UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D.C. 20555-0001

January 22, 2018

Mr. Brad Berryman
Site Vice President
Susquehanna Nuclear, LLC
769 Salem Boulevard
NUCSB3
Berwick, PA 18603-0467

SUBJECT: SUSQUEHANNA STEAM ELECTRIC STATION, UNITS 1 AND 2 – ISSUANCE OF AMENDMENTS RE: DIESEL GENERATOR SURVEILLANCE REQUIREMENTS WITH NEW STEADY-STATE VOLTAGE AND FREQUENCY LIMITS (CAC NOS. MF9131 AND MF9132; EPID L-2017-LLA-0180)

Dear Mr. Berryman:

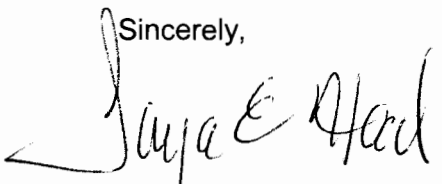
The U.S. Nuclear Commission (Commission) has issued the enclosed Amendment No. 269 to Renewed Facility Operating License No. NPF-14 and Amendment No. 251 to Renewed Facility Operating License No. NPF-22 for the Susquehanna Steam Electric Station, Units 1 and 2, respectively. These amendments consist of changes to the technical specifications in response to your application dated January 25, 2017,[1] as supplemented by letters dated March 21, 2017;[2] August 4, 2017;[3] and December 4, 2017.[4]

These amendments revise certain surveillance requirements in Technical Specification 3.8.1, "AC [Alternating Current] Sources – Operating." The changes are in the use of steady-state voltage and frequency acceptance criteria for onsite standby power source of the diesel generators, allowing for the use of new and more conservative design analysis.

[1] Agencywide Documents Access and Management System (ADAMS) Accession No. ML17044A149
[2] ADAMS Accession No. ML17080A405
[3] ADAMS Accession No. ML17216A283
[4] ADAMS Accession No. ML17338A516

A copy of our safety evaluation is also enclosed. Notice of Issuance will be included in the Commission's Biweekly *Federal Register* Notice.

Sincerely,



Tanya E. Hood, Project Manager
Plant Licensing Branch I
Division of Operating Reactor Licensing
Office of Nuclear Reactor Regulation

Docket Nos. 50-387 and 50-388

Enclosures:
1. Amendment No. 269 to License No. NPF-14
2. Amendment No. 251 to License No. NPF-22
3. Safety Evaluation

cc w/enclosures: Distribution via Listserv

UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D.C. 20555-0001

SUSQUEHANNA NUCLEAR, LLC

ALLEGHENY ELECTRIC COOPERATIVE, INC.

DOCKET NO. 50-387

SUSQUEHANNA STEAM ELECTRIC STATION, UNIT 1

AMENDMENT TO FACILITY OPERATING LICENSE

Amendment No. 269
Renewed License No. NPF-14

1. The U.S. Nuclear Regulatory Commission (NRC or the Commission) has found that:

   A. The application for the amendment filed by Susquehanna Nuclear, LLC, dated January 25, 2017, as supplemented by letters dated March 21, 2017; August 4, 2017; and December 4, 2017, complies with the standards and requirements of the Atomic Energy Act of 1954, as amended (the Act), and the Commission's regulations set forth in 10 CFR Chapter I;

   B. The facility will operate in conformity with the application, the provisions of the Act, and the regulations of the Commission;

   C. There is reasonable assurance: (i) that the activities authorized by this amendment can be conducted without endangering the health and safety of the public, and (ii) that such activities will be conducted in compliance with the Commission's regulations set forth in 10 CFR Chapter I;

   D. The issuance of this amendment will not be inimical to the common defense and security or to the health and safety of the public; and

   E. The issuance of this amendment is in accordance with 10 CFR Part 51 of the Commission's regulations and all applicable requirements have been satisfied.

2. Accordingly, the license is amended by changes to the Technical Specifications as indicated in the attachment to this license amendment and paragraph 2.C.(2) of Renewed Facility Operating License No. NPF-14 is hereby amended to read as follows:

   (2) Technical Specifications and Environmental Protection Plan

   The Technical Specifications contained in Appendix A, as revised through Amendment No. 269, and the Environmental Protection Plan contained in Appendix B are hereby incorporated in the license. Susquehanna Nuclear, LLC shall operate the facility in accordance with the Technical Specifications and the Environmental Protection Plan.

3. This license amendment is effective as of its date of issuance and shall be implemented within 60 days.

FOR THE NUCLEAR REGULATORY COMMISSION

James G. Danna, Chief
Plant Licensing Branch I
Division of Operating Reactor Licensing
Office of Nuclear Reactor Regulation

Attachment:
Changes to the Renewed Facility Operating License and Technical Specifications

Date of Issuance: January 22, 2018

ATTACHMENT TO LICENSE AMENDMENT NO. 269

SUSQUEHANNA STEAM ELECTRIC STATION, UNIT 1

RENEWED FACILITY OPERATING LICENSE NO. NPF-14

DOCKET NO. 50-387

Replace the following page of the Renewed Facility Operating License with the attached revised page. The revised page is identified by amendment number and contains marginal lines indicating the areas of change.

REMOVE	INSERT
Page 3	Page 3

Replace the following pages of the Appendix A Technical Specifications with the attached revised pages. The revised pages are identified by amendment number and contain marginal lines indicating the areas of change.

REMOVE	INSERT
TS / 3.8-6	TS / 3.8-6
TS / 3.8-7	TS / 3.8-7
TS / 3.8-8	TS / 3.8-8
TS / 3.8-9	TS / 3.8-9
TS / 3.8-12	TS / 3.8-12
TS / 3.8-15	TS / 3.8-15
TS / 3.8-16	TS / 3.8-16

(3) Susquehanna Nuclear, LLC, pursuant to the Act and 10 CFR Parts 30, 40, and 70, to receive, possess, and use at any time any byproduct, source and special nuclear material as sealed neutron sources for reactor startup, sealed neutron sources for reactor instrumentation and radiation monitoring equipment calibration, and as fission detectors in amounts as required;

(4) Susquehanna Nuclear, LLC, pursuant to the Act and 10 CFR Parts 30, 40, and 70 to receive, possess, and use in amounts as required any byproduct, source or special nuclear material without restriction to chemical or physical form, for sample analysis or instrument calibration or associated with radioactive apparatus or components; and

(5) Susquehanna Nuclear, LLC, pursuant to the Act and 10 CFR Parts 30, 40, and 70 to possess, but not separate, such byproduct and special nuclear materials as may be produced by the operation of the facility.

C. This license shall be deemed to contain and is subject to the conditions specified in the Commission's regulations set forth in 10 CFR Chapter I and is subject to all applicable provisions of the Act and to the rules, regulations and orders of the Commission now or hereafter in effect; and is subject to the additional conditions specified or incorporated below:

(1) Maximum Power Level

Susquehanna Nuclear, LLC is authorized to operate the facility at reactor core power levels not in excess of 3952 megawatts thermal in accordance with the conditions specified herein. The preoperational tests, startup tests and other items identified in License Conditions 2.C.(36), 2.C.(37), 2.C.(38), and 2.C.(39) to this license shall be completed as specified.

(2) Technical Specifications and Environmental Protection Plan

The Technical Specifications contained in Appendix A, as revised through Amendment No. 269, and the Environmental Protection Plan contained in Appendix B are hereby incorporated in the license. Susquehanna Nuclear, LLC shall operate the facility in accordance with the Technical Specifications and the Environmental Protection Plan.

For Surveillance Requirements (SRs) that are new in Amendment 178 to Facility Operating License No. NPF-14, the first performance is due at the end of the first surveillance interval that begins at implementation of Amendment 178. For SRs that existed prior to Amendment 178, including SRs with modified acceptance criteria and SRs whose frequency of performance is being extended, the first performance is due at the end of the first surveillance interval that begins on the date the Surveillance was last performed prior to implementation of Amendment 178.

