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4 Integrated Evaluation

This chapter of the safety evaluation (SE) describes the NRC staff's review and evaluation of the Long Mott Generating Station's (LMGS) preliminary safety analysis report (PSAR) chapter 4, "Integrated Evaluation." The integrated evaluations described in PSAR chapter 4 consider the impact from anticipated operational occurrences (AOOs), design basis events (DBEs), and beyond design bases events (BDBEs) on the overall plant risk performance and the adequacy of defense-in-depth (DID).

4.1 Overall Plant Risk Performance Summary

PSAR section 4.1 summarizes the overall plant risk to public health and safety from plant operation and compares analysis results to the risk metrics described in Nuclear Energy Institute (NEI) 18-04. The applicable regulatory requirements for the evaluation of PSAR section 4.1 are as follows:

- 10 CFR 50.34(a)(4)

The applicable guidance documents for the evaluation of overall plant risk performance are as follows:

- Regulatory Guide (RG) 1.233, "Guidance for a Technology-Inclusive, Risk-Informed, and Performance-Based Methodology to Inform the Licensing Basis and Content of Applications for Licenses, Certifications, and Approvals for Non-Light-Water Reactors" (ML20091L698), which endorses NEI 18-04, "Risk-Informed Performance-Based Technology Inclusive Guidance for Non-Light Water Reactor Licensing Basis Development," Revision 1 (ML19241A472), with clarifications.
- RG 1.253, "Guidance for a Technology-Inclusive Content-of-Application Methodology to Inform the Licensing Basis and Content of Applications for Licenses, Certifications, and Approvals for Non-Light-Water Reactors" (ML23269A222), which endorses NEI 21-07, "Technology Inclusive Guidance for Non-Light Water Reactors, Safety Analysis Report Content: For Applicants Using the NEI 18-04 Methodology," Revision 1 (ML22060A190), with clarifications and additions.

4.1.1 Technical Evaluation

The NRC staff reviewed PSAR section 4.1 against the guidance discussed above to assess whether the overall integrated plant performance meets the established risk metrics in RG 1.253, Section C.5, "Integrated Evaluations." The PRA used to assess the overall integrated plant risk performance is evaluated in section 3.1 of this SE. The preliminary assessment of the overall integrated plant performance is based on the scope of the PRA, and a comparison is made against the three cumulative plant risk performance metrics from RG 1.253 and is evaluated below.

The NRC staff reviewed PSAR section 4.1.1, which states that the LMGS estimated total mean frequency of exceeding a site boundary dose of 100 mrem is 3.49E-04/plant-year. The NRC staff compared this against the RG 1.253 criteria that the total mean frequency of exceeding a site boundary dose of 100 mrem from all non-design-basis accidents (DBA) licensing basis events (LBEs) should not exceed 1/plant-year.

PSAR section 4.1.2 states that the LMGS estimated total mean average individual risk of early fatality within one mile of the exclusion area boundary (EAB) is 0/plant-year. The NRC staff compared this against the RG 1.253 criteria that the average individual risk of an early fatality within one mile of the EAB from all non-DBA LBEs should not exceed 5E-7/plant-year.

PSAR section 4.1.3 states that the LMGS estimated average individual total mean risk of latent cancer fatalities within 10 miles of the EAB is 7.15E-08/plant-year. The NRC staff compared this against the RG 1.253 criteria that the average individual risk of latent cancer fatalities within 10 miles of the EAB from all non-DBA LBEs should not exceed 2E-6/plant-year.

These three cumulative plant risk performance metrics are consistent with RG 1.233. NEI 18-04, which is endorsed by RG 1.233 with clarifications, describes the three cumulative risk metrics that need to be met to evaluate the integrated plant performance in any application based on the licensing modernization project (LMP) methodology. As described in NEI 18-04, an applicant using LMP evaluates the integrated risk of all LBEs against three cumulative risk metrics. The first cumulative risk metric is based on the annual radiation dose limit for individual members of the public as specified in 10 CFR 20.1301(a)(1). The other two cumulative risk metrics ensure that the NRC safety goal quantitative health objectives (QHOs)¹ are satisfied. These three cumulative risk metrics as defined in NEI 18-04 are the same as those stated above for RG 1.253.

