



SMPAG Task 5.8:

Consequences, including Failure, of a NEO Mitigation Space Mission

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Task 5.8 Report status: High level sections

- Purpose and scope
- Introduction and background
- Mitigation Scenarios
- Desirable/successful outcome
- Alternative outcomes/failure
- Post-failure/impact scenarios
- Consequential hazards in case of failure
- Strategic planning
- Civil protection
- Priorities
- Communication and interfaces
- Legal issues
- Appendices

Threat Scenario

Several impact scenarios have been played out in exercises conducted during various Planetary Defense Conferences: <https://cneos.jpl.nasa.gov/pd/cs/>

Large Body, long lead time: While a large body represents a high level of danger, the long lead time would allow the careful planning of a mitigation mission, including possibly a pathfinder mission to determine the characteristics and the composition of the object

Small body, long lead time: In many ways this is the most benign scenario

Small body, short lead time: To mount a mitigation mission might be challenging, but while the consequences might be quite severe they would not be cataclysmic

Large body, short lead time: This is the most challenging scenario. It will require a predefined, well prepared mission, with mitigation assets ready to go. It might require the nuclear option as a last-ditch effort to at least reduce the effects of the collision.

Mitigation Scenario

NEO characterization/pathfinder missions: missions which are designed to fly by or arrive at the target and remain on station for the purpose of monitoring the object, or installing hardware on the object.

Slow pull/push techniques: missions which stay near the target NEO for longer periods (months to years) to deflect the object by controlled low level pull or push actions over extended periods (e.g. by laser ablation, ion beams or gravitational attraction)

Impulsive mitigation techniques: missions which are designed to impart kinetic momentum on the object in order to deflect or destroy it.

Evacuation

Will have to be considered in case the space mission fails, or as a contingency measure.

Evacuation includes issues of transportation, food and shelter, safety and security, resources, as well as the special needs of certain groups like: handicapped, elderly, and gravely ill persons.

The PDC exercise which had an asteroid fragment impacting in the area of New York City revealed that the evacuation of the greater NYC area is nearly impossible.

Any actual mitigation campaign will most likely involve a combination of the above mission scenarios, depending on the available lead time and on the most appropriate mitigation strategy. The nuclear option could utilize either a slow or a fast approach option.

Task 5.8 Report

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References



Issues of Most Concern (a personal assessment; goes beyond task 5.8)

International Decision Making

- It will not be equally clear to all nations and to all governments that something has to be done and in what manner
- Depending on object size and impact corridor, some nations might even refuse to cooperate
- Even though the decision making process might be clearly spelled out, the actual decision making will most likely be much more convoluted. Especially in case of a major threat.
- The military of some large nations might have their own ideas of how to deal with the problem

Interagency Collaboration

- Establishing agreements between space agencies is an elaborate and drawn out process. Intellectual property rights, trade secrets, national security concerns and ITAR might get in the way
- Different space agencies are structured differently. It might be difficult to decide who can talk to whom about what, and which decisions can be made at which level.
- Some space agencies are more equal than others...

Issues of Most Concern (a personal assessment)

Industry Collaboration

- It has been notoriously difficult to establish interfaces between agencies, contractors and subcontractors. If this is to be done at an international level it adds another dimension of difficulty
- Planes have crashed and spacecraft have malfunctioned because of imperial vs metric units, fpm vs m/sec, knots vs mph vs kph, liters per 100 km vs miles per gallon, lb/sq" vs hectopascal, etc.
- While the management methodologies between the US and Europe are similar, there are large differences with the management methodologies of organizations in other areas

Socio-Economic Consequences

- This issue needs considerable thought: in the extreme it could mean that a successful mitigation could cause more damage than an impact

Communication/ Interface with the Public

- COVID demonstrates that a large fraction of humankind is basically irrational. It will be difficult to convey complex issues and to implement drastic measures.

Food for Thought

