POLICY ISSUE
(Notation Vote)

June 25, 2013 SECY-13-0070

FOR: The Commissioners

FROM: R. W. Borchardt
Executive Director for Operations

SUBJECT: STATUS REPORT ON POWER UPRATES

PURPOSE:

To summarize the power uprate program accomplishments and challenges since the last update in SECY-12-0084, "Status Report on Power Uprates," dated June 15, 2012, and to request Commission approval to reduce the frequency of future status reports. This paper does not address any new commitments.

BACKGROUND:

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

DISCUSSION:

The staff continues to ensure that the goal of protection of public health and safety remains paramount throughout its power uprate license application reviews and is not compromised to meet the associated timeliness and resource performance goals. Since the last update, the NRC staff has approved power uprates for five plants. The staff is currently reviewing 14 power uprates. Over the next 5 years, the staff expects that licensees will submit an additional three power uprate applications. The enclosed status report provides detailed information on the power uprates approved since June 15, 2012, applications under review, applications expected in the future, accomplishments, status of technical challenges, and programmatic changes.

Because of continuing challenges with meeting the timeliness review goals for power uprates, the staff discussed plans to lengthen these performance goals in the last power uprate status report, SECY-12-0084. The timeliness review goals for measurement uncertainty recaptures

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(MURs) was changed from 6 to 9 months; the goal for stretch power uprates was changed from 9 to 12 months; and the goal for extended power uprates (EPUs) was changed from 12 to 18 months. However, these revised timeliness goals only applied to applications received after June 2012, and most of the power uprate applications currently being reviewed remain under the previous performance goals. Current application review resource estimates remain unchanged since the last report.

For those applications received prior to June 2012, the staff encountered challenges in meeting the previous timeliness review goals. The staff exceeded the prior 12-month goal for the Grand Gulf, Unit 1, EPU by 7 months because of staff concerns associated with the steam dryer analysis. The staff exceeded the prior 12-month review goal for the St. Lucie, Units 1 and 2, EPU reviews by 3 and 4 months, respectively, because of staff and Advisory Committee on Reactor Safeguards concerns relating to nuclear fuel thermal conductivity degradation affecting reactor safety analysis calculations. The staff exceeded the prior 6 month review goal for the McGuire, Units 1 and 2, MUR by 7 months due to licensee delays in responding to a request for additional information and associated staff review of those responses.

In addition to revising the timeliness goals, the staff has continued to explore programmatic enhancements to improve the execution of power uprate reviews. One area where the staff has looked for efficiency and effectiveness is streamlining administrative requirements. Given the maturity of the power uprate program, limited staff resources and the forecast of few power uprate applications being submitted in the coming years, the staff recommends informing the Commission of the status of power uprate activities with this report on a biennial basis, vice annually. The staff will evaluate other changes to seek opportunities to enhance the program and improve upon the execution of power uprate reviews.

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.

RECOMMENDATION:

The staff recommends that the Commission approve reducing the frequency of the Power Uprate Status Report from annual to biennial.

RESOURCES:

This paper contains no new commitments and requests no additional resources.

Since March 2013, there have been a number of cancellations of power uprate projects because of commercial considerations. These cancellations equate to a 3.9 full-time equivalent reduction of expected staff work for fiscal year (FY) 2014. Since the congressional budget justification for FY 2014 has already been submitted, these fact of life changes will be reprioritized during execution of the fiscal year FY 2014 Operating Reactor business line. There were no significant changes to the FY 2015 budget, as these recently cancelled applications were not scheduled for review during FY 2015.

COORDINATION:

The Office of the General Counsel reviewed this report and has no legal objection. The Office of the Chief Financial Officer reviewed this paper for resource implications and has no objection.

/RA Michael R. Johnson for/

R. W. Borchardt
Executive Director
for Operations

Enclosure:
Power Uprate Program Status Report

COORDINATION:

The Office of the General Counsel reviewed this report and has no legal objection. The Office of the Chief Financial Officer reviewed this paper for resource implications and has no objection.

/RA Michael R. Johnson for/

R. W. Borchardt
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Enclosure:
Power Uprate Program Status Report

ADAMS Accession No.: ML13098A298 WITS 200200020 *via e-mail

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Power Uprate Program Status Report
June 2013

Power uprates are categorized based on the magnitude of the thermal power increase and the methods used to achieve the increase. Measurement uncertainty recapture (MUR) power uprates result in power-level increases of less than two 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 seven 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 thermal power increases as high as 20 percent.

