

Gaiashield Group



Open Letter to Congress:

**Comments on October 15, 2010 Response to Congress on Near-Earth Objects
Re: Section 804 NASA Authorization Act of 2008
by Executive Office of the President Office of Science and Technology Policy**

<http://www.whitehouse.gov/administration/eop/ostp/library/docsreports>

When we appeal to random-chance with an expectation of good luck, then the only tool at our disposal to engineer a desirable outcome is hope. And hope has never been a reliable survival tactic. And when our survival or well-being is at risk, we will always stack the deck, fix the race, load the dice... game the system. It's what we do. Limited only by our capability, we will always endeavor to leave nothing to chance. We understand that we can only afford to ever hope for the best after we have prepared for the worst.

Page 1

OSTP: *NEOs are asteroids or comets whose orbits bring them within a set distance of the Earth,*

GS: False: The term Near Earth Object (NEO) is in fact a misnomer. A NEO is an object that comes close to Earth's orbit: Near Earth-orbit Object. But NEOO does not roll off the tongue.

OSTP: (footnote) *in general terms, this distance is equivalent to about one-third of the average distance of the Earth from the Sun.*

GS: Only at its furthest margin. A substantial portion of the NEO population presently cross Earth's orbit: Earth-orbit Crossing Object or Asteroid (ECO/ECA) and constitutes the most proximate threat population.

OSTP: *with a portion of these objects traveling sufficiently close to make an eventual collision a possibility.*

GS: False: At random: without any recursive pattern in either their occasion or magnitude, over the course of the next billion years of the life of Earth, given the number, dynamics and distribution of asteroids in our solar system, our rational and deterministic understanding of the geometry and dynamics of the Solar System would dictate that, we will either deal with or suffer the consequences of ten to twenty million asteroid impact events. Luckily, most will be in the 10 meter range and relatively harmless high altitude airbursts but one to two hundred thousand will be 100 meter major city killers, and one to two thousand will be 1,000 meter human civilization killers, and ten to twenty will be 10,000 meter Chicxulub class extinction level impact events.

All these rocks are out there, in orbit around the Sun and on course to strike Earth and are effectively impact events in progress, *now*. Clearly, the very definition of a credible imminent and existential threat and clear and present danger. The first strategically relevant question is which one is the next large asteroid on its way to strike Earth and the vehicle for our extinction?

The Near Earth-orbit Object population is the most proximate candidate group for manifesting this effect over the next billion years and we can safely postulate that most of the current NEO population will, at random, sooner-or-later, come to strike Earth.

Eventual collision is not a mere *possibility*. Eventual collision is an absolute *certainty*.

OSTP: *No NEO large enough to present a hazard is known to be on a collision course with the Earth,*

GS: Which, were this a responsible assessment of this risk, should dramatically and clearly qualify and disclaim our merely emergent and nascent capability to know such things. Our present capability for surveillance at any given moment, weather permitting, would constitute only one part in four million of the entire 100 trillion, trillion cubic mile area of interest these objects are in. The equivalence of turning on NORAD's DEW Line six seconds a year. Further, as things stand, we never look inside Earth's orbit or much further than the orbit of Mars or very often more than fifteen degrees above or below the ecliptic.

What we definitively do *not* know now is which asteroid is the next asteroid on its way to strike Earth. And sooner-or-later, one way or the other, we will *know* that. If the absence of evidence of a threat were evidence of absence then the best path to our safety here would be to go blind.

With this assessment, what we *do* have here is a substantial absence of objective integrity.

OSTP: *and the probability of an impact by such a NEO is extremely low.*

GS: False: In the context of this thought and as stated, the kind of 'probability' referenced here can only be a conditional-empiric/evidential probability. Then, from this perspective, only the probability that at random, sooner-or-later, we will *not* suffer an impact by a NEO large enough to present a hazard is extremely low... less than a Non Zero probability. This threat is clearly a perpetual and existential condition of our existence... or our extinction, as the case may be.

