



## **Concept of stress limitation for CASTOR® casks made of ductile cast iron**

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Since 1979 experience is gained with the design, licensing, fabrication and application of transport- and storage casks made of ductile cast iron. Up to now a total of about 750 so called CASTOR® casks were produced and loaded with high level radioactive waste world-wide. During this time period a broad basis of theoretical and experimental knowledge for different design areas were generated. Especially the mechanical properties of all fabricated casks were extensively tested according the manufacturing specification. With the large number of fabricated casks a worthful statistical data base were formed and reflects the high quality and level of the ductile cast iron, which is used for the thick walled monolithic cask body of the CASTOR® casks. It has been shown, that the ductility of the material were continuously improved and reaches a mean value of approximately 15 % elongation at this time. This guarantees a high degree of safety for the mechanical design of the cask under accidental design conditions.

Based on this experience an improvement of the mechanical design methodology for current and future casks was established. The mechanical analysis under accident conditions for different loading cases (drop and impact orientations of the cask) were performed with numerical methods, like Finite-Element-calculations (FEM). The used calculational model consists of lower bound material properties, 3-dimensional simulation of the cask geometry, reasonable assumptions and clearly defined boundary conditions. As a result of the calculation the local distribution of all stress tensors inside the cask body is known. In the framework of the safety assessment it has to be demonstrated, that the integrity and tightness of the cask are maintained under hypothetical accident conditions. Therefore stress limitation criteria were defined in order to assure a sufficient margin against unacceptable local plastic deformation and brittle failure. These criteria consider the behaviour of ductile cast iron as well as the applied method for stress calculation.

On the other hand the numerical method has to be validated. For that purpose the experimental results of series of already performed drop tests with similar cask types were appraised and recalculated using the design calculational model. It will be shown, that the applied method and the stress limitation criteria guarantee a safe mechanical design of CASTOR® casks made of ductile cast iron.