3.8 Electrical Power Systems

SURVEILLANCE REQUIREMENTS (continued)

	SURVEILLANCE	FREQUENCY
SR 3.8.1.4	Verify each engine mounted day tank fuel oil level is ≥ 420 gallons for DG A-D and ≥ 425 gallons for DG E.	In accordance with the Surveillance Frequency Control Program
SR 3.8.1.5	Check for and remove accumulated water from each engine mounted day tank.	In accordance with the Surveillance Frequency Control Program
SR 3.8.1.6	Verify the fuel oil transfer system operates to automatically transfer fuel oil from the storage tanks to each engine mounted tank.	In accordance with the Surveillance Frequency Control Program
SR 3.8.1.7	----------NOTES---------- 1. All DG starts may be preceded by an engine prelube period. 2. A single test at the specified Frequency will satisfy this Surveillance for both units. ---------- Verify each DG starts from standby condition and achieves, in ≤ 10 seconds, voltage ≥ 3793 V and frequency ≥ 58.8, and after steady state conditions are reached, maintains voltage ≥ 4000 V and ≤ 4400 V and frequency ≥ 59.3 Hz and ≤ 60.5 Hz.	In accordance with the Surveillance Frequency Control Program
SR 3.8.1.8	----------NOTE---------- The automatic transfer of the unit power supply shall not be performed in MODE 1 or 2. ---------- Verify automatic and manual transfer of unit power supply from the normal offsite circuit to the alternate offsite circuit.	In accordance with the Surveillance Frequency Control Program

(continued)

3.8 Electrical Power Systems

SURVEILLANCE REQUIREMENTS (continued)

SURVEILLANCE		FREQUENCY
SR 3.8.1.9	----------NOTE---------- A single test at the specified Frequency will satisfy this Surveillance for both units. ---------- 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 ≤ 64.5 Hz; b. Within 4.5 seconds following load rejection, the voltage is ≥ 3760 V and ≤ 4560 V, and after steady state conditions are reached, maintains voltage ≥ 4000 V and ≤ 4400 V; and c. Within 6 seconds following load rejection, the frequency is ≥ 59.3 Hz and ≤ 60.5 Hz.	In accordance with the Surveillance Frequency Control Program
SR 3.8.1.10	----------NOTES---------- A single test at the specified Frequency will satisfy this Surveillance for both units. ---------- Verify each DG does not trip and voltage is maintained ≤ 4560 V during and following a load rejection of ≥ 4000 kW.	In accordance with the Surveillance Frequency Control Program

(continued)

3.8 Electrical Power Systems

SURVEILLANCE REQUIREMENTS (continued)

SURVEILLANCE	FREQUENCY
SR 3.8.1.11 ----------NOTES---------- 1. All DG starts may be preceded by an engine prelube period. 2. This SR shall be performed for each DG on a rotational test basis and for each 4.16 kV ESS bus at the specified FREQUENCY. 3. This Surveillance shall not be performed in MODE 1, 2 or 3. ---------- Verify on an actual or simulated loss of offsite power signal: a. De-energization of 4.16 kV ESS buses; b. Load shedding from 4.16 kV ESS buses; and c. DG auto-starts from standby condition and: 1. energizes permanently connected loads in ≤ 10 seconds, 2. energizes auto-connected shutdown loads through individual load timers, 3. maintains steady state voltage ≥ 4000 V and ≤ 4400 V, 4. maintains steady state frequency ≥ 59.3 Hz and ≤ 60.5 Hz, and 5. supplies permanently connected loads for ≥ 5 minutes.	In accordance with the Surveillance Frequency Control Program

(continued)

3.8 Electrical Power Systems

SURVEILLANCE REQUIREMENTS (continued)

SURVEILLANCE	FREQUENCY
SR 3.8.1.12 ----------NOTES---------- 1. All DG starts may be preceded by an engine prelube period. 2. DG E, when not aligned to the Class 1E distribution system, may satisfy this SR for both units by performance of SR 3.8.1.12.a, b and c using the test facility to simulate a 4.16 kV ESS bus. SR 3.8.1.12.d and e may be satisfied with either the normally aligned DG or DG E aligned to the Class 1E distribution system. ---------- Verify, on an actual or simulated Emergency Core Cooling System (ECCS) initiation signal, each DG auto-starts from standby condition and: a. In ≤ 10 seconds after auto-start achieves voltage ≥ 3793 V, and after steady state conditions are reached, maintains voltage ≥ 4000 V and ≤ 4400 V; b. In ≤ 10 seconds after auto-start achieves frequency ≥ 58.8 Hz, and after steady state conditions are reached, maintains frequency ≥ 59.3 Hz and ≤ 60.5 Hz; c. Operates for ≥ 5 minutes; d. Permanently connected loads remain energized from the offsite power system; and e. Emergency loads are energized or auto-connected through the individual load timers from the offsite power system.	In accordance with the Surveillance Frequency Control Program

(continued)

3.8 Electrical Power Systems

SURVEILLANCE REQUIREMENTS (continued)

SURVEILLANCE	FREQUENCY
SR 3.8.1.15 ----------NOTES---------- 1. This Surveillance shall be performed within 5 minutes of shutting down the DG after the DG has operated ≥ 2 hours loaded ≥ 3800 kW. Momentary transients outside of load range do not invalidate this test. 2. All DG starts may be preceded by an engine prelube period. 3. A single test at the specified Frequency will satisfy this Surveillance for both units. ---------- Verify each DG starts and achieves, in ≤ 10 seconds, voltage ≥ 3793 V and frequency ≥ 58.8 and after steady state conditions are reached, maintains voltage ≥ 4000 V and ≤ 4400 V and frequency ≥ 59.3 Hz and ≤ 60.5 Hz.	In accordance with the Surveillance Frequency Control Program

(continued)

3.8 Electrical Power Systems

SURVEILLANCE REQUIREMENTS (continued)

SURVEILLANCE	FREQUENCY
SR 3.8.1.19 ----------NOTES---------- 1. All DG starts may be preceded by an engine prelube period. 2. This SR shall be performed for each DG on a rotational test basis and for each 4.16 kV ESS bus at the specified FREQUENCY. 3. This Surveillance shall not be performed in MODE 1, 2 or 3. ---------- Verify on an actual or simulated loss of offsite power signal in conjunction with an actual or simulated ECCS initiation signal: a. De-energization of 4.16 kV ESS buses; b. Load shedding from emergency buses; and c. DG auto-starts from standby condition and: 1. energizes permanently connected loads in ≤ 10 seconds, 2. energizes auto-connected emergency loads through individual load timers, 3. achieves steady state voltage ≥ 4000 V and ≤ 4400 V, 4. achieves steady state frequency ≥ 59.3 Hz and ≤ 60.5 Hz, and 5. supplies permanently connected and auto-connected emergency loads for ≥ 5 minutes.	In accordance with the Surveillance Frequency Control Program

(continued)

3.8 Electrical Power Systems

SURVEILLANCE REQUIREMENTS (continued)

SURVEILLANCE	FREQUENCY
SR 3.8.1.20 ----------NOTES---------- 1. All DG starts may be preceded by an engine prelube period. 2. This SR does not have to be performed with DG E substituted for any DG. ---------- Verify, when started simultaneously from standby condition, each DG achieves, in ≤ 10 seconds, voltage ≥ 3793 V and frequency ≥ 58.8 and after steady state conditions are reached, maintains voltage ≥ 4000 V and ≤ 4400 V and frequency ≥ 59.3 Hz and ≤ 60.5 Hz.	In accordance with the Surveillance Frequency Control Program

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SUSQUEHANNA NUCLEAR, LLC

ALLEGHENY ELECTRIC COOPERATIVE, INC.

DOCKET NO. 50-388

SUSQUEHANNA STEAM ELECTRIC STATION, UNIT 2

AMENDMENT TO FACILITY OPERATING LICENSE

Amendment No. 251
Renewed License No. NPF-22

1. The U.S. Nuclear Regulatory Commission (NRC or the Commission) has found that:

   A. The application for the amendment filed by the Susquehanna Nuclear, LLC, dated January 25, 2017, as supplemented by letters dated March 21, 2017; August 4, 2017; and December 4, 2017, complies with the standards and requirements of the Atomic Energy Act of 1954, as amended (the Act), and the Commission's regulations set forth in 10 CFR Chapter I;

   B. The facility will operate in conformity with the application, the provisions of the Act, and the regulations of the Commission;

   C. There is reasonable assurance: (i) that the activities authorized by this amendment can be conducted without endangering the health and safety of the public, and (ii) that such activities will be conducted in compliance with the Commission's regulations set forth in 10 CFR Chapter I;

   D. The issuance of this amendment will not be inimical to the common defense and security or to the health and safety of the public; and

   E. The issuance of this amendment is in accordance with 10 CFR Part 51 of the Commission's regulations and all applicable requirements have been satisfied.

2. Accordingly, the license is amended by changes to the Technical Specifications as indicated in the attachment to this license amendment and paragraph 2.C.(2) of Renewed Facility Operating License No. NPF-22 is hereby amended to read as follows:

   (2) Technical Specifications and Environmental Protection Plan

   The Technical Specifications contained in Appendix A, as revised through Amendment No. 251, and the Environmental Protection Plan contained in Appendix B are hereby incorporated in the license. Susquehanna Nuclear, LLC shall operate the facility in accordance with the Technical Specifications and the Environmental Protection Plan.

