# Space Reactors Aff

## 1AC

### 1AC – Weapons

#### Nuclear power in space leads to space weapons—inevitable consequence and hidden motive for nuclear space programs. Grossman ‘03

Karl Grossman, professor of journalism at the State University of New York/College at Old Westbury, February 5 2003, “Nukes-in-Space in Columbia's Wake”, http://www.space4peace.org/articles/columbiaswake.htm

Gagnon, coordinator of the Global Network Against Weapons and Nuclear Power in Space, warns that the process of manufacturing space nuclear power systems has had human health costs from the process of manufacturing and building more “will lead to significant numbers of workers and communities being contaminated.” He says: “Serious questions need to be asked: Where will they test the nuclear rocket? How much will it cost? What would be the impacts of a launch accident? These nuclearization of space plans are getting dangerous and out of control.” Also, Gagnon sees a military connection, describing the use of nuclear power in space as “the foot in the door, the Trojan horse, for the militarization of space.” Space weapons sought by the military--space-based lasers, hypervelocity guns and particle beams--would require large amounts of power which the military sees as coming from on-board nuclear power systems, thus the close cooperation between the Pentagon and NASA in space nuclear efforts. Dr. Dave Webb, who had been a scientist in the British space program and is now principal lecturer at the United Kingdom's Leeds Metropolitan University’s School of Engineering, and is also Global Network secretary, says, "Star Wars projects like the Space-Based Laser require significant sources of power and it is very useful for the U.S. government to be able to bury some of the costs for the development work in ‘civilian’ or ‘dual use’ programs.” This week, the Global Network was leading protests at the 11th Annual Symposium on Space Nuclear Power and Propulsion in Albuquerque, New Mexico. The gathering, organized by the University of New Mexico’s Institute for Nuclear Space Power Studies, drew NASA, nuclear industry, academic, government and military space nuclear proponents. Said Gagnon from New Mexico: “We’re not saying there shouldn’t be any space program. It’s a question of what kind of seed do we carry with us out into space.”

#### Orbiting reactors lead to arms races for space weapons

Primack et al 89 [Joel R. Primack (professor of physics and astrophysics at the University of California, Santa Cruz and is a member of the Santa Cruz Institute for Particle Physics), Nancy E. Abrams , Steven Aftergood , David W. Hafemeister, Daniel O. Hirsch, Robert Mozley , Oleg F. Prilutsky, Stanislav N. Rodionov, and Roald Z. Sagdeeva, "Space Reactor Arms Control," 1989] AZ

The United States built and ground-tested several nuclear reactors as part of the Rover/NERVA program to develop a reactor-powered rocket in the late 1960s and early 1970s. Several reactors for generation of electric power in space were also designed, but until 8DI there was little demand for them.8 A National Academy study recommended in 1983-before SDI-that a program to develop a 100-kilowatt electric space reactor be funded at an annual level of $10-15 million.9 Current funding for this reactor program, now called the SP-100, is ten times higher. According to Congressional testimony by a senior DoE officiapo ...1 would say that, frankly speaking, the major rebirth and driving factor [for the space reactor program] is [President Reagan's] strategic defense initiative. I think if it were not for that, we would be hard pressed to have a sufficient number of defined missions to sustain it at the levels we're talking about today. The deployment of space-based defenses against strategic missiles (as proposed in Sm) or of anti satellite weapons (ASATs) could involve, among other things, attack with directed-energy weapons (DEWs) such as lasers, orbiting space mirrors (in conjunction with ground-based lasers), particle beams, or hypervelocity guns-missions with large requirements for electric power. The power requirements of such orbiting battle stations can be listed under three headings: .Housekeeping under standby conditions, which includes spacecraft. inertial stabilization. One major power need is likely to be for cryogenic refrigeration of chemical fuels. .Alert mode, when the spacecraft. is fully powered and maneuverable. This might occur for many periods of hours or days during tests, exercises, or crises. The total time in alert mode might be as much as a year over the lifetime of the spacecraft.. .Burst mode, when the weapons are actually firing-possibly on hundreds or thousands of targets in a period of perhaps a few hundred seconds. It is difficult to discuss the corresponding power requirements in the absence of any specific sm or ASAT design. Housekeeping is likely to consume tens to hundreds of kilowatts of electricity over a lifetime of perhaps 10 years, which could be supplied by . either solar cells or a nuclear reactor. Alert mode exercises might involve velocity changes due to rotations or evasive maneuvers of the order of 10 meters per second for lasers, mirrors, or other objects with masses of about a tonne (1,000 kilograms) on times cales of a second, which implies a minimum power requirement of about 100 kilowatts electric. Similar power requirements characterize other alert mode activities. 11 This would probably require reactor power sources, especially if the spacecraft. is supposed to be compact and hardened against attack. In burst mode, the power required to destroy one target each second ; is likely to be of the order of 1,000 megawatts. If the total number of l targets each orbiting battle station is designed to attack is about 100, then allowing a factor of three for misses and an electric conversion efficiency of about 10 percent, about 100 tonnes of high-power-density chemical fuel such as beryllium burning in a fluorine atmosphere (30 megajoules per kilogram) should suffice. One could use closed-cycle multi-megawatt reactors to power burst mode operations, but they are likely to be extremely heavy, especially in view of the requirement of rapid-energy conversion. However, open-cycle reactors may be competitive with chemical energy sources in energy storage density (energy output per unit mass).12 The strength of materials limits energy storage in devices such as flywheels and magnets to considerably less than 1 electron volt (eV) per atom, which is probably not competitive in energy density with the best chemical fuels or open-cycle reactors. Thus, for sm DEW satellites, reactors are being considered for burst mode, could be useful for housekeeping, and might be essential for alert mode. Former sm director Lt. Gen. James Abrahamson said that space nuclear reactors will be an essential component of the second phase of SDI, and that without reactors in orbit, "that's going to be a long, long lightcord that goes down to the surface of the Earth."13 This is the main justification for the SP-100 project, although its current design power capacity of 2.5 megawatts thermal and 100 kilowatts electric may be too small for many sm needs: several contracts have recently been granted by the sma for the design of multi-megawatt reactors.1' Studies by an American Physical Society group and the Congressional Office of Technology Assessment have concurred that reactors are probably necessary for sm.1S,lS But a recent National Research Council study has concluded that the technological challenges of building launchable multi-megawatt reactors are truly formidable. I? Since satellite-based directed energy weapons to attack ICBMs, if they are possible at all, would have relatively short range, DEW battle stations would have to be placed in low earth orbit (LEO-about 400 kilometers), with orbital periods of 1.5-2 hours. In order to have these satellites over enemy ICBM launching sites at all times, many, perhaps hundreds, would be required. That means that many operating nuclear reactors, each many times more powerful than the current RORSAT reactors, would be within sight of almost every point on earth at all times.

#### Space-mil causes nuclear war – norm building is key

Gallagher, senior research scholar at the University of Maryland's School of Public Policy, 15

(Nancy, interim director of the Center for International and Security Studies at Maryland, “Antisatellite warfare without nuclear risk: A mirage,” <http://thebulletin.org/space-weapons-and-risk-nuclear-exchanges/antisatellite-warfare-without-nuclear-risk-mirage>)

But even if the norm against attacking another country’s satellites is never broken, developing and testing antisatellite weapons still increase the risk of nuclear war. If, for instance, US military leaders became seriously concerned that China or Russia were preparing an antisatellite attack, pressure could build for a pre-emptive attack against Chinese or Russian strategic forces. Should a satellite be struck by a piece of space debris during a crisis or a low-level terrestrial conflict, leaders might mistakenly assume that a space war had begun and retaliate before they knew what had actually happened. Such scenarios may seem improbable, but they are no more implausible than the scenarios that are used to justify the development and use of antisatellite weapons. Reducing danger. One way to moderate the nuclear risks associated with antisatellite weapons is to realistically assess arguments that attacking satellites would be an easy way to achieve major military advantages without creating unanticipated or uncontrollable consequences. For example, unclassified analysis by Jaganath Sankaran, a research scholar at the Center for International and Security Studies at Maryland, suggests that the practical limitations of Chinese ballistic missiles and launch facilities would make it much harder for China to attack critical US satellites during a crisis than it would be for Washington to respond in ways that denied Beijing any military advantage from such an attack. As more such studies are conducted and given serious consideration, policy makers will be less likely to invest heavily in antisatellite capabilities or to take pre-emptive action against purported antisatellite threats. Another important way to reduce risk is to strengthen both the norms and the legal rules that protect satellites. The most straightforward way to accomplish this would be to prohibit using anything, including other space objects, to damage or destroy satellites that are not themselves being used as space weapons; and to prohibit any testing of methods for damaging or destroying such satellites. Currently, the biggest threat to established norms and legal protections comes from people who cite anticipatory self-defense—during a crisis or at the outset of hostilities—as a justification for disabling or destroying satellites, launch facilities, or ground stations. Almost as dangerous are those who argue that, once war begins, anything in space becomes fair game and therefore should be targeted. Although it might be legal in the midst of a war to attack satellites used for command, control, communications, and intelligence, it doesn't follow that attacking satellites would be smart strategy.

