

May 27, 2004

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

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

SUBJECT: NRR USER NEED REQUEST - MATERIALS DEGRADATION (NRR-2004-003)

Your January 12, 2004 memorandum requested RES to determine the types of material degradation that may occur in nuclear power reactors and to assess whether current inspection and leak monitoring requirements will ensure the timely detection of these forms of degradation. As a proactive measure, RES had already initiated activities to develop a foundation for appropriate actions to keep materials degradation from adversely impacting safety. Based on this interest and your User Need Request, in coordination with your staff, we have initiated a program for Proactive Materials Degradation Assessment (PMDA). The elements from the User Need are being addressed in two activities: (1) Review Past Materials Degradation Experience for Nuclear Power Plant Components, and (2) Identification of Potentially Susceptible Nuclear Power Plant Components. The work is being conducted by the Division of Engineering Technology and the Division of Risk Analysis and Applications. A schedule which summarizes the planned activities is attached. There are some differences between the attached schedule and the User Need schedule which have been coordinated with your staff. The two Activities are summarized below:

1. Review Past Materials Degradation Experience for Nuclear Power Plant Components

To address User Need Task 1 and 2, RES will form a task group on Nondestructive Examination and Leak Monitoring (NDELM). The NDELM task group will be comprised of NRR, RES, and national laboratory experts in inspection and leak monitoring techniques and requirements. The task group's activities will build upon activities conducted under the barrier integrity action plan which is implementing some of the Davis Besse LLTF recommendations. The NDELM task group will use the GALL report (and other pertinent information) to identify materials and components that have experienced degradation in LWRs and the associated current inservice inspection and leak monitoring programs. The NDELM task group will evaluate whether or not the current inservice inspection and leakage monitoring requirements ensure timely detection of known degradation mechanisms for plant components. As a result of this review and evaluation, the NDELM task group will compile a list of components whose inspection methods and requirements are considered inadequate to ensure timely detection of known degradation mechanisms and will develop recommendations to improve these requirements. A final draft report with findings and recommendations will be submitted to NRR in November 2004.

For each of the components identified by the NDELM task group, the Conditional Core Damage Probabilities (CCDPs) will be determined. The CCDPs will be calculated using the Standardized Plant Analysis Risk (SPAR) models. Since SPAR models are plant specific, a subject plant will be chosen whose SPAR model will be used to determine CCDPs for each component. SPAR models for plant systems are on a significantly coarser basis than is expected for the individual system components that will be identified. Therefore, it is assumed that a number of identified component failures will be modeled by a single active component failure, where the failure of the active component approximates the failure of any one of several passive components. This may lead to a reduction in the number of assessments needed, though the number of passive components identified may number in the hundreds. The CCDP analysis for the components identified by the NDELM task group will be initiated in November 2004, with a final draft report submitted to NRR in March 2005.

Based on available resources, RES will collect probability of failure information where it already exists from other programs and sources such as aging programs, the LBLOCA redefinition effort, and in licensee degradation assessments to support Risk Informed Inservice Inspection (RI-ISI) programs. This information will be provided by September 2005. The information collected from these sources is unlikely to contain probability of failure estimates for all of the components identified by the NDELM task group or by the PIRT Expert Panel (see Activity 2 below), nor will it generally contain uncertainty estimates. A comprehensive effort to determine these probability of failure and uncertainty estimates will be completed in FY06. This time frame is appropriate because it will allow inclusion of all components identified by the NDELM task group and the PIRT Expert Panel which will be completed in FY05.

2. Identification of Potentially Susceptible Nuclear Power Plant Components

To address User Need Tasks 3, 4, and 5, RES will employ a modified PIRT process to identify components that may be susceptible to degradation phenomena in the future. This process will use a panel of international experts in materials degradation to examine both PWR and BWR plant types, component-by-component, and assign potential degradation phenomena to each component based upon each component's stressors. The component background and stressor information will be compiled by Brookhaven National Laboratory. This information may be augmented with input from an NRC task group on identification of stressors (TGIS). The TGIS will be composed of NRR and RES staff who have knowledge and access to information that could contribute to this process. In some cases the TGIS may be required to estimate stressors where quantitative information is unavailable. Assembling quality background information is important for the panel experts to be able to make informed decisions about potential future degradation phenomena for each component.