However, if the OSTP has conflated probabilistic logics, as has been a common practice in this issue. The probability referenced is likely intended to be a random-chance/frequentist (statistical) probability where the assessment would necessarily need to be corrected or amended to refer to some increment of the relative frequency, either in terms of time or opportunity, for the random occasion of the event to occur. Since the characterization offered here is 'low' then that increment necessarily must be a relatively small portion of the relative frequency. The problem then, in terms of being relevant information, would be that when the increment for the random occasion of the event to occur selected is small then the probability will be small and when the increment for the random occasion of the event to occur selected is large then the probability will be large. Like saying that eggs at 10 cents a piece are cheap compared to eggs a \$1.20 a dozen... An academic slight-of-mind. At best, a kind of quantitative tautology and not rational information.

As for even trying to employ statistical probabilities in any form of rational decision making or strategic thinking or risk management effort, consider the prospect of playing Russian Roulette, once. The statistical probability that you will lose is only 1:6. Good odds and intuitively suggest a good outcome... so you might choose to gamble and pull the trigger.

However, with asteroid impact, it is as if you choose to play Russian Roulette once a day every day for the rest of your life... odds are 6:6 (100%) you won't survive the week. A really, really bad Gamble. Then the question becomes not *if* but rather *when* you will blow our head off. And since the daily 1:6 odds that we will do so on the first day we play are the same as the sixth, the daily statistical probability tells us nothing relevant to *when*... what day we will lose the game. Not information constructive to a Decision or a Strategy or any Risk Management process.

The use by scientists and 'experts' of the arational non analogous mathematical abstraction of relative frequency derived random-chance/frequentist (statistical) probabilities serves only to intentionally obfuscate the fact that these events occur at random. They would seem to want to address this fear by mitigating our perception of the threat rather than mitigate the threat itself. Because, in the end, such perspectives serve as little more than comfort-food-for-thought.

Empirically, this existential condition presents itself as a never-ending sequence of randomly occurring events: without any recursive pattern, in both their occasion and magnitude... *Period!* And if we would engineer an effective response to this threat it must only ever be seen and understood to be as such. To characterize or reorder or abstract the perception of this threat in any other form should be taken as a product of cowardice or fraud or delusion or ignorance or some combination of the above. We simply can not afford to fool ourselves here.

At present, we do not have anything approaching a completely comprehensive and absolutely precise real-time observation of every last NEO in the Solar System in order to afford us a true systemic conditional and evidential probability for the occasion and magnitude of the next NEO impact event. Until we do, to offer an abstract non analogous mathematical artifact in terms of a statistical probability, fostering an expectation that any such event will not or can not occur in any increment of time, is little more than creating a threat greater than the threat of NEO impact.

Further, OSTP's probabilistic assessment of the risk is presented a priori. A common knowledge and consensus mandated fact serving as the fundamental truth for our understanding of this issue. Much in the same way, when science was young and evolving, we long accepted the truth that the Earth is at the center of the universe... and ostensibly for the same reason. It is a truth we like. It makes us comfortable to believe it is true. Time to evolve... again.

As stated, this probability can not be true, or in any other form, can not be in any way relevant.

A Rational Threat Assessment

Strategically: Essential to the conduct of implementing a response

Fact: Earth will be struck by an asteroid again... Then again, and again, and again... forever.

Fact: Asteroid impact events are aperiodic and random: without any recursive pattern, in both their occasion or magnitude.

Fact: All that is required for one asteroid impact event is one asteroid.

Fact: All that is required for the risk of one near-term asteroid impact event, large or small, to persist complete and unmitigated, is the mere possibility of just one undiscovered asteroid or the mere possibility of one asteroid/asteroid or comet/asteroid collision.

Fact: We do not know which asteroid is the next asteroid on its way to strike Earth.

Fact: We do not know when the next asteroid on its way to strike Earth will strike.

Fact: We do not know how large the next asteroid on its way to strike Earth is.

Fact: We do not know when we are going to know which, when or how large.

Tactically: Essential to the response

Those conducting current NEO survey efforts hold that in discovering and finding a substantial portion of the ~1,000 Large NEOs estimated to not be apparent impact threats for the near-term, they have substantially reduced the abstract and academic statistical probability and therefore the near-term existential risk of Earth impact from this population.

