NRC Staff's Graded Approach for Power Uprate Reviews

Power Uprate Public Meeting
December 11, 2025

U.S.NRC
United States Nuclear Regulatory Commission
Protecting People and the Environment

Agenda

- Power Uprate Forecast
- Power Uprate Review Timelines
- Streamline Review through Graded Approach
- Review Area Examples
  - Containment accident pressure (CAP)
  - Transient and Accident Analysis (NUREG-0800, Chapter 15)
  - Adverse Flow Effects (including Steam Dryer)

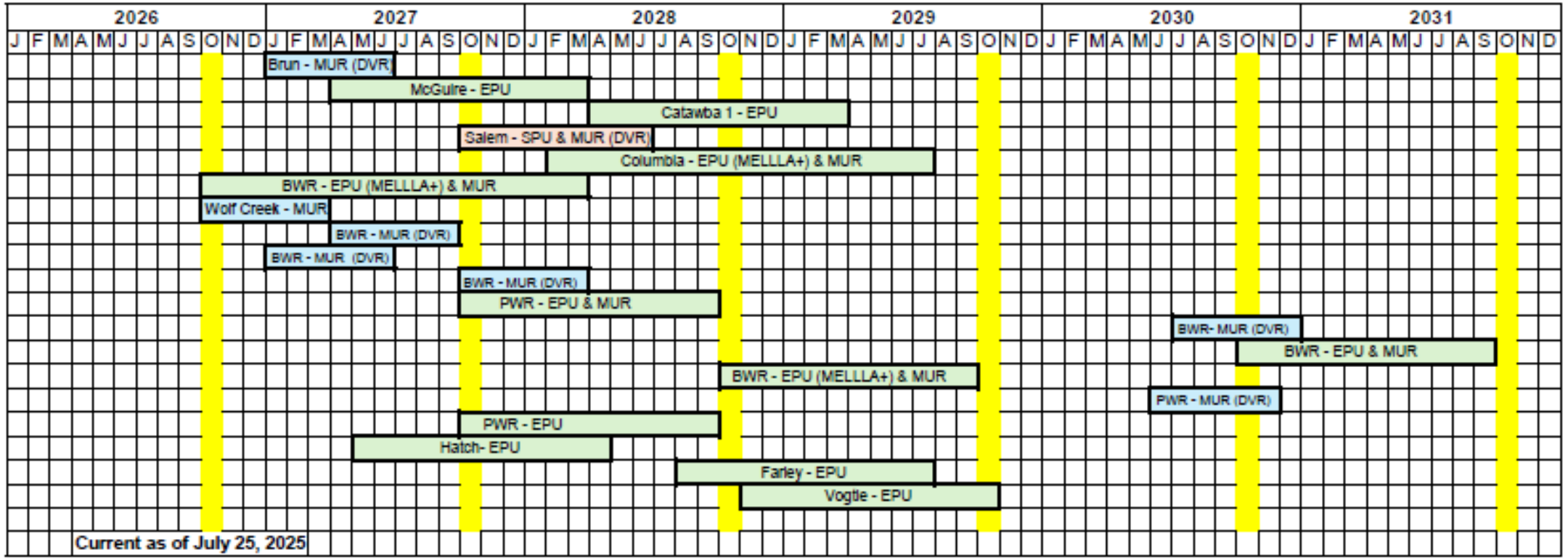
Power Uprate Forecast (by unit)

Calendar Year	Total Power Uprates Expected	Measurement Uncertainty Recapture Power Uprates	Stretch Power Uprates	Extended Power Uprates	Megawatts Thermal	Approximate Megawatts Electric
2026	3	1	0	2	1,075	355
2027	16	7	2	7	2,589	854
2028	0	0	0	8	2,281	753
2029	0	0	0	0	0	0
2030	3	2	0	1	554	183
TOTAL	**30**	**10**	**2**	**18**	**6,495**	**2,143**

*Responses to Regulatory Issue Summary 2025-02, "Planned Power Uprate-Related Licensing Submittals for All Power Reactor Licensees

https://www.nrc.gov/reactors/operating/licensing/power-uprates/status-power-apps/expected-applications

Power Uprate Forecast



U.S.NRC
United States Nuclear Regulatory Commission
Protecting People and the Environment

Executive Order 14300
"Ordering the Reform of the Nuclear Regulatory Commission"

Applicable to power uprate license amendment requests

- Including bundled applications
- When applications are complete

Review Targets*

Measurement Uncertainty Recapture Power Uprate (MUR) - 6 Months

Strech Power Uprate (SPU) - 9 Months

Extended Power Uprate (EPU) - 12 Months

Aligns with May 7, 2024, letter from NRC to Nuclear Energy Institute (ML24106A068)

*After acceptance review complete

Graded Approach for Power Uprate Reviews

The purpose of the guidance is to provide the NRC staff with a risk-informed framework for determining the appropriate level of review of power uprate license amendment requests. The objective is to enhance the efficiency of technical review to support a finding of reasonable assurance of adequate protection of public health and safety.