#### Recent dynamics prove space supremacy has a high chance of escalation.

Hitchens, CISSM senior research scholar, 2016

(Theresa, “Toward a New National Security Space Strategy: Time for a Strategic Rebalancing”, 6-17, <http://www.atlanticcouncil.org/publications/reports/toward-a-new-national-security-space-strategy-time-for-a-strategic-rebalancing>)

During the Bush administration, the space-control and dominance rhetoric emanating from the US military created external perceptions of aggressive US intentions in space. These perceptions were initially soothed by the Obama administration’s policies, rhetoric, and focus on multilateral diplomacy. Recent rhetoric, however, is once again changing the US profile. For example, in statements as recently as 2014, Assistant Secretary of State for Arms Control, Verification, and Compliance Frank Rose stated that the United States was amenable to space arms-control agreements if they are “equitable, effectively verifiable, and enhance the security of all nations [emphasis added].”17 By contrast, in his November 2015 remarks, Rose stated that the United States would consider arms-control measures if they are “equitable, effectively verifiable, and enhance the national security of the United States and its allies [emphasis added].”18 This distinction was reminiscent of the “us” and “them” view of the world after 9/11, and of language in the Bush administration space policy that focused almost exclusively on US rights in space. Since this phrase is an often-heard talking point of US space policy, it is unlikely the recently selected wording was simply a misstep. Given the danger of space warfare and its escalation potential, Bruce MacDonald pointed out how the hegemonic space strategy of the Bush administration was misaligned, in a 2008 report for the Council on Foreign Relations. First, the 2002 US space doctrine included language about the imperative of being able to deny the use of space assets by US adversaries—language that has caused considerable angst among countries increasingly using space in many of the same ways as the United States. The United States has ranged from hinting to overtly stating its desire to “control” space. Second, since the 2006 National Space Policy, space has been considered a US “vital interest” that must be protected. MacDonald highlighted the incongruous nature of those two points: Identifying one’s own space capabilities as a vital national interest while reserving the right to attack others in space (which would likely provoke retaliatory attacks against our “vital” space assets), appears internally inconsistent, even contradictory…Attacking other’s satellites would invite retaliation, putting at risk a “vital national interest” where the United States has much more to lose than the attacker.19 Rational decision-making is goal directed, with internally consistent choices. Therefore, if the ­­­­United States wants to maintain access to its vital interests, avoiding an attack becomes just as important as defending against and defeating an attack. Yet, since the 2013 Chinese launch, the United States is once again considering systems to attack adversary counterspace capabilities, as well as offensive actions against adversary satellites—including potential first-strike, preemptive options—which could lead to a similar misalignment of goals with means. A closer look at the “congested, contested, and competitive” space environment (as characterized by current US policy) is important to understand the backdrop within which threat assessments and strategies are being developed. While management of the environment is both useful and necessary, control of the environment is already out of the reach of any one country. Though a politically potent objective, pursuing space control and domination is a futile, costly quest, and can be counterproductive. In some cases, it already has been. The United States attempted to control satellite technology through the International Trafficking and Arms Regulations (ITAR), until revisions were made in 2014. In a globalized market, the primary effect of those controls was to see satellite sales go to other countries. Not only is unilateral control of space technology and the space environment now impossible, but attempts at control create the perception of denying other countries benefits from space that the United States enjoys. If the United States is to be the leader of the family of spacefaring nations, it must be seen to hold the moral high ground in terms of upholding the principle of “access to space,” as codified in the 1967 Outer Space Treaty, and seeking to avert space warfare.

#### Space wars are the greatest existential risk – damage is irreparable and all activity is affected

Primack & Abrams 2 [Joel Primack (professor of physics and astrophysics at the University of California, Santa Cruz and is a member of the Santa Cruz Institute for Particle Physics) and Nancy Abrams, "Star Wars Forever? — A Cosmic Perspective," 2002] AZ

The depth of our moral understanding depends on our perspective. The view of the Earth changes from flat at a shallow perspective to spherical at a larger perspective. So should our unwillingness as a species to make permanent deleterious changes in the entire Earth, when we view the present epoch in the history of our planet in cosmic perspective. Such considerations arise in connection with issues such as global warming and species extinction. The example of space debris from star wars is a particularly clear case, because the possible benefits to any nation from militarizing space are so obviously short-lived, and the political issues in space are particularly stark, with no pre-existing territorial divides to complicate things as always happens on Earth. Space is the most fragile environment that exists because it has the least ability to repair itself. Only the Earth’s atmosphere can remove satellites from orbit. When the sun flares up in its eleven year cycle, it heats the upper atmosphere and makes it expand so that debris and spacecraft in low orbits are subjected to increased drag. But the higher the original orbit, the less air there is to collide with. Near-Earth space is already at risk from human activities, and it is in great need of protection by scientists and humanity at large.1 We scientists should be especially concerned, both because we place many crucial scientific instruments in near-Earth space, and also because we are in a unique position to foresee the problems human activities are causing and to propose measures to mitigate or avoid them. In particular, scientists need to emphasize that a war in space could create a battlefield that will last forever, encasing our entire planet in a shell of whizzing debris that will thereafter make space near the Earth highly hazardous for peaceful as well as military purposes. Millions of land mines left from earlier wars in Afghanistan and other countries can eventually be removed, but debris in orbit higher than about 800 km above the Earth’s surface will be up there for decades, above 1000 km for centuries, and above 1500 km effectively forever. Over 9000 objects larger than 10 cm in diameter are currently tracked, and there are probably more than 100,000 pieces of orbiting debris larger than a marble. But crowded near-Earth orbits are where the Bush administration wants to put parts of its proposed missile defense system such as Space-Based Lasers and thousands of “Brilliant Pebbles” space-based interceptor missiles. Such weapons are forbidden by the 1972 Anti-Ballistic Missile (ABM) Treaty, but on 13 December 2001 President George W. Bush unilaterally announced his intention to withdraw from this treaty.

#### Turns every space DA – wars kill satellites and the economy

Lamrani, Stratfor security analyst, 2016

(Omar, “What the U.S. Military Fears Most: A Massive Space War”, 5-18, http://nationalinterest.org/blog/the-buzz/what-the-us-military-fears-most-massive-space-war-16248)

The High Cost of a War in Space: Increased competition in space is reviving fears of a war there, one with devastating consequences. Humanity depends on space systems for communication, exploration, navigation and a host of other functions integral to modern life. Moreover, future breakthroughs may await in space, including solar energy improvements, nuclear waste disposal and extraterrestrial mining. A war in space would disable a number of key satellites, and the resulting debris would place vital orbital regions at risk. The damage to the world economy could also be disastrous. In severity, the consequences of space warfare could be comparable to those of nuclear war. What's more, disabling key constellations that give early launch warnings could be seen as the opening salvo in a nuclear attack, driving the threat of a wider conflagration. The small satellite revolution promises the speedy replacement of disabled satellites in the event of attack — theoretically securing the U.S. military's use of space constellations in support of operations during a conflict. Small satellites are not a magic bullet, however; key satellite functions will still depend on bulkier and more complex systems, such as the large but critically important nuclear-hardened command-and-control mission satellites. Many of these systems involve hefty antennas and considerable power sources. Given that access to orbit may not be guaranteed during a war in space, the United States has also been exploring alternative ways to perform some of the core functions that satellites now provide. At this stage, high-flying unmanned aerial vehicles with satellite-like payloads offer the most advanced alternative. But considering the vehicles' vulnerability to sophisticated air defenses, their lower altitude and endurance relative to orbital satellites, and their limited global reach, this remains a tentative solution at best. Overall, the United States is getting far more serious about the threat of space warfare. Investment in new technologies is increasing, and the organizational architecture to deal with such a contingency is being put in place. In the race between shield and sword, however, there is no guarantee that offensive ASAT capabilities will not have the advantage, potentially denying critical access to space during a catastrophic celestial war.

#### Turns space col – space wars cause atmospheric debris that prevents deep space missions

Primack & Abrams 2 [Joel Primack (professor of physics and astrophysics at the University of California, Santa Cruz and is a member of the Santa Cruz Institute for Particle Physics) and Nancy Abrams, "Star Wars Forever? — A Cosmic Perspective," 2002] AZ

Maybe the reason missile defense has gotten as far as it has is that so few people understand the laws of physics. But these laws, unlike human laws, are immutable. We can ignore them, but we cannot escape them. The nickname “Star Wars” for missile defense all too accurately reflects the popular fantasy impression of how things work in space. In the Star Wars movies and in hundreds of other popular science fiction films, we see things blow up in space and the fragments quickly dissipate, leaving space clear again. But in reality, space never clears after an explosion near our planet. The fragments continue circling the Earth, their orbits crossing those of other objects. Paint chips, lost bolts, pieces of exploded rockets—all have already become tiny satellites, traveling about 17,000 miles per hour, ten times faster than a high-powered rifle bullet. There is no bucket we could ever put up there to catch them. Anything they hit will be destroyed and only increase the debris. A marble traveling at that speed would hit with the energy of a one-ton safe dropped from a three-story building. With enough orbiting debris, pieces will begin to hit other pieces, fragmenting them into pieces, which will in turn hit more pieces, setting off a chain reaction of destruction that will leave a lethal halo around the Earth. To operate a satellite within this cloud of millions of tiny missiles would become impossible: no more Hubble Space Telescopes or International Space Stations. Even the higher communications and GPS satellites would be endangered. Every person who cares about the human future in space should also realize that militarizing space jeopardizes the possibility of space exploration.

