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AIRBURST & BLAST DAMAGE FOR THE PDC25 IMPACT SCENARIO: WHY THE LARGEST ASTEROID IS NOT THE WORST CASE

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Keywords: *asteroid, impact risk, blast damage, airburst*

Asteroid strikes can cause extensive blast damage to surrounding regions, either by impacting the surface or bursting explosively during entry. The severity and extent of the resulting blast damage areas depend both upon the energy of the airburst/impact and the airburst altitude at which most of that energy is deposited into the primary blast. For a given blast energy, there is an 'optimal' height of burst (HOB) that produces the largest ground damage extent for a given blast overpressure level. This optimal HOB altitude is much higher for larger energies than it is for smaller energies, and can also be somewhat higher for weaker blast overpressure levels than stronger blast overpressure levels. Below the optimal HOB altitude, the extent of the blast overpressure on the ground can fall off sharply.

These airburst energy-altitude effects are particularly pertinent to the damage estimates for the PDC25 Impact Exercise scenario. In this scenario, the hypothetical asteroid has been constrained to a potential size range and type with estimated

airburst altitudes spanning across the associated optimal HOBs, making damage estimates particularly sensitive to the entry conditions and uncertain asteroid properties affecting its breakup. The scenario's initial impact corridor also has entry angles spanning from nearly vertical to very shallow, and these entry angles substantially affect which sizes burst above, below, or near their optimal burst height at different locations. These variations produce counter-intuitive trends in the blast damage estimates for different asteroid sizes at the different potential impact locations.

In this study, we present airburst and blast damage modeling trends from the Asteroid Threat Assessment Project (ATAP) Probabilistic Asteroid Impact Risk (PAIR) assessment of the PDC25 impact exercise scenario. These results illustrate how asteroid airbursts occurring near their optimal burst heights could cause significantly greater blast damage than much larger surface impacts that release their blast energy far below their respective optimal HOBs. We compare the optimal burst altitudes for the impact energy range of the initial PDC25 case (~3–720 Mt) with the range of burst altitudes modeled for the entry conditions across the initial PDC25 corridor, and show which sizes or properties drive the greatest damage among the resulting combinations of burst energies and altitudes. Demonstrating these nonintuitive damage factors helps identify what asteroid sizes may actually pose the greatest risk when considering mitigation and response options, and helps raise awareness that the largest potential asteroid size is not necessarily the worst-case scenario.

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Comments:

Either the Hypothetical Asteroid Threat Exercise session or Impact Effects session would be appropriate for this talk. Oral preferred.