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Technologies for integrated safety management regarding gas generation in spent fuel dry storage systems or transport systems, wet or dry

The gas build up in the casks and potential presence of hydrogen are important safety issues in our industrial activities. For wet packages, radiolysis of water in the cavity is the main mechanism for gas and hydrogen generation whereas for dry systems, radiolysis of residual water in case of incomplete drying is the most significant mechanism for gas production.
An evaluation of hydrogen generation in packages is necessary to ensure that a flammable mixture will not be formed during transportation and to verify that casks do not accumulate an unsafe concentration of hydrogen.
The purpose of this paper is to give an overview of the current R&D programs to mitigate the hydrogen risk in the transportation or storage casks.
The technology for wet transportation of spent fuel is a catalytic recombining system which is qualified through tests at various temperatures. Particular attention is placed on the recombining efficiency after immersion of the catalyst in borated water, which would occur in a nuclear reactor pool during loading of used fuel.
For dry storage and transportation of normal spent fuel (not damaged), water can be removed or the water amount reduced to a very low level with AREVA TN cask vacuum drying technology and high efficiency procedure.
Concerning the transport of leaking assemblies, there is potentially generation of hydrogen connected to the presence of residual water within the fuel rods.

For addressing gas generation issues, R&D results and technologies are now available. Experimental programs have been performed in order to obtain measurements of the gas generation rate so as the empirical data can be used in analytical models to predict H2 concentration.
New technologies have been developed to mitigate the hydrogen risk. A high efficient method for the elimination of gas generated is the introduction in the transport cask of materials able to trap the radiolytic H2 or to buffer the hydrogen concentration far below the flammability limit: the hydrogen getters. The hydrogen gas is absorbed by these materials and chemically bound in the crystalline structure. The materials under study belong to the class of the intermetallic compounds. Such intermetallic compounds able to store irreversibly hydrogen are known as Non Evaporable Getters (NEG).

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