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An Open Letter to the United Nations Committee On the Peaceful Uses of Outer Space

Re: A critical response to “Asteroid Threats: A Call for Global Response”

To Whom This Should Concern:

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A report on the need to develop an international decision-making program for global response to Near Earth Object threats. Submitted for consideration and subsequent action by the United Nations, its goal is to assist the international community in preventing loss of life and property resulting from an asteroid impact on Earth.

This has to be Plan B... Trusting such a mission to the United Nations has all the strategic wisdom of *planning* to bring a knife to a gunfight. Would even the delegates and ambassadors to the United Nations ever bet the lives of their children and grandchildren on the expertise and judgment of this agency? Responsibility only ever works when there is some manifest, or even potential, ability to respond.

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Association of Space Explorers International Panel on Asteroid Threat Mitigation

When you attach their respective disciplines to these names some few of these members may understand something of space and some of those something of asteroids, but ostensibly none would appear to have any aptitude or training or experience constructive to managing threats... and here the operative word in the term “Asteroid Threat” would be 'Threat'...

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Earth's geological and biological history is punctuated by evidence of repeated and devastating impacts from space. Sixty-five million years ago, an asteroid impact caused the extinction of the dinosaurs along with some 70% of Earth's living species.

And there is no empirical logic or rational argument that this could not happen again tomorrow.

Devastating impacts are clearly infrequent events compared to a human lifetime:

In terms of rational, deterministic information, the abstracted infrequency of aperiodic and randomly occurring events is irrelevant if not inherently false: only comfort-food-for-thought... A human artifact and basis for little more than hope. If we are going to consider responding to this threat and no longer gamble on the odds it is time to abandon hope as a reliable survival trait.

Tunguska, thought to be caused by the impact of a 45-meter-wide asteroid, is an event that occurs on average two or three times every thousand years.

Which, at any level, can not be taken that the distribution of these events is in any way actually periodic. The intellectual process of 'averaging' is the principal corruption of a sound empirical appreciation of what is in fact aperiodic and random.

However, when Near Earth Object (NEO) impacts occur they can cause terrible destruction, Up to and including Extinction of all life on Earth... including We The Species.

Astronomers today can detect a high proportion of Near Earth Objects and predict potential collisions with the Earth.

This should read: *may* be able to predict some portion of potential collisions. However, as things stand and are currently planned there is no reason for any confidence that this capability will result in the detection of the *next* impact threat. With the Survey approach and methodology the prospect of detecting an impending impact threat can only ever be a product of very good luck and serendipity, not one of design. Far more vigilance in the form of Surveillance is required.

Evacuation and mitigation plans can be prepared to cope with an unavoidable impact.

Plan B thinking for when Plan A fails due to inadequate preparation and training to successfully respond to the obvious need to deflect these objects from Earth impact.

the technical capacities exist to prevent such cosmic collisions with Earth. The keys to a successful outcome in all cases are preparation, planning, and timely decision-making.

And an honest, rational appreciation of both the full scope and scale and sheer magnitude of the threat and correspondingly, the full scope and scale and sheer magnitude the preparation, training and vigilance that will be required for a successful response.

These considerations make it inevitable that the international community, through the United Nations and its appropriate organs, will be called upon to make decisions on whether or not to deflect a NEO, and how to direct a proposed deflection campaign.

The United Nations is a world forum for diplomacy and statesmanship. Where nations go to wage war by other means... Other means will not do here. This business will only be resolved to a desirable outcome through the precise application of nuclear explosive devices. Once we come to appreciate that the magnitude of this threat is truly Global, in the sense that all life on Earth is at risk, our response should warrant something new... A global agency dedicated exclusively to the mission of defending the planet from this threat 24/7/52... forever. To piggyback this issue on the United Nations appears to be only an appeal to convenience... However, a Global expression and resolution of sociopolitical will *would* be in order here. A consensus ultimately constructive to an executable policy determination and creation of such a Planetary Defense agency.

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But the advanced telescopes and technology available today provide us with the necessary early warning and deflection capabilities to prevent these...

Should read: provide us with the *potential chance* for the necessary early warning... a great deal of space based detection capability needs to be developed and implemented before we could ever consider our vigilance here as anything reliable. Statistical probabilistic assessments lead only to hope and hope can never be a reliable tool for achieving a desirable outcome.

The physical and orbital characteristics of near-Earth objects, the capabilities of the early warning systems, and the performance of deflection alternatives are presented in greater detail in the appendices of this document.

