



UNITED STATES  
**NUCLEAR REGULATORY COMMISSION**  
ADVISORY COMMITTEE ON NUCLEAR WASTE  
WASHINGTON, DC 20555 - 0001

ACRSR-2226

November 17, 2006

Mr. Luis Reyes  
Executive Director for Operations  
U.S. Nuclear Regulatory Commission  
Washington DC 20555-0001

**SUBJECT:** DRAFT FINAL REVISION 3 TO REGULATORY GUIDE 1.7, "CONTROL OF COMBUSTIBLE GAS CONCENTRATIONS IN CONTAINMENT FOLLOWING A LOSS-OF-COOLANT ACCIDENT," AND STANDARD REVIEW PLAN SECTION 6.2.5, "COMBUSTIBLE GAS CONTROL IN CONTAINMENT"

Dear Mr. Reyes:

During the 537<sup>th</sup> meeting of the Advisory Committee on Reactor Safeguards, November 1-3, 2006, we completed our review of the draft final Revision 3 to Regulatory Guide 1.7, "Control of Combustible Gas Concentrations in Containment Following a Loss-of-Coolant Accident," and a proposed revision to Standard Review Plan (SRP) Section 6.2.5, "Combustible Gas Control in Containment." During our 536<sup>th</sup> meeting, October 4-6, 2006, we met with representatives of the NRC staff to discuss these documents. We had the benefit of the documents referenced.

## **RECOMMENDATIONS**

1. Regulatory Guide 1.7, Revision 3, "Control of Combustible Gas Concentrations in Containment Following a Loss-of-Coolant Accident," along with the corresponding SRP Section 6.2.5 should be issued after including References 19-22 from the SRP in the Regulatory Guide.
2. The staff should develop additional guidance on acceptable methods for demonstrating the effective achievement of a mixed atmosphere in the containment. Such guidance should caution that current analytical codes may overestimate mixing and that applicants will need to substantiate the applicability of these codes to their analyses.

## **DISCUSSION**

10 CFR 50.44, "Combustible Gas Control for Nuclear Power Reactors," was revised in 2003. The revised rule recognizes that sufficient combustible gas to pose a risk-significant threat to containment integrity is generated only during a beyond-design-basis accident. The requirements in the prior version of the rule for systems to mitigate hydrogen release during a

design-basis loss-of-coolant accident were eliminated. For currently licensed plants, all boiling water reactor (BWR) Mark I and Mark II containments must have an inerted atmosphere. BWRs with Mark III containments and pressurized water reactors (PWRs) with ice condenser containments must have the capability for controlling combustible gas generated from a metal-water reaction involving 75 percent of the fuel cladding surrounding the active fuel region (excluding the cladding surrounding the plenum volume) so that there is no loss of containment structural integrity. Future water-cooled reactor applicants and licensees are required to have either an inerted containment or must limit hydrogen concentrations in containment during and following the release of an amount of hydrogen equivalent to that generated from a 100 percent fuel clad-coolant reaction, uniformly distributed, to less than 10 percent (by volume) and maintain containment structural integrity and appropriate accident mitigating features.

The revised rule also retains the requirement to monitor hydrogen concentrations in the containment atmosphere for all containment designs and includes a requirement for oxygen monitors in containments with inerted atmospheres. However, monitors are no longer classified as safety-related components.

The revised Regulatory Guide provides guidance for the design of combustible gas control systems. It also provides guidance for design, qualification criteria, and functional requirements for hydrogen and oxygen monitors. Although the combustible gas control systems are no longer considered safety related, the Regulatory Guide notes that systems installed and approved by the NRC prior to October 16, 2003, the effective date of the revised 10 CFR 50.44, are sufficient to meet these criteria. The guidance provided is appropriate and consistent with the requirements for severe-accident mitigation equipment in evolutionary and passive plant designs.

The revised rule requires that containment structural integrity be demonstrated. The Regulatory Guide identifies criteria of the ASME Boiler and Pressure Vessel Code that provide an acceptable method for demonstrating that the requirements are met. These requirements are appropriate and consistent with current ASME code analyses used by licensees for this purpose.

The revised rule requires that all containments have a capability for ensuring a mixed atmosphere to avoid the potential for detonation of combustible gases. The Regulatory Guide provides general guidance on how this may be achieved. It allows this capability to be provided by an active, passive, or combination system. Active systems may consist of a fan, fan cooler, or containment spray. For passive or combination systems that use convective mixing to mix the combustible gases, it recognizes that the containment internal structures can have significant effects on the mixing in the containment and that the containment should have design features that promote the free circulation of the atmosphere. References 19-22 in the SRP Section 6.2.5 provide important insights into the potential for detonation of hydrogen-air mixtures and should be included as references in the Regulatory Guide prior to issuance.

Additional guidance on acceptable methods for demonstrating the effective achievement of a mixed atmosphere would be helpful and should be developed. Such guidance should caution that current analytical codes widely used to evaluate mixing and transport within containments may overestimate mixing and that applicants will need to substantiate the applicability of these codes to their analyses.

The revised SRP Section 6.2.5 has been updated to be consistent with the revised 10 CFR 50.44. It provides appropriate acceptance criteria and review procedures. Revision 3 to Regulatory Guide 1.7 and the revised SRP Section 6.2.5 should be issued.

Sincerely,

**/RA/**

Graham B. Wallis  
Chairman

References:

1. Memorandum from Jimi T. Yerokun, Chief, Risk Applications and Special Projects Branch, Division of Risk Assessment and Special Projects, Office of Nuclear Regulatory Research, to Michael R. Snodderly, Chief, Technical Support Branch, Advisory Committee on Reactor Safeguards, "Additional Information - Regulatory Guides 1.7, 'Control of Combustible Gas Concentrations in Containment Following a Loss-of-Coolant Accident,' and 1.196, 'Control Room Habitability at Light-Water Nuclear Power Plants'," September 6, 2006.
2. Memorandum from Thomas O. Martin, Director, Division of Safety Systems, Office of Nuclear Reactor Regulation, to John T. Larkins, Executive Director, Advisory Committee on Reactor Safeguards, "Transmittal of Proposed Revision to Standard Review Plan NUREG-0800 Section 6.2.5, 'Combustible Gas Control in Containment'," October 2, 2006.