Photo credit: https://theaviationgeekclub.com/10-able-rtb-right-engine-struck-iraqi-sam-today-aircrafts-damaged-cowling-display-national-guard-museum/

DS Success Story

Improved Modeling of Combined Effects from HE Threats in COVART

https://dodiac.dtic.mil

Customer:	Deputy Under Secretary of the Air Force for International Affairs (SAF/IF)
Challenge:	High Explosive (HE) threats have two damage mechanisms: explosive blast and fragments impacting target components. The Calculation of Vulnerable Area Tool (COVART) had a limited ability to capture those two damage mechanisms as combined effects because the current combined effects methodology did not account for actual fragment penetration patterns and density in combination with blast distances. This resulted in inaccurate Probability of Component Dysfunction ($P_{CD/H}$) calculations thus, potentially, leading to errors in overall aircraft vulnerability estimates. $P_{CD/H}$. Additionally, the old methodology seemed to be intended only for HE projectiles detonating after impact; limiting its application to the full range of operational threats to aircraft.
Approach:	As part of the Aircraft Damage Effects Assessment (ADEA) project collaborative agreement with Germany, a new HE threats combined

	effects methodology was developed for COVART. This methodology is a function of distance between component(s) of interest and burst point, fragment density, and fragment impact kinetic energy (KE). The methodology has a more generalized applicability to all HE threats than the older methodology and considers scaling with reference to explosive charge weight. As part of the new methodology, the user is able to define multiple $P_{CD/H}$ tables applicable to their respective distances from the point of detonation. The user will also specify whether the methodology is applied globally (i.e., all vulnerable components) or applied to specific components of the target. $P_{CD/H}$ is determined by comparing the area of fragment cluster(s) to user-provided thresholds of number of impact points and minimum area. Clusters not meeting those thresholds are dropped from $P_{CD/H}$ calculations. These calculations use double interpolation between total fragment impact KE vs. $P_{CD/H}$ probability curves for anticipated fragment densities.
Value:	This new methodology provides improved handling of combined effects from a wider range HE threats in order to estimate $P_{CD/H}$ and aircraft-level vulnerability more accurately. The new methodology also incorporates programing “hooks” for future improvement of the methodology.

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