Limerick Generating Station (LGS) WCAP-17308 Implementation LAR

NRC Pre-submittal Meeting
October 06, 2021

Exelon

Agenda / Opening Remarks

- Introductions
- License Amendment Request (LAR) Team
- Goals of Meeting
- Overview
- Consistency with WCAP-17308
- Need for Emergency Core Cooling System (ECCS) Pump Technical Specification (TS) Surveillance Requirement (SR) flow acceptance criteria changes
- Proposed TS Changes
- NRC Feedback
- Closing Remarks

Introductions / LAR Team

LAR Team

- Sponsor - Matt Bonanno Director Site Engineering
- Lead Licensing Engineer - Frank Mascitelli
- Site Regulatory Assurance - George Budock
- LAR Technical Lead - Emmanuel Rosa
- Manager Engineering Lead - Laura Velez
- Central Design Organization (CDO) Lead - Jacob Giovanni Sherk
- CDO Manager - Brian Madderom
- Maintenance Manager I&C - Joe Drahus
- Supporting Engineering Staff
  - Senior Staff Engineer - Greg Curtin
  - Emergency Diesel Generator System Engineer - Farad Zaman
  - ECCS System Engineers - Jim Berg, John George
  - Operations - Craig Myers

Goals Of Meeting

- Present clear description of the LAR and proposed changes
- NRC has clear understanding of minor deviations to WCAP-17308 Methodology
- NRC has clear understanding of the proposed ECCS Pump TS SR changes that are not within the scope of WCAP-17308
- NRC provides feedback to Exelon approach and justification
- Discuss potential for future audit of supporting calculations and analyses
- Results of NRC feedback contribute to an efficient Acceptance Review and reduction of future potential Requests for Additional Information (RAIs)
- NRC review time is less than or equal to one year

Overview

- The proposed amendments would revise certain frequency and voltage acceptance criteria for steady-state emergency diesel generator surveillance requirements under TS 3/4.8.1, "AC Sources - Operating." The proposed changes are consistent with WCAP-17308." In addition, the proposed amendment would revise the flow acceptance criteria of the emergency core cooling system pumps surveillance requirements under TS 3/4.5.1, "ECCS-Operating."
- The LAR is required to correct a non-conservative TS. Plant operations are currently administratively controlled as described in NRC Administrative Letter (AL) 98-10, "Dispositioning of Technical Specifications that are Insufficient to Assure Plant Safety." In accordance with the guidance in AL 98-10, this LAR is required to resolve a non-conservative TS and is not a voluntary request to change the LGS licensing basis.
- The LAR will be a non-proprietary submittal, but parts of the LAR are based on proprietary analyses.

Overview

- The analysis performed per LM-0736, "Analyses of Emergency Diesel Generator Technical Specification Voltage and Frequency Range and Tolerances," revealed that a Technical Specification (TS) change is needed to maintain margin for ECCS pumps and to correct a non-conservative TS. This LAR will change the Emergency Diesel Generator (EDG) steady-state operating frequency band from 60 Hz ± 1.2 Hz to 59.8 - 60.8 Hz for eight TS SRs. Note that the steady-state TS voltage tolerance expressed as "4280 ± 120 volts" is proposed to change to "≥ 4160 V and ≤ 4400 V" for greater clarification and the actual voltage tolerance is not changed. The functions of the EDGs are not changed as a result of this modification. The LAR is changing the steady-state operating frequency of the EDGs to a more realistic value, is more conservative and resolves a non-conservative TS.

- In addition, to address the non-conservative TS and to gain additional margin at the proposed EDG frequency and voltage steady state frequency tolerances, the ECCS Core Spray System (CSS) and Low Pressure Coolant Injection (LPCI) Pumps will have their TS SR flow acceptance criteria revised from 3,175 and 10,000 gpm to 2,500 and 8,000 gpm, respectively.

- Also, this LAR will include correcting a typographical error. For Unit 1, TS 3.8.3.1.a.8.b, the 480-VAC load center labeled "D224" is a typographical error and should be labeled as "D244."