Fact: Neither the expression or observation of a randomly occurring event alters or in any way effects the statistical probability of a randomly occurring event.

Fact: There is no constructive or causal relationship between any specific impact event and the asteroid population in general. There is no critical mass or tipping point that can be effected by either the existence of more or less asteroids or our perception of their systemic behavior. As a consequence, conditional probabilistic assessments can only apply to these objects individually.

Fact: If there were in fact either one Large NEO on course to strike Earth in the near-term or if there were no Large NEO on course to strike Earth in the near-term, we would expect to find 999 of the ~1,000 objects estimated to *not* be on course to strike Earth in the near-term. If we have found only what we necessarily should have expected to find, how then can we then change our expectation? How then can we passably change our initial perception and postulate of the risk?

Fact: In that a statistical probabilistic calculation of the risk can not tell us when to respond to any given threat, such an assessment would be tactically irrelevant and useless.

Fact: There are only two ways to successfully definitively resolve the near-term tactical risk of large asteroid impact: A) Find The Next Large Asteroid on its way to strike Earth, as such, or B) Discover and find safe the Last Large NEO in the Solar System. Anything less is failure.

Fact: What this survey has done is reduce Uncertainty, to some degree. Which is not a factor of their abstract statistically expressed risk but rather one of the rational conditional strategic risk as essential to implementing a response. Then, from that binary and absolute perspective, there is no reason that the next large asteroid they discover will not be a Certain near-term impact threat. However, since we have no standing tested means to defend ourselves from this threat as it presents itself in any size or term: near or long, the benefit of reducing any Uncertainty is only potential. In 2007 NASA's PA&E determined that even with proposed new heavy-lift capabilities they could only expect to reach 60% of the total NEO population considered. That would only get us to the 200 to 300 meter threats and did *not* include any warrants for successful deflection.

Academically: Without apparent use

To afford the OSTP some benefit of the doubt, their probabilistic assessment here may have been a simple misstatement. If astronomers and aerospace engineers were as clumsy with their mathematical semantics as they are with their linguistic semantics we would still be observing the Sun as it revolved around the Earth. The current mantra and meme of the scientists and academics would be: "The statistical probability for large asteroid impact in this century is low".

If this is the logic that the OSTP intended to convey then the assessment is not so much false as it is irrelevant in this probabilistic form and tautological in its characterization as 'low'. The same kind of gambler's rationalization the government of Louisiana used 15 years ago when they ignored the Army Corps of Engineers recommendation to improve the levies of New Orleans to withstand the effects of a Category 5 hurricane. And we all know how that worked out.

The probability in this probabilistic rationale is not deterministic or in any way predictive as to any *when* but rather only a product derived from an expression of how many randomly occurring events, reordered in the artifact of an averaged relative frequency, are likely to occur over a large

period of time. At best, it is only ever a metric of Random-Chance, an abstraction, and never a metric of any empirical condition. It is the kind of probability where, although you might choose to bet a hundred dollars on the outcome, it is never the kind of logic you would rely upon when the lives of your children and grandchildren are on the line. More to the point, never the kind of logic that any *government* should *ever* rely upon regardless of how much or what is at stake.

Then, the characterization of this probability as 'low' is only relative to a small increment of time. In any small increment of the averaged relative frequency interval of one event the probability is always small. While in any large increment of that interval the probability is always large. In other words, the probability for large asteroid impact in any 100 year increment of the life of Earth is always 'low'. Whereas the probability for large asteroid impact in any 100,000 year increment of the life of Earth is always 'high'. There can be no 100 year increment where the probability is ever 'high'. By this logic, the probability of large asteroid impact can only be said to be low in the Next Century and be true because it is low in every century of the life of Earth. Even if you looked out your window and saw a 10 km asteroid 10 seconds away from impact the daily statistical probability for such an event would be 1 in 36.5 billion and as such... 'low'.

Fact: Statistical probabilistic assessments, as non analogous mathematical abstract artifacts, are completely unsuitable for any sound and rational Risk Management, Strategic Thinking or Decision Making process and should be reserved only for setting the line in Vegas.

