# NRC R&D Grants


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Nuclear Regulatory Commission

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# Overview - NPUF SARs & Grant Opportunities

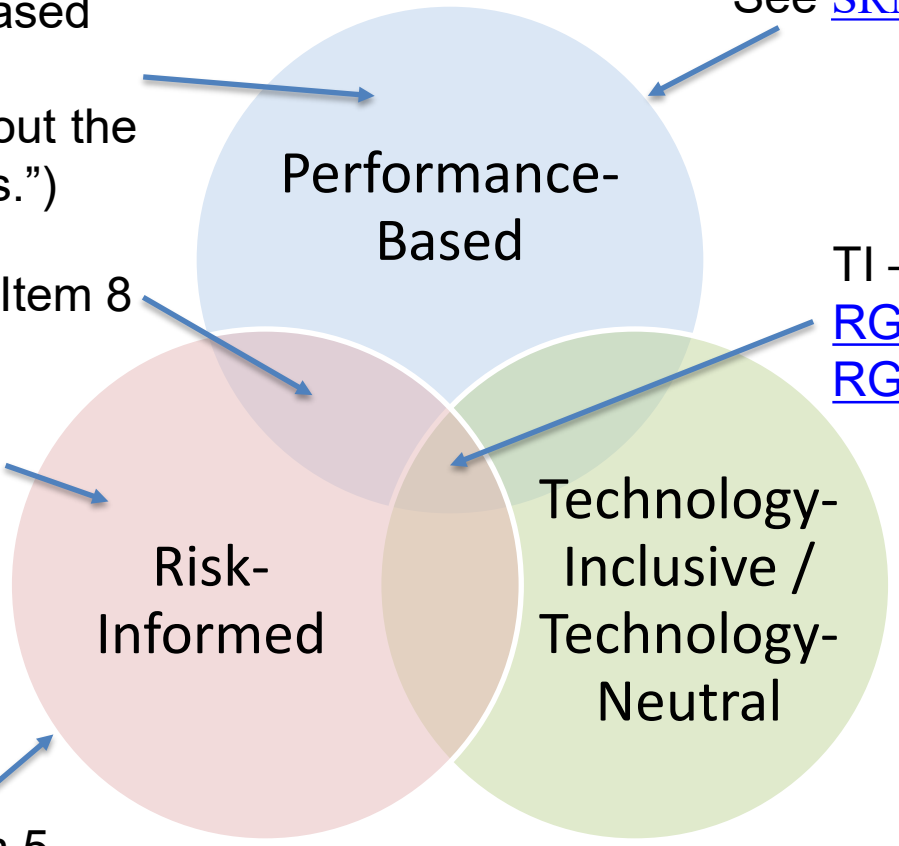
- Performance-Based Approach to NPUF and Advanced Reactor design bases in Safety Analysis Reports and Licensing Applications
  - Application/SAR Based on Regulatory Requirements in 10 CFR 50.34
  - Improve Regulatory Efficiency and Effectiveness
    - Improve document quality
    - Include only Necessary and Sufficient information in SAR
  - Regulatory Framework: *New Performance-Based Approach* (see also ML22339A221 & ML24150A116)
    1. *Establish Goals*
    2. *Describe how goals are met*
    3. *Describe why approach to meeting goals is adequate*
    4. *Provide evidence*

- Proposed NRC Grant Opportunities for U.S. universities & citizens
  - Demonstrate **proof of concept** of *Correct by Construction (CbC)*
    - To create a Reactivity Calculator, for example (**NOT** an equipment grant)
    - To extend NRC Research: Performance-based regulatory infrastructure, Model-Based System Engineering, and Safety Assurance Case
  - **Proof of Concept:** Use AI to update and/or review SAR
    - AGN, TRIGA, …
    - Collaboration is given preference in grant applications
    - Can include Performance-based concepts

# Approaches to Analyzing Safety

Scope
(SRM-98-0144:
"A performance-based approach can be implemented without the use of risk insights.")

