COMPUTATIONAL ASSESSMENT OF WARSHIP VULNERABILITY TO SYMPATHETIC DETONATION OF NAVAL ARTILLERY SHELLS

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ABSTRACT

Magazine stores, such as those within warships, contain several to hundreds of munitions equivalent to tonnes of explosive material. A high energy event from a weapon strike or accidental denotation could result in catastrophic detonation of a significant number of munitions in the magazine. This kind of event poses an extreme safety risk to the ship's crew, but also the surrounding infrastructure, personnel and civilians when the warship is in harbour. This paper looks at a method for modelling the reactive sensitivity of two types of high explosive munitions (focusing on the warhead only) in a donor/acceptor munition configuration to mimic a magazine storage scenario.

The sensitivity or the energetic reactivity of the explosive in the acceptor munition ultimately determines whether sympathetic detonation from an event will occur. For an air blast shock load this is termed shock-to-detonation transition (SDT) [1]. Several explosive variants used in naval artillery shells are assessed as both the donor and acceptor munition in this study. These include PBXN-107, PBXN-109 and PBXN-9. The donor models were developed in the finite element modelling code IMPETUS [1] to produced fragment distributions for each of the donor munition variants.

The sensitivity of the acceptor munitions was then assessed using the solid mechanics software CTH[2]. The spacing between the munitions in the models were reflective of distances used in magazine storage compartments in a magazine stand. The acceptor munition was assessed for sensitivity to both shock from the blast wave of the donor munition detonation and from the fragmentation of the warhead casing as determined in Impetus for the different stand-offs distances. The resulting sympathetic reaction information was then used to perform an assessment of the effective vulnerability of a generic warship should such an event occur within the ships magazine.

REFERENCES

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[1] https://www.impetus.no/

[2] https://www.sandia.gov/cth/