**From:** "Wade J. Richards" <wade.richards@nist.gov>
**To:** <MMM@nrc.gov>
**Date:** 11/27/2006 10:55:51 AM
**Subject:** RAI

Marvin,
Attached is the response to the RAI you sent me. Let me know if further clarification is needed.

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| **Created By:** | wade.richards@nist.gov |

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Response to RAI 1

**Question**

Do we have the calculations and/or analysis to support the statement the ".... less than 3% of the total Iodine released will be present as I(2) gas?

This statement can be found in section 13.2.1 Maximum Hypothetical Accident (MHA), paragraph 3 ( All of the noble gas ...).

**Response**

This statement follows from the References "Weber, 1992[1] and 1993[2]", and calculations based upon the former in NUREG/CR-5732[3] (ORNL/TM-12202) and NUREG 1465[4]. In NUREG CR-5732, the chemical forms of the iodine releases in a light water severe reactor accident are analyzed, and it is shown that under the conditions pertaining to a severe fuel melt, most of the iodine will combine with Cs to from CsI in solution. The origin of this result is the release of Cs during the accident, which immediately goes into solution as CsOH, increasing the local pH (in this response, we use pH throughout rather the more accurate pD when referring to the NBSR. The fact that the primary is heavy water will not affect the analysis in any significant way). As discussed in detail in the references, under these conditions, over 99 % of the $I_2$ in solution will very rapidly convert to CsI. This form is soluble, and is only released by either radiolysis or a small vapor pressure of $I_2$ above the solution that is given by Henry's law, as discussed in the Chapter 13 analysis. NUREG 1465 uses these results to estimate accident source terms, including $I_2$ releases, and concludes that no more than 4 % of the iodine will be present in the water as $I_2$ (with an additional 1 % as HI), even under the severe conditions of a complete fuel melt in a light water reactor. As stated in the references, these results depend only on Iodine chemistry as a function of pH, temperature and, secondarily, radiation (which can convert CsI to $I_2$ at equilibrium levels of up to approximately 3 % at the pH of the NBSR primary). Weber shows in reference 2 that the same chemistry applies to a severe accident in the HFIR, and there is nothing specific to light water in the analysis. The figure used of less than 3 % follows from the fact that this is larger than the largest estimate in Reference 3, which was 2.8 %.

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[1] Weber, C. F., Beahm, E. C., and Kress, T. S. (1992). *Models of Iodine Behavior in Reactor Containments.* ORNL/TM-12202, Oak Ridge National Laboratory: Oak Ridge, Tennessee.
[2] Weber, C. F. and Beahm, E. C. (January 1993). *Iodine Transport During a Large Pipe Break LOCA in the Pipe Tunnel With Drainage Outside Confinement.* Research Reactors Division CHFIR-92-032, Oak Ridge National Laboratory: Oak Ridge, Tennessee
[3] Beahm, E. C., C. F. Weber, and T. S. Kress (July, 1991). *Iodine Chemical Forms in LWR Severe Accidents.* NUREG/CR-5732 (ORNL/TM-11861) Oak Ridge National Laboratory: Oak Ridge, Tennessee
[4] Soffer, L., Burson, S. B., Ferrell, C. M., Lee, R. Y., and Ridgely, J. N. (February, 1995). *Accident Source Terms for Light-Water Nuclear Power Plants.* NUREG-1465, U. S. Nuclear Regulatory Commission, Washington, DC