

## Hydrogen Management Strategies Using the Igniters and Recombiners

Seung-Dong Lee, Kune Y. Suh, Goon Cheri Park

Seoul National University

San 56-1 Shinrim-dong, Kwanak-gu, Seoul, 151-742, Korea

Moosung Jae

Hansung University, Seoul, Korea

### Abstract

Hydrogen, which is generated by cladding oxidation, can diffuse to all subcompartments in the containment so that high hydrogen concentration may be induced only locally. If the hydrogen concentration in containment reaches to the flammability limit and enough hydrogen is allowed to build up, the hydrogen can ignite and cause a spike in containment pressure that exceeds the containment ultimate design pressure, thereby failing the containment. It is thus important to analyze the accident sequence inducing high hydrogen concentration locally and to develop adequate control and management strategies. In this paper, a framework for evaluating hydrogen control and management strategies involving multiple decisions is presented. The compact influence diagrams including multiple decisions are constructed and evaluated with the MAAP4 calculations. Each decision variable, represented by a node in the influence diagrams, has an uncertainty distribution. Using the values from standard safety analysis report of the reference plant, Advanced Power Reactor 1400MWe (APR1400), the hydrogen control and accident management strategies are assessed. The strategies are ranked with respect to a new measure in terms of hydrogen concentration. The MAAP4 code calculations are performed to generate data for hydrogen concentrations and to identify the important severe accident phenomena in containment for the decision-making analysis as well. In this paper, a problem with two decisions is modeled for a simplistic illustration. One decision is whether or not to actuate the igniters at the time of core uncover; another decision is to use the passive autocatalytic recombiners (PARs). We chose a small-break loss-of-coolant accident (LOCA) sequence, which was one of the dominant accident sequences in the reference plant, as the reference case. The framework of the decision problem by using the decision-making tools, data analysis, and the MAAP4 calculations. It is shown that the proposed framework with a new measure for assessing the hydrogen control and accident management strategies is very flexible in that it can be applied to any kind of accident management strategy for any accident sequence. The igniters are the fastest way of reducing the containment hydrogen concentration, whereas the PARs remove hydrogen at a slow rate.