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

January 3, 2023

Mr. David P. Rhoades
Senior Vice President
Constellation Energy Generation, LLC
President and Chief Nuclear Officer
Constellation Nuclear
4300 Winfield Road
Warrenville, IL 60555

SUBJECT: LIMERICK GENERATING STATION, UNITS 1 AND 2 – ISSUANCE OF AMENDMENTS NOS. 258 AND 220 REGARDING TECHNICAL SPECIFICATIONS 3/4.8.1, "AC SOURCES-OPERATING" AND 3/4.5.1, "ECCS-OPERATING" (EPID L-2020-LLA-0233)

Dear Mr. Rhoades:

The U.S. Nuclear Regulatory Commission has issued the enclosed Amendment No. 258 to Renewed Facility Operating License No. NPF-39 and Amendment No. 220 to Renewed Facility Operating License No. NPF-85 for the Limerick Generating Station, Units 1 and 2, respectively. The amendments are in response to your application dated December 15, 2021 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML21349B378).

The amendments revise the Technical Specifications (TSs) of certain frequency and voltage acceptance criteria for the steady-state emergency diesel generator surveillance requirements under TS 3/4.8.1, "AC [Alternate Current] Sources -Operating." In addition, the amendments revise the flow acceptance criteria for the emergency core cooling system (ECCS) pump under TS 3/4.5.1, "ECCS-Operating."

A copy of the Safety Evaluation is also enclosed. A Notice of Issuance will be included in the Commission's monthly *Federal Register* notice.

Sincerely,

/RA/

V. Sreenivas, Project Manager
Plant Licensing Branch I
Division of Operating Reactor Licensing
Office of Nuclear Reactor Regulation

Docket Nos. 50-352 and 50-353

Enclosures:
1. Amendment No. 258 to NPF-39
2. Amendment No. 220 to NPF-85
3. Safety Evaluation

cc: Listserv

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

CONSTELLATION ENERGY GENERATION, LLC

DOCKET NO. 50-352

LIMERICK GENERATING STATION, UNIT 1

AMENDMENT TO RENEWED FACILITY OPERATING LICENSE

Amendment No. 258
Renewed License No. NPF-39

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

   A. The application for amendment by Constellation Generation Company, LLC (Constellation Generation Company), dated December 15, 2022, complies with the standards and requirements of the Atomic Energy Act of 1954, as amended (the Act), and the Commission's rules and 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 rules and 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;

   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 renewed 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-39 is hereby amended to read as follows:

(2) Technical Specifications

The Technical Specifications contained in Appendix A as revised through Amendment No. 258 and the Environmental Protection Plan contained in Appendix B, both of which are attached hereto, are hereby incorporated into the renewed license. The licensee shall operate the facility in accordance with the Technical Specifications and the Environmental Protection Plan.

3. This license amendment is effective as of the date of its issuance and shall be implemented within 120 days of the date of issuance.

FOR THE NUCLEAR REGULATORY COMMISSION

Hipolito J. Gonzalez

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Date: 2023.01.03 16:10:56 -05'00'

Hipólito J. González, 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

ATTACHMENT TO LICENSE AMENDMENT NO. 258

LIMERICK GENERATING STATION, UNIT 1

RENEWED FACILITY OPERATING LICENSE NO. NPF-39

DOCKET NO. 50-352

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 a marginal line indicating the area of change.

Remove Page	Insert Page
3	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 a marginal line indicating the areas of change.

Remove Page	Insert Page
3/4 5-4	3/4 5-4
3/4 8-3	3/4 8-3
3/4 8-4	3/4 8-4
3/4 8-5	3/4 8-5
3/4 8-6	3/4 8-6
3/4 8-7a	3/4 8-7a
3/4 8-16	3/4 8-16

(2) Pursuant to the Act and 10 CFR Part 70, to receive, possess and to use at any time special nuclear material as reactor fuel, in accordance with the limitations for storage and amounts required for reactor operation, as described in the Final Safety Analysis Report, as supplemented and amended;

(3) 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 sources for reactor instrumentation and radiation monitoring equipment calibration, and as fission detectors in amounts as required;

(4) Pursuant to the Act and 10 CFR Parts 30, 40, 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) 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, and to receive and possess, but not separate, such source, byproduct, and special nuclear materials as contained in the fuel assemblies and fuel channels from the Shoreham Nuclear Power Station.

C. This renewed 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 (except as exempted from compliance in Section 2.D. below) 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

Constellation Energy Generation, LLC is authorized to operate the facility at reactor core power levels not in excess of 3515 megawatts thermal (100% rated power) in accordance with the conditions specified herein and in Attachment 1 to this license. The items identified in Attachment 1 to this renewed license shall be completed as specified. Attachment 1 is hereby incorporated into this renewed license.

(2) Technical Specifications

The Technical Specifications contained in Appendix A and the Environmental Protection Plan contained in Appendix B, as revised through Amendment No. 258, are hereby incorporated into this renewed license. Constellation Energy Generation Company shall operate the facility in accordance with the Technical Specifications and the Environmental Protection Plan.

SURVEILLANCE REQUIREMENTS

4.5.1 The emergency core cooling systems shall be demonstrated OPERABLE by:

a. In accordance with the Surveillance Frequency Control Program:

1. For the CSS, the LPCI system, and the HPCI system:

a) Verifying locations susceptible to gas accumulation are sufficiently filled with water.

b) Verifying that each valve (manual, power-operated, or automatic) in the flow path that is not locked, sealed, or otherwise secured in position, is in its correct* position.***

2. For the LPCI system, verifying that both LPCI system subsystem cross-tie valves (HV-51-182 A, B) are closed with power removed from the valve operators.

3. For the HPCI system, verifying that the HPCI pump flow controller is in the correct position.

4. For the CSS and LPCI system, performance of a CHANNEL FUNCTIONAL TEST of the injection header ΔP instrumentation.

b. Verifying that, when tested pursuant to Specification 4.0.5:

1. Each CSS pump in each subsystem develops a flow of at least 2500 gpm against a test line pressure corresponding to a reactor vessel to primary containment differential pressure of $\geq$ 105 psid plus head and line losses.

2. Each LPCI pump in each subsystem develops a flow of at least 8000 gpm against a test line pressure corresponding to a reactor vessel to primary containment differential pressure of $\geq$ 20 psid plus head and line losses.

3. The HPCI pump develops a flow of at least 5600 gpm against a test line pressure which corresponds to a reactor vessel pressure of 1040 psig plus head and line losses when steam is being supplied to the turbine at 1040, +13, -120 psig.**

c. In accordance with the Surveillance Frequency Control Program:

1. For the CSS, the LPCI system, and the HPCI system, performing a system functional test which includes simulated automatic actuation of the system throughout its emergency operating sequence and verifying that each automatic valve in the flow path actuates to its correct position. **** Actual injection of coolant into the reactor vessel may be excluded from this test.

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* Except that an automatic valve capable of automatic return to its ECCS position when an ECCS signal is present may be in position for another mode of operation.

** The provisions of Specification 4.0.4 are not applicable provided the surveillance is performed within 12 hours after reactor steam pressure is adequate to perform the test. If OPERABILITY is not successfully demonstrated within the 12-hour period, reduce reactor steam dome pressure to less than 200 psig within the following 72 hours.

*** Not required to be met for system vent flow paths opened under administrative control.

**** Except for valves that are locked, sealed, or otherwise secured in the actuated position.

SURVEILLANCE REQUIREMENTS

4.8.1.1.1 Each of the above required independent circuits between the offsite transmission network and the onsite Class 1E distribution system shall be:

a. Determined OPERABLE in accordance with the Surveillance Frequency Control Program by verifying correct breaker alignments and indicated power availability, and

b. Demonstrated OPERABLE in accordance with the Surveillance Frequency Control Program by transferring, manually and automatically, unit power supply from the normal circuit to the alternate circuit.

4.8.1.1.2 Each of the above required diesel generators shall be demonstrated OPERABLE:

a. In accordance with the Surveillance Frequency Control Program on a STAGGERED TEST BASIS by:

1. Verifying the fuel level in the day fuel tank.

2. Verifying the fuel level in the fuel storage tank.

3. Verifying the fuel transfer pump starts and transfers fuel from the storage system to the day fuel tank.

4. Verify that the diesel can start* and gradually accelerate to synchronous speed with steady-state generator voltage ≥ 4160 V and ≤ 4400 V and frequency ≥ 59.8 Hz and ≤ 60.8 Hz.

5. Verify diesel is synchronized, gradually loaded* to an indicated 2700-2800 KW** and operates with this load for at least 60 minutes.

6. Verifying the diesel generator is aligned to provide standby power to the associated emergency busses.

7. Verifying the pressure in all diesel generator air start receivers to be greater than or equal to 225 psig.

*This test shall be conducted in accordance with the manufacturer's recommendations regarding engine pre-lube and warmup procedures, and as applicable regarding loading and shutdown recommendations.

**This band is meant as guidance to avoid routine overloading of the engine. Loads in excess of this band for special testing under direct monitoring by the manufacturer or momentary variations due to changing bus loads shall not invalidate the test.

b. By removing accumulated water:

1) From the day tank in accordance with the Surveillance Frequency Control Program and after each occasion when the diesel is operated for greater than 1 hour, and

2) From the storage tank in accordance with the Surveillance Frequency Control Program.

c. By sampling new fuel oil in accordance with ASTM D4057-81 prior to addition to the storage tanks and:

1) By verifying in accordance with the tests specified in ASTM D975-81 prior to addition to the storage tanks that the sample has:

a) An API Gravity of within 0.3 degrees at 60°F or a specific gravity of within 0.0016 at 60/60°F, when compared to the supplier's certificate or an absolute specific gravity at 60/60°F of greater than or equal to 0.83 but less than or equal to 0.89 or an API gravity at 60°F of greater than or equal to 27 degrees but less than or equal to 39 degrees.

b) A kinematic viscosity at 40°C of greater than or equal to 1.9 centistokes, but less than or equal to 4.1 centistokes, if gravity was not determined by comparison with the supplier's certification.

c) A flash point equal to or greater than 125°F, and

d) A clear and bright appearance with proper color when tested in accordance with ASTM D4176-82.

2) By verifying within 31 days of obtaining the sample that the other properties specified in Table 1 of ASTM D975-81 are met when tested in accordance with ASTM D975-81 except that the analysis for sulfur may be performed in accordance with ASTM D1552-79 or ASTM D2622-82.

d. In accordance with the Surveillance Frequency Control Program by obtaining a sample of fuel oil from the storage tanks in accordance with ASTM D2276-78, and verifying that total particulate contamination is less than 10 mg/liter when checked in accordance with ASTM D2276-78, Method A, except that the filters specified in ASTM D2276-78, Sections 5.1.6 and 5.1.7, may have a nominal pore size of up to three (3) microns.

e. In accordance with the Surveillance Frequency Control Program by:

1. Deleted

2. Verifying each diesel generator's capability to reject a load of greater than or equal to that of its single largest post-accident load, and:

a) Following load rejection, the frequency is $\leq$ 66.5 Hz;

b) Within 1.8 seconds following the load rejection, the voltage is $\geq$ 3865 V and $\leq$ 4705 V, and frequency $\geq$ 58.8 Hz and $\leq$ 61.2 Hz; and

c) After steady-state conditions are reached, voltage is maintained $\geq$ 4160 V and $\leq$ 4400 V and frequency $\geq$ 59.8 Hz and $\leq$ 60.8 Hz.

SURVEILLANCE REQUIREMENTS (Continued)

3. Verifying the diesel generator capability to reject a load of 2850 kW without tripping. The generator voltage shall not exceed 4784 volts during and following the load rejection.

