

# *GaiaShield*



## *The Falling Stars War*

*Once upon a time there was a Big Bang...  
Cause/Effect, Cause/Effect, Cause/Effect  
and 15 billion years later, at A Million Miles A Day,  
we have some rock; hair-on-fire,  
screaming around our Solar System  
on course to the subjective center of the universe.*

*On impact it will generate the equivalence of 1.2 Hiroshima  
bombs for every man woman and child on the planet:  
Game Over. No Joy. All there is, gone... Forever.  
Restart Darwin's Clock, again.*

*Since this threat will always include the prospect for our  
extinction by some random large asteroid impact event,  
and because we can, knowing which asteroid is  
The Next Large Asteroid on its way to strike Earth  
will always be the most important thing Mankind can ever know.  
And deflecting The Next Large Asteroid on its way to strike Earth  
will always be the most important thing Mankind can ever do.  
And being prepared to effectively respond to the threat of  
The Next Large Asteroid on its way to strike Earth  
will always be the most important thing Mankind can ever be.*

**AND WE ARE NOT PREPARED.**

*We have neither the standing tested capability  
to deflect even the smallest of these threats  
nor any reliable means to even see them coming.*

*What is required is a network of space based  
full spectrum surveillance observatories  
strategically deployed throughout the Solar System  
informing a squadron of nuclear armed BattleStar  
Class interceptor craft stationed to the orbit of Mars  
manned and operated by planetary defenders  
trained and experienced to the point of expertise.*

*We need to either build an effective Planetary Defense or  
expect to sooner-or-later go extinct by asteroid impact.  
This existential condition will never change or go away.*

*What we decide to do in order to effectively deal  
with this Cosmic Threat today we need to do forever.  
And what we can foresee we will need to do tomorrow  
we need to begin doing today!*

*Time is simply not on our side...  
The Sky Is Falling... Now!*

*And we start The Falling Stars War...  
here: <DearPOTUS.Com>*

*The Universe is a dangerous place.  
It does not suffer dilettantes or fools gladly.*

*This Is War!*

*Not some super-sized candy assed science fair project...  
Si vis pacem in Terra, para bellum et Stellae!*

# *The Sky Is Falling... Now!*

## **The Astronomy**

The geometry and dynamics of our Solar System relative to the asteroid and comet impact threat: In the beginning, sometime after The Big Bang, matter began to accrete into stars and planets... and locally, many smaller objects in orbit around our Sun. A large belt of these smaller objects, asteroids, 100 million miles wide and 25 million miles deep, formed between the orbits of Mars and Jupiter. Billions of rocks, also known as Minor Planets, ranging in size from basketballs to the Texas sized Ceres and likely tens of thousands in the 10km or greater Dallas sized Chicxulub Class extinction level range.

As these Main Belt asteroids orbited below Jupiter, the gravity of the gas giant pulled on these asteroids slightly perturbing some of them from stable circular orbits into unstable elliptical orbits crossing the orbits of other asteroids putting them at risk of the occasional asteroid/asteroid collision resulting in even greater degrees of perturbation. Add to that, a similar effect generated by Mars orbiting below the Main Asteroid Belt, and the occasional passing collision with Comets and Centaurs randomly perturbed and falling from the Oort Cloud and the Kuiper Belt, which are in and of themselves existential Earth impact threats. And these forces and conditions persist.

Today we have a population of millions of rogue asteroids in highly elliptical, relatively random and unique and discrete orbits, colliding not only with each other, but with the extant Main Belt population and becoming even more dramatically perturbed and eccentric while also generating new rogue asteroids. As well as becoming perturbed by just passing close to the inner planets and their moons and, at random, occasionally end up crossing the orbit of Earth as impact threats. We understand that at random these objects will continue to become perturbed into new orbits and that we have enough rational empirical evidence to know that these objects have, and will continue to strike Earth... Forever. It's like some Rube Goldberg designed astronomical three dimensional Pachinko machine arcade out there... all the way out to the Oort Cloud... and we are in the middle of it all: Chaos.

But keep in mind that as a threat, this is now and forever will be about just one rock at a time:

The Next Large Asteroid on its way to strike Earth.

## **Relevant Existential Conditions**

Five strategically relevant and fearful core existential conditions the scientific experts have either failed to account for or express in shaping and informing their understated clearly Hope Based assessment of this Cosmic threat:

A) The general prospect and threat of asteroids striking Earth is an existential condition that will never change and will persist... Forever.

B) There is no imaginable strategic response we can direct against the existential condition and threat of asteroid impact systemically: we can not change the laws of physics and affect the condition of impending Earth impact threats or beam these asteroids to a Galaxy far, far away. We can only respond to this threat tactically, as asteroids become manifest as impending impact threats individually, One Rock at a time. Therefore, the only strategically responsible definition of the threat would be in its tactical definition: 'the next asteroid on its way to strike Earth'. And within that, given the greater magnitude of loss, the best definition of the threat would Forever be 'The Next Large Asteroid on its way to strike Earth'.

C) The principle or even proximate cause of asteroid impact events would be some random and dramatic kinetic or gravitational perturbation. The proximity of an asteroid's orbit to Earth's orbit is generally irrelevant. Consequentially, the existential condition is that any asteroid of any size

anywhere in the Solar System: PHA, NEO, NMO or Main Belt, discovered or undiscovered, can become perturbed into an Earth-orbit crossing orbit and its inevitable or even immediate impact with Earth, at any time. Therefore, the only rational expectation we can hold here is that The Next Large Asteroid on its way to strike Earth has already been or will eventually be generated by some random and dramatic kinetic or gravitational perturbation. And that no asteroid in the Solar System can ever be considered 'safe' unless it has been completely destroyed.

D) There is no imaginable Cosmic mechanism or existential condition that could generate asteroid impact events periodically, nor is there any empirical dated Earth impact crater evidence that suggests that such events are periodic. And since, relative to each other, at any given time the size, distribution, speed and direction of asteroids in our Solar System is random: without any recursive pattern. And further, that these variables are dynamic, rationally we can only conclude that their perturbation into Earth-orbit crossing orbits or direct Earth impact threats will occur at random. Therefore, we can understand and characterize asteroid impact events as completely random: without any recursive pattern or periodicity, both in their occasion and magnitude.

E) The asteroid population contains thousands of asteroids large enough that if Perturbed into becoming The Next Large Asteroid on its way to strike Earth, will, at Random, result in the extinction of Mankind. Therefore our rational expectation for the next asteroid impact event should Forever include the existential condition of a 10km Chicxulub Class extinction level event. Since Hope is not reason, there is simply no reason not to. Not now... not ever. And as a consequence, all tactical and strategic considerations should refer back to this reality.

Conclusion: Therefore, once we find the courage to appreciate the true scale of this clear and present danger and the wisdom to build and deploy a commensurate Space Based thermonuclear response, the recurring nightmare of any honest Planetary Defender should be that we would complete such an endeavor almost in time to successfully defend against such an impact event. In other words, there is no such thing as too much urgency here. Time will never be on our side.

