# \*1AC

## 1AC: Inherency

### Contention 1 --- Inherency

### Near-Earth Object detection is underfunded --- preventing NASA from beginning key projects

New Yorker 11 (“Vermin of the Sky; Who Will Keep The Planet Safe From Asteroids?”, 2-28, Lexis)

At the moment, the number of asteroids judged suitable for a human visit is fewer than nine, and perhaps as few as zero. So there is an obvious need to find more asteroids-and to learn considerably more about what it's like to operate in their neighborhoods. Paul Abell, the lead NEO scientist at NASA's Johnson Space Flight Center, said that, to find the right asteroid for a human mission, "my personal opinion is we need a space-based survey telescope, which could give us up to forty times the number of targets." Within two and a half years, the Venus-orbit telescope touted by the Task Force could find several hundred promising asteroids closer to home, which could cut billions of dollars out of the price of a mission. Yet what would be a small step for a human mission turns out to be a giant leap for planetary defense: NASA has already indicated that it doesn't have the roughly six hundred and fifty million dollars needed to fund the telescope. And a practice grapple with an asteroid may occur, as vaguely promised by the White House, only when the human mission launches, in fourteen years. (If it does launch: in January, an internal NASA study suggested that a human mission to an asteroid would be "too costly.")

Current *detection* and *deflection* measures will both fail

New Yorker 11 (“Vermin of the Sky; Who Will Keep The Planet Safe From Asteroids?”, 2-28, Lexis)

That was a long time ago, even before Ben Franklin or Copernicus. More recently, in 2002, an asteroid exploded over the Mediterranean, and later that year a fiery NEO crashed into a Siberian mountain. In 2008, S.U.V.-size asteroids plunged into the Sudanese desert and streaked over Saskatchewan, and, in 2009, one blew up high above Indonesia, with three times the power of the atom bomb that destroyed Hiroshima. Just last week, a several-ton rock blazed across the noonday sky above the Atlantic Ocean so brightly that it was visible from Massachusetts to Maryland. And still we earthlings haven't mustered a response. The administrator of NASA, Charlie Bolden, recently declared that deflecting a NEO will be "what keeps the dinosaurs-we are the dinosaurs, by the way-from becoming extinct a second time." Then he admitted that the agency couldn't afford to do that. The annual federal allocation for "planetary defense" is $5.8 million-.03 per cent of NASA's budget-which supports a shoestring program to find NEOs and track their orbits. In truth, NASA doesn't really want the job of global savior, and no one else does, either. "With planetary defense, there's a complex interaction of science, psychology, politics, and money-and everything falls into a gap between disciplines," Robert Arentz, who heads the NEOs team at Ball Aerospace and Technologies Corp., said. "The science guys say, 'NEOs are not scientifically interesting, and saving the planet is not our job,' and the military guys say, 'We'll blow them up, but we don't have anything to do with telescopes or space missions.' The issue's an orphan."

## 1AC: NEO Strike Advantage

### Advantage 1 --- NEO Strikes

### Huge numbers of NEOs could hit at any time without warning and cause extinction --- lack of detection technology leaves us helpless

NRC 10 (National Research Council, “Defending Planet Earth: Near-Earth Object Surveys and Hazard Mitigation Strategies”, Committee to Review Near-Earth-Object Surveys and Hazard Mitigation Strategies, http://www.nap.ed u/catalog.php?record\_id=12842)

2. In December 2004, astronomers determined that there was a non-negligible probability that near-Earth asteroid Apophis (see Chapter 4 for more details) would strike Earth in 2029. As Apophis is an almost 300-meterdiameter object, a collision anywhere on Earth would have serious regional consequences and possibly produce transient global climate effects. Subsequent observations of Apophis ruled out an impact in 2029 and also determined that it is quite unlikely that this object could strike during its next close approach to Earth in 2036. However, there likely remain many Apophis-sized NEOs that have yet to be detected. The threat from Apophis was discovered only in 2004, raising concerns about whether the threat of such an object could be mitigated should a collision with Earth be determined to have a high probability of occurrence in the relatively near future.

### Strikes are likely --- two distinctions:

### 1st --- *Long-Period Comets* --- they’re likely, evade current defenses, and risk extinction

IAA 9 (International Academy of Astronautics, “Dealing With The Threat To Earth From Asteroids And Comets”, http://iaaweb.org/iaa/Scientific%20Activity/Study%20Groups/SG%20Commission%203/sg35/sg35finalreport.pdf)

Detection of Long-Period Comets Long-period comets (LPCs) tend to be ignored in NEO studies at this time because the probability of an impact by a long-period comet is believed to be very much smaller than by an asteroid. However, virtually all NEOs larger than a few kilometers are comets rather than asteroids, and such large NEOs are the most destructive, and potentially the “civilization killers”. Additionally, the Earth regularly passes through the debris field of short-period comets giving us the annual meteoroid showers such as the Leonids and Taurids. These are very predictable but thankfully benign impact events. If the Earth were to encounter sizable objects within the debris field of a long-period comet, we would likely have very little warning time and would potentially be confronted with many impactors over a brief period of time. Although this type of event is currently speculative, this is a conceivable scenario which humanity could face. While the risk of a cometary impact is believed to be small, the destruction potential from a single large, high velocity LPC is much greater than from a NEA. Therefore, it is important to address their detection and potential methods for deflecting, disrupting, or mitigating the effects before one impacts the Earth.

### 2nd --- *Small NEOs* --- they’re extremely frequent and pass through current detection

Binzel 11 (Richard, Professor of Planetary Sciences – MIT, “Richard Binzel on Near-Earth Asteroids”, Space Daily, 7-1, http://www.spacedaily.com/reports/Richard\_Binzel\_on\_near\_Earth\_asteroids\_999.html)

Actually, asteroids of this size passing this close to Earth is relatively normal and the fact that they miss more often than hit is just good fortune - Earth is a relatively small target in the vastness of space. We expect that objects like this come by this close once every five to 10 years - very frequently by astronomical standards. Credit goes to the LINEAR program for their dedicated survey work that found this one. Even though Lincoln Lab astronomers and a very small number of other teams are working to scan the entire sky over the course of a month searching for incoming asteroids, the telescopes available for this work are rather modest in size and objects such as this might easily slip through the search network. Our Lincoln Lab colleagues have been surveying for more than a decade and it has been just a matter of time that an object like this one might be caught in their search pattern.

### It’s try-or-die --- comet or asteroid impact is inevitable

Verschuur 96 (Gerrit, Adjunct Professor of Physics – University of Memphis, Impact: The Threat of Comets and Asteroids, p. 158)

In the past few years, the comet impact scenario has taken on a life of its own and the danger of asteroids has been added to the comet count. In the context of heightened interest in the threat, reassuring predictions have been offered about the likelihood of a civilization-destroying impact in the years to come. Without exception, the scientists who have recently offered odds have been careful in making any statement. They have acted in a "responsible" manner and left us with a feeling that the threat is not worth worrying about. This is not to criticize their earnest efforts, only to point out that estimates have been attempted for centuries. The way I look at the business of offering odds is that it hardly matters whether the chance of being wiped out next century is 1 in 10,000, for example, or that the likelihood of a civilization-destroying impact is once in a million years. That's like betting on a horse race. The only thing that is certain is that a horse will win. What matters is the larger picture that begins to force itself into our imagination; comet or asteroid impacts are inevitable. The next one may not wipe us out in the coming century, or even in the century after that, but sooner or later it will happen. It could happen next year. I think that what matters is how we react to this knowledge. That, in the long run, is what will make a difference to our planet and its inhabitants. It is not the impact itself that may be immediately relevant; it is how we react to the idea of an impact that may change the course of human history. I am afraid that we will deal with this potentially mind-expanding discovery in the way we deal with most issues that relate to matters of great consequence; we will ignore it until the crisis is upon us. The problem may be that the consequences of a comet catastrophe are so horrendous that it is easiest to confront it through denial. In the end, though, it may be this limitation of human nature that will determine our fate.

### The impact is extinction --- *high magnitude* and *aperiodic strikes* shatter traditional considerations of “timeframe” and mean we should treat NEO threats as immanent

Brownfield 4 (Roger, Gaishiled Project, “A Million Miles a Day”, Presentation at the Planetary Defense Conference: Protecting Earth From Asteroids, 2-26, [http://www.aiaa.org/content.cfm?pageid=406&gTable= Paper&g](http://www.airpower.maxwell.af.mil/airchronicles/cc/france2.html?pageid=406&gTable=%20Paper&g) ID=17092)

Once upon a time there was a Big Bang... Cause/Effect - Cause/Effect -Cause/Effect and fifteen billion years later we have this chunk of cosmos weighing in at a couple trillion tons, screaming around our solar system, somewhere, hair on fire at a million miles a day, on course to the subjective center of the universe. Left to its own fate -- on impact -- this Rock would release the kinetic energy equivalent of one Hiroshima bomb for every man, woman and child on the planet. Game Over... No Joy... Restart Darwin's clock… again. No happy ever after. There is simply no empirical logic or rational argument that this could not be the next asteroid to strike Earth or that the next impact event could not happen *tomorrow*. And as things stand we can only imagine a handful of dubious undeveloped and untested possibilities to defend ourselves with. There is nothing we have actually prepared to do in response to this event. From an empirical analysis of the dynamics and geometry of our solar system we have come to understand that the prospect of an Earth/asteroid collision is a primal and ongoing process: a solar systemic status quo that is unlikely to change in the lifetime of our species. And that the distribution of these impact events is completely aperiodic and random both their occasion and magnitude. From abstracted averaged relative frequency estimates we can project that over the course of the next 500 million years in the life of Earth we will be struck by approximately 100,000 asteroids that will warrant our consideration. Most will be relatively small, 100 to 1,000 meters in diameter, millions of tons: only major city to nation killers. 1,000 or so will be over 1,000 meters, billions of tons and large enough to do catastrophic and potentially irrecoverable damage to the entire planet: call them global civilization killers. Of those, 10 will be over 10,000 meters, trillions of tons and on impact massive enough to bring our species to extinction. All these asteroids are out there, orbiting the sun... now. Nothing more needs to happen for them to go on to eventually strike Earth. As individual and discrete impact events they are all, already, events in progress. By any definition this is an existential threat. Fortunately, our current technological potential has evolved to a point that if we choose to do so we can deflect all these impact events. Given a correspondingly evolved political will, we can effectively manage this threat to the survival of our species. But since these events are aperiodic and random we can not simply trust that any enlightened political consensus will someday develop spontaneously before we are faced with responding to this reality. If we would expect to deflect the next impact event a deliberate, rational punctuated equilibrium of our sociopolitical will is required now. The averaged relative frequency analysis described above or any derived random-chance statistical probabilistic assessment, in itself, would be strategically meaningless and irrelevant (just how many extinction level events can we afford?). However, they can be indirectly constructive in illuminating the existential and perpetual nature of the threat. Given that the most critically relevant strategic increment can be narrowly defined as the next “evergreen” 100 years, it would follow that the strategic expression of the existent risk of asteroid impact in its most likely rational postulate would be for one and only one large asteroid to be on course to strike Earth in the next 100 years... If we do eventually choose to respond to this threat, clearly there is no way we can address the dynamics or geometry of the Solar System so there is no systemic objective we can respond to here. We can not address 'The Threat of Asteroid Impact' as such. We can only respond to this threat as these objects present themselves as discrete impending impactors: one Rock at a time. This leaves us the only aspect of this threat we *can* respond to - a rationally manifest first-order and evergreen tactical definition of this threat Which unfortunately, as a product of random-chance, includes the prospect for our extinction. Asteroid impact is a randomly occurring existential condition. Therefore the next large asteroid impact event is inevitable and expectable, and that inevitable expectability begins... now. The Probability is Low: As a risk assessment: “The probability for large asteroid impact in the next century is low”... is irrelevant. Say the daily random-chance probability for large asteroid impact is one in a billion. And because in any given increment of time the chance that an impact will not happen is far greater than it will, the chance that it will happen can be characterized as low. However, if we look out the window and see a large asteroid 10 seconds away from impact the daily random-chance probability for large asteroid impact will still be one in a billion... and we must therefore still characterize the chance of impact as low... When the characterization of the probability can be seen to be tested to be in contradiction with the manifest empirical fact of the assessed event it then must also then be seen to be empirically false. Worse: true only in the abstract and as such, misleading. If we are going to *respond* to these events, when it counts the most, this method of assessment will not be relevant. If information can be seen to be irrelevant ex post it must also be seen to be irrelevant ex ante. This assessment is meaningless. Consider the current threat of the asteroid Apophis. With its discovery we abandon the average relative frequency derived annual random-chance probability for a rational conditional-empiric probabilistic threat assessment derived from observing its speed, vector and position relative to Earth. The collective result is expressed in probabilistic terms due only to our inability to meter these characteristics accurately enough to be precise to the point of potential impact. As Apophis approaches this point the observations and resulting metrics become increasingly accurate and the conditional-empiric probability will process to resolve into a certainty of either zero or one. Whereas the random-chance probability is unaffected by whether Apophis strikes Earth or not. These two probabilistic perceptions are inherently incompatible and unique, discrete and nonconstructive to each other. The only thing these two methodologies have in common is a nomenclature: probability/likelihood/chance, which has unfortunately served only to obfuscate their semantic value making one seem rational and relevant when it can never be so. However, merely because they are non rational does not make averaged relative frequency derived random-chance probabilities worthless. They do have some psychological merit and enable some intuitive 'old lady' wisdom. When we consider the occasion of some unpredictable event that may cause us harm and there is nothing tangible we can do to deflect or forestall or stop it from happening, we still want to know just how much we should worry about it. We need to quantify chance not only in in case we can prepare or safeguard or insure against potentially recoverable consequences after the fact, but to also meter how much hope we should invest against the occasion of such events. Hope mitigates fear. And when there is nothing else we can do about it only then is it wise to mitigate fear... “The probability for large asteroid impact in the next century is low” does serve that purpose. It is a metric for hope. Fifty years ago, before we began to master space and tangibly responding this threat of asteroid impact became a real course of action, hope was all we could do. Today we can do much more. Today we can hold our hope for when the time comes to successfully deflect. And then, after we have done everything we can possibly do to deflect it, there will still be of room for hope... and good luck. Until then, when anyone says that the probability for large asteroid impact or Extinction by NEO is low they are offering nothing more than a metric for hope -- not rational information constructive to metering a response or making a decision to do so or not. Here, the probability is in service to illusion... slight-of-mind... and is nothing more than comfort-food-for-thought. We still need such probabilistic comfort-food-for-thought for things like Rogue Black Holes and Gamma Bursts where we are still imaginably defenseless. But if we expect to punctuate the political equilibrium and develop the capability to effectively respond to the existential threat of asteroid impact, we must allow a rational and warranted fear of extinction by asteroid impact to drive a rational and warranted response to this threat forward. Forward into the hands and minds of those who have the aptitude and training and experience in *using* fear to handle fearful things. Fear focuses the mind... Fear reminds us that there are dire negative consequences if we fail. If we are going to concern ourselves with mounting a response and deflecting these objects and no longer tolerate and suffer this threat, would it not be far more relevant to know in which century the probability for large asteroid impact was *high* and far more effective to orient our thinking from when it *will not* to when it *will* occur? But this probabilistic perspective can not even pretend to approach providing us with that kind of information. As such, it can never be strategically relevant: contribute to the conduct of implementing a response. The same can be said when such abstract reasoning is used to forward the notion that the next asteroid to strike Earth will likely be small... This leads us to little more than a hope based Planetary Defense. If we are ever to respond to this threat well then we must begin thinking about this threat better. Large Asteroid Impacts Are Random Events. Expect the next one to occur at any time. Strategically speaking, this means being at DefCon 3: lock-cocked and ready to rock, prepared to defend the planet and mankind from the worst case scenario, 24/7/52... forever. Doing anything less by design, would be like planning to bring a knife to a gunfight. If we expect our technological abilities to develop and continue to shape our nascent and still politically tacit will to respond to this threat: if we are to build an effective Planetary Defense, we must abandon the debilitating sophistry of “The probability for large asteroid impact in the next century is low” in favor of rational random inevitable expectation... and its attendant fear.