Fact: Statistical probabilities are derived from the averaged relative frequency of what are in fact randomly occurring events. In that they are the product of either the corruption of a sound empirical observation of this condition or a flawed rational assumption ignoring this condition then, either way, statistical probabilities should be anathema to Scientific Method.

General: The problems with probabilities

Those who choose to reference and traffic in probabilities should at least understand that there are two kinds of probability and appreciate the fundamental differentials in their logics and application. Because despite the unfortunate inconvenience of having a common nomenclature and semantics, these two probabilistic perspectives are unique and discrete from, incompatible with and non constructive to each other. Most importantly, one is rational, and one is not.

Conditional-Empiric/Evidential/Bayesian Probabilities are the core of rational Decision Making. They are what Politicians use to orchestrate their campaigns, what CEOs use to conduct their businesses, what Stock Brokers use to select their investments, what Generals use to prosecute their wars and what aerospace engineers have used to estimate the future position and potential for impact of the asteroid Apophis with Earth... or not. They are what we use to Manage Risk and manipulate things in the Real World... What we use to get us to work in the morning. This is what we use to make predictions for the future based on the laws of physics in a deterministic universe. The basis for foresight. The ability to make Conditional-Empiric/Evidential/Bayesian Probabilistic assessments has enhanced our evolution far more even than the opposable thumb.

Random-Chance/Statistical/Frequentist Probabilities are what the boys in Vegas use to determine the payout on games of chance... and what the astronomers et al have used to obfuscate and misconstrue the existential nature of the threat of asteroid impact and our Extinction by NEO. And from time to time what we rely upon as comfort-food-for-thought when we are faced with a threat we can do nothing about. Is it any wonder then, that Academics embrace them so easily?

What is at issue here is not simply the semantics and dialectic and rhetoric of the OSTP, which in its precision and rational integrity is clearly inadequate to the task at hand. What is at issue here in principle, is that it is only statistical probabilistic sophistries and comfort-food-for-thought and academic-slight-of-mind that stand between the survival mankind and our Extinction by NEO.

Here, Scientists have set their perception and argument to mitigate only our Fear at the expense of promoting a rational response to the Fearful Thing itself. Consequentially they have served to only obfuscate the scope and scale and the dire and urgent necessity to begin responding to this threat in its fullest Worst Case manifestation... *Now!*

If we expect to hold a reasonable expectation of successfully responding to this threat as it will present itself in fact, we need to successfully *understand* how this threat, in fact, presents itself. No probabilistic sophistries or comfort-food-for-thought or academic-slights-of-mind allowed.

If we persist in failing to understand probabilities, fail to understand what they do or do not tell us and when they are rational and relevant and when they are not, it will be the death of us all. And perhaps, deservedly so.

The threat of asteroid impact is one that we understand we can manage to its worst case manifestation and that it will always include the random prospect for our extinction. As such, the most important thing Mankind can ever know will always be which asteroid is The Next Large Asteroid on its way to strike Earth and deflecting it will always be the most important thing Mankind can ever do. At any cost. By any means necessary... Failure will *never* be an option.

How can we consider ourselves wise and leave the survival of the species to be defended from the prospect of our Extinction by NEO only by some rationalization that the probability is *low*?

Page 2

OSTP: *Any strategy for addressing the potential hazard of a future NEO impact depends in the first instance on the detection, precision tracking, and characterization of potentially hazardous space objects.*

GS: False: Or merely only true in a chronological sense. Tactically speaking, we do have to identify an impending impact threat prior to destroying or deflecting it. However, strategically speaking, there is no point to finding an impending impact threat unless we already have a standing and tested means to deal with it, entrusted to a qualified and trained responsible Agency delegated and enabled by a comprehensive codified Policy. You don't go big game hunting and only take a scope, then go running back to camp to invent, build and learn to shoot a gun when you see a Grizzly. You get lock-cocked and loaded for bear before you ever step into the woods.