### **Relevant Tactical Conditions**

Ten strategically relevant and critical core tactical conditions the engineering experts have either failed to account for or express in shaping and informing their Best Case Assumption based overstated assessment of our capability to respond to this Cosmic threat:

#### **A) Launch Windows**

When NASA looks at its long term/five year plans for space missions the first element on their list of criteria is having a launch window. How much force/speed, how large a rocket, will be required to rendezvous with another object in orbit around the Sun with a given payload mass. Here, since the orbital elements of every asteroid in the Solar System are unique and discrete from each other and can be rationally considered relatively random; and we can not know which asteroid is the next asteroid on its way to strike Earth until we see it coming, we will not know when or even if we will have an optimum, or any, launch window to implement our response through. The prospect of having a suitable launch window will always be a matter of random chance and good luck. In the case of the larger threats and/or shorter warning times and the need for multiple rocket launches, with every rocket the odds against successfully implementing an effective response increases exponentially. Or Lady Luck could decide it should rain or snow or hail on the only day we have to Save the World and No Joy... all there is, gone... Forever.

#### **B) Margins of Error**

- Target Mass: The mass of an impact threat can range from 1 to 5 tons/cubic meter - water ice to iron ore. Which directly affects the force required and mass of the deflection mission. Without a precursor mission, which could take as much as 10 years, we have to at least afford a mission multiplier of 2x based with a most statistically likely composition of stone at 2 tons/cubic meter.

- Impact Probability: Given that we are looking at an object that will, in fact, impact Earth, at 30 years before the actual event, it will be unlikely that we will be able to meter its position relative to Earth accurately enough to afford us more than a 1 in 1,000 conditional probability it will do so. At 10 years, the latest point at which we should execute any deflection effort, we may still have only a 1 in 10 probability of impact. Therefore, we have to be prepared to plan and build and launch a mission sufficient to deflect the threat not just the ideal 1 Earth radius but outside a 10% impact probability ellipse requiring a mission multiplier of 3.5x. Again, if time and conditions permit, a precursor mission should enhance our long range accuracy.

- Technological Confidence: Anywhere in the process of building, launching, orbital insertion, transit, interception and execution, at random our man-made technology can and to some degree likely will, fail... and catastrophically so. Therefore, if we absolutely/positively have to have one rocket arrive on target we need to plan to send three. Giving us a mission multiplier of 3x. Here, experience and preparation before this becomes an 11<sup>th</sup> Hour ad hoc extemporaneous effort may afford a better multiplier of 2x. But Murphy's Law will always rule the efforts of Man.

Note that all these conditions compound each other:  $2 \times 3.5 \times 3 = 21$  times the theoretical ideal and what the engineers want us to think will work with their preferred tactic of choice.

#### C) Space Capable Nuclear NEOMines

Our current thermonuclear explosive device technology is designed to be launched into Earth's upper atmosphere and fall harmfully back to Battlefield Earth. Here, we will need Nukes that can tolerate being rapidly accelerated to heliocentric orbital velocities and survive an environment of -240C, Hard Vacuum, Zero G and radiation outside the Earth's Magnetosphere for perhaps years... before we need them to perform as advertised. Likely, some degree of ad hoc design and modification is required to make this technology Space Capable and reliable as NEOMines.

#### D) Detection-to-Impact Window Elements

From the back end: 5 basic elements we must allow for in any Detection-to-Impact Window.

5) 10 years: Displacement Window. The time required after application of force in order to impart 1 cm/sec Delta Vee to a target object and achieve 1 Earth radius (6,000 km) displacement.

4) 5 years: Transit Window. Time that may be required to intercept/rendezvous with the target.

3) 5 years: Launch Window. At 5 years, an optimistic assessment that within any such period of time we will even have this opportunity *when we need it... if at all*.

2) 5 years: Design/Build Window. As things stand, select, design, develop, build, test and train personnel to operate and execute our deflection response... if the asteroid is small.

1) 10 years: Decision Window. Politics, precursor mission, responsible agency delegation, tactical selection, funding... Politics.

#### E) Preparation, Training, Vigilance

The Stargazers chant: Find them early/Find them early/Find them early. The Rocketboys cry: Build it now/Build it now/Build it now. And the Commanders beg: Practice/Practice/Practice. We should be deflecting or exploding an asteroid every 5 years. We would be fools not to have our planetary defenders always be experts at deflecting asteroids before they have to do it for real.

#### F) Bad Luck

AKA Contingencies. Optimism seems to be the rule of the day in this community when Risk Management is the art of applied rational Pessimism. Murphy's Law, Shit Happens, Bad Luck never seem to factor into their calculus.

#### G) Mission Magnitude

Target mass determines mission magnitude. A 1,000 meter asteroid is 1,000 times more massive than a 100 meter asteroid. A 10,000 meter asteroid is 1,000,000 times more massive than a 100 meter asteroid. As such, whatever force it might require to deflect a 100 meter asteroid would require 1,000,000 times more to deflect a 10,000 meter asteroid. This formula would be modified

by the size of the Displacement Window and how much time we will have after the application of force. Therefore, when the asteroid is large and/or the Detection-to-Impact window small, then one rocket will not be enough and non Nuclear/Green alternatives would require as much as 10,000 times greater mission payload and 10,000 times more rockets to deliver.

#### H) Logistics

Typically, it takes about five years to build one medium launch vehicle. One rocket may be enough with very good luck and the asteroid is small and the detection-to-impact window is large and we ignore all margins of error. There may also be a number of launch vehicles in different stages of construction that can be commandeered for this purpose and the US is not the sole producer of space launch vehicles. So after we see it coming an extemporaneous 11<sup>th</sup> hour ad hoc global response may be able to afford some small portion of Bad Luck.

The same problem exists for expanding our manufacturing facilities and training personnel after the fact. Then, given the inherent restrictions of launch windows, the same considerations would apply to having enough launch and mission control facilities. And no one is even thinking about building space capable nuclear NEOMines yet. However, if our luck is bad and the next asteroid on its way to strike Earth is large and/or the detection-to-impact window is small and we decide to attend to the margins of error, we will need hundreds of such devices and hundreds of launch vehicles and launch and mission control facilities to deliver them on target. In a word, in the face of more than 'some small portion of Bad Luck', the problem here is Time.

#### I) Time

Until we know which asteroid is the next asteroid on its way to strike Earth we can not know when it will strike or how large it is. Worse, strategically speaking, we can never know when we are going to know which, when and how large... until it is *Now!*

Therefore, Time will never be on our side here. Therefore, anything we *can* do before we see it coming we *should* do. And since this threat includes the prospect for our extinction: at any cost and by any means necessary... Here, failure is really not an option. And *before* begins... *Now!*

#### J) Funding

You don't get what you don't pay for... the money must flow. And only Fear Defines Necessity.

#### K) Risk

In Risk Management terms, both Existential Conditions and Tactical Conditions must be taken together as the principal elements in any comprehensive operational Strategic Risk Assessment:

*Risk equals Probability of Event times Magnitude of Loss times Probability of Failure.*

### **NASA's Asteroid Grand Challenge**

*"Find all asteroid threats to human populations and know what to do about them."*

*"Find all asteroid threats to human populations..."*

NASA seems to see the behavior of the asteroid population to be fixed and immutable in order to afford a perception of some strategic value to the Congressionally mandated one-time/at-a-time short-term observation and Survey to "detect, track, catalog and characterize" 90% of the estimated NEO population. A thing that can be accomplished to a completion over the course of the next few years with the delusion of their potentially eliminating the threat. However, since the proximate cause for all asteroid impact events is some dramatic perturbation, this aspect should be to "Immediately develop and perpetually maintain the capability to determine when an asteroid is now or *has become* a threat to human populations." The current Scientific approach is nothing more than a census, counting rocks in Space, with little strategic value.