### Asteroid-induced extinction is *by far* the biggest impact

Matheny 7 (Jason G., Professor of Health Policy and Management – Bloomberg School of Public Health at Johns Hopkins University, “Reducing the Risk of Human Extinction”, Risk Analysis, 27(5), October, [http://jgmatheny.org/ matheny\_extinction\_risk.htm](http://www.airpower.maxwell.af.mil/airchronicles/cc/france2.html))

Even if extinction events are improbable, the expected values of countermeasures could be large, as they include the value of all future lives. This introduces a discontinuity between the CEA of extinction and nonextinction risks. Even though the risk to any existing individual of dying in a car crash is much greater than the risk of dying in an asteroid impact, asteroids pose a much greater risk to the existence of future generations (we are not likely to crash all our cars at once) ([Chapman, 2004](http://www.airpower.maxwell.af.mil/airchronicles/apje.html)). The "death-toll" of an extinction-level asteroid impact is the population of Earth, plus all the descendents of that population who would otherwise have existed if not for the impact. There is thus a discontinuity between risks that threaten 99% of humanity and those that threaten 100%.

[CONTINUES – OMITTING SEVERAL MATH-CENTRIC TABLES]

I believe that if we destroy [hu]mankind, as we now can, this outcome will be *much worse* than most people think. Compare three outcomes:

1. Peace

2. A nuclear war that kills 99% of the world's existing population

3. A nuclear war that kills 100%

2 would be worse than 1, and 3 would be worse than 2. Which is the greater of these two differences? Most people believe that the greater difference is between 1 and 2. I believe that the difference between 2 and 3 is very much greater … . The Earth will remain habitable for at least another billion years. Civilization began only a few thousand years ago. If we do not destroy [hu]mankind, these thousand years may be only a tiny fraction of the whole of civilized human history. The difference between 2 and 3 may thus be the difference between this tiny fraction and all of the rest of this history. If we compare this possible history to a day, what has occurred so far is only a fraction of a second.

Human extinction in the next few centuries could reduce the number of future generations by thousands or more. We take extraordinary measures to protect some endangered species from extinction. It might be reasonable to take extraordinary measures to protect humanity from the same.19 To decide whether this is so requires more discussion of the methodological problems mentioned here, as well as research on the extinction risks we face and the costs of mitigating them.20

### Even small strikes have a massive impact --- *economic* and *climatic* effects are on par with nuclear war

Nemchinov 8 (Ivan, Valery Shuvalov, and Vladimir Svetsov, Institute for Dynamics of Geospheres, Russian Academy of Sciences, Main Factors of Hazards Due to Comets and Asteroids, Catastrophic Events Caused by Cosmic Objects)

A large number of special and review papers devoted to the problems of hazards due to comets and asteroids have been published recently, e.g., Morrison et al. (1994, 2002), Toon et al. (1994, 1997), Binzel (2000), and Chapman et al. (2001). It is now generally accepted that impacts of cosmic bodies of about 1 km and larger pose a serious danger to modern civilization and even to the survival of humanity. Nevertheless, smaller bodies can be hazardous also. Asteroids and comets from 30-50 m to 0.5-1 km, “small” cosmic bodies, collide with the Earth much more frequently than large impactors. The NEO programs now search for objects 1-2 to 0.1-0.2 km in size, but it is difficult to find small bodies in space because their cross-sections are very small and they are faint at large distances from the Earth. Therefore, catalogues of these bodies will be 90% completed not earlier than 15-20 years from now, even if the necessary large telescopes are constructed. If some of the NEOs are on a collision course with Earth, they will be found only a short time before impact, and a short warning time hinders adoption of necessary mitigation measures. The consequences of the impact of small cosmic bodies have not been thoroughly studied; however, they have specific features in comparison with larger impacts. During a passage through the atmosphere small bodies become deformed and fragmented by aerodynamic forces. A resulting stream of fragments, vapor, and air has a larger cross-section and smaller density, and releases a large portion of its energy in the atmosphere before the impact on the ground or the surface of oceans and seas. Thus, amplitudes of seismic and/or tsunami waves substantially differ from those produced by impactors that hit the ground as compact bodies. To predict these and other effects investigators need to know the shape, structure, strength, composition, and other properties of impactors that influence the result of impacts much more than in the case of large bodies. Nevertheless, simple estimates and analysis of the famous Tunguska event, which occurred in the almost uninhabited Siberian taiga in 1908, show that even if energy on the order of 5-20 Mt TNT is released above the ground (e.g., at altitudes of 5-10 km in the case of the Tunguska event), the resultant shock wave and thermal radiation produce great devastation. If such an event were to happen above a major city with a size of about 20-30 km and a population of several million persons, economic losses and human casualties would be enormous. Hazardous factors such as shock waves, fires, ejection of dust and formation of soot, seismic waves, and tsunamis are now well known. Some additional bodies: the presence on the Earth’s surface of so-called dangerous, e.g., hydroelectric dams, nuclear power plants, radioactive waste depositories, chemical plants producing poisonous substances, and so on. Concentration of such objects, as well as population density, differs from one geographic region to another. Some regions, such as Europe, are much more vulnerable to impacts than others. The study of the consequences of small impacts is partially based on the results of nuclear tests. The yield of the most powerful nuclear explosion exploded in the air at a low altitude above Novaya Zemlya in 1961 was 58 Mt TNT. This is on the order of the energy released by the Tunguska meteoroid on 30 June 1908. However, cosmic bodies, which here are named small bodies, may have a much larger kinetic energy equivalent of 10^3- 10^4 Mt TNT. The characteristic sizes of high-pressure volumes and fireballs produced by impacts with such energies are comparable to the atmospheric scale height. Moreover, behind a descending body heated air expands of the atmosphere leads to substantial difference in the shock wave amplitude and thermal radiation flux at the Earth’s surface. Therefore, the usage of a simple energy scaling law is not accurate, and the authors use the results of numerical simulations. High energies, in comparison with nuclear tests, cause severe ionospheric and magnetospheric disturbances that may lead to disruption of radio communications and hinder normal functioning of radiolocation, GPS, and other technical systems, which play more and more important roles for modern humanity.

### *Undetected* small objects trigger military early-warning systems, sparking accidental nuclear war

David 2 (Leonard, Senior Space Writer – Space.com, “First Strike or Asteroid Impact?”, 6-6, http://abob.libs.uga.edu/bobk/ccc/cc060702.html)

Military strategists and space scientists that wonder and worry about a run-in between Earth and a comet or asteroid have additional worries in these trying times. With world tensions being the way they are, even a small incoming space rock, detonating over any number of political hot-spots, could trigger a country's nuclear response convinced it was attacked by an enemy. Getting to know better the celestial neighborhood, chock full of passer-by asteroids and comets is more than a good idea. Not only can these objects become troublesome visitors, they are also resource-rich and scientifically bountiful worlds. Slowly, an action plan is taking shape. Noted asteroid and comet experts met here May 23-27, taking part in the National Space Society's International Space Development Conference 2002. Sweat the small stuff Being struck by a giant asteroid or comet isn't the main concern for Air Force Brigadier General Simon Worden, deputy director of operations for the United States Space Command at Peterson Air Force Base, Colorado. He sweats the small stuff. Worden painted a picture of the next steps needed in planetary defense. His views are not from U.S. Department of Defense policy but are his own personal perspectives, drawing upon a professional background of astronomy. For example, Worden said, several tens of thousands of years ago an asteroid just 165-feet (50 meters) in diameter punched a giant hole in the ground near Winslow, Arizona. Then there was the Tunguska event. In June 1908, a massive fireball breached the sky, then exploded high above the Tunguska River valley in Siberia. Thought to be in the range of 165-feet (50 meters) to 330 feet (100 meters) in size, that object created a devastating blast equal to a 5 to 10 megaton nuclear explosion. A similar event is thought to have taken place in the late 1940s in Kazakhstan. "There's probably several hundred thousand of these 100-meter or so objects...the kind of ones that we worry about," Worden said. However, these are not the big cosmic bruisers linked with killing off dinosaurs or creating global catastrophes. On the other hand, if you happen to be within a few tens of miles from the explosion produced by one of these smaller near-Earth objects, "you might think it's a pretty serious catastrophe," Worden said. "The serious planetary defense efforts that we might mount in the next few decades will be directed at much smaller things," Worden said. Some 80 percent of the smaller objects cross the Earth's orbit, "some of which are potentially threatening, or could be in the centuries ahead," he said. Nuclear trigger One set of high-tech military satellites is on special round-the-clock vigil. They perform global lookout duty for missile launches. However, they also spot meteor fireballs blazing through Earth's atmosphere. Roughly 30 fireballs detonate each year in the upper atmosphere, creating equivalent to a one-kiloton bomb burst, or larger, Worden said. "These things hit every year and look like nuclear weapons. And a couple times a century they actually hit and cause a lot of damage," Worden said. "We now have 8 or 10 countries around the world with nuclear weapons...and not all of them have very good early warning systems. If one of these things hits, say anywhere in India or Pakistan today, we would have a very bad situation. It would be awfully hard to explain to them that it wasn't the other guy," Worden pointed out. Similarly, a fireball-caused blast over Tel Aviv or Islamabad "could be easily confused as a nuclear detonation and it may trigger a war," Worden said. Meanwhile, now moving through the U.S. Defense Department circles, Worden added, is a study delving into issues of possibly setting up an asteroid warning system. That system could find a home within the Cheyenne Mountain Complex outside Colorado Springs, Colorado. The complex is the nerve center for the North American Aerospace Defense Command (NORAD) and United States Space Command missions. Next steps Where do we go from here? An important step, Worden said, is cataloging all of the objects that are potentially threatening, down to those small objects that could hit and destroy a city. To do this type of charting, military strategists now champion a space-based network of sensors that keep an eye on Earth-circling satellites. These same space sentinels could serve double-time and detect small asteroids, he said.

### That escalates to global nuclear war

Forrow 98 (Lachlan, MD, et al, “Accidental Nuclear War – A Post-Cold War Assessment”, New England Journal of Medicine, iis-db.stanford.edu/pubs/20625/acciden\_nuke\_war.pdf)

Earlier assessments have documented in detail the problems of caring for the injured survivors of a nuclear attack: the need for care would completely overwhelm the available health care resources. Most of the major medical centers in each urban area lie within the zone of total destruction. The number of patients with severe burns and other critical injuries would far exceed the available resources of all critical care facilities nationwide, including the country's 1708 beds in burn-care units (most of which are already occupied). The danger of intense radiation exposure would make it very difficult for emergency personnel even to enter the affected areas. The nearly complete destruction of local and regional transportation, communications, and energy networks would make it almost impossible to transport the severely injured to medical facilities outside the affected area. After the 1995 earthquake in Kobe, Japan, which resulted in a much lower number of casualties (6500 people died and 34,900 were injured) and which had few of the complicating factors that would accompany a nuclear attack, there were long delays before outside medical assistance arrived. From Danger to Prevention Public health professionals now recognize that many, if not most, injuries and deaths from violence and accidents result from a predictable series of events that are, at least in principle, preventable. The direct toll that would result from an accidental nuclear attack of the type described above would dwarf all prior accidents in history. Furthermore, such an attack, even if accidental, might prompt a retaliatory response resulting in an all-out nuclear exchange. The World Health Organization has estimated that this would result in billions of direct and indirect casualties worldwide.