Power Uprates Approved Since June 2012

Power uprates approved since June 15, 2012, have added 1,266 megawatts thermal (MWt) or approximately 422 megawatts electric (MWe) to the Nation's electric generating capacity. This brings the total number of power uprates approved since 1977 to 148, resulting in a combined increase of about 20,586 MWt (6,862 MWe) to the Nation's electric generating capacity. Table 1 provides information on the power uprates approved since June 15, 2012.

Table 1 – Power Uprates Approved Since June 15, 2012

No.	Plant	% Uprate	MWt	Application Date	Acceptance Date	Approval Date	Type
1	Grand Gulf 1	13.1	510	9/08/2010	12/09/2010	7/18/2012	EPU
2	St. Lucie 1	11.9	320	11/22/2010	3/03/2011	7/09/2012	EPU*
3	St. Lucie 2	11.9	320	2/25/2011	6/23/2011	9/24/2012	EPU*
4	McGuire 1	1.7	58	3/05/2012	4/25/2012	5/16/2013	MUR
5	McGuire 2	1.7	58	3/05/2012	4/25/2012	5/16/2013	MUR
		Total	**1,266**				

* St. Lucie 1 and 2 EPU applications included a 1.7 percent MUR.

The staff continued to encounter challenges in meeting the timeliness review goal for EPUs and MURs.[1] The staff exceeded the 12-month review goal for Grand Gulf, Unit 1, EPU by seven months because of staff concerns resulted in revisions to the licensee's steam dryer analysis. The staff identified concerns with the licensee's application of the General Electric

[1] The timeliness goals do not include the duration of the staff's acceptance review, which the staff conducts upon receipt of the initial application. The timeliness goals for applications received before June 2012, are six months for MURs, nine months for SPUs, and 12 months for EPUs. As discussed in SECY 12-0084, "Status Report on Power Uprates," the timeliness review goals for applications received after June 2012, are nine months for MURs,12 months for SPUs, and 18 months for EPUs.

Hitachi plant-based load evaluation methodology for determining the steam dryer integrity. The licensee installed instrumentation on the steam dryer and benchmarked the methodology based on plant data during power ascension testing to confirm structural integrity during operation.

The staff exceeded the 12-month review goal for the St. Lucie, Units 1 and 2, EPU reviews by three and four months, respectively, because of staff and Advisory Committee on Reactor Safeguards (ACRS) concerns related to nuclear fuel thermal conductivity degradation affecting reactor safety analysis calculations. The licensee's subsequent analysis demonstrated modest impacts to the safety analysis calculation results and showed that the results remained conservative to acceptance criteria. There were also delays with the licensee's response to requests for additional information (RAIs) associated with stress analyses for modifications to structures, systems, and components.

The staff exceeded the six-month review goal for the McGuire, Units 1 and 2, MUR by seven months because of licensee delays in responding to an RAI and the time needed for the associated staff review of the licensee's RAI responses.

Power Uprate Applications Currently under Staff Review

As illustrated in Table 2, power uprates currently under review could add an additional 3,001 MWt or approximately 1,000 MWe to the Nation's electric generating capacity, if approved.

Table 2 – Power Uprate Applications under Staff Review

No.	Plant	% Uprate	MWt	Application Date	Projected Completion Date	Type
1	Browns Ferry 2	14.3	494	6/25/2004	To be determined	EPU
2	Browns Ferry 3	14.3	494	6/25/2004		EPU
3	Browns Ferry 1	14.3	494	6/28/2004		EPU
4	Monticello	12.9	229	11/05/2008	October 2013	EPU
5	Braidwood 1	1.6	58.4	6/23/2011	To be determined	MUR
6	Braidwood 2	1.6	58.4	6/23/2011		MUR
7	Byron 1	1.6	58.4	6/23/2011		MUR
8	Byron 2	1.6	58.4	6/23/2011		MUR
9	Oconee 1	1.6	42	9/20/2011	To be determined	MUR
10	Oconee 2	1.6	42	9/20/2011		MUR
11	Oconee 3	1.6	42	9/20/2011		MUR
12	Peach Bottom	12.4	437	9/28/2012	June 2014	EPU
13	Peach Bottom	12.4	437	9/28/2012	June 2014	EPU
14	Fermi	1.6	56	2/07/2013	November 2013	MUR
	Total MWt		**3,000.6**			

Withdrawn Application

Crystal River, Unit 3, containment structure was damaged during a refueling outage in September 2009. In February 2013, the business decision was made by Duke Energy, the licensee, to retire Crystal River and withdraw the EPU application.

