UNITED STATES
NUCLEAR REGULATORY COMMISSION
Washington, D.C. 20555-0001

ERRATA

August 20, 2010

Report Number: **NUREG/CR-7011**

Report Title: Evaluation of Treatment of Effects of Debris in Coolant on ECCS and CSS Performance in Pressurized Water Reactors and Boiling Water Reactors

Prepared by: Mechanical and Electrical Branch
Division of Engineering
Office of Nuclear Regulatory Research
U.S. Nuclear Regulatory Commission
Washington, DC 20555-0001

Date Published: May 2010

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Publications Branch
Office of Administration

to aid in radioiodine control. The pH adjustment is accomplished in different ways in different plants, including the addition of

- sodium hydroxide (NaOH; to about 0.2 M)
- trisodium phosphate (TSP, $Na_3PO_4 \cdot 12H_2O$; to about 0.01 M)
- sodium tetraborate (STB, also known as borax, $Na_2B_4O_7 \cdot 10H_2O$; to about 0.028 M, or 0.11 M boron).

These dissolved chemicals can interact with other materials present in the post-LOCA PWR containment environment to form chemical reaction by-products.

Although the BWR cooling water does not contain dissolved boric acid during normal operation and therefore is immune from debris formation related to buffer additions/chemical reaction by-products, chemical reactions including metal and insulation corrosion and interactions of dissolved materials with each other and with solids are possible in post-LOCA BWR waters. Some BWRs also manually add a solution of sodium pentaborate (SPB; $Na_2B_{10}O_{16} \cdot 10H_2O$) to the post-LOCA coolant by way of the standby liquid control (SLC) system as a back-up reactivity control or for radioiodine control. The typical quantity[e] of SPB added to the post-LOCA coolant is equivalent to 600 lbm (pounds, mass) of boron (~3000 to 4000 gallons of 8 to 10 wt% SPB) and is sufficient to give a final boron concentration of ~ 550 ppm in the Reactor Cooling System, or approximately up to ~120 ppm in the suppression pool resulting from SPB injected from SLC system.

The debris generated by the physical destruction of materials or the mobilization of latent and transient materials in BWRs and PWRs in the post-LOCA environment within containment is considered in Section 2.1. The debris generated by chemical reactions in BWRs and PWRs in the post-LOCA coolant and its interactions with the wetted materials, both other debris and fixed hardware, are considered in Section 2.2. These sections also include assessment of the comparative scope of knowledge of debris sources and generation in both PWRs and BWRs.

2.1 Physical Debris

The primary source of physical debris in both BWRs and PWRs is thermal insulation on piping, vessels, and other components of the system. Other significant contributors are transient debris (i.e., foreign materials), fixed debris (e.g., coatings), and latent debris (e.g., dirt, dust, and [for BWRs only] suppression pool sludge). The characteristics and sources of BWR physical debris are considered in Section 2.1.1. Physical debris sources and characteristics in PWRs are discussed in Section 2.1.2.

2.1.1 Physical Debris in BWRs

Debris for BWRs is categorized according to its genesis within the drywell or the wetwell (or Mark III containment), including the suppression pool. The primary source of drywell debris is thermal insulation materials. The primary source of wetwell debris is the suppression pool sludge. Section 2.1.1.1 describes pipe insulation sources, and Section 2.1.1.2 describes other drywell debris. Section 2.1.1.3 describes wetwell debris.

(e) For specific examples, see Columbia Generating Station, Calculation, "Dose Calculation Database." Calculation Number NE-02-04-1, Revision 2. Energy Northwest. Richland, WA. 2004. ADAMS accession number ML042930379 and NE-02-03-15, ADAMS accession number ML042930715; or Nuclear Engineering Calculation EC-059-1041, Rev. 02, "Suppression Pool pH Post LOCA." Susquehanna Steam Electric Station, Berwick, PA. 2006. ADAMS accession number ML063060122.