### 1AC – Accidents

#### Accidents likely

Harrington 16 [Rebecca Harrington (reporter on Tech Insider's science section, covering all matters of science and health. She just received her Master's degree from New York University's Science, Health and Environmental Reporting Program. She also received a B.S. in Biology and a B.A. in Journalism from the University of Minnesota. Rebecca has previously written for Popular Science, Scientific American, the Minneapolis Star Tribune and the Minnesota Daily. ), "Dozens of dead nuclear reactors are floating in space and they'll eventually hit the Earth," Tech Insider, 3/10/2016] AZ

At the height of our adoration of atomic energy, space agencies experimented with launching nuclear-powered spacecraft into orbit around the Earth. It makes sense if you think about it. Radioactive materials, like uranium-235, can power a tiny satellite for years. They're more reliable than batteries and provide more energy than solar panels. But back then, space-faring nations weren't as concerned with radioactive waste. Nuclear disasters like Three Mile Island and Chernobyl hadn't happened yet, and now we're much more worried about radiation exposure. That's why the last nuclear-powered satellite, launched by the Soviet Union, blasted into orbit in 1988. More than 30 different nuclear reactor-powered satellites still orbit the Earth. The US only ever launched one while the USSR launched all the rest. Those nuclear reactors are similar to the ones in nuclear power plants on the ground. Uranium-235 undergoes fission, where its nucleus splits, giving off energy. This energy can be converted into electricity to power satellite instruments, or your house. America's uranium-fueled SNAP-10A entered into an orbit of 575 miles above the Earth in 1965. It operated for 43 days before it stopped responding. It's now in a slow trajectory to hit the ground in about 3,000 years. By then, hopefully its radioactive cargo will be mostly harmless. But if any of these nuclear reactor-powered satellites collide with another object in space, or suddenly crash to the ground, they could release radioactivity. The Soviet Union had a few such mishaps since it launched all those nuclear satellites. In 1978, its spy satellite COSMOS 954 crashed into the Northwest Territories, scattering radioactivity across almost 48,000 square miles. Russia had to pay Canada $10 million for the damage. And in 1995, NASA scientists found a cloud of liquid, radioactive sodium and potassium coolant in orbit. The space agency eventually figured out it came from the Soviet satellite Cosmos 1900. Something else in space crashed into it, causing the nuclear reactor to leak. The cloud of radioactive fluids is still floating up there, and space agencies continue to monitor it.

#### Release dangerous radioactive material

Drughi 15 [Octavia Drughi (Romanian writer and journalist), "NASA’s Orbiting Nuclear Reactor Could Rain Radiation Down on Us," 4/30/2015] AZ

Dozens of potentially dangerous nuclear-powered satellites, operational or not, continue to orbit the Earth, residing over densely populated areas. Since 1965, the Soviet Union launched approximately 30 nuclear-powered spacecrafts, used by their Radar Ocean Reconnaissance Satellites (Rorsats).

Together, they carried more than 1,300 kg of radioactive fuel. At the end of their missions, they are programmed to eject the fuel core of the reactor into a high orbit. Unfortunately, accidents can and do happen. Statistically speaking, 20% of these fission reactors end in failure (1).

Space vehicles rely on solar cells and chemical batteries. The latter have a limited life span unless recharged by solar cells. In turn, solar cells have a low power output that diminishes as the vehicle recedes from the sun. The solution to overcoming these limitations is SNAP (System for Nuclear Auxiliary Power), which uses radioisotopes and nuclear reactors to generate auxiliary power.

There are two types of SNAPs. The odd-numbered SNAPs generate electricity using heat from radioisotopes. Even-numbered SNAPs use nuclear reactors as energy sources. Radioisotopes can generate up to a few thousand watts, while nuclear reactors can produce up to 1 or 2 megawatts (2).

In the 50s and 60s, the US went to great lengths to develop a functional and fully operational SNAP mission. In 1964, the navigational satellite carrying SNAP-9A failed to reach orbit and the nuclear reactor’s power source, namely plutonium, was dispersed in the atmosphere over the Southern Atlantic Ocean. In 1970, the widely-disputed Apollo 13 Moon Mission was aborted and its nuclear-powered lunar lander was dropped in the Pacific Ocean (1).

The Snapshot Program

At the same time, the Soviet Union leaders were making efforts of their own, and not without incidents. In 1969, a Soviet rocket carrying two Cosmos-type nuclear reactors exploded and radioactivity reached the atmosphere over a large part of Russia. In 1978, the Soviet Cosmos 954 fell out of orbit and spread radioactive debris over Canada. And, in 1983, Cosmos 1402 fell out of orbit and its nuclear reactor burned up and the fuel was dispersed in the atmosphere (1).

The US built and tested several nuclear reactors between 1957 and 1973, but only one was launched into space – SNAP-10A (3). In 1960, the US started a test flight program with the intention of launching four reactors into space. Due to budget constraints, only one of them made it past the drawing board.

SNAP-10A was the first and so far the only US nuclear reactor launched into space, developed by the Snapshot program under the US Atomic Energy Commission’s supervision. It was designed to produce up to 500 watts of electrical power over the course of one year. The system weighed 950 pounds, which included instruments and shielding, and could be remotely started and operated in space (4).

On April 3, 1965, SNAP-10A was launched from Vanderberg Air Force Base by an Atlas Agena D rocket. It was placed on a 500-nautical-mile Earth orbit carrying a nuclear electrical source on board, namely a nuclear reactor. The launch was a success and SNAP-10A reached its orbit with zero incidents.

Twelve hours after launch, the beryllium reflectors rotated into place and the heat from the reactor converted into electricity by a thermoelectric converter. The fission reaction started. At first, the reactor produced more than 600 watts of electrical power, but it eventually stabilized at 530 watts (3).

SNAP-10A was the first US complete reactor electrical power system to have gone past the design stage. For 43 days after launch it operated flawlessly. But in May 1965, a high voltage failure in the electrical system of the Agena spacecraft caused one of the voltage regulators to fail. The reactor core was shut down. It was the end of the Snapshot mission.

Despite its abrupt ending, the mission was a success. All the objectives of SNAP-10A were met except the length of operation. Over the course of those 43 days, the reactor produced a total of 500,000 watt-hours of electricity, pretty impressive for an experimental nuclear reactor.

After its premature shutdown, SNAP-10A continued to orbit the Earth, no longer operational and without incident until late November 1979 when it started shedding pieces while remaining largely intact. Researchers called it an “anomalous event.”

Throughout the next six years, approximately half a dozen of these anomalous events occurred and around 50 trackable pieces were released from the reactor. Radar examination of the debris does not show traces of a NaK coolant leak, but the possibility of radioactive debris has not been excluded. Taking past events into consideration, it’s very likely that radiation from SNAP-10A could have reached the Earth, but in extremely small amounts.

These anomalous events might have been caused by one or possibly several collisions with another space object. At the same time, an internal malfunction seems much more plausible.

Nowadays, SNAP-10A remains adrift in a 700-nautical-mile earth orbit and is expected to stay that way for the next 4,000 years (3). That is, if it manages to avoid collisions or any other severe malfunctions that could cause it to break apart entirely, in which case significant amounts of radioactive debris could indeed reach the atmosphere (5).

#### Disrupts satellites and collides with space debris

Aftergood et al 91 [Steven Aftergood (executive director of the Committee to Bridge the Gap, a Los Angeles-based public interest research organization), David W. Hafemeister, Oleg F. Prilutsky, Joel R. Primack and Stanislav N. Roclionov, "Nuclear Power in Space," Scientific American, June 1991] AZ

But accidental reentry is not the only danger that space nuclear power holds. Even those reactors that are launched or later boosted into a long-lived orbit present hazards because they could collide with orbital debris. Although it is unlikely at present, a collision between a nuclear reactor and one of the thousands of sizable objects traveling at a relative velocity of 10 kilometers per second could yield an abundance of radioactive fragments. Many of them would be driven into the lower orbits utilized by manned spacecraft and back into the earth's atmosphere within a few years. Unfortunately, most of the spent nuclear power supplies in orbit now reside in those parts of space near the earth that are most densely populated with debris. Furthermore, even while they are operating safely, reactors can disrupt the operation of other satellites. To minimize mass and cost, orbiting reactors are largely unshielded. They thus produce strong emissions of radiation that can make it difficult for astronomical satellites to detect signals from distant sources. This phenomenon (which was kept secret by the U.S. government until 1988) has already significantly interfered with the work of orbiting gammaray detection systems such as that on board the National Aeronautics and Space Administration's Solar Maximum Mission. The gamma rays emitted by orbiting reactors do not just outshine distant supernovas or black holes; in addition, the more energetic gamma rays interact with the outer shell of the reactor to produce streams of electrons and positrons. These charged particles are trapped in the earth's magnetic field, forming a temporary radiation belt. When another spacecraft passes through such a cloud, the positrons annihilate electrons in the spacecraft's skin, producing penetrating gamma rays that can overload the spacecraft's detectors. These brief interruptions of astronomical observations afflicted the Solar Maximum Mission spacecraft an average of eight times a day for much of 1987 and early 1988, when the Topaz reactors were operating. Similar interference with the gamma-ray burst detector on board the Japanese Ginga satellite effectively blinded it during about a fifth of the same period. NASA is endeavoring to limit the threat from orbiting reactors to its $500-million Gamma Ray Observatory mission, launched in April of this year. One proposed safeguard involves simply shutting off the gamma-ray burst trigger at times when it might be subject to interference. This strategy assumes, however, that only one or two low-power reactors, in predictable orbits, will be operating at any given time. If the number and operating power of orbiting reactors increase, the ability to conduct X- and gamma-ray observations from near-Earth platforms will be severely restricted.

#### Likely to break – debris

Wade 16 [Heather Wade (radio host, science writer, and commentator), "Old Nuclear-Powered Satellites Orbit Earth with Plutonium Onboard," Midnight in the Desert, 4/1/2016] AZ

A report in 2011 by the U.S. National Research Council warned NASA that the amount of orbiting space debris is at a critical level. According to some computer models, the amount of space debris “has reached a tipping point, with enough currently in orbit to continually collide and create even more debris, raising the risk of spacecraft failures.” The report called for international regulations to limit debris that is now in the thousands of pieces and figure out a way to get rid of it.