After all, there can only ever be one 'next asteroid on its way to strike Earth' at a time and Planetary Defense will always only be about this one rock. What the rest of the asteroids in the

Solar System are doing is strategically irrelevant. However, in order to know which asteroid it is, since any asteroid of any size anywhere in the Solar System: ECA, PHA, NEO, NMO, Main Belt or even Jovian Trojan; discovered or undiscovered, can become randomly perturbed into an eventual or near-term or impending 'threat to human populations' at any time, the problem then, theoretically, becomes one of Surveillance: watching all the asteroids in the Solar System all the time... Forever. *Pachinko Machine*... There is no such thing as a 'safe' asteroid!

Ignoring this random causal condition is one critical way in which this threat has been grossly understated. In practical terms, an effective response would manifest as establishing a 41,253 square degree spherical Area of Interest with a radius from the Sun to the orbit of Mars swept by scores of space based observatories strategically deployed around the Solar System to watch this volume of Space and actually monitor the behavior of all the current and any newly-made rogue asteroids in Real Time 24/7/52... Forever. Not merely 'track' new discoveries for a few days or weeks to meter their current orbital elements before they move on the next one. Surveillance: A dramatic evolution from Survey... And such a thing is not even in anyone's dreams at NASA.

*and know what to do about them.*”

“Knowing is not enough. We must apply.  
Willing is not enough. We must do.” Goethe.

“Vision without execution is hallucination” T. Edison

In context here, at the lower threshold of a worst case scenario - a 10 km trillion ton extinction level threat - even at 10,000 times more effective than any of the second best alternatives, mounting an extemporaneous 11<sup>th</sup> hour nuclear response with a reasonable expectation of success would require building 400 Atlas V heavy rockets each payloaded with a modern designed space-capable 25 MT thermonuclear NEOMine (total mission yield of twice the world's current nuclear arsenal). Then launched into some random chance determined heliocentric orbit through 400 random chance determined launch windows. On the Hope everything might perform as advertised and deflect a threat of this dire magnitude. All that based on the random chance Good Luck it will have been discovered at least 50 years or more before impact in order to implement and enable the execution of any deflection effort 10 years before impact...

Such a mission, as an extemporaneous ad hoc post detection strategy, should not present itself in any rational mind as being potentially feasible or in any way Wise. Such a mission would be a thing that must be built and tested and deployed well before we see any threat approaching this magnitude coming. It would seem that both the engineers of technology and the engineers of method at NASA would rather *take* this risk and gamble than *manage* this risk and actually become prepared. How can the boys at NASA appeal to random chance with an expectation of Good Luck and call it engineering? This aspect is based on both a grossly negligent underestimate of the threat and an overstatement of our ability to respond. If we follow this advice, at least we will go extinct 'knowing' what we *should* have 'done'. Leave Nothing To Chance! Knowing alone is nothing. This aspect should be “and at any cost become expertly prepared to effectively defend against this threat to its worst case event.”.

Taken together, NASA's Asteroid Grand Challenge is academic and nothing more than another formula for our sooner-or-later suicide by asteroid impact. No wisdom or courage here... It is as if the boys at NASA only want to prepare to respond to the random chance that we will *not* be struck by another large asteroid... not the sooner-or-later random certainty that we *will*.

KISS: Big Rock Come. Kill All.  
Not Know When. Must Move Rock.  
Build Spaceship...  
*Not Know When!* Build Spaceship *NOW!*  
(So simple even a Caveman can get this.)

Then again, NASA has yet to be charged with the dire onus and responsibility for responding to the threat of asteroid and comet impact... and the survival of our species. As such, they have the license of an academic to be wrong without any consequence. We can only ever expect to get the best thinking for doing a thing from those that are charged with the primary responsibility for actually doing it. Fear of Failure focuses the mind... makes us smart... and clever... and wise.

### **The Nuclear Option**

Many things invented and developed for military purposes have found their way into peaceful applications. Thermonuclear explosive devices can now be seen as the most important one of them all. We should appreciate that the highest and best use of this technology is not in killing each other over economic, political and religious principles, but rather in defending the survival of our species from the threat of asteroid impact. Oppenheimer redeemed... However, Nukes are not magic with infinite energy. Though it is common to hear, even from the opponents of Nukes, that if the asteroid is larger than ~200 meters we can use 'a' Nuke, they do have their limits and just one will not address anything much larger than that. As we approach the worst case threats we begin needing hundreds of Nukes and hundreds of spacecraft to deliver them with.

Yet in any deflection mission, nuclear ablation will still be 10,000 times less in terms of mission mass, therefore 10,000 times more effective, than any of the Second Best *Green* alternatives. Further, Nukes: a) can be applied in either decelerating or accelerating an asteroid depending on the aspect of their approach to the Earth, b) can be employed in either a standoff or at surface ablation approach depending on the asteroid's cohesion and structure. c) can intercept the target and detonate in either a fast flyby or more accurate gradual rendezvous approach, d) can be delivered in multiple smaller devices and phased over time in response any unintended incidental disruption, e) can be designed with on-the-fly variable yields addressing the needs of Real Time circumstances and in response to smaller threats, f) in a standoff approach are the only feasible means for deflecting loose, gravitationally, bound rubble pile structured asteroids and comets, g) at surface, are the only means to reliably explode and disperse asteroids and comets where the Detection-To-Impact Window is too small for any kind of deflection mission, which would be the case for all Long Period Comet threats. And since even a successful *deflection* mission will still result in an extant and sooner-or-later future threat, exploding these objects into a rapidly expanding ball of Space gas and debris is a best and permanent resolution to any threat.

We have become a nuclear species. We can not allow a fear of Nukes to be greater than our fear of asteroid impact. It tends to mitigate a rational perception of the scale of the threat. When you think you only have a small hammer you only see small nails as the problem... However, Nukes are the one tactic that fits all size threats. There is no reason to think we need to wait until we see one coming before choose from some basket of alternative tactics. With Nukes, we would only need to determine how to best apply our well tested arsenal of multimegaton nuclear NEOMines. To think it would be wise to address this threat with anything other than modern designed Space Capable thermonuclear explosive devices would be planning to take a gun to a bomb fight.

### **Probability... of Loss**

Given the consistent geometry and dynamics of the Solar System and the empirical evidence of impact craters on both the Earth and the Moon, the Threat of asteroid impact is understood to be an existential condition. A reoccurring random inevitability. A sooner-or-later rational certainty at any magnitude. Therefore it is not a matter of *if* but only *when* the next asteroid will strike Earth and *how large* it will be. As such, given that Risk is defined as '*probability of loss*', we can only approach assessing this threat as Risk in either small increments of time or as individual expressions. So when we look at say the incremental 100 year Risk of asteroid impact we first have to appreciate that there are two forms of probability. These two perspectives are unique and discrete from each other, nonconstructive to and incompatible with each other and that one is rational and one is not. Unfortunately, they have come to share a common nomenclature and semantics and ideas and understandings are easily confused and can be conflated with each other.

The art of Risk Management exclusively employs the rational causal principles and perspectives of Conditional (Bayesian) Probability to forecast the expression of a Threat. However, pro forma, Statistical (Frequency) Probabilities are fabricated by averaging random information. Effectively a corruption of empirical data and employing a flawed rational assessment in order to create a false frequency. Therefore, in terms of forecasting either the occasion or magnitude of these events, the principles and perspectives of Statistical (Frequency) Probability can only ever give us intuitive, metaphysical metrics resulting in invalid, arational assessments of a Threat.