## 1AC: Nuclear Option Advantage

### Advantage 2 --- Nuclear Option

### U.S. *attempts* at NEO deflection are inevitable --- the only question is *what form* it’ll take

Koplow 5 (Justin, JD Candidate – Georgetown University Law Center, Georgetown International Environmental Law Review, Lexis)

C. ROCKS NOT ROCKETS The fundamental procedures of intercepting an incoming missile and diverting an asteroid are significantly different. But the fundamental legal theory is strikingly similar. What the United States has done through the Bush expansion of missile defense is to make a commitment to aid foreign nations in preventing a disaster that would not cause injury to U.S. territory. In this sense, the foreign impact of an asteroid and the foreign impact of a ballistic missile are remarkably similar and so are the U.S. agreements and legal conceptions of duty and response there under. Many States -- including England, Japan, Australia, Canada, Italy, and Poland -- have shown interest in the U.S. BMD plans. n119 The desired fruit of discussions with such States is a framework agreement whereby the one party agrees to host U.S. interceptors, radar installations, or related facilities, and the United States agrees that the shield will be extended to the protection of that state. n120 Presumably typical of such framework agreements is the 2003 Memorandum [\*299] of Understanding Between Secretary of Defense on Behalf of the Department of Defense of the United States of America and the Secretary of State for Defense of the United Kingdom of Great Britain and Northern Ireland Concerning Ballistic Missile Defense (MOU). n121 As stated in its title, the MOU was concluded between U.S. Secretary of Defense Donald Rumsfeld and U.K. Secretary of State for Defense Geoff Hoon to cover the establishment of cooperative relations in missile defense. The introductory section begins with recitation of the "recognitions" that are the foundation for the agreement, including that the United States and the United Kingdom have a "common interest in defense;" that the U.S. government has made the decision to "develop and deploy a set of missile defense capabilities;" and that the cooperation envisioned in the MOU should proceed to the understanding that "security of the Participants will be enhanced." n122 The MOU's first section, Purpose and Scope, reiterates the basis of the U.S. decision to pursue this line of technology and defense, as well as recalling the Bush line of "friends and allies," before getting to the real substance of the agreement: "the United Kingdom (U.K.) government supports these U.S. [missile defense] efforts and has welcomed assurances that the United States is prepared to extend coverage and make missile defense capabilities available to the U.K." n123 The subsequent paragraphs establish a few concrete details of the cooperation, including that the United Kingdom will upgrade the early warning radar systems at the Royal Air Force base at Fylingdales; that the United States and United Kingdom will engage in closer technical cooperation in other areas of missile defense; and that the MOU should serve to facilitate opportunities for U.K. and U.S. industries to participate in the U.S. ballistic missile defense system (BMDS) program. n124 The tangible products of such agreements are also in their effect. While several countries already have a substantial U.S. military presence (such as Fylingdales, the U.S. military bases in Japan, and the jointly-run NORAD system with Canada) that makes cooperation a commonplace occurrence, there are new indications and emplacements that can only be attributed to missile defense commitments and cooperation. In the Pacific theater, where North Korea is the [\*300] greatest threat and China a no-less-significant but less likely threat, the United States has moved an Aegis class cruiser equipped with a Standard Missile 3 system to defend against short-or medium-range missiles into permanent patrol on the Sea of Japan. n125 The Bush administration has also considered selling advanced missile defense systems to Taiwan. n126 In the European theater, interceptors and sensors have been placed in England, while Poland and Turkey, per strategic geography, would be prime locations for similar installations. n127 Israel has long been a missile defense partner and permitted use of the Patriot and jointly developed Arrow systems in both Iraq conflicts. n128 Both wars with Iraq also featured the use of interceptors to combat Iraqi Scud missiles, whether fired at U.S. troops or into Kuwait and neighboring states. n129 The simple fact is that the United States, and specifically the Bush administration, has made a commitment to missile defense and is willing to export it around the world in the interest of promoting international peace and security. The realities of shooting down a missile in its boost phase, the fundamental logic behind missile defense, and the idea that U.S. national defense is served by having missile interceptors stationed around the globe can each be analogized to the asteroid scenario. In the initial boost phase, it is not immediately apparent what the final target of a missile will be because trajectories can be adjusted and manipulated such that a missile launched from North Korea could be targeted for Seoul, Tokyo, Beijing, Sydney, Honolulu, or Los Angeles. n130 But despite all of these possibilities in the first few moments, the missile defense systems in the area would activate and attempt to destroy the missile without care for whether a MOU has been worked out with every specific possible target. The rewards, stopping a missile that might hit Japan, a missile defense cooperating State, are far greater than the "risk," a "free rider" concern that, for instance, Beijing would be protected without China having to explicitly agree to cooperate. In essence, what the United States has committed itself to is not defense of specific countries with which it makes explicit agreements, but rather to whole regions, and indeed, to the whole world. This "boost phase anonymity" situation shows how the United States will be willingly acting in the world's interests without a concern for exactly whom it is they are protecting. In any missile launch where there is the possibility that it would be in the United States' interests to prevent the impact, the missile defense system will attempt to do just that. [\*301] Under a system of foreign asteroid defense, the United States would be bound to defend countries from an attack little different, save for the presence of an instigating party, from a missile launch. The main difference is that the actual or predicted target would be known in the case of an asteroid; however, as the United States has shown a blanket willingness to protect States under the missile defense system, it would be hard-pressed not to use the tools and methods at its disposal in an asteroid context simply because the area of impact was not politically "desirable." VI. TREATY ON POINT AND CONCLUSION The ultimate question of this note is whether the United States has through its participation in various space and weapons treaties and agreements created a duty by which it would be bound to attempt to avert the catastrophic effects of a foreign asteroid impact. The above explorations demonstrate that there is a large basis for an affirmative answer. Examination of U.S. involvement in space treaties and its own pursuit of international missile defense shows that the United States has created a special relationship from actual and superior knowledge coupled with a situation in which foreign States are being denied normal means and opportunities for self-defense and protection. This would, if it were under Minnesota law, indicate a special relationship and thereby a duty of protection. This is important in an era where space travel is increasingly privatized, and it also points to a possibly emerging custom. n131 However, U.S. law neither makes international law nor binds the relationships of the United States and foreign sovereign States. The international community is loath to simply create and foist duties and obligations upon members who did not actively participate in the bargaining for such deals and understandings. n132

### Nuclear deflection will be used now --- only the combination of detection and deflection forces the U.S. away

Chapman 6 (Clark, Senior Scientist – Southwest Research Institute Dept. of Space Studies, and Member of the Board – B612 Foundation, “Critique of "2006 Near-Earth Object Survey and Deflection Study: Final Report" Published 28 Dec. 2006 by NASA Hq. Program Analysis & Evaluation Office”, http://www.b612foundation.org/papers/NASA-CritChap.doc)

Furthermore, the Report takes a totally backwards approach to characterization, saying that we first need to determine what deflection system we will use before addressing what characterization option we will try to build and implement. The "logic" is not what it should be, namely that we will select (from a tool-kit of relevant technologies) what deflection approach would be appropriate for an \*identified\* threatening NEO of a particular size; rather, it says (specifically in the last paragraph of pg. 73) that we will soon select a one-approach-fits-all deflection system (e.g. stand-off nuclear) as the preferred generic deflection scheme and only then design a characterization effort that will address the needs of that sole deflection approach. (The seriousness of this error is illustrated by the fact that the Report seems to select stand-off nuclear as the preferred approach -- because it is "most effective" -- and then ridiculously concludes that we need to know \*less\* about the physical nature of the NEO for stand-off nuclear than for all other deflection options! [This absurd argument is "developed" in the middle paragraph of pg. 61.].) The logical approach, instead (and of course!), is to have a tool-kit of deflection approaches that will address the range of feasible cases, then characterize any threatening NEO that is found, and finally fold the results of that characterization into designing the appropriate deflection mission (which may involve more than one deflection technique) from among the techniques in our tool-kit.

### Nuclear deflection *fails* and sends warheads *back to Earth* --- risks extinction

IAA 9 (International Academy of Astronautics, “Dealing With The Threat To Earth From Asteroids And Comets”, http://iaaweb.org/iaa/Scientific%20Activity/Study%20Groups/SG%20Commission%203/sg35/sg35finalreport.pdf)

There is a persistent notion in lay circles that the way to deal with a dangerous NEO is to simply hit it with an ICBM and vaporize it in space. Unfortunately, reality is far removed from this illusion. While it is likely that we may be able to rapidly reconfigure an ICBM computer guidance system to intercept a point or object in near-Earth space, ICBM propulsion system performance is insufficient to enable intercept beyond a few hundred kilometers above the Earth’s surface. Stages must be added to an ICBM to enable it to achieve the necessary escape velocity and to place the weapon on an intercept trajectory with a NEO. While these upper stage technologies are space qualified, such a system would have too low a reliability for the NEO intercept mission given the potentially horrendous consequences of an Earth impact, and might thus require many sequential launches of several such vehicles to have any reasonable chance of successfully deflecting a NEO. Such attempts would be part of a dedicated “campaign” utilizing several different launch vehicle types, designed with different upper stages, using different end game techniques, and different nuclear warhead types, in order to obtain a high probability of success. Furthermore at least one failed launch attempt is likely if many are required, and with a nuclear payload this could result in serious environmental effects in and of itself. Thus, it is clear that for the nuclear concept several dedicated designs of a inherently highly reliable launch vehicles and multi-stage interceptors would be extremely desirable to loft the nuclear warheads, and thus the use of existing ICBMs, even if outfitted with current technology upper stages, is highly undesirable if not essentially ruled out. Nevertheless, if there were no other option due to insufficient warning time we might want to do all we can with the tools at hand rather than sit passively like the dinosaurs, and attempt intercepts with current space launchers and current upper stages if no dedicated vehicles exist or could be developed in the time available. It would be perfectly rational to divert any and all launchers and spacecraft being designed for planetary exploration to becoming NEO interceptors, whatever their state of development. Finally it must be made clear that many nuclear warheads intended for ICBMs exist that could be used with few, if any, modifications as payloads for the purpose of deflection of NEOs, whatever launch vehicle and upper stage is used to get them to the NEO (see ref. 4).

### The U.S. is key --- no one else will invest in deflection and only the U.S. act act

Koplow 5 (Justin, JD Candidate – Georgetown University Law Center, Georgetown International Environmental Law Review, Lexis)

A third, but related question, goes to how to pay for the system contemplated in the above discussion. The costs involved in such a system are not minimal, and there will be those who claim that the costs of the system outweigh what would be saved from preventing an asteroid impact. This point is easy to dismiss. In the first place, just because one asteroid impact is detected and dealt with, the threat has not been permanently extinguished. Furthermore, the benefit of multiple preventions and the security and peace of mind provided by a known system would outweigh the costs. n138 Secondly, the system and whatever plans and tactics it devises would also be Earth's best strategy for planetary defense against a global killer. In that event, no cost would be too dear. Turning from justifications to actual expenses, the greatest costs will be in maintaining readiness for both the monitoring States and the acting States. n139 For the former, new observatories will [\*304] have to be constructed or current facilities will have to be re-tasked. This, however, will likely not be too great a cost as States will not be truly starting from scratch; as the Time article shows, many States already have facilities and astronomers who spend a great deal of time searching the skies. n140 This is further bolstered by the grassroots efforts of the legions of amateur astronomers, who would be an invaluable resource. In all, for the monitoring States, the greatest costs would be start-up: organizing individually to search, setting up new or re-tasking existent facilities, and organizing an international system to handle and maintain the data and monitor the search. The required costs for the acting States would be much higher in the event of an actual mission. These costs would have to be distributed among all parties, similar to U.N. dues allocations, to whatever degree they are identifiable and it is practicable. The harder part, but one that has been dealt with in the context of missile defense, is basic maintenance and readiness costs. The United States does not keep a space shuttle ready to fly at all times and could not immediately mount an emergency mission. Costs would be incurred in increasing availability. However, allocating costs between the benefit to the asteroid defense program and the benefit to the overall military of an actor State will be difficult. Each actor state would likely demand to retain close control over its weapons and systems, creating a further gap between the payments for the program and the payments for the national military. n141 These costs and problems are troublesome, but would likely have to be accepted for the greater good. One way to minimize the problems would be to have the specific actor country pay for a greater percentage of the improvements done to its systems, as it is receiving the primary benefit. n142 Asteroid defense agreements could also require a commitment that the actor States maintain an established level of readiness with minimal oversight, but with only a percentage of the costs of such readiness provided from other treaty participants.

