UNITED STATES
NUCLEAR REGULATORY COMMISSION
ADVISORY COMMITTEE ON REACTOR SAFEGUARDS
WASHINGTON, DC 20555 - 0001

ACRSR-2196

May 22, 2006

The Honorable Nils J. Diaz
Chairman
U.S. Nuclear Regulatory Commission
Washington, DC 20555-0001

SUBJECT: R.E. GINNA EXTENDED POWER UPRATE APPLICATION

Dear Chairman Diaz:

During the 532nd meeting of the Advisory Committee on Reactor Safeguards, May 4-5, 2006, we reviewed the Extended Power Uprate (EPU) application for the R.E. Ginna Nuclear Power Plant (Ginna) and the associated NRC staff's Safety Evaluation. Our Subcommittee on Power Uprates also reviewed this matter on March 14-15, 2006 and April 27, 2006. During these reviews, we had the benefit of discussions with the staff and representatives of Constellation Energy, the licensee. We also had the benefit of the documents referenced.

RECOMMENDATION

The application for a power uprate at the R.E. Ginna Nuclear Power Plant should be approved.

BACKGROUND

Ginna is a two-loop, Westinghouse-designed pressurized water reactor operating at a power level of 1520 MWt. Constellation Energy has applied for a power uprate of 17 percent to 1775 MWt. Kewaunee, a plant of similar design, is licensed to operate at a comparable level of 1772 MWt. The steam generators in Ginna were replaced in 1996, and the reactor vessel head was replaced in 2003.

A number of design changes are being made to support the power uprate. The current fuel design is being replaced by the Westinghouse 422V+ design. The newer design has a slightly longer fuel stack and a larger diameter fuel pin. These changes help preserve operating margins in the plant after the power uprate. The new fuel design also has improved resistance to vibration. This fuel will be introduced over the next three cycles. Other important changes to support the power uprate include replacement of the high-pressure turbine and turbine control valves.

<u>**Safety Analysis Results**</u>

At the uprated power, the nominal outlet temperature will increase from 590 ^{o}F to 607 ^{o}F. The primary coolant flow rate will be essentially unchanged. The secondary side flow rate will be increased by 18%, approximately equal to the percentage uprate in power. The increased primary system temperature could increase the rates of corrosion of components. The increased secondary side flow rate could lead to accelerated corrosion and fluid/structure interactions.

A number of transients have been analyzed at the uprated power to determine if they satisfy safety criteria for departure from nucleate boiling, overpressurization of the primary system, overpressurization of the secondary system, or conditions that could result in a more severe event, such as over-filling of the pressurizer. Constellation Energy provided information on the degree of conservatism in the analyses and on the validation of the analytical tools used. We concur with the staff's acceptance of these results.

A full spectrum of loss-of-coolant accident (LOCA) events has been analyzed at the uprated power. The results of these analyses show substantial margin to the established regulatory limits on peak clad temperature, oxidation, and hydrogen generation. The emergency core cooling system configuration at Ginna is somewhat different from later plant designs. The high-capacity, low-pressure system injects through two lines directly into the upper plenum. The high-pressure system also has high capacity and the accumulators inject at a relatively high pressure of 700 psia. This configuration of systems is quite effective in providing cooling over the entire spectrum of breaks.

At the time at which recirculation is initiated in a large LOCA, the sump temperature is too high to meet the net positive suction head limits for the high-pressure injection system. Thus, when recirculation is initiated, the low-pressure upper plenum injection system is switched from the injection mode to the recirculation mode but the high-pressure injection system is turned off. For a hot-leg break, there is some concern that, with injection occurring only on the hot side of the core, emergency core cooling water could escape out the break without effectively mixing in the core. Boric acid could concentrate within the vessel and potentially deposit within the core region. The licensee has performed analyses to determine when cold-leg injection should be reinitiated to flush the system and ensure that the concentration of boric acid does not approach saturation. The emergency operating procedures have been modified accordingly.

System Impacts

An assessment of the effect of the increased power output of the plant on grid stability indicates that the grid can withstand a trip of the unit from the EPU condition. The plant's ability to cope with a four-hour station blackout is virtually unaffected because the DC system loads are not significantly increased by the power uprate and substantial margin previously existed.

The CHECWORKS code was used to assess the impact of increased secondary side flow on flow accelerated corrosion. No components need to be replaced. Some inspection sampling rates will be increased based on this assessment. The plant's monitoring program is adequate to ensure the control of increased corrosion rates should they occur.

The potential for flow-induced vibration associated with higher secondary side flow rates has been assessed for the steam generators, feedwater heaters, condenser tubes, and moisture separator reheaters. Within the vibration monitoring program, a baseline will be established by a walkdown prior to EPU. After EPU plant modifications have been made, walkdowns will be performed at the initial power level and at the uprated power level.

Because the temperatures in the primary system will be somewhat higher after EPU, we requested that the licensee identify those components that contain Alloy 600 and its associated weld materials (Alloy 82/182) for which increased stress corrosion cracking might be expected. The licensee explained that these components are all located in regions of the primary system that will not experience high temperatures or are not load bearing.

Risk Assessment

The licensee performed a quantitative assessment of the change in risk associated with EPU for internal events, external events, and shutdown risk. This assessment was confined to changes in core damage frequency (CDF) and large early release frequency (LERF) and did not consider the impact of the increase in the radioactive inventory on risk. Changes were considered in initiating event frequencies, success criteria, equipment failure times, and operator response times. Some changes were required in success criteria. Significant reductions were identified in the time available for some key operator actions. In all cases, table top and simulator analyses indicated that the available time was sufficient for these actions. However, the human failure probabilities were increased.