Here, in terms of preparation and training and vigilance, it is not a matter of *first* but rather of thinking we can segregate the intrinsic tactical elements of our response: Detection, Deflection and Agency, likely because these functions are represented by different professional skill-sets. From a strategic perspective these elements must be seen as inseparable and to be developed simultaneously. Otherwise, the chain of our response will only be as strong as its weakest link.

The three point Battle Cry of the astronomers today is Find It Early, Find It Early, Find It Early. Which leaves all the heavy lifting to the aerospace engineers who are in the corner chanting Build It Now, Build It Now, Build It Now... In the end, just because we *need* to 'find it early' does not mean we *will*. *When*, will always be a matter of random-chance. Then it will be the random-chance *size* of the asteroid and our level of *readiness* that will determine what will be early *enough*. If we expect to engineer a desirable outcome through technology and method, we must approach this threat from both sides simultaneously. Strategically, the objective would be to *first* endeavor to mitigate and ultimately eliminate the random-chance disadvantages of small detection-to-impact windows and large impactor threats by developing a high level of standing deflection capability and maintaining a high state of readiness. The ad hoc extemporaneous post detection approach will not always work and may well not work next: Think Random!

This detection *first* strategy would fit only a strict objective empiricist scientific perspective wherein we would wait until we discover an imminent impact threat before we build a means to deflect it. Which, if we let scientists do our subjective security and risk management thinking, would be no different than waiting until your house is on fire before you build a fire department. Or waiting until the barbarians are at the gate before you recruit and train a city guard.

So *first*, we need to do *both*. Develop our detection and deflection capabilities equally. Otherwise we have nothing. The problem with this approach is that in order to maintain parity in degree of effectiveness, the cost of initiating and developing a deflection capability will be hundreds or even thousands of times greater than that of deflection. So here, *first* may also reflect caution at OSTP: taking the cheap and easy Gambler's path until they can see just how much fear is truly on the table. A simple failure of qualified and diligent research and of timely understanding.

When you ask a Scientist what to do, expect nothing more than an objective scientific answer. For sound subjective and relevant strategic thinking constructive to effective risk management decisions, go to minds that have some acuity, training and experience in thinking strategically and managing risk and shaping and informing sound decisions for a living. Think DoD!

Page 3

OSTP: NASA notes that a large number of the NEOs predicted to exist still remain undiscovered, and many of these could present a potential future hazard to the Earth.

GS: Misleading: Asteroids that have been discovered clearly still “present a potential future hazard to the Earth” even in the near-term. Aside from the fact that over the long-term the current NEO population is the most proximate candidate population for all the impact events that are certain to occur over the next billion years, any random-chance asteroid/asteroid or even asteroid/comet collision could put any discovered NEO on a near-term impact trajectory... and as things stand, there is no reason to think that we would ever even know it.

These objects collide with each other all the time. This dynamic is a fundamental and persistent causal element in the creation of the current 10 million NEO asteroid population as well as a perpetual randomizing force when considering the impact of these objects with Earth. Eros, the one asteroid we have visited, has over 100,000 impact craters visible on its surface, with every impact constituting some degree of change in its orbital path. Since most of the objects we are concerned with have elliptical orbits, they spend much of their time traversing the Main Asteroid Belt with its billions of potential asteroid/asteroid impact threats. If a large asteroid should collide with a small asteroid with only 0.1% of the mass, the larger asteroid could be displaced in its orbit by as much as a million miles in as little as three years... And again, as things stand, there is no reason to think that we would ever even know it.

Given the limitations of our nascent capability to observe and plot the orbits of all these objects in real time, no asteroid, be it PHA or ECA or NEO or Rogue or Main Belt or Trojan, large or small: undiscovered or discovered, can ever be dismissed as an existential near-term threat and the next asteroid on its way to strike Earth..

OSTP: latest estimates for the total population of NEOs below one kilometer in size indicate that these 6,416 known objects represent less than five percent of the total number of NEOs projected in this size category Thus, based upon simple probability, it seems quite likely that there are more than 993 objects of this smaller size traveling in orbits potentially hazardous to the Earth.