3. This license amendment is effective as of its date of issuance and shall be implemented within 60 days.

FOR THE NUCLEAR REGULATORY COMMISSION

James G. Danna, Chief
Plant Licensing Branch I
Division of Operating Reactor Licensing
Office of Nuclear Reactor Regulation

Attachment:
Changes to the Renewed Facility Operating License and Technical Specifications

Date of Issuance: January 22, 2018

ATTACHMENT TO LICENSE AMENDMENT NO. 251

SUSQUEHANNA STEAM ELECTRIC STATION, UNIT 2

RENEWED FACILITY OPERATING LICENSE NO. NPF-22

DOCKET NO. 50-388

Replace the following page of the Renewed Facility Operating License with the attached revised page. The revised page is identified by amendment number and contains marginal lines indicating the areas of change.

REMOVE	INSERT
Page 3	Page 3

Replace the following pages of the Appendix A Technical Specifications with the attached revised pages. The revised pages are identified by amendment number and contain marginal lines indicating the areas of change.

REMOVE	INSERT
TS / 3.8-8	TS / 3.8-8
TS / 3.8-9	TS / 3.8-9
TS / 3.8-10	TS / 3.8-10
TS / 3.8-11	TS / 3.8-11
TS / 3.8-14	TS / 3.8-14
TS / 3.8-17	TS / 3.8-17
TS / 3.8-18	TS / 3.8-18

(3) Susquehanna Nuclear, LLC, pursuant to the Act and 10 CFR Parts 30, 40, and 70, to receive, possess, and use at any time any byproduct, source and special nuclear material as sealed neutron sources for reactor startup, sealed neutron sources for reactor instrumentation and radiation monitoring equipment calibration, and as fission detectors in amounts as required;

(4) Susquehanna Nuclear, LLC, pursuant to the Act and 10 CFR Parts 30, 40, and 70 to receive, possess, and use in amounts as required any byproduct, source or special nuclear material without restriction to chemical or physical form, for sample analysis or instrument calibration or associated with radioactive apparatus or components; and

(5) Susquehanna Nuclear, LLC, pursuant to the Act and 10 CFR Parts 30, 40, and 70 to possess, but not separate, such byproduct and special nuclear materials as may be produced by the operation of the facility.

C. This license shall be deemed to contain and is subject to the conditions specified in the Commission's regulations set forth in 10 CFR Chapter I and is subject to all applicable provisions of the Act and to the rules, regulations and orders of the Commission now or hereafter in effect; and is subject to the additional conditions specified or incorporated below:

(1) Maximum Power Level

Susquehanna Nuclear, LLC is authorized to operate the facility at reactor core power levels not in excess of 3952 megawatts thermal in accordance with the conditions specified herein. The preoperational tests, startup tests and other items identified in License Conditions 2.C.(20), 2.C.(21), 2.C.(22), and 2.C.(23) to this license shall be completed as specified.

(2) Technical Specifications and Environmental Protection Plan

The Technical Specifications contained in Appendix A, as revised through Amendment No. 251, and the Environmental Protection Plan contained in Appendix B are hereby incorporated in the license. Susquehanna Nuclear, LLC shall operate the facility in accordance with the Technical Specifications and the Environmental Protection Plan.

For Surveillance Requirements (SRs) that are new in Amendment 151 to Facility Operating License No. NPF-22, the first performance is due at the end of the first surveillance interval that begins at implementation of Amendment 151. For SRs that existed prior to Amendment 151, including SRs with modified acceptance criteria and SRs whose frequency of performance is being extended, the first performance is due at the end of the first surveillance interval that begins on the date the Surveillance was last performed prior to implementation of Amendment 151.

SURVEILLANCE REQUIREMENTS (continued)

	SURVEILLANCE	FREQUENCY
SR 3.8.1.4	Verify each engine mounted day tank fuel oil level is ≥ 420 gallons for DG A-D and ≥ 425 gallons for DG E.	In accordance with the Surveillance Frequency Control Program
SR 3.8.1.5	Check for and remove accumulated water from each engine mounted day tank.	In accordance with the Surveillance Frequency Control Program
SR 3.8.1.6	Verify the fuel oil transfer system operates to automatically transfer fuel oil from the storage tanks to each engine mounted tank.	In accordance with the Surveillance Frequency Control Program
SR 3.8.1.7	----------NOTES---------- 1. All DG starts may be preceded by an engine prelube period. 2. A single test at the specified Frequency will satisfy this Surveillance for both units. ---------- Verify each DG starts from standby condition and achieves, in ≤ 10 seconds, voltage ≥ 3793 V and frequency ≥ 58.8, and after steady state conditions are reached, maintains voltage ≥ 4000 V and ≤ 4400 V and frequency ≥ 59.3 Hz and ≤ 60.5 Hz.	In accordance with the Surveillance Frequency Control Program
SR 3.8.1.8	----------NOTE---------- The automatic transfer of unit power supply shall not be performed in MODE 1 or 2. ---------- Verify automatic and manual transfer of unit power supply from the normal offsite circuit to the alternate offsite circuit.	In accordance with the Surveillance Frequency Control Program

(continued)

SURVEILLANCE REQUIREMENTS (continued)

SURVEILLANCE		FREQUENCY
SR 3.8.1.9	----------NOTE---------- A single test at the specified Frequency will satisfy this Surveillance for both units. ---------- 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 ≤ 64.5 Hz; b. Within 4.5 seconds following load rejection, the voltage is ≥ 3760 V and ≤ 4560 V, and after steady state conditions are reached, maintains voltage ≥ 4000 V and ≤ 4400 V; and c. Within 6 seconds following load rejection, the frequency is ≥ 59.3 Hz and ≤ 60.5 Hz.	In accordance with the Surveillance Frequency Control Program
SR 3.8.1.10	----------NOTE---------- A single test at the specified Frequency will satisfy this Surveillance for both units. ---------- Verify each DG does not trip and voltage is maintained ≤ 4560 V during and following a load rejection of ≥ 4000 kW.	In accordance with the Surveillance Frequency Control Program

(continued)

SURVEILLANCE REQUIREMENTS (continued)

SURVEILLANCE	FREQUENCY
SR 3.8.1.11 ----------NOTES---------- 1. All DG starts may be preceded by an engine prelube period. 2. This Surveillance shall not be performed in MODE 1, 2 or 3. 3. This SR shall be performed for each DG on a rotational test basis and for each 4.16 kV ESS bus at the specified FREQUENCY. ---------- Verify on an actual or simulated loss of offsite power signal: a. De-energization of 4.16 kV ESS buses; b. Load shedding from 4.16 kV ESS buses; and c. DG auto-starts from standby condition and: 1. energizes permanently connected loads in ≤ 10 seconds, 2. energizes auto-connected shutdown loads through individual load timers, 3. maintains steady state voltage ≥ 4000 V and ≤ 4400 V, 4. maintains steady state frequency ≥ 59.3 Hz and ≤ 60.5 Hz, and 5. supplies permanently connected loads for ≥ 5 minutes.	In accordance with the Surveillance Frequency Control Program

(continued)

SURVEILLANCE REQUIREMENTS (continued)

SURVEILLANCE	FREQUENCY
SR 3.8.1.12 ----------NOTES---------- 1. All DG starts may be preceded by an engine prelube period. 2. DG E, when not aligned to the Class 1E distribution system, may satisfy this SR for both units by performance of SR 3.8.1.12.a, b and c using the test facility to simulate a 4.16 kV ESS bus. SR 3.8.1.12.d and e may be satisfied with either the normally aligned DG or DG E aligned to the Class 1E distribution system. ---------- Verify, on an actual or simulated Emergency Core Cooling System (ECCS) initiation signal, each DG auto-starts from standby condition and: a. In ≤ 10 seconds after auto-start achieves voltage ≥ 3793 V, and after steady state conditions are reached, maintains voltage ≥ 4000 V and ≤ 4400 V; b. In ≤ 10 seconds after auto-start achieves frequency ≥ 58.8 Hz, and after steady state conditions are reached, maintains frequency ≥ 59.3 Hz and ≤ 60.5 Hz; c. Operates for ≥ 5 minutes; d. Permanently connected loads remain energized from the offsite power system; and e. Emergency loads are energized or auto-connected through the individual load timers from the offsite power system.	In accordance with the Surveillance Frequency Control Program