At least thirty of the satellites above Earth were launched with nuclear reactors powering them by the Soviet Union between the 1950s to 1988. There was also one from the United States Navy’s SNAP series, SNAP-10A, that entered into an orbit of 575 miles above the Earth in 1965. It operated for 43 days before it stopped responding. Now it drifts in a slow trajectory that will eventually cause the old satellite to hit the Earth with its dead nuclear reactor that can still spread dangerous radioactivity. On its own, that drift and fall to Earth could take 3,000 years. But in a debris field as crowded as the one around Earth now, a collision with the right force and direction could knock that SNAP-10A out of its orbit to a premature crash that could spread plutonium or other radioactive particles to Earth life.

That’s what happened to the Soviet Kosmos 954 satellite powered by a nuclear reactor containing about 110 pounds (50 kilograms) of Uranium-235. The satellite was intended to be a Soviet eye in the sky for a long time. But by mid-December 1977, the North American Aerospace Defense Command — also known as NORAD — noticed that Kosmos 954 was moving erratically, changing altitude in its orbit up to 50 miles as Soviet technicians tried to control the falling spacecraft. The Soviets wanted to put the satellite into a graveyard orbit where the nuclear reactor core would be safely out of trouble. But they failed, and the nuclear powered satellite crashed into Canada’s Northwest Territories.

#### Space debris

Primack et al 89 [Joel R. Primack (professor of physics and astrophysics at the University of California, Santa Cruz and is a member of the Santa Cruz Institute for Particle Physics), Nancy E. Abrams , Steven Aftergood , David W. Hafemeister, Daniel O. Hirsch, Robert Mozley , Oleg F. Prilutsky, Stanislav N. Rodionov, and Roald Z. Sagdeeva, "Space Reactor Arms Control," ] AZ

The number of man-made objects orbiting the earth is increasing very rapidly. The US North American Defense System (NORAD) is currently tracking some 6,000 objects larger than 10 centimeters across, and an MIT study recently estimated that there are 48,000 objects larger than 1 centimeter orbiting the earth.23 Since the relative speed of objects in orbit is about 10 km/s, ten times the speed of a rifle bullet, collision with space debris is a serious threat to satellites, including nuclear reactors. According to Nicholas Johnson24 The destruction of a radioactive satellite by hypervelocity collision not only will make it impossible to dispose of the satellite in the future, but also may create more immediate hazards to manned and unmanned satellites. A hypervelocity collision with a spent Soviet nuclear reactor may produce as many as 108 particles with a diameter of 1 millimeter or more. It is evident that it is in the long run unacceptable to place spent reactors in "nuclear safe" disposal orbits, where they exacerbate the space debris problem

#### Spreads radioactive material

Zhang 15 [Sarah Zhang (reporter), "For 50 Years Now, the U.S. Has Had a Nuclear Reactor Orbiting in Space," Gizmodo Magazine, 4/4/2015] AZ

SNAP 10-A was different. SNAP 1o-A was actually a functioning reactor with a controlled fission reaction inside. It contained enough uranium fuel to produce up to 600 watts of power for a year. Twelve hours after take off on April 3, 1965, it settled into orbit 500 kilometers above Earth and humans back on the ground remotely switched on the reactor.

At first, things went well. But 43 days into the mission, electrical systems on the satellite carrying it failed, and the reactor shut down. It’s still up there orbiting. Given its current trajectory, NASA expects it to stay in orbit for another 3,000 years.

But it’s getting crowded up there. In November 1979, SNAP-10A suffered an “anomalous event,” and the parent satellite begins shedding pieces. “Six more anomalous events occur in the next 6 years, releasing nearly 50 trackable pieces. Release of radioactives is possible but not confirmed,” reads a NASA report. These events were not documented in more detail, but they may have included a collision.

Since SNAP-10A, NASA has toyed with nuclear reactors in space, most notably the SP-100 starting the 70s. But funding issues and safety concerns terminated the program. The U.S. has only SNAP-1oA, but Russia has sent dozens of satellites with nuclear reactors into space, the most notorious of which crashed and scattered radioactive debris all over Canada in 1978.

So that’s one reason why sending nuclear reactors into space is not such a great idea.

### Inherency

#### Fission systems for nuclear power in space in development

WNA 16 [World Nuclear Association, "Nuclear Reactors and Radioisotopes for Space," February 2016] AZ

Fission systems – heat For higher power requirements, fission systems have a distinct cost advantage over RTGs.The US SNAP-10A launched in 1965 was a 45 kWt thermal nuclear fission reactor to produce 650 watts with ZrH moderator (or UZrH fuel) and eutectic NaK coolant feeding thermoelectric converter panels. It operated for 43 days and produced 590 watts, but was shut down due to a voltage regulator (not reactor) malfunction. It remains in orbit. The last US space reactor initiative was a joint NASA-DOE-Defence Dept program developing the SP-100 reactor – a 2 MWt fast reactor unit and thermoelectric system delivering up to 100 kWe as a multi-use power supply for orbiting missions or as a lunar/Martian surface power station. This was terminated in the early 1990s after absorbing nearly $1 billion. The reactor used uranium nitride fuel and was lithium-cooled. There was also a Timberwind pebble bed reactor concept under the Defence Dept Multi-Megawatt (MMW) space power program during the late 1980s, in collaboration with DOE. This had power requirements well beyond any civil space program. Between 1967 and 1988 the former Soviet Union launched 31 low-powered fission reactors in Radar Ocean Reconnaissance Satellites (RORSATs) on Cosmos missions. They utilised thermoelectric converters to produce electricity, as with the RTGs. Romashka reactors were their initial nuclear power source, a fast spectrum graphite reactor with 90%-enriched uranium carbide fuel operating at high temperature. Then the Bouk fast reactor produced 3 kW for up to 4 months. Later reactors, such as on Cosmos-954 which re-entered over Canada in 1978, had U-Mo fuel rods and a layout similar to the US heatpipe reactors described below. These were followed by the Topaz reactors with thermionic conversion systems, generating about 5 kWe of electricity for on-board uses. This was a US idea developed during the 1960s in Russia. In Topaz-2 each fuel pin (96% enriched UO2) sheathed in an emitter is surrounded by a collector and these form the 37 fuel elements which penetrate the cylindrical ZrH moderator. This in turn is surrounded by a beryllium neutron reflector with 12 rotating control drums in it. NaK coolant surrounds each fuel element.Topaz-1 was flown in 1987 on Cosmos 1818 & 1867. It was capable of delivering power for 3-5 years for ocean surveillance. Later Topaz were aiming for 40 kWe via an international project undertaken largely in the USA from 1990. Two Topaz-2 reactors (without fuel) were sold to the USA in 1992. Budget restrictions in 1993 forced cancellation of a Nuclear Electric Propulsion Spaceflight Test Program associated with this. Development of a small fission surface power system for the moon and Mars was announced by NASA in 2008. The 40 kWe system could utilise one of two design concepts for power conversion: The first, by Sunpower Inc., of Athens, Ohio, uses two opposed piston engines coupled to alternators that produce 6 kilowatts each, or a total of 12 kilowatts of power. The second, by Barber Nichols Inc. of Arvada, Colorado, is for development of a closed Brayton cycle engine that uses a high-speed turbine and compressor coupled to a rotary alternator that also generates 12 kilowatts of power. NASA itself will develop the heat rejection system and provide the space simulation facility. In mid-2012 NASA reported successful tests of power conversion and radiator components of this 40 kWe system, which is based on a small fission reactor heating up and circulating a liquid metal coolant mixture of sodium and potassium. The heat differential between this and the outside temperature would drive two complementary Stirling engines to turn a 40 kWe generator. Some 100 square metres of radiators would remove process heat to space.In December 2014 NASA’s Glenn Centre announced progress with its 4 kWt/1 kWe KiloPower project, using high-enriched uranium powering a heatpipe system and Stirling engine to generate electricity. NASA appealed to the US National Nuclear Security Administration (NNSA) to let it proceed. Following successful proof-of-concept testing carried out at NNSA's Nevada National Security site in 2012 in collaboration with NASA, critical experiments using the core are due to be carried out in fiscal 2017 under the Department of Energy's Criticality Safety Program working with NASA. The optimum fuel for the reactor would be an HEU alloy with 7% molybdenum. A beryllium oxide reflector would surround this, with eight heat pipes between the fuel and the reflector.

#### Increasing programs for space reactors

WISE 5 ["RADIOACTIVE SPACE DEBRIS: WHAT GOES UP, MUST COME DOWN," World Information Service on Energy, 10/06/2005] AZ

(629.5699) WISE-Amsterdam - Of these 13000 trackable objects, only about 600-700 are operational spacecraft; the remainder is space debris, objects that no longer serve any useful purpose. About half of the trackable objects are fragments from explosions, or from the breakup of satellites or rocket bodies. There are a much greater number of objects in orbit that cannot be tracked because of their small size and additionally hundreds of thousands, perhaps millions, of pieces of space litter too small to be seen - ranging from nuts and bolts to paint chips. They may be small, but with closing speeds of up to 12 miles per second, they pack tremendous energy. In 1999, the space shuttle Discovery landed showing evidence of 64 impacts, at least 10 caused by manmade debris. So far, nothing bigger than 0.08 of an inch (2 millimeters) has struck a shuttle. But even such tiny particles can damage thermal tiles and windows.

According to a recent report to the Fourth European Conference on Space Debris, held in April in Darmstad (Germany), the junk pile includes about a ton of radioactive fuel from defunct reactors launched into orbit between 1967 and 1988.