4. Simulating a loss-of-offsite power by itself, and:

   a) Verifying deenergization of the emergency busses and load shedding from the emergency busses.

   b) Verifying the diesel generator starts* on the auto-start signal, energizes the emergency busses within 10 seconds, energizes the auto-connected loads through the individual load timers and operates for greater than or equal to 5 minutes while its generator is loaded with the shutdown loads. After energization, the steady-state voltage and frequency of the emergency busses is ≥ 4160 V and ≤ 4400 V and ≥ 59.8 Hz and ≤ 60.8 Hz during the test.

5. Verifying that on an ECCS actuation test signal, without loss-of-offsite power, the diesel generator starts* on the auto-start signal and operates on standby for greater than or equal to 5 minutes. The generator voltage and frequency shall reach ≥ 4160 V and ≤ 4400 V and ≥ 58.8 Hz and ≤ 61.2 Hz within 10 seconds after auto-start signal; the steady state generator voltage and frequency shall be maintained ≥ 4160 V and ≤ 4400 V and ≥ 59.8 Hz and ≤ 60.8 Hz during this test.

6. Simulating a loss-of-offsite power in conjunction with an ECCS actuation test signal, and:

   a) Verifying deenergization of the emergency busses and load shedding from the emergency busses.

   b) Verifying the diesel generator starts* on the auto-start signal, energizes the emergency busses within 10 seconds, energizes the auto-connected shutdown loads through the individual load timers and operates for greater than or equal to 5 minutes while its generator is loaded with the emergency loads. After energization, the steady-state voltage and frequency of the emergency busses shall be maintained ≥ 4160 V and ≤ 4400 V and ≥ 59.8 Hz and ≤ 60.8 Hz during this test.

7. Verifying that all automatic diesel generator trips, except engine overspeed and generator differential over-current are automatically bypassed upon an ECCS actuation signal.

* This test shall be conducted in accordance with the manufacturer's recommendations regarding engine prelube and warm-up procedures, and as applicable regarding loading and shutdown recommendations.

SURVEILLANCE REQUIREMENTS (Continued)

8. a) Verifying the diesel generator operates* for at least 24 hours. During the first 2 hours of this test, the diesel generator shall be loaded to an indicated 2950-3050 kW** and during the remaining 22 hours of this test, the diesel generator shall be loaded to an indicated 2700-2800 kW**.

   b) Verifying that, within 5 minutes of shutting down the diesel generator after the diesel generator has operated* for at least 2 hours at an indicated 2700-2800 kW**, the diesel generator starts*. The generator voltage and frequency shall reach ≥ 4160 V and ≤ 4400 V and ≥ 58.8 Hz and ≤ 61.2 Hz within 10 seconds after the start signal. After steady-state conditions are reached, voltage is maintained ≥ 4160 V and ≤ 4400 V and frequency is maintained ≥ 59.8 Hz and ≤ 60.8 Hz.

9. Verifying that the auto-connected loads to each diesel generator do not exceed the 2000-hour rating of 3100 kW.

10. Verifying the diesel generator's capability to:

    a) Synchronize with the offsite power source while the generator is loaded with its emergency loads upon a simulated restoration of offsite power,

    b) Transfer its loads to the offsite power source, and

    c) Be restored to its standby status.

11. Verifying that with the diesel generator operating in a test mode and connected to its bus, a simulated ECCS actuation signal overrides the test mode by (1) returning the diesel generator to standby operation, and (2) automatically energizes the emergency loads with offsite power.

12. Verifying that the automatic load sequence timers are OPERABLE with the interval between each load block within ± 10% of its design interval.

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* This test shall be conducted in accordance with the manufacturer's recommendations regarding engine prelube and warmup procedures, and as applicable regarding loading and shutdown recommendations.

** This band is meant as guidance to avoid routine overloading of the engine. Loads in excess of this band for special testing under direct monitoring by the manufacturer or momentary variations due to changing bus loads shall not invalidate the test.

SURVEILLANCE REQUIREMENTS (Continued)

h. In accordance with the Surveillance Frequency Control Program the diesel generator shall be started* and verified to accelerate to synchronous speed in less than or equal to 10 seconds. The generator voltage and frequency shall reach ≥ 4160 V and ≤ 4400 V and ≥ 58.8 Hz and ≤ 61.2 Hz within 10 seconds after the start signal. After steady-state conditions are reached, voltage is maintained ≥ 4160 V and ≤ 4400 V and frequency is maintained ≥ 59.8 Hz and ≤ 60.8 Hz. The diesel generator shall be started for this test by using one of the following signals:

a) Manual***

b) Simulated loss-of-offsite power by itself.

c) Simulated loss-of-offsite power in conjunction with an ECCS actuation test signal.

d) An ECCS actuation test signal by itself.

The generator shall be manually synchronized to its appropriate emergency bus, loaded to an indicated 2700-2800 KW** and operate for at least 60 minutes. This test, if it is performed so it coincides with the testing required by Surveillance Requirement 4.8.1.1.2.a.4 and 4.8.1.1.2.a.5, may also serve to concurrently meet those requirements as well.

4.8.1.1.3 Deleted

*This test shall be conducted in accordance with the manufacturer's recommendations regarding engine prelube and warmup procedures, and as applicable regarding loading and shutdown recommendations.

**This band is meant as guidance to avoid routine overloading of the engine. Loads in excess of this band for special testing under direct monitoring by the manufacturer or momentary variations due to changing bus loads shall not invalidate the test.

***If diesel generator started manually from the control room, 10 seconds after the automatic prelube period.

LIMITING CONDITION FOR OPERATION (Continued)

c)	480-VAC Motor Control Centers:	D144-R-G	(10B222)
		D144-R-H	(10B218)
		D144-R-E	(10B224)
		D144-C-B	(00B132)
		D144-D-G	(10B518)
d)	120-VAC Distribution Panels:	10Y104	
		10Y164	

5. Unit 2 and Common Division 1, Consisting of:

a)	4160-VAC bus:	D21	(20A115)
b)	480-VAC load center:	D214	(20B201)
c)	480-VAC motor control centers:	D114-S-L	(00B519)
		D214-R-C	(20B213)
		D214-D-G	(20B515)
d)	120-VAC distribution panels:	01Y501	
		20Y101	
		20Y206	

6. Unit 2 and Common Division 2, Consisting of:

a)	4160-VAC bus:	D22	(20A116)
b)	480-VAC load center:	D224	(20B202)
c)	480-VAC motor control centers:	D124-S-L	(00B520)
		D224-D-G	(20B516)
d)	120-VAC distribution panels:	02Y501	
		20Y102	
		20Y207	

7. Unit 2 and Common Division 3, Consisting of:

a)	4160-VAC bus:	D23	(20A117)
b)	480-VAC load center:	D234	(20B203)
c)	480-VAC motor control centers:	D234-S-L	(00B521)
		D234-D-G	(20B517)
d)	120-VAC distribution panels:	03Y501	
		20Y103	
		20Y163	

8. Unit 2 and Common Division 4, Consisting of:

a)	4160-VAC bus:	D24	(20A118)
b)	480-VAC load center:	D244	(20B204)
c)	480-VAC motor control centers:	D244-S-L	(00B522)
		D244-D-G	(20B518)
d)	120-VAC distribution panels:	04Y501	
		20Y104	
		20Y164	

UNITED STATES
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WASHINGTON, D.C. 20555-0001

CONSTELLATION ENERGY GENERATION, LLC

DOCKET NO. 50-353

LIMERICK GENERATING STATION, UNIT 2

AMENDMENT TO RENEWED FACILITY OPERATING LICENSE

Amendment No. 220
Renewed License No. NPF-85

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

   A. The application for amendment by Constellation Energy Generation, LLC (Constellation Energy Generation), dated December 15, 2022, complies with the standards and requirements of the Atomic Energy Act of 1954, as amended (the Act), and the Commission's rules and 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 rules and 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;

   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-85 is hereby amended to read as follows:

(2) Technical Specifications

The Technical Specifications contained in Appendix A and the Environmental Protection Plan contained in Appendix B, as revised through Amendment No. 220, are hereby incorporated into this renewed license. Constellation Energy Generation 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 120 days.

FOR THE NUCLEAR REGULATORY COMMISSION

Hipolito J. Gonzalez

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Hipólito J. González, 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 3, 2023

ATTACHMENT TO LICENSE AMENDMENT NO. 220

LIMERICK GENERATING STATION, UNIT 2

RENEWED FACILITY OPERATING LICENSE NO. NPF-85

DOCKET NO. 50-353

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 a marginal line indicating the area of change.

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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 a marginal line indicating the areas of change.

Remove Page	Insert Page
3/4 5-4	3/4 5-4
3/4 8-3	3/4 8-3
3/4 8-4	3/4 8-4
3/4 8-5	3/4 8-5
3/4 8-6	3/4 8-6
3/4 8-7a	3/4 8-7a

(2) Pursuant to the Act and 10 CFR Part 70, to receive, possess and to use at any time special nuclear material as reactor fuel, in accordance with the limitations for storage and amounts required for reactor operation, as described in the Final Safety Analysis Report, as supplemented and amended;

(3) 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 sources for reactor instrumentation and radiation monitoring equipment calibration, and as fission detectors in amounts as required;

(4) Pursuant to the Act and 10 CFR Parts 30, 40, 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) 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, and to receive and possess, but not separate, such source, byproduct, and special nuclear materials as contained in the fuel assemblies and fuel channels from the Shoreham Nuclear Power Station.

C. This renewed 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 (except as exempted from compliance in Section 2.D. below) 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

Constellation Energy Generation, LLC is authorized to operate the facility at reactor core power levels of 3515 megawatts thermal (100 percent rated power) in accordance with the conditions specified herein.

(2) Technical Specifications

The Technical Specifications contained in Appendix A and the Environmental Protection Plan contained in Appendix B, as revised through Amendment No. 220, are hereby incorporated into this renewed license. Constellation Energy Generation shall operate the facility in accordance with the Technical Specifications and the Environmental Protection Plan.

SURVEILLANCE REQUIREMENTS

4.5.1 The emergency core cooling systems shall be demonstrated OPERABLE by:

a. In accordance with the Surveillance Frequency Control Program:

1. For the CSS, the LPCI system, and the HPCI system:

a) Verifying locations susceptible to gas accumulation are sufficiently filled with water.

b) Verifying that each valve (manual, power-operated, or automatic) in the flow path that is not locked, sealed, or otherwise secured in position, is in its correct* position.***

2. For the LPCI system, verifying that both LPCI system subsystem cross-tie valves (HV-51-282 A, B) are closed with power removed from the valve operators.

3. For the HPCI system, verifying that the HPCI pump flow controller is in the correct position.

4. For the CSS and LPCI system, performance of a CHANNEL FUNCTIONAL TEST of the injection header ΔP instrumentation.

b. Verifying that, when tested pursuant to Specification 4.0.5:

1. Each CSS pump in each subsystem develops a flow of at least 2500 gpm against a test line pressure corresponding to a reactor vessel to primary containment differential pressure of = 105 psid plus head and line losses.

2. Each LPCI pump in each subsystem develops a flow of at least 8000 gpm against a test line pressure corresponding to a reactor vessel to primary containment differential pressure of $\geq$ 20 psid plus head and line losses.

3. The HPCI pump develops a flow of at least 5600 gpm against a test line pressure which corresponds to a reactor vessel pressure of 1040 psig plus head and line losses when steam is being supplied to the turbine at 1040, +13, -120 psig.**

c. In accordance with the Surveillance Frequency Control Program:

1. For the CSS, the LPCI system, and the HPCI system, performing a system functional test which includes simulated automatic actuation of the system throughout its emergency operating sequence and verifying that each automatic valve in the flow path actuates to its correct position. **** Actual injection of coolant into the reactor vessel may be excluded from this test.