See SRM-98-0144 Item 7




See SRM-98-0144 Item 8

TI –RIPB: SRM-19-0117, RG 1.233, NEI 18-04, RG 1.253…

PRA, RG 1.174…
NPUFs can provided information to support Advanced Reactors

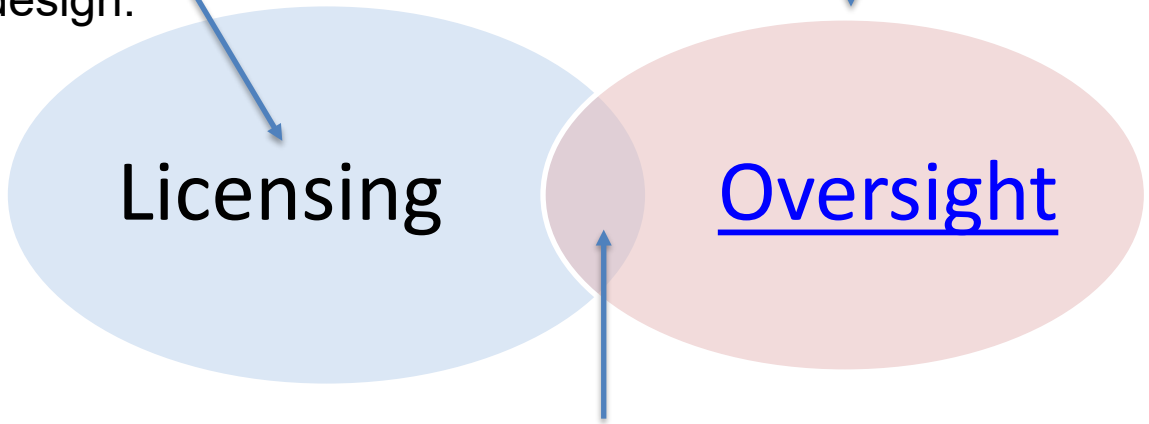
See SRM-98-0144 Item 5

Concepts Defined by SRM-98-0144

# A Performance Based Approach focuses on demonstrating that the facility meets its obligations

Establishes the goals for the design and operation of the facility and how those goals are met by the design.

Ensures facility is operated in accordance with: (1) the licensed design (i.e., the application as amended), and (2) conditions of the license.

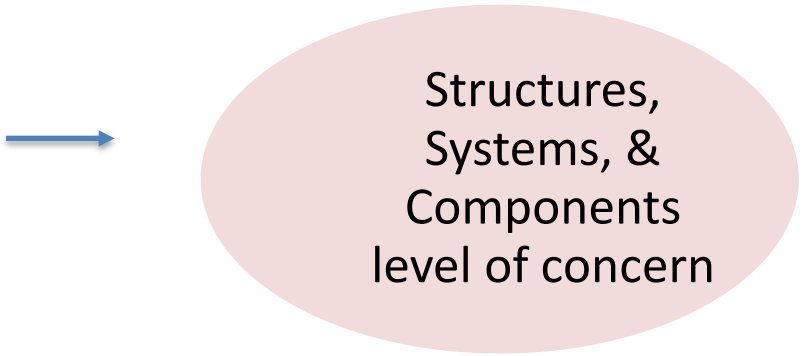



Application as Amended, e.g.: (1) Technical Specifications, & (2) 10 CFR 50.34(b)(6)(iv) requires each application for an operating license to include a final safety analysis report that includes plans for conduct of normal operations, including maintenance, surveillance, and periodic testing of structures, systems, and components.

# Licensing Levels of Concern

Licensing of the facility includes establishing the goals that the I&C equipment must meet such that the facility meets its goals (i.e., the application must include the design bases and the relation of the design bases to the principal design criteria for the facility).


Licensing ensures the equipment meets the goals established by the facilities needs (i.e., the application must include information relative to materials of construction, general arrangement, and approximate dimensions, sufficient to provide reasonable assurance that the final design of the I&C will conform to the design bases with adequate margin for safety).

