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A NEW LIHE TEST CAPABILITY FOR SPHERICAL TARGETS

A goal of the Defense Nuclear Agency Lethality and Target Hardening (LTH-3) Program is to assess the lethality of the x-ray laser against the SDI threat entourage of boosters, post-boost vehicles (PBVs), reentry vehicles, and defense suppression weapons (DSWs). A principal characteristic of the effects of the x-ray laser on such threats is the delivery of a coosine distributed impulsive load to exposed curved surfaces of the targets. The LTH-3 program is using test and analysis techniques to investigate the structural response of models of typical targets and target components subjected to impulsive flood loads. A new capability for testing spherical targets using Light Initiated High Explosive (LIHE) is the subject of this paper. Spherical targets are of interest to LTH-3 since vulnerable pressurant, propellant, and chemical reactant storage vessels in PBVs and DSWs are likely to be generally spherical in design.

Until recently only two test techniques, underground tests (UGTs) and contact sheet explosives, were available for delivering cosine distributed impulsive loads to doubly curved test objects. Each of these test techniques suffers from severe drawbacks; e.g., excessive cost, long lead times, instrumentation difficulties, and test space limitations in UGTs and stepped, nonsimultaneous loadings with sheet explosives. In conttrast, the LIHE approach is a moderate cost aboveground test gtechnique which delivers a simultaneous impulsive load and is capable of testing full-scale hardware (up to about .5 m diameter).

The capability to test impulsively loaded spherical vessels was developed at the Sandia National Laboratories (SNL) LIHE Facility utilizing 25.4 cm dia., 0.083 cm thick stainless steel tanks provided by APTEK, Inc. A spray application technique is used at SNL to apply the LIHE to the test article. A remote controlled, computer guided mechanical robot arm with a spray attachment is utilized to effect the application. A new combination of PETN and SASN explosives is used to obtain the high specific impulse levels desired (1000 to 1500 pa-s). The nearly simultaneous detonation of the explosive surface is produced by exposure to an intense flash of light. Several patterns and methods of explosive application were investigated to determine which spraying procedure results in the closest approximation to a cosine distributed loading in a reasonable spraying time. Acceptable magnitudes of deviation from a pure cosine loading were estimated analytically using two-dimensional plane strain finite element analyses.

As of mid-August 1986, two of the stainless steel tanks have been tested. The first test involved a peak specific impulse of 1660 Pa-s applied to an unpressurized sphere. Gross deformation with polar fracture at the location of the peak load were results in this test. In the second test, the sphere carried an internal pressure of 1.72 MPa and was subjected to a peak specific impulse of 900 Pa-s. The specimen survived this test with little damage. Both test articles were instrumented with strain gauges. Pretest analyses were performed to select impulse levels, to

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predict the test results, and to specify gauge calibrations. Presently two- and three-dimensional finite element analyses are in progress for correlation with test results. Two or three more spheres are planned to be tested at different pressurization and impulse levels during the next few months.

Presentation of the paper will include color viewfoils/35mm slides of the LIHE Facility, application of the explosive, test setup, and test/analysis results. In addition, a short 16mm film showing the testing of one sphere and a sample tested sphere will be presented.