Consistency with WCAP-17308

- To evaluate the acceptability of the proposed change, Exelon evaluated the proposed change consistent with WCAP-17308-NP-A, Revision 0, “Treatment of Diesel Generator (DG) Technical Specification Frequency and Voltage Tolerances”

- The analysis and supporting calculations are contained in Exelon Design Analysis, LM-0736, Revision 0, “Analyses of Emergency Diesel Generator Technical Specification Voltage and Frequency Range and Tolerances”

- Specifically, the following items were evaluated for changes in steady-state voltage and frequency:
  - Impact on Safety-Related Systems which include ECCS
  - Impact on EDG Loading
  - Impact on EDG Fuel Oil Consumption Calculations
  - Impact on Motor Operated Valve (MOV) Performance

Consistency with WCAP-17308

- Minor Electrical Deviations:
- Per Section 3.1.1 of WCAP-17308-NP-A, 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). A more realistic approach of separating the load profile out 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 was used.
- The load factor for induction motors was derived by using the equation 5 in WCAP-17308-NP-A to determine the uncertainty in motor speed then applying classical machine theory to determine the impacts or power changes. The load factor for static loads was derived by using classic electrical power laws. This results in not only a more realistic but also a more conservative result since in LGS's case, static loads provide a higher load factor than induction loads since the voltage variation is larger.

Consistency with WCAP-17308

- Minor Mechanical Deviations:

- The In-Service Test (IST) program at Limerick does not produce, or have available, 5-point IST curves. In some cases, either pre-operation test data (Residual Heat Removal (RHR), CS) were used, or vendor pump data were used to develop pump curves.

- The TS listed by WCAP-17308-NP Section 5.2 regarding fan acceptability do not encompass General Electric-built plants. However, LGS TS 4.6.5.3 and 4.6.5.4 require that flow rates for Standby Gas Treatment subsystems and Reactor Enclosure Recirculation subsystems not vary more than 10% from their nominal flowrates. Therefore, the modified fan performance for the Standby Gas Treatment System Room Unit Coolers, Standby Gas Treatment System Room Access Unit Coolers, Standby Gas Treatment System Exhaust Fan, Reactor Building Recirculation Fan, and Standby Gas Treatment System Room Vent Exhaust Fan are deemed acceptable so long as the flow rate at underfrequency and undervoltage is not less than 90% of the nominal flowrate. The acceptability of fans not included within the scope of LGS TS 4.6.5.3 and 4.6.5.4 is evaluated based on the ability of the fans to provide sufficient cooling load to their respective systems.

Consistency with WCAP-17308

- Minor MOV Deviations:
  - The frequency and voltage uncertainty is treated as an added uncertainty similar to how MOV testing uncertainties are evaluated. This WCAP described uncertainty is shown to be small relative to the pre-existing test uncertainty for all valves in the MOV testing population. The additional uncertainties are combined with the existing MOV testing uncertainty using standard square-root-sum-of-the-squares methods when the uncertainties are independent, and by sum when the uncertainty is not independent. The result is effectively an increased testing variability, which is compared against the existing valve capabilities. All valves are found to have sufficient margin to existing valve capabilities even upon imposing this increased uncertainty.

Need for ECCS Pump TS SR Flow Acceptance Criteria Change

- The results shown in calculation LM-0736 for LPCI and CS do not meet the required TS flow value of 10,000 gpm and 3,175 gpm, respectively. They do, however, exceed their respective flow values of 8,000 gpm and 2,500 gpm contained in the 10CFR50.46 Analysis of Record (AOR) 0000-0111-9078 (GNF2 fuel evaluation) and 005N3990 (GNF3 fuel evaluation).
- The AOR provides the results of the loss-of-coolant accident (LOCA) analysis performed by GE Nuclear Energy for LGS Units 1 and 2. The analysis, which uses the NRC approved SAFER/GESTR-LOCA application methodology, was performed in accordance with NRC requirements and demonstrates conformance with Emergency Core Cooling System (ECCS) acceptance criteria of 10CFR50.46 Appendix K.
- Exelon is proposing a TS change to reduce the allowable RHR and CS pump flow rates from their present values by 20% to match the existing LOCA AOR that meets the requirements of 10 CFR 50.46. Consistent with the existing LOCA analysis, the proposed TS changes, relating to ECCS flow, are justified.