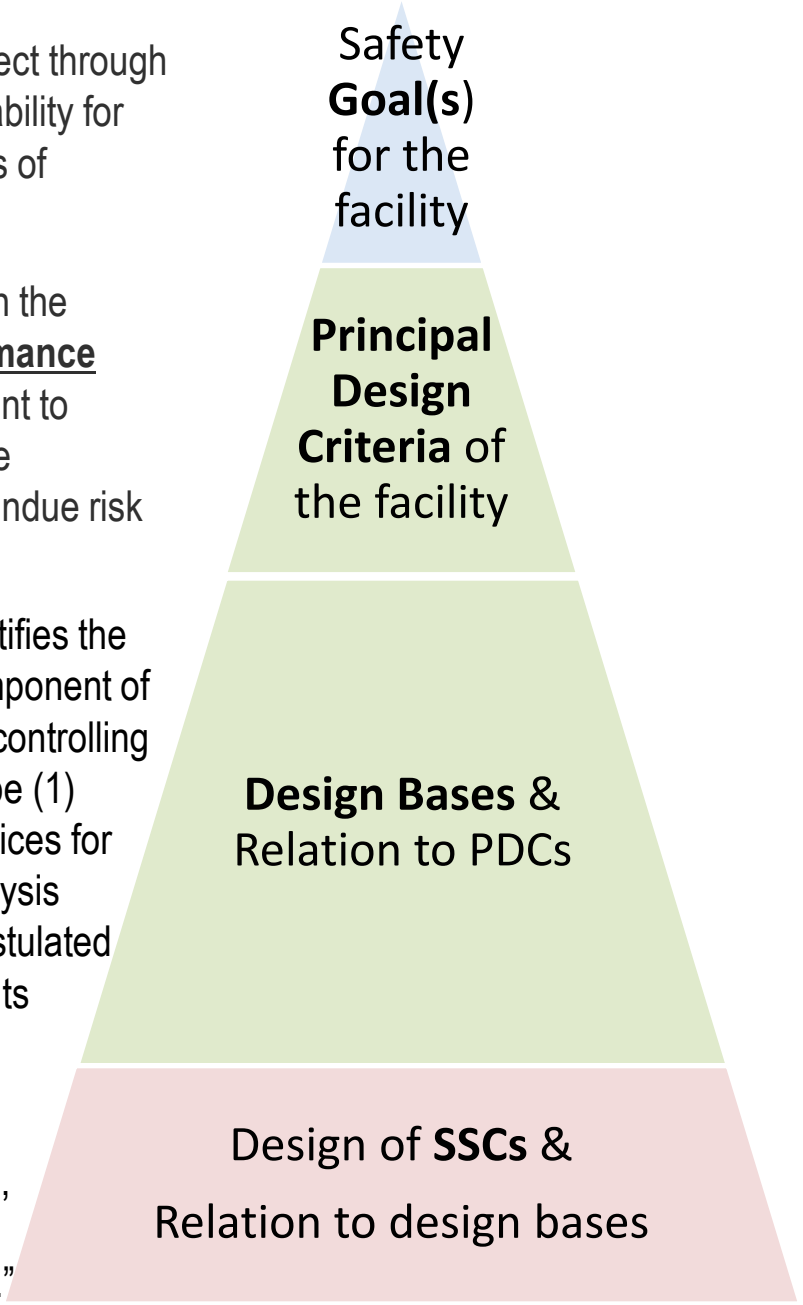


**Goals, e.g.,** 10 CFR 50.34: "It is expected that reactors will reflect through their design, construction and operation an extremely low probability for accidents that could result in the release of significant quantities of radioactive fission products."

10 CFR 50 Appendix A: "The **principal design criteria** establish the necessary design, fabrication, construction, testing, and **performance requirements** for structures, systems, and components important to safety; that is, structures, systems, and components that provide reasonable assurance that the facility can be operated without undue risk to the health and safety of the public."

10 CFR 50.2: "**Design bases** means that information which identifies the specific functions to be performed by a structure, system, or component of a facility, and the specific values or ranges of values chosen for controlling parameters as reference bounds for design. These values may be (1) restraints derived from generally accepted "state of the art" practices for achieving functional goals, or (2) requirements derived from analysis (based on calculation and/or experiments) of the effects of a postulated accident for which a structure system, or component must meet its functional goals."

**SSCs** in 10 CFR 50.34: "Information relative to materials of construction, general arrangement, and approximate dimensions, sufficient to provide reasonable assurance that the final design will conform to the design bases with adequate margin for safety."



# 10 CFR 50.34(a)

"(2) A summary description and discussion of the facility, with special attention to design and operating characteristics, unusual or novel design features, and principal safety considerations.