Delayed Reviews

The Browns Ferry, Units 1, 2, and 3, EPU review has been delayed primarily because of staff concerns and licensee delays with providing revised steam dryer analyses and analyses that take credit for containment accident pressure (CAP). Tennessee Valley Authority, the licensee, informed the staff by letter dated February 22, 2013, of its plans to complete the EPU review. In the fall of 2014, the licensee plans to provide a revised CAP analysis, engineering analysis for a replacement dryer, and revise, as necessary, all information to the NRC that has been superseded. A public meeting on these topics will be held as the submittal date nears. The staff review will resume upon receipt of the updated information.

After a long delay, the Monticello EPU review has resumed, and the staff is actively reviewing the steam dryer design, CAP analysis, and licensee gap analysis that identifies changes to information previously submitted to the NRC in the EPU license amendment request (LAR) application and supplements. The licensee discussed its gap analysis during a November 20, 2012, public meeting. In support of review completion, the ACRS sub-committee review has been scheduled for July 2013, and a full-committee review has been scheduled for September 2013.

The NRC suspended the Braidwood, Units 1 and 2, and Byron, Units 1 and 2, MUR review on December 6, 2012, because disposition of a nonconforming condition with high-energy line break (HELB) in the turbine building is required before implementation of the MUR. Through its review, the staff found that resolution of the turbine building HELB issue could require a departure from the current licensing and design-basis relied on in the application. In accordance with staff guidance from Regulatory Issue Summary 2002-03, “Guidance on the Content of Measurement Uncertainty Recapture Power Uprate Applications,” the NRC staff determined that the analysis of record for HELB does not bound the requested uprated power level. The NRC staff suspended the review of the MUR pending the completion of the required modifications and analyses associated with the HELB nonconformance. At present, the licensee is developing responses to staff questions from the December 6, 2012, letter. Following receipt of the licensee’s response, the staff plans to conduct an audit to verify the installation of the modifications and confirm that the licensing and design-basis analysis is technically sound.

The NRC suspended the Oconee, Units 1, 2, and 3, MUR review on August 31, 2012, because of licensee delays with implementation of the new protected service water (PSW) system. The NRC staff had proceeded with reviewing the MUR LAR with the understanding that the PSW system would be operational before the end of 2012. Because the PSW system is credited in the MUR LAR, the NRC staff determined that it cannot authorize the MUR power uprate amendment without the PSW system.

Expected Power Uprate Applications

Table 3 estimates future power uprate applications based on a survey of all licensees conducted in December 2012. Since the prior survey, there have been a number of cancellations of previously planned power uprate projects because of commercial considerations, including five EPU projects and five MUR projects. Six of these projects were cancelled since March 2013, equating to a reduction of 3.9 full-time equivalent work years of expected staff work for fiscal year (FY) 2014. Since the congressional budget justification for FY 2014 has already been submitted, these fact of life changes will be reprioritized during execution of the FY 2014 operating reactor business line. There were no significant changes to the FY 2015 budget, as these recently cancelled applications were not scheduled for review during FY 2015.

Table 3 - Projected Future Power Uprate Applications

Fiscal Year	Power Uprates Expected	MUR Power Uprates	SPUs	EPUs	MWt	MWe
2013	1	1	0	0	58	19
2014	0	0	0	0	0	0
2015	0	0	0	0	0	0
2016	2	1	0	1	491	164
2017	0	0	0	0	0	0
TOTAL	**3**	**2**	**0**	**1**	**549**	**183**

Accomplishments since June 15, 2012

In addition to routine power uprate licensing activities, the NRC staff has accomplished the following since June 15, 2012:

- Presented program activities at the Nuclear Energy Institute (NEI) Licensing Forum and at the third Annual Nuclear Power Uprate Industry Conference.

- Participated in discussions of program activities with the Licensing Action Task Force (LATF), and discussed the LaSalle EPU NEI pre-licensing checklist pilot with the LATF.

- Provided international support to Swedish Radiation Safety Authority interviews on regulatory approaches.

- Region III staff conducted a self-assessment of regional implementation of NRC Inspection Procedure 71004, "Power Uprate."

- Conducted pre-application public meeting on proposed LaSalle EPU to discuss licensee plans to defer implementation of the power uprate until 2019. Subsequently, the licensee cancelled the project in June 2013 due to commercial considerations.

Status of Technical Challenges

Depending upon the plant design, power uprate applications must address technical issues related to CAP credit and adverse flow effects on structures, systems, and components. This year, the NRC staff encountered two instances when deficiencies with the plant licensing and design basis necessitated that the reviews be suspended to allow for resolution. The progress made by staff and stakeholders to resolve these issues is discussed below.