Preliminary draft information to support interactions with internal and external stakeholders to facilitate feedback. This draft, iterative process is scheduled for initial implementation in early 2026 and will be refined over time using lessons learned and best practices.

Draft Appendix to NRR Office Instruction LIC-112, “Power Uprate Process”

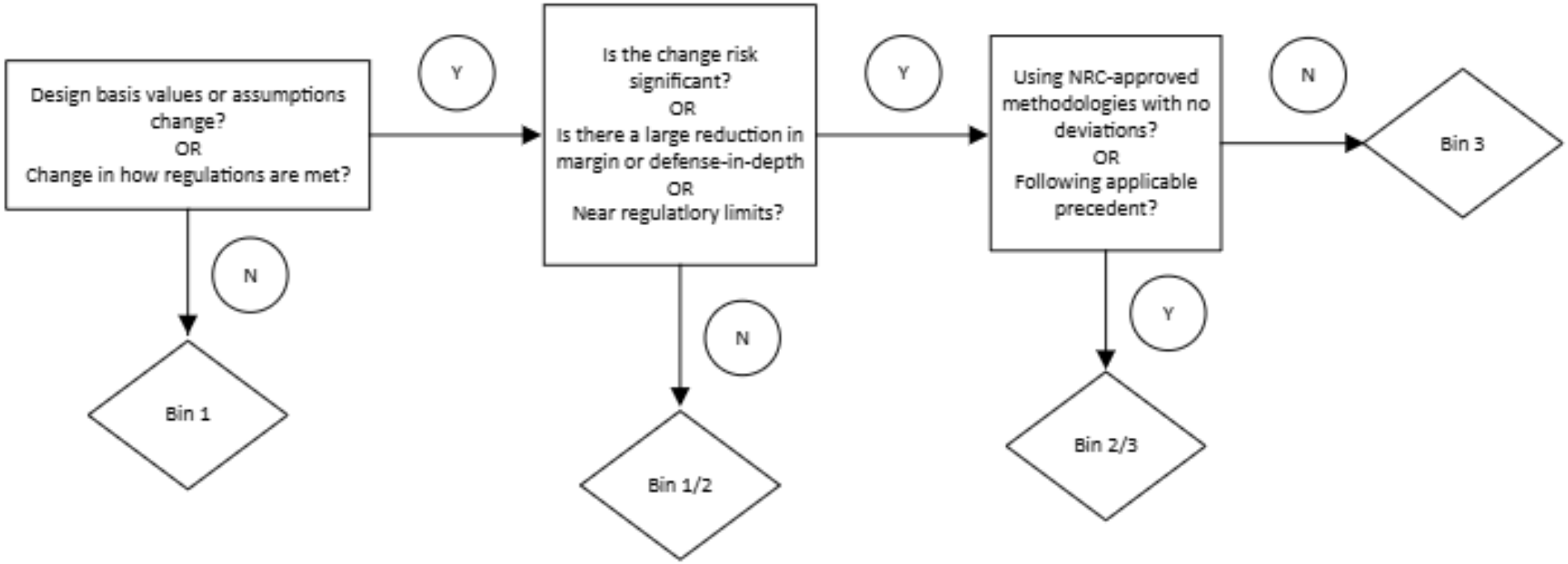
ML25273A236 (added to ADAMS on September 30, 2025).