Frequency Probabilities can forecast or reflect the number of events that may occur at random over a large interval of time. However, they can not forecast or reflect when the *next* event will occur making such information strategically irrelevant and useless. Although they fail to afford any rational quantifiable expectation for the expression of a *next* or any individual randomly occurring events, Frequency Probabilities could be seen to be an arational metric for quantifying the relative uncertainty inherent in such events: The lower the probability the greater the uncertainty for when a random event may occur. If we appreciate uncertainty as the primary consequence of an absence of rational information, and certainty to be the intended consequence of having rational information, then with this form of metric a lower probability and greater uncertainty would not reflect any reciprocal degree of relative certainty. Therefore, to then think we can diminish our expectation for the actual expression of a random low probability event due to its greater uncertainty would just be criminally stupid.

This form of probability is often useful in arational babushka logics as a psychological device when we want to dismiss the threat of a fearful thing we can, in fact, do nothing about: Rogue Black Holes, Gamma Bursts... merely as Comfort-Food-For-Thought. Which, technologically, is not the case here. As such, Frequency Probability can be seen as little more than a metric for Hope and Good Luck. And at this point, appealing to Hope and Good Luck would be anathema.

However, there is one rational understanding we can draw from the statistical aspect of this form of assessment that is useful: the big *If*. If we extrapolate these averaged frequencies over the next billion years of the life of Earth we can appreciate that, at random, we will be struck by millions of asteroids. Fortunately most of them will be small: 10m window busters to 100m city killers. However, thousands of them will be large: 1,000m or greater, large enough to destroy a nation, affect the Earth's climate and bring an end to mankind's civilization and culture. Unfortunately, at random a score or more will be 10,000m extinction level events: all there is, gone... Forever. This is an existential condition. All these rocks are out there, orbiting the Sun, Now! On whatever course they are on to sooner-or-later strike Earth. So it's not *If* but *Is*... and which one is *Next*?

Nonetheless, since all Frequency Probabilistic assessments are derived from an averaged relative frequency of randomly occurring events, such a corruption of otherwise rational and empirical information makes it arational and non empirical. Any conclusion or inference drawn from such a probability will be a non sequitur or tautology. As such it can never be taken to be in any way deterministic or predictive and will always fail to rise to the level of being strategically relevant.

Unfortunately, since any asteroid anywhere in the Solar System of any size can be randomly perturbed into an impending impact threat at anytime, no rational systemic Conditional Probability can be assessed unless and until we have developed the capability to watch all the asteroids all the time, Forever. Therefore, as things stand, we can only quantifiably assess the Risk of asteroid impact for individual objects conditionally, as we observe their orbital elements and size, one asteroid at a time. And after it has been perturbed, ever hope we discover the next asteroid on its way to strike Earth. But as for any conditional *systemic* Risk assessment, we can not know. Without a relevant rational probability, until we see one coming, there simply is no quantifiable Risk assessment available. However, qualitatively, with The Next Large Asteroid on its way to strike Earth closing at A Million Miles A Day, we can rationally understand this threat to clearly be a grave and gathering danger for which we are not remotely prepared to respond.

We are Forever surrounded by enemy and existential threat out to the Oort Cloud. It can attack us at any time without any warning with a terminal measure of force. We are Bowie and Travis at the Alamo, Russia at Stalingrad, the US Air Cavalry at Ia Drang. This *is* War! As such, we must assume the postures and wisdoms of war in our preparation, training, vigilance and mindset. Consequentially, given that asteroid and comet impact events are completely random both in their occasion and magnitude, then until we see one coming and the next asteroid or comet impact threat has become empirically manifest and impending, we must always rationally consider the prospect of the next impact event to be imminent and terminally catastrophic. Since we can never know when it is *not*, how could anything less possibly be wise? And since we currently have neither the standing, tested capability to defend against anything close to a worst case event or have even expressed the intention to develop such a capability, we must consider the potential magnitude of loss to be our extinction: all there is, gone... Forever.

Today, before we see it coming, the Strategic Risk would be  $R = ? \times \infty \times 100\%$ .

Conditionally, *before* we see it coming, we can not know when the next 10m asteroid will strike, or when the next 100m asteroid will strike, or when the next 1,000m asteroid will strike or when the next 10,000m extinction level asteroid will strike. This is a binary condition: know/not know. And since our uncertainty and ignorance here is absolute for every dimension we must consider the relative potential for their impact with Earth to be equal. We Can Not Know!

This is not a statistical issue. All that is required for one impact event is the behavior of just one asteroid. Given the mere possibility of A) just one undiscovered NEO or B) the perturbation of just one discovered NEO or C) the generation of just one new NEO from the Main Asteroid Belt then the risk of asteroid impact of any size will persist complete and unmitigated... Forever.

Both Statistical and Conditional probabilities are quantitative assessments. Only a qualitative assessment can address the near term threat of asteroid or comet impact before we see it coming. Then we have a binary and absolute condition where there is either an extinction level impact threat in the next 100 years, or equally, there is not: heads/tails, on/off, 0/1, yes/no. Since we will never be able to determine a *No* and yet if we are determined to survive this dire ignorance, we need to always think... *Yes!* And be suitably prepared and trained and vigilant... Forever.

This threat is a randomly occurring certainty. Therefore, *before* we see the next one coming, we can only shape our response from the perspective of The Precautionary Principle: 'Governments should take action to prevent harm even when it is uncertain if, when and where the harm will occur.' We already know the *if* and the *where*, but we can *never* know the *when*... until it is *Now!* You can only ever afford to think we can gamble when you are not responsible: academic.

Conditional Probability, as a function constructive to our rational foresight and decision making process, has served to advantage our evolution greater than the opposable thumb. In contrast, Frequency Probability gives us rationally and scientifically meaningless information, nothing to shape and inform our foresight, and here will only serve to mislead us to our extinction.

### **Policy/Agency**

We need to either build an effective Planetary Defense or expect to sooner-or-later, at random, go extinct by asteroid impact. This existential condition will never change or go away. What we decide to do in order to effectively deal with this Cosmic threat today we will need to do forever. And what we can foresee we will need to do tomorrow we need to begin doing today! Neither Gods or Odds will defend us from this threat. We must do this for ourselves.

Codifying a National Policy to defend our country and the planet from these objects as they become impending Earth impact threats as precedent to delegating a National Planetary Defense Agency: Part (b) SEC. 808 of the 2010 Space Act, are the first steps on a never ending journey to defend Mankind from this dire reality. How can knowingly deferring the expression of our Political Will to hindsight after-the-fact ever be considered wise? The Sky Is Falling... *Now!*

NASA's Near Earth Object Observation Program, self renamed to be the Planetary Defense Coordination Office, is not this. Mandated by Congress to conduct a Scientific Survey to detect, track, catalog and characterize 90% of the estimated NEO population over 140m it is merely counting rocks in Space, conducting a census, nothing more. The responsibility and onus for actually defending the United States and the Planet from asteroid or comet impact lies yet to be delegated by the Executive Office in the 2010 Space Act. The PDCO has neither the funding nor the governmental authority over any other agency nor any form of official responsibility to in fact coordinate or implement any aspect of a Planetary Defense effort. Its influence, at best, is only advisory. Tacit to an agency that does not yet exist or has yet to be tasked with this mission.

The PDCO is only addressing the academic's perception of the this threat. And the academic's perception is wrong. The onus of formal responsibility and a fear of failure will compel a far more realistic strategic perception. A perception that insists that our Planetary Defense has to work under any and all conditions, at any cost, by any means necessary. Failure is not an option.