Update on Containment Accident Pressure Credit

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

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

In response to SRM-M100609B, the staff provided Commission paper SECY-11-0014, "Use of Containment Accident Pressure in Analyzing Emergency Core Cooling System and Containment Heat Removal System Pump Performance in Postulated Accidents," on January 31, 2011. The staff provided two options to resolve the policy issues. In response, SRM-SECY-11-0014, dated March 15, 2011, the Commission approved the staff's recommended Option 1 and directed the staff to conduct CAP reviews consistent with the current practice of accepting CAP credit while also implementing new staff deterministic guidance. The staff guidance was developed based on ACRS recommendations to quantify uncertainty and margins in net positive suction head calculations. The Commission also directed the staff to ensure that the defense-in-depth philosophy is interpreted and implemented consistent with 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 staff

guidance. The staff is therefore proceeding with Option 1 and has resumed the CAP portion of the delayed EPU reviews. In letters dated April 5, 2011, (Monticello) and May 15, 2011, (Browns Ferry) licensees were informed that the staff was prepared to resume the reviews of their EPU applications.

By letters dated September 28, 2012, and November 30, 2012, the licensee for Monticello supplemented the EPU application to include an assessment of the Monticello ECCS and CHR pumps' ability to meet the uncertainties and margins described in Enclosure 1 of SECY 11-0014, using the uncertainties in Boiling Water Reactor Owners Group (BWROG) reports. The staff's review of these supplements is nearing completion.

Over the past year, the staff has progressed with its review of the BWROG Licensing Topical Report submitted by letter dated February 15, 2008. By letter dated October 24, 2012, the BWROG submitted six technical reports to address several topics for the use of CAP contained in Enclosure 1 of SECY-11-0014. Most significantly, these technical reports addressed the net positive suction head (NPSH) uncertainty analysis of Sulzer CVDS model single-stage, double-suction, centrifugal pumps used in BWR ECCS and CHR systems. Furthermore, the BWROG has informed the staff that additional technical reports are forthcoming in support of the Topical Report review.

The staff continues to develop a deterministic guidance document for CAP credit. Draft guidance was sent to the BWROG and Pressurized Water Reactor Owners Group by letters dated February 25, 2013. Revisions to the guidance clarified analyses required to be performed to support power uprate and other license amendment applications to demonstrate adequate NPSH for the ECCS and CHR pumps. The staff plans to finalize the guidance following the ACRS review of the Monticello EPU application.

Update on Adverse Flow Effects

Steam flow velocities at nuclear power plants increase under power uprate conditions. Operating experience has shown that as the higher velocity main steam line flow passes over branch lines, it can create an acoustic resonance in the steam lines that can vary greatly from one plant to another, depending on the routing of the main steam lines and the steam dryer vintage and geometry. The acoustic resonance can create fluctuating pressure waves that strike the steam dryer in BWRs with significant cyclic force. This cyclic loading could cause the stresses in the steam dryer to exceed the material fatigue limits, which may result in steam dryer cracking and subsequent generation of loose parts. These loose parts have the potential for affecting safety-related structures, systems, and components downstream of the steam dryer. 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 EPUs have provided complex steam dryer analyses to demonstrate the structural integrity of the steam dryers at uprated power levels.

These plant-specific reviews have remained challenging and contributed to the delays in the EPU reviews for several BWR plants (e.g., Grand Gulf and Monticello). The delays are typically caused by licensees introducing new refinements into analytical methods and the introduction of new steam dryer designs not used in previous EPU applications (e.g., Monticello and Peach Bottom Westinghouse steam dryer design). Delays also stem from the NRC staff identifying

new issues with licensees' analytical models, licensees needing to make steam dryer modifications to address analysis issues, and a lack of adequate plant measurement data needed for the steam dryer analyses.

One industry topical report is under NRC staff review. In December 2008, Electric Power Research Institute (EPRI) submitted Boiling Water Reactor Vessel and Internals Project (BWRVIP)-194, "Methodologies for Demonstrating Steam Dryer Integrity for Power Uprate," which presents an integrated evaluation approach and acceptance criteria for steam dryers. By letter dated September 8, 2011, EPRI provided supplemental information for BWRVIP-194. On March 27, 2013, the NRC staff informed EPRI that a detailed technical review of BWRVIP-194 had been delayed due to the priority of active EPU LAR reviews. The staff plans to issue RAIs associated with its review of BWRVIP-194 this summer. EPU reviews have not been delayed due to a lack of topical report as a thorough review of generic applicability of the methodology is required prior to approval.

