May 31, 2006

Mr. Michael Robinson, Chair
Issue and Integration Group
Materials Reliability Program
Duke Energy Corporation
P.O. Box 1006 M/C EC07C
Charlotte, NC 28201-1006

Dear Mr. Robinson:

NRC started approving leak-before-break (LBB) analyses in 1984 by granting exemptions from General Design Criterion (GDC)-4, "Environmental and dynamics effects design bases." In 1987, GDC-4 was revised to allow dynamic effects associated with postulated pipe ruptures to be excluded from the design basis when analyses reviewed and approved by the Commission demonstrate that the probability of fluid system piping rupture is extremely low (i.e., less than 10^{-6}/RY). The statement of considerations for the proposed revision to GDC-4 in 1986 said that "the leak-before-break approach should not be considered applicable to fluid system piping that operating experience has indicated is particularly susceptible to failure from the effects of corrosion." Regulatory guidance pertaining to review and approval of LBB indicates that licensee evaluations must demonstrate that degradation mechanisms are not potential sources of pipe rupture. In practice, review criteria were implemented that excluded application of LBB to systems with potential corrosion degradation mechanisms. Satisfying these criteria was considered a demonstration that the probability of fluid system piping rupture is extremely low.

Regulatory guidance also addressed the application of LBB to piping susceptible to stress corrosion cracking, specifically intergranular stress corrosion cracking (IGSCC) in boiling water reactor (BWR) piping at the time the guidance was written. LBB could be considered for this piping provided two mitigation methods (e.g., resistant materials, stress improvement, enhanced water chemistry) were applied to the piping. While no regulatory approvals have been made to apply LBB to BWR piping, this guidance is considered relevant to piping systems susceptible to other types of stress corrosion cracking.

In recent years, operating experience has occurred that indicates that Alloy 82/182/600 materials in butt welded configurations in the reactor coolant pressure boundary (RCPB) are susceptible to primary water stress corrosion cracking (PWSCC). In 2000, evidence of a large accumulation of boric acid deposits observed during a refueling outage at V.C. Summer led to the discovery of cracking in the "A" hot leg pipe-to-reactor pressure vessel nozzle dissimilar metal weld. An axial part through-wall indication found in the surge line to hot leg nozzle weld at TMI-1 in 2003 was attributed to PWSCC. Inspections of reactor coolant system piping at a number of PWRs in recent years have identified indications that were attributed to PWSCC. Occurrences of PWSCC similar to those detected in U.S. plants have been found in foreign nuclear power plants. Since the conditions at these plants do not appear to be unique, more PWSCC may be found in butt weld locations where LBB has been approved.

The Electric Power Research Institute (EPRI) Materials Reliability Project (MRP) developed inspection and evaluation guidelines for dissimilar metal (DM) butt welds in the reactor coolant system, MRP-139, “Primary System Piping Butt Weld Inspection and Evaluation Guidelines.” This industry guidance was issued for the purpose of managing PWSCC through a combination of inspection and/or mitigation. The industry guidelines do not discriminate between DM welds in LBB systems and DM welds in other systems.

The NRC is investigating strategies for managing PWSCC in LBB systems to ensure that the probability of fluid system piping rupture remains extremely low in accordance with the requirements of GDC-4. Because the LBB analyses approved by the NRC staff did not consider the possibility of stress corrosion cracking, the NRC is re-evaluating its guidance regarding the application of LBB in piping susceptible to PWSCC. In conducting this re-evaluation, the NRC is considering information on both the effectiveness of mitigation techniques and on the reliability of qualified ultrasonic inspection of DM nickel-based alloy welds in these systems. The Office of Nuclear Regulatory Research (RES) recently initiated a research program to develop this information as part of the larger effort to improve the existing regulatory guidance on LBB.

RES is requesting assistance from the Issue and Integration Group, Materials Reliability Program in obtaining data to assess the reliability of qualified ultrasonic inspection of DM nickel-based alloy welds in LBB piping. Specifically, RES would like to obtain the following information:

- The bounding range of configurations for existing DM welds in LBB piping systems, including actual component cross-sectional geometries, piping diameters and nominal wall thicknesses, and materials (wrought and cast austenitic/ferritic and welded alloys);

To support this effort, we request that the Issue and Integration Group, Materials Reliability Program, authorize cognizant Electric Power Research Institute (EPRI) NDE Center personnel to collaboratively assist our contractor, Pacific Northwest National Laboratory (PNNL), in collecting this information.

To obtain all of the data required to address PWSCC in LBB systems, a letter has also been transmitted to Mr. Gary Lofthus, Chair, Electric Power Research Institute Performance Demonstration Initiative, requesting data on issues that may impact the volumetric examination of DM welds, and data to support a determination of nondestructive examination reliability for DM welds and weld overlays.

Should you have any questions regarding this request, please contact Wallace Norris of my staff at (301) 415-6796.

Sincerely,

/RA/ Deborah Jackson for

Jennifer L. Uhle, Deputy Director
Materials Engineering
Division of Fuel, Engineering and
Radiological Research
Office of Nuclear Regulatory Research

cc: K. Gruss, NRR
E. Sullivan, NRR
A. Hull, RES
A. Csontos, RES

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