(3) The preliminary design of the facility including:

(i) The principal design criteria for the facility. Appendix A, General Design Criteria for Nuclear Power Plants, establishes minimum requirements for the principal design criteria for watercooled nuclear power plants similar in design and location to plants for which construction permits have previously been issued by the Commission and **provides guidance to applicants for construction permits in establishing principal design criteria for other types of nuclear power units;**

(ii) The design bases and the relation of the design bases to the principal design criteria;

(iii) Information relative to materials of construction, general arrangement, and approximate dimensions, sufficient to provide reasonable assurance that the final design will conform to the design bases with adequate margin for safety.

(4) A preliminary analysis and evaluation of the design and performance of structures, systems, and components of the facility with the objective of assessing the risk to public health and safety resulting from operation of the facility and including determination of the margins of safety during normal operations and transient conditions anticipated during the life of the facility, and the adequacy of structures, systems, and components provided for the prevention of accidents and the mitigation of the consequences of accidents. …."

# Grant Opportunities

- Office of Nuclear Regulatory Research (RES) Financial Assistance Program
- "Funding under this program includes, but is not limited to, research in support of nuclear materials safety, radioactive waste safety, fire safety and testing, digital instrumentation and controls, advanced very high temperature gas-cooled reactors, probabilistic risk assessment, high temperature gas reactor thermal hydraulics, and reactor physics. RES shows a high regard for institutions and organizations that propose to conduct independent experiments and analyses, develop technical basis for supporting realistic safety decisions, and the evaluation of safety issues involving current and new designs and technologies. Additionally the RES financial assistance program funds high quality conferences/scientific meetings, which facilitate the coordination, exchange, and /or dissemination of information in any of the previously listed topics or significant topics of interest, in support of nuclear research."
- Funding Opportunity Announcement Awards – 2023
  - FY2023 Research and Development Award Executive Summaries

# Rough Idea About What to Expect in 2025

- Key Dates from 2024:
  - Release/Posted Date: 02/16/2024
  - Application Due Date: 04/01/2024
  - Earliest Anticipated Start Date: 11/30/2024
- NRC Staff can talk to potential applicants before Release/Posting or after award, but NOT during evaluation period
  - Staff that talks to applicant would not review proposals

# 2024 Numbers

- Funds Available and Anticipated Number or Awards:
  - Award of these grants is contingent upon the availability of funds. The estimated budget for this program is $9,000,000.00 – $10,000,000.00. The NRC anticipates that there may be up to twenty (20) grants awarded as a result of this NOFO. The number of awards depends on the number, quality, duration, and costs of the applications received.
- Budget and Project Period:
  - This is a three (3)-year program. Research and development funds may be requested up to $500,000.00 total costs (direct costs and facilities and administrative costs) for the project period.

# 2024 Program Objectives

The program provides funding to support research and development (R&D) for nuclear science, engineering, technology, and related disciplines to develop a workforce capable of supporting the design, construction, operation, and regulation of nuclear facilities and the safe handling of nuclear materials. University R&D activities provide an opportunity to complement current, ongoing NRC-led research.

More specifically, the program shall be used to provide financial assistance for R&D projects relevant to the programmatic mission of the NRC referenced above, with an emphasis on providing federal financial assistance with respect to research, development, demonstration, and commercial application of new and advanced nuclear technologies...

The NRC invites R&D projects that complement its current research portfolio and that help the NRC prepare for upcoming challenges. A summary of NRC planned research activities can be found at https://www.nrc.gov/about-nrc/regulatory/research/activities.html in the FY22-24 Research Prospectus. The NRC seeks projects that provide a variety of direct and indirect, near- and longer-term benefits. These benefits include:

- Identification and closure of potentially important technical gaps ahead of regulatory needs,
- Heightened awareness and knowledge of key advanced technology developments being pursued outside of NRC, and
- Improved foundational knowledge on key topics of future regulatory interest.