Resolution of Issues with the Licensing and Design Bases

This year two power uprate reviews were suspended because of deficiencies identified with the uprate applications. Typically, licensee's through their corrective action programs address deviations and nonconformances with most licensing bases issues. Provided the licensee is able to promptly correct the problem and restore compliance, nonconformance or temporary deviations from the licensing bases will not impact the licensing review.

The staff suspended the Braidwood, Byron, and Oconee MUR reviews because licensees failed to resolve known plant configuration issues that impacted the submittal. The Braidwood and Byron MUR was suspended because disposition of a nonconforming condition with HELB in the turbine building is required before implementation of the MUR. The Oconee MUR was suspended because of licensee delays with implementation of the PSW system. The PSW system is credited in the MUR application, and the staff had accepted the application and proceeded with the review with the understanding that the PSW system would be operational before the end of 2012. Additional details are discussed above in the delayed reviews section.

For these cases, the staff determined that a safety evaluation could not find that the proposed licensing amendment was adequate without reviewing the modified analysis and design. In last year's power uprate status report, a similar issue occurred when the St. Lucie EPU submittal was withdrawn during the staff acceptance review to allow the licensee time to evaluate concerns with the station blackout coping analysis identified during a 2007 Component Design Bases Inspection.

<u>Status of Programmatic Changes</u>

In addition to the progress the staff made on technical issues, programmatic changes are continuing. Work is planned to revise NRR Office Instruction LIC-112, "Power Uprate Process," explore use of interim staff guidance, and identify program activities that can be reduced in scope to better focus resources.

Resources and Schedules

There have been no significant changes in power uprate application review resources or review schedule requirements since June 15, 2012. Staff resource estimates for MUR, SPU, and EPU applications remain at 1,200, 3,500, and 7,500 hours, respectively. The timeliness goals for MUR, SPU, and EPU application reviews received after June 2012, remain at 9, 12, and 18 months, respectively, and continue to be appropriate.

Power uprate reviews are resource intensive for technical disciplines in NRR. The overlap of current power uprate applications with the Fukushima lessons-learned activities has impacted some groups of technical experts. Currently, the staff is reviewing three plant-specific EPU applications in conjunction with conducting activities associated with Fukushima Tier 1 Near-Term Task Force recommendations. This has resulted in some resource constraints associated with aligning and dedicating staff to meet power uprate schedules. Thus far, the staff has largely overcome these challenges by prioritizing power uprate reviews to support licensees' implementation schedules.

Power uprate application reviews remain a high priority. The staff will maintain its strong safety focus and commitment to higher priorities associated with safe plant operation, most notably, Fukushima lessons-learned activities and emergent safety issues.

Areas of Program Development

The staff plans to revise NRR Office Instruction LIC-112, "Power Uprate Process," to clarify project management responsibilities, reflect organization changes, explore use of interim staff guidance, and enhance knowledge management.

The staff plans to establish a framework to document incremental changes to Review Standard (RS)-001, "Review Standard for Extended Power Uprates," through interim staff guidance documents. Previously, the staff refrained from committing to a complete revision to RS-001, because of resource considerations and a perception that the cumulative change would not add significant value to stakeholders. Staff precedence for power uprate reviews has been captured in power uprate review RAIs and reliance on revisions to NUREG-0800, "Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants." Interim staff guidance will support knowledge management and provides thorough management review, opportunity for stakeholder input, and development of concise regulatory positions to support licensee uprate power application development.

Areas of Planned Reduction

Consistent with overall agency goals of promoting cost-effective program management, NRR recently reviewed aspects of the power uprate program that can be reduced with minimal impact to stakeholders. Therefore, the staff plans to reduce the frequency of several work products. Specifically, the staff (1) recommends that the Commission approve reducing the frequency of this Status Report on Power Uprates to a biennial basis, (2) will no longer update listings of RAIs for completed reviews on the public Web site, (3) will reduce to biennial a solicitation by memorandum for internal NRC stakeholder input on the program, and (4) will reduce to annual a

survey of power reactor licensees on their plans for power uprate license amendment applications.

The staff believes these reductions are appropriate considering the maturity of the power uprate program, limited resources, and the results of the latest licensee survey indicating that few power uprate applications are anticipated in the coming years. These reductions are not anticipated to diminish the effectiveness of the program. The staff's ongoing technical work and planned program enhancements are targeted to improve the overall stability, consistency, and predictability of power uprate reviews.

The staff will continue to evaluate the appropriateness of power uprate performance goals and explore enhancements to the power uprate program through interactions with internal and external stakeholders.