Comparison of the Behavior of a Finned and Unfinned Surface during a Drop test of a Cask onto a Steel Bar - ABSTRACT

For the licensing of type B(U) packages according to the IAEA regulations, it has to be demonstrated that the integrity of the confinement will be maintained after a sequence of mechanical and thermal hypothetical accident conditions. Within this sequence, a drop from a height of 1 m onto a steel bar has to be considered for any drop orientation that could lead to a maximum damage. Due to the locally induced load force of the dynamic plastically deformed steel bar, a high strain may occur within the cask body.
Transport and storage casks of the CASTOR®-type are made as monolithic, thick-walled cask bodies using ductile cast iron. The weight of a loaded cask is approx. 130 Mg and its dimensions in length are approx. 6.0 m and in diameter approx. 2.5 m. Due to the max. heat inventory of about 40 kW, the cylindrical cask surface is enlarged by circumferential fins which were machined off the cast piece. During transportation, the frontal area of the cask is protected against puncture by using impact limiters containing penetration-resistant inserts. In order to maintain the heat removal, the finned surface cannot be protected by an additional component. In order to demonstrate the ability of the package to withstand accident conditions, a combination of drop tests and numerical analysis needs to be applied. Currently, the fins were not taken into consideration conservatively for the structural analysis and the stresses inside the cask were consequently overestimated. Due to the complex geometry of the fins and the plastic deformation, including localized failure modes, a numerical approach is quite challenging.
In order to get an impression of the different behavior during the drop, a comparison of two drops onto an unfinned and finned surface with a prototype cask were performed. The forces, strains and accelerations were measured and compared. It could be demonstrated that there is a significant margin when the deformation of the fins is taken into account.