Graded Approach – Streamline Review

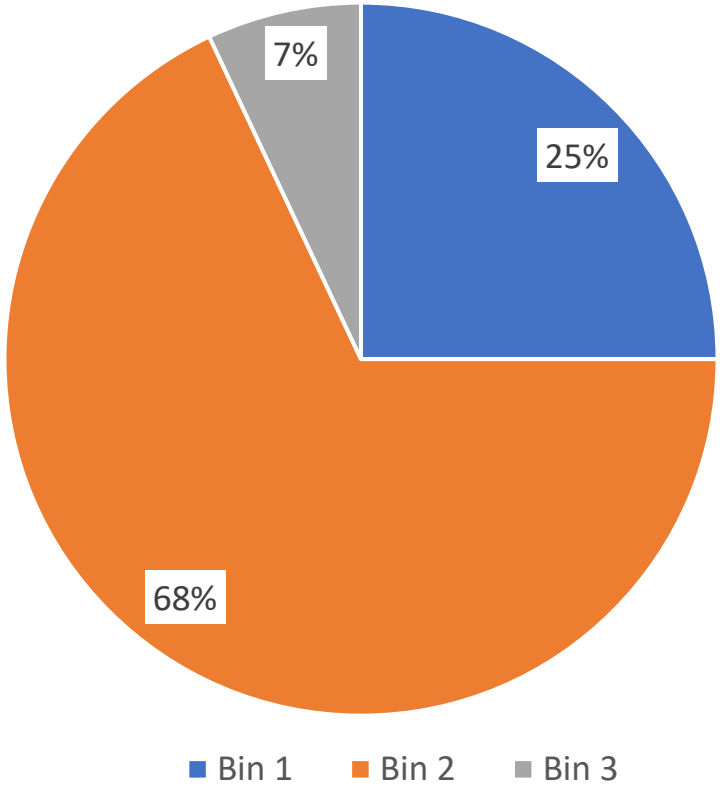
The goal to streamline technical reviews is consistent with:

- NRC's Mission Statement and NRC's Principles of Good Regulation.
- Executive Order 14300, "Ordering the Reform of the Nuclear Regulatory Commission,"
- Accelerating Deployment of Versatile ,Advanced Nuclear for Clean Energy Act of 2024 (ADVANCE Act 2024)
- NRC's Be riskSMART framework

Binning Strategy



Staff's Power Uprate Initial Results



Review Areas in RS-001, "Review Standard for Extended Power Uprates" (ML033640024)

Bin 1 – Minimal Review

Bin 1 is defined as review areas expected to require minimal NRC staff review effort.

For these review areas (or systems), the uprate will have no significant impact on system performance, operating conditions, or variables.

Bin 1 review considerations:

Have design or licensing basis values OR assumptions changed?

Is there a significant change in how requirements are met?

Bin 1 – Review Strategy

- Examples of Bin 1 – Electrical Engineering (Station Blackout, DC Onsite Power System), Emergency Diesel Engine Fuel Oil Storage and Transfer System, New Fuel Storage

Staff identified approximately 25% of the RS-001 areas to potentially be in Bin 1.

Staffs' review would not expect Request for Confirmatory Information (RCIs), Request for Additional Information (RAIs), or audits.

Bin 2 – Limited Review

Bin 2 is defined as review areas that are affected by a power uprate and require evaluation against NRC regulations but may not have a significant impact on nuclear safety and require limited staff review.

This category applies to review areas (or systems) where the power uprate may change system design, function, or operating conditions; however, these changes are not expected to exceed the system's design limits (e.g., pressure, temperature, flow).

Bin 2 review considerations:

Is the change risk significant?

Near regulatory limit?

Large reduction in margin?

Is there a large reduction in defense-in-depth?

Bin 2 – Review Strategy

- Examples of Bin 2 – Control Room Ventilation System, most transients and accident analyses, Source Terms and Radiological Consequences Analyses

Staff identified approximately 68% of the RS-001 areas to potentially be in Bin 2.

Staffs' review may include RCIs but RAIs and audits should be limited.

Bin 3 – Comprehensive / Detailed Review

Bin 3 is defined as review areas directly affected by the power uprate that warrant a comprehensive or detailed review by the NRC staff.

Review areas in Bin 3 typically involve significant changes in system design, analyses, or operation; large reduction in margin or defense-in-depth, or otherwise challenge regulatory limits; risk-significant changes; or deviations from NRC-approved methodologies.

Bin 3 review considerations:

Use of new or novel methods

Significant deviation from approved precedents

Bin 3 – Review Strategy

- Examples of Bin 3 – Containment Review Areas, Anticipated Transients without Scram (ATWS)

Staff identified approximately 7% of the RS-001 areas to potentially be in Bin 3.

Staff's review may include RCIs, RAIs, audits, and/or confirmatory calculations.