### The plan solves the “nuclear option” --- and even if it doesn’t, radar and telescopes provide data to make it effective

Schweickart 4 (Russell, Chair of the B612 Foundation, former astronaut, Executive Vice President of CTA Commercial Systems, Inc. and Director of Low Earth Orbit (LEO) Systems and research, and scientist at the Experimental Astronomy Laboratory of the Massachusetts Institute of Technology (MIT), “Asteroid Deflection; Hopes and Fears,” Aug., Presented at the World Federation of Scientists Workshop on Planetary Emergencies, Erice, Sicily, August 2004 http://www.b612foundation.org/papers/Asteroid\_Deflection.doc)

The nuclear explosive options will all be strongly dependent on the bulk and surface structural characteristics of asteroids, a feature about which we know very little today. It is also likely that we will find substantial variation in these structural characteristics from one asteroid type to another, and perhaps even within the population of any given type. Therefore the nuclear option may require quite extensive detailed information about each asteroid to be deflected, an information set not easily acquired. Until much more is known about this subject predicting the result of a nuclear explosive deflection effort will be highly unreliable. In addition to predicting the result of a nuclear deflection, measuring the actual result of a deflection mission will be challenging due to the violent nature of the operation. A double spacecraft compound mission, with one component serving as the deflector and a second as observer is one solution to this challenge. However since the velocity change being sought is less than one part in 106 verifying success from a spacecraft flying past at 10 km/sec is daunting. If the operation also fragments the asteroid, even partially, the task of determining the result of the operation may well be impossible. Finally, any nuclear explosive option is and will remain inextricably intertwined with global geopolitics and, in fact, raise to prominence the spectre of space nuclear weapons. International treaties ban these objects in space today, but if no other deflection technique has been tested and/or validated when the world experiences either a near miss or perhaps a small but significant impact, the world public demand for action to prevent a recurrence of such an event may be sufficient to enable a state, so determined, to justify abrogating the treaties against weapons in space on the grounds of protection of the world public. It is critical therefore, that the soft options be developed, demonstrated and known to be viable as soon as possible. This task is of utmost importance in order to avoid a situation in which the public misperception that the nuclear option is the only one available to protect the Earth from asteroid impacts.

## Plan

### The United States federal government should increase its exploration of near-Earth objects and its development of near-Earth object deflection systems, including telescopes, radar, and deflection technology.

## 1AC: Solvency

### Contention 2 --- Solvency

### Plan allows new telescopes, radar, and development of deflection tech

NRC 10 (National Research Council, Defending Planet Earth: Near-Earth Object Surveys and Hazard Mitigation Strategies, Committee to Review Near-Earth-Object Surveys and Hazard Mitigation Strategies, http://www.nap.edu/catalog.php?record\_id=12842)

The committee outlined three possible levels of funding and a possible program for each level. These three, somewhat arbitrary, levels are separated by factors of five: $10 million, $50 million, and $250 million annually. • $10-million level. The committee concluded that if only $10 million were appropriated annually, an approximately optimal allocation would be as follows: $4 million for continuing ground-based optical surveys and for making follow-up observations on long-known and newly discovered NEOs, including determining their orbits and archiving these along with the observations; the archive would continue to be publicly accessible; $2.5 million to support radar observations of NEOs at the Arecibo Observatory; $1.5 million to support radar observations at the Goldstone Observatory; and $2 million to support research on a range of issues related to NEO hazards, including but not necessarily limited to (see Chapter 6) the study of sky distribution of NEOs and the development of warning-time statistics; concept studies of mitigation missions; studies of bursts in the atmosphere of incoming objects greater than a few meters in diameter; laboratory studies of impacts at speeds up to the highest feasible to obtain; and leadership and organizational planning, both nationally and internationally. The $10-million funding level would not allow on any time scale the completion of the mandated survey to discover 90 percent of near-Earth objects of 140 meters in diameter or greater. Also lost would be any possibility for mounting spacecraft missionsfor example, to test active mitigation techniques in situ. (A caveat: The funds designated above to support radar observations are for these observations alone; were the maintenance and operations of the radar-telescope sites not supported as at present, there would be a very large shortfall for both sites: about $10 million annually for the Arecibo Observatory and likely a larger figure for the Goldstone Observatory.) • $50-million level. At a $50-million annual appropriations level, in addition to the tasks listed above, the committee notes that the remaining $40 million could be used for the following: Support of a ground-based facility, as discussed in Chapter 3, to enable the completion of the congressionally mandated survey to detect 90 percent of near-Earth objects of 140 meters in diameter or greater by the delayed date of 2030. The $50-million funding level would likely not be sufficient for the United States alone to conduct space telescope missions that might be able to carry through a more complete survey faster. In addition, this funding level is insufficient for the development and testing of mitigation techniques in situ. However, such missions might be feasible to undertake if conducted internationally, either in cooperation with traditional space partners or as part of an international entity created to work on the NEO hazards issue. Accommodating both the advanced survey and a mitigation mission at this funding level is very unlikely to be feasible, except on a time scale extended by decades. • $250-million level. At a $250-million annual budget level, a robust NEO program could be undertaken unilaterally by the United States. For this program, in addition to the research program a more robust survey program could be undertaken that would include redundancy by means of some combination of ground-and space-based approaches. This level of funding would also enable a space mission similar to the European Space Agency’s (ESA’s) proposed Don Quijote spacecraft, either alone, or preferably as part of an international collaboration. This space mission would test in situ instrumentation for detailed characterization, as well as impact technique(s) for changing the orbit of a threatening object, albeit on only one NEO. The target could be chosen from among those fairly well characterized by ground observations so as to check these results with those determined by means of the in situ instruments. The committee assumed constant annual funding at each of the three levels. For the highest level the annual funding would likely need to vary substantially as is common for spacecraft programs. Desirable variations of annual funding over time would likely be fractionally lower for the second level, and even lower for the first level. How long should funding continue? The committee deems it of the highest priority to monitor the skies continually for threatening NEOs; therefore, funding stability is important, particularly for the lowest level. The second level, if implemented, would likely be needed at its full level for about 4 years in order to contribute to the completion of the mandated survey. The operations and maintenance of such instruments beyond this survey has not been investigated by the committee. However, were the Large Synoptic Survey Telescope to continue operating at its projected costs, this second-level budget could be reduced. The additional funding provided in the third and highest level would probably be needed only through the completion of the major part of a Don Quijote-type mission, under a decade in total, and could be decreased gradually but substantially thereafter. Finding: A $10-million annual level of funding would be sufficient for continuing existing surveys, maintaining the radar capability at the Arecibo and Goldstone Observatories, and supporting a modest level of research on the hazards posed by near-Earth objects. This level would not allow the achievement of the goals established in the George E. Brown, Jr. Near-Earth Object Survey Act of 2005 on any time scale. A $50-million annual level of funding for several years would likely be sufficient to achieve the goals of the George E. Brown, Jr. Near-Earth Object Survey Act of 2005. A $250-million annual level of funding, if continued for somewhat under a decade, would be sufficient to accomplish the survey and research objectives, plus provide survey redundancy and support for a space mission to test in situ characterization and mitigation.

### Research on deflection methods *now* is key to effectiveness --- detection alone means tech will be undeveloped and untested

NRC 10 (National Research Council, Defending Planet Earth: Near-Earth Object Surveys and Hazard Mitigation Strategies, Committee to Review Near-Earth-Object Surveys and Hazard Mitigation Strategies, http://www.nap.edu/catalog.php?record\_id=12842)

WARNING TIME FOR MITIGATION A key issue associated with the hazard from NEOs is that the length of time needed to execute a mitigation strategy involving orbit change is likely to require acting before the knowledge of the trajectory is sufficiently accurate to know with high confidence that an impact would occur without mitigation. It is possible, therefore, that action to mitigate could be deferred until it is too late if plans are not already in place to act when the probability of impact reaches some level that is well below unity. As addressed in Chapter 5, the time required to mitigate optimally (other than only by means of civil defense) is in the range of years to decades, but this long period may require acting before it is known with certainty that an NEO will impact Earth. Chodas and Chesley (2009) have simulated the discovery of objects that would impact within the 50 years starting at the beginning of the next generation of surveys (see Chapter 3), using estimates of the (decreasing) orbital uncertainty as observations are accumulated. Although there are many assumptions in this approach, the most important is whether or not the surveys and the follow-up programs to determine the orbits will be funded and will operate as assumed. Chodas and Chesley (2009) assume that an NEO is declared “truly hazardous” and worthy of mitigation preparations when the probability of hitting Earth reaches 0.5 (any other assumption regarding the decision point is also easily simulated). In this simulation, about 90 percent of impacting NEOs larger than about 140 meters in diameter are discovered in a 10-year survey. The temporal distribution of discoveries in this simulation showed that several percent of the 140-meter-sized objects that impact do so before discovery, but the total number of impactors per century is not large, so that a few percent represents an exceptionally unlikely event. Most of the impactors in this size range are discovered to be truly hazardous within several years of discovery, typically at the next time that the object is in a location in which it is viewable, thus providing warning times of a decade to several decades. By contrast, more than 10 percent of the objects larger than 50 meters in diameter that would impact within 50 years do impact before discovery, and there are many more of these than there are of the larger objects. Such smaller objects would generally be found to be truly hazardous within weeks to months before impact. Objects in the size range of 10 to 50 meters in diameter make up the majority of all potentially hazardous NEOs larger than 10 meters. The damage that could be caused by one of these smaller objects is less than for a larger object, but those smaller ones that are detected are likely to be found, at most, hours to months prior to their final plunge, with civil defense then being the only plausible mitigation strategy. Currently, by far the most probable scenario is that of a small impactor, likely to cause at most only local destruction. However, the assessed probability of any particular scenario is changing with time as the next- generation surveys discover most of the larger objects and the understanding of impact processes, such as airbursts and tsunami generation, improves. Thus, planning for mitigation must continue to evolve over time. Furthermore, when working with the statistics of small samples, and particularly when less likely scenarios have outcomes that are so much more catastrophic than the most likely scenario, one should not assume that the next event will be the most likely one.

### Combination of ground and space-based observations is key --- they provide complementary data necessary to accurately deflect

NRC 10 (National Research Council, Defending Planet Earth: Near-Earth Object Surveys and Hazard Mitigation Strategies, Committee to Review Near-Earth-Object Surveys and Hazard Mitigation Strategies, http://www.nap.edu/catalog.php?record\_id=12842)

Combined ground- and space-based surveys have a number of advantages. Such surveys discover more NEOs of all sizes, including a substantial number smaller than 140 meters in diameter. These combined surveys also provide more characterization data about the entire NEO population. With both infrared and visible data for most targets, it would be possible to obtain accurate diameter estimates for all objects, as well as measurements of their albedos and their surface and thermal properties. These high-value characterization data could help to guide mitigation campaign studies. Additionally, a dual survey provides much information on the population of objects smaller than 140 meters in diameter. Finding: The selected approach to completing the George E. Brown, Jr. Near-Earth Object Survey will depend on nonscientific factors: • If the completion of the survey as close as possible to the original 2020 deadline is considered more important, a space mission conducted in concert with observations using a suitable ground-based telescope and selected by peer-reviewed competition is the better approach. This combination could complete the survey well before 2030, perhaps as early as 2022 if funding were appropriated quickly. • If cost conservation is deemed more important, the use of a large ground-based telescope is the better approach. Under this option, the survey could not be completed by the original 2020 deadline, but it could be completed before 2030. To achieve the intended cost-effectiveness, the funding to construct the telescope must come largely on the basis of non-NEO programs. As noted above, neither Congress nor the administration has requested adequate funding to conduct the survey to identify ≥90 percent of the potentially hazardous NEOs by the year 2020. Multiple factors will drive the decision on how to approach this survey in the future. These include but are not limited to the perceived urgency for completing the survey of 140-meter-diameter NEOs as close to the original 2020 deadline as feasible and the availability of funds to provide for the successful completion of the survey. The combination of a spacebased detection mission with a large ground-based telescope could complete the survey in the shortest time, that is, closest to the original 2020 deadline. A space-based mission alone could complete the survey only 2 to 4 years later than a survey conducted with both a space-based telescope and a large ground-based telescope. The cost of optimizing the LSST for NEO detection observations was estimated in 2007 to be an increment of approximately $125 million to the cost of the basic telescope system (Ivezić, 2009), becoming the most cost-effective means to complete the survey. (Note that the annual operating cost of a ground-based telescope is approximately 10 percent of the development and construction costs.) The completion date would be extended. The decision to extend this date requires the acceptance of the change in risk over that time.

# \*NEO STRIKE ADVANTAGE

## SQ Deflection Fails

### Can’t deflect now- both nuclear and nonnuclear options fail

IAA 9 (International Academy of Astronautics, “Dealing With The Threat To Earth From Asteroids And Comets”, http://iaaweb.org/iaa/Scientific%20Activity/Study%20Groups/SG%20Commission%203/sg35/sg35finalreport.pdf)

There are only two options for “fast” deflection: non-nuclear and nuclear. The principal non-nuclear approach is kinetic impact--simply ramming a spacecraft into a NEO at high relative velocity to provide an instantaneous velocity change of the NEO due to energy and momentum exchange. The technologies and systems are essentially the same as already demonstrated for planetary and solar system exploration, and are well understood and developed. Kinetic impactors are best suited for deflecting relatively small NEOs with little warning time or larger ones when there is lots of warning time. There is only one option for deflecting a large NEO or one with little warning time, and that is to use nuclear devices because the energy requirements can be enormous, and the energy release of nuclear devices can be millions of times greater than that produced by kinetic impacts. Existing nuclear devices could be used with few, if any, modifications and launched by current launch vehicles and current technology upper stages, however current ICBMs are too small to reach the required velocities. The probability of successfully deflecting a NEO with a single mission using any of the above techniques and current technologies is unacceptably low, given the status of technology and the likely scale of the consequences of a failure. Therefore the deflection of a NEO cannot be a mission but must rather be a campaign of multiple orchestrated missions deployed sequentially in increasingly capable stages using different technologies, with means emplaced to rapidly assess the status and effects of the missions as they unfold.