To further understand the summarized results of the preliminary assessment in PSAR section 4.1, the NRC staff audited document ID number 002200, "Probabilistic Risk Assessment: Risk Integration – Preliminary Scoping," Revision 5. The applicant's preliminary assessment demonstrated that the LMGS preliminary design satisfies the three risk metrics with margin based on the preliminary PRA at the CP application stage. The radiological consequence methodology used to calculate these cumulative risk metrics is described in PSAR section 3.1.5.1 and evaluated by the NRC staff in section 3.1.5 of this safety evaluation. The risk integration analysis is evaluated by the NRC staff in section 3.1.1. Consistent with RG 1.253, the applicant assesses the items outside of the CP PRA scope using other approaches (e.g., risk-informed supplemental evaluations and the use of design-basis hazard levels (DBHLs)) to support the CP application. These items are not included in the applicant's assessment of the overall plant risk in PSAR section 4.1. PSAR sections 3.10 and 3.11 include the results of the applicant's supplemental evaluations and PSAR section 6.1.1 includes the use of DBHLs. These items are evaluated in sections 3.10, 3.11, and 6.1 of this safety evaluation. Although limited in scope, the applicant's approach is reasonable given the preliminary stage of the design and PRA, that the estimated overall plant risk meets the metrics with margin, and the applicant plans to finalize the overall plant risk performance assessment at the OL stage.

¹ "Safety Goals for Operations of Nuclear Power Plants; Policy Statement; Republication," Federal Register, Vol. 51, No. 162, August 21, 1986, pp. 30028-30033 (51 FR 30028).

Therefore, the NRC staff finds that the applicant's preliminary assessment of the overall integrated plant risk performance of the LMGS is reasonable and consistent with the applicable guidance in RG 1.233 and RG 1.253 at the CP stage. The NRC staff will confirm that the final design meets the cumulative plant risk performance metrics during the evaluation of the final safety analysis report (FSAR) as part of the review of a future OL application.

4.1.2 Conclusion

Based on its review, the NRC staff finds that the overall plant risk performance, as described in PSAR section 4.1, is consistent with the applicable regulatory guidance and meets the regulatory requirements in 10 CFR 50.34(a)(4).

4.2 Defense-in-Depth

PSAR section 4.2 describes the applicant's approach to evaluating DID adequacy. The PSAR states that the approach is based on the guidance described in Section 5 of NEI 18-04 and the Chapter 4 structure and associated guidance provided in NEI 21-07, and includes plant capability DID, programmatic DID, and an integrated evaluation of DID.

The applicable regulatory requirements for the evaluation of DID are as follows:

- 10 CFR 50.34(a)(1) and (a)(4)
- 10 CFR 50.35

The applicable guidance documents for the evaluation of DID adequacy are as follows:

- RG 1.233, "Guidance for a Technology-Inclusive, Risk-Informed, and Performance-Based Methodology to Inform the Licensing Basis and Content of Applications for Licenses, Certifications, and Approvals for Non-Light-Water Reactors" (ML20091L698), which endorses NEI 18-04, "Risk-Informed Performance-Based Technology Inclusive Guidance for Non-Light Water Reactor Licensing Basis Development," Revision 1 (ML19241A472), with clarifications.
- RG 1.253, "Guidance for a Technology-Inclusive Content-of-Application Methodology to Inform the Licensing Basis and Content of Applications for Licenses, Certifications, and Approvals for Non-Light-Water Reactors" (ML23269A222), which endorses NEI 21-07, "Technology Inclusive Guidance for Non-Light Water Reactors, Safety Analysis Report Content: For Applicants Using the NEI 18-04 Methodology," Revision 1 (ML22060A190), with clarifications and additions.

4.2.1 Technical Evaluation

PSAR section 4.2 states that "[t]he systematic approach to evaluating DID adequacy is based on the guidance described in section 5 of NEI 18-04 and the Chapter 4 structure and associated guidance provided in NEI 21-07." The NRC staff's review of the PSAR identified that the scope of the DID evaluation described in the PSAR is limited to the evaluation of plant capability DID, which the NRC staff finds to be consistent with the discussion in NEI 21-07, Section 4.2 for content of application for a CP.