(continued)

SURVEILLANCE REQUIREMENTS (continued)

SURVEILLANCE	FREQUENCY
SR 3.8.1.15 ----------NOTES---------- 1. This Surveillance shall be performed within 5 minutes of shutting down the DG after the DG has operated ≥ 2 hours loaded ≥ 3800 kW. Momentary transients outside of load range do not invalidate this test. 2. All DG starts may be preceded by an engine prelube period. 3. A single test at the specified Frequency will satisfy this Surveillance for both units. ---------- Verify each DG starts and achieves, in ≤ 10 seconds, voltage ≥ 3793 V and frequency ≥ 58.8 and after steady state conditions are reached, maintains voltage ≥ 4000 V and ≤ 4400 V and frequency ≥ 59.3 Hz and ≤ 60.5 Hz.	In accordance with the Surveillance Frequency Control Program

(continued)

SURVEILLANCE REQUIREMENTS (continued)

SURVEILLANCE	FREQUENCY
SR 3.8.1.19 ----------NOTES---------- 1. All DG starts may be preceded by an engine prelube period. 2. This SR shall be performed for each DG on a rotational test basis and for each 4.16 kV ESS bus at the specified FREQUENCY. 3. This Surveillance shall not be performed in MODE 1, 2 or 3. ---------- Verify on an actual or simulated loss of offsite power signal in conjunction with an actual or simulated ECCS initiation signal: a. De-energization of 4.16 kV ESS buses; b. Load shedding from emergency buses; and c. DG auto-starts from standby condition and: 1. energizes permanently connected loads in ≤ 10 seconds, 2. energizes auto-connected emergency loads through individual load timers, 3. achieves steady state voltage ≥ 4000 V and ≤ 4400 V, 4. achieves steady state frequency ≥ 59.3 Hz and ≤ 60.5 Hz, and 5. supplies permanently connected and auto-connected emergency loads for ≥ 5 minutes.	In accordance with the Surveillance Frequency Control Program

(continued)

SURVEILLANCE REQUIREMENTS (continued)

SURVEILLANCE		FREQUENCY
SR 3.8.1.20	----------NOTES---------- 1. All DG starts may be preceded by an engine prelube period. 2. This SR must be met, but does not have to be performed with DG E substituted for any DG. ---------- Verify, when started simultaneously from standby condition, each DG achieves, in ≤ 10 seconds, voltage ≥ 3793 V and frequency ≥ 58.8 and after steady state conditions are reached, maintains voltage ≥ 4000 V and ≤ 4400 V and frequency ≥ 59.3 Hz and ≤ 60.5 Hz.	In accordance with the Surveillance Frequency Control Program
SR 3.8.1.21	----------NOTE---------- When Unit 1 is in MODE 4 or 5, or moving irradiated fuel assemblies in the secondary containment, the Note to Unit 1 SR 3.8.2.1 is applicable. ---------- For required Unit 1 AC sources, the following SRs of Unit 1 Specification 3.8.1 are applicable: SR 3.8.1.1; SR 3.8.1.10; SR 3.8.1.3; SR 3.8.1.11; SR 3.8.1.4; SR 3.8.1.14; SR 3.8.1.5; SR 3.8.1.15; SR 3.8.1.6; SR 3.8.1.16; SR 3.8.1.7; SR 3.8.1.18; SR 3.8.1.9; SR 3.8.1.19; and SR 3.8.1.8 (when more than one Unit 1 offsite circuit is required)	In accordance with applicable SRs

UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D.C. 20555-0001

SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

RELATED TO AMENDMENT NO. 269 TO

RENEWED FACILITY OPERATING LICENSE NO. NPF-14

AND AMENDMENT NO. 251 TO

RENEWED FACILITY OPERATING LICENSE NO. NPF-22

SUSQUEHANNA NUCLEAR, LLC

ALLEGHENY ELECTRIC COOPERATIVE, INC.

SUSQUEHANNA STEAM ELECTRIC STATION, UNITS 1 AND 2

DOCKET NOS. 50-387 AND 388

1.0 INTRODUCTION

By application dated January 25, 2017,[1] as supplemented by letters dated March 21, 2017;[2] August 4, 2017;[3] and December 4, 2017,[4] Susquehanna Nuclear, LLC (the licensee) requested changes to the Technical Specifications (TSs) for Susquehanna Steam Electric Station, Units 1 and 2 (Susquehanna 1 and 2). The supplements dated August 4, 2017, and December 4, 2017, provided additional information that clarified the application, did not expand the scope of the application as originally noticed, and did not change the U.S. Nuclear Regulatory Commission (NRC or the Commission) staff's original proposed no significant hazards consideration determination as published in the *Federal Register* on June 6, 2017 (82 FR 26139).

The proposed changes would revise certain surveillance requirements (SRs) in TS 3.8.1, "AC [Alternating Current] Sources – Operating." Specifically, the proposed changes would revise the allowable steady-state voltage and frequency limits for onsite standby power source of the diesel generators (DGs). The proposed steady-state DG voltage limits and DG frequency limits would allow for the use of a new and more conservative DG design analysis. Implementing the proposed TS SR changes would also resolve non-conservative TS SRs that are specific to the approved DG design analysis. Increasing the minimum acceptable steady-state voltage for the DG, a change from 3793V [volts] to 4000V, and narrowing the steady-state frequency limits, a change from 58.8 Hertz (Hz) to 59.3 Hz and 61.2 Hz to 60.5 Hz, would remove this non-conservatism.

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[1] Agencywide Documents Access and Management System (ADAMS) Accession No. ML17044A149
[2] ADAMS Accession No. ML17080A405
[3] ADAMS Accession No. ML17216A283
[4] ADAMS Accession No. ML17338A516

2.0 REGULATORY EVALUATION

The NRC staff considered the following regulatory requirements, guidance, and licensing and design-basis information during its review of the proposed change.

2.1 Regulatory Requirements

Title 10 of the *Code of Federal Regulations* (10 CFR) Part 50, "Domestic Licensing of Production and Utilization Facilities," Section 50.36, "Technical specifications," establishes the regulatory requirements related to the content of TSs.

Section 50.36(c)(2) to 10 CFR Part 50 states, in part, that the limiting conditions for operation (LCOs) are the lowest functional capability or performance level of equipment required for safe operation of the facility, and when LCOs are not met, the licensee shall shut down the reactor or follow any remedial action permitted by the TSs until the LCO can be met.

Section 50.36(c)(3) to 10 CFR Part 50 requires, in part, that TSs include SRs, which are requirements relating to test, calibration, or inspection to assure that the necessary quality of systems and components is maintained, that facility operation will be within safety limits, and that the LCOs will be met.

Section 50.46, "Acceptance criteria for emergency core cooling systems for light-water nuclear power reactors," to 10 CFR Part 50 requires, in part, that an emergency core cooling system (ECCS) must be designed so that its calculated cooling performance following postulated loss-of-coolant accidents (LOCAs) conform to the criteria set forth in regulations.

Appendix A to 10 CFR Part 50, "General Design Criteria for Nuclear Power Plants" (hereinafter referred to as GDC), establishes the minimum requirements for the principal design criteria for water-cooled nuclear power plants. The principal design criteria establish the necessary design, fabrication, construction, testing, and performance requirements for structures, systems, and components (SSCs) important to safety.

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

GDC 18, "Inspection and testing of electric power systems," requires, in part, that electric power systems that are important to safety must be designed to permit appropriate periodic inspection and testing of important areas and features to assess the continuity of the systems and the condition of their components. The systems shall be, in part, designed with a capability to test periodically (1) the operability and functional performance of the components of the systems, and (2) the operability of the systems as a whole and, under conditions as close to design as practical, the full operation sequence that brings the systems into operation.

2.2 Applicable Guidance

The guidance that the NRC staff considered in its review of this license amendment request (LAR) includes the following.

Regulatory Guide (RG) 1.9, "Application and Testing of Safety-Related Diesel Generators in Nuclear Power Plants," provides acceptable guidance to licensees that complies with the regulations for safety-related DGs intended for use as onsite emergency power sources in nuclear power plants, and specifically, that the emergency DGs be selected with sufficient capacity, be qualified, and have the necessary reliability and availability for design-basis events.

3.0 TECHNICAL EVALUATION

According to the Susquehanna Updated Final Safety Analysis Report, Revision 68, Chapter 8, the DGs provide sufficient power for the electrical loads required for simultaneous shutdown of both reactors during a design-basis event (DBE). This includes the loads required to mitigate the effects of a design-basis LOCA on one unit with a complete loss of offsite power (LOOP), plus a single failure in the onsite power system (such as the loss of one DG), concurrent with a safe shutdown on the other unit.

