

**GUIDANCE ON THE CONTENT OF
MEASUREMENT UNCERTAINTY RECAPTURE POWER UPRATE APPLICATIONS**

I. Feedwater flow measurement technique and power measurement uncertainty

1. A detailed description of the plant-specific implementation of the feedwater flow measurement technique and the power increase gained as a result of implementing this technique. This description should include:
 - A. Identification (by document title, number, and date) of the approved topical report on the feedwater flow measurement technique
 - B. A reference to the NRC's approval of the proposed feedwater flow measurement technique
 - C. A discussion of the plant-specific implementation of the guidelines in the topical report and the staff's letter/safety evaluation approving the topical report for the feedwater flow measurement technique
 - D. The dispositions of the criteria that the NRC staff stated should be addressed (i.e., the criteria included in the staff's approval of the technique) when implementing the feedwater flow measurement technique
 - E. A calculation of the total power measurement uncertainty at the plant, explicitly identifying all parameters and their individual contribution to the power uncertainty
 - F. Information to specifically address the following aspects of the calibration and maintenance procedures related to all instruments that affect the power calorimetric:
 - i. maintaining calibration
 - ii. controlling software and hardware configuration
 - iii. performing corrective actions
 - iv. reporting deficiencies to the manufacturer
 - v. receiving and addressing manufacturer deficiency reports
 - G. A proposed allowed outage time for the instrument, along with the technical basis for the time selected
 - H. Proposed actions to reduce power level if the allowed outage time is exceeded, including a discussion of the technical basis for the proposed reduced power level

II. Accidents and transients for which the existing analyses of record bound plant operation at the proposed uprated power level

1. A matrix that includes information for each analysis in this category and addresses the transients and accidents included in the plant's updated final safety analysis report (UFSAR) (typically Chapter 14 or 15) and other analyses that licensees are required to perform to support licensing of their plants (i.e., radiological consequences, natural circulation cooldown, containment performance, anticipated transient without scram, station blackout, analyses to determine environmental qualification parameters, safe shutdown fire analysis, spent fuel pool cooling, flooding):
 - A. Identify the transient or accident that is the subject of the analysis
 - B. Confirm and explicitly state that
 - i. the requested uprate in power level continues to be bounded by the existing analyses of record for the plant
 - ii. the analyses of record either have been previously approved by the NRC or were conducted using methods or processes that were previously approved by the NRC
 - C. Confirm that bounding event determinations continue to be valid
 - D. Provide a reference to the NRC's previous approvals discussed in Item B. above

III. Accidents and transients for which the existing analyses of record do not bound plant operation at the proposed uprated power level

1. This section covers the transient and accident analyses that are included in the plant's UFSAR (typically Chapter 14 or 15) and other analyses that are required to be performed by licensees to support licensing of their plants (i.e., radiological consequences, natural circulation cooldown, containment performance, anticipated transient without scrams, station blackout, analyses for determination of environmental qualification parameters, safe shutdown fire analysis, spent fuel pool cooling, flooding).
2. For analyses that are covered by the NRC approved reload methodology for the plant, the licensee should:
 - A. Identify the transient/accident that is the subject of the analysis
 - B. Provide an explicit commitment to re-analyze the transient/accident, consistent with the reload methodology, prior to implementation of the power uprate

- C. Provide an explicit commitment to submit the analysis for NRC review, prior to operation at the uprated power level, if NRC review is deemed necessary by the criteria in 10 CFR 50.59
 - D. Provide a reference to the NRC's approval of the plant's reload methodology
3. For analyses that are not covered by the reload methodology for the plant, the licensee should provide a detailed discussion for each analysis. The discussion should:
- A. Identify the transient or accident that is the subject of the analysis
 - B. Identify the important analysis inputs and assumptions (including their values), and explicitly identify those that changed as a result of the power uprate
 - C. Confirm that the limiting event determination is still valid for the transient or accident being analyzed
 - D. Identify the methodologies used to perform the analyses, and describe any changes in those methodologies
 - E. Provide references to staff approvals of the methodologies in Item D. above
 - F. Confirm that the analyses were performed in accordance with all limitations and restrictions included in the NRC's approval of the methodology
 - G. Describe the sequence of events and explicitly identify those that would change as a result of the power uprate
 - H. Describe and justify the chosen single-failure assumption
 - I. Provide plots of important parameters and explicitly identify those that would change as a result of the power uprate
 - J. Discuss any change in equipment capacities (e.g., water supply volumes, valve relief capacities, pump pumping flow rates, developed head, required and available net positive suction head (NPSH), valve isolation capabilities) required to support the analysis
 - K. Discuss the results and acceptance criteria for the analysis, including any changes from the previous analysis

IV. **Mechanical/Structural/Material Component Integrity and Design**

- 1. A discussion of the effect of the power uprate on the structural integrity of major plant components. For components that are bounded by existing analyses of

record, the discussion should cover the type of confirmatory information identified in Section II, above. For components that are not bounded by existing analyses of record, a detailed discussion should be provided.

