- Loads already sequentially connected that are required for an accident will remain connected.
- Loads pending sequential loading that are not required for an accident will not be connected.
- Loads pending sequential loading that are required for an accident will either be sequentially loaded as a result of the non-accident loading sequence or have their sequential timers reset to time zero from which they will then be sequentially loaded in accordance with the accident sequence.

An SIS received in the absence of a sustained loss of voltage on a 6.9 kV shutdown board will start the DGs but will not connect them to the shutdown boards.

Each DG consists of two 16-cylinder engines directly connected to a 6.9 kV generator. The continuous rating of each DG is 4400 kilowatt (kW) at 0.8 power factor, 6.9 kV, 3-phase, and 60 Hz. Each DG also has an additional rating of 4840 kW for 2 hours out of 24 hours (Reference 11).

Ratings for the DGs satisfy the requirements of Regulatory Guide 1.9, Revision 3 as clarified in section 4.1. The continuous service rating of each DG is 4400 kW with 10% overload permissible for up to 2 hours in any 24 hour period (Reference 11).

The normal operating speed of the DGs is 900 rpm. The DGs use a tandem arrangement; that is, each DG consists of two diesel engines with a generator between them connected together to form a common shaft. The DGs are physically separated, electrically isolated from each other, and located above the water level of the probable maximum flood.

The DGs are equipped with Woodward governors and consist of:

- an EGB-13P actuator on each engine
- a 2301A computer (reverse biased)
- a magnetic speed pickup

The Woodward EGB-13P actuator used with the 2301A computer is a proportional governor that moves the fuel rack in inverse proportion to the voltage signal from the computer. There is a governor actuator on each DG engine and they are electrically connected in series so that the loss of signal to one actuator would also result in the loss of signal to the other actuator. Based upon the input from the magnetic speed pickup, the electronic governor sends electric signals to the actuators on the two DG engines. This signal goes to the coils of each actuator that are connected in series so that each coil receives the same electric signal. The terminal shaft of each actuator will move exactly the same amount for each change in signal, thus the fuel control shaft movement on each DG engine will be identical.

Woodward states that the steady state speed control will be within 0.25 percent of rated speed. The governor design includes circuits to provide high- and low-limit adjustments. These limits set the maximum and minimum speed that can be set by varying the speed-setting milliamp or voltage reference. The low limit can be set as high as rated speed, if desired, eliminating the ability of the process or controller speed setting to reduce speed. The WBN Unit 1 DG electrical governor will be set within a speed band which is equivalent to a DG frequency of 59.95 Hz ± 0.05 Hz.

The WBN Unit 1 DG voltage and frequency regulators were evaluated to ensure they were capable of meeting the TS and associated SRs. The measured values for both voltage and frequency have not exhibited drift and have been consistently within the respective setting band.

The WBN Unit 1 DG voltage and speed regulators are independent of each other (i.e., the regulators are not volts (V) per hertz (Hz) regulators). In order to demonstrate this independence, historical test data of the current governors was evaluated utilizing a Pearson product-moment correlation coefficient (PPMCC). Operation outside both the frequency and voltage setting band would require both the speed controller and voltage regulator to operate erroneously.

Based on this independence and stability, the composite impact of frequency and voltage were evaluated independently for the Technical Specification band. The frequency range was analyzed over the full range (i.e., 59.8 Hz to 60.1 Hz) within the voltage setting range (i.e., 6925 V to 7000 V). Likewise, the voltage (i.e., 6800 V to 7260 V) was analyzed over the full range within the frequency setting range (i.e., 59.9 Hz to 60.0 Hz).

The DG will be set within a speed band which is equivalent to a frequency band of 59.95 Hz ± 0.05 Hz. Likewise the DG will be set within a voltage band of 6950 V, +50 V and -25 V. In the event that the frequency or voltage is found outside of their setting band, the ‘as-found’ values will be reset within the setting band, and the ‘as-found’ values will be entered into the WBN corrective action program (CAP) for evaluation of performance.

The DG governor setting methodology for speed (frequency) and voltage is consistent with the instrument calibration methodology used in Technical Specification Task Force

(TSTF) Standards TS Change Traveler, TSTF - 493, Revision 4, “Clarify Application of Setpoint Methodology for LSSS Functions” (Reference 12).

The nuclear steam supply system (NSSS) vendor, Westinghouse, performed an evaluation of the emergency core cooling system (ECCS) pump motors. Westinghouse utilized 6600 V for the ECCS motor terminal voltage and a nominal frequency of 60 Hz for the analysis. A sensitivity analysis performed by Westinghouse determined that a ± 0.3% motor speed variation would be acceptable, if the ECCS motors were at the analysis voltage of 6600 V. The composite effect of the voltage and frequency bands ensures that the ECCS pump speeds do not deviate more than 0.3% of rated values at rated horse power.

Tests confirming that the frequency is maintained in the specified limits are performed using the Diesel Generator Data Acquisition System (DG-DAQ). The DG-DAQ system is a portable data acquisition system developed by TVA for use as maintenance and test equipment (M&TE) for the DGs at TVA nuclear sites in order to satisfy plant technical specification and testing requirements. The system is specifically designed for DG load sequence, fast start, and load rejection surveillance testing at all TVA nuclear sites. The system is also capable of evaluating DG power system performance during startup, loading, and steady-state operation. The following are significant attributes of the DG-DAQ:

- Does not use transducers which can introduce measurement and integration errors. The DG-DAQ connects directly to the DG potential transformer and current transformer metering cutouts and directly samples the voltage and current waveforms. The desired scan rate is 2000 scans per second.

- Highly-accurate software algorithms are used to calculate power system parameters (true rms, frequency, power components) from the voltage and current waveforms.

- Superior accuracy: true rms voltage and current measured within 0.13% and frequency within 0.03% at the theoretical limit of one cycle resolution.

This test equipment verifies that the governor controls the DG frequency within the steady-state operational band of ≥ 59.8 Hz to ≤ 60.1 Hz.

The DGs as clarified in section 4.1, satisfy the requirements of Regulatory Guide (RG) 1.9, Revision 2 (Reference 5), and/or RG 1.9, Revision 3 (Reference 1).

3.2 Evaluation

3.2.1 Introduction

Evaluations were conducted to determine the effects of the DG frequency variation between 59.8 Hz to 60.1 Hz on plant equipment fed by these generators following a Loss of Offsite Power (LOOP) or a Loss of Coolant Accident (LOCA) coincident with a LOOP.

The changes in frequency from the nominal rating of 60 Hz assumed by Westinghouse has the direct effect of changing motor speeds for the motors fed from the generators following a LOOP or a LOOP/LOCA. The changes in motor speeds affect the following attributes:

1. Pump flow, Net Positive Suction Head (NPSH) availability and horsepower requirements,

2. Fan flow and horsepower requirements,

3. Motor operated valves opening/closing speed and horsepower requirements,

4. Air compressor flow and horsepower requirements, and

5. Chiller horsepower requirements

The changes in these parameters were evaluated to demonstrate that the subject equipment would continue to meet their safety related functions within the analyzed bounds documented in design documents. In addition, the increased horsepower associated with increased frequency was evaluated to ensure that the horsepower increases do not result in exceeding the sustained load ratings for the DGs and the decreased flowrate with decreased frequency was evaluated to ensure pump parameters are adequate. Battery chargers and power transformers do not have motors, but frequency changes were examined to determine if the chargers and transformers would provide acceptable output parameters to continue to meet the specifications and requirements of the downstream components.

Note that there are several large and small pumps identified in the DG loading list. Only major pumps in safety significant systems were individually evaluated and the results are summarized in Table 2. The Table 2 results conclude that the speed, load, flow, and NPSH are only slightly impacted (i.e., ± 0.3% to ± 1.0%).

The following equations were utilized to determine the impacts:

- $f = Np/120$, thus synchronous speed (N) is directly proportional to frequency (f) since the number of poles (p) is constant.

- Horsepower (HP)varies directly with the cube of the speed (i.e. $HP_1/HP_2 = S_1^3/S_2^3$);

- Flow (Q) varies directly with speed (i.e. $S_1/S_2 = Q_1/Q_2$);

- Head (H) losses vary directly with square of the speed (i.e. $S_1^2/S_2^2 = H_1/H_2$); and

- Valve stroke times vary inversely with speed since they are gear driven.

Table 2 provides a summary of the effective frequency as related to the various design parameters associated with the DGs and subsequently powered component categories.

Table 2 – Effective Frequency as Related to Various Parameters		
Parameter	**Lower Speed (- 0.3%) Effects**	**Higher Speed (+ 0.3%) Effects**
Motor Speed (S)	Slower: $S_2 = (59.8/60.0) * S_1$, thus $S_2 = 0.997 * S_1$	Faster: $S_2 = (60.2/60.0) * S_1$, thus $S_2 = 1.003 * S_1$
Motor Brake Horsepower (BHP)	Decreased: $BHP_2 = (59.8/60.0)^3 * BHP_1$, thus $BHP_2 = 0.990 * BHP_1$	Increased: $BHP_2 = (60.2/60.0)^3 * BHP_1$, thus $BHP_2 = 1.010 * BHP_1$
Pump Flow (Q)	Decreased: $Q_2 = (59.8/60.0) * Q_1$, thus $Q_2 = 0.997 * Q_1$	More: $O_2 = (60.2/60.0) * Q_1$, thus $O_2 = 1.003 * Q_1$
Pump NPSH available (NPSHa)	Increased margin by decreasing flow loss component of NPSH: $\Delta P_2 =(59.8/60.0)^2 * \Delta P_1$, thus $\Delta P_2 = 0.993 * \Delta P_1$	Decreased margin by increasing flow loss component of NPSH: $\Delta P_2 = (60.2/60.0)^2 * \Delta P_1$, thus $\Delta P_2 = 1.007 * \Delta P_1$
Fan Flow (Q)	Less: $Q_2 = (59.8/60.0) * Q_1$, thus $Q_2 = 0.997 * Q_1$	More: $Q_2 = (60.2/60.0) * Q_1$, thus $Q_2 = 1.003 * Q_1$
Valve Opening Time (T)	Increased: 1.008 (i.e., +0.8%)	Decreased: 0.994 (i.e., -0.6%)
Valve Closing Time (T)	Increased: 1.008 (i.e., +0.8%)	Decreased: 0.994 (i.e., -0.6%)
DG Loading	Decreased: 0.990 (i.e., -1.0%)	Increased: 1.010 (i.e., +1.0%)

3.2.2 Effect on Motors

Motors are designed to operate with a voltage of ± 10% of rated voltage and frequency variation of ± 5% of rated frequency (Reference 13). The impact to starting torque on motors is proportional to the square of the voltage and inversely proportional to the square of the frequency. Starting capability of safety related motors are analyzed for the degraded voltage set point of 6,555 V (95%) when supplied by offsite power. When the diesel generator is supplying the shutdown equipment, the voltage is maintained above 6,800 Volts (98%). The impact on starting torque at 60.1 Hz (0.1 Hz effective frequency change is reserved for voltage impact) is well bounded by the impact on starting voltage which has already been analyzed for offsite power.