Early warning here can only refer to discovered objects. Products of a random Survey effort. Otherwise, our current Surveillance capability, as such, amounts to little more than something on the order of one part in four million of the total 100 trillion, trillion cubic mile area of interest. The Next Large Asteroid on its way to strike Earth is in. In terms of Surveillance that would be the equivalence of turning on NORAD's DEW Line for six seconds a year...

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1. The early warning system must discover and track the entire cohort of sizeable near-Earth asteroids (approximately 500,000 objects)...

Which is impossible. Even if we do discover the Last NEO we can never know we have done so. We would have to somehow see and understand empirically that there are no more NEOs to be discovered anywhere else in the solar system. The problem here is that it only requires the mere possibility of one undiscovered NEO to constitute the unmitigated threat of one NEO impact... small, medium, large or extinction level. Further, the NEO population is dynamic. New NEOs are randomly perturbed from the Main Belt all the time. To afford us any measure of effective Early Warning capability, the current 'Survey' methodology must be supplanted with a real-time, full spectrum 'Surveillance' approach over the entire Area of Interest, 24/7/52... forever.

2. Spacecraft deflection systems should be designed and tested in demonstration missions that validate and provide confidence in their capability.

Given the potential magnitude of the threat and mass of any mission in response, including the first time we may need to do this, such deflection capability must not only be built and standing in its entirety before we see it coming but given the unknowability of whether or not we will have suitable (or any) launch windows available for such a mission, to be reliable our deflection capability must also be pre deployed in circumstellar orbit... before we see it coming... now!

Failing to provide a decision-making framework before a threatening NEO is discovered will result in lengthy argument, protracted delays, and collective paralysis.

Failing to fully appreciate this threat, codify a policy and delegate and fund an effective agency that will develop and implement a strategy to design, build, test, train personnel, launch and effectively pre position a suitable response before a threatening NEO is discovered, will likely incur realities and laws of physics that can not be overcome by mere reason and argument...

Once we see it coming not all the money in the world - not all the hubris, not all the resolve, not all the hope, not all the genius, not all the 11th hour road-to-hell-paving political good intentions mankind can bring to bear, altogether - will buy us more time.

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There are many more small asteroids than large ones.

Although true, despite the author's proximate intent, this does not afford a rational implication or logic that the *next* asteroid on its way to strike Earth is therefore small. The greater number of small asteroids does not justify preparation for responding to only a small asteroid threat. The fact of the greater number of small asteroids does not serve as a rational premise or assumption for any 'therefore' for what generally follows in the balance of this report. Which amounts to a grossly understated strategic context for any tactical considerations.

We understand that asteroid impact events are in fact aperiodic and random both in their occasion and magnitude. That a 1,000 meter asteroid is 1,000 times the mass of a 100 meter asteroid, and that a 10,000 meter asteroid is 1,000,000 times the mass of a 100 meter asteroid, and that consequentially the mission mass in response will necessarily be directly proportional to the mass of the asteroid. Then if we are going to aspire to any reasonable expectation of successfully deflecting the 10,000 meter worst case scenario we must increase the scope and scale of what follows in this report by a factor of 15,000 times the author's proffered 400 meter upper level threshold of this threat and 8,000,000 times that of the 45 meter minimum threshold.

What does it matter if on average, over the next million years, most impact threats will be small and we prepare to successfully deflect them if the *next* impact threat is large, and we do not, and we consequentially become extinct?

As a result, the decision to deflect an incoming NEO will often have to be taken when the probability of impact is 1 in 10, or even 1 in 100.

Given that these probabilities are a function of distance and time the larger the threat the more time (in terms of mission mass) required in response yet the size of the threat is not relative to probability. Therefore the larger the threat the lower the probability threshold for a mission commitment will necessarily have to be: 1 in 1,000 or even 1 in 10,000. Then you compound that cold objective math with the exponential increase in the magnitude of the loss to the point of extinction and erring on the side of caution becomes a force multiplier to the collective will... Probabilities become subordinate to the magnitude of the loss in our decision making. Time, Launch Windows Weather, Murphy's Sociopolitical/Economic Laws permitting of course.

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Humankind possesses the first two of the elements necessary for impact prevention: search telescopes and a proven spaceflight technology.

Make that the first *three* tactical elements. Thanks to the Cold War we have Nukes... According to NASA, used in an ablation approach: 100 times more effective in deflecting categorically small asteroids than the next best alternative. And for categorically large asteroids, where they can be employed in closer proximity to the asteroid, and given a modern device design, we could speculate 10,000 times more effective than the next best alternative. Effectiveness being defined as Delta Vee per ton of mission mass therefore as dollars, launch window availability, days of human endeavor and response time required to execute a successful mission.