PSAR table 4.2-1 provides a summary of the plant capability DID attributes from NEI 18-04, the focus of the DID adequacy evaluation as discussed in NEI 18-04, and Long Mott Energy's (LME's) implementation of the evaluation for the LMGS. The PSAR indicates that detailed

documentation of the DID adequacy evaluation is maintained in plant records and summarized in the PSAR.

For the plant capability DID evaluation, the NRC staff evaluated the information in PSAR section 4.2 against the criteria in NEI 21-07 for LBE margin, layers of defense, single feature reliance, and prevention-mitigation balance in sections 4.2.1.1 through 4.2.1.4 of this SE, respectively. In section 4.2.1.5 of this SE, the NRC staff additionally evaluated the applicant's implementation of the integrated decisionmaking process (IDP) and integrated decisionmaking process panel (IDPP), which support the applicant's DID adequacy evaluation as well as other topics such as safety classification and identification of special treatments.

4.2.1.1 LBE Margin

The NRC staff evaluated the information in PSAR section 4.2 against the following criterion from Section C.4.2.1.1 of NEI 21-07, as endorsed by RG 1.253, to ensure sufficient LBE margins in the LMGS design:

- Risk margins for individual risk-significant LBEs should be provided using both mean and 95th percentile values.

The NRC staff evaluated the information in PSAR section 4.2.1.1, "LBE Margin," and associated PSAR tables 4.2-2 and 4.2-3 to (1) ensure that the tables include all risk-significant LBEs and (2) ensure that the information in the tables show margin to the frequency-consequence (F-C) curve. Specifically:

- NRC staff compared the list of LBEs identified in PSAR tables 4.2-2 and 4.2-3 to the list of risk-significant LBEs identified by NRC staff and provided in table 3.2-1, "Risk Significant AOOs, DBEs, and BDBEs," in this SE and finds that the tables include all risk-significant LBEs.
- NRC staff examined the mean frequency margin and mean dose margin in PSAR table 4.2-2, and the 95th frequency margin and 95th dose margin in PSAR table 4.2-3 and confirmed that all values show margin to the F-C curve.

Based on this information, the NRC staff finds that the applicant meets the acceptance criterion for LBE margin from NEI 21-07 as endorsed by RG 1.253 because the PSAR provides information that shows that all risk-significant LBEs have margin to the F-C curve.

4.2.1.2 Layers of Defense Evaluation

The NRC staff evaluated the information in PSAR section 4.2 against the following criteria from Section C.4.2.1.2 of NEI 21-07, as endorsed by RG 1.253, to ensure that sufficient layers of defense are present in the LMGS design:

- The applicant should provide a summary identification of the layers of defense for each risk-significant LBE and describe the extent of independence between different LBE layers of defense.
- The LBE sequences should include the contributions from common-cause failures in accordance with the PRA standard.

- The applicant should identify any risk-significant common-cause failures that were not eliminated by design along with identification of the layers of defense impacted (i.e., layer independence impacts or reactor independence impacts) for risk-significant LBEs and the programmatic special treatments applied.
- The applicant should include an affirmative statement that there is no overreliance on a single layer of defense for any risk-significant LBE.
- The applicant should provide separate discussions of programmatic actions added as a result of a significant dependence on any single layer attribute evaluation. The description should be sufficient to identify the DID objectives requiring those actions.

As discussed in section C.4.2.1.2 of NEI 21-07, the layers of defense evaluation should be based on the quantitative and qualitative guidelines provided in Table 5-2 of NEI 18-04.

Layers of Defense Evaluations

The NRC staff reviewed PSAR section 4.2.1.2, which describes five layers of defense. Layer 1 acts to prevent off-normal operation and AOOs; layer 2 controls abnormal operation, detects failures, and prevents DBEs; layer 3 controls DBEs within analyzed design basis conditions and prevents risk-significant BDBEs; and layers 4 and 5 control severe plant conditions, mitigate consequences of BDBEs, deploy adequate offsite protective actions, and prevent adverse impacts on public health and safety. NRC staff reviewed the description of these five layers and finds them to be consistent with Table 5-2 of NEI 18-04.