The effect on motor operating temperature is proportional to the square of the horsepower to rated horsepower ratio as:

$$\Delta T_{insul} = (P/P_{sf})^2 * TR_{sf}$$

Where: P = motor power
P_{sf} = motor power at service factor
TR_{sf} = temperature rise of the insulation at service factor

For motors operating at -0.3% speed from nominal, this relationship equates to:

$$(0.990\ P/P_{SF})^2 * TR_{SF} = 0.980 * TR_{SF}$$

For motors operating at +0.3% speed from nominal, this relationship equates to:

$$(1.010\ P/P_{SF})^2 * TR_{SF} = 1.020 * TR_{SF}$$

A 2.0% increase or decrease in heat rise would have insignificant impact on motor life. In the case of continuously operated 480 V environmentally qualified (EQ) motors, the 40 year qualified life of the motor is based on an insulation temperature rise of 105 ^oC. Actual tested rise is ≤ 75 ^oC. Therefore, there is more than sufficient margin in the windings. Refer to section 3.2.5 for the discussion regarding large motors.

3.2.3 Effect on Pump Flow

Pump speed is directly proportional to flow (Reference 13). Therefore, a 0.3% speed increase will result in slightly higher flows and 0.3% decrease will result in slightly lower flows. The flow is considered acceptable if they are equal to or greater than those used in the safety analysis. For the Steam Generator Tube Rupture Margin To Overfill Analysis, the higher pump flow rates associated with a + 0.3% motor speed increase was analyzed for the Centrifugal Charging Pumps (CCP) and Safety Injection (SI) Pumps.

For the long term mitigation of a LOOP/LOCA, the DGs supply the following major pumps:

- Auxiliary Feedwater (AFW) Pump
- Containment Spray (CSS Pump)
- Residual Heat Removal (RHR) Pump
- Safety Injection (SI) Pump
- Centrifugal Charging (CC) Pump
- Emergency Raw Cooling Water (ERCW) Pump
- Component Cooling Water System (CCS) Pump

The DGs also supply the following 480 V pump motors:

- Station Fire Pump
- Control Room Chilled Water Circulating Pump
- Shutdown Board Room Chilled Water Circulating Pump
- Electric Board Room Chilled Water Circulating Pump
- DG Day Tank Fuel Oil Transfer Pump
- Boric Acid Transfer Pump
- Thermal Barrier System Booster Pump
- AFW Pump Lubrication Oil Pump
- Spent Fuel Pool Pump
- ERCW Screen Wash Pump

Only major pumps in safety significant systems were evaluated in detail, because, as summarized in Table 3, the speed, load, flow, and NPSH are minimally impacted (i.e., 0.3%).

Pump flow will increase as follows:

$$Q_2 = (60.2/60.0) * Q_1\text{, thus } Q_2 = 1.003 * Q_1$$

The flow at higher frequency (60.2 Hz) will be 0.3% higher. The impact on pump flow is defined in Table 3. The impact involves a negligible increase and does not have any impact on design safety function of the pumps listed above.

Pump flow will increase as follows:

$$Q_2 = 1.003 * Q_1$$

Pump flow will decrease as follows:

$$Q_2 = 0.997 * Q_1$$

For example, the 3 gpm diesel generator lube oil circulation pump flow increase/decrease will be 0.009 gpm and the 11,800 gpm Emergency Raw Cooling Water Pump flow increase/decrease will be 35.4 gpm. This is a negligible increase/decrease and does not have an impact on the design safety function of the pumps listed above.

The effect on the flow of the major pumps is shown in Table 3.

Table 3 – Impact on Pump Parameters

Pump	Rated Flow, gpm	Flow at -0.3%, gpm	Flow at +0.3%, gpm
Auxiliary Feed Water	450	449 [2]	451 [2]
Containment Spray	4,550	4,536	4,564
RHR	5,000	4,985	5,015
Safety Injection	675	673	677
Centrifugal Charging (Normal)	150	150 [3]	150 [3]
Centrifugal Charging (LOCA)	550	548	552
ERCW	11,800	11,765	11,835
Component Cooling - Trains A & B	6,000	5,982	6,018
Component Cooling - 2A-A [1]	9,500	9,472	9,529

[1] Component Cooling System (CCS) pump 2A-A has a flow range of 6,000 gpm to 9,500 gpm and serves Unit 2 only components. All other CCS pumps have a design flow of 6,000 gpm.
[2] These flow variances are insignificant with respect to NSSS flow transients and do not require further evaluation.
[3] Calculated flow is insignificantly different than the design flow such that flow appears to be unchanged.

The NSSS vendor, Westinghouse, has evaluated the impact of a ± 0.3% speed variation (i.e., 60 ± 0.2 Hz effective) on WBN Unit 1 pump flows and determined that previous analyses remain valid or do not significantly impact previous analyses. To support Westinghouse's DG frequency range evaluation, Flowserve, the ECCS pump vendor provided input as to the expected performance of the Centrifugal Charging pumps and Intermediate Head Safety Injection pumps for continuous operation up to 30 days. Flowserve concluded that both pumps are expected to undergo minor cavitation damage, but would remain operational for the 30 days, with gradual decline in pump/power performance. Additional detail regarding the impact of minor cavitation damage on pump performance is provided in Flowserve Report GS-8236, Revision 3, "Run-Out Flow Operation Capability Analysis" (Reference 18).

For 480 V motors, the speed reduction will be 0.3% to 0.63% due to greater voltage drop and higher rated motor slips. These are smaller motors with small speed changes (i.e., <1%) and would not be of concern.

The Westinghouse evaluation of the effect of the DG frequency range ≥ 59.8 Hz and ≤ 60.2 Hz (assuming rated terminal voltage, 6600 V, or ± 3% speed change) on pump flow rate determined that the previous analyses for the following conditions remain valid or were not significantly affected.

- Large Break LOCA
- Post LOCA Long Term Core Cooling
- Small Break LOCA
- Post LOCA Subcriticality
- Steam Generator Tube Rupture
- Transient Analysis (non-LOCA events)
- Steam Line Break Mass and Energy Release
- LOCA Mass and Energy Release

3.2.4 Effect on Pump Net Positive Suction Head (NPSH)

Table 4 provides a summary of the Net Positive Suction Head (NPSH) values for the selected pumps. The increased speed during operation will result in increased flows which in turn increase suction side losses and reduces margin between available and required NPSH. The decreased speed will result in decreased flows which in turn decreases suction side losses and increases the margin between available and required NPSH.

The NPSH margin is changed by ± 0.7 % as suction losses increase/decrease by 0.7%.

For increased speed (+ 0.3%): $\Delta P_2 = 1.007 * \Delta P_1$

For decreased speed (- 0.3%): $\Delta P_2 = 0.993 * \Delta P_1$

The decreased speed during operation at 59.8 Hz would result in reduced flows which in turn reduce suction side losses and increase available NPSH (NPSHa). As shown in Table 4, the margin between NPSHa and the required NPSH (NPSHr) would increase by approximately 0.7% at a frequency of 59.8 Hz as compared to during operation at a frequency of 60.0 Hz. A 0.7% increase in NPSH margin (i.e., NPSHa – NPSHr) adds to the margin and does not require additional evaluation. Table 4 provides a comparison of the NPSH values for the major pumps.

A 0.7% increase in NPSH margin (i.e., NPSHa – NPSHr) adds to the margin and does not require additional evaluation.

Table 4 - NPSH Evaluation				
Pump	**NPSHr (ft) at rated speed**	**Increased Margin NPSHr (ft) (-0.3% speed)**	**Decreased Margin NPSHr (ft) (+0.3% speed)**	**NPSHa (ft)**
Auxiliary Feed Water	25.0	24.8	25.2	28.33
Containment Spray	12.5	12.4	12.6	17.2
RHR [1]	12.0	11.9	12.1	13.12
Safety Injection	17.5	17.4	17.6	37.6
Centrifugal Charging	28.0	27.8	28.2	55.2
ERCW (submergence requirement)	6.04	5.99	6.07	12.07
Component Cooling - A Train	10.57	10.50	10.64	20.06
Component Cooling – B Train	17.38	17.26	17.50	24.88
Component Cooling - Pump 2A-A (8,444 gpm) [2]	29.25	29.05	29.45	29.57

[1] RHR Pump NPSH is most limiting when suction is aligned to the hot leg as analyzed for normal operation, as opposed to sump suction.

[2] The NPSH information provided here for CCS Pump 2A-A is for tornadic conditions. For any other conditions, NPSHa is an additional 8.904 feet higher.

As shown in Table 4, the NPSHa is greater than the NPSHr during operation in the range of 59.8 Hz to 60.2 Hz. Therefore, operation in a frequency range ≥ 59.8 Hz and ≤ 60.2 Hz would have no significant effect on pump NPSH.

3.2.5 Effect on Motor Horsepower

As shown in Table 2, the flow during pump operation at 59.8 Hz would be approximately 1% lower than at a frequency of 60.0 Hz. In addition, Tables 2 and 5 show that operation of pumps at 59.8 Hz results in reduced brake horsepower (BHP) for each pump. Therefore, operation in a frequency range ≥ 59.8 Hz and ≤ 60.1 Hz would have no significant effect on motor BHP.

In addition, also defined in Table 2, the brake horsepower at higher frequency will be 0.6% higher. Table 5 provides the BHP for the major pumps that would be supplied power by the DGs in the event of a LOOP/LOCA. The general acceptance criterion for horsepower is that the brake horsepower shall not exceed the motor nameplate rating times the motor service factor. Only major pumps in safety significant systems were evaluated, because, as shown in Table 2, the speed, load, flow, and NPSH are only impacted slightly (i.e., 0.2% to 0.6%). The Spent Fuel Pool pump motor and the high pressure fire protection pump motors operate at a horsepower that is less than their nameplate rating at a frequency of 60.1 Hz. The other pumps are low power and the increase in horsepower is negligible. In addition, the increase in horsepower due to the increase in frequency is less than the nameplate rating times the service factor.