The missing third element is the readiness and determination of the international community to establish decision-making capacities.

True... but only eventually. Achieving this objective would have a far greater expectation of success after the manifestation of National Policy determination and Agency delegation by the most capable individual 1st World stakeholders. Establishing both precedent and leadership for a discrete mission dedicated Global Agency to emulate. In the Real World, where these threats will be dealt with, where all things must be considered, can there be any doubt that whether it is before or after the fact of such a global will, that it will be the will of the United States and their delegated National Planetary Defense Agency that determines and dictates the fundamental tactics, strategy and decision-making in this? After all, what nation would ever subordinate the responsibility for its national security to any global body? Least of all the United States... and without the United States we can only hope that all our asteroid impact threats will be small.

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Recognizing that Near Earth Object impacts represent a global, long-term threat to our collective welfare, we recommend that international preparations, under the umbrella of the United Nations, are the only way

In that this threat is not merely long-term but perpetual, and that the scope and scale of any effective response would dwarf the budgets and responsibilities usually associated with the United Nations, and the potential consequences for failure dire to the point of the extinction of our species: this threat clearly warrants the creation of a new insular and discrete, exclusively dedicated international security minded body of its own. Planetary Defense business only! No sociopolitical diplomatic ambassadorial baggage allowed!

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the international community will face the decision to mount a costly deflection campaign while still uncertain that an actual impact will occur (an impact probability of 1 in 10, or lower).

In terms of any deflection mission commitment the greater the impactor mass the greater the mass of the mission in response so at some point the earlier we would need to begin to build and execute and look/hope for launch windows for a deflection mission. Therefore the further away from impact we would need to decide to deflect this threat (decades) and consequentially the less accurate the metrics that constitute the impact probability assessment. In other words, against larger impact threats we need to be prepared to implement correspondingly larger deflection efforts with much lower probabilities of impact. Probabilities of 1 in 1,000 are not unlikely. In practice, this probability will manifest geometrically as a probability/uncertainty ellipse. At 10% such an area would define a target 10 times that of Earth and the target area must be seen as not the 8,000 mile Earth but rather a 25,000 mile probability ellipse. Therefore the displacement objective would need to correspondingly reflect the radius of the ellipse. Since, given all the variables, there is no way to know if this uncertainty will be cured in time to be relevant to executing a deflection then at the point of mission commitment we must design/build/launch a mission relative to the size of the probability ellipse not just the Earth. Do the math...

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A key factor in this planning phase is the choice of deflection direction: whether to deflect the NEO ahead of or behind the Earth (increasing or decreasing the NEO's velocity).

Since this approach can only serve to decrease velocity, this limitation would eliminate the tactic of kinetic impactor from consideration as a reliable means of deflection before the fact. Before detection or even any precise placement of any impending threat within the ellipse, there would always be a 50% chance that it would require a far more massive mission to achieve a far greater displacement of the threat across the Earth in the long, and therefore wrong, direction.

The third phase is the time between the deflection maneuver and Earth impact. This phase must be long enough for the maneuver to displace the deflected NEO in its orbit enough

Which for categorically large asteroid threats this displacement period is generally seen as needing to be at least 10 years... suggesting a detection-to-impact window of something on the order of 3 or 4 decades. Even then it would tax the extemporaneous technological/industrial capability of a prepared world in good economic health to effect a successful response. Asteroid size/mass is the principal determinate for success in all phases of a response.

If a future direct impact is confirmed by the observer spacecraft, a second spacecraft would be deployed, capable of applying to the NEO a total impulse sufficient to avert an impact.

Given that from here and now we do not/can not know just how large the first asteroid we will actually need to deflect will be, and the first time we need to do this, this 'second' spacecraft may need to either be very, very large or in fact a virtual armada of vehicles. Flatfooted from Earth, even using a nuclear ablation approach at 100 times more effective than any second best alternative, a successful response could require the equivalent of hundreds of Ares IV mission launches... again, as always, launch windows permitting. Further, given all the new subsections of Murphy's Law we will encounter resulting in mission redundancy, and the very real likelihood that we may be executing a mission on the basis of a very low probability of impact - which will necessarily require displacement objectives defined by the impact probability ellipse, affording reasonable margins of error to this effort could make that thousands of Ares IV launches...

A kinetic impact (KI) mission is one in which an intercepting spacecraft crashes into the NEO in a precise manner, changing its velocity enough to cause it to miss the Earth.