Four Class 1E DGs (A, B, C, and D) are normally assigned to the four safety-related load groups and are shared by the two units. Additionally, a spare non-Class 1E DG (E) can be manually aligned as a substitute for any of the DGs (A, B, C, or D) without violating the independence of the redundant safety-related load groups. When a DG is aligned, it is connected to the 4.16 kilovolts (kV) bus of the assigned load group per unit. The spare DG (E) has the emergency loading capability of any of the other four DGs. Each DG (A, B, C, or D) is rated 4000 kilowatts (kW) at 0.8 power factor (pf) for continuous operation and 4700 kW for 2000-hour operation. The spare DG (E) is rated 5000 kW at 0.8 pf for continuous operation and 5500 kW for 2000-hour operation.

The ratings for each DG are calculated in accordance with the recommendation of RG 1.9. In the LAR, the licensee stated that DGs A through D are identical in construction and equipment. In support of the SR changes, the licensee provided a discussion of the effects of the SR changes on the transients and LOCA analysis.

3.1 Description of the Proposed TS SR Changes

The proposed TS SR changes would revise the steady-state DG voltage limits of $\geq$ 3793V and $\leq$ 4400V to $\geq$ 4000V and $\leq$ 4400V, and the steady-state DG frequency limits from $\geq$ 58.8 Hz and $\leq$ 61.2 Hz to $\geq$ 59.3 Hz and $\leq$ 60.5 Hz. The minimum steady-state output voltage of 4000V represents the value that will allow the degraded voltage relays to reset after actuation. In the LAR, the licensee stated that the minimum steady-state voltage (3793 V) cannot assure loading of all safety-related equipment onto the engineered safeguard system (ESS) bus during a LOCA, LOOP, or LOCA/LOOP. This value is based on the upper value of the degraded voltage relay reset voltage of 3938V, representing 94.68 percent of 4160V, plus the worst-case voltage drop from the DG to an associated 4.16 kV switchgear bus. The specified maximum steady-state output voltage of 4400V is equal to the maximum operating voltage specified for 4000V. The proposed DG maximum voltage limit ensures that for a lightly loaded distribution system, the voltage at the terminals of 4000V motors is no more than the maximum rated operating voltage.

The minimum frequency value is derived from the guidance in RG 1.9, Revision 0, for DGs A through D, and RG 1.9, Revision 2, for DG E. The allowable steady-state frequency for all DGs is 60 Hz ± 2 percent. The 2 percent margin allowed for the steady-state frequency is reduced to 1 percent, or 0.6 Hz. This value, added to the tolerance allowed for the DGs electronic governor (0.1 Hz), provides the 59.3 Hz minimum frequency value applicable for all DGs. The maximum frequency is derived from analysis based on an iterative approach using voltage and frequency variations of the DG to determine the maximum continuous loading on the DG such that the DG loading does not exceed its continuous rating and still performs its design function. Through a qualitative estimation and a dynamic transient simulation, the maximum frequency meeting the iterative approach is 60.5 Hz. The licensee stated that administrative controls have been established to support the implementation of the proposed DG frequency and voltage limits.

The proposed changes would affect the following SRs:

- SR 3.8.1.7 – Monthly Operability
- SR 3.8.1.9 – Load Reject
- SR 3.8.1.11 – LOOP
- SR 3.8.1.12 – LOCA
- SR 3.8.1.15 – Hot Restart
- SR 3.8.1.19 – LOCA/LOOP
- SR 3.8.1.20 – Simultaneous Start of all four Diesels

3.2 DG Steady-State Voltage

Section 4.1 of the enclosure to the LAR for Susquehanna 1 and 2 states that if the DG supplies voltage to the bus at the lower steady-state limit of 3793V, and the degraded voltage relays (DVRs) have already actuated, the DVRs will not reset, and the load shed signal will remain. This will prevent emergency equipment from loading onto the bus. To allow the reset of the 4160V degraded grid protection logic, the DGs' minimum steady-state voltage has been increased above the upper value of the DVR reset voltage of 94.68 percent of the 4.16 kV bus, or 3938V. The licensee also stated that the selected value of 4000V will not cause undesired operation of the degraded grid relay scheme. The selected value was also evaluated to ensure compatibility with other settings values to which it might be related.

Based on its review, the NRC staff finds that the DG minimum steady-state voltage of 4000V will allow the DG loads to start successfully since (1) the 4000V is above the minimum required equipment voltage and (2) the DVRs will be able to reset to allow load to sequence onto the bus. Therefore, the NRC staff finds the proposed DG minimum steady-state voltage of 4000V acceptable with respect to load starting because the 4000V ensures an adequate starting voltage for the DG loads.

The NRC staff notes that the proposed DG minimum voltage will be acceptable for steady-state operation if voltages are within the proposed range (≥ 4000 V and ≤ 4400 V) to ensure that equipment required for safe shutdown of the plant can successfully operate, as designed, to mitigate the consequences of a DBE.

3.3 DG Steady-State Frequency

Section 4.2 of the enclosure to the LAR for Susquehanna 1 and 2 states that the maximum frequency transient occurs during the start of residual heat removal (RHR) pump motor, which is

the first major and the largest load applied to the DGs during a LOOP, concurrent with a design-basis accident (DBA) test. Table 8.3-1, "Assignment of ESF and Selected Non-ESF Loads to Diesel Generators and ESS Buses," and Table 8.3-3, "Diesel Generator Loading Diesel B Unavailable Unit 1 – Design Basis Accident: Unit 2 – Forced Shutdown," of the Updated Final Safety Analysis Report show that other accident mitigation loads are sequentially loaded onto the DGs prior to the RHR pumps.

In its letter dated July 7, 2017,[5] the NRC staff asked the licensee in Request for Additional Information (RAI) 6 to discuss how the impacts of the frequency and voltage deviations affect the RHR pump and RHR train performance, considering the DGs' frequency and voltage variations during load sequencing when the RHR pump is manually loaded on a DG 30 minutes after the automatic loading of the DG has been completed. In its RAI response dated August 4, 2017,[6] the licensee stated that the guidance in RG 1.9 with respect to the transient frequency and voltage continues to be applicable to the DGs. The licensee also stated that the allowable minimum transient voltage and frequency for the DGs are 75 percent of rated voltage and 57 Hz, respectively. The licensee determined that, based on simulation studies, the worst voltage drop experienced by DGs A and E during the start of an RHR pump motor was 76.4 percent and 76.9 percent of rated voltage, respectively, when the DGs were operating at a voltage of 4400V and frequency of 60 Hz. The licensee also determined that, based on operation experience, the DGs would experience a minimum transient frequency of 57.3 Hz during the start of an RHR pump motor if the DGs were operating at the proposed minimum steady-state frequency limit of 59.3 Hz.

Based on its review, the NRC staff finds that the DGs' minimum transient voltages and frequency during the loading sequence will continue to operate above the allowable minimum transient voltage and frequency for the DGs per GDC 17 during the DG load sequencing. Therefore, the NRC staff concludes that the DG loads will not be negatively impacted by the DGs' transient voltage and frequency while the DGs operate within the proposed DG steady-state voltage and frequency ranges, since the DGs will remain within their design specifications.

3.4 Performance of the DG Lube Oil System

Section 4.3.1 of the enclosure to the LAR for Susquehanna 1 and 2 states that the volumetric flow rate of the engine-driven lube oil pump, a positive displacement pump, will decrease or increase proportionately with a decrease or increase in engine speed. At a minimum steady-state frequency of 59.3 Hz, the volumetric flow rate of the pump will be reduced by approximately 1.2 percent. The licensee stated that this reduction is negligible. The licensee also stated that the discharge pressure of the lube oil pump is relatively constant and independent of the shaft speed. The normal operating pressure of the lube oil pump is 50 pounds per square inch gauge (psig), and the engine low lube oil pressure setting is 30 psig. The licensee indicates that the changes in DG speed (+ 0.8 percent, - 1.2 percent) will not adversely affect the lube oil pump discharge pressure.

The NRC staff has evaluated the information provided by the licensee and finds that a 1.2 percent decrease in lube oil flow rate is not significant and will not affect the performance of the DG lube oil system. Also, the NRC staff finds that a relatively constant lube oil pump discharge

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[5] ADAMS Accession No. ML17180A200
[6] ADAMS Accession No. ML17216A283

pressure will not affect the DG lube oil system, since there is a 20 psig margin in the engine low lube oil pressure setting.