The NRC staff reviewed PSAR tables 4.2-4 through 4.2-6, which provide evaluations of layers 2, 3, and 4 and 5, respectively, against the quantitative and qualitative criteria from Table 5-2 of NEI 18-04. The NRC staff reviewed the format and structure of PSAR tables 4.2-4 through 4.2-6 and finds them to be consistent with section 4.2.1.2, “Layers of Defense Evaluation,” of NEI 21-07 as endorsed by RG 1.253. The NRC staff also confirmed that these PSAR tables contain the appropriate risk-significant LBEs, as listed in table 3.2-1 of this SE. The applicant also stated that while the content of PSAR section 4.2 is limited to risk-significant LBEs, consistent with the content of application guidance provided in NEI 21-07, the full scope of LBEs were considered in the DID evaluations used to identify non-safety-related with special treatment (NSRST) PRA safety functions (PSFs) necessary for adequate DID. The NRC staff finds this to be consistent with the DID evaluation process as discussed in NEI 18-04, which indicates that defense layer qualitative and quantitative guidelines are to be applied to all LBEs.

For layer 1, the applicant identified that provisions that act to prevent AOOs are NST, and any structures, systems, and components (SSCs) that are needed to reduce the frequency or severity of or prevent initiating events and are found to be necessary to provide adequate DID (and are thus classified as safety-related (SR) or NSRST) are identified in the evaluation of other layers of defense. The NRC staff finds this approach for the layer 1 evaluation acceptable because it is consistent with the discussion in NEI 21-07 section C.4.2.1.2.

For layer 2, PSAR table 4.2-4 provides the layers of defense evaluation for risk-significant AOOs. The applicant interpreted the guidance for layer 2 in Table 5-2 of NEI 18-04 as an objective for AOOs to rely on NST and NSRST SSCs for mitigation to minimize challenges to SR SSCs. The center column of PSAR table 4.2-4 provides a list of PSFs that serve to mitigate the AOO, and the right column provides the PSFs that prevent challenges to the required safety functions (RSFs). The applicant minimized challenges to the RSFs by considering the purpose

of each RSF and identifying at least one PSF that provides DID for that purpose and elevating it to NSRST for DID. Where more than one PSF provided DID, some PSFs that prevent challenges to RSFs remained NST based on adequate DID already being achieved. Additionally, some AOOs in PSAR table 4.2-4 rely on an RSF for mitigation (e.g., SPLPF-08, which relies on RSF 1.1.2, and SSGTL-03, which relies on RSF 1.2.1). In these cases, there is a PSF that prevents challenges to the RSF. Due to conservative assumptions for failure frequencies, the applicant identified that the LBEs with these functions failed appear in the AOO range for the CP. The applicant considered this to be reasonable for adequate DID because the qualitative objective in NEI 18-04 Table 5-2 is to minimize the frequency of challenges to the RSFs. The NRC staff developed a summary of the RSFs that are protected by NSRST PSFs and the associated NSRST SSCs in table 5.5-1 of this SE. The NRC staff finds the applicant's approach to layer 2 to be acceptable for a CP since it reflects a preliminary DID evaluation and the applicant identified PSFs responsible for reducing the frequency of challenges to RSFs. The NRC staff will review the applicant's justification for DID adequacy on an initiating event family basis, demonstrating that there is DID for each event type for the final evaluation at the OL application stage.

For layer 3, PSAR table 4.2-5 provides the layers of defense evaluation for risk-significant DBEs. The applicant interpreted the layer 3 considerations to apply to DBEs relying on performance of RSFs for mitigation and BDBEs relying on RSFs for prevention. The middle column of PSAR table 4.2-5 provides the PSFs and RSFs that mitigate the DBE. The NRC staff notes that several DBEs rely on PSF 1.2.2.1.3, "Maintain active heat removal during AOOs"; as discussed in section 5.2.1 of this SE, the name implying a connection to AOOs is an artifact of the applicant's process in determining PSFs, and PSF 1.2.2.1.3 is applicable to any type of transient.