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* Except that an automatic valve capable of automatic return to its ECCS position when an ECCS signal is present may be in position for another mode of operation.

** The provisions of Specification 4.0.4 are not applicable provided the surveillance is performed within 12 hours after reactor steam pressure is adequate to perform the test. If OPERABILITY is not successfully demonstrated within the 12-hour period, reduce reactor steam dome pressure to less than 200 psig within the following 72-hours.

*** Not required to be met for system vent flow paths opened under administrative control.

**** Except for valves that are locked, sealed, or otherwise secured in the actuated position.

SURVEILLANCE REQUIREMENTS

4.8.1.1.1 Each of the above required independent circuits between the offsite transmission network and the onsite Class 1E distribution system shall be:

a. Determined OPERABLE in accordance with the Surveillance Frequency Control Program by verifying correct breaker alignments and indicated power availability, and

b. Demonstrated OPERABLE in accordance with the Surveillance Frequency Control Program by transferring, manually and automatically, unit power supply from the normal circuit to the alternate circuit.

4.8.1.1.2 Each of the above required diesel generators shall be demonstrated OPERABLE:

a. In accordance with the Surveillance Frequency Control Program on a STAGGERED TEST BASIS by:

1. Verifying the fuel level in the day fuel tank.

2. Verifying the fuel level in the fuel storage tank.

3. Verifying the fuel transfer pump starts and transfers fuel from the storage system to the day fuel tank.

4. Verify that the diesel can start* and gradually accelerate to synchronous speed with steady-state generator voltage ≥ 4160 V and ≤ 4400 V and frequency ≥ 59.8 Hz and ≤ 60.8 Hz.

5. Verify diesel is synchronized, gradually loaded* to an indicated 2700-2800 kW** and operates with this load for at least 60 minutes.

6. Verifying the diesel generator is aligned to provide standby power to the associated emergency busses.

7. Verifying the pressure in all diesel generator air start receivers to be greater than or equal to 225 psig.

*This test shall be conducted in accordance with the manufacturer's recommendations regarding engine prelube and warmup procedures, and as applicable regarding loading and shutdown recommendations.

**This band is meant as guidance to avoid routine overloading of the engine. Loads in excess of this band for special testing under direct monitoring by the manufacturer or momentary variations due to changing bus loads shall not invalidate the test.

SURVEILLANCE REQUIREMENTS (Continued)

b. By removing accumulated water:

1) From the day tank in accordance with the Surveillance Frequency Control Program and after each occasion when the diesel is operated for greater than 1 hour, and

2) From the storage tank in accordance with the Surveillance Frequency Control Program.

c. By sampling new fuel oil in accordance with ASTM D4057-81 prior to addition to the storage tanks and:

1) By verifying in accordance with the tests specified in ASTM D975-81 prior to addition to the storage tanks that the sample has:

a) An API Gravity of within 0.3 degrees at 60°F or a specific gravity of within 0.0016 at 60/60°F, when compared to the supplier's certificate or an absolute specific gravity at 60/60°F of greater than or equal to 0.83 but less than or equal to 0.89 or an API gravity at 60°F of greater than or equal to 27 degrees but less than or equal to 39 degrees.

b) A kinematic viscosity at 40°C of greater than or equal to 1.9 centistokes, but less than or equal to 4.1 centistokes, if gravity was not determined by comparison with the supplier's certification.

c) A flash point equal to or greater than 125°F, and

d) A clear and bright appearance with proper color when tested in accordance with ASTM D4176-82.

2) By verifying within 31 days of obtaining the sample that the other properties specified in Table 1 of ASTM D975-81 are met when tested in accordance with ASTM D975-81 except that the analysis for sulfur may be performed in accordance with ASTM D1552-79 or ASTM D2622-82.

d. In accordance with the Surveillance Frequency Control Program by obtaining a sample of fuel oil from the storage tanks in accordance with ASTM D2276-78, and verifying that total particulate contamination is less than 10 mg/liter when checked in accordance with ASTM D2276-78, Method A, except that the filters specified in ASTM D2276-78, Sections 5.1.6 and 5.1.7, may have a nominal pore size of up to three (3) microns.

e. In accordance with the Surveillance Frequency Control Program by:

1) Deleted

2) Verifying each diesel generator's capability to reject a load of greater than or equal to that of its single largest post-accident load, and:

a) Following load rejection, the frequency is $\leq$ 66.5 Hz;

b) Within 1.8 seconds following the load rejection, the voltage is $\geq$ 3865 V and $\leq$ 4705 V, and frequency $\geq$ 58.8 Hz and $\leq$ 61.2 Hz; and

c) After steady-state conditions are reached, voltage is maintained $\geq$ 4160 V and $\leq$ 4400 V and frequency $\geq$ 59.8 Hz and $\leq$ 60.8 Hz.

SURVEILLANCE REQUIREMENTS (Continued)

3. Verifying the diesel generator capability to reject a load of 2850 kW without tripping. The generator voltage shall not exceed 4784 volts during and following the load rejection.

4. Simulating a loss-of-offsite power by itself, and:

   a) Verifying deenergization of the emergency buses and load shedding from the emergency buses.

   b) Verifying the diesel generator starts* on the auto-start signal, energizes the emergency buses within 10 seconds, energizes the auto-connected loads through the individual load timers and operates for greater than or equal to 5 minutes while its generator is loaded with the shutdown loads. After energization, the steady-state voltage and frequency of the emergency buses is ≥ 4160 V and ≤ 4400 V and ≥ 59.8 Hz and ≤ 60.8 Hz during the test.

5. Verifying that on an ECCS actuation test signal, without loss-of-offsite power, the diesel generator starts* on the auto-start signal and operates on standby for greater than or equal to 5 minutes. The generator voltage and frequency shall reach ≥ 4160 V and ≤ 4400 V and ≥ 58.8 Hz and ≤ 61.2 Hz within 10 seconds after auto-start signal; the steady state generator voltage and frequency shall be maintained ≥ 4160 V and ≤ 4400 V and ≥ 59.8 Hz and ≤ 60.8 Hz during this test.

6. Simulating a loss-of-offsite power in conjunction with an ECCS actuation test signal, and:

   a) Verifying deenergization of the emergency buses and load shedding from the emergency buses.

   b) Verifying the diesel generator starts* on the auto-start signal, energizes the emergency buses within 10 seconds, energizes the auto-connected shutdown loads through the individual load timers and operates for greater than or equal to 5 minutes while its generator is loaded with the emergency loads. After energization, the steady-state voltage and frequency of the emergency buses shall be maintained at ≥ 4160 V and ≤ 4400 V and ≥ 59.8 Hz and ≤ 60.8 Hz during this test.

7. Verifying that all automatic diesel generator trips, except engine overspeed and generator differential over-current are automatically bypassed upon an ECCS actuation signal.

*This test shall be conducted in accordance with the manufacturer's recommendations regarding engine prelube and warm up procedures, and as applicable regarding loading and shutdown recommendations.

SURVEILLANCE REQUIREMENTS (Continued)

8. a) Verifying the diesel generator operates* for at least 24 hours. During the first 2 hours of this test, the diesel generator shall be loaded to an indicated 2950-3050 kW** and during the remaining 22 hours of this test, the diesel generator shall be loaded to an indicated 2700-2800 kW**.

   b) Verifying that, within 5 minutes of shutting down the diesel generator after the diesel generator has operated* for at least 2 hours at an indicated 2700-2800 kW**, the diesel generator starts*. The generator voltage and frequency shall reach ≥ 4160 V and ≤ 4400 V and ≥ 58.8 Hz and ≤ 61.2 Hz within 10 seconds after the start signal. After steady-state conditions are reached, voltage is maintained ≥ 4160 V and ≤ 4400 V and frequency is maintained ≥ 59.8 Hz and ≤ 60.8 Hz.

9. Verifying that the auto-connected loads to each diesel generator do not exceed the 2000-hour rating of 3100 kW.

10. Verifying the diesel generator's capability to:

    a) Synchronize with the offsite power source while the generator is loaded with its emergency loads upon a simulated restoration of offsite power,

    b) Transfer its loads to the offsite power source, and

    c) Be restored to its standby status.

11. Verifying that with the diesel generator operating in a test mode and connected to its bus, a simulated ECCS actuation signal overrides the test mode by (1) returning the diesel generator to standby operation, and (2) automatically energizes the emergency loads with offsite power.

12. Verifying that the automatic load sequence timers are OPERABLE with the interval between each load block within ± 10% of its design interval.

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* This test shall be conducted in accordance with the manufacturer's recommendations regarding engine prelube and warmup procedures, and as applicable regarding loading and shutdown recommendations.

** This band is meant as guidance to avoid routine overloading of the engine. Loads in excess of this band for special testing under direct monitoring by the manufacturer or momentary variations due to changing bus loads shall not invalidate the test.

SURVEILLANCE REQUIREMENTS (Continued)

h. In accordance with the Surveillance Frequency Control Program the diesel generator shall be started* and verified to accelerate to synchronous speed in less than or equal to 10 seconds. The generator voltage and frequency shall reach ≥ 4160 V and ≤ 4400 V and ≥ 58.8 Hz and ≤ 61.2 Hz within 10 seconds after the start signal. After steady-state conditions are reached, voltage is maintained ≥ 4160 V and ≤ 4400 V and frequency is maintained ≥ 59.8 Hz and ≤ 60.8 Hz. The diesel generator shall be started for this test by using one of the following signals:

a) Manual***

b) Simulated loss-of-offsite power by itself.

c) Simulated loss-of-offsite power in conjunction with an ECCS actuation test signal.

d) An ECCS actuation test signal by itself.

The generator shall be manually synchronized to its appropriate emergency bus, loaded to an indicated 2700-2800 KW** and operate for at least 60 minutes. This test, if it is performed so it coincides with the testing required by Surveillance Requirement 4.8.1.1.2.a.4 and 4.8.1.1.2.a.5, may also serve to concurrently meet those requirements as well.

4.8.1.1.3 Deleted

*This test shall be conducted in accordance with the manufacturer's recommendations regarding engine prelube and warmup procedures, and as applicable regarding loading and shutdown recommendations.

**This band is meant as guidance to avoid routine overloading of the engine. Loads in excess of this band for special testing under direct monitoring by the manufacturer or momentary variations due to changing bus loads shall not invalidate the test.

***If diesel generator started manually from the control room, 10 seconds after the automatic prelube period.

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

SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

RELATED TO AMENDMENT NO. 258 TO RENEWED FACILITY

OPERATING LICENSE NO. NPF-39 AND AMENDMENT NO. 220

TO RENEWED FACILITY OPERATING LICENSE NO. NPF-85

CONSTELLATION ENERGY GENERATION, LLC

LIMERICK GENERATING STATION, UNITS 1 AND 2

DOCKET NOS. 50-352 AND 50-353

1.0 INTRODUCTION

By letter to the U.S. Nuclear Regulatory Commission (NRC, the Commission) dated December 15, 2021 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML21349B378), Constellation Energy Generation, LLC (Constellation, the licensee) submitted a license amendment request (LAR) to revise Technical Specification (TS) of certain frequency and voltage acceptance criteria for the steady-state emergency diesel generator (EDG) surveillance requirements (SRs) under TS 3/4.8.1, “AC [Alternate Current] Sources -Operating,” pursuant to Title 10 of the *Code of Federal Regulations*, Part 50, Section 90, “Application for amendment of license, construction permit, or early site permit” (10 CFR 50.90). In addition, the LAR would revise the flow acceptance criteria for the emergency core cooling system (ECCS) pump under TS 3/4.5.1, “ECCS-Operating.” to the Limerick Generating Station, Units 1 and 2.

