Assessment of the Use of Passive Autocatalytic Recombiners for Hydrogen Control in Future CANDU 6 Reactors

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Hydrogen can be produced by various sources inside a CANDU containment building following postulated events that lead to degraded fuel cooling and/or high steam content in the reactor building. Hydrogen sources include that produced from the zirconium–steam reaction, radiolysis of water, corrosion of metals, degassing of the primary circuit water, and releases from failed open hydrogen bottles used for primary circuit chemistry control.

If hydrogen accumulates, then the potential for a fast deflagration or detonation exists, which may threaten the integrity of containment or safety related systems inside containment. Therefore, the CANDU 6 design includes a hydrogen control system.
The issue of hydrogen behaviour in containment is still an open item on the Atomic Energy Control Board (AECB) Generic Action Item list. AECB has strongly recommended the use of passive autocatalytic recombiners for hydrogen control in future CANDU reactors.

Hydrogen igniters have been accepted for short and long term hydrogen control in Canada and have been installed in several Ontario Power Generation stations. For the Wolsong 2/3/4 reactors and the latest CANDU 6 reactor, at the Qinshan site in China, the hydrogen control is provided by a combination of igniters to prevent the global buildup of hydrogen and local air cooler fans to mix and dilute the hydrogen inside containment. However, AECL has recently developed a passive autocatalytic recombiner (PAR) design which is ideally suited for post–accident CANDU containments. The AECL recombiners are based on an AECL designed catalyst which has extremely high resistance to fouling from water and water vapour and a large thermodynamic range of operation.

The objective of the analysis presented in this paper is to consider various options aimed at optimizing the number and location of recombiners for future CANDU 6 reactors, and to demonstrate the effectiveness of the PARs in mitigating the effect of hydrogen on the safe operation of the CANDU 6 containment. Its purpose is to serve as a feasibility study on the potential of using hydrogen recombiners for hydrogen mitigation in future CANDU 6 reactors. The 3-D computer code GOTHIC (Generation Of Thermal-Hydraulic Information in Containments) is used for this assessment.