The last satellite containing a nuclear power source and intended for Earth orbit was launched in 1988. However a renewed interest in radioisotopes power systems (RPSs) and nuclear propulsion could lead to new nuclear power sources in orbit around the Earth later on in this decade or the next. Today, at least eight radioisotope thermoelectric generators (which use the heat from decaying radioisotope to produce electricity), 13 nuclear reactor fuel cores and 32 nuclear reactors (one from the US and 31 from the former Soviet Union) are known to be still circling the Earth in orbits below 1700 km. So, in total about one ton of nuclear fuel is orbiting the Earth.

The United States has launched 22 missions with nuclear power sources. Three accidents have occurred, one resulting in release of radioactive materials. The U.S. launched one experimental space reactor, in 1965. It is now in a 3,000-year orbit.

The Soviet RORSAT program (a spacecraft equipped with a nuclear-powered radar) began sporadic operations in 1967. The program ceased flight operations in 1988 after five serious mishaps in 33 missions, including two nuclear reactors falling back to Earth from orbit and two launch failures. The nuclear reactor and high altitude storage system (needed to maneuver the reactor from its operational orbit of 250 km to a long-lived disposal orbit of 900-1,000 km) accounted for 1,250 kg and slightly more than half (5.8 m) the length of the spacecraft. The fuel assembly consisted of 37 cylindrical fuel elements with 31.1 kg (beginning of life) of 90% enriched uranium.

Following the re-entry of Kosmos 954 over Canada in 1978, the RORSAT reactor underwent several modifications, including the ability to eject the fuel assembly at the end of life, hopefully in the disposal orbit but prior to re-entry in the event of accident, as with Kosmos 1402 in 1983. Between 1980 and 1988, at least 14 RORSATs performed fuel assembly ejection in higher altitude storage orbits. However, not until 1994 did terrestrial-based space surveillance sensors detect what may be large numbers of very small particles of radioactive debris. There is evidence that 16 out of 31 RORSAT reactors lost radioactive reactor coolant, released when the fuel assembly was ejected.

To prevent radioactive material re-entering the Earth's atmosphere and endangering human health, most of the nuclear satellites were retired into orbits of between 700 and 1500 kilometers above the Earth, where they, in theory, will remain for hundreds of years as their radioactivity decays. But over this long period they will inevitably collide with other objects and produce further debris. Eventually these bits will fall into Earth atmosphere.

Today the U.S. uses plutonium-238 on board deep space missions for a power-generating source (RTG). But it also now plans to build nuclear reactors to power rocket engines. In August last year NASA and DOE signed a Memorandum of Understanding "that will lead to the development, design, delivery and operational support of civilian space nuclear reactors within NASA's Project Prometheus". The partnership is responsible for the development of the first NASA spacecraft: the Jupiter Icy Moons Orbiter (JIMO). However, according to an article in the Aviation Week & Space Technology, NASA may try to demonstrate a space-rated nuclear reactor on the Moon first, instead of a mission to the moons of Jupiter. DOE's naval reactor office, which will develop the space reactor, may choose for a lunar demonstration because that is a quicker way to 'prove the basic technology'. The budget allocated for the project Prometheus in fiscal year (FY) 2005 is $431.7 million, and in FY 2006, $319.6 million.

The Global Network Against Weapons and Nuclear Power in Space is again organizing the international Keep Space for Peace international week of protest against the militarization of space running from October 1-8.

#### Space weapons coming – Air Force proves

David 12 [Leonard David (columnist), "Air Force Eyes Nuclear Reactors, Beamed Power for Spacecraft," Space.com, 2/22/2012] AZ

The U.S. Air Force has laid out a new vision for its energy science and technology needs over the next 15 years – a forecast that includes plans for space-based power stations and the prospective use of small nuclear reactors for new spacecraft. The report, entitled "Energy Horizons: United States Air Force Energy S&T Vision 2011-2026," focuses on core Air Force missions in space, air, cyberspace and infrastructure. A series of Air Force mission-focused workshops and summits were held to shape the new strategy. The report was released Feb. 9 and details how the Air Force plans to increase energy supply, reduce demand and change military culture to meet mission requirements. "Energy is a center of gravity in war and an assured energy advantage can enable victory," said Mark Maybury, chief scientist for the United States Air Force. He spearheaded the report. "While energy is already an essential enabler," Maybury said. "Global competition, environmental objectives and economic imperatives will only increase its importance." Space is the "ultimate high ground," providing access to every part of the globe, including denied areas, the report explains. "Space also has the unique characteristic that once space assets reach space, they require comparatively small amounts of energy to perform their mission, much of which is renewable," it states.

### 1AC – Plan

#### Plan: Countries should prohibit the production of nuclear power by orbiting nuclear reactors.

#### A prohibition prevents destabilizing space arms race

Primack et al 89 [Joel R. Primack (professor of physics and astrophysics at the University of California, Santa Cruz and is a member of the Santa Cruz Institute for Particle Physics), Nancy E. Abrams , Steven Aftergood , David W. Hafemeister, Daniel O. Hirsch, Robert Mozley , Oleg F. Prilutsky, Stanislav N. Rodionov, and Roald Z. Sagdeeva, "Space Reactor Arms Control," ] AZ

A primary reason for our proposing a ban on orbiting reactors is to restrict the development and deployment of new weapons in space, particularly destabilizing weapons for strategic defense or for anti-satellite applications. Because detection of operating reactors on earth satellites is relatively easy (see below), a ban on orbiting reactors would be among the most easily verifiable ways of supplementing and strengthening the AntiBallistic Missile Treaty of 1972.18 President Carter proposed a ban on orbiting reactors in the wake of the Cosmos 954 re-entry in 1978, but it was not accepted by the Soviet Union. In view of the present strong interest of the Soviet government in avoiding an arms race in space, now may be a good time to consider such a ban again. An FAS delegation was told by the responsible official at the Soviet Foreign Ministry in September 198819 If the US government were to say to the USSR, let us consider neither of us launching into outer space nuclear power, and such a matter were to be mutual, it would be very seriously considered by the Soviet side. It could be a good deal for both sides, trading off the US SDI investment in reactors against RORSATs and the larger orbiting reactors reportedly under development in the USSR.20 It is possible that an agreement to ban orbiting reactors, if it is achieved, would be part of a larger arms control package. For example, restrictions on ASATs might also be included, particularly since the Soviet RORSATs are the principal near-term target of the US ASAT program.

#### it's verifiable

Primack et al 89 [Joel R. Primack (professor of physics and astrophysics at the University of California, Santa Cruz and is a member of the Santa Cruz Institute for Particle Physics), Philip Pinto, and Oleg F. Prllutsky, "Detection of Space Reactors by their Gamma-ray and Positron Emissions," Science & Global Security, 1989, Volume 1, pp. 129-146] AZ

A ban on nuclear reactors in orbit could be verified using the tremendous flux of gamma rays and positrons that such reactors emit when operating. Indeed, these radiations already constitute a significant background for orbiting gamma-ray astronomical satellites. In this paper, we estimate the gamma-ray flux from reactors on spacecraft, using the design parameters for the US SP-100 space reactor as an example. We then summarize the sensitivities of several existing and planned gamma-ray detectors. We give special attention to the COMPTEL Compton telescope, one of the four instruments that will be included on the US Gamma Ray Observatory (GRO) satellite, which is scheduled for launch in 1990. We show that the gamma flux from an SP-100 could be detected at thousands of kilometers with COMPTEL, and demonstrate that COMPTEL would typically detect a reactor in low earth orbit several times per day. Finally, we briefly discuss positrons from orbiting reactors both as a signal for verification and as an undesirable background for gamma-ray astronomy.

#### Gamma ray detectors exist – checks circumvention

Primack et al 89 [Joel R. Primack (professor of physics and astrophysics at the University of California, Santa Cruz and is a member of the Santa Cruz Institute for Particle Physics), Philip Pinto, and Oleg F. Prllutsky, "Detection of Space Reactors by their Gamma-ray and Positron Emissions," Science & Global Security, 1989, Volume 1, pp. 129-146] AZ