## A2: Detection Solves

### Current detection fails and misses small objects

IAA 9 (International Academy of Astronautics, “Dealing With The Threat To Earth From Asteroids And Comets”, http://iaaweb.org/iaa/Scientific%20Activity/Study%20Groups/SG%20Commission%203/sg35/sg35finalreport.pdf)

The models of the NEO orbital and size distribution have been used to evaluate the effectiveness of the current surveys in discovering the remaining (i.e. not yet detected) NEO population30. It has been predicted that the discovery rate of new objects would have started to drop off in 2003 to lower and lower rates (this has indeed happened). The reason is not simply that it is statistically less probable to find one object, if fewer remain. It is also that the NEOs which are still to be discovered are the most difficult ones, as they are small (e.g. faint) and reside on orbits whose geometry relative to the Earth maximize the observational biases against discovery. Thus, according to [ref. 34], if there were no improvements to the current facilities the Spaceguard goal would not be reached before 2030, at best. Also, (see ref. 30) showed that the current surveys are completely inadequate to discover a large fraction of the population of NEOs smaller than 1 km in diameter. Despite their small size, these objects could still constitute a significant hazard for human civilization (see below). This has motivated NASA to mandate the SDT (see ref. 22) to study how the search for NEOs could be extended to smaller objects.

### Need to improve SQ detection- constant improvement key to track interactions between current objects and find new ones that will impact Earth

NRC 10 (National Research Council, Defending Planet Earth: Near-Earth Object Surveys and Hazard Mitigation Strategies, Committee to Review Near-Earth-Object Surveys and Hazard Mitigation Strategies, http://www.nap.edu/catalog.php?record\_id=12842)

Thus, assessing the completeness of the NEO surveys is subject to uncertainties: Some groups of NEOs are particularly difficult to detect. Asteroids and comets are continually lost from the NEO population because they impact the Sun or a planet, or because they are ejected from the solar system. Some asteroids have collisions that change their sizes or orbits. New objects are introduced into the NEO population from more distant reservoirs over hundreds of thousands to millions of years. The undiscovered NEOs could include large objects like 2009 HC82 as well as objects that will be discovered only months or less before Earth impact (“imminent impactors”). Hence, even though 85 percent of NEOs larger than 1 kilometer in diameter might already have been discovered, and eventually more than 90 percent of NEOs larger than 140 meters in diameter will be discovered, NEO surveys should nevertheless continue, because objects not yet discovered pose a statistical risk: Humanity must be constantly vigilant. Finding: Despite progress toward or completion of any survey of near-Earth objects, it is impossible to identify all of these objects because objects’ orbits can change, for example due to collisions. Recommendation: Once a near-Earth object survey has reached its mandated goal, the search for NEOs should not stop. Searching should continue to identify as many of the remaining objects and objects newly injected into the NEO population as possible, especially imminent impactors.

### Can’t detect small objects in SQ

IAA 9 (International Academy of Astronautics, “Dealing With The Threat To Earth From Asteroids And Comets”, http://iaaweb.org/iaa/Scientific%20Activity/Study%20Groups/SG%20Commission%203/sg35/sg35finalreport.pdf)

Once-in-a-Century Mini-Tunguska Atmospheric Explosion Consider a 30-40 m office-building-sized object striking at 100 times the speed of a jetliner. It would explode ~15 km above ground, releasing the energy of ~100 Hiroshima-scale bombs. Some researchers consider that such an event would be spectacular to witness but would not have lethal consequences. Our review of the literature suggests, however, that weak structures might be damaged or destroyed by the overpressure of the blast wave out to 20 km. The death toll might be hundreds; although casualties would be far higher in a densely populated place, they would much more likely be zero (i.e., if the impact were in the ocean or in a desolate location). Such an event is likely to occur before or during our grandchildren's lifetimes, although most likely over the ocean rather than land. Even with the proposed augmented Spaceguard Survey, it is unlikely that such a small object would be discovered in advance; impact would occur without warning. Since it could occur literally anywhere, there are no location-specific kinds of advance measures that could or should be taken, other than educating people (perhaps especially military forces that might otherwise mistake the event as an intentional attack) about the possibilities for such atmospheric explosions. In the lucky circumstance that the object is discovered years in advance, a relatively modest space mission could deflect such a small body, preventing impact (see ref. 65).

## NEO Strikes Likely

### Asteroid impact is very likely --- thousands of undiscovered asteroids exist

Rollins 11 [James, Bestselling Author, “10 Ways The World Could End Tomorrow” Guyism, 6-20, http://guyism.com/lifestyle/ways-the-world-could-end.html]

We all saw this earth-shattering disaster portrayed in movies like Armageddon and Deep Impact. But how likely is it that an asteroid or comet will hit the Earth? The answer: very likely. At this moment, astronomers have identified over 1000 near-earth asteroids that could be a danger. But that’s only those that we know about. Estimates suggest there are actually hundreds of thousands more out there. The Kuiper belt alone (near the planet Neptune) contains over a hundred thousand asteroids, which continually rain comets toward the sun and Earth. It would only take one unlucky hit to end life on this planet. Remember, it was an asteroid that killed the dinosaurs — are we next?

## Impact – Asteroids Outweigh

### The impact of a *large asteroid* is extinction --- only our impact ends all life on Earth instantaneously

IAA 9 (International Academy of Astronautics, “Dealing With The Threat To Earth From Asteroids And Comets”, http://iaaweb.org/iaa/Scientific%20Activity/Study%20Groups/SG%20Commission%203/sg35/sg35finalreport.pdf)

2-3 km Diameter Civilization Destroyer A million MT impact, even though ~100 times less energetic than the K-T impact, would probably destroy civilization as we know it. The dominant immediate global effect would be sudden cooling, lasting many months, due to massive injection of dust into the stratosphere following impact. Moreover, the ozone layer would be destroyed. Agriculture would be largely lost, worldwide, for an entire growing season. Combined with other effects (e.g. a firestorm the size of India), it is plausible that billions might die from collapse of social and economic institutions and infrastructure. No nation could avoid direct, as well as indirect, consequences of unprecedented magnitude. Of course, because civilization has never witnessed such an apocalypse, predictions of consequences are fraught with uncertainty: is civilization inherently fragile or robust?

### Our evidence is comparative --- war, environmental destruction, terrorism, and economic collapse are all dwarfed by an asteroid impact

Steel 2 - Joule Physics Laboratory, University of Salford (October 24, Duncan, “ Neo Impact Hazard: the Cancer Metaphor ” NASA Workshop on Scientific Requirements for Mitigation of Hazardous Comets and Asteroids, http://www.noao.edu/meetings/mitigation/media/arlington.extended.pdf pg. 93)

The Cancer Metaphor: Why facing up to hazardous asteroids and comets is like dealing with cancer: (1) Early identification is vital Most cancers need to be picked up very early in their development if they are to be treatable. So it is with NEOs. We have no time to lose in identifying any potential Earth impactor: there is no phony war with these objects. (2) Cancer screening (and NEO surveillance) is cheap The cost of screening is smaller than the cost of treatment, and much less than the cost of doing nothing. (3) Everyone can be involved in some way Self-inspection (e.g. for breast, skin or testicular cancer) is simple; but a corollary is that detailed investigations (e.g. for brain tumours) are expensive. Similarly amateur astronomers can provide vital help, although in the end the professionals will need to tackle the job. (4) Identification of a real problem is unlikely Individuals are unlikely to contract specific cancers for which screening is done, but we must aim to check everyone periodically. In the same way we need to seek out all NEOs, and keep tabs on them. (5) False alarms are common Any indicator of a potential problem necessitates careful monitoring, and causes considerable worry. But one should be pleased when the tumour proves benign. Precisely the same applies to NEOs: asteroids and comets discovered and initially flagged to be potential impactors but later shown to be sure to miss our planet represent victories on our part. (6) Tackling any confirmed cancer (NEO impact) is certain to be unpleasant No-one suggests that chemotherapy, radiotherapy or surgical intervention are fun, but they are necessary, as would be the steps employed to divert an NEO, such as the nuclear option. Nor would they be cheap: but the cost would be of no consequence, as with a serious cancer. (7) Just because we don't yet know the cure for cancer does not mean that we should give up looking and trying. Where there is life, there is hope. If we should find an NEO destined by the clockwork of the heavens to impact the Earth in the near future (within the next few decades to a century, say), and using our advanced science and technology we manage to divert it and so save ourselves, this will rank as perhaps the greatest achievement of modern-day civilisation. (8) Just because there are more significant problems facing the world does not mean that we should ignore this one. Having a bad cold or influenza does not mean that you should neglect to have the lump in your breast or the suspicious, dark skin blemish on your neck checked out. Another viewpoint would be that if there is a substantial NEO due to strike our planetary home soon, then we face no greater problem: not terrestrial disasters, not terrorism, not wars, not disease, not global warming, not unemployment nor economic downturns**.** The most likely result of a proper study of the impact hazard is that it will go away, because we will find that no impact is due within the foreseeable future. But the converse is also true: what we now see as a slim chance (low probability of a large impact) may turn into a virtual certainty, which would then supplant our Earthly concerns. (9) Just because we don't yet know a cure for the common cold does not mean that we cannot find the solution for this disease. Some of the greatest dangers we face on a daily basis have quite simple solutions, like imposing speed limits to cut down road fatalities. Conceptually, planetary defense against NEO impact is a far simpler problem than, say, trying to stop major earthquakes or volcanic eruptions, or halting a hurricane in its path.

### Only asteroid strikes cause immediate compound environmental crises --- nothing else comes close

Chapman 4(Senior Scientist at the Southwest Research Institute, Dept. of Space Studies, “the Hazard of near-Earth asteroid impacts on earth”, Earth and Planetary Science Letters 222)

I have argued [59] that impacts must be exceptionally more lethal globally than any other proposed terrestrial causes for mass extinctions because of two unique features: (a) their environmental effects happen essentially instantaneously (on timescales of hours to months, during which species have little time to evolve or migrate to protective locations) and (b) there are compound environmental consequences (e.g., broiler-like skies as ejecta re-enter the atmosphere, global firestorm, ozone layer destroyed, earthquakes and tsunami, months of ensuing “impact winter”, centuries of global warming, poisoning of the oceans). Not only the rapidity of changes, but also the cumulative and synergistic consequences of the compound effects, make asteroid impact overwhelmingly more difficult for species to survive than alternative crises. Volcanism, sea regressions, and even sudden effects of hypothesized collapses of continental shelves or polar ice caps are far less abrupt than the immediate (within a couple of hours) worldwide consequences of impact; lifeforms have much better opportunities in longer-duration scenarios to hide, migrate, or evolve. The alternatives also lack the diverse, compounding negative global effects. Only the artificial horror of global nuclear war or the consequences of a very remote possibility of a stellar explosion near the Sun could compete with impacts for immediate, species-threatening changes to Earth's ecosystem. Therefore, since the NEA impacts inevitably happened, it is plausible that they—and chiefly they alone—caused the mass extinctions in Earth's history (as hypothesized by Raup [60]), even though proof is lacking for specific extinctions. What other process could possibly be so effective? And even if one or more extinctions do have other causes, the largest asteroid/comet impacts during the Phanerozoic cannot avoid having left traces in the fossil record.

