

May 10, 2002

The Honorable Richard A. Meserve
Chairman
U.S. Nuclear Regulatory Commission
Washington, DC 20555-0001

Dear Chairman Meserve:

SUBJECT: CORE POWER UPRATE FOR THE BRUNSWICK STEAM ELECTRIC PLANT,
UNITS 1 AND 2

During the 492nd meeting of the Advisory Committee on Reactor Safeguards, May 2-3, 2002, we completed our review of the Carolina Power and Light Company (CP&L) license amendment request for an increase in core thermal power for the Brunswick Steam Electric Plant (BSEP), Units 1 and 2. Our Subcommittee on Thermal-Hydraulic Phenomena also reviewed this matter during a meeting held on April 23, 2002. During our review, we had discussions with representatives of the applicant and the NRC staff. We also had the benefit of the documents referenced.

Recommendation

The CP&L application for an increase in core thermal power from 2558 MWt to 2923 MWt (14.3%) for the Brunswick Steam Electric Plant, Units 1 and 2, should be approved.

Discussion

The BSEP reactors are BWR/4 Mark 1 units, originally licensed to a power level of 2436 MWt. A 5% power uprate to 2558 MWt was approved by the NRC in 1996.

The requested power uprate is similar to those already approved for the Duane Arnold Energy Center, Dresden Nuclear Power Station, and Quad Cities Nuclear Power Station. The CP&L application follows the General Electric (GE) Nuclear Energy and NRC-approved ELTR1 and ELTR2 extended power uprate (EPU) licensing topical report framework, with a few exceptions that are consistent with those previously granted to other applicants and described in GE topical report NEDC-33004P, "Constant Pressure Power Uprate" (CPPU). In our letter of April 17, 2002, we recommended approval of the CPPU topical report for application to BWR power increases of up to 20% of the original licensed thermal power.

CP&L has committed to modify the standby liquid control system (SLCS) in which the boron solution is sufficiently enriched with Boron-10. This modification will allow the shutdown

capability to be met in the event of an anticipated transient without scram (ATWS) with the use of only one of the two available SLCS pumps. The licensee calculates that this modification will reduce the plant's internal events core damage frequency (CDF) and large early release frequency (LERF) by 9% and 28%, respectively. Without the use of enriched boron, the ATWS risk increases slightly due to shortened times for operator decisions. Because of the significant safety benefit that is obtained by offsetting the most significant risk increase associated with EPU, we agree that this modification to the SLCS should be implemented.

The staff has determined that the application meets all of the requirements of the regulations, uses approved codes, and follows the required procedures. As in the case of previous staff evaluations of EPUs, these determinations could have benefitted by including the results of independent computations and detailed checks of calculations to support the staff's review and audits of the procedures and conclusions described by the applicant.

We encourage the staff to continue to pay close attention to the details of core reload analyses at Brunswick and other BWR EPU plants. This is particularly important with regard to the ways that core thermal success criteria will continue to be met as more sophisticated fuel design and reload management techniques are implemented. The staff should assess the need for more detailed thermal-hydraulic models of the core, replacing the current "averaging" approaches, to complement present neutronic analyses that model the wide variations in fuel composition and power level throughout the core.

This review demonstrates an inherent problem in the "two-tier" regulatory system. The application for the EPU was not risk-informed, yet a PRA was submitted. This creates a situation in which the PRA is not seriously reviewed, although it is part of the record. Also, the uncertainties in human reliability analysis are significant, but there is no mention of them. The applicant used human reliability models that have not been reviewed by the staff. The staff acknowledges that large uncertainties are present and that the models have not been reviewed. However, the staff concludes that insights regarding the relative importance of operator actions can be gained. In addition, the potential increases in the change in core damage frequency (Δ CDF), that could arise if the PRA were capable of modeling the effect of margin reductions on risk, are not included.

One can claim that the actual value of Δ CDF is not very relevant because the basis for the decision is not risk-informed. Yet, by not raising concerns about the quality of these numbers, the staff implies some degree of acceptance. Maintaining public confidence is a goal of the Commission, which is not served by tacit acceptance of unreviewed models.

PRA quality is essential for risk-informing the regulations. Improvements in PRA quality, such as inclusion of the effects of margin reductions on risk and improving human reliability models, may be discouraged as long as important decisions such as granting power uprates are made by "accepting" PRAs without criticism because the application is not risk-informed.

Drs. F. Peter Ford and Victor H. Ransom did not participate in the Committee's deliberations regarding this matter.

Additional comments by ACRS Member Thomas S. Kress and ACRS Member George E. Apostolakis are presented below.

Sincerely,

/RA/

George E. Apostolakis
Chairman

Additional Comments by ACRS Member Thomas S. Kress

I agree with the Committee's position on the way the PRA results are used in evaluating non-risk-informed submittals for changes to the licensing basis. I have an additional related concern that the concepts in Regulatory Guide 1.174 are not being properly implemented in the guidance on how to view these submittals in a risk-informed manner.