Several satellites presently in earth orbit carry gamma-ray detectors, and it is possible that they could be useful in monitoring a ban on reactors in space. For example, the gamma-ray detectors on the VELA early-warning satellite have sensitivities of order 0.1 cm"2 s"1 . 10 Those on the more modern NAVSTAR satellites are presumably better and are moreover in lower orbits (semi-synchronous with a 12-hour period). The Gamma Ray Spectrometer on the Solar Maximum Mission (SMM) satellite is pictured in figure 1. It has a minimum detectable flux Fm of about 0.001 cm"2 s"1 with an integration time of a few hours. It was launched in February 1980 and is still operating (it was repaired by space shuttle astronauts in 1984). It has seen gamma rays and positrons from almost every Soviet RORSAT (radar ocean reconnaissance satellite) operating since 1980. Tueller et al. from NASA/Goddard, Bell Labs, and Sandia, have an instrument called GRIS (Gamma-ray Imaging Spectrometer). It has seven 200-cubic-centimeter large-area germanium semiconductor detectors with a narrow-line sensitivity of 5 x 10"5 cm\*2 s"1 for an observing time of a few hours. While not incorporated in a satellite, this instrument has flown on high-altitude balloons. The Gamma Ray Observatory (GRO), planned for space shuttle launch in mid-1990, includes four gamma-ray sensors, of which two may be useful in detecting space reactors: the Oriented Scintillation Spectrometer Experiment (OSSE), which consists of four identical shielded and collimated scintillation detectors with an energy range of 0.1-10 MeV, each ghnbal-mounted allowing rotation in a plane, and each with a 3.8° x 10° field of view, and COMPTEL, shown in figure 2, a wide-field-of-view (1 steradian) imaging Compton gamma-ray telescope covering 1-30 MeV and providing 5-8 percent energy resolution and 7.5-arcminute angular resolution (l-o, strong source)." The estimated source sensitivities are 2 x 10~s cm"2 s"1 (line) and 3 x 10~5 cm"2 s"1 (continuum, 0.1-10 MeV) for OSSE, and 3 x 10-'-3 x 10"5 cm'2 s"1 (line) and 5 x 10"5 cm"2 s"1 (continuum, E > 1 MeV) for COMPTEL. (The quoted sensitivities are for observing times of about a month.) In addition, the GRO Burst and Transient Source Experiment (BATSE) will detect positrons from orbiting reactors. Indeed, these positrons could be a very deleterious background for GRO, as will be seen below. The proposed Nuclear Astrophysics Explorer (NAE) is a small and relatively inexpensive (about $80,000,000) satellite whose design uses sophisticated technology. Its gamma-ray detector achieves a high angular resolution of A9 = 2° with a 10° or 1° (selectable) field of view using a coded mask", and it has a very good energy resolution of AE <= 1 keV. It has a high-energy-resolution sensitivity Fm - 3 x 10"\* cm"2 s"1 with an integration time of 10s seconds (about 10 days), and Fm « 3 x 10"4 cm"2 s"1 in 30 minutes. The Advanced Nuclear Gamma-ray Analysis System (ANGAS) is being designed by Lockheed Palo Alto for the Defense Advanced Projects Research Agency (DARPA). It is planned to be flown in 1991 on a dedicated US Air Force satellite, P86-2, and is designed to operate for 3.5 years. It will be at least as sensitive as the NAE, and will probably be used to observe sources of gamma radiation in orbit. Sadoulet et al.13 have proposed to NASA the construction of an advanced double-Compton gamma-ray telescope called High Energy All Sky Imager (HEASI), incorporating a high-pressure drift chamber that would allow high precision ( < 1 millimeter) measurement of the Compton scattering position as well as measurement of the direction of the scattered electron. Its angular resolution for 1-MeV gammas remarkably would be a few arcminutes for each event, with energy resolution of order 1 percent, and its sensitivity would be of order 10"\* cm"2 s"1 with long integration times (months). Cline et al.1 \* have proposed a very large Compton telescope gammaray detector with a liquid argon converter and calorimeter separated by a methane gas drift chamber. This device, which in its largest form has been proposed for space station deployment, could achieve a sensitivity of perhaps 10"9 cm"2 s"1 with long integration times. These last proposals are an indication of the sensitivities that may be possible with the best current technology.

## Space Weapons

### Ext – Yes Weapons

#### Causes space weapons

Aftergood 88 [Steven Aftergood (executive director of the Committee to Bridge the Gap, a Los Angeles-based public interest research organization), "It's Time To Ban The Use Of Nuclear Power In Orbit," Chicago Tribune, 5/25/1988] AZ

A Soviet satellite now orbiting the Earth is steadily losing altitude and will re-enter the atmosphere in several months. What makes this a troubling prospect is that the Cosmos 1900 is powered by a nuclear reactor. When it re- enters, the reactor will break up and release radioactivity into the environment.

There is apparently nothing that can be done to reverse the fall of the reactor, which resulted from a loss of radio contact. But now is an opportune time to consider a ban on the use of nuclear power in orbit, particularly because its use for military space applications is likely to increase dramatically otherwise.

For many types of space weapons, including Star Wars systems, orbiting nuclear reactors would be necessary to provide power, and advanced reactors much larger than Cosmos 1900 are being developed for this purpose. A negotiated ban on nuclear power in orbit could help restrain the deployment of weapons in space, while averting a significant environmental hazard.

A fully deployed space-based weapons system could require "perhaps a hundred or more" space reactors, according to the landmark Report of the American Physical Society Study Group on Directed Energy Weapons. The authors explained that the need for even "a few tens of kilowatts of electrical power necessitates nuclear power reactors" because of their relative survivability against offensive and natural threats.

Similar conclusions have been expressed by Soviet scientists, who wrote in 1986 that "space power engineering for military purposes is likely to rely upon nuclear reactors with various energy converters." It is commonly agreed that the "weaponization" of space will entail, and depend upon, the placement of many nuclear reactors in orbit.

Both the United States and the Soviet Union have space nuclear power programs underway. The Strategic Defense Initiative, with its projected needs for electrically powered directed-energy weapons in orbit, is the driving force behind the U.S. programs.

Currently, the Soviet Union is the only nation that uses nuclear reactors in space. Compact reactors are required to power the Soviet reconnaissance satellites that track and target U.S. shipping. These satellites, which have no exact equivalent among American space systems, are regarded as particularly threatening to our national security, and have been cited by Air Force officials as justification for an anti-satellite program. Meanwhile, there are indications that the Soviet Union, like the U.S., is developing a new generation of space reactors.

### Light Pollution

#### light pollution

Astronomers are attempting to detect faint signals from phenomena distant in space and time amid background radiation ("light pollution") that has been growing rapidly near the earth because of activities such as lighting and communications. Orbiting reactors add significantly to this interference. They are very bright sources of infrared (heat) radiation, since their conversion of heat to electric power is inefficient and most of the heat produced in the reactor must be radiated into space. Space reactors are also intense sources of neutrons and gamma rays and are essentially unshielded except in the direction of the payload. NASA has recently revealed that an instrumment on the Solar Maximum Mission (SMM) satellite launched in 19S0 has seen gamma rays from the RORSATs and has also detected positrons (anti-electrons), which are produced by high-energy reactor gamma rays in the outer reactor casing.25 Some of these positrons are trapped in the earth's magnetic field, effectively becoming an artificial radiation belt. When another spacecraft passes through this cloud of positrons, the positrons annihilate with electrons in the spacecraft's outer casing, and this produces penetrating gamma rays. A gamma-ray burst experiment aboard the Japanese Ginga satellite has also been disabled for about 20 percent of the time by reactor-produced positrons. Positrons from orbiting reactors will also be a serious problem for the Gamma Ray Observatory, a major American astronomical satellite currently scheduled to be launched in 1990, and for other satellites as well.

### Future Gens

#### Future gens outweigh – space debris

Primack & Abrams 2 [Joel Primack (professor of physics and astrophysics at the University of California, Santa Cruz and is a member of the Santa Cruz Institute for Particle Physics) and Nancy Abrams, "Star Wars Forever? — A Cosmic Perspective," 2002] AZ

Morality has a lot to do with power—we can’t be morally responsible for something over which we have no power. Power without moral responsibility is evil, and it is probably also evolutionarily self-destructive. A sense of morality balancing power is what makes it possible for 5 us humans to use power productively to improve the world. Our sense of morality must expand as we acquire the concepts and perspective to understand the long tentacles of our power throughout the Earth and—in this case of star wars—into cosmic-scale time. National political leaders usually take a short-range view, hardly ever stretching past the next change of government; astronomers measure time in millions and billions of years. We must help to educate the general public to think with at least an intermediate perspective of centuries and millenia about the environmental degradation that our increasingly powerful technology is causing on and near our beautiful but fragile planet—the only one like it that we know in the entire universe. Wise people have pointed out that missile defense can’t work, will harm U.S. national security more than enhance it, and will waste hundreds of billions of dollars that could be spent defending ourselves against the real threats of the modern world.13 These truths are expressed on a scale of political debate to which the public is accustomed, and often cynically ignores. The true cost of Star Wars is on another scale entirely—a cosmic scale. Short term political interests pale before the overwhelming, eternal immorality of imprisoning Earth for all future generations in a halo of bullets. Even Nazi officers chose to disregard Hitler’s orders to destroy Paris. The American people must stop our short-sighted government from destroying something incomparably more valuable—the sky itself. This horrible crime would dishonor our ancestors, plant and animal alike, who bequeathed this beautiful blue planet to us, and cripple our descendents, who will never forgive us. It has become customary for U.S. presidents to end speeches by saying “God bless America.” It’s about time for people to start saying instead “God bless the Earth!”

### ! – Weapons

#### space weaponization ensures extinction

Primack & Abrams 2 [Joel Primack (professor of physics and astrophysics at the University of California, Santa Cruz and is a member of the Santa Cruz Institute for Particle Physics) and Nancy Abrams, "Star Wars Forever? — A Cosmic Perspective," 2002] AZ

Abstract: Many philosophers argue that one cannot derive an “ought” from an “is”, but sometimes science tells us things that should lead most people to the same conclusion about what ought to be done. The current debate over missile defense has failed to emphasize a crucial point: even one war in space will create a battlefield that will last forever, encasing the entire planet in a shell of whizzing debris that will thereafter make space near the earth highly hazardous for peaceful as well as military purposes. With enough orbiting debris, pieces will begin to hit other pieces, whose fragments will in turn hit more pieces, setting off a chain reaction of destruction that will leave a lethal halo around the Earth. No actual space war even has to be fought to create this catastrophe; any country that felt threatened by America’s starting to place lasers or other weapons into space would only have to launch the equivalent of gravel to destroy the sophisticated weaponry. Wise people have pointed out that missile defense will waste hundreds of billions of dollars that could be spent combating the real threats in the modern world. Short term political interests pale before the overwhelming, eternal immorality of imprisoning Earth for all future generations in a halo of bullets. This horrible crime would dishonor our ancestors, plant and animal alike, who bequeathed this beautiful blue planet to us, and cripple our descendants, who would never forgive us.

