

**Discussion Items on
“KP-FHR Risk-Informed Performance-Based Licensing Basis
Development Methodology Topical Report” (KP-TR-009)
Docket No. 99902069**

By letter dated August 5, 2019, Kairos Power LLC (Kairos) submitted for U.S. Nuclear Regulatory Commission (NRC) staff review KP-TR-009, “KP-FHR Risk-Informed Performance-Based Licensing Basis Development Methodology Topical Report” (Agencywide Documents Access and Management System (ADAMS) Accession No. ML19217A420). In this topical report (TR), Kairos requested NRC staff approval of the risk-informed performance-based (RIPB) methodology as an appropriate method to develop licensing basis events (LBEs), classify structures, systems, and components (SSCs), and ensure defense in depth (DID) adequacy as part of safety analysis reports required to be submitted in license applications to satisfy the applicable regulations in 10 CFR 50 and 10 CFR 52.

The NRC staff has completed an initial review of the topical report and developed preliminary comments and questions to facilitate its understanding of the information in the report. These comments and questions are intended to inform future discussions with Kairos and support the NRC staff in obtaining clarifying information. Based on the outcome of its discussions with Kairos on the topics identified below, the NRC staff may develop formal requests for additional information to complete its review of the topical report.

Licensing Basis Development Process (TR Section 2)

1. NEI 18-04, Section 2, has a footnote below that is not included in this TR. This footnote is also referred to in NEI 18-04 Section 3.

*Note that these upper tier regulations contain requirements for reactor designers and license applicants to provide information that demonstrates compliance with other, more topic-specific regulations.

† In this document, Licensing Basis Events are defined in terms of event sequences comprised of an Initiating Event, the plant response to the Initiating Event (which includes a sequence of successes and failures of mitigating systems) and a well-defined end state. The term “event sequence” is used in lieu of the term “accident sequence” used in LWR PRA standards because the scope of the LBEs includes Anticipated Operational Occurrences and Initiating Events with no adverse impacts on public safety. The only use of the term “accident” in the LMP process is with the term “Design Basis Accident,” which is one of the LBE categories developed for the safety analysis report. It is recognized that some design and licensing requirements (e.g., definition of the safe shutdown earthquake) are defined for individual events rather than event sequences.

Staff Feedback: Did Kairos consider including elements of the footnote, especially related to the second one, in this TR as applicable?

Selection of Licensing Basis Events (TR Section 3)

2. In describing Task 7a (Evaluate LBEs Against F-C Target) of Figure 3.2, this TR replaces the following in NEI 18-04:

The upper bound consequences for each DBA [design basis accident], defined as the 95th percentile of the uncertainty distribution, shall meet the 10 CFR 50.34 dose limit at the EAB [exclusion area boundary].”

With:

The mechanistic source term methodology and results will be provided in future licensing submittals.

Staff Feedback: Why did Kairos make this change? Is Kairos making a deviation from the criterion from NEI 18-04?

3. Under the discussion in Task 7c of TR Section 3.2.2, “LBE Selection Process,” this TR replaces the following in NEI 18-04:

These evaluations include the use of PRA risk importance metrics, where applicable, and the examination of the effectiveness of each of the layers of defense in retaining radionuclides.

With:

These evaluations include the examination of the effectiveness of each of the layers of defense in retaining radionuclides.

Staff Feedback: Why did Kairos make this change?

4. Under TR Section 3.3.4, “Safety Functions,” this TR states the following, which is the same as NEI 18-04:

RSFs [required safety functions] are defined starting with generic Fundamental Safety Functions (FSFs) defined by the International Atomic Energy Agency (IAEA)... These are refined as necessary into reactor technology-specific SFs that reflect the reactor concept and unique characteristics of the reactors. This provides the foundation for reactor technology-specific SSCs selected to perform each function.

Staff Feedback: It is generally a technology-inclusive discussion on identifying (required) safety functions. Should it be revised to reflect the Kairos-specific (e.g., technology-specific) process?

5. Under TR Section 3.3.6, “Contributors to Risk and Risk Importance Measures,” this TR states that:

In order to evaluate the risk contributions from basic events that may appear in two or more event sequences or cut-sets, risk importance measures are used. The risk measures used to define risk significance for basic events are listed in Table 3-1 for the three integrated plant risk measures... The risk achievement measure is compared to the full risk target for the measure. The risk reduction measure, on the other hand, is compared to 1% of the risk target for each measure.