If we read the mission statement like a Wall Street lawyer: "NASA's planetary defense *goals* include developing techniques for deflecting or redirecting PHOs, if possible, that are determined to be on an impact course with Earth." Goals are not duly authorized executable responsibilities. They are at best aspirations... intentions. The things we pave roads to Hell with. In short, the PDCO is only a thin veil... a facade for public perception and political optics... a slight-of-mind.

However, it is leaning in the right direction: leaning into the sound of the guns. Awaiting the *right* orders. Until then, the PDCO is little more than a placebo. A thing we can point at to fool ourselves into believing we actually have a delegated responsible National Planetary Defense Agency in compliance with the letter and spirit of part (b) SEC. 808 of the 2010 Space Act.

It is as if the PDCO can do this job effectively without any Congressional mandate or Executive orders or duly delegated responsibility and authority of any kind and consequentially, without any actual dedicated funding. As if this threat will not be real until we see it coming. The fact and problem is that the next asteroid on its way to strike Earth *is* real and *is* coming, *Now!* We just don't know which one it is, when it will strike or how large it is. Worse, we can never know *when* we are going to know which, when or how large. We can not afford to wait until we see it coming before *we* get real and *we* become prepared. That would be the best formula for failure...

NASA has the heliocentric orbital and manned spaceflight tactical experience, and more launch and mission control facilities. While US Space Command has the strategic mindset, the authority for the disposition of our nuclear arsenal, a far greater and more fungible budget and a 200 year history of defending this country from all threats foreign and domestic. Would it not be far easier to train a soldier for a mission in Space than it would be to train a scientist to think like a soldier?

In many ways this is like the Cold War. A war which was waged and we became prepared and trained and vigilant for, but never actually fought. Except here, sooner-or-later and occasionally and at random, we will have to fight. And sooner-or-later and occasionally and at random, it will be for the very survival of our species. Not just our ways of life. And if we expect to win this war we must become extremely vigilant, trained to to a level of expertise and prepared to best respond with thermonuclear payloaded delivery systems... Forever. This Is War! We The Species did not start it, We were born to it. We did not start this war but it falls to us to wage it... The prospect of asteroid impact is a dire and fearful thing. Not some super-sized science fair project...

Therefore, the command, control and strategic authority for going in Harm's Way and addressing this Threat should be in the hands and minds of those with aptitudes and training and experience and expertise... those accustomed to dealing with fearful things and dire threats. Then, Fear focuses the mind. Reminds us there are dire consequences if we fail. And that Fear is our friend. Only Fear Defines Necessity. Not really part of any credo or culture or mindset at NASA.

Therefore. since the business of Planetary Defense is not about Science but about Security. Not about Man in Space but the Survival of Mankind. How could it be anything but most wise to form our National Planetary Defense Agency as a hybrid from the relevant elements of both NASA and DoD's US Space Command and having one exclusive mission: Planetary Defense.

Ultimately, what will be required is a Global Planetary Defense Agency. As such, an agency of agencies. Think NEO-NATO not NEO-UN. And how else will such an agency be formed than as a consequence of a first leading step and commitment and formative design by the United States. Then, with the United States in a natural leading role in detecting and deflecting any serious asteroid threats from striking Earth, as *its* Commander in Chief it would then fall to the President of the United States to be the best informed and most qualified person on Earth to understand and serve as commander of the world's response against this threat.

The only means to effectively ensure a comprehensive understanding and capability from administration to administration would be by the creation of an institutional cache and expert bureaucracy to accrue and retain the appropriate intelligence and expertise and wisdom:

#### US National Planetary Defense Agency.

As things stand, Policy and Agency delegation is just another thing we have put off until we see one coming. If in a hundred years NEOPucker Time comes, then every man, woman and child... every scientist, soldier, businessman, politician and rice paddy farmer on the planet, will all expect The-Powers-That-Be to save and hold us all harmless from its impact. And on that day *they* will all wish their predecessors had the foresight and wisdom to codify a policy and delegate an agency to become prepared and expert in dealing with this dire threat... a hundred years ago.

Defending the planet and our species from our extinction by asteroid impact will be a journey of a thousand miles and for the United States to codify a National Policy and delegate a National Planetary Defense Agency, a single and giant evolutionary first step on that journey for Mankind.

#### **Academics' Hope Based Planetary Defense**

For engineers of method: professional strategic thinkers and executive decision makers, Risk Management is the art of applied rational pessimism... We stack the deck, fix the race, load the dice... game the system... Cheat. Tempered only by capability and value, We Leave Nothing To Chance. No Optimism Allowed! No expectations of Good Luck. Leave such perspectives for those things we can do nothing about and tolerate them in those people who lack the capability to do things... The current 'scientific' approach to Planetary Defense can be considered to be a Hope based approach. Not managing the risk but taking it... Gambling. Leaving *everything* to chance.

They Hope:

- That with the Scientific Survey approach we will discover the next asteroid impact threat.
- That it will have been perturbed into an apparent Earth impact trajectory before we discover it.
- That it will be small in order to accommodate our ad hoc extemporaneous deflection capability.
- That the Detection-to-Impact Window will be large to accommodate our extemporaneous plan.
- That there will be a Launch/Transit Window we can execute a response through.
- That the Launch/Transit Window is early enough to afford a suitable Displacement Window.
- That the Launch/Transit Window is late enough to afford us the time to select, design, develop, build, test, train personnel, deploy and execute an effective response.
- That such a hasty 11th Hour mission will not be delayed by political indecision and ignorance, or delayed in production, or blow up on the launch pad, or fail to achieve heliocentric orbital insertion, or get lost in Space, or miss the target, or not be big enough, or any otherwise fail to perform as advertised... or hoped.

The Hope Based Ex Post Foresight-Free Planetary Defense (wait until we see the next one coming before we actually do anything strategy, aka: the Blah/Blah/Blah/Blah... BANG! Plan), is a Goldilocks approach: everything here has to be just right.

This is a naive linear strategy that is little more than a formula for our sooner-or-later suicide by asteroid impact. Hope is not method. Abandon all Hope... Leave Nothing To Chance.

### **The Greater Threat**

If the 'experts' in a position of authority and influence who have taken on the sober responsibility for shaping and informing our perception of and response to the threat of asteroid impact, could actually appreciate the full scope and scale of this threat, and understand that we are not remotely prepared to effectively respond, they would recommend that we urgently endeavor to build and maintain a suitable Planetary Defense in response to the worst case scenario to correct this dire condition. However, as a consequence of thinking under the influence of their own academic slights-of-mind, statistical probabilistic sophistries, optimistic rationalizations and just bad judgment, they have grossly understated and/or misunderstood the threat, and overestimated and/or misunderstood our capability to respond. It is as if these 'experts' are drunk on stupidity and have been looking at this threat through the wrong end of the telescope. As a result we have become dangerously complacent and ultimately endeavor to do the wrong thing or not enough or nothing more in the direction of actually creating an effective response. These 'experts' have managed to make this now into a man-made threat greater than The Next Large Asteroid on its way to strike Earth itself. In effect, as a consequence *they* have become the even greater threat.

