July 18, 2007

Mr. Gordon Bischoff, Manager
Owners Group Program Management Office
Westinghouse Electric Company
P.O. Box 355
Pittsburgh, PA 15230-0355

SUBJECT: POTENTIAL ADVERSE FLOW EFFECTS IN NUCLEAR POWER PLANTS

Dear Mr. Bischoff:

Between 2002 and 2006, the Quad Cities Nuclear Power Station, Units 1 and 2 (Quad Cities), boiling water reactor (BWR) nuclear power plants experienced severe degradation of the steam dryers and main steam line relief valves during extended power uprate operation. To resolve this problem at Quad Cities, main steam system modifications were necessary to reduce the pressure loading on the steam dryer and vibrations in main steam line piping and components. Further, Palo Verde Nuclear Generating Station, Unit 1, pressurized water reactor (PWR) nuclear power plant experienced damage from adverse flow effects in a shutdown cooling line resulting from acoustic resonance with subsequent plant modifications performed to address the problem. As a result of these operating experience issues, the nuclear industry and U.S. Nuclear Regulatory Commission (NRC) staff are evaluating potential adverse flow effects from hydrodynamic loads and acoustic resonance in nuclear power plants in much more detail than in the past.

The acoustic resonance phenomenon that causes adverse flow effects in nuclear power plants is highly complex and requires extensive analyses to evaluate its potential impact on nuclear power plant structures, systems, and components over a wide frequency range. Further, scale model testing (SMT) and analytical tools have not matured sufficiently to allow minimal error and uncertainty values to be used in their application. This has resulted in the need to have significant margin available in stress analyses performed on nuclear power plant components (primarily BWR steam dryers) to account for errors and uncertainties. Consequently, applicants for power uprates, design certifications, construction permits, and operating licenses have a significant challenge in addressing potential adverse flow effects on nuclear power plant structures, systems, and components for their specific applications.

The NRC staff has updated Regulatory Guide 1.20, “Comprehensive Vibration Assessment Program for Reactor Internals During Preoperational and Initial Startup Testing,” and the Standard Review Plan (SRP) in Sections 3.9.2, “Dynamic Testing and Analyses of Systems, Structures, and Components,” and 3.9.5, “Reactor Pressure Vessel Internals,” to incorporate lessons learned from operating experience and the review of power uprate submittals. However, the NRC staff believes that additional generic communication would be helpful to the nuclear industry in addressing potential adverse flow effects in an adequate manner in power uprate and new reactor applications for BWRs and PWRs. Therefore, the NRC staff is considering the preparation of a Regulatory Issue Summary (RIS) to discuss the evaluation of potential adverse flow effects for power uprates and new reactors.

The NRC staff is considering addressing the following topics in the RIS:

1. Pressure Fluctuations and Vibration in Plant Systems (including the construction and validation of a small SMT facility, and method and approach for the measurement of plant-specific data to determine pressure fluctuations and vibration that can impact structures, systems, and components)

2. Design Load Definition for Steam Dryers (including the development of an analytical methodology to calculate fluctuating pressure loads on the steam dryer that is validated against SMT data and plant-specific instrumented steam dryers)

3. BWR Steam Dryer Stress and Limit Curves (including the performance of a finite element analysis using appropriate damping values, justification of bias error and uncertainty for each category of the stress calculation on a frequency-specific basis, and development of limit curves based on plant data accounting for bias errors and uncertainties as well as concentration and weld size factors)

4. PWR Steam Generator Stress and Design Margin (including the evaluation of the dynamic response, stress, and design margin of the internal components in steam generators)

5. Evaluation of Other Plant Components (including the evaluation of potential adverse effects from pressure fluctuations and vibration on piping and components in reactor coolant, steam, feedwater, and condensate systems, such as safety relief valves, power-operated valves, and sampling probes)

6. Power Ascension Data (including the development of power ascension procedures with limit curves and frequent data collection, walkdowns, and hold points for data evaluation and NRC staff interaction)

7. Monitoring of Potential Adverse Flow Effects (including the development of proactive methods for identifying acoustic resonance or severe hydrodynamic loading prior to component failure)

If you have any suggestions regarding these considerations, we would appreciate receiving your comments within one month such that the NRC staff can prepare the proposed RIS in a timely manner.

Please contact Kamal Manoly, Chief, Mechanical & Civil Engineering Branch, Division of Engineering, Office of Nuclear Reactor Regulation, at 301-415-2765, for any additional information.

Sincerely,
/RA/

John A. Grobe, Associate Director
for Engineering and Safety Systems
Office of Nuclear Reactor Regulation

Project No. 694

cc: See next page

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John A. Grobe, Associate Director
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Letter to Gordon Bischoff from John A. Grobe dated: July 18, 2007

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PWR Owners Group Project No. 694
cc:
Mr. James A. Gresham, Manager
Regulatory Compliance and Plant Licensing
Westinghouse Electric Company
P.O. Box 355
Pittsburgh, PA 15230-0355
greshaja@westinghouse.com

Westinghouse Electric Project No. 700
cc:
Mr. Gordon Bischoff, Manager
Owners Group Program Management Office
Westinghouse Electric Company
P.O. Box 355
Pittsburgh, PA 15230-0355
gordon.c.bischoff@us.westinghouse.com

AREVA Project No. 728
cc:
Mr. Ronnie L. Gardner
Site Operations and Regulatory Affairs Manager
AREVA NP Inc.
3315 Old Forest Road
Lynchburg, VA 24501
ronnie.gardner@areva.com