The largest impacts on CDF and LERF were obtained for the internal events and shutdown risks, where the estimated increases were on the order of 20%. The post-uprate value for overall CDF is $7x10^{-5}$ per yr and for LERF is $5x10^{-6}$ per yr, which represents approximately a 10% increase in each. Although these changes fall within values that are typically considered acceptable, the licensee undertook an evaluation of plant changes that could be made at the time of the power uprate that would result in an overall decrease in CDF. The licensee has committed to undertaking a set of modifications that will have a net impact on CDF and LERF such that after the EPU, the CDF and LERF will be slightly less than the pre-EPU values.

Power Ascension and Testing

The power escalation test plan extends over an eleven day period. During the first day, a number of low-power tests will be performed including a manual turbine trip from 30% power. In the second day, the power level will be raised from 30% to the old full power, which is 85% of the uprated power. The remaining increases will be made in five steps of 3%. Each increase will be followed by one day of testing before proceeding to the next step. There are no large integral tests planned at full power. By design, a turbine trip at full power would lead to a reactor trip. The planned turbine trip from 30% power is more challenging than a full power trip would be to the systems that control rod position, steam dump, and pressurizer level.

Summary

Although the proposed power uprate at Ginna represents a significant change in operating conditions, similar pressurized water reactors are operating at comparable conditions. While the uprate will lead to a decrease in margins, the remaining safety margins are sufficient to ensure that safety limits will not be challenged by anticipated operating occurrences. The plant also satisfies regulatory criteria for loss of coolant accidents with substantial margin. The power uprate application should be approved.

Sincerely,

/RA/

Graham B. Wallis
Chairman

ADDITIONAL COMMENTS BY ACRS MEMBER G.E. APOSTOLAKIS

I agree with the recommendations of the report. I am writing these comments to bring to the Commission's attention a general issue related to human reliability analysis (HRA).

The major impact of extended power uprates (EPUs) is on human performance. The higher power shortens the time available to the operators for action. This necessitates an estimation of the change in human error probabilities from the base case.

The licensees usually use the EPRI "calculator" to estimate these changes. We were told by EPRI and industry representatives at a Subcommittee meeting in December 2005 that the calculator itself is simply a computer program that facilitates the use of four HRA models. To my knowledge, the calculator and its models have not been reviewed by the NRC staff.

As an example, the Ginna EPU application states (Table 2.13-13) that, for the event FSHFDAWXX-2 (operator fails to manually align and start the turbine-driven auxiliary feedwater pump under certain conditions), the time for action is reduced from 47 minutes to 34. Table 2.13-14 lists a base value of the human error probability of 8.60×10^{-2} and an EPU value of 2.25×10^{-1}.

This change indicates that the EPRI model is remarkably accurate with respect to changes in the available time. Both of the NRC HRA models (ATHEANA and SPAR-H) treat the available time as one of many "performance shaping factors," i.e., factors that affect the judgements of experts when they evaluate human error probabilities.

The same issue arose when we reviewed Regulatory Guide 1.205, "Risk-Informed, Performance-Based Fire Protection for Existing Light-Water Nuclear Power Plants." The industry guidance document (NEI 04-02, Revision 1) recognized explicitly that, under fire conditions, it would be important to estimate the amount of time available to the licensee to actually complete a recovery action.

At this time, the agency does not have a tool to estimate human error probabilities as a function of available time for action. In addition, I don't believe that the staff should be accepting the results of the EPRI calculator without a review of its models.

My comments do not affect the recommendation to approve the Ginna EPU request. I agree with the staff's finding that "the licensee's HRA and its associated results are reasonable for this application."

ADDITIONAL COMMENTS BY ACRS MEMBERS T. KRESS, D. POWERS, AND G. E. APOSTOLAKIS

The assessed risk impacts of significant power uprate requests have been universally limited to ΔCDF and ΔLERF. The assessed changes to these metrics do not reflect the increase in fission-product inventory and invariably, turn out to be small. It is clear, however, that the real societal risk impact [total probabilistic deaths, injuries, and land contamination] due to the increased fission product inventory are at least as large as the total increase in site power.

With respect to applications for significant power uprates, PRA level-3 impacts are neither assessed nor reported. In addition, there are no criteria to judge the acceptability of such risk increases. These are regulatory shortcomings that need attention. Guidance on how to judge the acceptability of increases in societal risk is needed to be incorporated into the review standard. In a risk-informed regulatory system, a level-3 assessment should be part of the staff's review of the acceptability of any power uprate application.

References:
1. Memorandum from Catherine Haney to John Larkins, "R.E. Ginna Nuclear Power Plant - Draft Safety Evaluation for Proposed Extended Power Uprate (TAC No. MC7382)," dated March 6, 2006.
2. Memorandum from Catherine Haney to John Larkins, "R.E. Ginna Nuclear Power Plant - Draft Safety Evaluation for Proposed Extended Power Uprate (TAC No. MC7382)," dated April 6, 2006.
3. Letter from Mary G. Korsnick (Constellation Energy) to U.S. Nuclear Regulatory Commission, "License Amendment Request Regarding Extended Power Uprate," dated July 7, 2005.

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* See previous concurrence.
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