# 2024 AREAS OF INTEREST

Areas of interest include, but are not limited to:

…

• Digital instrumentation/controls, data analytics, and advanced sensors/instrumentation, at nuclear facilities;

…

• Advanced technology approaches (e.g., data and text analytics, data visualization techniques, and artificial intelligence) and applications (e.g., data mining, autonomous control) in nuclear power-related applications; Evaluation of the radiological releases and offsite consequences for fusion reactor accidents;

…

• Analytical approaches that combine probabilistic risk assessment (PRA) risk quantification methods with reactor systems sensitivity or uncertainty analysis methods to quantify the risk significance of safety analysis errors or uncertainties; Performance-based technology-neutral safety assurance;

…

# Reactivity Calculator

- If interested in Collaborating on Proposal Development, Contact:
  - Norbert.Carte@nrc.gov (301) 415-5890
- Can Collaborate with NRC in executing research
- Related NRC Research
  - MBSE
    - HARDENS
    - SAFEFRAME
  - Safety Assurance Case

# Update to SAR using AI-Based Tooling

- If interested in Collaborating on Proposal Development, Contact:
  - Norbert.Carte@nrc.gov (301) 415-5890
- Can Collaborate with NRC in executing research
- Related NRC Mission

# Backup Slides

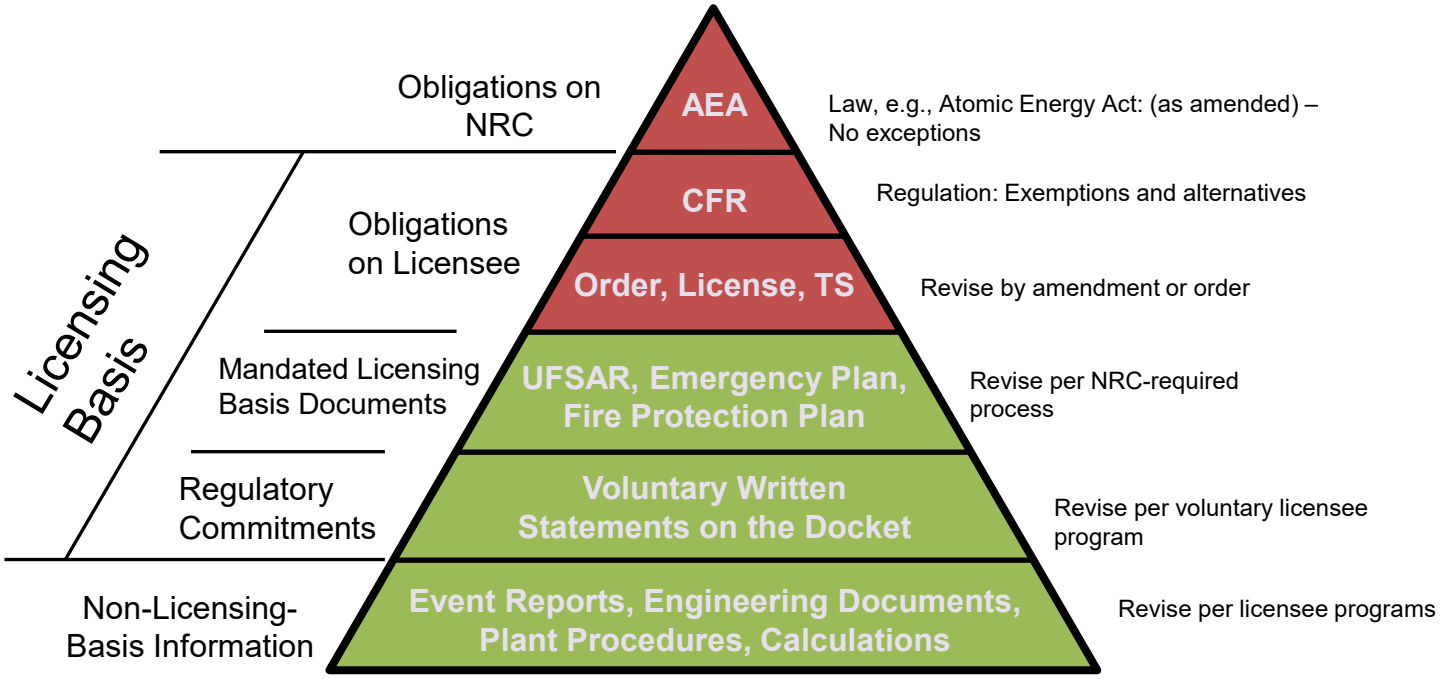
# Licensing Basis

- Not defined in regulation, policy, or guidance (grey areas exist).
- The collection of documents or technical criteria that provides the basis upon which the NRC issues a license.
- Selected information exchanged between a licensee and the NRC related to design features, equipment descriptions, operating practices, site characteristics, programs and procedures, and other factors that describe a plant's design, construction, maintenance, and operation.