From the perspective of expert executive risk managers experienced in addressing threats from a position of responsibility, the rationale here would be based on the general characterization and grading of any threat not only by its existential potential to do harm and the magnitude of loss, but reciprocally, by any strategic capability to respond and mitigate or eliminate the existential condition... or the degree of absence of any such capability. Unfortunately, such experts have not so far been involved in this issue and any sober rational assessments from a position of *this* class of expert authority have not been forthcoming to counter the comfort-food-for-thought and optimism driven academic consensus. You don't get what you don't pay for. Time to evolve this issue out of the hands of academics and dilettantes and into those of professional risk managers that are far more qualified and experienced in effectively dealing with dire and fearful things.

### **Gaiashield Abstract**

When you think about the threat of asteroid impact think as if it's your gene pool at Ground Zero. Think: at any cost, by any means, failure is not an option... Otherwise, you're just not doing it right. If we are thinking about the threat of asteroid impact and we are going to be honest and rational: attending to the laws of physics in a deterministic universe, we must abandon all hope and optimism and think first about the worst case scenario and what we can do about it. After all, Risk Management is the art of applied rational pessimism. Here, Murphy's Law rules.

That said, even if it is small and the warning time is large it should be obvious that waiting until we see the next asteroid on its way to strike Earth coming before we build and test and become expert in implementing a means to deflect this threat is naive to the point of foolishness. We would never think that waiting until our house caught fire before we decide to build a fire department would in any way ever be wise.

So wisdom here would be for We The Species to build, test and train to respond to this threat in its worst case scenario before we see it coming. And *before* begins... *Now!* Then, with the Existential Risk Forever at  $R = ? \times \infty$ , our Planetary Defense Condition must Forever be maintained at DefCon 2. Politically, strategically and tactically: lock cocked and loaded for bear.

Consequentially, a reasonably effective response to a worst case scenario would require gigatons of space capable thermonuclear NEOMines delivered to heliocentric orbit by hundreds of medium launch vehicles. Worse, given the random chance availability of enough or any suitable launch windows, not something we could ever rely on doing from the surface of the Earth post detection. Therefore we must not only build our Planetary Defense before we see it coming but

predeploy such a defense to some heliocentric orbit as well. Perhaps the orbit of Mars: L3, L4 and L5. Think nuclear armed manned Battlestar class NEO interceptor craft projecting power to a strategic high ground to multiple advantageous points in Space supported by a forward supply, maintenance and planetary defender training outpost on the surface of Mars.

Simultaneously, given that all that is required for one asteroid impact is the behavior of just one asteroid; and that the proximate cause for all asteroid impact events is some dramatic kinetic or gravitational perturbation, then if we are going to hold a reasonable expectation of detecting The Next Large Asteroid on its way to strike Earth coming or ever discover any Long Period Comet threats in time to mount an effective explosive response, we need to evolve our current ad hoc scientific Survey approach into a permanent strategic Surveillance network. Scores of space based observatories scanning an entire spherical Near-Earth-orbit Area of Interest giving us as near a Real Time full spectrum assessment of the entire potential asteroid threat population as technologically possible. An Early Warning system to tell us when a previously 'safe' asteroid has randomly become an impending Earth impact threat.

Then, given the worst 'worst case scenario' where the asteroid is large and the warning time is short, which will likely always be the case for Long Period Comets, we need a point defense predeployed to Low Earth Orbit. A large high yield thermonuclear device designed to fragment and explode threats far enough away to at least mitigate the effects of their impact with Earth. A new and permanent mission for the ISS?

Finally, training. Today, Space is the place where everything we try to do for the first time... fails. Therefore, if we are going to expect any level of success: Practice/Practice/Practice. We must develop our aptitudes to become an expert human capability for doing this. Therefore, we should be deflecting an asteroid every five years in order to maintain a standing body of highly trained planetary defenders. Because when NEOPucker Time does come institutional memory alone will be worth... next to nothing. And today, we don't even have that.

*GaiaShield: Preparation - Training - Vigilance.*

To defend We The Species from extinction by asteroid impact.

As things stand, we have not yet even begun to think about becoming actually prepared or expertly trained or sufficiently vigilant enough. To get there, we start here: Executive compliance with 'part (b) SEC. 808 of the 2010 Space Act'. Delegate a qualified U.S. federal agency to become responsible for taking the lead in defending the planet from asteroid impact events - as a consequence of the globally evolving precedent of a codified National Policy to endeavor to deflect these objects as they present themselves to be impending Earth impact threats.

Make no mistake, want it or not, admit it or not... we are already at war. And if we would expect to win, we must make this an Interplanetary Thermonuclear War... like it or not.

### **Funding**

The system cost will depend on the desired degree of strategic certainty to defend against worst case scenarios. But ultimately it will cost whatever it will cost. This is somewhere 'Where No Man Has Gone Before'. However, a notional Global allowance/allocation for a GaiaShield would be \$50b/yr... Forever. At that, we should be able to achieve a reasonable expectation for having an effective defense in 100 years or less. To be safer/sooner: Increase the annual appropriation. The epiphany here is our survival is not free. And you don't get what you don't pay for.

Beauty part: since rationally, this business is going to be a matter of Real Time surveillance and the delivery of Nukes to heliocentric orbit... And the World already spends \$100b/yr on watching our nuclear enemies and maintaining its nuclear weapons and their delivery systems and it is something we really do not want to do... Without any major change in our current agency and/or private sector industrial providers we can simply retask half that standing budget to Planetary

Defense and redevelop half that martial technology and Save The World at the cost of reducing Mankind's ability to kill each other over economic, religious and political principles by half: Win/Win. The economic stimulus would be like going back to the Cold War... Forever. Without the pesky side effect of pending global thermonuclear Armageddon. Perhaps we should double down and go *all* in here: pound *all* our thermonuclear swords into world saving plowshares.

The alternative would be to raise new funding through Planetary Defense taxation; Then we have to appreciate that \$50 billion a year is 10% of what We The Species manage to spend on Heroin and Cocaine every year, 3% of our annual world military budgets and only 0.006% of our yearly Gross World Product. Nationally our 22% share would not only amount to 0.006% of our Gross Domestic Product but coincidentally only an 0.006% annual increase in our National Debt... in the event the political Powers-That-Be elect to take the discretionary spending route. Either way, once we evolve the wisdom and political will to understand that building an effective Planetary Defense and saving ourselves from extinction by asteroid impact is the most important thing Mankind can ever do, it would still be a bargain. And this cost would be an economic stimulus: New jobs and profits and taxes. Like War, but without all the dead soldiers.

Here, it's not a matter of what it will cost to do this but rather, given a fixed dedicated allowance, what capabilities can we expect to have after given periods of time, and then to evolve and maintain them... Forever. Call this a never ending Cosmic Cost of Living. So it's a matter of how long and how well do we want to live... How soon do we want to be 'safe'? Only Fear Defines Necessity. And how would our random extinction by asteroid impact *not* be our greatest Fear?

In the end, it makes no difference how much this will cost or what finagle we chose to pay for it. Once we have come to understand the magnitude of this threat, we understand that we can not afford *not* to do this: ASAP. At any cost, by any means. Every billion we spend today increases the probability of our success... our *survival*, tomorrow. And here, failure is truly not an option. It will always be your children and grandchildren at Ground Zero here. What are they worth?

### **Nutshell**

Once upon a time there was a Big Bang: Cause/Effect, Cause/Effect, Cause/Effect, and today the Universe is a dangerous place. It does not suffer dilettantes or fools gladly. We The Species must either do this right or go extinct thinking about this wrong. If we look for some purpose in the evolution of humanity's industry and genius and power and courage, it can be seen in doing this.

