

POLICY ISSUE INFORMATION

May 25, 2011

SECY-11-0071

FOR: The Commissioners

FROM: Eric J. Leeds, Director
Office of Nuclear Reactor Regulation

SUBJECT: STATUS REPORT ON POWER UPRATES

PURPOSE:

This information paper summarizes the power uprate program accomplishments and challenges since the last update in SECY-10-0070, "Status Report on Power Uprates," dated May 20, 2010. This paper does not address any new commitments or resource implications.

BACKGROUND:

The staff provides the Commission with an annual update of significant power uprate activities, in accordance with the Staff Requirements Memorandum dated February 8, 2002, entitled "Briefing on Status of Nuclear Reactor Safety" (SRM-M020129).

DISCUSSION:

Since the last update, the U.S. Nuclear Regulatory Commission (NRC) staff has approved 10 plant-specific power uprates. The staff is currently reviewing 11 power uprates. Over the next 5 years, the staff expects that licensees will submit an additional 34 power uprate applications. The enclosed status report provides detailed information on the power uprates approved since May 20, 2010; applications under review; applications expected in the future; accomplishments; challenges associated with power uprates; and program performance.

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The staff generally met its timeliness goals for six of the eight measurement uncertainty recapture (MUR) power uprates approved since May 20, 2010 (for Prairie Island Units 1 and 2, LaSalle Units 1 and 2, and Surry Units 1 and 2). The staff exceeded the 6-month review goal for the Limerick Units 1 and 2 MUR power uprates by 5 months in order to resolve a staff-identified fracture toughness compliance issue regarding the low-pressure coolant injection nozzles and some water-level instrumentation nozzles on the reactor vessel.

The staff exceeded the 12-month review goal for the Point Beach Units 1 and 2 extended power uprates (EPUs) by 6 months because additional review time was needed to review key technical issues, including (1) a significant upgrade to and modification of the auxiliary feedwater system, (2) a reconstituted high-energy line break analysis, which included an onsite audit by the staff, and (3) a linked alternate source term license amendment request, which needed to be approved first.

The use of containment accident pressure credit in the safety analyses of some EPU applications continues to be an area of discussion between the Advisory Committee on Reactor Safeguards and the staff. This issue has delayed the staff's reviews of the Browns Ferry Units 1, 2, and 3, and Monticello EPU applications. The staff prepared SECY-11-0014, "Use of Containment Accident Pressure in Analyzing Emergency Core Cooling System and Containment Heat Removal System Pump Performance in Postulated Accidents," dated January 31, 2011, to obtain Commission direction on this issue. The staff proposed two options that involve policy issues. Both options include resuming work on EPU applications consistent with existing risk review guidance and recently-developed deterministic guidance.

In response to SECY-11-0014, Staff Requirements Memorandum SRM-SECY-11-0014, "Use of Containment Accident Pressure in Analyzing Emergency Core Cooling System and Containment Heat Removal System Pump Performance in Postulated Accidents," was issued on March 15, 2011. SRM-SECY-11-0014 approved the staff's recommended Option 1. The staff is therefore proceeding with Option 1 and plans to resume the CAP portion of the delayed EPU reviews.

The evaluation of potential adverse effects of increased steam flow rates associated with power uprates continues to be a challenge. Two independent industry topical reports were submitted for NRC review and approval, which could ultimately provide the industry with two independent integrated evaluation approaches and acceptance criteria for steam dryers. Additional details and review status are provided in the enclosure. The staff will resume its reviews of the topical reports after they are supplemented or resubmitted to address staff technical issues.

The continuing goal is for the staff to conduct timely power uprate reviews of appropriate scope and depth for each of the technical areas while ensuring that safety is maintained.

The Commissioners

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COORDINATION:

The Office of the General Counsel reviewed this report and has no legal objection.

/RA Bruce A. Boger for/

Eric J. Leeds, Director
Office of Nuclear Reactor Regulation

Enclosure:
Power Uprate Program Status Report

The Commissioners

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COORDINATION:

The Office of the General Counsel reviewed this report and has no legal objection.