# Licensing Basis categories

| Category | Created and Controlled by … | Change Process |
|---|---|---|
| Obligation | NRC | NRC approval needed.<br>NRC may initiate change.<br>Licensee may request change. |
| Mandated Licensing Basis (MLB) Document | Licensee | Defined by obligations.<br>Licensee initiates changes.<br>Licensee may make certain changes without prior NRC approval. |
| Regulatory Commitment (voluntary) | Licensee | Licensee-defined process (voluntary). |

# Regulatory hierarchy



# Obligations

- Conditions or actions that are legally binding requirements imposed on licensees through applicable rules, regulations, orders, and licenses.
- NRC imposition of obligations should be reserved for matters that satisfy the TS criteria of 10 CFR 50.36 or are otherwise found to be of high safety or regulatory significance.
- Obligations cannot be changed by licensee without prior NRC approval.

# Mandated Licensing Basis Documents

- Documents for which the NRC has established requirements (obligations) for content, change control, and reporting.
- Licensee is responsible for developing, implementing, and maintaining document consistent with NRC requirements.
- Licensee initiates changes to document and may make certain changes without prior NRC approval.

# Non-Licensing-bases information

- Within NRC's authority but not part of licensing basis.
- Supports, implements, or demonstrates compliance with licensing basis.
- Supports conduct of NRC business (e.g., event report).
- May be subject to inspection, review, and audit.
- May be controlled or limited by licensing basis (e.g., 50.59, QA program).
- Licensee may make changes consistent with licensing basis without NRC approval.
- Some changes may require prior NRC approval of changes to the licensing basis to implement.

# OTHER RELATED TERMS

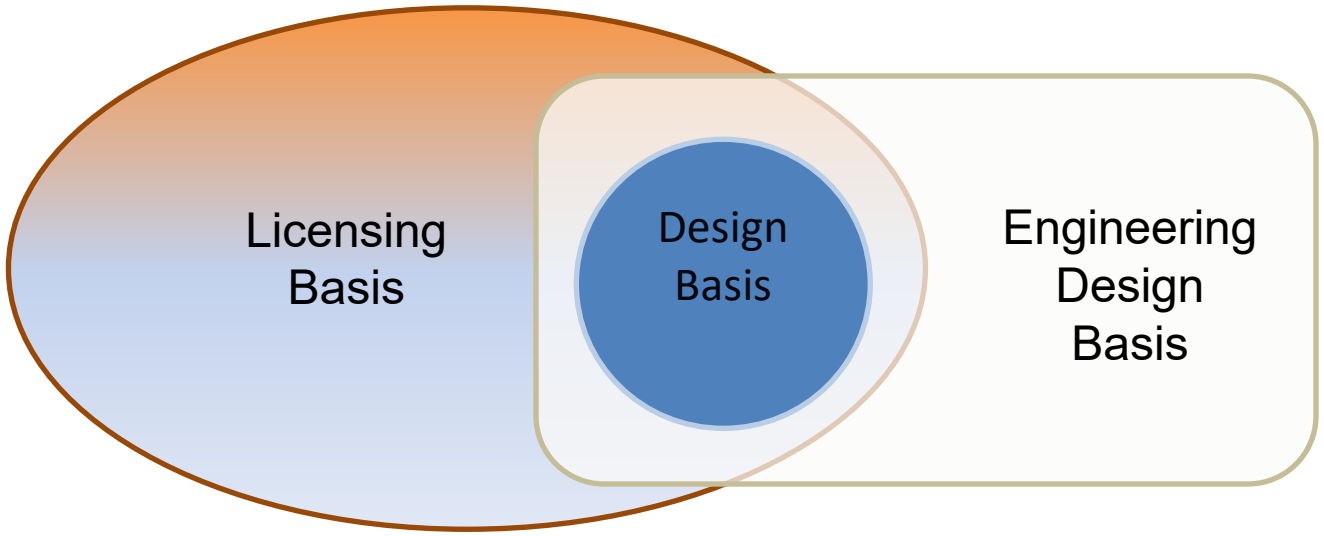
## Design Basis

- Defined in Part 50.
- The specific functions to be performed by a structure, system, or component of a facility, and the specific values or ranges of values chosen for controlling parameters as reference bounds for design.
- Subset of licensing basis and included in the FSAR.