The qualitative guideline from NEI 18-04 Table 5-2 is for no single design or operational feature to be relied upon to meet the quantitative objective for all DBEs. The applicant interpreted this as relating to all DBEs, rather than DBEs individually. For the current scope of events considered in the PRA this approach is appropriate. However, the NRC staff observes that in future analyses anticipated for a future OL application, it may not be appropriate to consider this criterion across all DBEs because there will likely be DBEs evaluated with sources of radionuclides outside of the core; these DBEs would rely on different safety functions, which if aggregated with DBEs involving the core could give a false determination on DID adequacy. The applicant identified that no single design or operational feature was relied upon because DBEs have functions available to maintain subcriticality, maintain the integrity of the helium pressure boundary, or maintain active heat removal.

For DBEs, because multiple functions are available to bring the reactor subcritical and maintain active heat removal to prevent challenges to fuel temperature limits, and additional radionuclide retention is provided by the helium pressure boundary if temperature limits are exceeded, NRC staff finds that there was no undue reliance on a single design or operational feature for DBEs for the CP. The NRC staff finds the applicant's approach to layer 3 to be acceptable for a CP. The NRC staff will review the applicant's evaluation results demonstrating that for DBEs there is no overreliance on a single design or operational feature on an initiating event family basis for the final evaluation at the OL application stage.

For layers 4 and 5, PSAR table 4.2-6 provides the layer of defense evaluation of the risk-significant BDBEs. The middle column of PSAR table 4.2-6 summarizes the credited PSFs and

RSFs for the BDBEs. As with the layer 3 qualitative guideline, the applicant evaluated whether a single design or operational feature is relied upon across all BDBEs to maintain individual risks within the QHOs. PSAR section 4.2.1.2 states that a single design or operational feature is not relied on because the fuel provides a SR means to retain radionuclides and the helium pressure boundary (HPB) provides an independent layer of protection against radionuclide release that does not experience the same failure modes as the fuel. The reliability of PSF 2.7, “Maintain the HPB pressure integrity,” prevents high frequencies for depressurization transients, which rely on the reactor cavity cooling system for heat removal to maintain fuel temperatures low enough to limit radionuclide releases. The applicant indicates that these functions together are able to maintain risks below the QHOs. Because the applicant met the quantitative objective of ensuring individual risks from LBEs are below the QHOs and the qualitative objective of ensuring no single barrier or feature is relied upon to limit releases, as discussed above, the NRC staff determined the applicant’s approach to layers 4 and 5 is acceptable for a CP. As noted above for the layers 2 and 3 evaluations, the NRC staff will review DID adequacy and single feature reliance on an initiating event family basis for the final evaluation at the OL application stage.

Independence between defense layers

PSAR section 4.2.1.2 provides a discussion on independence between layers. The applicant states that layer 2 fulfils some functions also provided by RSFs, such as controlling heat generation, controlling heat removal, and controlling water/steam ingress, in a manner that is functionally independent from the RSFs in layer 3. As discussed above, these functions help to maintain the integrity of the fuel and thus limit radionuclide releases for AOOs. Layers 4 and 5 provide sufficient independent means to limit the fraction of source term released from the HPB as discussed above. As such, the NRC staff considered the applicant’s approach to defense layer independence to be acceptable for the CP stage.

Common cause failures

Regarding the criteria related to the evaluation of common cause failures (CCFs), PSAR section 4.2.1.4 states that “[f]or each SSC, likelihood of RSF/PSF failure is minimized by considering potential for common-cause failures, single failure criterion, fail-safe design, sharing of SSCs and allowing for equipment outages.” The NRC staff’s evaluation of the PRA, which is used to identify LBEs, is described in section 3.1.1 of this SE and addresses the NRC staff’s review of CCF in accordance with the PRA standard.