This LAR addresses a non-conservative TS in accordance with the guidance in Nuclear Energy Institute (NEI) 15-03 (ADAMS Accession No. ML16309A012). The proposed changes are consistent with WCAP-17308-NP-A, “Treatment of Diesel Generator (DG) Technical Specification Frequency and Voltage Tolerances,” dated July 2017 (ML17215A232).

2.0 REGULATORY EVALUATION

2.1 Description of the Emergency Diesel Generators

The onsite AC electric power system consists of Class 1E and non-Class 1E power systems. The two offsite power systems provide the preferred AC electric power to all Class 1E loads. The EDGs are capable of supplying power to the loads necessary to shut down and cool down the associated unit safely. Per the Limerick Updated Final Safety Analysis (UFSAR) Section 8.3.1.1.3 (ADAMS Accession No. ML21133A090), each EDG is rated at 2850 kilowatts (kW) for continuous operation and at 3135 kW for 2 hours of short-time operation in any 24-hour

period. As stated in UFSAR Section 8.3.1.1.3.6, each EDG is designed to attain rated voltage and frequency and to accept load within 10 seconds after receipt of a start signal.

In the event of a total Loss-of-Offsite Power (LOOP), eight onsite independent EDGs (four EDGs per unit) provide the standby power for all engineered safeguard loads. The Class 1E power system for each unit consists of four independent Class 1E buses, powered by four independent EDGs, which provide power to four divisions of Class 1E loads. Each EDG is connected to only one 4 kV Class 1E bus and is interlocked to prevent parallel operation during a LOOP. The EDGs are selected so that their ratings satisfy the provisions of Regulatory Guide (RG) 1.9, “Application and Testing of Safety-Related Diesel Generators in Nuclear Power Plants,” (ADAMS Accession No. ML070380553). If a loss of coolant accident (LOCA) should occur and offsite power is available, the EDGs in the unit experiencing the LOCA would start automatically and run unloaded.

2.2 Reason for Proposed Change

In the LAR, the licensee stated:

> A concern was raised during a Component Design Bases Inspection (CDBI) associated with allowable Technical Specifications (TS) range of voltage and frequency for Emergency Diesel Generators (EDGs). Specifically, current analysis of LGS [Limerick] does not include the effects of operation of the EDGs over the allowable TS range of voltage and frequency. A new Exelon [Constellation] design analysis, LM-0736, “Analyses of Emergency Diesel Generator Technical Specification Voltage and Frequency Range and Tolerances” (Reference 1) was performed to evaluate the impacts of frequency and voltage variations on the EDG loading calculations, EDG fuel oil consumption calculations, Emergency Core Cooling System (ECCS) performance, motor-operated valve (MOV) performance, and Heating Ventilation and Air Conditioning (HVAC) fan/blower performance, consistent with WCAP-17308-NP-A, Rev 0, issued July 2017 (Reference 2). This formal design analysis includes the eight LGS EDGs: Unit 1 - D11, D12, D13, D14; Unit 2 - D21, D22, D23, and D24.
>
> The analysis performed per LM-0736 revealed that a TS change is needed to maintain operating margin for [ECCS] pumps and to correct a non-conservative TS.

2.3 Proposed TS SR Changes

This LAR will change the EDG steady-state operating frequency band from 60 hertz (Hz) ± 1.2 Hz to 59.8-60.8 Hz for eight SRs. The following TS SRs are affected by this proposed change.

The proposed changes are indicated in bold type:

SR 4.8.1.1.2.a.4: …
Verify that the diesel can start* and gradually accelerate to synchronous speed with **steady-state generator voltage ≥ 4160 V [volts] and ≤ 4400 V and frequency ≥ 59.8 Hz and ≤ 60.8 Hz.**

SR 4.8.1.1.2.e.2.b …..
Within 1.8 seconds following the load rejection, **the voltage is ≥ 3865 V and ≤ 4705 V and frequency ≥ 58.8 Hz and ≤61.2 Hz.**

SR 4.8.1.1.2.e.2.c ……
After steady state conditions are reached, voltage is maintained **≥ 4160 V and ≤ 4400 V and frequency ≥ 59.8 Hz and ≤60.8 Hz.**

SR 4.8.1.1.2.e.4.b ……
Verifying the diesel generator starts* on the auto-start signal, energizes the emergency busses within 10 seconds, energizes the auto-connected loads through the individual load timers and operates for greater than or equal to 5 minutes while its generator is loaded with the shutdown loads. After energization, the steady-state voltage and frequency of the emergency busess **is ≥ 4160 V and ≤ 4400 V and ≥ 59.8 Hz and ≤ 60.8 Hz during the test.**

SR 4.8.1.1.2.e.5 ……
Verifying that on an ECCS actuation test signal, without loss-of offsite power, the diesel generator starts* on the auto-start signal and operates on standby for greater than or equal to 5 minutes. **The generator voltage and frequency shall reach ≥ 4160 V and ≤ 4400 V and ≥ 58.8 Hz and ≤ 61.2 Hz within 10 seconds after auto-start signal; the steady-state generator voltage and frequency shall be maintained ≥ 4160 V and ≤ 4400 V and ≥ 59.8 Hz and ≤ 60.8 Hz during this test.**

SR 4.8.1.1.2.e.6.b …..
Verifying the diesel generator starts* on the auto-start signal, energizes the emergency busses within 10 seconds, energizes the auto-connected shutdown loads through the individual load timers and operates for greater than or equal to 5 minutes while its generator is loaded with the emergency loads. After energization, the steady-state voltage and frequency of the emergency busses shall be maintained **≥ 4160 V and ≤ 4400 V and ≥ 59.8 Hz and ≤ 60.8 Hz** during this test.

SR 4.8.1.1.2.e.8.b ……
Verifying that, within 5 minutes of shutting down the diesel generator after the diesel generator has operated* for at least 2 hours at an indicated 2700-2800 kW**, the diesel generator starts*. The generator voltage and frequency *shall reach* **≥ 4160 V and ≤ 4400 V and ≥ 58.8 Hz and ≤ 61.2 Hz within 10 second after the start signal. After steady-state conditions are reached, voltage is maintained ≥ 4160 V and ≤ 4400 V and frequency is maintained ≥ 59.8 Hz and ≤ 60.8 Hz.**

SR 4.8.1.1.2.h ……
In accordance with the Surveillance Frequency Control Program the diesel generator shall be started* and verified to accelerate to synchronous speed in less than or equal to 10 seconds. The generator voltage and frequency shall reach **≥ 4160 V and ≤ 4400 V and ≥ 58.8 Hz and ≤ 61.2 Hz** within 10 seconds after the start signal. **After steady-state conditions are reached, voltage is maintained ≥ 4160 V and ≤ 4400 V and frequency is maintained ≥ 59.8 Hz and ≤ 60.8 Hz**. The diesel generator shall be started for this test by using one of the following signals: …

SR 4.5.1.h.1 ……
Each CSS [core spray system] pump in each subsystem develops a flow of at least **2500** gpm [gallons per minute] against a test line pressure corresponding to a reactor vessel to primary containment differential pressure of ≥ 105 psid [pounds per square inch differential] plus head and line losses.

SR 4.5.1.h.2 …….
Each LPCI [low pressure coolant injection] pump in each subsystem develops a flow of at least **8000** gpm against a test line pressure corresponding to a reactor vessel to primary containment differential pressure of ≥ 20 psid plus head and line losses.

2.4 Applicable Regulatory Requirements

The Atomic Energy Act of 1954 (as amended) (AEA), Section 182a, requires applicants for nuclear power plant operating licenses to include TSs and other information deemed necessary by the NRC as part of their applications. The AEA requires that the TSs shall be part of the license. The TSs provide assurance of the operational capability of structures, systems, and components (SSCs) that are required to protect the health and safety of the public.

The regulatory requirements related to the content of the TSs are contained in Title 10, "Energy," of the U.S. *Code of Federal Regulations* Section 50.36, "Technical specifications." Section 50.36(a)(1) in 10 CFR Part 50 requires, in part, that proposed TSs shall be included by applicants for a license authorizing operation of a production or utilization facility. The regulations under 10 CFR 50.36(c) require that TSs include items in five specific categories related to station operation. These categories are (1) safety limits (SLs), limiting safety system settings, and limiting control settings; (2) LCOs (limiting conditions for operation); (3) SRs; (4) design features; and (5) administrative controls. The proposed changes in this LAR relate to the SR category. The regulations under 10 CFR 50.36(c)(3) state that "Surveillance requirements are requirements relating to test, calibration, or inspection to assure that the necessary quality of systems and components is maintained, that facility operation will be within safety limits, and that the limiting conditions for operation will be met."

The NRC regulations related to ECCS are contained in 10 CFR 50.46, "Acceptance criteria for emergency core cooling systems for light-water nuclear power reactors." The regulations in 10 CFR 50.46(a)(1)(i) require, in part, that nuclear power plants must be provided with an ECCS that must be designed so that its calculated cooling performance following postulated LOCAs conforms to the criteria set forth in 10 CFR 50.46(b). ECCS cooling performance must be

calculated in accordance with an acceptable evaluation model and must be calculated for a number of postulated LOCAs of different sizes, locations, and other properties sufficient to provide assurance that the most severe postulated loss-of-coolant accidents are calculated. Comparisons to applicable experimental data must be made and uncertainties in the analysis method and inputs must be identified and assessed so that the uncertainty in the calculated results can be estimated.

The NRC regulations in 10 CFR 50.55a, "Codes and standards," in paragraph (f)(4), "Inservice testing standards requirement for operating plants," state that throughout the service life of a boiling or pressurized water-cooled nuclear power facility, pumps and valves that are within the scope of the American Society of Mechanical Engineers (ASME) *Operation and Maintenance of Nuclear Power Plants*, Division 1, OM Code: Section IST (OM Code) must meet the inservice testing (IST) requirements (except design and access provisions) set forth in the ASME OM Code and addenda that become effective subsequent to editions and addenda specified in 10 CFR 50.55a(f)(2) and (3) and that are incorporated by reference in 10 CFR 50.55a(a)(1)(iv), to the extent practical within the limitations of design, geometry, and materials of construction of the components. The IST requirements for pumps and valves that are within the scope of the ASME OM Code but are not classified as ASME *Boiler and Pressure Vessel Code* (BPV Code) Class 1, Class 2, or Class 3 may be satisfied as an augmented IST program in accordance with 10 CFR 50.55a(f)(6)(ii) without requesting relief under 10 CFR 50.55a(f)(5) or alternatives under 10 CFR 50.55a(z). This use of an augmented IST program may be acceptable provided the basis for deviations from the ASME OM Code, as incorporated by reference in 10 CFR 50.55a, demonstrates an acceptable level of quality and safety, or that implementing the Code provisions would result in hardship or unusual difficulty without a compensating increase in the level of quality and safety, where documented and available for NRC review.

Appendix A, "General Design Criteria for Nuclear Power Plants" (hereinafter referred to as GDC) to 10 CFR Part 50 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 SSCs important to safety.

