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**PAPER TITLE**

**NEO Impact Mitigation Decision Steps and Triggers**

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**ABSTRACT**

Decisions aimed at reducing the impact risk posed by Near Earth Objects must be made prior to a potential threat, at the discovery of a potential threat, and as the threat evolves over time. These are three distinct phases, each requiring specific set of decisions. Pre-discovery decisions to develop guidelines balancing risk magnitude, consequences of impact, and preparation of mitigation capability, will improve the ability to respond to late warnings. In the second phase, a potential threat is characterized by confidence in the orbit determination solution, object size, and composition uncertainties. A decision must be made at discovery whether to launch deflection systems immediately based on what is known and the available mitigation capabilities, or to alternatively delay action until more information becomes available. As the threat evolves, the impact likelihood will diminish in the vast majority of cases as additional observations are made. The concern is for those rare objects whose

probability of impact grows over time, requiring additional decisions to be made based on new information. What can be decided at the time of discovery and what decision options remain available heavily depends on what pre-discovery decisions were made and executed in advance of the threat. This paper applies an end-to-end decision spectrum to the hypothetical threats presented at the 2015 planetary defense conference, and the 2016 NASA-FEMA planetary defense exercise. Insights gained from this analysis are then applied to the first two decision-making phases for the hypothetical threat prepared for the 2017 planetary defense conference. The results demonstrate that decisions made in the pre-discovery phase and at discovery time heavily influence mitigation possibilities during threat evolution. Early decisions to prepare mitigation systems open up more decision options when a threat becomes dangerous. A decision to launch a mitigation system shortly after discovery, when the uncertainty is large, will result in less resources being required of the mitigation response than if the decision is delayed. Effective and timely decisions during the threat assessment process rely on a balanced development of mitigation capability in advance and use of prediction tools to estimate the required response.