GS: So if we do the simple math on the simple probability that would be times 20 or say ~20,000 PHAs from a population of say ~130,000 NEOs below 1 km and greater than 100 m. Since these

objects are smaller and harder to see and therefore more difficult to find, and it has cost NASA about \$50 million to find ~7,000 objects over the last 12 years, if we then include some indirect cost for the USAF's contribution and costs deferred by international efforts... that's ~\$10,000.00 per rock or \$1.3 billion. We're going to need a bigger budget. Wait... there is no budget for this. Just another unfunded mandate. Which would be the same size drop but in a far much larger bucket if this responsibility were tasked to DoD and by extension the militaries of the world.

OSTP: *In light of such considerations and consistent with its Congressional direction, NASA has continued to pursue additional capabilities for a NEO surveillance program able to detect, track, catalogue, and characterize NEOs down to 140 meters in diameter.*

GS: This would be in conformance with the Brown Act but at 140 m the population is only estimated to be 20,000 objects. But still at \$10,000. per rock: that's \$200 million. But that would only afford the discovery costs. We have no basis for determining what the cost of perpetually tracking, cataloging, and characterizing will be. NASA can “pursue additional capabilities for a NEO surveillance program” until they run out of planet, but in the end, you don't get what you don't pay for. Unless of course this administration has taken the default position and chosen to take the cheap and easy path and Gamble after all. Take the Risk instead of Managing the Risk. Question is, *Do we feel Lucky...*

Page 5

OSTP: *President's New National Space Policy specifically directs NASA to "pursue capabilities, in cooperation with other departments, agencies, and commercial partners, to detect, track, catalog, and characterize near-Earth objects to reduce the risk of harm to humans from an unexpected impact on our planet and to identify potentially resource-rich planetary objects."*

GS: Forever... if this policy will be commensurate with the existential nature of the threat. But where is the dedicated funding to enable this policy? Just another unfunded mandate.

Then, and to the greater point, a Policy “to detect, track, catalog, and characterize” ...then what? What do we do when we see one coming? This is like watching a dog chase a car. You have to wonder what he's going to do when he catches it? Where is the bit where “We The People will endeavor to deflect or destroy these objects as they present themselves to be impending Earth impact threats.” Where is the codified National Policy and bold expression of Political Will to actually defend ourselves from this perpetual Cosmic threat? A Policy that would constructively justify Agency delegation and the appropriation of suitable Funding. This much, this Giant Step for Mankind, this punctuated equilibrium in the evolution of our species, simply can not be left as tacit and to Random-Chance and Hope and ever be expected to work successfully.

Page 8

OSTP: *an essential first step in in preparing for any future NEO mitigation and/or deflection activity is to continue to enhance our capabilities and efforts for detecting these objects. The goal of these efforts should be not only to identify potential NEO hazards, but also to provide as much advance warning of a threat as possible in order to enable more options for mitigation.*

GS: From a strategic perspective: what is essential to the conduct of implementing a response, we do not want to *need* options here. We want the engineers of technologies and energies to provide us with a One-Tactic-Fits-All-Size-Threats approach. Then we want to do as much as humanly possible before we need to implement our response *before* we see it coming. The notion of actually *planning* to respond from an ad hoc extemporaneous 11th hour Hail Mary undeployed hasty post detection of an impending impact threat position is anathema... strategically speaking.

To wait until we see it coming before we set a policy, delegate an agency, send a characterization mission, then decide to respond and select, develop, build, test, train and launch a tactic for a mission that may mass thousands of tons to deflect the next asteroid on its way to strike Earth is nothing short of insane. As engineers of method, Strategists would Leave Nothing to Chance... and here: At Any Cost and By Any Means Necessary. First: Preparation, Training, Vigilance!

Page 9

OSTP: *Accordingly. I recommend that NASA take the lead in conducting these foundational analysis and simulation activities as a key preparatory step, with NASA's role at this early stage revolving primarily around the options analysis and an assessment of the technologies that may be applicable to NEO mitigation/deflection (along with preliminary research and development activities concerning such technologies and capabilities, where appropriate).*

GS: This would be the first task for a duly delegated National Planetary Defense Agency. With an overall goal and responsibility to determine and develop a Strategy: what would be essential to the conduct of implementing a response, it would first be necessary to determine exactly what that response would be. Determine the most effective Tactic. Here, no Strategist *wants* to have to have multiple options. All Strategists *want* the Silver Bullet: One-Tactic-Fits-All-Size-Threats. A fighter/bomber/tank/gun/boat tool that can be applied to any situation in various configurations.