The regulations in 10 CFR Part 50, Appendix A, include the following GDC applicable to fracture prevention of the reactor coolant pressure boundary:

- GDC 17, "Electric power systems," requires, in part, that nuclear power plants have onsite and offsite electric power systems to permit the functioning of SSCs that are important to safety. The onsite system is required to have sufficient independence, redundancy, and testability to perform its safety function, assuming a single failure. The offsite power system is required to be supplied by two physically independent circuits that are designed and located so as to minimize, to the extent practical, the likelihood of their simultaneous failure under operating and postulated accident and environmental conditions. In addition, this criterion requires provisions to minimize the probability of losing electric power from the remaining electric power supplies because of loss of power from the unit, the offsite transmission network, or the onsite power supplies.

- GDC 34, "Residual heat removal," requires that a system to remove residual heat shall be provided. It requires system safety functions to transfer fission product decay heat and residual heat from the core such that acceptable fuel design limits and design conditions of the reactor pressure boundary are not exceeded. The GDC requires, in

part, that onsite electric power system operation shall be able to perform its safety functions assuming single failure and unavailability of offsite power.

- GDC 35, “Emergency Core Cooling,” requires a system to provide abundant emergency core cooling. It requires the system be capable of removing heat from the reactor core following any loss of reactor coolant to prevent fuel and cladding damage and limit the clad metal-water reaction to negligible. The GDC, in part, requires redundancy such that for both onsite and offsite electric power system operation, the system safety function can be accomplished assuming singe failure.

- GDC 37, “Testing of Emergency Core Cooling System,” requires, in part, that the ECCS shall be designed to allow for periodic pressure and functional testing to assure structural and leaktight integrity, and operability and performance of individual system components and the system as a whole, under conditions as close to design as practical.

2.5 Applicable Regulatory Guidance

The guidance that the NRC staff considered in its review of this LAR includes the following:

NRC RG 1.9, Revision 4, “Application and Testing of Safety-Related Diesel Generators in Nuclear Power Plants,” (ADAMS Accession No. ML070380553) provides capability guidance for EDGs selected for use in onsite electric power systems.

WCAP-17308-NP-A, Revision 0 (ML17215A230), as approved by the NRC by letter dated April 17, 2017 (ML17074A121), provides a methodology to evaluate the impact of EDG steady-state frequency and voltage variation on essential motor loads, such as ECCS pumps, MOVs, and fans/blowers. The report states that the impact of EDG steady-state frequency and voltage variation on the motor-driven pump parameters, such as flow rate and MOV actuation speed, can be compared to their expected performance values that are verified to be met on a periodic basis. Regarding the performance of ECCS pumps, the effect of frequency and voltage variation can be combined with other uncertainties to revise the limiting pump performance curves to account for those variables. The impact of frequency and voltage variation on the EDG loading and fuel oil consumption and the performance of MOVs and fans/blowers are determined in plant-specific evaluations.

3.0 TECHNICAL EVALUATION

The NRC staff reviewed the information provided in the LAR for the proposed changes to the SRs in the TS for EDG frequency and voltage tolerances and for ECCS pump flows. In its LAR, the licensee referenced WCAP-17308-NP-A as accepted by the NRC staff in a letter dated April 17, 2017.

The LAR requests a revision to the steady-state operating frequency of the EDGs to a more realistic value, which is more conservative, and resolves a non-conservative TS. The analysis performed per LM-0736, Revision 1, evaluated the impacts of EDG frequency and voltage variations on various calculations including but not limited to ECCS performance, MOV performance, motor-driven pumps, fans and compressors. The licensee determined that the impact on static loads and lumped loads (battery chargers) is negligible.

3.1 WCAP-17308 Methodology

In its LAR, the licensee stated that it evaluated the proposed TS changes consistent with WCAP-17308-NP-A. The licensee indicated that the analysis and supporting calculations are contained in Constellation LM-0736. For the changes in steady-state voltage and frequency, the licensee evaluated the impact of the changes in steady-state voltage and frequency on safety-related systems (including ECCS), EDG loading, EDG fuel oil consumption calculations, and MOV performance. In particular, the licensee discussed its review of pumps, fans, blowers, compressors, and MOVs with a listing of these components in attachments to the LAR. The licensee stated that the performance requirements of the pumps, fans, blowers, MOVs, and other equipment were not being modified; therefore, their impact was not evaluated in the LAR.

The NRC staff summarizes the licensee's justification for the minor deviations from the WCAP-17308-NP-A methodology as follows:

With respect to electrical aspects, the licensee notes that WCAP-17308-NP-A, Section 3.1.1, specifies that the impact of frequency variation on EDG loading is to be determined by assuming that the EDG entire load is an induction motor, and the increase in frequency is determined by a factor using the pump/fan affinity laws (e.g., speed increases by a cubic factor). The licensee asserts that it used a more realistic approach of separating the load profile by either induction motor, static, or lumped load, then applying the appropriate factor based on the load's behavior to the effects of frequency and voltage changes. The licensee states that the load factor for induction motors was derived by using the approach in WCAP-17308-NP-A to determine the uncertainty in motor speed, then applying classical machine theory to determine the impacts on power changes. The licensee indicates that the load factor for static loads was derived by using classical electrical power laws. The licensee considers that this results in a more realistic and conservative result because, in this case, static loads provide a higher load factor than induction loads due to the voltage variation being larger.

For WCAP pump evaluations, the licensee used the system preoperational test data pump curves, IST preservice five-point pump curves, or certified Original Equipment Manufacturer (OEM) pump curves when in-situ data were unavailable. At the time of initial preservice testing at Limerick, the 1986 Edition of ASME BPV Code, Section XI, required a single preservice reference point at normal operating speed to satisfy the Code. The five-point curve preservice testing requirement was instituted in the 1995 Edition of the ASME OM Code and, since January 2010, the Limerick licensee has acquired a preservice five-point curve to establish a new reference value if a pump is replaced or performance is significantly modified. The Emergency Service Water (ESW) and Residual Heat Removal Service Water (RHRSW) pumps were replaced at Limerick and per the applicable OM Code of record have applied IST preservice five-point pump curves. The Limerick licensee is currently required by the NRC regulations to implement the ASME OM Code, 2012 Edition, as incorporated by reference in 10 CFR 50.55a. Therefore, ASME OM Code, Appendix V, "Pump Periodic Verification Test Program," will be used to perform a pump periodic verification test once every 2 years at the pump design flow and pressure conditions, while accounting for instrument accuracies in the test acceptance criteria.

With respect to fans, the licensee reports that the TS references listed in WCAP-17308-NP-A regarding fan acceptability do not encompass General Electric-built plants. However, Limerick TS 4.6.5.3, 4.6.5.4, and 4.7.2.1 and NUREG 1433, "Standard Technical Specifications – General Electric BWR/4 Plants," (ADAMS Accession No. ML12104A192) require that flow

rates for the Standby Gas Treatment subsystem, Reactor Enclosure Recirculation subsystem and Control Room Emergency Fresh Air Supply subsystem not vary by more than 10 percent from their nominal flow rates. Therefore, the licensee asserts the modified fan performance for the Standby Gas Treatment System (SGTS) Exhaust Fan, Reactor Building Recirculation Fan, and Control Room Emergency Fresh Air Fan to be acceptable where the flow rates do not vary more than 10 percent from their nominal flow rates. The acceptability of fans not included within the scope of Limerick TS 4.6.5.3, 4.6.5.4 and 4.7.2.1 is evaluated based on the ability of the fans to provide sufficient cooling to their respective systems.

With respect to MOVs, the licensee states that the frequency and voltage uncertainties are treated as an added uncertainty similar to the method for evaluating MOV testing uncertainties. The licensee considers that the WCAP-described uncertainty is small relative to the pre-existing test uncertainty for all MOVs. The additional uncertainties are combined with the existing MOV testing uncertainty using the standard square-root-sum-of-the-squares method when the uncertainties are independent, and by the summation method when the uncertainty is not independent. The result is effectively an increased testing variability, which is compared against the existing MOV capabilities. The licensee asserts that all MOVs have sufficient margin to existing capabilities even upon imposing this increased uncertainty.

The NRC staff evaluated the justification provided by the licensee for the deviations from the WCAP-17308-NP-A methodology described above and concludes that these deviations will not have an impact on the licensee's application of the WCAP-17308-NP-A methodology in evaluating the impacts from the changes in voltage or frequency as proposed in the LAR for Limerick.

3.2 Impact Areas

3.2.1 EDG Loading

Per WCAP-17308-NP-A Section 3.1.1, an underfrequency would not negatively impact diesel generator loading calculations. By applying the upper bound of frequency (> 60 Hz) allowed by the EDG governor to the maximum inductive loads calculated for the EDG, an additional power load can be calculated for the potential variation in frequency allowed by the EDG governor operating range.

Per WCAP-17308-NP-A Section 3.1.2, the voltage variation of the EDG voltage regulator at steady-state operation should be confirmed to be within the allowable operating voltage range for the motors powered by the EDG. The effect of voltage variation from the nominal voltage rating of the EDG would cause the current of the motor load circuits to decrease or increase accordingly. The net change in power required by the loads on the EDG should be evaluated for lower than nominal voltage and frequency conditions, where there is a change in the power factor and real and reactive portions of the current. Because the real power is a function of the governor controls and reactive power is controlled by the EDG exciter and voltage regulator, the overall impact of EDG output voltage should be considered for real and reactive components of the EDG loading evaluation.

The NRC staff finds the methodology for evaluating the EDG loading to be acceptable because the licensee implemented the methodology described in WCAP-17308-NP for the effects of underfrequency and voltage variation on EDG loading, which was accepted by the NRC Staff in its safety evaluation dated April 17, 2017 .

3.2.2 EDG Fuel Consumption

Per WCAP-17308-NP-A, Section 3.2, a calculated change in EDG loading due to steady-state variation in frequency will require a commensurate evaluation of the impact on fuel oil consumption and stored fuel requirements as a result of the change in loading. The NRC staff finds the provision to evaluate the impact on EDG fuel consumption from the change in EDG loading to be acceptable. The NRC staff evaluates the method used by the licensee to evaluate the impact on EDG fuel consumption from the change in EDG loading in Section 3.3.2, "EDG Fuel Consumption," of this safety evaluation (SE).

3.2.3 Fan/Blower Performance

Per WCAP-17308-NP-A Section 5, the process for calculating the change in fan performance due to small diameter changes, speed variations, and density fluctuations is a matter of multiplying by the ratios of the target parameter to the initial parameter in accordance with the fan/blower affinity laws. Both direct drive and belt drive fans would be impacted in the same manner by EDG frequency and voltage variations.

For the upper bound of the EDG governor control band, the main concern from a higher than nominal frequency value (> 60 Hz) would be the additional power load required from the EDG. This additional power requirement is addressed in the diesel loading calculation.

The lower range of the EDG governor control band, frequency < 60 Hz, would cause a slight reduction in motor speed (revolutions per minute (rpm)) and a decrease in fan performance exhibited by reduced airflow (cubic feet per minute (cfm)) and static pressure (SP) as indicated by the fan/blower affinity laws.

For air filtration systems, TS 4.6.5.3, 4.6.5.4, and 4.7.2.1 require and NUREG-1433 provides that each Engineered Safety Feature (ESF) filter system be tested at ±10 percent of the specified system flow rate. Therefore, if the fan speed and corresponding air flow do not vary more than ±10 percent of the specified system flow rate from the effect of EDG frequency and voltage variation, the fan for that system can be said to be performing within its expected operating range.

The effect of voltage variation in excess of the nominal voltage rating of the fan/blower motors would cause the current of the motor load circuits to increase or decrease accordingly. The voltage variation of the EDG voltage regulator at steady-state operation should be confirmed to be within the allowable operating voltage range for the fan/blower motors to ensure that there would be no adverse impact to the fan/blower motors from the minimum and maximum expected steady-state voltage allowed by the voltage regulator.