Pump motor brake horsepower at higher speeds (+ 0.3%) will be slightly higher as follows:

$$BHP_2 = 1.010 * BHP_1$$

Pump motor brake horsepower at lower speeds (- 0.3%) will be slightly lower as follows:

$$BHP_2 = 0.990 * BHP_1$$

The brake horsepower with a speed variation of ± 0.3% will vary by 1.0%. Table 5 provides a summary of pump brake horsepower for the major pumps that would be supplied power by the DGs in the event of a LOOP/LOCA.

Table 5 - Brake Horsepower

Pump	Normal / Accident Brake Horsepower (HP)			Design
	Rated (@ 60.0 Hz Effective)	-0.3% (@ 59.8 Hz Effective)	+0.3% (@ 60.2 Hz Effective)	Name Plate (HP)
Auxiliary Feed Water [1]	601.5	595.5	607.5	600
Containment Spray	595.1	589.1	601.1	700
RHR	440.0	435.6	444.4	400
Safety Injection	453.4	448.9	457.9	400
Centrifugal Charging	695.0	688.1	702.0	600
ERCW [1]	805	797	813	800
Component Cooling - Trains A & B and 2A-A	360 (370) [2]	356 (366)	364 (374)	350

[1] See Sections 3.2.5.1 and 3.2.5.2 for additional evaluation regarding temperature increase for these pump motors.
[2] CCS Pump 2A-A is permitted to operate at flow rates resulting in excess of 360 BHP (but less than 378 BHP) for the operating range identified in Table 4.

All pumps have a slight increase/decrease in horsepower requirement; however, technical justification was provided for their acceptance (Reference 13):

1. The RHR, SI, and CCS pump motors have a service factor of 1.15 and are therefore acceptable.

2. The CSS pump motors do not exceed the nameplate rating and therefore, are acceptable.

3. The CCP motors were evaluated by Westinghouse to be acceptable for continuous operation up to 720 horsepower. The horsepower calculation was performed at conservative flows and this slightly higher/lower horsepower does not impact pump performance at an effective ± 0.3% speed change.

4. The AFW pump motors and the ERCW pump motors were specifically evaluated to determine the temperature rise, and shown to be acceptable as described in sections 3.2.5.1 and 3.2.5.2.

3.2.5.1 Auxiliary Feedwater Pump Motor Horsepower

The brake horsepower for the Auxiliary Feedwater Pump Motors with a speed increase of 0.3% would be 607.5 HP. The motors for these pumps have Class F insulation with a maximum allowable temperature rise of 105 ^{o}C. At 600 HP, the temperature rise for the motor is 57.4 ^{o}C. Therefore, at 607.5 HP, the temperature rise would be:

$$\Delta T_{INSULATION} = (P/P_{SF})^2 * (TR_{SF})$$

Where: P - motor power
P_{SF} - motor power at service factor
TR_{SF} - temperature rise of the insulation at service factor

$$(P/P_{SF})^2 * (TR_{SF}) = (607.5/600)^2 * (57.4\ ^{o}C) = 58.8\ ^{o}C$$

Thus, there is a negligible increase in temperature. Since the maximum allowable rise is 105 ^{o}C, less than 2 ^{o}C temperature rise is judged to be negligible.

3.2.5.2 ERCW Pump Motor Horsepower

For the ERCW Pump motors, the brake horsepower at a speed increase of 0.3% would be 813.1 HP. The motors for these pumps have Class F insulation with a maximum allowable temperature rise of 105 ^{o}C. At 800 HP, the temperature rise for the motor is 51 ^{o}C. Therefore, at 813.1 HP, the temperature rise would be:

$$(P/P_{SF})^2 * (TR_{SF}) = (813.1/800)^2 * (51\ ^{o}C) = 52.7\ ^{o}C$$

Thus, there is a negligible increase in temperature. Since the maximum allowable rise is 105 ^{o}C, less than 2 ^{o}C temperature rise is judged to be negligible.

3.2.6 Effect on Positive Displacement Pump (Fuel Oil Transfer Pump)

The Fuel Oil Transfer Pump (FOTP), a positive displacement pump transfers fuel oil from the fuel oil storage tank in the yard to the DG seven-day fuel oil tanks. The FOTP serves to replenish the volume of the seven-day tanks during DG operation. Slightly higher/lower flow rates results in the completion of the fuel oil transfer process in slightly faster/slower time durations.

The slightly higher/lower horsepower requirement (i.e., ±1.0%) and associated resultant slightly higher/lower flow rates has no impact of the safe operation of the FOTP, or the operation of the DGs. Therefore, operation in a DG frequency range ≥ 59.8 Hz and ≤ 60.1 Hz would have no significant effect on fuel oil transfer.

3.2.7 Effect on Fans and Air Handling Units

For the long term mitigation of a LOOP/LOCA, the DGs supply the following fans and air handling units (AHU):

- Containment Air Return Fan
- Electrical Board Room Air Handing Unit (AHU)
- Penetration Room El 713’ Cooler Fan
- Pipe Chase Cooler Fan
- 480V Board Room Pressurizing Air Supply Fan
- 480V Board Room Air Conditioning (A/C) AHU
- Control Room AHU
- 125V Vital Battery Room II Exhaust Fan
- Control Bldg Emergency Pressurizing Air Supply Fan
- Control Bldg Emergency Air Clean-up Fan
- Penetration Room El 692’ Cooler Fan
- Containment Spray Pump Room Cooler Fan
- Battery Room El 692’ Exhaust Fan
- 5th Vital Battery Room Exhaust Fan
- Emergency Gas Treatment System Fan
- SFP Pump & TB Booster Pump Space Cooler Fan
- CCS & AFW Pumps Space Cooler Fan
- 125V Vital Battery Room Exhaust Fan
- Safety Injection Pump Room Cooler Fan
- Penetration Room El 737’ Cooler Fan
- RHR Pump Room Cooler Fan
- 480V Transformer Room Exhaust Fan
- Diesel Generator Room Exhaust Fan
- Diesel Room Panel Vent Fan
- DG 480V Electrical Board Room Exhaust Fan
- DG Muffler Room Exhaust Fan

Fan speed is directly proportional to flow. Therefore, increased speed will result in increased flows and similarly for decreased fan speeds. From Table 2, it can be seen that fan flow will be ± 0.3% higher/lower.

Flow rate tolerances for fans and AHUs require total system airflow at the system fan and/or inlet to be not less than 90% of fan design rated flow for existing systems and 95% of fan design rated flow for new systems for other than air-cleaning units. In addition, the maximum system flow shall not exceed 110% of the system’s fan rated flow. Therefore, the required fans and AHUs continue to meet the acceptance criteria considering the 0.3% reduction of flow rate resulting from operation in the frequency range ≥ 59.8 Hz and ≤ 60.1 Hz.

Therefore, all of the fans affected by DG frequency variation are acceptable from a flow standpoint.

3.2.8 Effect on Valve Operating Times

The motor operated valves (MOV) were evaluated for frequency and voltage related to DG loading.

Motor torque and stroke time are two important parameters associated with MOV performance. The DG frequency affects the motor torque and speed. Valve stroke time is inversely proportional to motor speed. Therefore, slower motor speed will result in longer valve stroke times. From the MOV evaluation, the stroke time will be less than 0.8% longer as a result of the change in the frequency and voltage. These changes are negligible, and will not prevent the motor operated valve from meeting its stroke time requirements. Longer stroke time is not a concern because sufficient margin exists between the calculated stroke times and stroke times used in the safety analysis such that the assumed stroke times will not be exceeded by the longer stroke time.

Therefore, longer motor operated valve stroke times due to operation in the DG frequency range are not a concern. The minimum allowable DG voltage provides a voltage that is greater than the voltage used for the GL 89-10 (Reference 17) analysis. Therefore the impact to torque is acceptable. Faster motor speed will result in shorter valve stroke time. Shorter stroke time is not a concern because all pertinent stroke times used in the WBN Unit 1 safety analysis are the maximum stroke times. In addition, there would not be a concern for water hammer due to the small decrease in stroke time. Therefore, there are no concerns with MOV operation due to the variation in DG frequency and voltage.

3.2.9 Effect on Air Compressor and Chiller Flows

For the long term mitigation of a LOOP/LOCA, the DGs supply the following compressors:

- Control Room A/C Compressor
- 480V Board Room A/C Compressor
- Shutdown Board Room Chiller Package Compressor
- Electrical Board Room A/C Compressor
- Auxiliary Control Air Compressor

Air compressors and chillers are intermittently loaded equipment which store a commodity between selected high and low parameter setpoints within a fixed closed pressure boundary volume. For air compressors, the compressor cycles on to charge a header up to the high pressure setpoint and then remains off until header pressure drops below a starting setpoint. For chillers, the chiller compressor cycles on and off to maintain the refrigerant fluid temperature within the recommended temperature ranges. Room temperature maintained by the A/C compressors and air compressor pressure are not impacted by the DG frequency change. Load times are inversely proportional to the increase/decrease in rotational speed which is ± 0.3%. A ± 0.3% change in load times for intermittently operated equipment has negligible impact on the equipment and service to the plant.

3.2.10 Effects on Power Transformers

There is no detrimental effect on power transformers and additional evaluation is not required. This conclusion is based on the fact that the frequency range is very small (i.e., 59.8 Hz - 60.1 Hz).

3.2.11 Effect on Battery Chargers

For the long term mitigation of a LOOP/LOCA, the DGs supply the 125 V Vital Battery Chargers. As long as line frequencies are within ± 5% (i.e., 3 Hz) of the rated frequency, the battery chargers would maintain steady state output within ± 0.5% of the desired voltage. The proposed DG frequency range of approximately 0.3% of 60 Hz (i.e., ≥ 59.8 Hz and ≤ 60.1 Hz), is bounded by the operational tolerances of the battery chargers.

This variation is considered to be negligible and there is no effect on operation of the 125 V Vital Battery Chargers from this change.

3.2.12 Effect on Hydrogen Igniters

The concern with the hydrogen igniters is that their operating temperature may be affected by changes in voltage and/or frequency, and subsequently their ability to control hydrogen following a LOCA. The hydrogen igniters are supplied by a regulated transformer which maintains a ± 1% regulation for a voltage range of ± 10% and frequency range of ± 5%. Therefore, there is no impact to the hydrogen igniters due to minor voltage and/or frequency variations.