Single layer of defense

The applicant deviated from the NEI 21-07 Section 4.2.1.2 guidance in that the PSAR does not contain an affirmative statement that there is no overreliance on a single layer of defense. However, because there are PSFs that were specifically elevated to NSRST classification for DID adequacy to minimize challenges to the RSFs, and there are PSFs elevated to NSRST classification for DID adequacy and for risk-significance to mitigate consequences of events where the RSFs are assumed to fail, the NRC staff judged that there is not overreliance on a single layer of defense for the LMGS preliminary design.

4.2.1.3 Single Feature Reliance

The NRC staff evaluated the information in PSAR section 4.2 against the following criteria from Section C.4.2.1.3 of NEI 21-07, as endorsed by RG 1.253, to ensure that the LMGS design does not overly rely on any single feature across multiple layers of defense for any risk-significant LBE:

- The applicant should include an affirmative statement that the evaluation of the dependence on a single feature across the layers of defense was performed for all risk-significant LBEs and DBAs.
- The applicant should provide a brief discussion of the method used to evaluate this DID topic.
- The applicant should identify any special treatments added to provide assurance against over-reliance on any single feature across multiple layers of defense for any risk-significant LBE.
- The description should be sufficient to identify the DID objectives requiring actions to provide assurance against over-reliance on any single feature across multiple layers of defense for any risk-significant LBE. The details of this evaluation should be retained in plant records.

PSAR section 4.2.1.3 and associated PSAR table 4.2-7 summarize the applicant's evaluation of the dependence on a single feature across the layers of defense. The applicant followed a three-step approach that involved evaluating risk-significant DBEs and BDBEs, assessing common dependencies in these events and ensuring there is no undue reliance on a single barrier or feature, and, if undue reliance on a single barrier or feature is identified, taking action to reduce or eliminate it. Because the fuel plays a significant role in plant safety for LMGS, the applicant's evaluation focused on ensuring there was not undue reliance on the fuel. In the evaluation, the applicant first identified LBEs where RSF 1.2.1 for passive heat removal provides a preventative function, because these events have the most potential for overreliance on the fuel particles and pebbles due to the role the fuel plays in heat generation, heat removal, and provides radionuclide retention. These events were used to identify areas needed for more detailed analyses to reduce unnecessary conservatism. The full set of analyzed LBEs was then evaluated to identify if there is a feature that all LBEs rely on to meet the quantitative objectives. The applicant concluded based on this evaluation that there was no single feature reliance for the set of risk-significant LBEs.

As discussed in section 5.2 of this SE, radionuclide retention in the fuel is dependent on the success of four RSFs under RSF 1 (control reactivity, control heat removal, control water/steam ingress, maintain geometry), each of which is responsible for controlling different ways the fuel can exceed acceptable limits, thereby failing the radionuclide retention function. Because failure of the fuel's radionuclide retention function may occur if one of the four supporting RSFs fails, it follows that if all supporting RSFs are successful then the radionuclide retention is not challenged. With respect to single feature reliance, if none of the supporting RSFs rely on a single feature, then by extension there is not single feature reliance on the fuel. As noted in the layer 2 evaluation above, LME selected one or more NSRST function to support each RSF and elevated them to NSRST for ensuring DID adequacy. Additionally, PSF 2 ensures that the HPB appropriately retains radionuclides. The NRC staff finds the applicant's approach to evaluating single feature reliance acceptable for the CP application because this approach ensures that no single feature reliance exists for the current scope, which is limited to in core events. The NRC

staff will review considerations for single feature reliance for ex-core events in a future OL application.

4.2.1.4 Prevention-Mitigation Balance

The NRC staff evaluated the information in PSAR section 4.2 against the following criteria from Section C.4.2.1.4 of NEI 21-07, as endorsed by RG 1.253, to ensure that the applicant performed an evaluation of the prevention-mitigation balance for the LMGS design:

- The applicant should affirmatively state that the evaluation of prevention-mitigation balance across the layers of defense was performed for all risk-significant LBEs and DBAs.
- The applicant should provide a brief discussion of the method used to evaluate the prevention-mitigation balance for its design.
- The applicant should provide separate discussions of plant capability and/or programmatic actions added as a result of the prevention-mitigation balance attribute evaluations.
- The description should be sufficient to identify the DID objectives requiring actions to maintain prevention-mitigation balance. The details of this evaluation should be retained in plant records.