The LAR in Attachment 6 contains a list of analyzed fans and blowers in support of this request. Fan and blower data are tabulated in LM-0736, Attachment J. The licensee obtained the load data from analysis 6380E.07 and 6300E.18. Motor synchronous speed and nominal (running) speed were obtained from associated motor outline and/or induction motor data sheets as referenced in LM-0736, Attachment J. Various fans and blowers are connected to the EDGs during a Design Basis Accident as described in UFSAR Table 8.3-3 and analysis 6380E.07.

The NRC staff finds the methodology for evaluating the performance of the applicable fans and blowers to be acceptable because the licensee implemented the methodology described in

WCAP-17308-NP for calculating the change in fan/blower performance from EDG frequency and voltage variations, which was accepted by the NRC Staff in its SE dated April 17, 2017.

3.2.4 Pump Performance

The licensee states that WCAP-17308-NP-A, Section 2.1, directs that the total pump head uncertainty be calculated at discrete flow rates as a function of the combined uncertainties for frequency, voltage, and various other measurements, including flow and pressure. Therefore, flow variability due to measurement uncertainties and the effects of frequency and voltage on pump speed are statistically factored into the pump head uncertainty. For a simultaneous underfrequency and undervoltage event, the licensee indicated that the decrease in pump flow rates is evaluated to confirm the ECCS acceptance criteria. For a simultaneous overfrequency and overvoltage event, the licensee evaluates the increase in pump flow rates to ensure that the Net Positive Suction Head (NPSH) requirements are met and that MOV operation is acceptable. Therefore, the NRC staff finds that the licensee's approach to evaluate pump performance is acceptable because the licensee implemented the methodology described in WCAP-17308-NP for the effects on pump performance from EDG frequency and voltage variations, which was accepted by the NRC Staff in its SE dated April 17, 2017.

3.2.5 MOV Operation

As described in WCAP-17308-NP-A, Section 4, the impact of frequency and voltage variation on MOVs would be similar to the impact on other inductive motors, such as pump motors. Because the MOVs are powered by the 480 V system, the EDG bus frequency translates directly through the step-down transformer. With maximum frequency variations of 2 percent or less, the licensee considers that any change in transformer reactance and secondary side voltage to be negligible. In this section, the NRC staff discusses the licensee's evaluation of the impact of frequency and voltage variation on various aspects of MOV operation.

Per WCAP-17308-NP-A Section 4.3, as part of calculations performed in response to Generic Letter (GL) 96-05, "Periodic Verification of Design-Basis Capability of Safety-Related Motor-Operated Valves," (ADAMS Accession No. ML993490181) the MOV calculations are based on worst-case derated voltage conditions. LM-0736, Section 6, stated, in part, that the MOV thrust/torque calculations utilizes worst case degraded terminal voltage 3861 V to ensure that voltage at the 480 V motor control centers (MCCs) remain at 432 V (90 percent of 480 V). Per National Electrical Manufacturers Association (NEMA) Standard MG 1-2014, "Motors and Generators," AC motors should be designed to operate satisfactorily at ±10 percent of rated voltage and ±5 percent for frequency. The motor speed is directly proportional to the frequency, and speed will have minimal impact due to voltage variation. As per industry standards, AC motors typically run at 1725 rpm (design 1800 rpm) or 3450 (design 3600 rpm). The analysis performed per LM-0736 revealed that a TS change is needed to maintain operating margin for ECCS pumps and to correct a non-conservative TS. Therefore, the licensee proposed a TS frequency variation ≥ 59.8 Hz and ≤ 60.8 Hz, which is more conservative. Therefore, the impact on MOV motor rpm and, thus, the stroke time is minimal. The steady state TS voltage tolerance "≥ 4280 V ± 120 V" is proposed to be changed to "≥ 4160 V and ≤ 4400 V" for greater clarification and alignment to Improved Standard Technical Specification (ITS) format. The staff noted that alignment with the ITS format is acceptable. For induction motors, torque is directly proportional to the square of the voltage, and because of no change in the voltage tolerance, there is no impact on MOV output torque.

The licensee performed a sample calculation (posted in the e-portal) to demonstrate that all MOVs listed in Attachment 7 of the LAR can achieve their stroke time given the frequency variation. Based on its review of the analysis performed, in LM-0736 and NEMA Standard MG 1-2014, the NRC staff finds that the proposed TS frequency variation will have negligible impact on MOV stroke time.

3.2.5.1 Impact of MOV Motor Speed Change

As described in WCAP-17308-NP-A, Section 4.1, the MOV design-calculated stroke times are based on typical design speeds of 1725 and 3440 rpm for AC motors. The reduced EDG frequency will slow the MOV motor speed and increase the valve stroke time. The licensee considers that the impact of increased MOV stroke time caused by a decrease in motor speed due to a lower than nominal frequency will not adversely affect MOV performance, because the proposed change in EDG frequency, and thus motor speed, is minimal. An increase in EDG frequency would result in a faster MOV stroke time. In this case, the faster stroke time impact will be minimal because of only a small increase in EDG frequency. The licensee considers that the small increase in motor speed will not adversely affect valve performance. The NRC staff agrees that the impact of MOV motor speed change will not be significant because the EDG frequency change will be minimal.

3.2.5.2 Impact of Frequency Change on MOV Inertia

As described in WCAP-17308-NP-A, Section 4.2, the inertia of an MOV is associated with the moving parts of the valve assembly and consists of the sum of the inertia of the motor, gear train, and stem-disk assembly. In an MOV, the inertia effect on final load is measured during static diagnostic tests as the difference in thrust from the closed torque switch (CST) trip point and hard seat contact. A change in frequency will impact the energy content of the closing MOV taking into account the square of the rotational speed. As discussed above, the change in MOV motor speed will be minimal. Therefore, the NRC staff concludes that the impact of the frequency change on MOV inertia will not be significant.

3.2.5.3 Impact of MOV Voltage

As described in WCAP-17308-NP-A, Section 4.3, the MOV calculations at Limerick performed in response to NRC GL 96-05 are based on worst-case derated voltage conditions. There would be no change in the calculation results unless the low-end voltage range for the EDG voltage regulator is less than the derated voltage condition analyzed in the MOV calculations. For typical AC motor and actuator applications, voltage variation from 90 to 100 percent will not affect the output torque outside its operating range if the nominal ratings are used. The licensee stated that the voltage variation of the EDG voltage regulator at steady-state operation will be confirmed to be within the allowable operating voltage range for the MOV motors to ensure that there would be no adverse impact on the MOV motors from the maximum expected steady-state voltage allowed by the voltage regulator. The NRC staff concludes that the licensee's action to confirm that the voltage variation will be within the allowable operating voltage range for the MOV motors is consistent with the guidance in WCAP-17308-NP for the impact of MOV voltage variations on MOV performance, which was accepted by the NRC Staff in its SE dated April 17, 2017. The NRC staff describes its review of the licensee's action to confirm that voltage variation will not adversely affect MOV performance in Section 3.3.5, "MOV Operation," of this safety evaluation.

3.2.5.4 Impact of Pump Output Pressure/Differential Pressure (DP) on the MOV

As described in WCAP-17308-NP-A, Section 4.4, an increase in pump output pressure and, consequently, the differential pressure caused by a higher than nominal frequency will create a higher DP at the valve. For those MOV calculations that are based on the vendor pump performance curve at zero flow rate (i.e., shutoff head), the calculations would be affected if the pump head increased above the nominal shutoff head. The impact on MOV calculations performed at a DP lower than the pump shutoff head is also evaluated. The NRC staff finds the methodology for evaluating the impact of pump outlet pressure/differential pressure on MOV performance to be acceptable because the licensee implemented the methodology described in WCAP-17308-NP for calculating the change in MOV performance from EDG frequency and voltage variations, which was accepted by the NRC staff in its SE dated April 17, 2017, describing the NRC evaluation of WCAP-17308-NP. The NRC staff describes its review of the licensee's action to evaluate the impact of DP on the MOV from the change in EDG frequency and voltage in Section 3.3.5 of this SE.

3.3 Results of Design Analysis LM-0736

The NRC staff reviewed the results of the Constellation Design Analysis LM-0736 summarized in the LAR. Based on its review, the NRC staff did not identify any concerns with the summary provided in the LAR

3.3.1 EDG Loading

Per LM-0736 Section 8.1.1, the analysis performed in Constellation 6300E.23, Revision 12, Millstone Undervoltage Study, demonstrates that the safety-related loads met the performance requirements under degraded voltage condition. The analysis that was performed for 3861 V at the 4 kV bus is bounding the EDG lower uncertainty voltage of 4158 V.

The EDG is rated at 2850 kW. The EDG D12 loading at a maximum frequency of 60.8 Hz with D11 out of service is 2487 kW, with a margin of 363 kW available. The change in loading with the increase in frequency is obtained by cubing the ratio of maximum frequency divided by nominal frequency. The Fairbanks Morse (EDG vendor) determined, based on operating at ±2 percent of frequency and within torque rating, that there will be no EDG operating issues at ±2 percent of frequency.

Based on its review, the NRC staff finds that the EDG loading is acceptable.

3.3.2 EDG Fuel Consumption

Per LM-0736 Section 7.2 and in Attachment L, the maximum total fuel oil consumption for a 7-day LOCA is calculated to be 33,444 gallons, as calculated for the D11 EDG, which has the highest expected fuel consumption of the three EDGs. This quantity is bounded by the minimum storage tank volume of 33,500 gallons in the TS. The NRC staff accepts the licensee's assertion that this approach is conservative in that it assumes that the maximum load, and thus maximum consumption rate, is used for the entirety of a 7-day LOCA/LOOP. Therefore, NRC staff finds the methodology for evaluating the EDG fuel consumption to be acceptable, and that the proposed changes to EDG frequency and voltage tolerances will not require any changes to the stored fuel requirements.

3.3.3 Fan/Blower Performance

Per LM-0736 Section 8.3, the fan/blower performance evaluated in the analysis shows a reduction in speed dependent on the motor slip calculated for each fan. The licensee calculated that the respective flow rates for the SGTS Exhaust Fan, Reactor Enclosure Recirculation Fan, and CREFAS Fan at undervoltage and underfrequency vary by less than 10 percent of their nominal flow rates. The licensee evaluated the other fans based on their ability to remove heat at their reduced flow rates. The licensee determined that the small reduction in cooling capacity at undervoltage and underfrequency conditions is insufficient to overcome the margin in heating load on these fans. At overvoltage and overfrequency conditions, the fans within the scope of Limerick TS 4.6.5.3, 4.6.5.4 and 4.7.2.1 are able to maintain their respective flow rates within 10 percent of their nominal flow rates.

The SGTS has pressure control dampers, the Reactor Enclosure Recirculation subsystem has flow control dampers, and the CREFAS subsystem has flow and pressure control dampers that will compensate and maintain their respective TS flow rate tolerances. In addition, each independent train of CREFAS and main control room (MCR) supply and exhaust fans are powered from an independent Class 1E power source; therefore, MCR habitability will not be challenged at the proposed EDG frequency range because the system will be capable of maintaining a positive pressure above atmospheric to inhibit unfiltered air leakage into the control room areas. The other fans are expected to provide more cooling at the higher end of the proposed EDG frequency. At the proposed TS frequencies, there may be minor changes of in-leakage in the MCR, but these minor changes will not affect the MCR habitability. Therefore, the NRC staff finds the fan and blower performance to be acceptable.