3.2.13 Effect on DG Loading

As described in Section 3.1, each DG has a continuous load rating of 4400 kW (i.e., 100% load) and a two-hour rating of 4840 kW (i.e., 110% load). Table 2 shows that DG frequencies above 60 Hz directly increase motor speed and frequencies below 60 Hz directly decrease motor speed. Horsepower requirements for a motor increase/decrease by the cube of the speed change. Therefore, increased speed will result in increased horsepower demands and decreased speed will result in decreased horsepower demands on the diesel which feed the subject loads.

As stated above, the power consumption associated with electric motors increases/decreases by the cube of the speed change. Not all loads are affected by frequency increase (e.g. battery chargers and transformers); however, it is conservative to assume that they are affected. Therefore, if all of the total loads in Reference 11 are multiplied by 1.010, the total loading is still under the DG load rating.

The cumulative impact of the DG upper voltage limit of 7260 V and frequency of 60.2 Hz has been evaluated for DG loading under the LOOP/LOCA scenario (Section 3.2.1) for DG 1A-A which is the heaviest loaded DG. Table 6 summarizes the DG 1A-A total loading.

Table 6 – DG 1A-A Maximum Steady State Running Load			
Parameter	**DG 1A-A Load (2 hours - End)**	**Continuous Rating**	**Minimum Margin (%)**
kW	4116	4400	6.4
kVA	4762	5500	13.4

Therefore with conservative loading, it is seen that for a LOOP/LOCA scenario, the DG loading is within its continuous rating, have sufficient loading margin and therefore not analyzed any further.

3.2.14 Effect on DG Fuel Oil Consumption

In determining the required volume of fuel oil for seven days of DG operation, TVA assumed that the DGs operate at the two-hour overload rating of 4840 kW (i.e., 110% load) for the first two hours of the seven-day period. For the remaining 166 hours of the seven-day period, the DGs are assumed to operate continuously at 4400 kW (i.e., 100% load). As discussed in Section 3.2.13, the loading on each of the DGs while operating in the frequency range ≥ 59.8 Hz and ≤ 60.2 Hz remains below the two-hour and continuous ratings.

The DG fuel oil consumption calculation was performed at the DG continuous rating of 4400 kW. As shown in Table 6, the loading on each of the DGs while operating at ≤ 60.2 Hz remains below the continuous rating of 4400 kW. Therefore, there is no impact to the calculated DG fuel oil consumption rate.

3.3 Summary

TVA evaluated frequency and voltage variation in the ranges of 59.8 Hz to 60.2 Hz and 6800 V to 7260 V, respectively for WBN Unit 1 equipment and equipment categories fed by the DGs following a LOOP or LOOP/LOCA. The aspects examined were the effects of frequency and voltage increase/decrease on pumps, fans, motor-operated valves, compressors, power transformers, battery chargers, and hydrogen igniters. In addition, the effects of the proposed steady state DG frequency change on the DG steady state loading, and the DG fuel oil consumption rates were also evaluated. It was confirmed that the WBN Unit 1 DG loading will not exceed the ratings or fuel oil consumption rates.

3.4 Conclusion

This evaluation examined the effects of changing the steady state DG frequency from 60.0 Hz to a range of ≥ 59.8 Hz and ≤ 60.1 Hz on plant equipment powered by the DGs following a LOOP or LOOP/LOCA. The aspects examined included the effects of the frequency decrease/increase on various WBN Unit 1 equipment and components, including pumps, fans, MOVs, compressors, power transformers, and battery chargers. In addition, this evaluation examined the effects of the proposed steady state DG frequency change on the DG steady state loading and the DG fuel oil consumption rates.

The evaluation establishes that the equipment required to mitigate the effects of a LOOP or LOOP/LOCA that are supplied power by the DGs are capable of performing their intended functions at a steady state frequency of a range of ≥ 59.8 Hz and ≤ 60.1 Hz. Therefore, the DGs and supplied loads would continue to function as assumed in the safety analyses during operation in the proposed DG frequency range of ≥ 59.8 Hz and ≤ 60.1 Hz. Accordingly, TVA has concluded that this proposed change is acceptable.

4.0 REGULATORY EVALUATION

4.1 Applicable Regulatory Requirements and Criteria

The onsite standby ac power systems at WBN Unit 1 are designed to comply with the following applicable regulations and requirements.

- Title 10 Code of Federal Regulations (CFR) Part 50, Appendix A, General Design Criterion (GDC) 17, "Electric power systems," specifies that an onsite electric power system shall be provided to permit functioning of structures, systems, and components important to safety.

- Title 10 CFR Part 50, Appendix A, GDC 18, "Inspection and testing of electric power systems," specifies that electric power systems important to safety shall be designed to permit appropriate periodic inspection and testing of important areas and features.

- Regulatory Guide 1.6, Revision 0, "Independence Between Redundant Standby (Onsite) Power Sources and Between Their Distribution Systems," describes an acceptable degree of independence between redundant standby (onsite) power sources and between their distribution systems.

- Regulatory Guide 1.9, Revision 3, "Selection, Design, Qualification, and Testing of Emergency Diesel Generator Units Used as Class 1E Onsite Electrical Power Systems at Nuclear Power Plants," describes the selection, design, qualification, and testing of DGs (Reference 1). WBN Unit 1 complies with Regulatory Guide 1.9, Revision 3, with the following exceptions:

Regulatory Position C.0	WBN meets the intent of Institute of Electrical and Electronics Engineers (IEEE) Standard 387-1984, “IEEE Standard Criteria for Diesel Generator Units Applied as Standby Power Supplies for Nuclear Power Generating Stations."
Regulatory Position C1.3	WBN DG load assignment is based on Regulatory Guide 1.9, Position C2 of Revision 2 required the predicted loads not to exceed the short time rating.
Regulatory Position C1.7.2	Although a first-out surveillance system is not installed for the DG system at WBN, DG protective trips such as differential overcurrent have been provided with targets to indicate which protective device operated. In addition, the status of protective devices installed to

shutdown the DG for generator or engine trouble is alarmed in the Main Control Room. Where more than one protective device function group is operated, the information is fed to the Main Control Room computer/display which would provide the information as to which group operated first.

Regulatory Position C2.2.5	WBN meets the intent of this position. DGs 1A-A and 1B-B are started by an SI event by 1E circuits. However, the starting of DGs 2A-A and 2B-B is implemented with a non-1E circuit (i.e., a common start circuit). The intent of this position is to have all the DGs started in case there is a LOOP. WBN meets this precautionary requirement with the common start circuit. In the event of a LOOP, the 1E LOOP circuits also start the DGs, independent of the common start circuit.
Regulatory Position C2.2.6	The design basis at WBN is a simultaneous LOOP/LOCA, not LOOP followed by LOCA. Although there are some design features to meet the effects of LOOP followed by LOCA, there is no analysis to demonstrate the design will meet the DG voltage and frequency requirements.
Regulatory Position C2.3.1	Exceptions are identified by Regulatory Position C2.2.5 and C2.2.6, above.
Regulatory Position C2.3.2	TS SR 3.8.1.21, developed and approved for initial plant licensing, eliminates the requirement to perform the ten-year independence testing during a plant shutdown.

- IEEE Standard 308-1971, "Criteria for Class 1E Power Systems for Nuclear Power Generating Stations," provides criteria for the determination of Class 1E power system design features and the requirements for their testing, surveillance, and documentation.

With the implementation of the proposed change, WBN Unit 1 continues to meet the applicable regulations and requirements, subject to the previously approved exceptions.

Implementation of administrative controls to assure that the DG steady state frequency is controlled at ≥ 59.8 Hz and ≤ 60.1 Hz requires adjustment of the DG governor potentiometers that set the DG frequency of operation. Therefore, TVA commits to the following actions:

- Adjust the WBN DG governor controls to assure operation within the steady state frequency band of ≥ 59.8 Hz and ≤ 60.1 Hz during the March/April 2015 DG outage.

- Revise WBN surveillance instructions to incorporate the DG SR steady state frequency band of ≥ 59.8 Hz and ≤ 60.1 Hz during the March/April 2015 DG outage.

4.2 Precedent

The NRC has previously approved changes revising the TS SR acceptance criteria for steady state DG frequency.

1. Amendment Numbers 227 and 105 were issued for Beaver Valley Power Station, Units 1 and 2, respectively, in a Safety Evaluation dated February 11, 2000 (Reference 6). The Amendment corrected non-conservative TSs by clarifying the fuel oil storage volume requirements, increasing the load requirement for the single largest load rejection test, establishing criteria for maximum frequency that should not be exceeded following a load rejection, and revising the DG SR steady state frequency to ≥ 60.0 Hz and ≤ 60.6 Hz for Unit 1 and ≥ 59.9 Hz and ≤ 60.3 Hz for Unit 2.

2. Amendment Number 129 was issued for the Palo Verde Nuclear Generating Station, Units 1, 2, and 3, in a Safety Evaluation dated October 4, 2000 (Reference 7). The Amendment corrected non-conservative TSs by revising the current steady-state DG voltage limits of ≥ 3740 V and ≤ 4580 V and steady state frequency limit of ≥ 59.7 Hz and ≤ 61.2 Hz to a steady state voltage of ≥ 4000 V and < 4377.2 V, and steady state frequency of ≥ 59.7 Hz and ≤ 60.7 Hz for the affected SR, except that for SR 3.8.1.2, the lower frequency limit is ≥ 58.8 Hz instead of the ≥ 59.7 Hz.

3. Amendment Numbers 309 and 291 were issued for the Donald C. Cook Nuclear Plant, Units 1 and 2, respectively, in a Safety Evaluation dated April 30, 2009 (Reference 8). The Amendment corrected non-conservative TSs by reducing the maximum DG steady state frequency in the associated SRs from 61.2 Hertz to 60.5 Hz. The Amendment also revised the minimum steady state voltage from 3740 V to 3910 V for certain TS SRs for consistency with the minimum steady state voltage specified in the acceptance criteria for other TS SRs, and reduced the criteria for maximum frequency that should not be exceeded following a load rejection.

4. Amendment Number 236 was issued for Crystal River, Unit 3 in a Safety Evaluation dated December 10, 2009 (Reference 9). The Amendment corrected non-conservative TSs by revising the DG steady state voltage to ≥ 4077 V and ≤ 4243 V and DG steady state frequency to ≥ 59.4 Hz and ≤ 60.6 Hz.

5. Amendment 204 was issued for the Wolf Creek Generating Station in a Safety Evaluation dated April 11, 2013 (Reference 10). The Amendment corrected non-conservative TSs by revising minimum DG steady state voltage to 3950 V and DG steady state frequency to ≥ 59.4 Hz and ≤ 60.6 Hz. The Amendment also revised the DG loading requirements to reflect the results of updated calculations.

