
Insights from Public Workshop on Risk Metrics and Reliability Data to Support Risk-Informed Programs for Advanced Reactors

NRC Working Group on Technology Inclusive Risk Metrics

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Periodic Advanced Reactor Stakeholder Meeting

July 24, 2024

NRC Considering Needs for Non-LWR Risk Metrics and Reliability Data

In 1990, the Commission established three risk metrics for new reactors and associated quantitative goals:

- **Core Damage Frequency (CDF) < 1×10^{-4} /year** – A measure of overall safety performance in prevention of severe accidents
- **Large Release Frequency (LRF) < 1×10^{-6} /year** – A measure of prevention of significant offsite consequences
- **Conditional Containment Failure Probability (CCFP) < 0.1** – A measure of the capability of design to mitigate a severe accident

Traditional risk metrics, e.g., CDF, have been used effectively in NRC's risk-informed decision-making processes

- *May not be applicable to all advanced reactor designs*

SRM SECY-23-0021 provides direction on applicant proposed risk metrics

“The staff should revise draft 10 C.F.R. 53.220 to specify that applicants must propose a comprehensive plant risk metric (or set of metrics) ...”

Need to consider alternative risk metrics that:

- Are applicable to Non-light-water reactor (NLWR) designs
- Support NRC licensing and regulatory processes

Public Workshop on July 18, 2024

- SRM-SECY-23-0021 provided motivation and direction to staff-related NLWR risk metrics, but this workshop was *not* part of the Part 53 rulemaking
- Presented NRC staff's ongoing efforts on developing the following items related to risk metrics for NLWRs:
 - **Interim staff guidance (ISG) on the review of applicant-proposed risk metrics**
 - **Potential NRC risk metrics**
 - **Reliability data**
- **166 online attendees and 19 in-person attendees**

External Presenters (sorted by last name)

| Name and Organization | Presentation Title |
|--|--|
| Cyril Draffin, U.S. Nuclear Industry Council | USNIC Perspectives on Risk |
| Dave Grabaskas, Argonne National Lab. | NLWR Data Insights and Experience |
| Kyle Hope, Westinghouse Electric Company | Challenges and Lessons Learned in Applying NEI 18-04 During Active Design: The eVinci™ Microreactor |
| Ed Lyman, Union of Concerned Scientists | UCS Views on Advanced Reactor Risk Metrics |
| Jessica Maddocks, X-Energy | Hazard Level Selection for LMP |
| Diego Mandelli, Idaho National Laboratory | Intertwining of Data, Decisions, and Reliability |
| Adam Stein, The Breakthrough Institute | Breakthrough Institute Perspectives on Risk Metrics |
| Eric Thornsberry, Electric Power Res. Inst. | EPRI's Risk Metric Work |
| Patrick White, Nuclear Innovation Alliance | NIA Perspectives on Comprehensive Risk Metrics |
| Sai Zhang, Idaho National Laboratory | Advanced Reactor Operating Experience Data Analysis to Support Risk Estimation - Challenges, Current Practice, and Needs |

Development of ISG to Review Applicant-Proposed Risk Metrics

- The staff presented its tentative approach to developing interim staff guidance (ISG) for review of applicant-proposed risk metrics:
 - ISG applicability
 - Terminology related to risk metrics
 - Flowchart for conducting the review
 - Change provisions
 - Intellectual property

Summary of Initial Approach to Risk Metrics for NLWRs

- For accident prevention:
 - Use CDF whenever core damage is applicable
 - Use new metrics when core damage is not applicable (e.g., frequency of failure of initial confinement of radioactive material)
- For accident mitigation, large early release frequency (LERF) and LRF are technology inclusive
- Consequence metrics are technology inclusive, but there are challenges associated with them
- Desirable attributes for risk metrics and for using the metrics were proposed

Planned Data Activities



Workshop (July 18, 2024)



Examine available existing databases of operating experience of advanced reactors



Establish database templates, reporting criteria, and data methods/procedures to support risk modeling and regulatory oversight



Populate the new database with operational data from prominent advanced reactor designs

Next Steps

- Received many constructive and thoughtful suggestions during the workshop
 - The staff looks forward to continued stakeholder engagement
- Develop **ISG on the review of applicant-proposed risk metrics**
 - Tentative plan to issue the ISG when proposed Part 53 is finalized
- Develop **NRC white paper on potential risk metrics**
 - Tentative middle of calendar year 2025
- Establish a **task on reliability data**
 - By the end of calendar year 2024
- Contact if interested in providing additional feedback
 - Jeffery Wood (jeffery.wood@nrc.gov)

Acronyms

| | |
|-------|---|
| CCFP | Conditional Containment Failure Probability |
| CDF | Core Damage Frequency |
| CFR | Code of Federal Regulations |
| ISG | Interim Staff Guidance |
| EPRI | Electric Power Research Institute |
| LERF | Large Early Release Frequency |
| LMP | Licensing Modernization Project |
| LRF | Large Release Frequency |
| NEI | Nuclear Energy Institute |
| NIA | Nuclear Innovation Alliance |
| NRC | Nuclear Regulatory Commission |
| NRR | (NRC) Office of Nuclear Reactor Regulation |
| RES | (NRC) Office of Nuclear Regulatory Research |
| UCS | Union of Concerned Scientists |
| USNIC | U.S. Nuclear Industry Council |