The KI tactic can be dismissed for three reasons: First, it could be far too massive for anything over 100 meter threats. For a 1,000 meter threat, to impart 10 cm of Delta Vee would require 10,000 tons of impact mass delivered to the target. Whereas with nukes... as little as one ton (modern design). Second, A kinetic impactor at 10,000 meters per second relative impact velocity would surely be the single most effective way to blow the asteroid apart. Third, a KI approach can only reduce velocity and before the fact could only be considered reliable half the time. Therefore, in the context of this assessment, that would leave us with... Nukes.

In the exceptional instance of a NEO greater than about 400 meters... However, the frequency of NEO collisions where kinetic impact cannot accomplish deflection is low: approximately once every 100,000 years.

This strategic characterization of the existential threat here is wholly misleading. Perhaps little more than a product of hope in service to short-term-self-interest and an irrational fear of nukes. What part of aperiodic and random is not understood? The notion of any 'frequency' is nothing more than adopting a mathematical artifact as real. Even when expressed as an 'averaged relative frequency' it is still a corruption of empirical observation: an illusion, a complete abstraction and as rational information therefore false. What does it matter if we hold to the expectation that the next asteroid on its way to strike Earth will be small, and plan and design and build a means to deflect a mere 400 meter city killing threat when there is no logic or argument that the *next* asteroid on its way to strike Earth will not be a 10,000 m whole Earth extinction level event?

In dealing with NEO threats, the use of specific national assets, such as space hardware and technical manpower, will be required. Using such assets (e.g., observational, computational, analytic, and management capabilities) will reduce the risk to people and property irrespective of national borders.

Yeah, this is going to happen... The United States or any other 1st world power is going to subordinate the discretionary authority for the disposition of their national space programs and nuclear weapons systems to the United Nations...

A successful NEO deflection must modify the orbit of a threatening NEO... and that the deflection itself does not result in a subsequent impact within a few years.

Although remotely possible, in terms of random-chance probability once deflected such an asteroid is no more likely than any other asteroid to impact Earth in any given time. It simply goes back into the aperiodic and random mix of Near Earth Objects. There is no inherent or having come close any acquired tendency to come back and strike Earth. However, as a matter of random-chance, like all NEOs it rises to the level of a virtual absolute certainty that any deflected asteroid will sooner or later be back to strike Earth... It would just be highly unlikely that once deflected it will also become the *next* impact threat we would have to deal with. The odds for that would be truly astronomical. However, perhaps there is a 'as long as we are there' argument for blowing them up in here somewhere... at least the little ones.

If a threatening NEO passes close by the Earth in the decades prior to a potential impact, it will have to pass through a keyhole during that close encounter in order to subsequently impact...

A big If... Mere decades before an impact is a very narrow window in the life of a NEO. As a function of random-chance probability, although it is certain that any object that threatens a random impact with Earth by periodically crossing Earth's orbital path will also cross Earth's orbital path when Earth is only close to this terminal intersection. Given the timescale for the life of NEOs, the distribution of such close passages could be thousands of years before or after (theoretically) any point of impact with Earth. To posit that such a fortuitous circumstance would conveniently present itself within mere years or decades before the single impact point in the life of that object in service to our best interests would be to beg the work of some intelligent designer. Apophis has served to spoil what should be our rational expectations here...

Continuous force (CF) deflection methods, such as a gravity tractor, can provide only limited total impulse, but that impulse can be provided with high precision resulting in a well-determined (even a pre-determined) final NEO orbit, thereby being ideal for shepherding operations.

If (Big If) such rare rocket surgery is ever required, given the inherent tactical flexibility in the application of thermonuclear explosive devices in an ablation approach, and given enough preparation and training (surely required to a large degree for any tactic), we could develop the skill and ability to steer an asteroid into your shirt pocket. That said, given that any interception will take place tens if not hundreds of millions of miles from Earth, and that time will be of the essence, the same vehicle recommended here for addressing the shepherding problem would be indispensable as a platform and rapid delivery system for any nuclear or kinetic deflection tactic.

The vast majority of actual and potential NEO impacts will have experienced a keyhole passage in the years or decades immediately prior to the impact.

Or hundreds of millennia... This seems to be little more than a desperate and gross exaggeration designed to promote the notion of Gravity Tractors at the expense of a rational perception of the threat. Beyond random-chance and coincidence there simply is no consistent causal relationship or even high probability between a close passage and an impact event. From the perspective of an Earth orbit crossing asteroid relative to Earth's position in its orbital path, although more numerous throughout the course of their long life as a NEO, close passage events would be just as aperiodic and random in their distribution as their one-time terminal collision with Earth.