3.5 DG Jacket Water System

Section 4.3.2 of the enclosure to the LAR for Susquehanna 1 and 2 states that the engine-driven jacket water pump is a centrifugal pump and its discharge pressure variation is proportional to the square of the change in speed. The licensee stated that at normal operation (60 Hz), the engine-driven jacket water pump discharge pressure for DG A and DG E is 30 psig. The low pressure alarm is 12 psig for DG A and 10 psig for DG E. When the DG is operating at the minimum steady-state frequency of 59.3 Hz, the engine-driven jacket water pump discharge pressure will decrease by approximately 0.70 psig. In its letter dated July 7, 2017, the NRC staff asked the licensee in RAI 3 to provide the engine-driven jacket water pump pressures and low pressure alarm settings for DGs B through D. In its RAI response dated August 4, 2017, the licensee indicated that the A thru D DGs are identical models and have the same nameplate rating and low pressure alarm. Based on this information, the reduced discharge pressure is well above the jacket water low pressure alarm setpoint.

When the DG is operating at the maximum steady-state frequency of 60.5 Hz, the engine-driven jacket water pump discharge pressure would be approximately 30.5 psig, which is an increase of approximately 0.5 psig. In its letter dated July 7, 2017, the NRC staff asked the licensee in RAI 4 to discuss whether or not any relief valves on the pumps' discharge piping will lift due to the higher discharge pressure when the DG is operating at 60.5 Hz. In its RAI response dated August 4, 2017, the licensee indicated no relief valves on the pumps' discharge piping will lift due to the higher pressure in the DG. The licensee stated that the increase in operating pressure due to the higher DG frequency is small and that system pressures do not operate that close to the relief valve settings. Therefore, the DG frequency variations between 59.3 Hz and 60.5 Hz will not adversely affect the capability of the engine-driven jacket water pump to provide cooling to the engine during DG operation.

Based on its review, the NRC staff finds that a 0.70 psig decrease, or a 0.5 psig increase, in the engine-driven jacket water pump discharge pressure is not significant and will not prevent the DG jacket water system from performing its design function.

3.6 Transients and LOCA Analysis SR Changes

Section 4.3.3 of the enclosure to the LAR for Susquehanna 1 and 2 states that the flow rate of the fuel oil transfer pump is greater than the fuel oil consumption rate of the DG during operation. When the DG is operating at the minimum steady-state voltage and frequency, the fuel oil transfer pump flow rate would decrease by approximately 2.06 percent. The licensee stated that this decreased fuel oil flow rate will exceed the flow rate requirement for all of the DGs. DG operation at the maximum steady-state voltage and frequency will increase the fuel oil transfer pump flow rate. This increase in flow rate will result in increased pipe velocities and system pressures. The increased flow rate will increase the pump suction side losses and will reduce the available net positive suction head (NPSHa). A decrease in fuel oil flow due to decreased DG speed will decrease the pump suction side losses, which will increase the NPSHa. Based on the above, the margin between NPSHa and the required NPSH (NPSHr) would increase by approximately 4.1 percent during DG steady-state operation at 59.3 Hz. Conversely, the margin between NPSHa and NPSHr would decrease by approximately 3.1 percent when the DG is operating at a steady-state frequency of 60.5 Hz. The licensee

stated that the excess margin in NPSHa more than compensates for the changes in the fuel oil transfer pump flow rate resulting from the variations in the DG frequency and voltage.

In its letter dated July 7, 2017, the NRC staff asked the licensee in RAI 2 to discuss the change in NPSH margin for each pump affected by the LAR when the DG operates at a steady-state frequency of 60.5 Hz. In its RAI response dated August 4, 2017, the licensee discussed the change in NPSH margin for the ECCS pumps (RHR pumps, core spray pumps, emergency service water pumps, and residual heat removal service water (RHRSW) pumps) when the DGs operate at a steady-state frequency of 60.5 Hz. The licensee stated that based on the pump affinity laws, the change in pump flow is directly proportional to the frequency increase. Therefore the pump flow will increase by a factor of 1.008 at 60.5 Hz. Also, the pump suction line losses are proportional to the square of the frequency increase, and will increase by a factor of 1.017. The licensee provided data that showed that all of the ECCS pumps have margin between the NPSHr and the NPSHa. The RHRSW pumps have a margin of 0.7 feet at a flow rate of 11,340 gallons per minute (gpm) at 60.5 Hz. However, the licensee stated that plant operating procedures limit the RHRSW flow rate to 8,000 – 9,000 gpm, which significantly increases the available NPSH margin for these pumps.

Based on its review, the NRC staff finds that due to the existing margin in the fuel oil transfer pump flow rate and NPSH, a 2.06 percent decrease in the fuel oil transfer pump flow rate and a 3.1 percent decrease in the fuel oil transfer pump NPSHa will not prevent the fuel oil transfer pump from performing its design function. The NRC staff finds that a 2.06 percent decrease in the fuel oil transfer pump flow rate is acceptable because the licensee stated that this flow rate is greater than the DG fuel consumption rate. Also, the NRC staff finds that the NPSH margin for the RHRSW pumps will be increased at a lower flow rate of 8,000 – 9,000 gpm, instead of a flow rate of 11,340 gpm, because the NPSHr will be reduced at the lower flow rate. The NRC staff finds that the NPSHr and NPSHa values generated by the licensee using the pump affinity laws provide sufficient margin to allow the ECCS pumps to perform their design functions when the DGs are operating at a frequency of 60.5 Hz.

3.7 Impact on DG Loading

Section 4.3.4 of the enclosure to the LAR for Susquehanna 1 and 2 states that the cumulative impact of the voltage and frequency variations was evaluated for the DG loading during the worst-case DBE. The licensee indicated that it performed the DG loading analysis with DG A and DG E because DG A has the most connected loads at 60 minutes and beyond the worst-case DBE, and DG E can be substituted for DG A. The licensee used the DG loading in Updated Final Safety Analysis Report Table 8.3-3 without non-engineered safety feature (ESF) loads manually initiated for the DG loading analysis. Only major ESF motor-pump loads were evaluated individually, and the remaining loads were lumped for the analysis.

The NRC staff evaluated the above-mentioned analysis regarding the total loading of DG A and DG E and determined that additional information was required. In its letter dated July 7, 2017, the NRC staff asked the licensee in RAI 5 to provide a discussion, including a tabulated summary of the analysis that demonstrates DG A and DG E total loadings with and without non-ESF loads required for mitigating the worst-case DBE when the DGs operate at the extremes of the proposed steady-state voltage and frequency ranges.

In its RAI response dated August 4, 2017, the licensee referred to excerpts of calculation EC-024-1035 in Attachment 3 of the LAR for the summary of the DG loading analysis. Section 7.3, "Diesel Loading," Table 8, "DG A and E Total Estimated Loading when Unit 1 DBA

and Unit 2 Forced Shutdown with DG Unavailable (at 60 Min & Beyond) – Without Non-ESF Loads Manually Initiated," of Attachment 3 of the LAR, provides the estimated DGs A and E total loadings for limiting voltage and frequency within the proposed DG stated voltage and frequency ranges. The licensee stated that the results of voltage and frequency variations on DG A and E loadings are considered bounding for all DGs.

Based on its review, the NRC staff finds that the maximum estimated total loadings at the extreme voltage and frequency limits for DG A and DG E remain within the DGs' respective continuous ratings. Since the results of voltage and frequency variations on DG A and E loadings are bounding for all DGs, the NRC staff finds that the loadings for all DGs within the proposed steady-state voltage and frequency ranges will remain within the continuous ratings of the DGs. Therefore, the NRC staff concludes that the DGs have capacities to supply power to the loads required to mitigate the worst-case DBE at the proposed steady-state voltage and frequency, since the DGs ratings will bound their loadings expected at the extreme proposed DG voltage and frequency limits.

3.8 DG Fuel Oil Consumption

Section 4.3.5 of the enclosure to the LAR for Susquehanna 1 and 2 states that the required fuel oil volumes for 7 days of operation are determined based on the full load continuous rating of 4000 kW for DG A through D, and 5000 kW for DG E. The licensee stated that the total loading of each DG required for the mitigation of a Unit 1 DBA with a Unit 2 forced shutdown while operating within the acceptable TS steady-state voltage and frequency ranges remains below the continuous ratings stated above. The fuel oil tanks for DGs A through D have approximately 1,574 gallons of spare volume above the volume required for 7 days of operation. The fuel oil tank for DG E has approximately 16,670 gallons of spare volume above the volume required for 7 days of continuous operation. The licensee stated that the DG fuel oil consumption resulting from the operation within the steady-state voltage and frequency ranges considered will not adversely affect the fuel oil volume required for 7 days of continuous operation of each DG.