## Impact – Accidental Nuclear War

### Asteroid impact collapses the economy and guarantees miscalulation and escalating conflict

Schmitt 3 (Dr. Harrison H. Schmitt ET AL , Former Astronaut, U.S. Senator Dr. Carolyn S. Shoemaker David H. Levy Lowell Observatory Jarnac Observatory, Inc. Planetary Geologist Dr. John Lewis Professor of Planetary Sciences Dr. Neil D. Tyson ,Director, Hayden Planetarium Dr. Freeman Dyson Dr. Richard P. Hallion Dr. Thomas D. Jones Bruce Joel Rubin Dr. Lucy Ann McFadden Erik C. Jones Marc Schlather William E. Burrows , July 8, 2003, “An Open Letter to Congress on Near Earth Objects” , PDF , www.CongressNEOaction.org)

Although the annual probability of a large NEO impact on Earth is relatively small, the results of such a collision would be catastrophic. The physics of Earth’s surface and atmosphere impose natural upper limits on the destructive capacity of natural disasters, such as earthquakes, landslides, and storms. By contrast, the energy released by an NEO impact is limited only by the object’s mass and velocity. Given our understanding of the devastating consequences to our planet and its people from such an event, (as well as the smaller-scale but still-damaging effects from smaller NEO impacts), our nation should act comprehensively and aggressively to address this threat. America’s efforts to predict, and then to avoid or mitigate such a threat, should be at least commensurate with our national efforts to deal with more familiar terrestrial hazards. If space research has taught us anything, it is the certainty that an asteroid or comet will hit Earth again. Impacts are common events in Earth’s history: scientists have found more than 150 large impact craters on our planet’s surface. Were it not for Earth’s oceans and geological forces such as erosion and plate tectonics, the planet’s impact scars would be as plain as those visible on the Moon. Potential Misinterpretation of NEO Impacts Even small NEO impacts in the atmosphere, on the surface, or at sea create explosions that could exacerbate existing political tensions and escalate into major international confrontations. For example, an atmospheric impact in 2002 produced a large, highly visible burst of light in the sky during the height of war tensions between nuclear-armed countries India and Pakistan. That high-altitude explosion happened to occur over the Mediterranean, just a few thousand miles from their disputed border region. Had that NEO impact occurred less than three hours earlier, it would have detonated over southern Asia, where its misinterpretation as a surprise attack could have triggered a deadly nuclear exchange. With military and diplomatic tensions at their peak in other areas of conflict in the world, the potential for a mistake is even greater today. Conclusion For the first time in human history, we have the potential to protect ourselves from a catastrophe of truly cosmic proportions. All of us remember vividly the effect on our nation of terrorist strikes using subsonic aircraft turned into flying bombs: thousands of our citizens dead, and our economy badly shaken. Consider the ramifications of an impact from a relatively small NEO: more than a million times more massive than an aircraft, and traveling at more than thirty times the speed of sound. If such an object were to strike a city like New York, millions would die. In addition to the staggering loss of life, the effects on the national and global economy would be devastating. Recovery would takedecades. We cannot rely on statistics alone to protect us from catastrophe; such a strategy is like refusing to buy fire insurance because blazes are infrequent. Our country simply cannot afford to wait for the first modern occurrence of a devastating NEO impact before taking steps to adequately address this threat. We may not have the luxury of a second chance, for time is not necessarily on our side. If we do not act now, and we subsequently learn too late of an impending collision against which we cannot defend, it will not matter who should have moved to prevent the catastrophe . . . only that they failed to do so when they had the opportunity to prevent it. Our nation, our families, and others around the globe deserve our best efforts to protect against the NEO impact threat. We urge the Congress to call on this nation’s ready supply of talents and energies to responsibly address this threat. Our international partners also should be called upon to help meet this challenge, but the United States has a compelling responsibility to lead the way. Preventing an NEO impact is a vital mission for our nation’s space program and for the American people. For the first time since Apollo, our astronauts should once again leave low-Earth orbit and journey into deep space, this time to protect life on our home planet. We strongly recommend your prompt attention and action to address this too-long-ignored threat to the security of America and to the world. The accompanying recommendations are prudent and concrete steps each of you can now take to safeguard our nation. Your timely and effective response can protect the people of the United States and the world from the real threat posed by Near Earth Objects.

## Impact – Small NEOs

### Small asteroids risk nuclear winter- even if they hit water

Easterbrook 8 (Gregg, Editor of The Atlantic and The New Republic and Sr. Fellow at Brookings, “The Sky is Falling,” June, http://www.theatlantic.com/doc/200806/asteroids)

Abbott believes that a space object about 300 meters in diameter hit the Gulf of Carpentaria, north of Australia, in 536 A.D. An object that size, striking at up to 50,000 miles per hour, could release as much energy as 1,000 nuclear bombs. Debris, dust, and gases thrown into the atmosphere by the impact would have blocked sunlight, temporarily cooling the planet—and indeed, contemporaneous accounts describe dim skies, cold summers, and poor harvests in 536 and 537. “A most dread portent took place,” the Byzantine historian Procopius wrote of 536; the sun “gave forth its light without brightness.” Frost reportedly covered China in the summertime. Still, the harm was mitigated by the ocean impact. When a space object strikes land, it kicks up more dust and debris, increasing the global-cooling effect; at the same time, the combination of shock waves and extreme heating at the point of impact generates nitric and nitrous acids, producing rain as corrosive as battery acid. If the Gulf of Carpentaria object were to strike Miami today, most of the city would be leveled, and the atmospheric effects could trigger crop failures around the world.

### It doesn’t need to be huge to trigger climate shifts, etc. that kill everyone

NRC 10 (National Research Council, Defending Planet Earth: Near-Earth Object Surveys and Hazard Mitigation Strategies, Committee to Review Near-Earth-Object Surveys and Hazard Mitigation Strategies, http://www.nap.edu/catalog.php?record\_id=12842)

• Beyond very crude estimates, it is not known what the size threshold is for impacts that would lead to a global catastrophe and kill a significant fraction of Earth’s population as a result of firestorms or climate change and the associated collapse of ecosystems, agriculture, and infrastructure. There may not even be a well-defined threshold, because global effects probably depend critically on impact location and surface material properties (e.g., land, sea, ice sheet), season, and so on.

### Seriously- they have the equivalent of nuking all of France at once.

Easterbrook 8 (Gregg, Editor of The Atlantic and The New Republic and Sr. Fellow at Brookings, “The Sky is Falling,” June, http://www.theatlantic.com/doc/200806/asteroids)

A more recent event gives further cause for concern. As buffs of the television show The X Files will recall, just a century ago, in 1908, a huge explosion occurred above Tunguska, Siberia. The cause was not a malfunctioning alien star-cruiser but a small asteroid or comet that detonated as it approached the ground. The blast had hundreds of times the force of the Hiroshima bomb and devastated an area of several hundred square miles. Had the explosion occurred above London or Paris, the city would no longer exist. Mark Boslough, a researcher at the Sandia National Laboratory, in New Mexico, recently concluded that the Tunguska object was surprisingly small, perhaps only 30 meters across. Right now, astronomers are nervously tracking 99942 Apophis, an asteroid with a slight chance of striking Earth in April 2036. Apophis is also small by asteroid standards, perhaps 300 meters across, but it could hit with about 60,000 times the force of the Hiroshima bomb—enough to destroy an area the size of France. In other words, small asteroids may be more dangerous than we used to think—and may do considerable damage even if they don’t reach Earth’s surface.

## Impact – Any Risk Matters

### Any differential between the plan and the CP should get the full weight of our advantage- the one they don’t detect could be the one that hits

Barbee 9 (4/1, Brent W., BS, Aerospace Engineering degree from UT Austin; MS in Engineering from the Department of Aerospace Engineering and Engineering Mechanics at the University of Texas, Austin specializing in Astrodynamics and Spacecraft Mission Design, currently working as an Aerospace Engineer and Planetary Defense Scientist with the Emergent Space Technologies company in Greenbelt, Maryland, teaches graduate Astrodynamics in the Department of Aerospace Engineering at The University of Maryland, College Park, “Planetary Defense”, [http://www.airpower.au.af.mil/apjinternational//apj-s/2009/1tri09/barbeeeng.htm](http://www.airpower.maxwell.af.mil/airchronicles/cc/france2.html))

It is generally accepted that statistics and probability theory is the best way to handle partial information problems. Gamblers and insurance companies employ it extensively. However, one of the underlying premises is that it is acceptable to be wrong sometimes. If a gambler makes a bad play, the hope is that the gambler has made more good plays than bad ones and still comes out ahead. This however is not applicable to planetary defense against NEOs. Being wrong just once may prove fatal to millions of people or to our entire species. If we trust our statistical estimates of the NEO population and our perceived collision probabilities too much, we risk horrific damage or even extinction. This is how we must define the limit for how useful probability theory is in the decision-making process for defense against NEOs.

# \*NUCLEAR OPTION ADVANTAGE

## Yes Nuclear Deflection

### Asteroid deflection attempts are inevitable but they will fail without early warning

NRC 10 (National Research Council Committee to Review Near-Earth Object Surveys and Hazard Mitigation Strategies, “Defending Planet Earth: Near-Earth Object Surveys and Hazard Mitigation Strategies,” http://www.nap.edu/catalog.php?record\_id=12842)

In contrast to other known natural hazards, there has been no significant loss of human life to impacts in historical times, due to the low frequency of major impacts and the higher probability of impact in unpopulated areas (notably the oceans) rather than in populated regions. Unlike the other hazards listed in Table 2.2, the hazard statistics for NEOs are dominated by single events with potentially high fatalities separated by long time intervals. Should scientists identify a large life-threatening object on a collision course with Earth, tremendous public resources to mitigate the risk would almost certainly be brought to bear. However, options for effective mitigation become much more limited when threatening objects are identified with only months to years, rather than decades or centuries, before impact. Thus, one of the greatest elements of risk associated with NEOs is the public’s expectation that governments will provide protection against any threat from NEOs, even as governments and agencies have been unwilling so far to expend public funds in a concerted effort to identify, catalog, and characterize as many potentially dangerous NEOs as possible, as far in advance of a damaging impact event as feasible.

## Nuclear Fails

### Nuclear blasts fail and fragment the asteroid- makes other deflection efforts impossible

Lu 4 (Statement of Dr. Ed Lu President, B612 Foundation, “Near-Earth Objects,” testimony before the Committee on Senate Commerce, Science and Transportation Subcommittee on Science, Technology, and Space, Apr.7 CQ, lexis)

Why does the asteroid need to be moved in a "controlled manner"? If the asteroid is not deflected in a controlled manner, we risk simply making the problem worse. Nuclear explosives for example risk breaking up the asteroid into pieces, thus turning a speeding bullet into a shotgun blast of smaller but still possibly deadly fragments. Explosions also have the drawback that we cannot accurately predict the resultant velocity of the asteroid - not a good situation when trying to avert a catastrophe. Conversely, moving an asteroid in a controlled fashion also opens up the possibility of using the same technology to manipulate other asteroids for the purposes of resource utilization.

### That’s *worse-* can’t prevent it, and makes it more likely to hit cities

Chapman 3 (Clark, scientist at the Southwest Research Institute's Department of Space Studies, Great Impact Debates, Collision Course for Earth, http://www.astrobio.net/debate/396/encore)

The advantage of using nuclear weapons to destroy asteroids is that they are our most powerful devices by far. But the disadvantages are many. In particular, the more we learn about asteroids and comets, the more we realize that they are incredibly fragile. Most asteroids larger than a few hundred meters across are now thought to be "rubble piles" -- collections of rocks, boulders, and "mountains" simply resting against each other, loosely held together by the tenuous gravitational field of the ensemble. Any sudden force applied to such an object would likely tear it apart into a swarm of objects. The total impacting energy of the swarm would be the same as the original asteroid, but spread out across the Earth's surface. In any case, once you disrupt a comet or asteroid into many different chunks, you've lost all ability to affect what happens next. In short, it is a very bad idea.

# \*SOLVENCY

## Solvency – Advance Warning/Detection Key

### Adding warning time solves- key to tech development and deflection

Easterbrook 8 (Gregg, Editor of The Atlantic and The New Republic and Sr. Fellow at Brookings, “The Sky is Falling,” June, http://www.theatlantic.com/doc/200806/asteroids)

None of this will be easy, of course. Unlike in the movies, where impossibly good-looking, wisecracking men and women grab space suits and race to the launchpad immediately after receiving a warning that something is approaching from space, in real life preparations to defend against a space object would take many years. First the necessary hardware must be built—quite possibly a range of space probes and rockets. An asteroid that appeared to pose a serious risk would require extensive study, and a transponder mission could take years to reach it. International debate and consensus would be needed: the possibility of one nation acting alone against a space threat or of, say, competing U.S. and Chinese missions to the same object, is more than a little worrisome. And suppose Asteroid X appeared to threaten Earth. A mission by, say, the United States to deflect or destroy it might fail, or even backfire, by nudging the rock toward a gravitational keyhole rather than away from it. Asteroid X then hits Costa Rica; is the U.S. to blame? In all likelihood, researchers will be unable to estimate where on Earth a space rock will hit. Effectively, then, everyone would be threatened, another reason nations would need to act cooperatively—and achieving international cooperation could be a greater impediment than designing the technology.

### Only early detection solves

Universe Today 10 (Asteroid Detection, Deflection Needs More Money, Report Says, http://www.universetoday.com/51811/asteroid-detection-deflection-needs-more-money-report-says/)

Schweikart quoted Don Yeomans as saying the three most important things about asteroid mitigation is to find them early, find them early and find them early. “We have the technology today to move an asteroid,” Schweikart said. “We just need time. It doesn’t take a huge spacecraft to do the job of altering an asteroid’s course. It just takes time. And the earlier we could send a spacecraft to either move or hit an asteroid, the less it will cost. We could spend a few hundred million dollars to avoid a $4 billion impact.”

## Solvency – A2: False Alarms

### Better detection is key- makes reports more accurate and leads to development of better deflection strategies

IAA 9 (International Academy of Astronautics, “Dealing With The Threat To Earth From Asteroids And Comets”, http://iaaweb.org/iaa/Scientific%20Activity/Study%20Groups/SG%20Commission%203/sg35/sg35finalreport.pdf)

In addition to locating NEOs, there is a critical need to bring on line a capability to more precisely locate high threat objects. A significant contribution to the inability to implement response plans in an early and measured fashion is the inherent uncertainty in object location and propagation. The ability to precisely forecast the path of a NEO threat would remove ambiguity in whether the object is or is not going to impact Earth, a critical piece of information if a deflection scheme is to be employed, knowing that any deflection scheme could fail or only partially deflect the object. In addition, if an impact is inevitable, knowing the precise impact point and the nature of the asteroid would enable focused response and recovery planning.