To rely on such a serendipitous opportunity to facilitate deflection would be like repeatedly casting a pair of 6 sided dice and relying on getting an 11 just before you get the 12. A strategy based on hope and very good luck. We can only ever afford to hope for the best after we have prepared for the worst. To hinge a strategy upon the occasion of very good luck is a product of optimized thinking and best case assumptions. It has the same rational mass as playing the lottery and thinking that you are actually going to win just because you really, really need the money.

No matter the odds, we can not allow any potential for good luck to discount the need for a standing, tested means to directly deflect impact threats sans any chance keyhole opportunity.

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What can then be said about the risk corridor is that if a particular NEO is going to impact Earth it will do so somewhere within this narrow corridor.

What should be said about the risk corridor *first* is that if a NEO is large enough, no matter where Ground Zero is, we all die. All there is, forever... gone. Restart Darwin's clock... again.

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4. Low Probability Mitigation Alerts... The cost of such an ongoing last minute warning operation will have to be weighed against the very occasional life-saving benefit by the world community.

Given that the magnitude of the loss in such “low probability” albeit sooner or later certain events includes the prospect for our extinction, the potential for suffering such events would be drastically mitigated once we think this all the way through and realize that all things considered, if it is to be based on something more than hope, we must afford that our Planetary Defense be built and pre deployed to circumstellar orbit *Before* we see it coming... which will effectively enable our seeing it coming sooner increasing our chance that we will successfully deflect it..

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The information basis for much of what we anticipate about the NEO environment is illustrated in the statistical size-frequency distribution diagram...

As such, much of what has been anticipated here is and always will be strategically irrelevant. The threat is and always will be “The Next Large Asteroid on its way to strike Earth” and what we need to know to respond to this threat can never be appreciated or approached “statistically”. Aperiodic and random both in their occasion and magnitude... How is this difficult?

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It is this rapid expansion of the inventory of these potentially dangerous NEOs that will inform us of the existence of many potential future impacts and ultimately necessitate decisions being made on whether or not to take protective action.

This section may be interesting... academically. But it only suggests that we desperately need to develop a means of deflecting the threat of statistics... Nukes? NEO population estimates and distributions and all derived abstract probabilities aside, the strategically relevant question here is, is there or is there not one large asteroid on its way to strike Earth in the next 100 years? The context for the answer to this absolute and binary problem lies in the rationale that all that is required to constitute the unmitigated existential Threat/Risk on one large asteroid impact in the next 100 years is the mere possibility of just one undiscovered asteroid...

With the current Survey methodology, finding The Last Large NEO and knowing we have done so is impossible. And the Threat/Risk, up to and including the prospect for our extinction, will persist... forever. The decision on 'whether or not to take protective action' is due... now!

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Deflection involving nuclear devices. The last resort-option, referred to by NASA, and therefore cannot be ruled out.

This can not be read to say that NASA referred to or in any way considered the tactic of nuclear ablation or the use of nuclear explosive devices to be a “last-resort-option”. From a professional engineering perspective, their objective and politically oblivious findings, were that nuclear ablation would be 100 times more effective than the second best alternative. By effective that means 100 times less mass to deliver on target per cm of Delta Vee required. That means a 100 times quicker response or 100 times more margin of error to ensure mission success or some combination of both, over the second best alternative. The characterization of a last-resort-option is a reflection of the authors' persistent irrational fear of nukes compounded by a transparent bias for the Gravity Tractor technology they advocate and have come to represent in this issue.

The nuclear option calls for due attention to relevant rules of space law and related regimes such as the Test Ban Treaties.

Rules and laws and treaties are changed when they fail to serve the best interests of the stakeholders. Particularly when they start to look like suicide pacts... After all, Nukes don't kill people. People kill people... and asteroids. Asteroids kill people. Plan A: Let's use Nukes to kill asteroids! And we can finally have something we can thank the Cold War for.

This “Call for Global Response” has failed to convey the full scope and scale of this threat and consequentially, the full scope and scale of any effective response. This is first about deflecting our extinction and the next extinction level impact threat: building and deploying gigatons of space capable Earth-friendly nuclear mines to the orbit of Mars before we see it coming... now. Instead, the authors have portrayed the asteroid threat from the perspective of their preferred technological response. The result is a hope based Planetary Defense where, despite the potential dire magnitude of the loss, they would have us trust in the odds and continue to gamble on the extinction level impact threat and prepare to respond to the small asteroid best case scenario. How is this wise?

Additional logics and arguments available on request.

A Million Miles A Day...

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Enclosure: A Million Miles A Day... Towards A Strategic Context
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