3.3.4 Pump Performance

The licensee used the methods described in WCAP-17308-NP-A to address the EDG voltage and frequency variances. Per WCAP-17308-NP-A Section 2.1, the total pump head uncertainty is calculated at discrete flow rates as a function of the combined uncertainties for frequency, voltage, and various other measurements including flow and pressure. Therefore, flow variability due to measurement uncertainties and the effects of frequency and voltage on pump speed are statistically factored into the pump head uncertainty. For the simultaneous underfrequency and undervoltage event, the decrease in pump flow rates is evaluated to ensure ECCS acceptance criteria remain acceptable. For the simultaneous overfrequency and overvoltage event, the increase in pump flow rates is evaluated to ensure NPSH requirements are met and MOV operation is acceptable.

The licensee’s evaluation determined that at undervoltage and underfrequency conditions, the speed of the pumps decreased by less than 1 percent while at overvoltage and overfrequency conditions the speed increased between 1 to 2 percent for each pump. The licensee further determined that the discharge pressures delivered by safety-related pumps decreased at underfrequency conditions and increased at overfrequency conditions.

The impact of the change in pump performance at these conditions as analyzed by the licensee for each of the safety-related pumps is discussed below.

<u>Residual Heat Removal (RHR)</u>

The licensee applied the acceptance criteria of 8000 gpm at 150 pounds per square inch (psi) discharge pressure for the RHR pumps based on its General Electric (GE) LOCA Analysis of

Record, instead of the current TS minimum of 10,000 gpm. The licensee stated that the WCAP-17308-NP-A methodology for reducing the pump discharge pressure is applied to each flow point to determine the minimum discharge pressure at underfrequency conditions. The data provided by the licensee in the LAR, Table 8.4.2.1, show that each RHR pump exceeds the minimum discharge pressure of 150 psi at 8000 gpm.

The licensee did not identify any concerns regarding cavitation of the RHR pumps at overfrequency and overvoltage conditions because sufficient margin will remain to accommodate the increased pump speed. At overfrequency and overvoltage conditions, the pumps are running at a higher speed, which reduces the NPSH margin. Because at the proposed overfrequency and overvoltage the speed increase is small (only 1 to 2 percent), the NRC staff finds the licensee's determination that margin will remain to accommodate the pump speed increase to be acceptable.

Upon reviewing all the details, the NRC staff finds the licensee's evaluation that the proposed changes in EDG frequency and voltage will not lead to degraded performance of the RHR pumps to be acceptable.

Core Spray (CS)

The licensee evaluated the acceptance criteria for the Core Spray pumps with respect to the GE LOCA analysis instead of the TS minimum of 3175 gpm. The licensee considers that the pumps are acceptable if each loop can produce 250 psi discharge head at 5000 gpm flow because, by design, each pump is operating at 50 percent capacity in each loop. The data provided by the licensee in the LAR from LM-0736, Table 8.4.2.2, using the WCAP-17308-NP-A methodology, show the discharge pump pressure of the Core Spray pumps to be above 250 psi in each loop.

The licensee did not identify any concerns regarding cavitation of the Core Spray pumps at overfrequency and overvoltage conditions because sufficient margin remains to accommodate the increased pump speed. In that the proposed overfrequency and overvoltage results in only a small speed increase (1 to 2 percent), the NRC staff agrees that margin will remain to accommodate the pump speed increase.

Upon detailed review, the NRC staff finds the licensee's evaluation that the proposed changes in EDG frequency and voltage will not lead to degraded performance of the Core Spray pumps to be acceptable.

Suppression Pool Cooling and Suppression Pool Spray Modes of RHR

The licensee calculated a 0.53 percent reduction in pump speed at a lower frequency of 59.8 Hz. The licensee considers that the reduction in pump speed from nominal will not impact the ability of the RHR pumps to provide a design-rated shell-side heat exchanger flow of 10,000 gpm for post-accident decay heat removal or 500 gpm for suppression pool spray mode. This is due to the full flow test return valves being throttled when the RHR system is in the suppression pool cooling or suppression pool spray mode of operation, and the slight decrease in pump performance can be addressed by further opening the throttled valve. The licensee determined that operating the RHR pumps above 60 Hz produces more pump flow and head, which can be addressed by further closing the throttled valve.

Based on its review, the NRC staff finds the licensee's evaluation that the slight increase or decrease in the pump speeds due to the proposed change in EDG frequency and voltage will not adversely affect post-accident RHR cooling flow to be acceptable.

Emergency Service Water (ESW) Pumps

The licensee periodically demonstrates the ability of the ESW pumps (weakest per loop) to supply the minimum required cooling water flow rates to components cooled by the ESW system under the design-basis system operating mode. The licensee considers the ESW pumps to be acceptable at underfrequency and undervoltage conditions per Section 7.6.1.3 of LM-0736 due to their capability to deliver higher than the minimum required ESW pump flow rate under the design-basis system operating mode of 3392.4 gpm. The licensee determined that for the overfrequency and overvoltage conditions, sufficient margin remains to accommodate the pump speed increase. The licensee noted that the reactor operators would receive a low-pressure alarm well in advance of cavitation in the ESW system.

The NRC staff finds the licensee's determination of the ESW pumps being at higher than the design-basis system operating mode flow rate at underfrequency and undervoltage conditions to be acceptable because of the capability of the ESW pumps to deliver more than the minimum required ESW pump flow. The NRC staff also finds the licensee's determination of sufficient margin being present to accommodate the pump speed increase for overspeed and overvoltage conditions for the ESW pumps to be acceptable because of the available margin for the ESW pump capability.

RHR Service Water (RHRSW) Pumps

The licensee stated that for two-unit operation at Limerick, during an operating mode where one unit is in an accident shutdown (LOCA) and the other unit is in a normal shutdown (including LOOP occurring during normal shutdown) with one RHRSW loop in service, the unit undergoing normal shutdown will be supplied with 5570 to 8000 gpm of RHRSW flow to the RHR heat exchanger. The licensee determined that the unit in an accident shutdown will be supplied 8000 gpm with each of the four RHR heat exchangers being maintained such that a minimum RHRSW flow of 5570 gpm will ensure that the minimum required heat removal duty is met. In that the minimum RHRSW flow required is met during all conditions, the underfrequency and undervoltage condition for the RHRSW pumps will not lead to adverse pump performance.

For the overfrequency and overvoltage conditions where the pumps are running at a higher speed might lead to a concern regarding pump cavitation, the licensee stated that the output flow can be throttled by reactor operators when controlling the RHRSW system, allowing the control of flow to the desired rate and eliminating any cavitation concerns.

The NRC staff finds the licensee's determination that the RHRSW pumps will supply minimum required flow (5570 gpm) during underfrequency and undervoltage conditions to be acceptable because the minimum RHRSW pump flow of 5570 gpm will ensure that the required heat removal capability is met. The NRC staff also finds the licensee's position for throttling of the outflow by reactor operators when controlling the RHRSW system during overfrequency and overvoltage conditions to be acceptable because potential cavitation concerns will be avoided.

Control Room Chiller Water Pumps

The licensee removed conservatism in its calculations to ensure that the Control Room Chiller Water Pumps met the criteria outlined in the IST requirements. The licensee presented the results of its Control Room Chiller Water Pump evaluation at decreased speeds due to underfrequency and undervoltage conditions from LM-0736, Table 7.6.46. The table shows that the discharge pressure for both pumps is within the acceptable criteria for the underfrequency and undervoltage conditions. The licensee did not identify any concerns regarding pump cavitation at the overfrequency and overvoltage conditions.

Based on the data presented in the LAR attachment 1, Table 7.6.46, and the proposed frequency band, the NRC staff finds that the removal of conservatism in the calculation does not adversely impact the licensee's determination of Control Room Chiller Water Pumps being acceptable within the scope of LM- 0736, consistent with WCAP-17308-NP-A.

Safeguard Piping Fill Pumps

The licensee presented the discharge pressures for the Safeguard Piping Fill Pumps at decreased speed due to undervoltage and underfrequency conditions from LM-0736, Table 7.6.41. The licensee considered these discharge pressures to be acceptable within the scope of LM-0736, consistent with WCAP-17308-NP-A. Based on the discharge pressures presented by the licensee and determination that they are within the acceptance criteria, the NRC staff agrees that the operation of Safeguard Piping Fill Pumps is acceptable at decreased speed due to undervoltage and underfrequency conditions.

For the overvoltage and overfrequency conditions, the licensee determined that a maximum 1.64 percent increase in pump speed will have a negligible effect on NPSH margin. The licensee stated that the NPSH available is 18.07 feet while the NPSH required is 2.75 feet. Given the available margin compared to the required NPSH and the minimal change in speed (only 1.64 percent), the NRC staff finds the licensee's determination that there is no concern regarding cavitation at overvoltage and overfrequency conditions for the Safeguard Piping Fill Pumps to be acceptable.

Diesel Fuel Oil Transfer Pumps

The licensee indicated that the Diesel Fuel Oil Transfer Pumps operate normally at 20 gpm, which is significantly higher than the minimum flow requirement of 3.323 gpm. Based on the margin available, the licensee considered that the pump performance is acceptable at underfrequency and undervoltage conditions based on engineering judgment from the significant margin between the nominal flow and the minimum flow. The licensee also considered that the effect on NPSH required during overvoltage and overfrequency conditions is negligible.

Given the available margin for the underfrequency and undervoltage conditions and the relatively small change in pump speeds at the proposed overfrequency and overvoltage conditions, the NRC staff finds the licensee's determination of the capability of the Diesel Fuel Oil Transfer Pumps to be acceptable.

Positive Displacement Pumps

The licensee discussed the impact of the EDG voltage and frequency changes on two sets of positive displacement pumps at Limerick.

The licensee stated that the Standby Liquid Control pumps operate at a nominal flow of 43 gpm such that the flow rate at undervoltage and underfrequency conditions will be well above the TS minimum of 37 gpm. The licensee also considered the effect on NPSH required due to overvoltage and overfrequency to be negligible. Based on the margin between nominal flow to TS minimum flow and the minimal change in pump speeds, the NRC staff finds the licensee's determination that the Standby Liquid Control pumps are acceptable within the scope of LM-0736, consistent with WCAP-17308-NP-A.

For the Control Room Chiller Oil pumps, the licensee stated that their nominal flow rate of 33 gpm has a 10 percent margin above the minimum acceptable flow rate. The licensee considered the decrease in flow for the Control Room Chiller Oil pumps due to undervoltage and underfrequency conditions to be negligible. The licensee considered the effect on NPSH required during overvoltage and overfrequency conditions to also be negligible. Based on the margin available for the flow decrease at underfrequency and undervoltage conditions and small increase in pump speeds at overfrequency and overvoltage conditions, the NRC staff finds the licensee's determination that the Control Room Chiller Oil pumps are acceptable within the scope of LM-0736, consistent with WCAP-17308-NP-A.

Compressors

The Control Room Enclosure Chiller 0A and 0B-K112 were the only safety-related compressors within the scope of this LAR. The Control Enclosure Chillers have a revised rating of 192 tons and a minimum required cooling capacity of 157.3 tons. A margin of 34.7 tons is available with an additional assumed cooling load margin of 7 percent. This margin is sufficient to bound any decreases in cooling capacity as a result of the speed decrease at undervoltage and underfrequency conditions. Based on the available margin, the NRC staff finds the licensee's determination of adequate performance of the compressors to be acceptable.

