

October 17, 2001

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

SUBJECT: DUANE ARNOLD ENERGY CENTER EXTENDED POWER UPRATE

Dear Chairman Meserve:

During the 486<sup>th</sup> meeting of the Advisory Committee on Reactor Safeguards, October 4-6, 2001, we met with representatives of the NRC staff and the Nuclear Management Company to review the license amendment request for an increase in core thermal power for the Duane Arnold Energy Center (DAEC), pursuant to the General Electric Nuclear Energy Extended Power Uprate Program. Our subcommittee on Thermal-Hydraulic Phenomena also reviewed this matter during meetings held on June 12 and September 26-27, 2001. During our review, we had the benefit of the documents referenced.

### **CONCLUSIONS AND RECOMMENDATIONS**

1. The DAEC application for the extended power uprate should be approved.
2. The Safety Evaluation Report (SER) should be revised to document adequately the technical resolution of the issues raised by the staff.
3. The staff should develop improved guidance on the detail to be provided in SERs and criteria for when independent assessments should be performed to complement its reviews of applicant submittals.

### **DISCUSSION**

The Nuclear Management Company has requested an amendment to the DAEC operating license for a 15.3% increase over the plant's current operating power limit. Previously, the staff had approved a smaller power uprate. Consequently, the current application is for a power uprate of 20% over the originally licensed power. This is the largest power uprate ever considered for boiling water reactors (BWRs) in the United States. It is anticipated that many other licensees will request similarly large increases in the operating powers of BWRs. Consequently, we anticipate that staff review of the DAEC power uprate will be a template for future reviews and will set the expectations for many future power uprate applications.

A generic methodology for evaluating and justifying power uprates of up to 20% for BWRs has been developed by General Electric. This generic methodology has been approved by the staff. The DAEC application has adopted this methodology and, in fact, the NRC staff has used the methodology to guide its review of this power uprate application.

The power increase at DAEC will be achieved by increasing steam production, while holding liquid flow in the core, dome pressure and temperatures quite near current values. The increased steam production is achieved by “flattening” the core power profile, which involves increasing power generation in the outer regions of the core. There is an increase in feedwater flow to match the increased production of steam. Balance-of-plant modifications are required and will cause the DAEC power increase to be performed in two steps.

Many technical issues must be addressed in an application for power uprate. Of these, we consider five to be especially significant:

1. Susceptibility of the plant to ATWS (Anticipated Transients Without Scram)
2. ATWS recovery
3. Reduction in some of the times available for operator actions because of higher decay heat
4. Material degradation due to irradiation-assisted stress corrosion cracking (IASCC) of reactor internals and flow-assisted corrosion and fatigue of feedwater piping
5. Containment response to accident events involving higher decay heat levels

Our examinations of the staff’s SER and Requests for Additional Information submitted by the staff to the applicant persuaded us that the staff had raised numerous, pertinent issues concerning the conformance of the power uprate to approved methodologies. Though we persuaded ourselves eventually that the DAEC power uprate could be accomplished safely, we found it difficult to obtain information on the technical resolution of the issues either in the staff’s SER or in our meetings with the staff. An exception to this common difficulty was the resolution of issues concerning containment response to design-basis accident events. In this case, the staff provided us a report on comparisons of applicant analyses with analyses done using an independent computational tool.

We found it far more difficult to assure ourselves that the DAEC core is susceptible only to global power oscillations and does not need to consider local power oscillations. It was similarly difficult to assure that ATWS recovery methods were applicable to cores with flattened power profiles, that critical human actions had been identified with adequate independence by the staff, and that material degradation sensitivities had been adequately assessed.

Many of the challenges that we encountered in our review of the DAEC power uprate application could have been eased if the staff had improved guidance on the detail to be provided in SERs and developed criteria for when independent assessments should complement reviews of applicant submittals.

ACRS Members Mario Bonaca and F. Peter Ford did not participate in the Committee's review of this matter.

Sincerely,

/RA/

George E. Apostolakis  
Chairman

References:

1. Memorandum dated September 5, 2001, to John T. Larkins, ACRS, from J. Zwolinski, Office of Nuclear Reactor Regulation, NRC, Subject: Draft Safety Evaluation for Duane Arnold Energy Center Extended Power Uprate (draft Predecisional report).
2. GE Nuclear Energy, Topical Report, NEDC-32424P-A, "Generic Guidelines for General Electric Boiling Water Reactor Extended Power Uprate," February 1999 (Proprietary).
3. GE Nuclear Energy, Topical Report, NEDC-32523P-A, "Generic Evaluations of General Electric Boiling Water Reactor Extended Power Uprate," February 2000 (Proprietary)
4. 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 (Proprietary).
5. GE Nuclear Energy, Topical Report, NEDC-32992P, "ODYSY Application for Stability Licensing Calculations," October 2000 (Proprietary).
6. BWR Owners' Group Letter dated March 8, 1996, transmitting GE Nuclear Energy Licensing Topical Report, BWR Owners Group Long-Term Stability Solutions Licensing Methodology, NEDO-31960-A, November 1995.
7. Report (draft final) from A. Cronenberg, ACRS, "Margin Reduction Estimates for Re-Licensed/Uprated Plants: Hatch Case Study," August 2001.
8. Response by Nuclear Management Company to ACRS Thermal-Hydraulic Phenomena Subcommittee question, undated, attached to October 3, 2001 Memorandum from P. Boehnert to ACRS Members.
9. U.S. Nuclear Regulatory Commission, Technical Evaluation Report, ISL-NSAD-NRC-01-001, "Duane Arnold Energy Center Extended Power Uprate Containment Analysis Audit Calculation," B. Gitnick, Information Systems Laboratory, Inc., July 2001.
10. Memorandum (undated) from J. Zwolinski, Office of Nuclear Reactor Regulation, NRC, Subject: Responses to Advisory Committee on Reactor Safeguards (ACRS) Subcommittee Questions Regarding Duane Arnold Energy Center Extended Power Uprate, attached to October 3, 2001, Memorandum from P. Boehnert, to ACRS Members (contains Proprietary information).
11. GE Nuclear Energy Licensing Topical Report, NEDC-32980P, Rev. 1, "Safety Analysis Report for Duane Arnold Energy Center Extended Power Uprate," April 2001 (Proprietary).
12. Nuclear Management Company Memorandums: Response to Request for Additional Information - Duane Arnold Energy Center Extended Power Uprate, dated April 9, March 23, April 16, April 16 (Proprietary), May 8 (Proprietary), May 10, May 11, May 11 (Proprietary), May 22, May 29 (Proprietary), and June 5, 2001.
13. Nuclear Management Company Memorandums: Response to Request for Additional Information - Extended Power Uprate, June 11, June 18, June 21, June 28, July 11, July 19, July 25, August 1 (proprietary), August 1(proprietary), August 10 (proprietary), August 16 (proprietary), and August 21, 2001.