6. WBN Unit 1 license amendment request is based on the similar WBN Unit 2 submittal response to NUREG-0847, SSER 22, Open Item 32. The NRC staff had questions regarding the limits of the diesel generator (DG) voltage and frequency range as specified in the developmental revision Technical Specifications (TS). TVA stated that the DG steady state frequency would be revised from the values currently in the WBN Unit 1 TS to a frequency band of ≥ 59.8 Hz and ≤ 60.1 Hz. The stated steady state voltage band of ≥ 6800 V and ≤ 7260 V was acceptable and not changed. NUREG-0847, SSER 27 documented the staff acceptance of the proposed changes and closure of NUREG-0847, SSER 22, Open Item 32 consistent with NRC regulations and regulatory guidance.

TVA is proposing to revise the DG SR steady state frequency range to ≥ 59.8 Hz and ≤ 60.1 Hz. No changes are proposed to the TS SR acceptance criteria for DG steady state voltage or DG loading requirements.

4.3 Significant Hazards Consideration

The proposed change would modify Watts Bar Nuclear Plant (WBN), Unit 1, Technical Specification (TS) 3.8.1, "AC Sources - Operating," by revising the acceptance criteria for the Diesel Generator (DG) steady state frequency acceptance criteria specified in TS Surveillance Requirements (SRs) 3.8.1.2, 3.8.1.7, 3.8.1.9, 3.8.1.11, 3.8.1.12, 3.8.1.15, 3.8.1.19, and 3.8.1.21. The proposed change to SR 3.8.1.2 will result in a 60.0 Hz nominal frequency. The frequency will be changed from ≥ 58.8 Hz and ≤ 61.2 Hz to ≥ 59.8 Hz and ≤ 60.1 Hz for SRs 3.8.1.7, 3.8.1.9, 3.8.1.11, 3.8.1.12, 3.8.1.15, 3.8.1.19, and 3.8.1.21.

This proposed change also affects TS 3.8.2, "AC Sources - Shutdown," because SR 3.8.2.1 requires the following TS 3.8.1 SRs affected by the change to be met: SR 3.8.1.2, SR 3.8.1.7, SR 3.8.1.9, SR 3.8.1.11, SR 3.8.1.12, and SR 3.8.1.15, SR 3.8.1.19.

TVA has concluded that the proposed change does not involve a significant hazards consideration. TVA's conclusion is based on its evaluation in accordance with 10 CFR 50.91(a)(1) of the three standards set forth in 10 CFR 50.92, "Issuance of Amendment," as discussed below:

1. *Does the proposed amendment involve a significant increase in the probability or consequence of an accident previously evaluated?*

   Response: No

   The DGs are required to be operable in the event of a design basis accident coincident with a loss of offsite power to mitigate the consequences of the accident. The DGs are not accident initiators and therefore these changes do not involve a significant increase in the probability of an accident previously evaluated.

   The accident analyses assume that at least one load group bus is provided with power either from the offsite circuits or the DGs. The change proposed in this license amendment request will continue to assure that the DGs have the capacity and capability to assume their maximum design basis accident loads.

The proposed change does not significantly alter how the plant would mitigate an accident previously evaluated.

The proposed change does not adversely affect accident initiators or precursors nor alter the design assumptions, conditions, and configuration of the facility or the manner in which the plant is operated and maintained. The proposed change does not adversely affect the ability of structures, systems, and components (SSC) to perform their intended safety function to mitigate the consequences of an initiating event within the assumed acceptance limits. The proposed change does not affect the source term, containment isolation, or radiological release assumptions used in evaluating the radiological consequences of any accident previously evaluated. Further, the proposed change does not increase the types and amounts of radioactive effluent that may be released offsite, nor significantly increase individual or cumulative occupational/public radiation exposure.

Therefore, this proposed amendment does not involve a significant increase in the probability or consequences of an accident previously evaluated.

2. *Does the proposed amendment create the possibility of a new or different kind of accident from any accident previously evaluated?*

Response: No.

The proposed change does not involve a change in the plant design, system operation, or the use of the DGs. The proposed change requires the DGs to meet SR acceptance criteria that envelope the actual demand requirements for the DGs during design basis conditions. These revised acceptance criteria continue to demonstrate the capability and capacity of the DGs to perform their required functions. There are no new failure modes or mechanisms created due to testing the DGs within the proposed acceptance criteria. Testing of the DGs at the proposed acceptance criteria does not involve any modification in the operational limits or physical design of plant systems. There are no new accident precursors generated due to the proposed test loadings.

Therefore, the proposed amendment does not create the possibility of a new or different kind of accident from any accident previously evaluated.

3. *Does the proposed amendment involve a significant reduction in a margin of safety?*

Response: No.

The proposed change will continue to demonstrate that the DGs meet the TS definition of operability, that is, the proposed acceptance criteria will continue to demonstrate that the DGs will perform their safety function. The proposed testing will also continue to demonstrate the capability and capacity of the DGs to supply their required loads for mitigating a design basis accident.

The proposed change does not alter the manner in which safety limits, limiting safety system settings or limiting conditions for operation are determined. The safety analysis acceptance criteria are not affected by this change. The proposed change will not result in plant operation in a configuration outside the design basis.

Therefore, the proposed amendment does not involve a significant reduction in a margin of safety.

4.4 Conclusion

In conclusion, based on the considerations discussed above, (1) there is reasonable assurance that the health and safety of the public will not be endangered by operation in the proposed manner, (2) such activities will be conducted in compliance with the Commission’s regulations, and (3) the issuance of the amendment will not be inimical to the common defense and security or to the health and safety of the public.

5.0 ENVIRONMENTAL CONSIDERATION

A review has determined that the proposed amendment would change a requirement with respect to installation or use of a facility component located within the restricted area, as defined in 10 CFR 20, or would change an inspection or surveillance requirement. However, the proposed amendment does not involve (i) a significant hazards consideration, (ii) a significant change in the types or significant increase in the amounts of any effluents that may be released offsite, or (iii) a significant increase in individual or cumulative occupational radiation exposure. Accordingly, the proposed amendment meets the eligibility criterion for categorical exclusion set forth in 10 CFR 51.22(c)(9). Therefore, pursuant to 10 CFR 51.22(b), no environmental impact statement or environmental assessment need be prepared in connection with the proposed amendment.

6.0 REFERENCES

1. Regulatory Guide 1.9, Revision 3, "Selection, Design, Qualification, and Testing of Emergency Diesel Generator Units Used as Class 1E Onsite Electrical Power Systems at Nuclear Power Plants."

2. NRC Administrative Letter 98-10, "Dispositioning of Technical Specifications That Are Insufficient to Assure Plant Safety," dated December 29, 1998.

3. WBN Updated Final Safety Analysis Report Section 8.3, "Onsite (Standby) Power System."

4. NUREG-0847, Safety Evaluation Report Related to the Operation of Watts Bar Nuclear Plant, Unit 2," Supplement 22, published February 2011 (ADAMS Accession No. ML110390197).

5. Regulatory Guide 1.9, Revision 2, "Selection, Design, and Qualification of Diesel-Generator Units Used as Standby (Onsite) Electric Power Systems at Nuclear Power Plants."

6. NRC Letter, "Beaver Valley 1 and 2 – Amendment for Revised Technical Specification Requirements for Emergency Diesel Generators (TAC Nos. MA4438 and MA4439)," dated February 11, 2000 (ADAMS Accession No. ML003684928).

7. NRC Letter, "Palo Verde Nuclear Generating Station, Units 1, 2, and 3 – Issuance of Amendments on Diesel Generator Steady-State Voltage and Frequency (TAC Nos. MA9214, MA9215, and MA9216)," dated October 4, 2000 [(ADAMS Accession No. ML003758500).

8. NRC Letter, “Donald C. Cook Nuclear Plant, Units 1 and 2 – Issuance of Amendment to Renewed Facility Operating License Regarding Technical Specification Change Relating to Diesel Generator Steady-State Parameters (TAC Nos. MD8773 and MD8774),” dated April 30, 2009 (ADAMS Accession No. ML090630245).

9. NRC Letter, "Crystal River Unit 3 Nuclear Generating Plant – Issuance of Amendment Regarding Request to Revise the Technical Specification Surveillance Requirements for Emergency Diesel Generator Voltage and Frequency Limits (TAC No. ME0107), dated December 10, 2009 (ADAMS Accession No. ML092680285).

10. NRC Letter, "Wolf Creek Generating Station – Issuance of Amendment Re: Revise Technical Specification 3.8.1, "AC Sources – Operating" (TAC No. ME7674)," dated April 11, 2013 (ADAMS Accession No. ML13077A147).

11. TVA, NPG System Description Document, N3-82-4002, Revision 0021, “Standby Diesel Generator System (Unit 1).”

12. Technical Specification Task Force (TSTF) Standards TS Change Traveler, TSTF - 493, Revision 4, “Clarify Application of Setpoint Methodology for LSSS Functions,” dated July 2009 (ADAMS Accession Number ML092150990).

13. TVA, Letter to the NRC, “Watts Bar Nuclear Plant (WBN) Unit 2 - Diesel Generator Frequency - Response to NUREG 0847 Supplemental Safety Evaluation Report (SSER) 22, Open item 32,” dated February 3, 2014 (ADAMS Accession Number ML14038A079).

14. TVA, Letter to the NRC, “Watts Bar Nuclear Plant Unit 2 – Submittal of Developmental Revision I of the Unit 2 Technical Specification & Technical Specification Bases and Developmental Revision D of the Unit 2 Technical Requirements Manual & Technical Requirements Manual Bases,” dated June 16, 2014 (ADAMS Accession Number ML14169A525).

15. NUREG-0847, “Supplemental Safety Evaluation Report 27,” dated January 2015, Appendix HH, Watts Bar Unit 2 Action Items Table (ADAMS Accession Number ML15033A041).

16. NUREG-0847, “Supplemental Safety Evaluation Report 22,” dated February 2011, Appendix HH, Watts Bar Unit 2 Action Items Table (ADAMS Accession Number ML110390197).

17. Generic Letter (GL) 89-10, “Safety-Related Motor-Operated Valve Testing and Surveillance,” dated June 28, 1989 and “Supplement 1 to Generic Letter 89-10: Results of the Public Workshops,” dated June 13, 1990.

18. Flowserve Report GS-8236, Revision 3, “Run-Out Flow Operation Capability Analysis,” dated March 27, 2013.

ATTACHMENT 1

List of Regulatory Commitments

The following table identifies those actions committed to by WBN Unit 1 in this document. Any other statements in this submittal are provided for information purposes and are not considered to be commitments. Please direct questions regarding these commitments to Mr. Gordon Arent at (423) 365-2004.