Eric J. Leeds, Director
Office of Nuclear Reactor Regulation

Enclosure:
Power Uprate Program Status Report

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**Power Uprate Program Status Report
May 2011**

Power uprates are categorized based on the magnitude of the power increase and the methods used to achieve the increase. Measurement uncertainty recapture (MUR) power uprates result in power-level increases of less than 2 percent and are achieved by implementing enhanced techniques for calculating reactor power. Stretch power uprates (SPUs) typically result in power-level increases of up to 7 percent and generally do not involve major plant modifications. Extended power uprates (EPUs) result in greater power-level increases than SPUs and usually require significant modifications to major plant equipment. The U.S. Nuclear Regulatory Commission (NRC) has approved EPUs for increases as high as 20 percent.

Power Uprates Approved since May 2010

Power uprates approved since May 20, 2010, have added 884 megawatts thermal (MWt) or approximately 295 megawatts electric (MWe) to the Nation's electric generating capacity. This brings the total number of power uprates approved since 1977 to 139, resulting in a combined increase of about 18,063 MWt (6,021 MWe) in the Nation's electric generating capacity. Table 1 provides information on the power uprates approved since May 20, 2010; details on program performance versus established goals for these approved power uprates appear later in this report.

Table 1 - Power Uprates Approved since May 20, 2010

No.	Plant	% Uprate	MWt	Application Date	Approval Date	Type
1	Prairie Island 1	1.6	27	12/28/2009	08/18/2010	MUR
2	Prairie island 2	1.6	27	12/28/2009	08/18/2010	MUR
3	LaSalle 1	1.6	57	01/27/2010	09/16/2010	MUR
4	LaSalle 2	1.6	57	01/27/2010	09/16/2010	MUR
5	Surry 1	1.6	41	01/27/2010	09/24/2010	MUR
6	Surry 2	1.6	41	01/27/2010	09/24/2010	MUR
7	Limerick 1	1.6	57	03/25/2010	04/08/2011	MUR
8	Limerick 2	1.6	57	03/25/2010	04/08/2011	MUR
9	Point Beach 1	17	260	04/07/2009	05/03/2011	EPU
10	Point Beach 2	17	260	04/07/2009	05/03/2011	EPU
		Total	884			

Power Uprate Applications Currently under Staff Review

As illustrated in Table 2, power uprates currently under review could add 4,118 MWt or approximately 1,372 MWe to the Nation's electric generating capacity, if approved.

Table 2 - Power Uprate Applications under Review

No.	Plant	% Uprate	MWt	Application Date	Projected Completion Date	Type
1	Browns Ferry 2	14.3	494	06/25/2004	To Be Determined	EPU
2	Browns Ferry 3	14.3	494	06/25/2004	To Be Determined	EPU
3	Browns Ferry 1	14.3	494	06/28/2004	To Be Determined	EPU
4	Monticello	12.9	229	11/05/2008	To Be Determined	EPU
5	Nine Mile Pt. 2	15	521	05/27/2009	Fall 2011	EPU
6	Grand Gulf 1	13.1	510	09/08/2010	Fall 2011	EPU
7	Turkey Point 3	15	344	10/21/2010	Fall 2011	EPU
8	Turkey Point 4	15	344	10/21/2010	Fall 2011	EPU
9	St. Lucie 1	11.9	320	11/22/2010	To Be Determined	EPU
10	St. Lucie 2*	11.9	320	02/25/2011	To Be Determined	EPU
11	Harris 1*	1.6	48	04/28/2011	To Be Determined	MUR
		Total	4,118			

* These applications are currently undergoing NRC acceptance review.

Expected Power Uprate Applications

Table 3 estimates future power uprate applications based on a survey of all licensees conducted in December 2010.

Table 3 - Projected Future Power Uprate Applications

Fiscal Year	Power Uprates Expected	MUR Power Uprates	SPUs	EPUs	MWt	MWe
2011	10	8	0	2	1,095	365
2012	15	9	0	6	2,486	829
2013	0	0	0	0	0	0
2014	8	5	0	3	1504	501
2015	1	0	0	1	435	145
Total	34	22	0	12	5,520	1840

Accomplishments since May 20, 2010

The NRC staff accomplishments since May 20, 2010, are as follows:

- Approved ten plant-specific power uprates, specifically eight MUR power uprates (Prairie Island Units 1 and 2, LaSalle Units 1 and 2, Surry Units 1 and 2, and Limerick Units 1 and 2) and two EPU applications (Point Beach Units 1 and 2).
- Issued acceptance letters for the EPU applications for Grand Gulf Unit 1, Turkey Point Units 3 and 4, and St. Lucie Unit 1 (which was resubmitted).
- Presented information on the Point Beach Units 1 and 2 EPU application to the Advisory Committee on Reactor Safeguards (ACRS) Subcommittee on Power Uprates and the ACRS Full Committee.
- Presented general power uprate information at the International Atomic Energy Agency Regional Workshop on Regulatory Review of Safety Submittals in Moscow, Russia, which included information in the areas of power uprate background, review process, and current technical issues.
- Supported the Integrated Regulatory Review Service Mission by answering questions about general licensing processes and specific questions on power uprates, and by providing information regarding the staff's power uprate review process.
- Issued a revision to an internal office instruction entitled "Power Uprate Process" primarily to provide a format to document late power uprate reviews (i.e., those reviews that are exceeding the review duration performance goals discussed later in this paper).

Challenges Associated with Power Uprates

Containment Accident Pressure Credit

EPU applications result in an increase in the temperature of the sump water (in pressurized-water reactors) and suppression pool water (in boiling-water reactors) during certain postulated accidents or abnormal events. This could affect the performance of the emergency core cooling system (ECCS) pumps taking suction from these water sources. In some cases, licensees have included containment accident pressure (CAP) in their safety analyses to demonstrate acceptable performance of the ECCS pumps. The ACRS recommended changes to this practice in a letter to the Executive Director for Operations (EDO) dated March 18, 2009.

The staff responded to the ACRS by letter dated June 4, 2009. The staff informed ACRS that it was carefully reviewing the recommendations of the March 18, 2009, letter and would brief the Committee on the results of its review. The staff response also stated that it would consider delaying approval of licensing actions that included the use of CAP credit.

In September and October 2009, the NRC informed two licensees requesting EPU applications (i.e., the licensees for Browns Ferry Units 1, 2, and 3, and Monticello), which take credit for CAP and are currently undergoing NRC staff review, that the agency needed more time to develop additional

regulatory guidance to ensure the technical adequacy of their applications. This resulted in delays in the staff's review of these applications.

By letters dated March 1 and 24, 2010, the NRC provided draft guidance to the Boiling Water Reactor Owners Group (BWROG) and the Pressurized Water Reactor Owners Group, respectively, and requested that they meet with the NRC staff to discuss it. The staff discussed the draft guidance with the BWROG on April 14, 2010, and presented it to the ACRS Power Uprate Subcommittee and ACRS Full Committee on April 23 and May 6, 2010, respectively. The ACRS made recommendations in a letter to the EDO dated May 19, 2010, that included the following: (1) that licensees should first demonstrate the plant-specific impracticality of making plant modifications to eliminate need for CAP credit, (2) that licensees complement their deterministic analyses with plant-specific probabilistic analyses of the impact of CAP credit, (3) support for the staff's reassessment of potential problems associated with operation of pumps near or below the pump's required net positive suction head (NPSH), (4) support for the staff's draft guidance on consideration of uncertainty in the required NPSH, and (5) criteria for when CAP credit can be deemed small enough that it is acceptable. The ACRS's May 19, 2010, letter reiterated the Committee's concern about the defense-in-depth philosophy for accident mitigation and the independence of barriers. Subsequently, the ACRS met with the Commission on June 9, 2010, and discussed CAP credit along with other topics.

On June 25, 2010, Staff Requirements Memorandum SRM M100609B, "Meeting with the Advisory Committee on Reactor Safeguards," was issued. It directed that the staff's forthcoming paper on CAP should discuss where the staff aligns and disagrees with the ACRS regarding CAP credit, including use of risk information, defense-in-depth implications, and need to assess the practicality of hardware changes to eliminate the need for CAP credit.

On January 31, 2011, the staff provided SECY-11-0014, "Use of Containment Accident Pressure in Analyzing Emergency Core Cooling System and Containment Heat Removal System Pump Performance in Postulated Accidents." SECY-11-0014 proposed two options that involve policy issues. The staff recommended Option 1, which proposed resuming reviews of EPU applications taking CAP credit, as well as reviewing future applications for new or increased use of CAP credit. Under this Option, the staff proposed to conduct these reviews consistent with staff practice in implementing the current risk review guidance and the recently-developed deterministic guidance based on ACRS recommendations to include uncertainty and margins in CAP calculations. The staff also proposed to update the regulatory guidance to remove the specific guidance disfavoring the use of CAP in determining NPSH margin.