Based on its review, the NRC staff finds that the existing fuel oil storage volume is adequate for 7 days of continuous DG operation within the steady-state voltage and frequency ranges because there is adequate margin in the stored amount of fuel oil to operate the DGs at a load less than the continuous rating.

3.9 Impact on Motor-Driven loads

Section 4.3.6 of the enclosure to the LAR for Susquehanna 1 and 2 discusses the impact of the frequency variations on the plant's motors. In its letter dated July 7, 2017, the NRC staff asked the licensee in RAI 7 to provide a discussion regarding the impact of the voltage and frequency variations on the motors. In its RAI response dated August 4, 2017, the licensee stated that the protective relays associated with the DG motor loads would not be impacted because the minimum settings for the relays incorporate a margin that would envelope the small changes experienced by the motors during the DG frequency and voltage variations. The licensee also stated that the settings of the overload protective trip devices include margins that would protect the motors against pump runout conditions. The NRC staff reviewed the licensee's evaluation for the protective devices and finds that the existing protective devices for the DG motor loads remain adequate for operation at the proposed DG voltage and frequency limits because the existing protective devices are set with margins to protect the motors during variations of the proposed DG steady-state voltage and frequency.

Also, in its RAI response dated August 4, 2017, the licensee referenced the excerpts of calculation EC-024-1035 in Attachment 3 to the LAR. In Section 7.5, "Effects on Motors," of Attachment 3 of the LAR, the licensee used a ΔS equation to estimate the net effect of the DG voltage and frequency variations on motor steady-state speed. The ΔS equation is approximated by considering the motor speed-torque curves in the area of intersection with the pump speed-torque curve as straight lines. In its request dated October 27, 2017,[7] the NRC staff asked the licensee in RAI 1 to discuss any errors introduced by the approximation for the ΔS equation based on the DGs' motor and pump loads speed-torque curves. Different motors with the same nominal horsepower may have different start current, torque curves, speeds, and other variables. In its RAI response dated December 4, 2017,[8] the licensee stated that the DG major ESF motor loads at Susquehanna 1 and 2 are National Electrical Manufacturers Association design B motors and follow the characteristics of a typical pump motor curve with steep slopes in their operational regions. The licensee stated that as the slopes of these curves approach infinity, the error introduced by the approximation for the ΔS equation approaches zero. The licensee concluded that this small error introduced in the ΔS equation is insignificant and will not produce a negative impact on the performance of the motors or their intended safety stations.

Based on its review, the NRC staff finds that the use of the ΔS equation approximation to estimate the change in the steady-state speed of the Susquehanna 1 and 2 DGs' major motors is acceptable based on the fact that the small error introduced in the ΔS equation is not significant and will not produce a negative impact on the performance of the motors with typical National Electrical Manufacturers Association design B motor characteristics.

Table 11, "Speed & HP [Horsepower] Variation Matrix of Major Motor Loads," of Section 7.5 of Attachment 3 of the LAR, provides the results of calculated changes in the speed and HP of the DG major motor loads due to changes in DG steady-state voltage and frequency. The DG major motor loads evaluated were the reactor core spray pump motors, the RHR pump motors, the RHR service water pump motors, and the emergency service water pump motors. Table 11 of Section 7.5 shows that the maximum change in motor HP would occur when the DG is operating at maximum steady-state voltage and frequency (4400V and 60.5 Hz). In its request dated October 27, 2017, the NRC staff asked the licensee in RAI 2 to discuss the impact of the increased HP on the DG motor loads capabilities. In its RAI response dated December 4, 2017, the licensee provided the maximum brake HP for the major ESF pumps and their associated motors' service factors. The licensee stated that the DG static voltage regulator maintains a constant generator output voltage of 4250V nominal, and the DG electronic governors are set to control the frequency of the DGs to 60 Hz ± 0.1 Hz. The licensee further stated that the operation of the DG at the proposed voltage and frequency limits will only occur on a temporary basis in cases where the static voltage regulator or the electronic governor fails, or the DG is synchronized with offsite sources.

Based on its review, the NRC staff finds that the maximum increased HP demands of the RHR pumps, the RHR service water pump motors, and the emergency service water pump motors are within their respective motors' capabilities, considering the motors' ratings and service factors. Therefore, the NRC staff finds that the DGs' major ESF motor loads will be able to perform their safety functions when operating within the proposed steady-state voltage and frequency ranges because the motors will be capable of supplying the maximum HP demands.

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[7] ADAMS Accession No. ML17317A022
[8] ADAMS Accession No. ML17338A516

The NRC staff also noted that the increased HP demand from the reactor core spray pump at the proposed maximum voltage and frequency is higher than the core spray pump motor's nameplate rating. If the core spray pump motor were to operate above its nameplate rating, the motor's windings would overheat. In addition, the operating temperature of all the DG motor loads are impacted by the voltage and frequency variations within the proposed ranges. In its request dated October 27, 2017, the NRC staff asked the licensee in RAI 2 to discuss the cumulative impact of the DG frequency and voltage variations on the motors' operating temperatures.

In its RAI response dated December 4, 2017, the licensee stated that with the DG motors operating at the proposed maximum voltage and frequency, the net effect on the motors' windings would be a temperature rise of approximately 1 to 2 degrees Celcius (°C) for frequency plus an approximate -3 °C drop for voltage. The licensee concluded that, "The increase in operating temperature of the motor by an approximate 1 to 2 °C will not have a negative impact to the motor." In Section 7.5 of Attachment 3 of the LAR, the licensee stated that Susquehanna non-environmentally qualified motors have Class B or F insulation system with allowable motor winding temperature rises of 80 °C and 105 °C (based on ambient temperature of 40 °C), respectively, and the environmentally qualified motors have a winding temperature of ~110°C.

Based on its review, the NRC staff finds that the minor increase in winding temperature rise of the DGs' motor loads is acceptable and will not have a negative impact on the performance of the motors since the motors' allowable temperature rises will bound the minor increase. The NRC staff also finds that the core spray pump motors will be able to perform their safety functions when operating at the maximum proposed steady-state voltage and frequency because the resulting motor temperature rise is acceptable, and operation of the DG at the proposed maximum voltage and frequency will only occur on a temporary basis.

3.10 Impact of Changes to DG Voltage and Frequency Limits on Motor-Operated Valves (MOV) Operation

Section 4.3.7 of the enclosure to the LAR for Susquehanna 1 and 2 discusses the effects of the DG voltage and frequency limits changes on the performance of the MOVs related to the valve stroke time. Regarding the voltage changes effects, the licensee indicates that the motor torque capability for the MOVs is calculated based on the ESS 4.16kV bus voltage set at the minimum degraded grid voltage dropout of 91.2 percent (~3793V). This setting represents the most degraded voltage level expected when accounting for the degraded voltage relay tolerance prior to the bus undervoltage protection scheme operation. The proposed lower limit of the DG steady-state voltage of 4000V is higher by ~207V than the 4.16 kV ESS bus voltage level currently used to evaluate MOV motor torque capability.

For the frequency changes, the licensee indicated that the DG operation at a steady-state frequency of 59.3 Hz will increase the MOV close stroke time, and operation at a steady-state frequency of 60.5 Hz will shorten the MOV close stroke time. The licensee evaluates the effects of a 2 percent frequency reduction, which bounds the 1 percent reduction for the proposed low frequency limit of 59.3 Hz changed from 60 Hz, on the MOV stroke time. The licensee indicates on page 8 in Section 3-2 of Attachment 3 to the enclosure of the LAR that, although reducing the frequency would decrease the synchronous speed, the decrease would be offset by a slight increase in torque due to higher magnetizing current and magnetic flux at a higher volts per hertz ration. The licensee stated that a shorter close stroke time due to an increase in motor speed operating at 60.5 Hz will not adversely affect the valve performance. Therefore, the MOV

stoke times would increase by slightly less than 2 percent. A total of 74 MOVs are identified as critical and have a TS or Final Safety Analysis Report stroke time limit. The licensee verifies that the stroke times of these valves when adjusted for the effects of the DG steady-state frequency limits changes have positive margin remaining when compared with the TS/Final Safety Analysis Report limiting value for full stroke time, which bounds the MOV stroke times assumed in the accident analysis.