## Engineering Design Basis

- Defined in NUREG-1397.
- The entire set of design constraints that are implemented.
- Design basis is a subset of the engineering design basis.

# Relationships



# Requested Licensing Action
## application and supplements

- Licensee (or applicant) requests change to licensing basis.
  - May propose changes to obligations.
  - May propose changes to MLB documents.
  - May provide regulatory commitments to support proposed changes.
- Application may include licensing basis and non-licensing basis information that is not part of the request.
  - Planned or completed changes.
  - Supporting information.

# Requested Licensing Action

## NRC Review and safety evaluation

- Staff performs independent review of application.
- Safety evaluation (SE) or safety evaluation report (SER):
  - Documents staff review and basis for staff's decision.
  - Not part of the licensing basis.
  - Does not modify or add to the licensing basis.
  - Provides staff's understanding of requested licensing basis changes and the staff's basis for approving or disapproving changes.
  - Regulatory commitments cannot form the basis for the staff's decision unless elevated to an obligation or MLB document.

# Requested Licensing Action

## NRC Issues Decision

- Approval (changes or permits changes to licensing basis).
  - NRC issues change to obligations as requested, unless modified by NRC conditions.
  - Licensee will revise MLB documents as requested, subject to NRC conditions.
- Denial (does not change licensing basis).
- NRC condition on approval (changes licensing basis).
  - Condition is an obligation that limits request, adds to request, or elevates information.
  - Implementation requirements (e.g., license amendments impose implementation date).
  - Elevating information examples:
    - Making a regulatory commitment an obligation.
    - Requiring certain information to be added to an MLB document.

# Other documents

| | |
|---|---|
| NRC Guidance and SRP | • Not part of licensing basis unless added by licensee (applicant).<br>• NRC review against guidance and SRP does not make it part of licensing basis.<br>• NRC revision or withdrawal does not affect licensing basis. |
| NRC Policy | • Not part of licensing basis.<br>• Policy applies to staff not licensee.<br>• May be part of the basis for staff decision. |
| Topical Reports | • NRC generic approval does not affect licensing basis.<br>• Not part of licensing basis unless added by licensee (applicant).<br>• NRC revision or withdrawal of generic approval does not affect licensing basis. |
| Generic Letters and Bulletins | • Do not revise the licensing basis.<br>• Licensee's associated response and actions may revise the licensing basis. |

# Data Science and Artificial Intelligence Regulatory Applications Workshops

Workshop #5

AI Regulatory Framework Applicability Considerations

September 17, 2024

9:00 a.m. – 5:00 p.m. Eastern

NRC Public Web page on AI:: https://www.nrc.gov/about-nrc/plans-performance/artificial-intelligence.html

AI Public Workshops: https://www.nrc.gov/about-nrc/plans-performance/artificial-intelligence.html#workshops


BLUE WAVE AI LABS

# NUCLEAR INDUSTRY AI

*September 17, 2024*

*Michael Brasel*
*SVP, Nuclear Product Solutions*

# REVIEWER.AI

BLUE WAVE AI LABS

## Minimize the Mundane

- AI assisted documentation review and validation tool
  - Performs automated review for numerical and validity errors
  - Insert into any document review process
  - Focuses human review on what matters
  - Saves time and improves quality of documents
- Experience
  - ~90% of documents with at least one numerical linkage or formatting error
  - ~15% of documents with at least one validity error
- Numerical Linkage Example

Uses:
- Licensing applications
- Component qualification packages
- Manufacturing documentation
- Engineering change packages
- Request for Information
- Regulatory submittals

| SUMMARY OF TEST | METHOD OF ACCEPTANCE | CRITERIA FOR ACCEPTANCE |
|---|---|---|
| $T_A$ = 25°C [20 - 30 °C].<br><br>Apply 300% of rated current, 150.0A [147.0 – 153.0A] to each pole sequentially, perform time-delay overcurrent trip test.<br>Observe breaker trip status.<br>Record applied current, trip time and ambient temperature. | Method 1 | Breaker trips between [12 – 140 s] |