- A. This discussion should address the following components:
 - i. reactor vessel, nozzles, and supports
 - ii. reactor core support structures and vessel internals
 - iii. control rod drive mechanisms
 - iv. Nuclear Steam Supply System (NSSS) piping, pipe supports, branch nozzles
 - v. balance-of-plant (BOP) piping (NSSS interface systems, safety-related cooling water systems, and containment systems)
 - vi. steam generator tubes, secondary side internal support structures, shell, and nozzles
 - vii. reactor coolant pumps
 - viii. pressurizer shell, nozzles, and surge line
 - ix. safety-related valves

- B. The discussion should identify and evaluate any changes related to the power uprate in the following areas:
 - i. stresses
 - ii. cumulative usage factors
 - iii. flow induced vibration
 - iv. changes in temperature (pre- and post-uprate)
 - v. changes in pressure (pre- and post-uprate)
 - vi. changes in flow rates (pre- and post-uprate)
 - vii. high-energy line break locations
 - viii. jet impingement and thrust forces

- C. The discussion should also identify any effects of the power uprate on the integrity of the reactor vessel with respect to:
 - i. pressurized thermal shock calculations
 - ii. fluence evaluation
 - iii. heatup and cooldown pressure-temperature limit curves
 - iv. low-temperature overpressure protection
 - v. upper shelf energy
 - vi. surveillance capsule withdrawal schedule

- D. The discussion should identify the code of record being used in the associated analyses, and any changes to the code of record.

- E. The discussion should identify any changes related to the power uprate with regard to component inspection and testing programs and erosion/corrosion programs, and discuss the significance of these changes. If the changes are insignificant, the licensee should explicitly state so.

- F. The discussion should address whether the effect of the power uprate on steam generator tube high cycle fatigue is consistent with NRC Bulletin 88-02, "Rapidly Propagating Fatigue Cracks in Steam Generator Tubes," February 5, 1988.

V. Electrical Equipment Design

- 1. A discussion of the effect of the power uprate on electrical equipment. For equipment that is bounded by the existing analyses of record, the discussion should cover the type of confirmatory information identified under Section II, above. For equipment that is not bounded by existing analyses of record, a detailed discussion should be included to identify and evaluate the changes related to the power uprate. Specifically, this discussion should address the following items:
 - A. emergency diesel generators
 - B. station blackout equipment
 - C. environmental qualification of electrical equipment
 - D. grid stability

VI. System Design

- 1. A discussion of the effect of the power uprate on major plant systems. For systems that are bounded by existing analyses of record, the discussion should cover the type of confirmatory information identified under Section II, above. For systems that are not bounded by existing analyses of record, a detailed discussion should be included to identify and evaluate the changes related to the power uprate. Specifically, this discussion should address the following systems:
 - A. NSSS interface systems for pressurized-water reactors (PWRs) (e.g., main steam, steam dump, condensate, feedwater, auxiliary/emergency feedwater) or boiling-water reactors (BWRs) (e.g., suppression pool cooling), as applicable
 - B. containment systems
 - C. safety-related cooling water systems
 - D. spent fuel pool storage and cooling systems
 - E. radioactive waste systems
 - F. Engineered safety features (ESF) heating, ventilation, and air conditioning systems

VII. **Other**

1. A statement confirming that the licensee has identified and evaluated operator actions that are sensitive to the power uprate, including any effects of the power uprate on the time available for operator actions.
2. A statement confirming that the licensee has identified all modifications associated with the proposed power uprate, with respect to the following aspects of plant operations that are necessary to ensure that changes in operator actions do not adversely affect defense in depth or safety margins:
 - A. emergency and abnormal operating procedures
 - B. control room controls, displays (including the safety parameter display system) and alarms
 - C. the control room plant reference simulator
 - D. the operator training program
3. A statement confirming licensee intent to complete the modifications identified in Item 2. above (including the training of operators), prior to implementation of the power uprate.
4. A statement confirming licensee intent to revise existing plant operating procedures related to temporary operation above “full steady-state licensed power levels” to reduce the magnitude of the allowed deviation from the licensed power level. The magnitude should be reduced from the pre-power uprate value of 2 percent to a lower value corresponding to the uncertainty in power level credited by the proposed power uprate application.
5. A discussion of the 10 CFR 51.22 criteria for categorical exclusion for environmental review including:
 - A. A discussion of the effect of the power uprate on the types or amounts of any effluents that may be released offsite and whether or not this effect is bounded by the final environmental statement and previous Environmental Assessments for the plant.
 - B. A discussion of the effect of the power uprate on individual or cumulative occupational radiation exposure.

VIII. **Changes to technical specifications, protection system settings, and emergency system settings**

1. A detailed discussion of each change to the plant's technical specifications, protection system settings, and/or emergency system settings needed to support the power uprate:

- A. a description of the change
- B. identification of analyses affected by and/or supporting the change
- C. justification for the change, including the type of information discussed in Section III, above, for any analyses that support and/or are affected by change