Relief Valve Lift

The licensee reported that the pressure relief valve setpoints associated with the centrifugal pumps were determined by using the shutoff head pressure of its associated pump. The licensee considered that sufficient margin exists between the expected pressure at the design flow and the shutoff head pressure to preclude lifting of a relief valve during a design-basis accident. As a result, the affected pumps will operate within the limits of the relief valves. In addition, the licensee determined that the increase in speed does not affect the discharge pressure of positive displacement pumps. Therefore, the licensee did not identify any concerns that at a higher frequency of 60.8 Hz, a safety relief valve would lift affecting the design functions of the systems. Based on the minimal increase in discharge pressure from the higher motor frequency of the pumps, the NRC staff finds the licensee's determination of the absence of concerns regarding inadvertent relief valve lift to be acceptable.

3.3.5 MOV Operation

In the LAR, the licensee summarized its evaluation of the impact of the EDG voltage and frequency changes on MOV operation, including terminal voltage, inertia effect, differential pressure, stroke time, ESW/RHRSW flow balance impact, and spray pond temperature impact.

With respect to terminal voltage, the licensee determined that all MOVs are acceptable as indicated in LM-0736, Section 8.5.1, given the EDG voltage uncertainty described in LM-0736, Section 7.1. The licensee based its determination on MOV thrust calculations that were considered acceptable using an MCC voltage of 432 V (90 percent of 480 V rated voltage). The licensee referenced its analysis demonstrating that the safety-related loads met the performance requirements under degraded voltage conditions. The licensee reported that the degraded voltage analysis was performed at the design limit of 3861 V, which is the minimum required voltage on the 4.16 kV bus during steady state operation. As a result, the licensee determined that the analysis that was performed based on 3861 V at the 4 kV bus is bounding the EDG lower uncertainty voltage of 4158 V.

With respect to the inertia effect, the licensee reported that the inertia effect due to the increased frequency was analyzed as indicated in LM-0736, Section 8.5.2, for the AC motor valves for the impact on thrust for gate valves and non-rising rotating-stem globe valves. The licensee stated that this inertial effect on torque is analyzed for AC motor valves for valves where torque is measured in place of thrust, such as for butterfly valves. The licensee determined that the MOV inertia evaluation demonstrates the maximum allowable MOV thrust or torque (as applicable) is not exceeded. The licensee reported that all analyzed valves are operated with a thrust or torque requirement below the maximum allowable with margin; therefore, ensuring the frequency uncertainty impact is minimal relative to the maximum MOV thrust and torque capabilities. Thus, the licensee determined that the respective valve integrity remains acceptable for the EDG voltage and frequency changes. Even upon imposing the additional thrust due to the frequency uncertainty, the licensee determined that sufficient margin exists to provide assurance that all MOVs continue to be within their thrust and torque capabilities when considering typical valve testing variances.

With respect to differential pressure effects, the licensee reported that the MOV differential pressure was analyzed as indicated in LM-0736, Section 8.5.3, to assess the effect of the frequency uncertainty due to a combined inertial effect and differential pressure on the analyzed MOVs. The licensee stated that this frequency uncertainty is an uncertainty independent of the other MOV testing uncertainties. As independent uncertainties can be combined, the licensee determined that the frequency uncertainty impact has minimal impact on the overall test uncertainty, which is also used to establish MOV operability. In that the frequency uncertainty has a minimal impact on the MOV testing, and the MOV testing limits have included margins to the overall MOV thrust and torque capabilities, the licensee determined that the frequency uncertainty has a negligible impact on the MOV capabilities. The licensee considered the increased uncertainty to be less than 1 percent for all analyzed MOVs. The licensee determined that all MOVs are assessed to be fully capable of withstanding any potential adverse effects due to the frequency uncertainty which may be impacted when the EDG is operating within the bounds of the established frequency uncertainty. Therefore, the MOVs remain capable given the range of the expected EDG frequency uncertainty.

With respect to stroke time effects, the licensee indicated, in LM-0736, Section 8.5.4, that the impact of stroke time is insignificant. Therefore, the licensee considered that stroke time effects are not a concern when the motors are operating within the bounds of the EDG frequency

uncertainty. The licensee stated that a review of the MOV stroke time requirements shows that all MOVs that may be powered from the EDG will stroke within the required times given the expected frequency uncertainty range.

With respect to the ESW/RHRSW flow balance impact, the licensee reported that the results provided in LM-0736, Attachment AA, “Evaluation of the Effects of Diesel Generator Frequency Shifts on the Performance of the Limerick ESW/RHRSW Systems and Spray Pond,” indicate that there is no adverse impact on the ESW and RHRSW flow balance during both underfrequency and overfrequency operation.

With respect to the spray pond temperature impact, the licensee reported that the results provided in LM-0736, Attachment AA, indicate that there is no adverse impact on spray pond temperature increase during overfrequency operation.

The NRC staff reviewed the evaluation summarized by the licensee in the LAR of the potential impact of the EDG voltage and frequency changes on MOV operation with respect to terminal voltage, inertia effect, differential pressure, stroke time, ESW/RHRSW flow balance impact, and spray pond temperature impact. The staff reviewed the detailed analysis of the EDG TS voltage and frequency range and tolerances described in by the licensee in the LAR Attachment 1. Based on its review, the staff concluded that the licensee’s determination of minimal changes in EDG voltage and frequency will not have an adverse impact on MOV operation.

3.4 ECCS Pump Flow SR Acceptance Criteria

The licensee stated that the analysis performed in LM-0736 revealed that a TS change is needed to maintain operating margin for the ECCS pumps and to correct a non-conservative TS. To address the non-conservative TS and to gain operating margin at the proposed EDG frequency and voltage, the licensee proposed to revise the TS SR flow acceptance criteria for the ECCS Core Spray system and the Low Pressure Coolant Injection pumps from 3175 gpm and 1000 gpm to 2500 gpm and 8000 gpm, respectively.

The licensee stated that while the CS and LPCI pumps do not meet the required TS flow values, they exceed their respective pump flow values of 8000 gpm and 2500 gpm contained in the analysis of record (AOR) for the GNF2 and GNF3 fuel. The licensee reported that the ECCS-LOCA analysis for the GNF2 fuel for Limerick was performed using the NRC-approved SAFER/GESTRLOCA methodology and is supplemented by the implementation of the PRIME methodology (NRC-approved SAFER/PRIME methodology (ADAMS Package No. ML19276D426)). Similarly, the licensee stated that the ECCS-LOCA analysis for the GNF3 fuel was performed using the NRC-approved SAFER/PRIME methodology. Based on the ECCS-LOCA analysis, the licensee determined that the Licensing Basis peak clad temperature (PCT) conforms to all the requirements of 10 CFR 50.46 and Appendix K, and proposed to revise the TS values to match the LOCA AOR.

In Section 3.4 of Attachment 1 to the LAR, the licensee provided technical details of the design of the CS and LPCI injection and their acceptance criteria. The licensee stated that General Electric-Hitachi (GEH) performed a supplemental LOCA analysis using the NRC-approved SAFER/PRIME methodology using the Limerick 10 CFR 50.46 LOCA AOR flowrate of 8000 gpm for a LPCI pump and 5000 gpm for the CS loops (2500 gpm per loop). Per the licensee, the analysis was performed for both limiting liquid line breaks (recirculation suction line breaks) and the limiting steam line breaks (main steam line breaks inside containment). The licensee reported that the analysis was performed for GNF3 fuel, but also bounds the GNF2

response. The licensee stated that GEH/GNF performed LOCA break spectrum runs for the cases listed in Table 3-7 of BWR Owners' Group (BWROG) Report NEDC-30936P-A (ADAMS Accession No. ML19302D893) with either one LPCI pump at 8000 gpm considering LPCI coupling leakage or one Low Pressure Core Spray (LPCS) loop at 5000 gpm while also considering CS process bypass leakage at 3515 Megawatt thermal (MWt) reactor power. The analyzed break spectrum cases were performed for the various line break scenarios consistent with the NEDC-30936P-A basis.

Based on the supplemental analysis performed in the NRC-approved SAFER/PRIME methodology, the licensee determined that the limiting PCT for all cases is below the acceptance criteria of 2200 Fahrenheit (˚F) for ECCS performance, which is same as the acceptance criteria as that specified in NEDC-30936P-A. The licensee stated that in addition to the margin demonstrated the supplemental analysis, the analysis retains conservatisms in the approved methodology that support the bounding nature of the results of the analysis.

The NRC staff notes that the ECCS-LOCA AOR for the GNF2 and GNF3 fuel was performed using the NRC-approved SAFER/PRIME methodology . The analysis assumes 8000 gpm and 2500 gpm flow values for LPCI and CS pumps, respectively. The analysis was performed for various limiting line break scenarios consistent to the NEDC-30936P-A basis and resulted in limiting the PCT below the acceptance criteria of 2200 ˚F for ECCS performance for all cases analyzed. Based on its review, the NRC staff agrees that the ECCS-LOCA analysis presented meets the requirements of 10 CFR 50.46 and Appendix K as demonstrated by the licensee in Attachment 1 of the LAR. Based on these findings, the NRC staff finds the updated ECCS pump flow SR criteria to be acceptable.

3.5 Technical Specification Typographical Errors

In the LAR, the licensee proposes to correct two typographical errors in the Limerick TS. The NRC staff considers these minor corrections to the Limerick TS to be editorial in nature, and therefore, acceptable.

3.6 Technical Conclusion

Based on the technical evaluation provided above, the NRC staff finds the licensee has adequately evaluated the impact of the proposed TS changes on the safety-related loads fed by the EDGs. The proposed TS changes would have minimal or no impact on the continued safe operation and shutdown capability of loads fed by the EDGs. As described in this safety evaluation, the NRC staff reviewed the proposed changes to revise frequency acceptance criteria from 60 Hz ± 1.2 Hz to 59.8-60.8 Hz for surveillance testing. Based on its review, the staff finds that the proposed TS changes will not adversely impact the capacity and capability of the safety-related electrical equipment required for accident mitigation and plant shutdown. Therefore, the staff finds that the revised SRs provide reasonable requirements to ensure the necessary quality of the electrical equipment is maintained and the associated LCOs will be met. Consistent with 10 CFR 50.36(c)(3), the licensee's proposed change to the SRs would continue to maintain reasonable assurance that the necessary quality of systems and components are being maintained. Therefore, the NRC staff finds the proposed TS changes are acceptable and concludes that there is reasonable assurance that the requirements of 10 CFR 50.36(c)(3) will continue to be met. Therefore, the staff finds that the proposed TS changes in the LAR are acceptable. Based on its review described in this safety evaluation, the NRC staff concludes that the proposed amendment submitted by the licensee to revise the TS surveillance requirements for EDG frequency and voltage tolerances and for ECCS pump flows

for Limerick Units 1 and 2 is acceptable. The NRC staff further concludes that there is reasonable assurance that the health and safety of the public will be protected following approval of this LAR.

4.0 STATE CONSULTATION

In accordance with the Commission's regulations, the Pennsylvania State official was notified of the proposed issuance of the amendment on September 27, 2022. The State official had no comments.

5.0 ENVIRONMENTAL CONSIDERATION

The amendment changes a requirement with respect to installation or use of a facility component located within the restricted area as defined in 10 CFR Part 20 or changes surveillance requirements. The NRC staff has determined that the amendment involves 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 amendment involves no significant hazards consideration, and there has been no public comment on such finding published in the Federal Register on February 22, 2022 (87 FR 9647). Accordingly, the amendment meets 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 amendment.

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 amendment 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 3, 2023

SUBJECT: LIMERICK GENERATING STATION, UNITS 1 AND 2 – ISSUANCE OF AMENDMENTS NOS. 258 AND 220 REGARDING TECHNICAL SPECIFICATIONS 3/4.8.1, "AC SOURCES-OPERATING" AND 3/4.5.1, "ECCS-OPERATING" (EPID L-2020-LLA-0233) DATED JANUARY 3, 2023

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