### Increasing information reduces the number and impact of false alarms

IAA 9 (International Academy of Astronautics, “Dealing With The Threat To Earth From Asteroids And Comets”, http://iaaweb.org/iaa/Scientific%20Activity/Study%20Groups/SG%20Commission%203/sg35/sg35finalreport.pdf)

An additional important element of planning for the possibility of a NEO impact is educating the public. An informed public is less likely to panic from false alarms and is more likely to react positively to mitigation efforts should an impact appear probable. An informed public is also more likely to engage fruitfully in an intelligent debate of what measures are appropriate in the absence of a clear and present danger. The NASA NEO Program in the United States is specifically “responsible for facilitating communications between the astronomical community and the public should any potentially hazardous objects be discovered”. Each professional society that has taken on the issue of the NEO risk is obligated to conduct outreach to the public17. But there is also a need to identify at the international level a single credible clearinghouse of information analogous to the NASA NEO Program.

## Solvency – A2: Cooperation Key

### The US can do it alone- has the best tech

Morrison 5 - NASA Astrobiology Institute (David, “ Defending the Earth Against Asteroids: The Case for a Global Response ” http://www.princeton.edu/sgs/publications/sgs/pdf/13%201-2%20Morrision.pdf Science and Global Security, 13:87–103)

We do not have today the technology to deflect an asteroid, especially not one of the most dangerous class, which are larger than 1 km. However, it seems reasonable to expect that if such a large asteroid is discovered, one whose impact could kill more than 1 billion people and destabilize world civilization, the space-faring nations would find a way to accomplish the deflection and save the planet. One hopes that this could be accomplished through broadly based international collaboration, but it is also plausible that one nation, such as the United States, might take the lead or even go it alone. Given such a specific threat to our planet, almost any level of expense could be justified. This effort would represent the largest and most important technological challenge ever faced, and whether it is successful or not, world civilization would be forever changed.

## Solvency – Space-Based Telescope

### Only a space-based telescope provides enough information to precisely track NEOs

Easterbrook 8 (Gregg, Editor of The Atlantic and The New Republic and Sr. Fellow at Brookings, “The Sky is Falling,” June, http://www.theatlantic.com/doc/200806/asteroids)

Current telescopes cannot track asteroids or comets accurately enough for researchers to be sure of their courses. When 99942 Apophis was spotted, for example, some calculations suggested it would strike Earth in April 2029, but further study indicates it won’t—instead, Apophis should pass between Earth and the moon, during which time it may be visible to the naked eye. The Pan-STARRS telescope complex will greatly improve astronomers’ ability to find and track space rocks, and it may be joined by the Large Synoptic Survey Telescope, which would similarly scan the entire sky. Earlier this year, the software billionaires Bill Gates and Charles Simonyi pledged $30 million for work on the LSST, which proponents hope to erect in the mountains of Chile. If it is built, it will be the first major telescope to broadcast its data live over the Web, allowing countless professional and amateur astronomers to look for undiscovered asteroids. Schweickart thinks, however, that even these instruments will not be able to plot the courses of space rocks with absolute precision. NASA has said that an infrared telescope launched into an orbit near Venus could provide detailed information on the exact courses of space rocks. Such a telescope would look outward from the inner solar system toward Earth, detect the slight warmth of asteroids and comets against the cold background of the cosmos, and track their movements with precision. Congress would need to fund a near-Venus telescope, though, and NASA would need to build it—neither of which is happening.

### New space-based telescopes key to advance warning of comets and small objects

IAA 9 (International Academy of Astronautics, “Dealing With The Threat To Earth From Asteroids And Comets”, http://iaaweb.org/iaa/Scientific%20Activity/Study%20Groups/SG%20Commission%203/sg35/sg35finalreport.pdf)

Ground-based telescopes cannot observe during local daytime or when there are clouds, and their sensitivity is seriously affected by moonlight and atmospheric effects. One or more dedicated robotic observatory telescopes of greater capability than the upcoming NEOSSat instrument could readily be placed into Earth orbit or in solar orbit near the Earth or at a Earth-Sun (E-S) Lagrangian point. Such telescopes would be able to observe nearly continuously, and their angular coverage would be almost spherical except for angles near the Sun. At the L2 point the telescope would also be continuously shielded from interference by sunlight. There would be no cloud or day-night effects either, and therefore a telescope in orbit could have 10-18 times the observing time on NEOs compared to any one ground observatory, and could be dedicated to NEO observation rather than be shared with other astronomical observations, as is typical with large ground telescope facilities. The sensitivity obtained from a space-based observatory like this could be sufficient even with an aperture diameter of approximately one meter, which is easily achievable with today’s technology. Future technology will support space telescopes whose primary mirrors consist of thin membranes, and thus will be orders of magnitude lighter and cheaper than space telescopes such as the Hubble or James Webb. Feasibility studies2 have indicated that with 5-10 years of technology development such membrane mirror space telescopes could be developed to have apertures of at least 25 meters yet weigh under 700 kg. One such telescope placed into a solar orbit near Earth would extend the detection distance and sensitivity enormously so that a 1 km long-period new apparition comet could be detected well beyond 10 AU. Detection this far away could yield on the order of 5-6 years of warning time,3 provided that the comet’s orbital path could be calculated with sufficient accuracy. Since such instruments would rapidly detect asteroids and short period comets as well, those as small as 70 meters could be detected at 2.5 AU, and 140 m asteroids could be detected at 5 AU. These detection distances are far greater than can be rapidly accomplished with ground-based telescopes. Thus, large yet lightweight space-based telescopes would be extremely valuable as a principal means of detecting, tracking, and providing up to several years warning time on long-period comets, in the not too distant future.

### Tech is available- it needs funding.

Space Daily 11 (5/10, NASA Selects Investigations for Future Key Missions, Lexis)

The three selected technology development proposals will expand the ability to catalog near-Earth objects, or NEOs; enhance the capability to determine the composition of comet ices; and validate a new method to reveal the population of objects in the poorly understood, far-distant part of our solar system. During the next several years, selected teams will receive funding that is determined through contract negotiations to bring their respective technologies to a higher level of readiness. To be considered for flight, teams must demonstrate progress in a future mission proposal competition. The proposals selected for technology development are: + NEOCam would develop a telescope to study the origin and evolution of near-Earth Objects and study the present risk of Earth-impact. It would generate a catalog of objects and accurate infrared measurements to provide a better understanding of small bodies that cross our planet's orbit. Amy Mainzer of JPL is principal investigator. A space-based telescope, NEOCam would be positioned in a location about four times the distance between Earth and the moon. From this lofty perch, NEOCam could observe the comings and goings of NEOs every day without the impediments to efficient observing like cloud cover and even daylight. The location in space NEOCam would inhabit is also important, because it allows the monitoring of areas of the sky generally inaccessible to ground-based surveys. "Near-Earth objects are some of the most bountiful, intriguing and least understood of Earth's neighbors," said Amy Mainzer. "With NEOCam, we would get to know these solar system nomads in greater detail."

## Solvency – Space-Based Telescope – Comets

### Space-based telescopes key to solve long-period comets

IAA 9 (International Academy of Astronautics, “Dealing With The Threat To Earth From Asteroids And Comets”, http://iaaweb.org/iaa/Scientific%20Activity/Study%20Groups/SG%20Commission%203/sg35/sg35finalreport.pdf)

5) Impact prediction and warning The Palermo Scale was developed in order for the ability to uniformly assess potential impact risks spanning a wide range of impact dates, energies and probabilities. It is now in general use. Computing Earth impact probabilities for NEOs is a complex process and requires sophisticated mathematical techniques. Due to the usual paucity of early observations computed collision probabilities tend to be initially too high, but reduce as more observations are obtained. The likely warning time available will be decades for known NEAs, years for newly discovered NEAs and short-period comets, and a few months to less than one year for Small Earth-Crossing Asteroids and Long-Period Comets (if no space-based telescopes exist). However, approximately 6 years of warning time of the potential impact of Long-Period Comets would be possible if a large space-based telescope is developed.

### Space-based telescopes are key to detect long-period comets in advance- allows deflection

IAA 9 (International Academy of Astronautics, “Dealing With The Threat To Earth From Asteroids And Comets”, http://iaaweb.org/iaa/Scientific%20Activity/Study%20Groups/SG%20Commission%203/sg35/sg35finalreport.pdf)

Because of their high velocities (mean impact velocities of approximately 55 km/s)1 and lack of a coma far from the Sun, as well as their generally low albedo, detection of long-period comets with ground-based telescopes is generally limited to distances of several AU, with resulting warning times of only a few months or at most half a year or so, which makes deflection or disruption extremely difficult compared to asteroids, for which decades of warning could be expected. Thus long-period comets are generally placed into the “too hard” category which, coupled with their much lower probability of occurrence, usually prevents their consideration as “serious” candidates for defensive actions among many scientists. This condition could change, however, if much greater warning time were obtainable for long-period comets. New technologies for space-based telescopes could make that a reality.

# \*\*\* OTHER

## Soft Power Add-On – 2AC

### The plan leads to international cooperation on space and spills over to overall leadership

Koplow 5 (Justin, JD Candidate – Georgetown University Law Center, Georgetown International Environmental Law Review, Lexis)

The free rider problem that could be one of the treaty's greatest weaknesses would become one of its greatest successes; such a situation creates a duty to attempt to avert a foreign asteroid impact even outside of the structures of a treaty and, thereby, international humanitarianism and the world community are greatly served. The actor States would become the greatest proponents of the treaty system because without it they could still be bound to act but would have to foot the bill for their own domestic protection and their own coordination with foreign States. [\*306] Similarly, much of the criticism of U.S. hegemony and military brutishness would also be turned on its head. n144 The United States would be seen as engaging the world and looking out for its protection rather than dictating what other countries should do. Renouncing placement of nuclear weapons in space as part of this program will also show that the actor States are not using this as an excuse to militarize space. The bureaucratic system of the world would yield to a dedicated structure and system, creating an efficient and greatly needed body. n145 Additionally, this system would remove a great deal of currently existing duplicity and waste. Ultimately, a treaty on the topic of cooperation in asteroid diversion would be a fantastic opportunity to address a very real threat and to do so in a roundly beneficial fashion. An eventual asteroid impact is not an "if" because the asteroid that might eventually collide with Earth is even now coming closer; thus, catastrophe is coming that much closer, too. With the realness of the threat, there are too many "ifs" in both the current legal frameworks and the current response framework to leave the problem for another day.

### Soft power key to heg

Nye 4 (Joseph S., Professor of International Relations at Harvard. “Soft Power and American Foreign Policy,” Summer 2004, Political Science Quarterly, Volume 119, Issue 2; page 255, proquest, download date: 9-21-07)

In the global information age, the attractiveness of the United States will be crucial to our ability to achieve the outcomes we want. Rather than having to put together pick-up coalitions of the willing for each new game, we will benefit if we are able to attract others into institutional alliances and eschew weakening those we have already created. NATO, for example, not only aggregates the capabilities of advanced nations, but its interminable committees, procedures, and exercises also allow these nations to train together and quickly become interoperable when a crisis occurs. As for alliances, if the United States is an attractive source of security and reassurance, other countries will set their expectations in directions that are conducive to our interests. Initially, for example, the U.S.-Japan security treaty was not very popular in Japan, but polls show that over the decades, it became more attractive to the Japanese public. Once that happened, Japanese politicians began to build it into their approaches to foreign policy. The United States benefits when it is regarded as a constant and trusted source of attraction so that other countries are not obliged continually to re-examine their options in an atmosphere of uncertain coalitions. In the Japan case, broad acceptance of the United States by the Japanese public "contributed to the maintenance of US hegemony" and "served as political constraints compelling the ruling elites to continue cooperation with the United States."18 Popularity can contribute to stability. Finally, as the RAND Corporation's John Arquila and David Ronfeldt argue, power in an information age will come not only from strong defenses but also from strong sharing. A traditional realpolitik mindset makes it difficult to share with others. But in an information age, such sharing not only enhances the ability of others to cooperate with us but also increases their inclination to do so. As we share intelligence and capabilities with others, we develop common outlooks and approaches that improve our ability to deal with the new challenges. Power flows from that attraction. Dismissing the importance of attraction as merely ephemeral popularity ignores key insights from new theories of leadership as well as the new realities of the information age. We cannot afford that.

### Heg solves nuclear war

Khalilzad 95 (Zalmay Khalilzad, RAND, The Washington Quarterly, Spring 1995)

Under the third option, the United States would seek to retain global leadership and to preclude the rise of a global rival or a return to multipolarity for the indefinite future. On balance, this is the best long-term guiding principle and vision. Such a vision is desirable not as an end in itself, but because a world in which the United States exercises leadership would have tremendous advantages. First, the global environment would be more open and more receptive to American values -- democracy, free markets, and the rule of law. Second, such a world would have a better chance of dealing cooperatively with the world's major problems, such as nuclear proliferation, threats of regional hegemony by renegade states, and low-level conflicts. Finally, U.S. leadership would help preclude the rise of another hostile global rival, enabling the United States and the world to avoid another global cold or hot war and all the attendant dangers, including a global nuclear exchange. U.S. leadership would therefore be more conducive to global stability than a bipolar or a multipolar balance of power system.