In response to SECY-11-0014, Staff Requirements Memorandum SRM-SECY-11-0014, "Use of Containment Accident Pressure in Analyzing Emergency Core Cooling System and Containment Heat Removal System Pump Performance in Postulated Accidents," was issued on March 15, 2011. The SRM approved the staff's recommended Option 1. The SRM also directed the staff to revise Regulatory Guide 1.174, "An Approach for Using Probabilistic Risk Assessment in Risk-Informed Decisions on Plant-Specific Changes to the Licensing Basis," and other regulatory guidance, using precise language to assure that the defense-in-depth philosophy is interpreted and implemented consistently. The staff is therefore proceeding with Option 1 and plans to resume the CAP portion of the delayed EPU reviews.

Potential Adverse Flow Effects

At power uprate conditions, nuclear power plants can experience significant increases in steam flow velocities. Plant experience has shown that as the higher velocity main steamline flow passes over branch lines, it can create an acoustic resonance in the steamlines that can vary greatly from one plant to another, depending on the routing of the main steamlines and the steam dryer vintage and geometry. The acoustic resonance can create pressure waves that strike the steam dryer in boiling-water reactors (BWRs) with significant force. This force could cause the stress in the steam dryer to exceed the material fatigue limits, which may result in steam dryer cracking. The acoustic resonance can also cause excessive vibration that may damage steamline and feedwater line components, such as relief valves and piping.

To address this issue, BWR applicants for EPU have provided complex steam dryer analyses to demonstrate the structural integrity of the steam dryers at uprated power levels. However, it has been challenging for licensees to provide acceptable steam dryer analyses and this has significantly contributed to the delays in the EPU reviews for several BWR plants. Reasons for these delays typically include: licensees introducing new refinements to analytical methods not used in previous EPU applications, the NRC identifying new issues with licensees' acoustic circuit models, licensees needing to make steam dryer modifications to address analysis issues, and lack of adequate plant measurement data needed for the steam dryer analyses.

To address this issue, two independent industry topical reports have been submitted to the NRC for review and approval. These reports present two independent integrated evaluation approaches and acceptance criteria for steam dryers. GE Hitachi Nuclear Energy submitted NEDC-33436P, "GEH Boiling Water Reactor Steam Dryer - Plant Based Load Evaluation," on November 7, 2008. The Electric Power Research Institute resubmitted BWRVIP-194, "Methodologies for Demonstrating Steam Dryer Integrity for Power Uprate," on December 18, 2008. By letters dated June 30, 2009, and September 15, 2009, the NRC accepted topical reports BWRVIP-194 and NEDC-33436P, respectively, for a detailed technical review.

However, the NRC letters also identified the need for complementary or related topical reports, as well as additional information, to continue its review. The staff will resume its reviews of the topical reports after they are supplemented or resubmitted to address staff technical issues. If the NRC ultimately approves these topical reports, licensees referencing them will only need to provide the plant-specific items (which the NRC will develop) for the NRC's review. This process should improve the review timeliness of future requests that involve evaluation of potential adverse flow effects on steam dryers.

Program Performance versus Established Goals

The established performance goals for power uprate review durations are the following: 6 months for reviewing MUR power uprate applications, 9 months for reviewing SPU applications, and 12 months for reviewing EPU applications.¹ The staff will continue to ensure that protection of public health and safety is not compromised through its efforts to meet these

¹ These goals do not include the duration of the staff's acceptance review, which the staff conducts upon receipt of the initial application.

timeliness goals. Individual applications may require more or less review time, depending on the nature of the technical issues.

Completed Reviews

The staff generally met its timeliness goals for six of the eight MUR power uprates approved since May 20, 2010 (for Prairie Island Units 1 and 2, LaSalle Units 1 and 2, and Surry Units 1 and 2). The staff met the 6-month review goal for the Prairie Island Units 1 and 2 MUR power uprates. The staff slightly exceeded the 6-month review goal for the LaSalle Units 1 and 2 MUR power uprates by two weeks partly because of a linked alternate source term (AST) license amendment request, that needed to be approved first, and partly because of the need to resolve internal-staff comments to ensure a quality safety evaluation. The staff slightly exceeded the 6-month review goal for the Surry Units 1 and 2 MUR power uprates by 3 weeks in order to resolve internal-staff comments to ensure a quality safety evaluation.