Based on its review, the NRC staff concludes that the licensee has shown that the effects of the calculation for MOV motor torque capability and stroke time bound the DG minimum TS steady-state voltage limit of 4000V, and their impact on MOV operation is negligible with no adverse impact for the limiting value for full stroke time. The NRC staff determines that the analysis of record (AOR) for the transients and the LOCA remains valid in terms of the subject MOV stroke times under the proposed DG steady-state voltage and frequency conditions. The NRC staff finds that the lower voltage limit is increased, thus improving the previous calculated margins, and the tighter frequency band will mean a tighter stroke band. The total band difference is negligible on overall MOV stroke time.

3.11 Battery Chargers

Section 4.3.8 of the enclosure to the LAR for Susquehanna 1 and 2 states that the DGs supply the 250V direct current ESS battery chargers and the 125V direct current battery chargers during the long-term mitigation of the worst-case DBE. The licensee stated that the battery chargers will regulate output voltage within ± 0.5 percent of the desired steady-state voltage with AC line voltage and frequency variations of ± 10 percent and ± 5 percent, respectively.

Based on its review, the NRC staff finds that the battery charger's output voltage will vary less than 0.5 percent, since the battery charger's AC input voltage and frequency variations bound the DG voltage and frequency variations within the proposed TS ranges. The NRC staff finds that the voltage and frequency variations within the proposed steady-state range will not adversely impact the battery chargers since these variations will remain within the capability of the battery chargers.

3.12 Impact of DG Voltage and Frequency Limits Changes on the LOCA Analysis

Section 4.3.9 of the enclosure to the LAR for Susquehanna 1 and 2 discusses the effects of the DG voltage and frequency limits changes on the LOCA analysis. The licensee performs LOCA analyses for the Susquehanna 1 and 2 units using the AREVA methodology, which is an NRC-approved evaluation model using Appendix K models described in paragraph (a)(1)(ii) of 10 CFR 50.46 requirements. Based on the conservative nature of the AREVA Appendix K evaluation model, the licensee stated that there is no need to account for the impacts of uncertainties in site-specific ECCS flow rates induced by a < 2 percent reduction in DG speed in the LOCA analysis.

The proposed TS changes to the voltage and frequency limits could reduce the ECCS flow rates required to provide core cooling and reactor vessel water inventory makeup for LOCA events. In its letter dated March 6, 2017,[9] the NRC staff asked the licensee in RAI 2 to provide an estimate of the effects of the TS changes to demonstrate that the impact of the TS changes would be small, and the calculated peak cladding temperature (PCT) for the limiting LOCA event would not exceed the allowable limit in 10 CFR 50.46.

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[9] ADAMS Accession No. ML17059D214

In its RAI response dated March 21, 2017,[10] the licensee identified that two ECCS systems credited in the current AOR for the LOCA event would be impacted by the TS changes. They are the core spray system and the RHR system operated in the low pressure coolant injection mode. The LOCA AOR uses a reduced flow rate with respect to the required TS ECCS flow rates specified in TS SR 3.5.1.7, System Flow Rate. To determine if the AOR would be affected, the licensee performs an estimate to assess whether the expected ECCS flow rates at the proposed DG voltage and frequency limits are bounded by the flow rates used in the AOR. The estimate analysis utilizes two methods: (1) the use of a formula (ΔS equation) to determine the change in pump speed due to voltage and frequency variations, and (2) the application of the commonly-used pump affinity laws to determine the change in pump flow rates and heads for the values in TS SR 3.5.1.7 based on the change in pump speed.

The NRC staff notes that the derivation of the ΔS equation uses an approximation assuming that the relationship of the pump speed and the associated torque is linear from the point of the maximum torque to the end of the pump speed-torque curve at synchronous speed. Although the use of the ΔS equation would involve uncertainties in determining the ECCS pump speed change, and thus, result in a reduction in the minimum ECCS flow rate due to voltage and frequency variations, the NRC staff concludes that the effect of the uncertainties on the ECCS flow rates on the LOCA analysis would be minor and would be adequately compensated by the conservatisms in the AREVA Appendix K evaluation model used in the LOCA analysis for Susquehanna 1 and 2.

The results of the estimate analysis for the ECCS flow rate show that:

- The calculated core spray flow rates at the reduced DG frequency and voltage conditions are bounded by the flow rates used in the LOCA analysis at all differential pressures.

- The calculated RHR flow rates at the reduced DG frequency and voltage conditions are slightly below the values assumed in the LOCA analysis from 270 psig to about 200 psig. At pressures below 200 psig, the calculated RHR flow rates are greater than that assumed in the LOCA analysis. The PCT for the limiting LOCA event would occur at approximately 118 seconds following the LOCA initiation when the reactor vessel pressure decreases to 25 psig. A comparison of the RHR flow rates shows that the integrated RHR flow rate under the reduced DG voltage and frequency conditions from 270 psig to 25 psig, where the PCT occurs, is greater than that used in the AOR for the LOCA, assuring the adequacy of the AOR at the reduced DG voltage and frequency conditions.

In its letter dated July 7, 2017, the NRC staff asked the licensee in RAI 1 to evaluate the effects of the reduced DG frequency and voltage on non-limiting LOCA analysis. In its RAI response dated August 4, 2017, the licensee indicated that for the non-limiting cases that undergo a rapid pressure transient, the same rationale demonstrating the acceptable AOR limiting case is applicable to these cases. For relatively slower depressurization LOCAs, the automatic depressurization system would rapidly depressurize the reactor vessel, resulting in the same condition for these non-limiting LOCAs characterized by a rapid pressure transient. In addition,

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[10] ADAMS Accession No. ML17080A405

the PCTs for that non-limiting LOCA event are at least 65 degrees Fahrenheit (°F) lower than the limiting case.

Based on its review, the NRC staff has determined that the information provides reasonable assurance that the impact on ECCS flow rates as a result of the ECCS flow rate estimate analysis is bounded by the conservatisms in the AREVA Appendix K evaluation model. The NRC staff also finds that the non-limiting LOCA cases would remain non-limiting, and the voltage and frequency limits in the proposed TS SRs would not adversely affect the ECCS flow rates used in the LOCA analysis. Therefore, the NRC staff concludes that the AOR remains acceptable.

3.13 NRC Staff Summary

The NRC staff reviewed the proposed changes to Susquehanna 1 and 2 TS 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 3.8.1.20 for onsite standby power source of the DGs. The changes would narrow the DG steady-state voltage and frequency ranges in the SRs. Based on its review, the NRC staff finds that although the changes would narrow the DG steady-state voltage and frequency ranges in the SRs, the DGs' minimum transient voltages and frequency during the loading sequence remain above the allowable minimum transient voltage and frequency for the DGs.

The proposed amendments comply with GDC 17 because the SSCs important to safety will continue to operate with sufficient power sources. The proposed amendments comply with GDC 18 because the emergency DGs may be safely tested in Modes 1 or 2. The proposed amendments comply with 10 CFR 50.36(c)(3) because facility operation will be within safety limits, and the LCOs will be met. The proposed amendments comply with 10 CFR 50.46 as far as they are related to the requirement of the acceptable ECCS performance. Therefore, the NRC staff concludes that the proposed TS changes will have minimal impact on the licensee's ability to continue to comply with the requirements of 10 CFR 50.36(c), 10 CFR 50.46, GDC 17, and GDC 18.

4.0 STATE CONSULTATION

In accordance with the Commission's regulations, the Pennsylvania State official was notified of the proposed issuance of the amendments on December 21, 2017. The State official had no comments.

5.0 ENVIRONMENTAL CONSIDERATION

The amendments change a requirement with respect to installation or use of a facility component located within the restricted area as defined in 10 CFR Part 20 and changes SRs. The NRC staff has determined that the amendments involve no significant increase in the amounts, and no significant change in the types, of any effluents that may be released offsite, and that there is no significant increase in individual or cumulative occupational radiation exposure. The Commission has previously issued a proposed finding that the amendments involve no significant hazards consideration, and there has been no public comment on such finding (82 FR 26139). Accordingly, the amendments meet the eligibility criteria for categorical exclusion set forth in 10 CFR 51.22(c)(9). Pursuant to 10 CFR 51.22(b), no environmental impact statement or environmental assessment need be prepared in connection with the issuance of the amendments.

6.0 CONCLUSION

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

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Date: January 22, 2018

SUBJECT: SUSQUEHANNA STEAM ELECTRIC STATION, UNITS 1 AND 2 – ISSUANCE OF AMENDMENTS RE: DIESEL GENERATOR SURVEILLANCE REQUIREMENTS WITH NEW STEADY-STATE VOLTAGE AND FREQUENCY LIMITS (CAC NOS. MF9131 AND MF9132; EPID L-2017-LLA-0180) DATED JANUARY 22, 2018

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