And make no mistake, this is War, and it will last Forever. We did not start it, We were born to it. We did not start it but We must wage it, and wage it well and win or go extinct as a consequence.

*Si vis pacem in Terra, para bellum et Stellae.*

Since it is possible to reliably see it coming, although we may be able to know when the next extinction level asteroid impact *has become* imminent it will always be imposible to know when it is *not*. The absence of evidence is never evidence of absence here.

To understand that building a comprehensive Planetary Defense *Now* is the most important thing Mankind will ever do would be the epitome of wisdom.

A Million Miles A Day,  
R. Dale Brownfield  
Gaiashield Group  
<<http://Gaiashield.Com>>  
<<http://DearPOTUS.Com>>

## Addendum A:

### Comets

Massive chunks of dirty water ice perturbed from the Oort Cloud, 50,000 AU from the Sun, by the occasional passing rogue star onto some random million year elliptical orbit into the inner Solar System achieving terminal velocities three times that of the typical asteroid, Long Period Comets pose a unique problem in comparison to asteroids. Although the existential conditions in terms of Probability and Magnitude of Loss result in the same academic Risk, the Strategic Risk becomes far greater due to the Tactical challenges required to determine an impact threat and mount an effective response. In the case of asteroids, since their orbits are entirely inside the orbit of Jupiter, and in their typical ~2 year orbits often pass only millions of miles from Earth, compared to LPCs they are relatively easy to observe and accurately characterize metering their speed, direction and position relative to Earth and we can see them coming or not decades before impact and to attempt to deflect them 10 years before impact we can likely intercept them only tens of millions of miles away from Earth somewhere inside the orbit of Mars.

However with LPCs and their relatively straight-line approach into the inner Solar System, to see them coming in time to trigger an effective response decades before impact we would have to discover and accurately characterize their orbits as impact threats far beyond the outer edge of the Kuiper Belt: tens of billions of miles away. And even though with their million year orbital periods deflection would be a suitable long term solution, to be effective this approach would require a precisely accurate interception far beyond the orbit of Pluto - billions of miles away, in order to afford force sufficient to be anything more than a marginal and token effort. And today, such human capabilities are only imagined in the better works of science fiction.

Given that even with an up graded Gaiashield Surveillance Network we may not be able to detect these threats much further out than when they begin to sublimate water ice around the orbit of Jupiter... and potentially, with as little as 9 months warning, leaving us with only what we can imagine we can do today: blow it up. Explode it with a large yield Space Capable thermonuclear device from a point defense facility predeployed to Low Earth Orbit.

Advantage: a) Comets are composed of water ice and as a result of explosively vaporizing their mass should fracture and fragment far easier than stoney asteroids. b) Being water ice, a nuclear detonation should vaporize far more of a comet's volume than that of a stoney asteroid.

Disadvantage: a) In Space, water ice would have a vaporization point of close to Zero C whereas stone would vaporize around 1,250 C resulting a far greater velocity in the expanding asteroid gas than that of the comet and as a result, far less dispersion of the comet's fragments than that of an asteroid. Leaving us with the mitigated threat of a cometary cluster impact. b) Worse, despite comets/water ice and being half the mass of a stoney asteroid and far more frangible, at Zero C the force generated by vaporized water ice may not be sufficient to even fragment let alone disperse the comet's fragments to any great degree. Resulting in an incompletely vaporized extant cometary core with some low degree of deflection.

Approach: In exploding a stoney asteroid we need to do it 'in one'. In the event the Nuke is too small and we get insufficient dispersion of the fragments there is little more we can do to divert any impending cluster threat. However, with a comet, with water ice, we can subsequently salvo into any resulting cluster or residual cometary core and continue to vaporize the threat into slowly expanding balls of Space Gas.

It would also be likely that such a secondary Point Defense be comprised of smaller tactical Nukes that need only be deployed on Earth's surface: Planetary Defense missile silos. Also effective for dispatching those pesky 30 meter Window Busters.

## *Ten Steps to a Planetary Defense:*

Rational Appreciation of the Fear

Responsible Definition of the Threat

Conditional Assessment of the Risk

Determination of a Policy

Delegation of a Responsible Agency

Engineer a Strategy in principles

Select the Most Effective Tactic

Develop the Strategic Infrastructure

Deploy the Tactical Response

Execute Deflection of The Next Asteroid on its way to strike Earth

All but the last taken *before* we detect an impending impact threat... *Now!*



Addendum C:

Selected comments from the OSTP's December 2016

## NATIONAL NEAR-EARTH OBJECT PREPAREDNESS STRATEGY

[https://www.whitehouse.gov/sites/default/files/microsites/ostp/NSTC/national\\_neo\\_preparedness\\_strategy\\_final.pdf](https://www.whitehouse.gov/sites/default/files/microsites/ostp/NSTC/national_neo_preparedness_strategy_final.pdf)

*Executive Summary: The Strategy and Action Plan build on efforts at the National Aeronautics and Space Administration (NASA) to better detect and characterize the NEO population as well as recent efforts at the Department of Homeland Security (DHS) to prepare for and respond to a NEO impact.*

So, despite the complete absence of any codified National Policy to compel and justify funding any response to this threat, we have an agency delegated with seeing them coming and an agency for digging through the rubble when they strike but not one responsible for “implementing a deflection campaign” - the principal strategic objective of a Planetary Defense - or to formulate a strategy developing the elements essential to the conduct of implementing a response.

*1. Enhance NEO Detection, Tracking, and Characterization Capabilities. <SNIP> improving observation capabilities for more complete and rapid observation of the entire population of NEOs;*

Yes... Since the principal and often proximate cause for all asteroid impacts is some dramatic kinetic or gravitational perturbation, we need to evolve our nascent Survey efforts to generate a scientific census of the NEO population to a Real-Time full spectrum strategic Surveillance of the entire NEO Area of Interest 24/7/52... Forever. Scores of space-based observational satellites strategically deployed in a network around our inner Solar System.

*2. <SNIP> researching deflection and disruption capabilities for NEOs of varying size, mass, composition, and impact warning times; and researching technologies required for deflection and disruption concepts.*

To determine the best deflection tactic we have been researching candidates theoretically for 20 years now and 10 years ago NASA's PA&E declared Nukes the winner: 100 times more effective than the first second best alternative. Subsequent research would increase that margin to 10,000 times. 20 more years of theoretical research is not going to change any laws of physics: Nukes! What we need now is empirical research. Nuke a few asteroids and test what is clearly tactical Plan A. And since 'strategic' is what is essential to the conduct of implementing a response, how can we engineer a strategy until we have determined the best tactical response to employ?

*Introduction: a small asteroid approximately 20 meters wide that had an energy equivalent of almost 500 kilotons*

That can't be right. 500 kt would be the same kinetic energy equivalent if a 20m stoney asteroid actually struck the *surface* at 15 km/s... Someone needs to do some research on exactly why these objects explode in the atmosphere. Think shocked acceleration.

*Larger NEOs (>140 m), representing the potential to inflict serious damage to entire cities or regions, are also easier to detect and track, therefore more is known about this population than what is known about smaller objects.*

'Damage' to the point of our extinction. 'Easier to detect and track' only if we are lucky enough to be looking where they are and they are close enough to resolve. Unfortunately, what is *not* 'known' is which large NEO is the next large NEO on its way to strike Earth. Everything else is irrelevant... strategically speaking. If there are 1,000 large NEOs and we find 1 of them on course to strike Earth then we would expect to find 999 that are not. Therefore, if we find only 999 that are not, then the Risk of 1 large asteroid impact stands complete and unmitigated... One Rock!