Commitment	Due Date
Adjust the WBN DG governor controls to assure operation within the steady state frequency band of ≥ 59.8 Hz and ≤ 60.1 Hz.	March/April 2015 DG Outage
Revise WBN surveillance instructions to incorporate the DG SR steady state frequency band of ≥ 59.8 Hz and ≤ 60.1 Hz.	March/April 2015 DG Outage

ATTACHMENT 2

Proposed TS Changes (Mark-Ups) for WBN Unit 1

SURVEILLANCE REQUIREMENTS

SURVEILLANCE		FREQUENCY
SR 3.8.1.1	Verify correct breaker alignment and indicated power availability for each offsite circuit.	7 days
SR 3.8.1.2	------------------------------NOTES---------------------------- 1. Performance of SR 3.8.1.7 satisfies this SR. 2. A modified DG start involving idling and gradual acceleration to synchronous speed may be used for this SR as recommended by the manufacturer. When modified start procedures are not used, the time, voltage, and frequency tolerances of SR 3.8.1.7 must be met. -- Verify each DG starts from standby conditions and achieves steady state voltage ≥ 6800 V and ≤ 7260 V, and frequency ~~≥ 58.8 Hz and ≤ 61.2 Hz.~~	As specified in Table 3.8.1-1

(continued)

of 60 Hz nominal.

SURVEILLANCE REQUIREMENTS (continued)

SURVEILLANCE		FREQUENCY
SR 3.8.1.7	Verify each DG starts from standby condition and achieves in ≤ 10 seconds, voltage ≥ 6800 V, and frequency ≥ 58.8 Hz. Verify after DG fast start from standby conditions that the DG achieves steady state voltage ≥ 6800 V and ≤ 7260 V, and frequency ≥ 59.8 ~~58.8~~ Hz and ≤ ~~61.2~~ 60.1 Hz.	184 days
SR 3.8.1.8	-----------------------------NOTE------------------------------- For the 1A-A and 1B-B Shutdown Boards, this Surveillance shall not be performed in MODE 1 or 2. However, credit may be taken for unplanned events that satisfy this SR. -- Verify automatic and manual transfer of each 6.9 kV shutdown board power supply from the normal offsite circuit to each alternate offsite circuit.	18 months

(continued)

SURVEILLANCE REQUIREMENTS (continued)

SURVEILLANCE		FREQUENCY
SR 3.8.1.9	--------------------------------NOTES---------------------------- 1. For DGs 1A-A and 1B-B, this Surveillance shall not be performed in MODE 1 or 2. However, credit may be taken for unplanned events that satisfy this SR. 2. If performed with the DG synchronized with offsite power, it shall be performed at a power factor ≥ 0.8 and ≤ 0.9. --- Verify each DG rejects a load greater than or equal to its associated single largest post-accident load, and: a. Following load rejection, the frequency is ≤ 66.75 Hz; b. Within 3 seconds following load rejection, the voltage is ≥ 6555 V and ≤ 7260 V; and c. Within 4 seconds following load rejection, the frequency is ≥ ~~58.8~~ 59.8 Hz and ≤ ~~61.2~~ 60.1 Hz.	18 months
SR 3.8.1.10	---------------------------NOTE-------------------------------- For DGs 1A-A and 1B-B, this Surveillance shall not be performed in MODE 1 or 2. However, credit may be taken for unplanned events that satisfy this SR. --- Verify each DG operating at a power factor ≥ 0.8 and ≤ 0.9 does not trip and voltage is maintained ≤ 8880 V during and following a load rejection of ≥ 3960 kW and ≤ 4400 kW and ≥ 2970 kVAR and ≤ 3300 kVAR.	18 months

(continued)

SURVEILLANCE REQUIREMENTS (continued)

SURVEILLANCE		FREQUENCY
SR 3.8.1.11	-------------------------------NOTE------------------------------ For DGs 1A-A and 1B-B, this Surveillance shall not be performed in MODE 1, 2, 3, or 4. However, credit may be taken for unplanned events that satisfy this SR. ---	
	Verify on an actual or simulated loss of offsite power signal: a. De-energization of emergency buses; b. Load shedding from emergency buses; c. DG auto-starts from standby condition and: 1. energizes permanently connected loads in ≤ 10 seconds, 2. energizes auto-connected shutdown loads through automatic load sequencer, 3. maintains steady state voltage ≥ 6800 V and ≤ 7260 V, 4. maintains steady state frequency ≥ ~~58.8~~ 59.8 Hz and ≤ ~~61.2~~ 60.1 Hz, and 5. supplies permanently connected and auto-connected shutdown loads for ≥ 5 minutes.	18 months

(continued)

SURVEILLANCE REQUIREMENTS (continued)

SURVEILLANCE		FREQUENCY
SR 3.8.1.12	-------------------------------NOTE------------------------------ This Surveillance shall not be performed in MODE 1 or 2. However, credit may be taken for unplanned events that satisfy this SR. --- Verify on an actual or simulated Engineered Safety Feature (ESF) actuation signal each Unit 1 DG auto-starts from standby condition and: a. In ≤ 10 seconds after auto-start and during tests, achieves voltage ≥ 6800 V and frequency ≥ 58.8 Hz; b. After DG fast start from standby conditions the DG achieves steady state voltage ≥ 6800 V and ≤ 7260 V, and frequency ≥ ~~58.8~~ 59.8 Hz and ≤ ~~61.2~~ 60.1 Hz. c. Operates for ≥ 5 minutes; d. Permanently connected loads remain energized from the offsite power system; and e. Emergency loads are energized from the offsite power system.	18 months

(continued)

SURVEILLANCE REQUIREMENTS (continued)

SURVEILLANCE		FREQUENCY
SR 3.8.1.15	---------------------------------NOTE------------------------------ This Surveillance shall be performed within 5 minutes of shutting down the DG after the DG has operated ≥ 2 hours loaded ≥ 3960 kW and ≤ 4400 kW. Momentary transients outside of load range do not invalidate this test. -- Verify each DG starts and achieves, in ≤ 10 seconds, voltage ≥ 6800 V, and frequency ≥ 58.8 Hz. Verify after DG fast start from standby conditions that the DG achieves steady state voltage ≥ 6800 V and ≤ 7260 V, and frequency ≥ ~~58.8~~ 59.8 Hz and ≤ ~~61.2~~ 60.1 Hz.	18 months
SR 3.8.1.16	------------------------------NOTE-------------------------------- For DGs 1A-A and 1B-B, this Surveillance shall not be performed in MODE 1, 2, 3, or 4. However, credit may be taken for unplanned events that satisfy this SR. -- Verify each DG: a. Synchronizes with offsite power source while loaded with emergency loads upon a simulated restoration of offsite power; b. Transfers loads to offsite power source; and c. Returns to ready-to-load operation.	18 months

(continued)

SURVEILLANCE REQUIREMENTS (continued)

SURVEILLANCE		FREQUENCY
SR 3.8.1.17	------------------------------NOTE------------------------------ This Surveillance shall not be performed in MODE 1, 2, 3, or 4. However, credit may be taken for unplanned events that satisfy this SR. -- Verify, with each Unit 1 DG operating in test mode and connected to its bus, an actual or simulated ESF actuation signal overrides the test mode by: a. Returning DG to ready-to-load operation; and b. Automatically energizing the emergency load from offsite power.	18 months
SR 3.8.1.18	------------------------------NOTE------------------------------ For DGs 1A-A and 1B-B, this Surveillance shall not be performed in MODE 1, 2, 3, or 4. However, credit may be taken for unplanned events that satisfy this SR. -- Verify the time delay setting for each sequenced load block is within limits for each accident condition and non-accident condition load sequence.	18 months

(continued)

SURVEILLANCE REQUIREMENTS (continued)

SURVEILLANCE		FREQUENCY
SR 3.8.1.19	-----------------------------NOTE------------------------------- For DGs 1A-A and 1B-B, this Surveillance shall not be performed in MODE 1, 2, 3, or 4. However, credit may be taken for unplanned events that satisfy this SR. --- Verify on an actual or simulated loss of offsite power signal in conjunction with an actual or simulated ESF actuation signal: a. De-energization of emergency buses; b. Load shedding from emergency buses; c. DGs of the same power train auto-start from standby condition and: 1. energizes permanently connected loads in ≤ 10 seconds, 2. energizes auto-connected emergency loads through load sequencer, 3. achieves steady state voltage: ≥ 6800 V and ≤ 7260 V, 4. achieves steady state frequency ≥ ~~58.8~~ 59.8 Hz and ≤ ~~61.2~~ 60.1 Hz, and 5. supplies permanently connected and auto-connected emergency loads for ≥ 5 minutes.	18 months
SR 3.8.1.20	Verify during idle operation that any automatic or emergency start signal disables the idle start circuitry and commands the engine to full speed.	18 months

(continued)

SURVEILLANCE REQUIREMENTS (continued)

SURVEILLANCE		FREQUENCY
SR 3.8.1.21	Verify when started simultaneously from standby condition, each DG achieves, in ≤ 10 seconds, voltage ≥ 6800 V and frequency ≥ 58.8 Hz. Verify after DG fast start from standby conditions that the DG achieves steady state voltage ≥ 6800 V and ≤ 7260 V, and frequency ≥ ~~58.8~~ Hz and ≤ ~~61.2~~ Hz.	10 years

59.8

60.1

ATTACHMENT 3

Proposed TS Bases Changes (Mark-Ups) for WBN Unit 1

(For Information Only)

BASES

ACTIONS (continued)

H.1 and I.1

Condition H and Condition I corresponds to a level of degradation in which all redundancy in the AC electrical power supplies cannot be guaranteed. At this severely degraded level, any further losses in the AC electrical power system will cause a loss of function. Therefore, no additional time is justified for continued operation. The plant is required by LCO 3.0.3 to commence a controlled shutdown.

SURVEILLANCE REQUIREMENTS

The AC sources are designed to permit inspection and testing of all important areas and features, especially those that have a standby function, in accordance with 10 CFR 50, Appendix A, GDC 18 (Ref. 8). Periodic component tests are supplemented by extensive functional tests during refueling outages (under simulated accident conditions). The SRs for demonstrating the OPERABILITY of the DGs are in accordance with the recommendations of Regulatory Guide 1.9 (Ref. 3) and Regulatory Guide 1.137 (Ref. 9), as addressed in the FSAR.