Staff Feedback: Table 3-1 only discusses the risk reduction importance measure while the TR discusses the risk achievement measure. The staff is not clear which importance measures are to be used and how.

Safety Classification and Performance Criteria for Structures, Systems, and Components (TR Section 4)

6. This TR proposes the criteria for the definition of the Safety-Related classification category as follows:
 - SSCs to perform the RSFs to mitigate the consequences of DBEs to within the LBE F-C Target, and to mitigate DBAs that only rely on the SR SSCs to meet the dose limits of 10 CFR 50.34 using conservative assumptions
 - SSCs relied on to perform RSFs to prevent the frequency of BDBE with consequences greater than the 10 CFR 50.34 dose limits from increasing into the DBE region and beyond the F-C Target
 - Shut down the reactor and maintain it in a safe shutdown condition.

The first two criteria are the same as those in NEI 18-04; however, this TR adds the third criterion.

Staff Feedback: Has Kairos evaluated any impact of adding the 3rd criterion on other parts of the TR? For example, would it have any impact on determining SFs, RSFs, RFDCs, SRDCs, and so on as well as special treatment provisions? What would be the specific impacts of the addition?

7. Under TR Section 4, Table 4-1, "Summary of Special Treatment for SR and NSRST SSCs," provides a list of special treatment categories and their applicability to SR, NSRST, and NST SSCs. NEI 18-04 had an additional column called Available Guidance, which is not included in TR Table 4-1.

Staff Feedback: The Available Guidance column appears to contain some useful information related to existing guidance on each of the special treatment categories. Why is this not included in the TR?

Evaluation of Defense-In-Depth Adequacy (TR Section 5)

8. Under TR Section 5.7, "Evaluation of LBEs against Layers of Defense," Kairos did not include NEI 18-04, Table 5-4, "Event Sequence Model Framework for Evaluating Plant Capabilities for Prevention and Mitigation of LBEs," and the associated paragraphs.

Staff Feedback: Why is this not included in the TR?

9. Under TR Section 5.8.1, "Guidelines for Programmatic DID Adequacy," Kairos did not include one of the objectives of the adequacy of programmatic DID adequacy in NEI 18-04. Specifically, the following bullet has been deleted from NEI 18-04:
 - Assuring that appropriate targets for SSC reliability and performance capability are reflected in design and operational programs for each LBE

Staff Feedback: Why is this objective not included in the TR?

10. Under TR Section 5.8.3, "IDP Actions to Confirm DID Adequacy," the following bullet exists regarding one of the IDP actions and decisions on the adequacy of programmatic DID:

- Special Treatment for all NSRST SSCs is sufficient.

This bullet is different from that of NEI 18-04, which include both SR and NSRST SSCs. It appears that a similar change has been made in other parts of the TR.

Staff Feedback: Why did Kairos make this change?

11. In Table 5.6, "Examples of Special Treatments Considered for Programmatic DID," the following has been removed from the Elements column, which existed in NEI 18-04:

Owner-directed independent reviews and performance monitoring programs

Periodic drills

Emergency response equipment maintenance programs

These correspond to the following Programs - Independent Oversight and Monitoring Programs and Emergency Planning, respectively, in the table.

Staff Feedback: Why were these removed from the TR?

Others

12. DG-1353 contains various NRC staff discussions (including contexts) on NEI 18-04 and its use within the overall RIPB framework for non-LWRs. In addition, endorsing NEI 18-04, the NRC staff provided a set of clarifications (i.e., C.1, C.2, and C.3) in DG-1353.

Staff Feedback: From the NRC staff's perspective, both DG-1353 and NEI 18-04 together provide the comprehensive guidance on the methodology and its use. This TR states in Section 1.4 that "This report provides the KP-FHR methodology for LBE identification, SSC classification, and DID adequacy using the guidance in DG-1353 and NEI 18-04." It appears, however, that the TR is generally limited to the Kairos-specific customization of NEI 18-04 and did not address clarifications made in DG-1353. Did Kairos consider adding a discussion of how the clarifications in DG-1353 are addressed?

- NEI 18-04, Revision 1 (ADAMS Accession No. ML19241A472) has been issued. Note that SECY-19-0117, "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," December 2019, mentions NEI 18-04, Revision 1.

Staff Feedback: Did Kairos consider updating this TR to be consistent with this latest revision?