December 9, 2004

MEMORANDUM TO: James E. Dyer, Director
Office of Nuclear Reactor Regulation

FROM: Carl J. Paperiello, Director
Office of Nuclear Regulatory Research

SUBJECT: IMPENDING PUBLICATION OF NUREG/CR-xxxx, "BARRIER INTEGRITY RESEARCH"

With this memorandum, I am providing for your information, the attached foreword for NUREG/CR-xxxx, "Barrier Integrity Research." We intend to submit that report for publication in December 2004.

This report documents the results of a research study, which the Office of Nuclear Regulatory Research sponsored in response to recommendations from the Davis-Besse Lessons Learned Task Force (DBLLTF). Specifically, the DBLLTF recommended that the U.S. Nuclear Regulatory Commission (NRC) should analyze its existing requirements, as they relate to the integrity of the reactor coolant system (RCS) and its reactor coolant pressure boundary during reactor operation. Toward that end, Argonne National Laboratory conducted a comprehensive review of the NRC's RCS leakage requirements, created a database of RCS leakage from 1974 through June 2004, and evaluated new monitoring systems and techniques that could potentially be beneficial for detecting small volumes of leakage.

Please feel free to contact me if you have any questions concerning the impending issuance of this report.

Attachment: As stated

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FOREWORD

This report documents the results of barrier integrity research conducted by the Argonne National Laboratory (ANL). The U.S. Nuclear Regulatory Commission (NRC), Office of Nuclear Regulatory Research, sponsored this research in response to recommendations from the Davis-Besse Lessons Learned Task Force (DBLLTF). Specifically, the DBLLTF recommended that the NRC should analyze its current requirements for the integrity of the reactor coolant system (RCS) and the reactor coolant pressure boundary. The DBLLTF further recommended that the NRC should improve its requirements to better discriminate identified and unidentified leakage rates, and to ensure that the reactor is not operated at power with pressure boundary leakage. In addition, the DBLLTF recommended that the NRC should determine whether online leakage monitoring systems should be installed on critical components in pressurized water reactors, to detect leakage rates which are significantly less than 3.8 liters (1 gallon) per minute.

ANL conducted a comprehensive review of the NRC's existing RCS leakage rate requirements. ANL first reviewed the technical bases for existing leakage rate requirements and considered previous work related to the potential revision of the Regulatory Guide 1.45 on leakage detection systems. ANL evaluated the sensitivity, accuracy, reliability, and response time of each type of leakage detection system. As a second task, ANL created a database of reported leakage at U.S. plants from 1974 through June 2004. For each instance, that database includes detailed information on the source and cause of leakage, how the leakage was determined, the results of any destructive and nondestructive tests, and actions taken by the licensee upon identification of the leakage. As a third task, ANL reviewed newer leak detection and monitoring systems that detect significantly lower leakage rates than currently required. Further, ANL assessed each system's potential for use for continuous online monitoring. Finally, to establish the technical basis for realistic leakage rate requirements, ANL reviewed the current theoretical models that predict leakage rates through cracks of various configurations to evaluate how well the model predictions correlate with plant data.

ANL identified a variety of monitoring systems, some of which are currently in use in the U.S. and Europe, that provide online and continuous leakage monitoring. However, some of the identified systems need further field development to validate and confirm their reliability under reactor conditions. Further, the research described in this report did not consider the economic implications of the installation of newer monitoring systems. Consequently, cost-benefit analysis, backfit analysis, potential increases in rate of false alarms (as a results of lowering the existing leakage rate requirements), and other such issues are beyond the scope of this research.

Issues that warrant further consideration before the NRC revises its existing RCS leakage requirements include the technical bases for those requirements, the sensitivity and reliability of monitoring systems, the inability to relate predicted leakage rates to predicted and observed crack sizes, and the inability to relate the low leakage rates to potential corrosion rates. It would be very difficult to ensure adequate structural integrity to mitigate the effects of corrosion solely by reducing the leakage rates specified in the existing requirements. Although online monitoring can be of considerable benefit, inspections play a significant the role in ensuring adequate structural integrity of the pressure boundary.

/RA/

Carl J. Paperiello, Director
Office of Nuclear Regulatory Research

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