PSAR section 4.2.1.4 summarizes the applicant's evaluation of prevention-mitigation balance. The applicant considered prevention and mitigation balance to be sufficient when the integrated decision-making process confirmed no single design or operational feature is excessively relied upon for the LBEs evaluated for prevention-mitigation balance. The applicant also evaluated prevention-mitigation balance for DBAs by considering functions that prevent the DBEs mapped to each DBA. PSAR table 4.2-7 provides the results of the evaluation, which was performed on an LBE-specific basis, and contains a list of the PSFs that prevent and mitigate each evaluated LBE.

The NRC staff disagrees with LME that evaluating single feature reliance for LBEs is sufficient to demonstrate that there is adequate prevention and mitigation balance, because ensuring more than one function is available does not ensure the functions are balanced between prevention and mitigation. The NRC staff additionally finds that the LBE-specific evaluation provided in PSAR table 4.2-7 appears reasonable, but the evaluation provides a PRA-centric view of prevention that does not address the issue holistically. This method of assessing what SSCs are preventative versus mitigative based on the PRA success or failure is not consistent with how the prevention and mitigation has traditionally been assessed. The prevention and mitigation balance should look at each function and identify whether its role is to preclude a release from occurring (i.e., prevention function) or to reduce the consequences once a release does occur (i.e., mitigative function), consistent with the NEI 18-04 definitions for prevention and mitigation functions. As discussed in NEI 18-04, SSCs may perform both preventative and mitigative functions. Looking at each function to identify its role as a prevention function or a mitigation function helps address the key safety principle that protection should not rely solely on prevention or solely on mitigation.

The applicant's evaluation does not consider the balance of prevention and mitigation across sequences or LBEs with the same or similar initiating events; this grouping is necessary to

clearly address prevention-mitigation balance since lower-frequency LBEs may have many failed functions. Additionally, the applicant's approach does not address any prevention that is not modeled in the PRA – i.e., design features or SSCs that prevent the occurrence of initiating events outright. These features are essential to the safe design of the facility and should be considered in evaluating prevention-mitigation balance. However, despite the applicant's limited evaluation described above, based on the NRC staff's review of the LBEs discussed in PSAR chapter 3, "Methodologies, Analyses, and Licensing Basis Events," and the functions described in PSAR chapter 5, "PRA Safety Functions, Design Criteria, and SSC Classification," the NRC staff determined that there was adequate prevention-mitigation balance in the design for the CP stage based on the presence of multiple functions to initiate a reactor trip and perform the heat removal function to prevent release from the fuel along with the functional containment layers in the fuel and the additional mitigation provided by the HPB. The NRC staff expects that a more comprehensive discussion of prevention-mitigation balance, consistent with the discussion above, will be provided for review at the OL application stage.

4.2.1.5 Integrated Decision-making Process and Integrated Decision-making Process Panel

The PSAR describes that the applicant used the LMP methodology, as described in NEI 18-04 and endorsed by RG 1.233, to establish a structured risk-informed, and performance-based framework for the selection of LBEs, classification of safety functions, and determination of the appropriate classification and performance requirements for SSCs. One of the key features of the LMP methodology is the use of the IDP, implemented through a multidisciplinary IDPP, to ensure that the risk-informed, performance-based approach is applied consistently and appropriately to establish special treatments and evaluate the adequacy of DID. NEI 18-04 states that the IDP should be conducted by a knowledgeable, multidisciplinary panel, and that the process should be traceable, documented, and consistent with the LMP framework. The DID evaluation ensures that plant design and operational strategies provide multiple, independent, and layered means to protect public health and safety, consistent with NRC safety philosophy and the Commission's safety goal policy statement.

The NRC staff reviewed PSAR section 4.2, which includes the applicant's descriptions of the IDP and IDPP implementation. The NRC staff audited supporting documentation to confirm appropriate implementation of the IDP and IDPP. The NRC staff determined that the applicant's IDP approach is consistent with NEI 18-04 as endorsed by RG 1.233, and that the IDPP deliberations resulted in defensible, traceable decisions that support the preliminary licensing basis for the CP stage as discussed below.