## Disads

### A2 Satellites DA

#### Nuclear not key – solar and chemical propulsion

Singh & Walker 15 [Lake A. Singh (‎Member of the Technical Staff at The Aerospace Corporation), Mitchell L.R. Walker, "A review of research in low earth orbit propellant collection," Progress in Aerospace Sciences 75 (2015) 15–25] AZ

In 1960, only a year after Demetriades' seminal work; Bussard proposed scooping hydrogen from the interstellar medium [6]. The vehicle would release energy from the collected hydrogen via fusion and accelerate the reaction products to generate thrust. This concept has been made famous in Science Fiction works as the Bussard Ramjet [7] and remains the most extreme “air” breathing concept in scientific literature. While nearly all documented airbreathing concepts developed in the Cold War era considered nuclear power sources [3,5,6,8–14], no other concept proposed performing nuclear reactions directly with the collected matter. Berner and Camac worked concurrently with Demetriades to develop a detailed analysis of an air-breathing concept for collecting propellant for other vehicles [14]. Their work was published to the broader scientific community in 1961 [8]. Their work includes a basic analysis of all of the major components of a propellant-collecting spacecraft and makes a number of notable contributions. This is the first work to seriously consider and analyze solar power in addition to nuclear power. It is also the first work to propose and analyze a chemical absorption process for collecting incoming air as opposed to a compressing inlet. The first detailed analysis of the incident heat flux on the spacecraft as aresult of accelerating the oncoming flow is also included in this work. Perhaps most importantly, Berner and Camac establish the “weight-doubling time” parameter. This is the amount of time required for the spacecraft to store a surplus of propellant equal to its dry mass. They go on to use this parameter along with the launch vehicle and spacecraft costs to estimate the vehicle lifetime necessary to recover these investments (economic breakeven time) for a propellant-collecting concept. Using this methodology along with data available to the community in 1961, Berner and Camac determine that the economic breakeven time for a propellant-collecting vehicle is less than a year for both nuclear powered and solar powered craft. By establishing the weightdoubling time and using it to arrive at the economic breakeven time, they show that elliptical orbits will take longer to break even economically. Berner and Camac's work relies on primitive atmospheric data which limits its accuracy. Additionally, they fail to factor eclipsing of the sun by the Earth into their analysis for solar powered options. Berner and Camac also fail to consider variation in atmospheric density as a result of solar and geomagnetic activity. These limitations to the Berner and Camac work cast doubt on the validity of their findings. Berner and Camac themselves conclude that limitations in propulsion technology at the time of publishing are the primary obstacle to feasibility. With 50 years of development in electric propulsion technology since then, this may no longer be the case. In 1961, Zukerman and Kretshmer considered utilizing energy released from atomic oxygen recombination during compression of incoming air to provide all of the input energy into the flow for acceleration as part of a ramjet system [15]. This work determined that there is insufficient energy from atomic oxygen recombination to enable sufficient thrust to counteract the drag force. However, Zukerman and Kretshmer note that the addition of a fuel into the flow can supply enough energy to overcome drag. This work allows us to exclude chemical propulsion as a sustainable option for propellant-collecting space vehicles. Reichel et al. expanded on Berner and Camac's work with a paper in 1962 studying the possibility of a nuclear-powered, airscooping electric propulsion system [9]. Their proposed concept would operate just on the edge of space at 110 km with a 5-MW nuclear power source. At this altitude their vehicle would be able to collect nearly 60 kg of air per hour. Reichel conducted an analysis of the compression and liquefaction power requirements for his design, and in 1978 Reichel resurrected his proposed concept under the name AIRScoop as a means to deliver the components needed for a 475-GW space solar power plant [10].

### A2 Space Col DA

#### Space nuclear reactors are distinct from plutonium-powered spacecraft – NASA proves

Grossman 15 [Karl Grossman (professor of journalism at the State University of New York/College of New York), "The Perils of Nuclear-Powered Space Flights," Counterpunch, 6/29/2015]

NASA has released a study claiming there is a need for continued use of plutonium-energized power systems for future space flights. It also says the use of actual nuclear reactors in space “has promise” but “currently” there is no need for them. The space plutonium systems—called radioisotope thermoelectric generators (RTGS)—use the heat from the decay of plutonium to generate electricity in contrast to nuclear reactors, usually using uranium, in which fission or atom-splitting takes place. The “Nuclear Power Assessment Study” describes itself as being done as a “collaboration” involving “NASA centers,” among them Johnson Space Center, Kennedy Space Center and the Jet Propulsion Laboratory, “the Department of Energy and its laboratories including Los Alamos National Laboratory, Idaho National Laboratory, Sandia National Laboratories,” and the Johns Hopkins University Applied Physics Laboratory. The study, released this month, comes as major breakthroughs have been happening in the use of solar and other benign sources of power in space. The situation parallels that on Earth as solar and wind power and other clean, safe technologies compete with nuclear, oil, coal and other problematic energy sources and the interests behind them. Examples of the use of benign power in space include the successful flight in May of a solar-powered spacecraft named LightSail in a mission funded by members of the Planetary Society. Astronomer Carl Sagan, a founder of the society, was among those who have postulating having a spacecraft with a sail propelled through the vacuum of space by the pressure of photons emitted by the sun. LightSail demonstrates his vision.

#### Nuclear reactors distinct

Zhang 15 [Sarah Zhang (reporter), "For 50 Years Now, the U.S. Has Had a Nuclear Reactor Orbiting in Space," Gizmodo Magazine, 4/4/2015] AZ

Exactly half a century ago this week, a rocket shot off from the California coast. It carried the U.S.’s first and only (known) space nuclear reactor, SNAP-10A, which has been circling the Earth ever since and will continue to circle for another 3,000 years.

Back in the 1960s, NASA ran a Systems for Nuclear Auxiliary Power (SNAP) program to study nuclear power’s potential in space exploration. This program sent up the first radioisotope thermoelectric generators, a technology still used in space probes like Voyager and Curiosity today. Radioisotope thermoelectric generators aren’t nuclear reactors, though. They simply harness the heat from a decaying element, such as plutonium-238.

#### Technical difference between reactors and RTGs

Aftergood et al 91 [Steven Aftergood (executive director of the Committee to Bridge the Gap, a Los Angeles-based public interest research organization), David W. Hafemeister, Oleg F. Prilutsky, Joel R. Primack and Stanislav N. Roclionov, "Nuclear Power in Space," Scientific American, June 1991] AZ

There are two fundamental sources of nuclear power for applications in space: reactors and radioisotope power supplies. Whereas a reactor produces heat through the controlled fission of uranium fuel, a radioisotope thermoelectric generator, or RTG, derives heat simply from the decay of a highly radioactive material. In both cases, the heat is converted to electric power. The RTG is best suited for power requirements of less than a few kilowatts, the reactor for higher power levels. Although the U.S. has launched only one nuclear reactor into orbit, an ambitious reactor development project has been under way for most of the past decade [see illustration below]. As currently planned, the SP-1 00 reactor would generate approximately 100 kilowatts of electricity from 2.5 megawatts of thermal power-far more power than any reactor flown to date. It would contain about 190 kilograms of uranium nitride fuel enriched to 96 percent in the fissionable isotope uranium 235. The entire reactor is intended to weigh approximately 3,000 kilograms, a mass-to-power ratio of 30 kilograms per kilowatt. Except for a small "shadow shield," which helps to protect the payload from the intense radiation emitted during operation, the SP-1 00 is designed to be unshielded. The reactor would be cooled by liquid lithium metal, which would flow through pipes to thermoelectric cells-circuits containing junctions between dissimilar metals that can transform a temperature difference into a voltage difference. These cells would convert about 4 percent of the reactor-generated heat into electricity. The considerable waste heat would be ejected through a set of radiator panels with a surface area of around 100 square meters. Nearly every component of the SP-1 00 design extrapolates beyond existing technological experience, making it uncertain whether the program will be able to achieve its goals. Moreover, the reactor has been designed in the absence of a proposed mission, and 50 any specific application is likely to require substantial revision. Flight-testing of the SP-1 00 will not be possible before the turn of the century; cost estimates for the test alone exceed $1 billion, a discouragingly large sum. Furthermore, as the program moves toward its second decade, a specific mission for the SP-1 00 has still not been defined.

## T/Theory

### A2 Must Be Domestic

#### We meet – the airspace above each country is part of that government's jurisdiction.

#### We meet – space isn't part of any one country's authority, so every country as partial control over orbiting reactors.

#### Counterinterpretation – the aff may specify countries banning a type of reactor outside of their domestic boundaries if we have a solvency advocate

#### Standard –

### A2 T – Nuclear Power

#### Merriam-Webster defines nuclear power as

energy that is created by splitting apart the nuclei of atoms

#### We don't underlimit – the aff can only ban reactors that use fission reactions, not fusion or experimental reactors

### A2 Can't Spec Reactor

#### Prohibit merely means to hinder

Collins English Dictionary – Complete and Unabridged, 12th Edition 2014 © HarperCollins Publishers 1991, 1994, 1998, 2000, 2003, 2006, 2007, 2009, 2011, 2014 http://www.thefreedictionary.com/prohibit

to hinder or prevent

#### Aff flex – the topic is heavily neg biased already – forcing the aff to defend the categorical ban of all nuclear power makes being aff impossible and grants them a huge variety based on regulation, process, and PICs – allowing the aff to specify a type of nuclear power levels the playing field

#### Neg generics still apply – all their links are in the context of uranium reactors, since those are the ones used currently

#### We don't underlimit – there are only five types of nuclear reactors: light water, heavy water, fast breeder, graphite, and thorium.