Where the SRs discussed herein specify voltage and frequency tolerances, the following is applicable. 6800 volts is the minimum steady state output voltage and the 10 second transient value. 6800 volts is 98.6% of the nominal bus voltage of 6900 V corrected for instrument error and is the upper limit of the minimum voltage required for the DG supply breaker to close on the 6.9 kV shutdown board. The specified maximum steady state output voltage of 7260 V is 110% of the nameplate rating of the 6600 V motors. The specified 3 second transient value of 6555 V is 95% of the nominal bus voltage of 6900 V. The specified maximum transient value of 8880 V is the maximum equipment withstand value provided by the DG manufacturer. ~~The specified minimum and maximum frequencies of the DG are 58.8 Hz and 61.2 Hz, respectively. These values are equal to ± 2% of the 60 Hz nominal frequency and are derived from the recommendations given in Regulatory Guide 1.9 (Ref. 3).~~

The specified minimum and maximum transient frequencies for the DG are 58.8 Hz and 61.2 Hz, respectively. The steady state minimum and maximum frequency values are 59.8 Hz and 60.1 Hz. These values ensure that the safety related plant equipment powered from the DGs is capable of performing its safety functions.

SR 3.8.1.1

This SR ensures proper circuit continuity for the offsite AC electrical power supply to the onsite distribution network and availability of offsite AC electrical power. The breaker alignment verifies that each breaker is in its correct position to ensure that distribution buses and loads are connected to their preferred power source, and that appropriate independence of offsite circuits is maintained. The 7 day Frequency is adequate because breaker position is not likely to change without the operator being aware of it and because its status is displayed in the control room.

(continued)

BASES

SURVEILLANCE REQUIREMENTS (continued)

SR 3.8.1.2 and SR 3.8.1.7

These SRs help to ensure the availability of the standby electrical power supply to mitigate DBAs and transients and to maintain the plant in a safe shutdown condition.

For the purposes of SR 3.8.1.2 and SR 3.8.1.7 testing, the DGs are started from standby conditions. The DG engines for WBN have an oil circulation and soakback system that operates continuously to preclude the need for a prelube and warmup when a DG is started from standby. Standby conditions for a DG mean that the diesel engine coolant and oil are being continuously circulated and temperature is being maintained consistent with manufacturer recommendations.

In order to reduce stress and wear on diesel engines~~. T~~he manufacturer recommends a modified start in which the starting speed of DGs is limited, warmup is limited to this lower speed, and the DGs are gradually accelerated to synchronous speed prior to loading. These start procedures are the intent of Note 2, which is only applicable when such modified start procedures are recommended by the manufacturer.

SR 3.8.1.7 requires that, at a 184 day Frequency, the DG starts from an actual or simulated loss of offsite power signal and achieves required voltage and frequency within 10 seconds. The 10 second start requirement supports the assumptions of the design basis LOCA analysis in the FSAR, Section 15 (Ref. 5). Starting the DG from an emergency start signal ensures the automatic start relays are cycled (deenergized) on a 184 day Frequency.

, t

The 10 second start requirement is not applicable to SR 3.8.1.2 (see Note 2) when a modified start procedure as described above is used. If a modified start is not used, the 10 second start requirement of SR 3.8.1.7 applies. Stable operation at the nominal voltage and frequency values is also essential to establishing DG OPERABILITY, but a time constraint is not imposed. This is because a typical DG will experience a period of voltage and frequency oscillations prior to reaching steady state operation if these oscillations are not dampened out by load application. This period may extend beyond the 10 second acceptance criteria and could be a cause for failing the SR. In lieu of a time constraint in the SR, WBN will monitor and trend the actual time to reach steady state operation as a means of ensuring there is no voltage regulator or governor degradation which could cause a DG to become inoperable.

During this testing, the diesel is not in an accident mode and the frequency is controlled by the operator instead of the governor's accident speed reference.

Since SR 3.8.1.7 requires a 10 second start, it is more restrictive than SR 3.8.1.2, and it may be performed in lieu of SR 3.8.1.2. This is the intent of Note 1 of SR 3.8.1.2.

(continued)

BASES

SURVEILLANCE REQUIREMENTS

SR 3.8.1.9 (continued)

voltage and frequency and while maintaining a specified margin to the overspeed trip. The largest single load for each DG is the essential raw cooling water pump at 800 HP. This Surveillance may be accomplished by: 1) tripping the DG output breaker with the DG carrying greater than or equal to its associated single largest post accident load while paralleled to offsite power or while solely supplying the bus, or 2) tripping its associated single largest post accident load with the DG solely supplying the bus. As required by Regulatory Guide 1.9, C1.4 (Ref. 3), the load rejection test is acceptable if the increase in diesel speed does not exceed 75% of the difference between synchronous speed and the overspeed trip setpoint, or 15% above synchronous speed, whichever is lower.

and

The time~~,~~ voltage~~, and frequency~~ tolerances specified in this SR are derived from Regulatory Guide 1.9 (Ref. 3) recommendations for response during load sequence intervals. The 3 seconds specified is equal to 60% of a typical 5 second load sequence interval associated with sequencing of the largest load. The voltage and frequency specified are consistent with the design range of the equipment powered by the DG. SR 3.8.1.9.a corresponds to the maximum frequency excursion, while SR 3.8.1.9.b and SR 3.8.1.9.c are steady state voltage and frequency values to which the system must recover following load rejection. The 18 month Frequency is consistent with the recommendation of Regulatory Guide 1.9 (Ref. 3).

maximum transient

This SR is modified by two Notes. The reason for Note 1 is that during operation with the reactor critical, performance of this SR for DG 1A-A or 1B-B could cause perturbations to the electrical distribution systems that could challenge continued steady state operation and, as a result, plant safety systems. Credit may be taken for unplanned events that satisfy this SR. Examples of unplanned events may include:

1) Unexpected operational events which cause the equipment to perform the function specified by this Surveillance, for which adequate documentation of the required performance is available; and

(continued)

ATTACHMENT 4

Proposed TS Changes (Final Typed) for WBN Unit 1

SURVEILLANCE REQUIREMENTS

SURVEILLANCE		FREQUENCY
SR 3.8.1.1	Verify correct breaker alignment and indicated power availability for each offsite circuit.	7 days
SR 3.8.1.2	------------------------------NOTES--------------------------- 1. Performance of SR 3.8.1.7 satisfies this SR. 2. A modified DG start involving idling and gradual acceleration to synchronous speed may be used for this SR as recommended by the manufacturer. When modified start procedures are not used, the time, voltage, and frequency tolerances of SR 3.8.1.7 must be met. --- Verify each DG starts from standby conditions and achieves steady state voltage ≥ 6800 V and ≤ 7260 V, and frequency of 60 Hz nominal.	As specified in Table 3.8.1-1

(continued)

SURVEILLANCE REQUIREMENTS (continued)

SURVEILLANCE		FREQUENCY
SR 3.8.1.7	Verify each DG starts from standby condition and achieves in ≤ 10 seconds, voltage ≥ 6800 V, and frequency ≥ 58.8 Hz. Verify after DG fast start from standby conditions that the DG achieves steady state voltage ≥ 6800 V and ≤ 7260 V, and frequency ≥ 59.8 Hz and ≤ 60.1 Hz.	184 days
SR 3.8.1.8	------------------------------NOTE------------------------------- For the 1A-A and 1B-B Shutdown Boards, this Surveillance shall not be performed in MODE 1 or 2. However, credit may be taken for unplanned events that satisfy this SR. -- Verify automatic and manual transfer of each 6.9 kV shutdown board power supply from the normal offsite circuit to each alternate offsite circuit.	18 months

(continued)

SURVEILLANCE REQUIREMENTS (continued)

SURVEILLANCE		FREQUENCY
SR 3.8.1.9	--------------------------------NOTES---------------------------- 1. For DGs 1A-A and 1B-B, this Surveillance shall not be performed in MODE 1 or 2. However, credit may be taken for unplanned events that satisfy this SR. 2. If performed with the DG synchronized with offsite power, it shall be performed at a power factor ≥ 0.8 and ≤ 0.9. ---	
	Verify each DG rejects a load greater than or equal to its associated single largest post-accident load, and: a. Following load rejection, the frequency is ≤ 66.75 Hz; b. Within 3 seconds following load rejection, the voltage is ≥ 6555 V and ≤ 7260 V; and c. Within 4 seconds following load rejection, the frequency is ≥ 59.8 Hz and ≤ 60.1 Hz.	18 months
SR 3.8.1.10	---------------------------NOTE-------------------------------- For DGs 1A-A and 1B-B, this Surveillance shall not be performed in MODE 1 or 2. However, credit may be taken for unplanned events that satisfy this SR. ---	
	Verify each DG operating at a power factor ≥ 0.8 and ≤ 0.9 does not trip and voltage is maintained ≤ 8880 V during and following a load rejection of ≥ 3960 kW and ≤ 4400 kW and ≥ 2970 kVAR and ≤ 3300 kVAR.	18 months

(continued)

SURVEILLANCE REQUIREMENTS (continued)

SURVEILLANCE		FREQUENCY
SR 3.8.1.11	--------------------------------NOTE----------------------------- For DGs 1A-A and 1B-B, this Surveillance shall not be performed in MODE 1, 2, 3, or 4. However, credit may be taken for unplanned events that satisfy this SR. ---	
	Verify on an actual or simulated loss of offsite power signal: a. De-energization of emergency buses; b. Load shedding from emergency buses; c. DG auto-starts from standby condition and: 1. energizes permanently connected loads in ≤ 10 seconds, 2. energizes auto-connected shutdown loads through automatic load sequencer, 3. maintains steady state voltage ≥ 6800 V and ≤ 7260 V, 4. maintains steady state frequency ≥ 59.8 Hz and ≤ 60.1 Hz, and 5. supplies permanently connected and auto-connected shutdown loads for ≥ 5 minutes.	18 months

(continued)

SURVEILLANCE REQUIREMENTS (continued)

SURVEILLANCE		FREQUENCY
SR 3.8.1.12	-------------------------------NOTE------------------------------ This Surveillance shall not be performed in MODE 1 or 2. However, credit may be taken for unplanned events that satisfy this SR. --- Verify on an actual or simulated Engineered Safety Feature (ESF) actuation signal each Unit 1 DG auto-starts from standby condition and: a. In ≤ 10 seconds after auto-start and during tests, achieves voltage ≥ 6800 V and frequency ≥ 58.8 Hz; b. After DG fast start from standby conditions the DG achieves steady state voltage ≥ 6800 V and ≤ 7260 V, and frequency ≥ 59.8 Hz and ≤ 60.1 Hz. c. Operates for ≥ 5 minutes; d. Permanently connected loads remain energized from the offsite power system; and e. Emergency loads are energized from the offsite power system.	18 months

