

11/7/02

2.0 JETLINER CRASH

This section describes the basis for the selection of a large commercial jetliner used in evaluating the crash on to a spent fuel dry cask storage facility and transportation casks, for determining the vulnerability. Section 3.0 describes the method and results of the structure evaluation.

The world-wide family of large commercial jetliners can be classified either as single-aisle or double-aisle commercial passenger jetliners. This classification system recognizes in general terms the relative size (cross-section) of the fuselage and hence the jetliner. In some sense this also categorizes the jetliner by the mass associated with the jetliner. Another and most obvious means of jetliner classification is by the manufacturer, and the specific model of the jetliner.

World-wide the population of jetliner in the class of large commercial jetliners is dominated by the models manufactured by the Boeing Company. Classifying the Boeing aircraft into the single-aisle and double-aisle categories results in the following lists of aircraft in each category for those models with a significant number currently in operation.

Single-aisle: Boeing 717, 727, 737 and 757 models (maximum take-off weight 110,000 to 273,000 lbs.)

Double-aisle: Boeing 747, 767 and 777 models (maximum take-off weight 395,000 to 910,000 lbs.)

2.1 PLANE SELECTION

The [redacted] was selected as the study model. The following are the reasons for selecting the [redacted] in the study:

Ex 2

The recent 9/11/01 events in which large commercial passenger jetliner were commandeered and flight controls taken over by individuals who directed the jetliner into civilian targets and military targets were executed using the Boeing 757 and 767 class jetliner. These models [redacted] It should be noted that these two Boeing models share identical flight control systems so that a pilot for one can also easily pilot the other jetliner. The Boeing 757, with a reputation of being the cheapest jetliner for airlines to operate, is the work horse of airlines worldwide.

Previous analytical work had been performed by Sandia, that had included an analytical representation of a [redacted] model jetliner suitable for use with structural analysis computer software is based on information sources that do not include the Boeing Company, but rely on other sources to obtain physical information that could be used to develop an analytical model. The staff contacted other national laboratories, the armed services, and other government agencies in search of analytic models of jetliners. The [redacted] model at Sandia was the only one available.

Ex 2

Because of the need for expedient commencement of the vulnerability studies, the NRC staff decision was made to use the [redacted] jetliner as the crash jetliner. A contract has been established by Sandia with the Boeing Company, to confirm the adequacy of the jetliner analytical model being used and for NRC's intended purpose.

Ex 2

Portions Ex 2

E/td

Although there are larger and heavier jetliner than the () the staff decided that the expedient approach to began the vulnerability assessments for the spent fuel transportation and dry spent fuel storage casks was to use the existing work that had been completed in the creation of an analytical model of an jetliner as the beginning basis. Effort would then be made to improve the analytical model characteristics so as to more closely represent an actual jetliner. Furthermore, this study is not intended to be a bounding analysis but representative of typical of the jetliner used during the events of 11 September 2001. The () model series currently being analyzed represents the () events and therefore represents a realistic jetliner for the study effort.

Ex 2

2.2 ANALYTICAL MODEL OF PLANE

The initial finite-element model of the () jetliner was developed by reviewing information available in the open literature. Such information includes the physical dimensions, materials, and the mass of the various elements of the jetliner. A model for analytical simulations of crash scenarios must have the capability of allowing the study of the global response as well as the localized response, to identify the most vulnerable behavior of the cask being studied. Based on the available information, Sandia has developed the finite element model that incorporates this geometry, the mass of the jetliner along with a stiffness of the jetliner structure. It has been used at Sandia extensively for many of the current vulnerability studies being conducted at Sandia. However, several important aspects of truly representative modeling, such as the mass distribution of elements within the jetliner structure, accurate location and geometry of the hard or resistant components, still need to be verified and perhaps refined.

Ex 2

In order to verify and improve this current finite element model of the () an effort is underway with the Boeing Company to examine the current state of the Sandia jetliner model. However, based on the contract provisions, the information to be provided by the Boeing Company will not be specific to a particular model/type of jetliner, rather the information will be for a typical double aisle large jetliner. This current effort in working with Boeing may result in a new analytical model for the () jetliner being used in the assessments. Such a model is expected to have additional mass and have a different mass distribution within the model structure. Additionally, it is expected that the stiffness of the model structure may change as a result of more detailed knowledge relative to the connection rigidity between various elements important to the vulnerability assessment such as between the wing and the fuselage and the landing gear assembly and the airframe. Sandia intends to rerun the jetliner crash calculations using the new model of the jetliner developed as a result of the process. The results of these computer simulations may enable the staff to address the vulnerability of the casks from jetliner impact on a generic basis. If such is not the case, other jetliner may need to be studied based on other threat information or management decisions.

Ex 2

Portions Ex 2