There will be four one-week long meetings for PWRs and four one-week long meetings for BWRs to complete the PIRT process. The first three meetings for each plant type will examine a representative PWR and BWR, with the additional meeting used to extend the results to the rest of the PWR and BWR fleets. The first plant type examined will be the PWR plant type.

There will be six weeks between meetings to allow the panel experts sufficient time to complete their assessments for each set of plant components. The first meeting will be completed in August 2004. After each meeting, the components and degradation identified at the meeting will be provided to the NDELM task group to identify areas where there may be no inspection

requirements or the requirements are insufficient for timely detection of degradation. The results of this examination should be available approximately two months after each PIRT panel meeting, and will be provided periodically to NRR. The results from the first set of PWR components will be provided in November 2004. The final report compiling all of the results from the PWR examination, including international peer review, will be submitted to NRR in June 2005. The final report for BWRs will be submitted in December 2005.

The components identified from each PIRT panel meeting will also be used to conduct the CCDP analysis in the same manner as for the components identified in the first Activity. As a direct result of the coarseness of the level of detail in a PRA, and because many components were already evaluated in the first Activity, it is expected that many of the PIRT-identified components will fall into existing analysis bins and few new analyses will be needed for the new components. A report on the CCDP assessment for the PWR plant type will be submitted to NRR in June 2005 and on the BWR in December 2005.

As stated under the description of Activity 1, the probability of failure and uncertainty estimates for the components identified through the PIRT process will be determined in a comprehensive study along with the components identified in the GALL review. The study will be completed in FY06.

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Attachment: As stated

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Schedule of Activities for Proactive Materials Degradation Assessment

Activity 1: Evaluate inspection and leak monitoring requirements and techniques for known degradation mechanisms using the GALL report.		
<u>Sub-activity</u>		<u>Completion Date</u>
GALL	Conduct workshop to assess inspection and leak monitoring techniques and requirements. Provide a report detailing findings and recommendations	November 2004
	Report on conditional core damage probabilities (CCDPs) for components that have experienced degradation and whose inspection and leak monitoring requirements are considered ineffective.	March 2005
Activity 2: Identify future susceptible LWR plant components using a modified PIRT process and evaluate inspection and leak monitoring requirements and techniques.		
<u>Sub-activity</u>		<u>Completion Date</u>
PWR	Letter report to identify components susceptible to degradation from the first and second batches of representative PWR components examined by the PIRT Expert Panel and to provide nondestructive examination and leak monitoring (NDELM) assessment and recommendations.	November 2004
	Update letter report to include all components susceptible to degradation by incorporating results from the third and final batch of representative PWR components examined by the PIRT Expert Panel and to provide NDELM assessment and recommendations.	January 2005
	Final letter report to include previously identified components as well as PIRT Expert Panel consideration of other components to extend previous PWR results to the rest of the PWR fleet with NDELM assessment and recommendations.	February 2005
	Internationally peer reviewed report on the PIRT Expert Panel identification of susceptible components for the PWR plant type.	June 2005
	Report on CCDP analysis for PWR components identified by the PIRT Expert Panel as susceptible to degradation and where leak monitoring and inspection requirements are considered ineffective.	June 2005
BWR	Letter report to identify components susceptible to degradation from the first batch of representative BWR components examined by the PIRT Expert Panel and to provide NDELM assessment and recommendations.	April 2005

BWR	Update letter report to include components susceptible to degradation by incorporating results from the second batch of representative BWR components examined by the PIRT Expert Panel and to provide NDELM assessment and recommendations.	June 2005
	Update letter report to include all components susceptible to degradation by incorporating results from the third and final batch of representative BWR components examined by the PIRT Expert Panel and to provide NDELM assessment and recommendations.	July 2005
	Final letter report to include previously identified components as well as PIRT Expert Panel consideration of other components to extend previous BWR results to the rest of the BWR fleet with NDELM assessment and recommendations.	September 2005
	Internationally peer reviewed report on the PIRT Expert Panel identification of susceptible components for the BWR plant type.	December 2005
	Report on CCDP analysis for BWR components identified by the PIRT Expert Panel as susceptible to future degradation and whose leak monitoring and inspection requirements are considered ineffective.	December 2005
	Collect existing probability of failure and uncertainty estimates for plant components where available.	September 2005
Complete probability of failure studies with uncertainty estimates for components identified through the GALL examination and PIRT Expert Panel meetings where degradation can be expected and inspection and leak monitoring techniques and requirements are considered ineffective.	September 2006	