A Great Strategist is a logistical genius. He understands that multiple options, a basket of tactics, would require multiple developmental and logistical tails and that the net effect would be a dilution of the always limited resources available to produce, improve and maintain any potential Silver Bullet. Effectively reducing the potential to have more than he needs to ensure success. Great Strategists always *want* to be able to apply Clearly Superior Force... *Always*.

As such, the subjective Strategic objective of this recommendation by the OSTP should be taken as the determination of the Single Best Tactical Approach to dealing with this threat. Determine, test and prove the Silver Bullet. This is not some academic super-sized science fair project to learn something about those tactics proffered that will clearly only work at a cost of far greater mission mass and/or in a very limited set of circumstances or not work at all even on paper. In this direction, from the final report of the NASA Ad Hoc Task Force on Planetary Defense:

Until non-nuclear techniques of comparable capability are proven, NASA should collaborate in nuclear deflection technique analysis and simulation.

Merely because a technology can imaginably be used to deflect an asteroid does not qualify it as a potential means for actually employing it in the crucial defense of the planet.

Further, the results of NASA's PA&E 2007 Near-Earth Object Survey and Deflection Study, as an initial technological feasibility analysis and differential guide, has already concluded that the modeling of nuclear alternatives indicate that, in terms of mission mass, nuclear alternatives are 100 times more effective than any of the Second Best Alternatives. Subsequent studies have extended that mass differential to 2,000 times and expanded the conditions for feasibility to be universal and comprehensive. Therefore, the nuclear alternatives need to be considered as the base-line and control example to which all other tactics are measured. To have that empirical standard, what is required now is a demonstration of concept: empirical proof. We need to both deflect and destroy an asteroid in Space... with Nukes. Test the apparent Silver Bullet. Then, every few years or so, do it again until we can do it to perfection. Practice/Practice/Practice.

What is of note here is that the OSTP's recommendation for NASA to conduct a foundational analysis was done four years ago. I guess even institutional memory ain't what it used to be.

OSTP: *In my view, this recommended framework is an appropriate and effective way forward with regard to NEO protection issues at this stage. It is important to note, however, that this approach will be subject to further review as more information about NEO mitigation and deflection costs, approaches, and requirements comes to light. This in turn could lead to different philosophies on agency roles and responsibilities in this arena as we continue to consider the most effective way to address these potential threats.*

GS: Since this issue is about nothing less than diverting our sooner-or-later Extinction by NEO, the only philosophy allowed here would be the primal doctrine of the Survival of the Species. And in that direction, we Leave Nothing To Chance: At Any Cost and By Any Means Necessary. Failure is *Never* an Option. And the only rationale we can tolerate here would proceed from a postulate of the Laws of Physics in a deterministic universe. No gambling on random-chance probabilities. No ideological artifact founded hope. No sociopolitically correct bias of any kind. No Quarter. No Prisoners... The only philosophy allowed here is Whatever Works... *Best!* How can anything less be considered wise, or even sane?

Unless of course you are a Scientist. Then, you let Nature take its course and the philosophy would be to objectively observe and take copious notes on the demise of a species. No fear here.

Precautionary Principle: Governments should take action to prevent harm even when it is uncertain if, when or where the harm will occur.

So, we have taken the question of Agency delegation to a Scientist and he has recommended more scientific research and study... no surprise there. The clear implication here is that after such a campaign of scientific inquiry on various technologies for destroying or deflecting these objects, the most effective technology will indicate the most qualified Agency to be strategically responsible for developing and executing our Planetary Defense.