Graded Approach Examples

- Areas which required significant resources to resolve historically (i.e., Bin 3 Review):
  - Containment accident pressure (CAP)
  - Transient and Accident Analysis (NUREG-0800, Chapter 15)
  - Adverse Flow Effects
- Application attributes that could significantly streamline staff review by enabling staff to conduct a Bin 2 (Limited) Review for areas that traditionally required a Bin 3 (Comprehensive) Review
- Staff strategies to implement a Bin 2 Review
- Feedback and ideas from industry

Containment accident pressure (CAP) & Transient and Accident Analysis

Nicholas Difrancesco, Chief
Nuclear Systems Performance Branch (SNSB)
Division of Safety System (DSS)
Office of Nuclear Reactor Regulation

Containment Accident Pressure

- Staff reviews use of Containment Accident Pressure (CAP) for Net Positive Suction Head (NPSH) evaluations
  - Loss-of-Coolant-Accident (LOCA) Long-term cooling, sump temperature response (PWR)
  - LOCA Short-term cooling, suppression pool temperature response (BWR)
  - Appendix R fire, station blackout, and Anticipated Transient without scram (ATWS) (BWR)
- Regulatory guidance on CAP is established
  - General Electric Hitachi Topical Report NEDC 33347P-A, "Containment Overpressure Credit for Net Positive Suction Head (NPSH)" [BWR]
  - NRC SECY Paper 11-0014, "Use of Containment Accident Pressure in Analyzing Emergency Core Cooling System and Containment Heat Removal System Pump Performance in Postulated Accidents"
  - NRC Regulatory Guide (RG) 1.82, Rev 5, "Water Sources for Long-Term Recirculation Cooling Following a Loss-of-Coolant Accident"

Attributes that Would Support a Bin 2 Review

- Containment Accident Pressure / Net Positive Suction Head Analysis
  - Use of established guidance without significant deviations
    - e.g., SECY-11-0014, RG 1.82 Rev. 5, NEDC-33347P-A
  - Use of analysis codes that have been accepted or approved by NRC
  - Use of appropriate precedence
  - Performance of bounding analysis (e.g., consideration of ultimate heat sink (UHS) and containment temperatures)
- Attributes of a Bin 3 review may include:
  - Pre-application engagement is encouraged if proposing alternative approaches
  - Transient Reactor Analysis Code (TRACG) is not currently approved for containment analysis and may require additional staff review if used.
  - SHEX for BWR Mark II containments may require additional staff review (Ref: Safety Evaluation on the GE CLTR (NEDC-33004P-A))
  - If needed, availability of containment data earlier (before submittal) for staff confirmatory analysis may facilitate timely review

Transient and Accident Analysis

- Staff intends apply a Bin 2 Review if the application is consistent with following:
  - Applies NRC-approved methodologies within the range of applicability and proposes no deviations.
  - Satisfies all topical report limitations and conditions, as applicable.
  - Anticipated Operational Occurrences (AOOs) are analyzed on a cycle-specific basis or bounded by other analyses.
- Attributes of Bin 3 reviews may include:
  - Use of unapproved analysis methods or significant deviation from approved methods

Adverse Flow Effects

John Bozga, Mechanical Engineer
Mechanical Engineering and Inservice Testing Branch (EMIB)
Division of Engineering and External Hazards (DEX)
Office of Nuclear Reactor Regulation

Adverse Flow Effects – Attributes to Support Bin 2 Review

- Replacement Steam Dryer (RSD) Structural Integrity
  - Use endorsed NRC guidance (e.g., RG 1.20, Revision 4) for Comprehensive Vibration Assessment Program
  - Minimum Alternating Stress Ratio of 2.0 for fatigue
  - Stress Analysis - ASME BPV Code Section III, Subsection NG (Standard Review Plan 3.9.5)
  - use of approved topical reports for steam dryer inspection and structural integrity analysis
  - replacement steam dryer fabricated from material resistant to various degradation mechanisms and compatible with reactor pressure vessel material
  - reactor pressure vessel and its support structure evaluated for the additional weight of a heavier replacement steam dryer
- Effects of acoustic loads induced by flow-induced resonances at main steam line valves and steam dryer effects
- Evaluate the implementation of steam dryer and main steam line instrumentation dependent on robust design of the RSD
- Operating Experience based on past EPUs and higher EPUs might need additional consideration

Adverse Flow Effects – License Conditions

- RSD License Condition Efficiencies
  - Available for NRC onsite review
    - Implementing hold points during power ascension testing
    - Submission of power ascension testing results
    - Submission of results of the visual inspections of the steam dryer
  - Monitoring of potential acoustic resonance and vibration levels during initial EPU startup
  - Notify NRC of any changes to the long-term steam dryer inspection plan

Considerations to Streamline NRC Review

- For an efficient NRC review, licensees are expected to thoroughly review the SEs and RAIs on the previous similar power uprate LARs and incorporate items to minimize RAIs
- Focused use of Regulatory Audits
- Focused use of pre-application meetings
  - Multiple for different technical areas.
  - Graded approach