# \*INTERNATIONAL CP ANSWERS

## International CP – General 2AC

### Doesn’t solve the nuclear advantage- 1AC Koplow says the US is *obligated* to act, and that it’s the only country that would feel pressure to do so

### Doesn’t solve strikes-

### The US is key- only country with resources and capability

Dinerman 9 (Taylor, author and journalist based in New York City, The new politics of planetary defense, Space Review, http://www.thespacereview.com/article/1418/1)

While the US is obviously going to have to take the lead in any effort to detect and possibly deflect any celestial object that might do our planet harm, it will have to consult with others, both to keep other nations informed and to help make the choices needed to deal with the threat. Yet in the end, it is likely that the decision, if there is one, will rest with the President of the United States. He or she is the only world leader today with the wherewithal to deal with such a threat. This is why any planning effort that leans to heavily on international institutions may endanger the whole planet. The process inside an organization like the UN would simply get bogged down in procedural and political questions. US leaders may find that the system would be paralyzed while, for example, nations argued over deflection or destructions methods or who would control and pay for them. Precious time would be lost while nations would consider their own best interests in supporting one approach or another. If the US is [to] have any claim to global leadership in the 21st century it will have to unambiguously take the lead in planetary defense. It should do so in an open way and be ready to listen to everyone’s concerns and ideas. But if the Earth is to be effectively protected, the ultimate decisions will have to be American. In this case “global governance” could end up setting the stage for a disaster.

### US action is key to fund critical *radar arrays*

NRC 10 (National Research Council, Defending Planet Earth: Near-Earth Object Surveys and Hazard Mitigation Strategies, Committee to Review Near-Earth-Object Surveys and Hazard Mitigation Strategies, http://www.nap.edu/catalog.php?record\_id=12842)

Recommendation: Immediate action is required to ensure the continued operation of the Arecibo Observatory at a level sufficient to maintain and staff the radar facility. Additionally, NASA and the National Science Foundation should support a vigorous program of radar observations of NEOs at Arecibo, and NASA should support such a program at Goldstone for orbit determination and the characterization of physical properties. For both Arecibo and Goldstone, continued funding is far from assured, not only for the radar systems but for the entire facilities. The incremental annual funding required to maintain and operate the radar systems, even at their present relatively low levels of operation, is about $2 million at each facility (see Chapter 4). The annual funding for Arecibo is approximately $12 million. Goldstone is one of the three deep-space communications facilities of the Deep Space Network, and its overall funding includes additional equipment for space communications.

### Those arrays are key to get information necessary to deflect NEOs

NRC 10 (National Research Council, Defending Planet Earth: Near-Earth Object Surveys and Hazard Mitigation Strategies, Committee to Review Near-Earth-Object Surveys and Hazard Mitigation Strategies, http://www.nap.edu/catalog.php?record\_id=12842)

In addition to spacecraft reconnaissance missions as needed, the committee concluded that vigorous, groundbased characterization at modest cost is important for the NEO task. Modest funding could support optical observations of already-known and newly discovered asteroids and comets to obtain some types of information on this broad range of objects, such as their reflectivity as a function of color, to help infer their surface properties and mineralogy, and their rotation properties. In addition, the complementary radar systems at the Arecibo Observatory in Puerto Rico and the Goldstone Solar System Radar in California are powerful facilities for characterization within their reach in the solar system, a maximum of about one-tenth of the Earth-Sun distance. Arecibowhich has a maximum sensitivity about 20-fold higher than Goldstone’s but does not have nearly as good sky coverage as Goldstonecan, for example, model the three-dimensional shapes of (generally very odd-shaped) asteroids and estimate their surface characteristics, as well as determine whether an asteroid has a (smaller) satellite or satellites around it, all important to know for planning active defense. Also, from a few relatively closely spaced (in time) observations, radar can accurately determine the orbits of NEOs, which has the advantage of being able to calm public fears quickly (or possibly, in some cases, to show that they are warranted). Finding: The Arecibo and Goldstone radar systems play a unique role in the characterization of NEOs, providing unmatched accuracy in orbit determination and offering insight into size, shape, surface structure, and other properties for objects within their latitude coverage and detection range.

### Having the best radar tech is key- it’s the only way to accurately prevent collisions and identify near-term risks

IAA 9 (International Academy of Astronautics, “Dealing With The Threat To Earth From Asteroids And Comets”, http://iaaweb.org/iaa/Scientific%20Activity/Study%20Groups/SG%20Commission%203/sg35/sg35finalreport.pdf)

Additionally, determining the physical characteristics of an asteroid or comet is crucial in the design of a mission to deflect or disrupt an Earth impactor as well as planning any robotic precursor missions. Of primary importance are the characterization of the object’s mass, gravity field, spin state, surface topography and roughness, surface gravity field, and density distribution. Astrometric measurements (ground or space-based) can improve the accuracy of the orbit knowledge, estimate the body size, and potentially identify the existence of co-orbitals. Spectral imaging using filters can be used to determine asteroid type including composition, grain density, surface albedo, and size. Finally, intensity fluctuations can be used to estimate spin period, spin state, body shape, and rotation angular momentum. However, telescopic observations have their inherent limitations. Radar measurements provide a unique and highly capable source of information about a NEO’s physical properties and orbit. The general methodology for a radar observation is to transmit a well characterized signal and compare it with the return echo to analyze the object’s properties. Radar can be used to determine body shape, rotation state, co-orbitals, rotation angular momentum, improve heliocentric orbit prediction, and place constraints on surface density and roughness. Radar systems are limited in their range, but given sufficiently strong return signals they can permit two-dimensional spatial resolutions on the order of meters. The accuracy of orbit determination can be improved greatly with measurements of range and range rate obtained from radar instruments. Radar measurements can determine the orbit well enough to prevent “loss” of a newly discovered asteroid and reduce the positional uncertainty by several orders of magnitude compared to optical astrometric observations only. Predictions based solely on optical data typically contain significant errors, even with long data arcs. Radar measurements can make the difference between estimating that an object will pass several Earth-Moon distances away from the Earth and realizing that the NEO will actually impact the Earth. However, because radar is an active technique it has very limited range capability compared to optical observations, and thus can only add to optical observations when the object passes relatively close to the Earth. This limits its ability to provide ephemeris-refining information, which could improve warning times when optical observations are not sufficiently accurate. Nonetheless radar is an extremely powerful detection tool and an indispensable observatory for detection and impact prediction of NEOs. Radar has another vital capability, which is to help characterize the NEO. Given sufficient directional coverage of the object, the measurements can be combined to provide detailed three- dimensional models on the NEO and accurately define its rotation state. Detailed models of the object can provide tremendous insight into many of the areas critical to averting an impact with Earth. One critical area is the effect of the mass distribution on the stability of an orbit close to the NEO, which is required for any sort of rendezvous mission or landing. In addition radar observation can help to characterize the makeup of the object so that estimates can be made of its stability if it were subjected to various deflection or disruption techniques.

### Doesn’t solve fast enough --- other countries lack the infrastructure to quickly detect NEOs

### National Academies 9

[Over many decades, the National Academy of Sciences, National Academy of Engineering, Institute of Medicine, and National Research Council have earned a solid reputation as the nation's premier source of independent, expert advice on scientific, engineering, and medical issues. “Near-Earth Object Surveys and Hazard Mitigation Strategies:

Interim Report” http://www.nap.edu/catalog.php?record\_id=12738]

Despite expressions of interest in various countries around the globe, the majority of search efforts and funding for discovering NEOs comes from the United States. Several smaller projects, such as the Beijing Schmidt CCD Asteroid Program (no longer operational) and the Asiago DLR Asteroid Survey (an ongoing joint venture between the German Aerospace Agency’s [DLR’s] Institute of Space Sensor Technology and Planetary Exploration, the University of Asiago, and the Astronomical Observatory of Padua in Italy), have made so me inroads on detecting NEOs, but not on the scale of the U.S. projects. In addition, with the notable exception of Canada, through its Near-Earth Object Surveillance Satellite (NEOSSat) mission, and Germany, via its AsteroidFinder mission, which are both relatively limited in scope, no other countries have committed funding for a “next generation” NEO-discovery program. AsteroidFinder The German Aerospace Agency has selected AsteroidFinder as the first pay load to be launched under its new national compact satellite program. Currently the spacecraft is planned to launch sometime in 2012 with a 1-year baseline-mission duration and the possibility of an extension; this mission is funded through the development stage. It will be equipped with a 30-centimeter telescope mirror. Its primary science goals are to estimate the population of NEOs interior to Earth orbit, their size-frequency distribution, and their orbital properties. AsteroidFinder will also aid in the assessment of the imp act hazard due to NEOs and provide a space-based platform detecting space debris from artificial satellites. Near-Earth Object Surveillance Satellite NEOSSat is currently in development and is being constructed in Canada as a joint venture between the Canadian Space Agency (CSA) and Defense Research and Development Canada, an agency of the Canadian Department of National Defence. NEOSSat is based on a previous satellite, MOST, launched in 2003, that remains operational long after completion of its initial mission. Set to launch in mid 2010, NEOSSat is scheduled to operate continuously for at least one year and should operate considerably longer. NEOSSat will conduct two simultaneous projects during its operational lifetime—High-Earth Orbit Surveillance System (HEOSS), which will monitor and track human-made satellites and orbital debris, and Near-Earth Space Surveillance (NESS), which will discover and track NEOs. NEOSSat will be the first satellite to be built on Canada’s Multi-Mission Microsatellite Bus and will be roughly the size of a large suitcase with a mass of approximately 75 kilograms. It will have a 15-centimeter mirror. This microsatellite will operate in a Sun-synchronous orbit at an altitude of ~700 kilometers. NEOSSat will be the first dedicated space platform designed to obtain observations on both human-made and natural objects in near-Earth space. The NESS project will focus primarily on discovering NEOs whose orbits are partially or fully inside Earth’s. NEOSSat will expand overall knowledge of NEOs, monitor them for cometary activity, perform follow-up tracking of newly discovered targets, aid in the development of asteroid search and tracking algorithms for space-based sensors, and explore the synergies between ground- and space-based facilities involved in NEO discovery and characterization. Finding: The United States is the only country that currently has an operating survey/detection program for discovering near-Earth objects; Canada and Germany are both building spacecraft that may contribute to the discovery of near-Earth objects. However, neither mission will detect fainter or smaller objects than ground-based telescopes.

## 1AR – US Leadership Critical

### U.S. must lead in asteroid deflection --- no other country can fill in

France 00 (Martin, Lt. Colonel, USAF, “Planetary Defense: Eliminating the Giggle Factor, [Air](http://www.airpower.maxwell.af.mil/airchronicles/cc/france2.html) [&](http://www.airpower.maxwell.af.mil/airchronicles/apje.html) [Space](http://jgmatheny.org/matheny_extinction_risk.htm)[Power](http://www.airpower.maxwell.af.mil/airchronicles/apje.html)[Journal](http://www.airpower.maxwell.af.mil/airchronicles/apje.html), [http](http://www.airpower.maxwell.af.mil/airchronicles/cc/france2.html)[://](http://www.airpower.maxwell.af.mil/airchronicles/apje.html)[www.airpower](http://www.airpower.maxwell.af.mil/airchronicles/cc/france2.html)[.](http://www.airpower.maxwell.af.mil/airchronicles/apje.html)[maxwell.af.mil](http://www.airpower.maxwell.af.mil/airchronicles/cc/france2.html)[/](http://jgmatheny.org/%20matheny_extinction_risk.htm)[airchronicles/](http://www.airpower.maxwell.af.mil/airchronicles/cc/france2.html)[cc](http://www.aiaa.org/content.cfm)[/](http://www.airpower.maxwell.af.mil/airchronicles/cc/france2.html)[france](http://www.airpower.maxwell.af.mil/airchronicles/apje.html)[2.html](http://www.airpower.maxwell.af.mil/airchronicles/cc/france2.html))

A key component of the Shoemaker Report, as in the earlier Spaceguard Survey, was its international character. However, it seems that most nations interested in the NEO threat are still awaiting America’s lead. Russia, for example, has the technology and interest (Tunguska) among its astronomy and military communities to play a significant role in the Spaceguard Survey, but economic circumstances have precluded them from taking the initiative. Australia has recently backed away from its fledgling telescope program, which played a critical role in confirming NEOs first seen by other telescopes from its unique location in the southern hemisphere, and international attempts to encourage the Australian government to bring its program back into operation have failed.23 The United Kingdom, home of some of the most enthusiastic NEO watchers, formed a "Task Force on NEOs" led by Dr. Harry Atkinson. This group of four scientists has limited funding and is only tasked with making recommendation to Her Majesty’s Government by mid-2000 on how the UK should best contribute to the international effort on NEOs.24 Additionally, Spaceguard is a loose, voluntary consortium of international observatories and interested parties that serves to relay NEO identification to concerned groups and fellow participants.

## 1AR – Radar Key

### U.S. is radar key to accurate and timely detection --- it’ll be shut down now

IAA 9 (International Academy of Astronautics, “Dealing With The Threat To Earth From Asteroids And Comets”, http://iaaweb.org/iaa/Scientific%20Activity/Study%20Groups/SG%20Commission%203/sg35/sg35finalreport.pdf)

In addition the NASA study concluded that ground-based radars were an extremely valuable tool for rapid and precise orbit determination of a few objects of potentially high interest when they approach Earth closely enough for the radar systems to be effective. As a particularly telling example, ground-based radars provided the definitive data when the orbit of the Apophis NEA was being intensely examined, and resulted in a lowering of the threat estimate to low enough probabilities that it is no longer considered an impact threat in the year 2029. The radars, principally Goldstone and Arecibo, would add another $100 M to the above life cycle cost estimates. However the funding for continued operation of Arecibo radar, and thus its availability, is in grave doubt. The National Science Foundation is unwilling to continue its funding and absent a successful intervention effort in the US Congress the radar will soon be decommissioned. This would be a tragedy for the NEO community, and potentially for the world when, not if, another NEO with uncertain orbital parameters is found.