(continued)

SURVEILLANCE REQUIREMENTS (continued)

SURVEILLANCE		FREQUENCY
SR 3.8.1.15	-----------------------------------NOTE----------------------------------- This Surveillance shall be performed within 5 minutes of shutting down the DG after the DG has operated ≥ 2 hours loaded ≥ 3960 kW and ≤ 4400 kW. Momentary transients outside of load range do not invalidate this test. --- Verify each DG starts and achieves, in ≤ 10 seconds, voltage ≥ 6800 V, and frequency ≥ 58.8 Hz. Verify after DG fast start from standby conditions that the DG achieves steady state voltage ≥ 6800 V and ≤ 7260 V, and frequency ≥ 59.8 Hz and ≤ 60.1 Hz.	18 months
SR 3.8.1.16	-----------------------------------NOTE----------------------------------- For DGs 1A-A and 1B-B, this Surveillance shall not be performed in MODE 1, 2, 3, or 4. However, credit may be taken for unplanned events that satisfy this SR. --- Verify each DG: a. Synchronizes with offsite power source while loaded with emergency loads upon a simulated restoration of offsite power; b. Transfers loads to offsite power source; and c. Returns to ready-to-load operation.	18 months

(continued)

SURVEILLANCE REQUIREMENTS (continued)

SURVEILLANCE		FREQUENCY
SR 3.8.1.17	------------------------------NOTE------------------------------ This Surveillance shall not be performed in MODE 1, 2, 3, or 4. However, credit may be taken for unplanned events that satisfy this SR. --	
	Verify, with each Unit 1 DG operating in test mode and connected to its bus, an actual or simulated ESF actuation signal overrides the test mode by: a. Returning DG to ready-to-load operation; and b. Automatically energizing the emergency load from offsite power.	18 months
SR 3.8.1.18	------------------------------NOTE------------------------------ For DGs 1A-A and 1B-B, this Surveillance shall not be performed in MODE 1, 2, 3, or 4. However, credit may be taken for unplanned events that satisfy this SR. --	
	Verify the time delay setting for each sequenced load block is within limits for each accident condition and non-accident condition load sequence.	18 months

(continued)

SURVEILLANCE REQUIREMENTS (continued)

SURVEILLANCE		FREQUENCY
SR 3.8.1.19	------------------------------NOTE-------------------------------- For DGs 1A-A and 1B-B, this Surveillance shall not be performed in MODE 1, 2, 3, or 4. However, credit may be taken for unplanned events that satisfy this SR. --	
	Verify on an actual or simulated loss of offsite power signal in conjunction with an actual or simulated ESF actuation signal: a. De-energization of emergency buses; b. Load shedding from emergency buses; c. DGs of the same power train auto-start from standby condition and: 1. energizes permanently connected loads in ≤ 10 seconds, 2. energizes auto-connected emergency loads through load sequencer, 3. achieves steady state voltage: ≥ 6800 V and ≤ 7260 V, 4. achieves steady state frequency ≥ 59.8 Hz and ≤ 60.1 Hz, and 5. supplies permanently connected and auto-connected emergency loads for ≥ 5 minutes.	18 months
SR 3.8.1.20	Verify during idle operation that any automatic or emergency start signal disables the idle start circuitry and commands the engine to full speed.	18 months

(continued)

SURVEILLANCE REQUIREMENTS (continued)

SURVEILLANCE		FREQUENCY
SR 3.8.1.21	Verify when started simultaneously from standby condition, each DG achieves, in ≤ 10 seconds, voltage ≥ 6800 V and frequency ≥ 58.8 Hz. Verify after DG fast start from standby conditions that the DG achieves steady state voltage ≥ 6800 V and ≤ 7260 V, and frequency ≥ 59.8 Hz and ≤ 60.1 Hz.	10 years

ATTACHMENT 5

Proposed TS Bases Changes (Final Typed) for WBN Unit 1

(For Information Only)

BASES

ACTIONS (continued)

H.1 and I.1

Condition H and Condition I corresponds to a level of degradation in which all redundancy in the AC electrical power supplies cannot be guaranteed. At this severely degraded level, any further losses in the AC electrical power system will cause a loss of function. Therefore, no additional time is justified for continued operation. The plant is required by LCO 3.0.3 to commence a controlled shutdown.

SURVEILLANCE REQUIREMENTS

The AC sources are designed to permit inspection and testing of all important areas and features, especially those that have a standby function, in accordance with 10 CFR 50, Appendix A, GDC 18 (Ref. 8). Periodic component tests are supplemented by extensive functional tests during refueling outages (under simulated accident conditions). The SRs for demonstrating the OPERABILITY of the DGs are in accordance with the recommendations of Regulatory Guide 1.9 (Ref. 3) and Regulatory Guide 1.137 (Ref. 9), as addressed in the FSAR.

Where the SRs discussed herein specify voltage and frequency tolerances, the following is applicable. 6800 volts is the minimum steady state output voltage and the 10 second transient value. 6800 volts is 98.6% of the nominal bus voltage of 6900 V corrected for instrument error and is the upper limit of the minimum voltage required for the DG supply breaker to close on the 6.9 kV shutdown board. The specified maximum steady state output voltage of 7260 V is 110% of the nameplate rating of the 6600 V motors. The specified 3 second transient value of 6555 V is 95% of the nominal bus voltage of 6900 V. The specified maximum transient value of 8880 V is the maximum equipment withstand value provided by the DG manufacturer. The specified minimum and maximum transient frequencies for the DG are 58.8 Hz and 61.2 Hz, respectively. The steady state minimum and maximum frequency values are 59.8 Hz and 60.1 Hz. These values ensure that the safety related plant equipment powered from the DGs is capable of performing its safety functions.

SR 3.8.1.1

This SR ensures proper circuit continuity for the offsite AC electrical power supply to the onsite distribution network and availability of offsite AC electrical power. The breaker alignment verifies that each breaker is in its correct position to ensure that distribution buses and loads are connected to their preferred power source, and that appropriate independence of offsite circuits is maintained. The 7 day Frequency is adequate because breaker position is not likely to change without the operator being aware of it and because its status is displayed in the control room.

(continued)

SURVEILLANCE REQUIREMENTS (continued)

SR 3.8.1.2 and SR 3.8.1.7

These SRs help to ensure the availability of the standby electrical power supply to mitigate DBAs and transients and to maintain the plant in a safe shutdown condition.

For the purposes of SR 3.8.1.2 and SR 3.8.1.7 testing, the DGs are started from standby conditions. The DG engines for WBN have an oil circulation and soakback system that operates continuously to preclude the need for a prelube and warmup when a DG is started from standby. Standby conditions for a DG mean that the diesel engine coolant and oil are being continuously circulated and temperature is being maintained consistent with manufacturer recommendations.

In order to reduce stress and wear on diesel engines, the manufacturer recommends a modified start in which the starting speed of DGs is limited, warmup is limited to this lower speed, and the DGs are gradually accelerated to synchronous speed prior to loading. These start procedures are the intent of Note 2, which is only applicable when such modified start procedures are recommended by the manufacturer.

SR 3.8.1.7 requires that, at a 184 day Frequency, the DG starts from an actual or simulated loss of offsite power signal and achieves required voltage and frequency within 10 seconds. The 10 second start requirement supports the assumptions of the design basis LOCA analysis in the FSAR, Section 15 (Ref. 5). Starting the DG from an emergency start signal ensures the automatic start relays are cycled (deenergized) on a 184 day Frequency.

The 10 second start requirement is not applicable to SR 3.8.1.2 (see Note 2) when a modified start procedure as described above is used. During this testing, the diesel is not in an accident mode and the frequency is controlled by the operator instead of the governor's accident speed reference. If a modified start is not used, the 10 second start requirement of SR 3.8.1.7 applies. Stable operation at the nominal voltage and frequency values is also essential to establishing DG OPERABILITY, but a time constraint is not imposed. This is because a typical DG will experience a period of voltage and frequency oscillations prior to reaching steady state operation if these oscillations are not dampened out by load application. This period may extend beyond the 10 second acceptance criteria and could be a cause for failing the SR. In lieu of a time constraint in the SR, WBN will monitor and trend the actual time to reach steady state operation as a means of ensuring there is no voltage regulator or governor degradation which could cause a DG to become inoperable.

Since SR 3.8.1.7 requires a 10 second start, it is more restrictive than SR 3.8.1.2, and it may be performed in lieu of SR 3.8.1.2. This is the intent of Note 1 of SR 3.8.1.2.

(continued)

SURVEILLANCE REQUIREMENTS

SR 3.8.1.9 (continued)

voltage and frequency and while maintaining a specified margin to the overspeed trip. The largest single load for each DG is the essential raw cooling water pump at 800 HP. This Surveillance may be accomplished by: 1) tripping the DG output breaker with the DG carrying greater than or equal to its associated single largest post accident load while paralleled to offsite power or while solely supplying the bus, or 2) tripping its associated single largest post accident load with the DG solely supplying the bus. As required by Regulatory Guide 1.9, C1.4 (Ref. 3), the load rejection test is acceptable if the increase in diesel speed does not exceed 75% of the difference between synchronous speed and the overspeed trip setpoint, or 15% above synchronous speed, whichever is lower.

The time and voltage tolerances specified in this SR are derived from Regulatory Guide 1.9 (Ref. 3) recommendations for response during load sequence intervals. The 3 seconds specified is equal to 60% of a typical 5 second load sequence interval associated with sequencing of the largest load. The voltage and maximum transient frequency specified are consistent with the design range of the equipment powered by the DG. SR 3.8.1.9.a corresponds to the maximum frequency excursion, while SR 3.8.1.9.b and SR 3.8.1.9.c are steady state voltage and frequency values to which the system must recover following load rejection. The 18 month Frequency is consistent with the recommendation of Regulatory Guide 1.9 (Ref. 3).

This SR is modified by two Notes. The reason for Note 1 is that during operation with the reactor critical, performance of this SR for DG 1A-A or 1B-B could cause perturbations to the electrical distribution systems that could challenge continued steady state operation and, as a result, plant safety systems. Credit may be taken for unplanned events that satisfy this SR. Examples of unplanned events may include:

1) Unexpected operational events which cause the equipment to perform the function specified by this Surveillance, for which adequate documentation of the required performance is available; and

(continued)