By this logic, if the results conclude that nuclear explosive devices are the most effective approach for dealing with these threats (which was determined to be the case by NASA in 2007) then the best Agency would be DoD. But then the Kinetic Impactor approach: to hit things with projectiles traveling at high velocity and put-steel-on-target, would also indicate the expertise of DoD. However, what Agency would a Gravity Tractor approach possibly suggest... John Deere? Except, as the world's greatest logistical agency and expert in moving things (land, sea, air or space) again this approach would suggest DoD as principal agency. In fact, it would seem that by this metric, NASA, as a delivery system and tactical logistical element in this endeavor, would be disqualified as a candidate for the role of strategically responsible Agency altogether!

Or is it perhaps that what we have here is a newly formed Politician just using Science as a rug under which he can sweep problems and questions he does not have the courage or wisdom or authority to address? After all, Agency Delegation is an extension of National Policy and a matter for the Chief Executive, not his Science Advisor.

Surely there are more, and are more important, strategic considerations: what will be essential to the conduct of implementing a successful response, than who is most familiar and controls the tactic we will employ to deal with this threat. Then, it would seem that in terms of responsible National Agency the principal qualifying deterministic elements in any decision making process here should necessarily include having an organic Space capability. Which would limit the field to only NASA or DoD. But even more, a tested experience for going into Harm's Way and successfully achieving the mission would be a prerequisite. Ability to Respond successfully is the essence of Responsibility... not just where to place the blame when things go wrong.

Clearly, as a principal logistical element, NASA must be at the *tactical* core of such an Agency. However, at the responsible *strategic* level the exclusively qualified and experienced risk and threat management mindset of DoD is required. After all, this is not about Science or Man in Space but rather Security and the Survival of Mankind. Not about National Space Policy but rather National Security Policy.

Setting aside DoD's two hundred year evolved security mindset, and its two hundred year history of successfully defending the security and interests of this nation, and their standing and suitably fungible threat management/defense budget (and by extension the military budgets of the world), and the fact that every nation on Earth has a military which can serve as a common vehicle to build a *Global* Planetary Defense Agency and that within any such Agency of Agencies the United States should endeavor to match the influence of both Russian and Chinese national space programs which are integral elements of their militaries. Aside from the fact that this business will only ever be effectively managed to a desirable outcome with the surgical and expert application of thermonuclear explosive devices... All this aside, if we recognize that sooner or later this *will* evolve to become a Global issue involving if not every nation on Earth at least those that have a developed space capability, and as such every space agency on Earth manifest in an Agency of Agencies... Then, sooner or later US Space Command (USSTRATCOM), in terms of budget arguably the second largest space agency on Earth, *will* have a major leadership role in Planetary Defense. And in such things, sooner is *always* better.

Will the United States represent its interests with two discrete space agencies demonstrating an inability to even create a single coherent National agency and effectively abandon any pretense of leadership at the Global level? Or will we merge NASA and DoD at this point and for this mission into a single National Agency comprised of the relative mission appropriate skill sets and relevant resources inherent to both *now*? If a limited and ad hoc merger of these agencies will clearly be our rational and inevitable response in the end, then such a merger should be the nature of our response from the beginning. Let those best able to respond, shape and determine the Response and the Rules of Engagement required for a successful outcome. This is not the time or place to lead with strategic dilettantes or professional bureaucrats or political expeditors.

Consider that if for some reason we did have to choose between NASA and DoD as the sole National Agency representing the United States in a Global Planetary Defense Agency: choose between the civilian/scientific and the military/security aspects of our national space capability, given the dire nature of the mission would we not clearly be far better served with the inherent capabilities DoD here? How could any National Planetary Defense Agency that did not include the expertise and strategic acuties and resources and mind-set of DoD ever be wise? Doing this right will be a journey of a thousand miles. Let this first bold step be in the right direction.

We are coming to understand that the Universe is a dangerous place. It does not suffer dilettantes or cowards gladly. So let's try this again. Only this time, let's leave OSTP out of it. Go through the front door with the core of the issue and directly solicit the attention of the President for a codified National Planetary Defense Policy determination. As a simple matter of practical execution, a National Planetary Defense Agency delegation will necessarily follow.

A Million Miles A Day

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