*there are far fewer larger objects than smaller objects, so the probability of impact of a larger object is much lower compared to the probability of impact of a smaller object.*

A) ... and/so/therefore, what? This is only half a thought. Are we to infer that because there are far fewer large asteroids than small we only need to prepare for small asteroid impact threats?  
B) Asteroid impact events are random: without any recursive pattern or periodicity, both in their occasion and magnitude. We can not know how large the next asteroid on its way to strike Earth will be until we see it coming. This logic fosters only an expectation of good luck... Hope.

C) The probability here can only be a Frequency/Statistical Probability. A metric of random chance and uncertainty. As such, it would be the product of an averaged relative frequency of random events. Corrupted empirical information that can never be taken as rational or in any way scientific. Even when done properly, such a probability can never be strategically relevant. We are Managing Risk here not taking it and gambling. Let's save such logics for Vegas...

*As more NEOs are detected, and the total population of NEOs is better characterized, assessing the overall hazard of a NEO impact will become more achievable.*

Since there is no imaginable response to the overall condition: we can not change the laws of physics or beam these objects to a Galaxy far, far away, any perceived assessment of the overall threat of asteroid impact is strategically irrelevant. We can only ever respond to this threat one rock at a time as they present themselves to be impending Earth impact threats. Consequentially, the only thing we will ever need to know is which asteroid is the next asteroid on its way to strike Earth. Only then can we ever know when it will strike and how large it is. Strategically speaking, the greatest problem here that we can *never* know when we are going to know the responsible which, when and how large... until it has become *Now!*

*NEO impacts are predictable many years in advance and, most importantly, potentially preventable when a survey of the population is complete.*

Only if the asteroids have been perturbed into an impact trajectory many years in advance and we are lucky enough to see them coming. At random, any asteroid of any size anywhere in the Solar System: ECA, PHA, NEO, NMO, Main Belt or Jovian Trojan, can be perturbed into a short term impending impact trajectory at any time. And as things stand, to prevent their impact we will need decades, not years. Making the current Survey approach grossly inadequate.

*When a NEO that is on course to impact Earth is identified, it is a global threat that requires the leadership of the United States*

On that day, it will then be the responsibility of the President of the United States to know everything that needs to be known in order to address this this threat. The only way to achieve this level of preparation would be to have a single Federal Agency that has become expressly trained and experienced and expert at identifying impact threats and deflecting and exploding asteroids, that he can call upon to shape and inform his decisions. An institutional repository and bureaucratic memory for responding to this threat. A National Planetary Defense Agency. Like what was asked of the director of the OSTP by Congress in both the 2008 and 2010 Space Acts...

*While it is highly unlikely that there will be a civilization-ending NEO impact over the next two centuries, the risk of smaller but still catastrophic NEO impacts is real,*

Absurd. Since our ignorance for both small and large is absolute, both small and large are equally 'real'. An abstract Frequency Probability can never even pose to be a predictor of any *next* randomly occurring event. Then, empirically, although if/when we see it coming we can then know a large extinction level impact event is imminent, we can never know it is *not* imminent just because we do *not* see it coming. The absence of evidence is not evidence of absence.

All that is required for one Extinction Level impact is the behavior of just one Extinction Level asteroid. This risk will persist complete and unmitigated with the mere possibility of:

- a. Just one undiscovered EL NEO. And/or
- b. The perturbation of one discovered EL NEO. And/or
- c. The generation of one new EL NEO from the Main Asteroid Belt.

*and there is currently no whole-of-government or international strategy to respond to such an event throughout all phases of a NEO impact scenario timeline*

A consequence of the failure of the Director of OSTP to comply with the Congressional mandates of both the 2008 and 2010 Space Acts. When NEOPucker Time comes, what will *not* work is some three-ring circus of governmental agencies reporting to the Executive Office. What *will* work is a single responsible focal point of Command, Control and Communication.

*Authority for Creation of the National Near-Earth Object Preparedness Strategy: Section 804 of the NASA Authorization Act of 2008 requires that the Director of OSTP: <SNIP> (2) recommend a Federal agency or agencies to be responsible for: (A) protecting the United States from a NEO that is expected to impact Earth; and (B) implementing a deflection campaign in consultation with international bodies, should one be necessary. In October 2010, OSTP responded to Congress and laid out Administration plans to meet the requirements...*

And by the 2010 two year deadline the Director of OSTP had failed to comply with (2). Then, the next day in October 2010, President Obama signed into law S. 3729: the NASA Authorization Act of 2010: SEC. 808. <SNIP> The Director of the OSTP shall implement, before September 30, 2012, <SNIP> and assign a Federal agency or agencies to be responsible for protecting the United States and working with the international community on such threats. In six years, this order to implement the first and most critical element of any strategy... who will be authorized and funded to execute it, has not been followed. Perhaps in the next administration.

*Enhance NEO Detection, Tracking, and Characterization Capabilities: Finding NEOs as early as possible is the first priority for planetary defense, in order to give adequate time to make decisions and implement action.*

Which would be dependent not only on having a comprehensive Real-Time Surveillance of the entire NEO Area of Interest but that an impending threat becomes perturbed early enough to afford any extemporaneous 11<sup>th</sup> hour knee jerk response. We need a predeployed Point Defense.

*Methods for NEO Deflection and Disruption: Technologies to deflect the NEO away from Earth can be used, but to either disrupt or deflect a very large object, research and development of high-energy solutions is required.*

'High-energy' would be testosterone free zone code for thermonuclear explosive device... Nukes. The threshold for their use: a 'very large object', would begin at around 140 meters where the Green alternatives all begin to become impractical. Nukes become 'required' because in terms of relative mission mass they will always be at least 10,000 times more effective.

*Leverage and Support International Cooperation: The risk of a NEO impact is a global hazard best addressed well in advance of detecting the first potential impact through consultations, coordination, and cooperation with the international community*

And by delegating a US National Planetary Defense Agency as an anchor to a Global Planetary Defense Agency comprised of dedicated national planetary defense agencies. Think NEO-NATO not NEO-UN. And then doing whatever *can* be done before we see it coming, *before* we see it coming. And before we see it coming begins... *Now!*

*For example, the NASA Planetary Defense Coordination Office*

A facade. A thing in name only. No governmental authority or mandate or funding... however, it seems to be leaning in the right direction: into the sound of the guns.

*Build international support for acknowledging and addressing the potential Earth impact of a large NEO...*

And the notion of a *large* NEO as a threat should begin with the next 10km Chicxulub Class extinction level object. And the place to start acknowledging the threat and the challenge at this level would be in this committee and the OSTP. If we are going to think strategically, a reliable mission for deflecting a 10km asteroid could require as many as 400 nuclear payloaded Atlas Vs.

*Conclusion: potential NEO impacts pose a significant and complex challenge.*

Complex... Here, unnecessarily so. Apparently a consequence of employing three dozen assorted scientists, academics and bureaucrats in a committee to formulate a strategy and then irrationally expect a seamless, integrated, coherent result. What we have here is a dire need for a hierarchical US Military Grade KISS. Soldier Up... This is War! Not some super-sized science fair project.

Summary: Once again we have Holdren trying to sweep this threat under a rug of Science. Science Time is over. We already know enough about this threat and our capabilities to build an effective Planetary Defense. Time to put this issue into the hands and minds of our best engineers of technology and method... and *do* it!