The NRC staff reviewed the applicant's description of the IDP evaluation of LBEs, including DBAs, and the associated limitations of the analyses, assumptions, and uncertainties. The applicant acknowledged the IDP's role in integrating deterministic and probabilistic approaches, which the applicant states ensures that all relevant scenarios are evaluated, limitations are acknowledged and managed, and safety margins are maintained using conservative assumptions. The NRC staff conducted a detailed assessment of the applicant's approach to LBE evaluation in chapter 3 of this SE, which was found to be acceptable for the CP stage.

The NRC staff reviewed the applicant's description of the composition of the IDPP as a diverse group of experts covering important process and functional elements of the organization, following a structured process for documenting IDPP meetings and decisions. The PSAR states that the IDPP's primary responsibility is to review and approve SSC classifications, and the

IDPP's decisions support the development, modification, and confirmation of design requirements, including quality assurance requirements, to appropriately reflect SSC safety significance and classification. The NRC staff conducted a detailed assessment of SSC classifications in chapter 5 of this SE, where they were found to be acceptable for the CP stage.

As captured in RCI-1 and discussed in section 5.1 of this SE, LME added a step to their SSC classification process in which the results of an evaluation of SSCs identified as significant risk contributors through an evaluation that assumes failure of the SSC and compares the resulting cumulative risk metrics to their respective limits are provided to the IDPP for their determination on whether the SSCs should be classified as risk-significant as part of the SSC safety classification process. This step was not fully incorporated into the CP application. The implementation of this step will be reviewed as part of a future OL application review.

The NRC staff also reviewed the applicant's description stating that the IDP is used to establish the plant DID capabilities in accordance with NEI 18-04 Section 5.7.2, which provides questions to focus the IDP on the evaluation of LBEs. The IDPP also reviews and approves both plant capability and programmatic DID, including reliability and capability targets and special treatments. The NRC staff reviewed the applicant's discussion of plant capability DID adequacy in PSAR section 4.2 and determined that it reflected consideration by the IDPP. While programmatic DID is not fully addressed in the PSAR as discussed in section 4.2.1 of this SE, the NRC staff assessed the applicant's approach to reliability and capability targets in chapters 6 and 7 of this SE for SR and NSRST SSCs, respectively, where they were found to be acceptable for the CP stage.

Finally, the applicant noted that, for the FSAR, the IDP and IDPP must be proceduralized and controlled, formal training and qualification will be required for IDPP members, special treatments will be finalized and detailed to the component level for SR and NSRST SSCs, and programmatic special treatments will be developed to ensure reliability and capability targets will be met. Because the IDP and IDPP were sufficiently implemented to develop preliminary evaluations for the PSAR, the NRC staff finds them to be acceptable for a CP application. The NRC staff will review the applicant's final implementation of IDP and IDPP in a future OL application.

Based on its review of the PSAR, the NRC staff finds that LME's implementation of the IDP and IDPP for the LMGS application is consistent with the methodology described in NEI 18-04 as endorsed by RG 1.233. The NRC staff finds that the IDPP composition is appropriately diverse and the IDP is implemented to ensure balanced consideration of probabilistic and deterministic approaches while allowing engineering judgment to be appropriately exercised. Therefore, the NRC staff concluded that LME's IDP and IDPP implementation provides an acceptable basis for supporting the CP application in accordance with 10 CFR 50.34(a)(1) and (4) and 10 CFR 50.35, consistent with the NRC-endorsed LMP methodology.

4.2.2 Conclusion

Based on the information provided in PSAR section 4.2, the NRC staff finds that the LMGS design includes DID sufficient to meet 10 CFR 50.34(a)(1) and (a)(4). This finding is based on the applicant's completion of the appropriate plant capability DID evaluations to an extent that is acceptable for a CP, as documented in sections 4.2.1.1 through 4.2.1.4 of this SE, as well as

the applicant's implementation of the IDP and IDPP for the CP application, as documented in section 4.2.1.5 of this SE.

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