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Evaluation of sealing performance of metal gasket used in dual purpose metal cask subjected to an aircraft engine missile

The CRIEPI (Central Research Institute of Electric Power Industry) has executed several study programs on demonstrative testing for interim storage of spent fuel, related to metal cask storage technology to reflect in Japanese safety requirements for dry casks.

If a metal gasket used in a dual purpose metal cask was subjected to high temperature for a long term, the residual linear loads and total spring back distance of a metal gasket might decrease due to the creep deformation of the outer jacket made of soft metal. Therefore, when the cask would receive the severe mechanical force under hypothetical accidental condition, the sealing performance of metal gaskets might be considerably affected.

In this paper, to investigate of the integrity of the lid structure of the metal cask during the extreme impact loads due to aircraft crash, two impact scenarios for aircraft engine crash onto the metal cask without impact limiters are considered for both, a vertical impact onto the lid structure and a horizontal impact hitting the cask. The horizontal impact test using scale model engine of aircraft has been executed and leak rate from the metallic gasket in the cask also measured at the impact in the test. The vertical impact onto the head of the full-scale metal cask has been also executed. The test cask was mounted on a supporting frame structure by the specific panel. The reaction forces were measured by six load cells installed between the panel and the supporting frame. At the impact in the test, the leak rate, inner pressure between the lids and displacement of the lids were measured. From these experimental results, it seems that the loss of the inner pressure of the cask cavity may be avoided in the impact event with the horizontal and vertical orientation even if the severe impact load was applied on to the metal cask due to aircraft engine crash. Moreover, in order to evaluate the deformation response of the metal gasket subjected to the accidental loads measured during experiments, the impact analysis by LS-DYNA code was executed. As a result, it was found that the opening displacement of the gasket was negligible as compared with the evaluated spring back distance of metal gasket used for 60 years.

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