The staff exceeded the 6-month review goal for the Limerick Units 1 and 2 MUR power uprates by 5 months in order to resolve a staff-identified compliance issue with Title 10 of the *Code of Federal Regulations* (10 CFR) Part 50, "Domestic Licensing of Production and Utilization Facilities," Appendix G, "Fracture Toughness Requirements," regarding the low-pressure coolant injection nozzles and some water-level instrumentation nozzles on the reactor vessel. The staff exceeded the 12-month review goal for the Point Beach Units 1 and 2 EPUs by 6 months because additional review time was needed to review key technical issues, including (1) a significant upgrade to and modification of the auxiliary feedwater system, (2) a reconstituted high-energy line break analysis, which included an onsite audit by the staff, and (3) a linked AST license amendment request, which needed to be approved first.

Delayed Ongoing Reviews

The Nine Mile Point Unit 2 EPU review has been delayed primarily in order to resolve concerns with the licensee's steam dryer analyses. The staff identified that the licensee's application of its methodology of the acoustic circuit model (ACM) Revision 4.0 for determining the steam dryer loading was nonconservative. This nonconservatism existed because the licensee was taking credit for items that were inconsistent with the ACM Revision 4.0 benchmarking. This results in underestimation of the steam dryer loads and underprediction of the steam dryer stresses. In response to the staff's initial request for additional information (RAI) questions of March 2010, the licensee opted to revise its ACM code to Revision 4.1 to address the staff's concerns. This approach involved extensive rebenchmarking and analysis by the licensee, who submitted a partial response to the associated supplemental RAIs in December 2010. The staff anticipates the need for additional followup RAIs as the licensee provides the remainder of its response in support of the staff's evaluation of the new ACM Revision 4.1 methodology.

The Browns Ferry Units 1, 2, and 3, and Monticello EPU reviews have been delayed primarily because of staff concerns with the licensees' steam dryer analyses and analyses that take credit for CAP. General discussion of these issues appeared previously in the "Challenges Associated with Power Uprates" section of this report. Specific details pertaining to these EPU reviews are discussed below.

The staff plans to resume the CAP portion of the Browns Ferry Units 1, 2, and 3, and Monticello EPU reviews. With respect to the Monticello EPU review, the staff is discussing with the licensee the information needed to complete the CAP portion of the review. With respect to the Browns Ferry EPU reviews, the licensee informed the staff in a December 15, 2010, public meeting that it will submit its plans regarding CAP in March 2012. At that time, the staff will resume the CAP portion of those reviews.

Regarding the steam dryer portion of the delayed EPU reviews, the steam dryer was replaced earlier this year at Monticello and there are plans to replace the steam dryers at Browns Ferry Units 1, 2, and 3. The staff has issued RAIs regarding the replacement steam dryer at Monticello and recently conducted an audit to identify any additional information needed to complete its review. With respect to the Browns Ferry EPU reviews, the licensee informed the staff in a December 15, 2010, public meeting that it will submit its replacement steam dryer analyses in February 2012. At that time, the staff will resume the steam dryer portion of the Browns Ferry EPU reviews.

General Observation: Licensees Bundling Other Requests with the Power Uprate Request

The staff notes that some licensees use power uprate requests as an opportunity to include (i.e., bundle) other requests that perhaps could have been submitted separately by the licensee and approved by the NRC, before the licensee submits the power uprate request. Based on preapplication meetings with licensees, it appears that this trend may continue. Sometimes the staff can accommodate these requests within the normal power uprate review schedule. However, in some cases, this bundling results in review durations that are significantly longer than would otherwise be the case.

The staff has encouraged licensees to have preapplication interactions (e.g., meetings, phone calls) with the staff to discuss any new, different or complex issues with regard to their planned power uprate application as compared to other NRC-approved power uprates, and to discuss any other requests that they plan on bundling with their power uprate request. In some of these preapplication interactions, the staff has requested that licensees voluntarily limit the number and/or complexity of certain other requests that they plan on bundling with the power uprate request, depending on the specific issues and circumstances under consideration. The staff will continue to request that licensees voluntarily limit the amount of bundling in future preapplication interactions, as appropriate and on a case-by-case basis.