Need for ECCS Pump TS SR Flow Acceptance Criteria Change

- To support the TS ECCS flow rate changes, LGS requested GEH to perform a supplemental LOCA analysis using NRC approved SAFER/PRIME methodology using nominal assumptions (GEH document 006N4699) per the rules of engagement contained in NEDC-30936P at the Limerick 10CFR50.46 LOCA AOR flowrate of 8,000 gpm for a LPCI pump and 5,000 gpm for CS loop for both limiting liquid line breaks (recirculation suction line breaks, RSLB) and the limiting steam line breaks (main steam line breaks inside containment, STML)."
- The supplemental GEH 006N4699 analysis concluded that the limiting Peak Cladding Temperature (PCT) for all cases was below the acceptance criteria of 2200˚F for ECCS performance, same acceptance criteria as that specified in Section 3.3.2 of NEDC-30936P.
- With the revised ECCS Pump flow acceptance criteria, the CSS and LPCI pumps can deliver these lower flows within the new proposed TS SR EDG steady state frequency uncertainty bands.

Need for ECCS Pump TS SR Flow Acceptance Criteria Change

- References / Precedent:
- AORs:
  - GE-Hitachi Nuclear Energy, 0000-0111-9078-R0, “Limerick Generating Station Units 1 and 2 GNF2 ECCS-LOCA Evaluation,” February 2011
  - GE-Hitachi Nuclear Energy, 005n3990, “Limerick Generating Station Units 1 and 2 GNF3 ECCS-LOCA Evaluation,” December 2020
- GEH document 006N4699, “Limerick Supplemental ECCS Flow Reduction LOCA Analysis for NEDC-30936,” dated June 2021
- NEDC-30936P-A,General Electric Company, "BWR Owner's Group Technical Specification Improvement Methodology (with Demonstration for BWR ECCS Activation Instrumentation)," December 1988
- There is applicable precedent for ECCS Pump flow consideration with a Susquehanna submittal (ADAMS Accession No. ML17352A711); however, Susquehanna did not formally change their TS SR flow acceptance criteria

Proposed TS Changes

Table 2.3 Proposed TS SR Changes

Surveillance Requirement	Description	Frequency (from current SFCP***)
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 and ≤ 4400 V and frequency ≥ 59.8 Hz and ≤ 60.8 Hz.*	In accordance with Surveillance Control Program
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; and*	"
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 busses is *≥ 4160 V and ≤ 4400 V and ≥ 59.8 Hz and ≤ 60.8 Hz during the test.*	"

Exelon

Proposed TS Changes

Table 2.3 Proposed TS SR Changes

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 is ≥ 4160 V and ≤ 4400 V and ≥ 58.8 Hz ≤ 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 *is ≥ 4160 V and ≤ 4400 V and ≥ 58.8 Hz ≤ 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.*	"

Exelon

Proposed TS Changes

Table 2.3 Proposed TS SR Changes

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.b.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.	“
SR 4.5.1.b.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 ≥ 20 psid plus head and line losses.	“

NRC Feedback

- Feedback on minor WCAP-17308 Methodology deviations?
- Feedback on proposed ECCS Pump Flow Acceptance Criteria changes?
- Results of Design Analysis LM-0736 (over 600 pages) and GEH LOCA Analysis (proprietary) will be described, but full copies are not included in the LAR.
- Will NRC be considering a Design Audit? There were no Design Audits for Braidwood/Byron WCAP-17308 submittals; Calvert Cliffs WCAP-17308 submittal did have a Design Audit.
- Any other concerns / insights?

Closing Remarks

- Questions?
- Summary of Feedback gained
- Schedule for Submittal
  - Submittal planned by 10/29/21