Evaluation of Wood Impact Limiter Performance Using LS-DYNA

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Design of impact limiters for transportation casks is well adapted for the use of the finite element code LS-DYNA. Impact limiters are typically comprised of material that can absorb energy and limit the accelerations imposed on the cask system during a 9 meter drop accident. These materials exhibit highly nonlinear stress strain curves and are observed to be strain rate dependent. Cask orientation for the 9-meter drop is of significant interest, since the controlling orientation resulting in the largest accelerations must be identified. In this paper, the end drop, CG over corner, side and a shallow angle drop are examined using a detailed model of the impact limiters using LS-DYNA. The cask body is modeled to account for any effect due to the elastic response, but it is observed to have a minimal effect. The LS-DYNA results are compared to quarter scale test drops. The maximum accelerations and durations are found to be in good agreement with the test data. The shallow angle drop is further examined analytically in conjunction with another angle, as well as with the effect of friction. It is shown that for this cask, which has a length to radius of gyration ratio less than 2, the side drop provides the bounding accelerations. It is observed that friction affects the maximum accelerations observed during the shallow angle drops. The results are also compared to the results using the methodology comprised of a simplified spring model previously developed by SANDIA.