For example, the Brunswick PRA submittal reports a LERF value of $4.27 \times 10^{-6}/\text{yr}$ and a ΔLERF of about $2 \times 10^{-7}/\text{yr}$ as a result of the power uprate, not including the SLCS modifications. The claim is that these values place this change to the licensing basis into Region II of the Regulatory Guide 1.174 acceptance guideline, which would permit this proposed power uprate.

There are a number of things wrong with this view of Regulatory Guide 1.174.

1. The PRA did not include fire, seismic, or shutdown conditions. If included, these are likely to increase the assessed LERF value by a factor of 2.
2. There are two units on the site. As LERF is a site criterion that is a surrogate for the Commission's prompt fatality safety goal, then the LERF value for each unit must be added together to constitute the appropriate Regulatory Guide 1.174 site LERF. This increases the LERF by a factor of 2.
3. The LERF value submitted was a "point estimate" It can be guessed that the actual mean can be at least a factor of 2 greater than this.
4. The site LERF acceptance value is supposed to be a surrogate for the Commission's prompt fatality safety goal. The power uprate, to a first approximation, will increase the fission product inventory by 15% and, if the dose/consequence model were linear, this would increase the prompt fatalities by 15%. To account for this, the calculated LERF for comparison with the acceptance criteria in Regulatory Guide 1.174 should be increased by 15%.

If these missing conditions were included, the most appropriate site LERF at Brunswick should be about:

$$(2)(4.27 \times 10^{-6}) (3) (1.15) = 3.0 \times 10^{-5}/\text{yr}$$

The assessed Δ LERF of $2 \times 10^{-7}/\text{yr}$ must also be doubled because there are two units on the site; therefore, site Δ LERF = $4.0 \times 10^{-7}/\text{yr}$.

These two values (LERF = $3.0 \times 10^{-5}/\text{yr}$ and Δ LERF = $4.0 \times 10^{-7}/\text{yr}$) place Brunswick squarely into Region I of the Regulatory Guide 1.174 acceptance guidelines, which is supposed to put into question the presumption that adequate protection is preserved.

It can be claimed that the modification to SLCS in combination with the power uprate actually results in a decrease in risk and therefore ought to be automatically acceptable. We must be careful with this approach to dealing with aggregate changes. Clearly, the modifications to SLCS that result in a risk decrease are acceptable. However, this change at Brunswick does not by itself decrease the LERF enough to take Brunswick out of the Region I. Therefore, even with this modification, the plant is still in the Region for which increase in risk (due to the power uprates) should not be allowed without additional justification.

While I am convinced that a proper Level 3 risk analysis for the Brunswick site would justify approving the power uprate request, I am disturbed by the staff's cavalier use of the risk-informed decisionmaking process.

Additional Comments by ACRS Member George E. Apostolakis

Dr. Kress' comments are an excellent example of what happens when the staff does not subject the submitted risk information to serious review because the application is not risk-informed. They also demonstrate how conclusions can be affected when the PRA is incomplete and/or poorly done.

References:

1. Memorandum dated March 29, 2002, from John A. Zwolinski, Office of Nuclear Reactor Regulation, NRC, to John T. Larkins, ACRS, Subject: Brunswick Steam Electric Plant, Units 1 and 2 - Draft Safety Evaluation for Proposed Extended Power Uprate License Amendment (Predecisional).
2. Memorandum dated August 9, 2001, from John S. Keenan, CP&L, to U.S. NRC, Subject: Brunswick Steam Electric Plant, Units Nos. 1 and 2, Request for License Amendments Extended Power Uprate (Proprietary).
3. CP&L Memorandums dated March 22, March 20, March 14 (proprietary), March 12 (proprietary), March 7, March 5, March 4 (proprietary), February 25 (3), February 21 (2), February 14, February 13, February 4, February 1, and January 24 (proprietary), 2002, December 20, December 17 (2), December 4, December 1, November 30, November 28 (proprietary), November 7, November 1, and October 17, 2001, regarding Brunswick Steam Electric Plant, Unit Nos. 1 and 2, Extended Power Uprate, responses to request for additional information from NRC.
4. Letter dated May 1, 2002, from Edward T. O'Neil, CP&L, to George E. Apostolakis, ACRS, Subject: Brunswick Steam Electric Plant, Unit Nos. 1 and 2, Response to Request for Information - Extended Power Uprate (Proprietary).
5. GE Nuclear Energy, Topical Report, NEDC-32424P-A, "Generic Guidelines for General Electric Boiling Water Reactor Extended Power Uprate" (ELTR-1), February 1999 (Proprietary).

5. GE Nuclear Energy, Topical Report, NEDC-32523P-A, "Generic Evaluations of General Electric Boiling Water Reactor Extended Power Uprate" (ELTR-2), February 2000 (Proprietary).
6. GE Nuclear Energy, Topical Report, NEDC-32523P-A, Supp 1, Volume 1, "Generic Evaluations of General Electric Boiling Water Reactor Extended Power Uprate - Supplement 1, Volume I," February 1999, and Volume II, April 1999 (ELTR-2) (Proprietary).
7. GE Nuclear Energy Topical Report, NEDC-33004P, Revision 1, "Constant Pressure Power Uprate," July 26, 2001 (Proprietary)