#### [A2 GROUND] They have plenty of ground – say that space reactors don't exist, space reactors are key to exploration, or that reactors increase international cooperation

#### [A2 "HAVE TO REDUCE PRODUCTION"] Their interp is contrived and mixes burdens – the aff shouldn't have to prove that they reduce power production in order to be topical, since that would make topicality a question of solvency –any doubt about whether the aff solves is potentially an auto-loss on T

## Neg

#### Advantage counterplan for debris + space weapons

Primack & Abrams 2 [Joel Primack (professor of physics and astrophysics at the University of California, Santa Cruz and is a member of the Santa Cruz Institute for Particle Physics) and Nancy Abrams, "Star Wars Forever? — A Cosmic Perspective," 2002] AZ

Scientists can foresee problems of which others are unaware. Our dual role in helping to avert a space “tragedy of the commons”10 is to increase the understanding of relevant basic science, and to define and advocate needed policies, such as the following: · Do not introduce attack weapons into space. · Avoid fragmentation of satellites from explosions due to accidents and antisatellite weapons tests, the main cause of space debris. Prohibit explosions of any kind in space. · Design boost and deployment systems for satellites that minimize the production of space debris. Require all satellites in LEO to carry a mechanism, such as rockets or inflatable devices to increase drag, that will cause them to reenter when their useful life is over. · Ban nuclear reactors in orbit.11 · Minimize light pollution from orbit.

### to integrate

### Relations

#### Uncertainty and tension from space weapons negatively impacts the whole bilateral relationship

Weeden, Secure World Foundation technical adviser, 2016

(Brian, “USE OUTER SPACE TO STRENGTHEN U.S.-CHINA TIES”, 4-26, <http://warontherocks.com/2016/04/use-outer-space-to-strengthen-u-s-china-ties/>)

As the two nations act on these differing priorities and goals, tensions in the space domain have had ramifications for the overall bilateral relationship. Recent testing and development of anti-satellite capabilities by China, and a doctrinal focus on “active defense” have caused the United States to openly call for a stronger focus on space protection and warfighting. From the Chinese perspective, it is necessary to develop such capabilities to support national security, close the power gap, and defend itself from American aggression., Failure to reconcile their differences in this domain could lead to a renewed arms race that could be to the detriment of both sides. Both countries have acknowledged the importance of developing a more stable, cooperative, and long-lasting bilateral relationship in space. Washington still hopes that Beijing can be a constructive partner for greater international space security. While China still chafes at the largely American constructed rules-based order, it likewise has a clear interest in using its development of space capabilities to promote bilateral cooperation and to play a role the formation of new international regimes. Both of these dynamics were evident in recent United Nations discussions on space governance, with an isolated Russia attempting to undermine international consensus on new guidelines for enhancing the long-term sustainability of space activities. Thus, the two sides have overlapping interests that present opportunities for cooperation and bilateral engagement. Accordingly, the United States and China should continue to engage in both bilateral and multilateral initiatives that enhance the long-term sustainability and security of space. Working together, and with other stakeholders, to help ensure the success of these initiatives would go a long way toward reinforcing the desire of both countries to be seen as playing leading roles in space governance and being responsible space powers. The United States and China, as well as the private sectors of the two countries, should also find a way to engage in bilateral and multilateral civil space projects, including science and human exploration, though doing so will need to overcome strong political challenges. At the same time, both the United States and China should be cognizant of where their interests differ in space and look to enact confidence-building measures to reduce tensions and the risk of a crisis escalating into outright conflict. While the prospects for legally binding arms control measures are slim at this stage, they could put in place unilateral and bilateral measures to reduce tensions and development of direct ascent kinetic-kill and rendezvous and proximity operations (RPO) capabilities. Finally, both countries would benefit significantly from improving their national space situational awareness (SSA) capabilities, and increasing data sharing with each other and the spacefaring community.

#### Positive engagement provides a foundation for a stronger overall relationship and reverses anti-Chinese sentiment amongst government planners – that allows cooperation on space weather modeling, satellite observation, and exploration

Weeden, Secure World Foundation technical advisor, 2015

(Brian, “An Opportunity to Use the Space Domain to Strengthen the U.S.-China Relationship”, 9-9, http://nbr.org/research/activity.aspx?id=602)

The U.S.-China relationship in space has the potential to be a stable foundation for a stronger overall relationship between the two countries. Space was arguably a stabilizing element in the relationship between the United States and Soviet Union during the Cold War by providing national capabilities to reduce tensions and an outlet for collaboration. Although the future of the U.S.-China relationship will be characterized by both competition and cooperation, taking concrete steps to stabilize relations in space can be part of the solution to avoiding the “Thucydides trap,” where an established power’s fear of a rising power leads to conflict. The Role of Space in the U.S.-China Relationship Space is a critical domain to the security of the United States. Space capabilities enable secure, hardened communications with nuclear forces, enable the verification and monitoring of arms control treaties, and provide valuable intelligence. Such capabilities are the foundation of the United States’ ability to defend its borders, project power to protect its allies and interests overseas, and defeat adversaries. The space domain, however, is currently experiencing significant changes that could affect the United States’ ability to maintain all these benefits in the future. A growing number of state and nonstate actors are involved in space, resulting in more than 1,200 active satellites in orbit and thousands more planned in the near future. Active satellites coexist in space along with hundreds of thousands of dead satellites, spent rocket stages, and other pieces of debris that are a legacy of six decades of space activities. As a result, the most useful and densely populated orbits are experiencing significant increases in physical and electromagnetic congestion and interference. Amid this change, China is rapidly developing its capabilities across the entire spectrum of space activities. It has a robust and successful human spaceflight and exploration program that in many ways mirrors NASA’s successes in the 1960s and 1970s and is a similar source of national pride. Although it still has a long way to go, China is developing a range of space capabilities focused on national security that one day might be second only to those of the United States. Some of China’s new capabilities have created significant concern within the U.S. national security community, as they are aimed at countering or threatening the space capabilities of the United States and other countries. The massive changes in the space domain and China’s growing capabilities have affected the U.S.-China relationship in space. There is growing mistrust between the two countries, fueled in part by their development and testing of dual-use technologies such as rendezvous and proximity operations and hypervelocity kinetic kill systems. This mistrust is compounded by a misalignment in political and strategic priorities: China is focused on developing and increasing its capabilities in the space domain, whereas the United States is focused on maintaining and assuring access to its space capabilities. Recommendations for Managing Tensions and Promoting Positive Engagement Despite these challenges and concerns, there are concrete steps that the United States and China can take to manage tensions and possibly even work toward positive engagement. In 2011, President Barack Obama and then Chinese president Hu Jintao issued a joint statement on strengthening U.S.-China relations during a visit by President Hu to the White House. As one of the steps outlined in the statement, the two presidents agreed to take specific actions to deepen dialogue and exchanges in the field of space and discuss opportunities for practical future cooperation. President Xi Jinping’s upcoming visit presents an opportunity to build on the 2011 agreement and take steps toward these goals. The first step should be to have a substantive discussion on space security. President Obama should clearly communicate the importance that the United States places on assured access to space, U.S. concerns with recent Chinese counterspace testing, and the potential negative consequences of any aggressive acts in space. Both countries should exchange views on space policies, including their interpretations of how self-defense applies to satellites and hostile actions in space. Doing so can help avoid misunderstandings and misperceptions that could lead either country to unwittingly take actions that escalate a crisis. Second, Presidents Obama and Xi should discuss specific ideas for cooperation in civil and scientific space activities and the use of space for peaceful applications on earth. Continuing to exclude China from civil space cooperation will not prevent it from developing its own capabilities; this approach will only ensure that China cooperates with other countries in space in a way that advances its own national interests and goals. Space weather, scientific research, exploration, capacity building for disaster response, and global environmental monitoring are all areas where the United States and China share joint interests and could collaborate with each other and other interested countries to help establish broader relationships outside the military realm.

#### Plan creates constituencies for cooperation and dampers aggression

Johnson-Frees, US Naval War College national security affairs professor, 2015

(Joan, "Found in Space: Cooperation," China-US Focus, 10-9, www.chinausfocus.com/foreign-policy/u-s-china-space-cooperation-a-welcome-dialogue-begins/)

Apparently also, according to the media note, space debris and satellite collision avoidance were discussed, in acknowledgement that those issues cannot be handled solely on a national basis and are critical to maintaining the sustainability of the space environment. Since the United States has more assets in space and is more dependent on those space assets in both civil and military operations than any other country, it behooves the U.S. to pursue all potentially valuable avenues available to protect the space environment. It is in U.S. interests. Given the increasing number of Chinese assets in space, sustainability of the space environment is in Chinese interests as well. Countries cooperate where both have a vested interest. Other topics that were discussed in conjunction with potential cooperation were civil Earth-observation activities, space sciences, space weather and the civil Global Navigation Satellite System. Beyond the general benefits that flow to the U.S. from cooperation – including learning Chinese standard operating procedures in decision making and operations, **establishing an** internal Chinese constituency **to argue against aggressive Chinese actions** that threaten cooperative programs **by** creating a vested interest in continuance, and getting a closer look at Chinese capabilities – cooperation in each of these areas offers the U.S. more in benefits than associated risks. Working together on civilian-Earth observation activities would likely involve sharing data on complex Earth-system processes relevant to everyone on the planet. There are frequently data gaps in the models designed to address these complex processes, gaps that can be closed by sharing data. Better models would yield positive benefits to both countries in fields like disaster management, environmental studies, coastal and marine planning, and sustainable land use. Everybody wins. Space-science cooperation has long been discussed as potentially valuable and viable for two reasons. First, it can be an area of cooperation where technology-transfer concerns can be minimized. Although it would likely begin only with data exchanges, ideally data exchanges could lead to more extensive projects so that Americans can learn more about Chinese decision making and foster positive constituencies within China. Further, space scientists in both countries are notoriously like stepchildren when it comes to funding allocations. Working cooperatively could enable scientists in both countries to do more with their limited funds. One area of space science with practical application is space weather – being able to anticipate solar flares and geomagnetic storms that are potentially damaging to satellites in orbit and negatively affecting ground facilities and operations, and thereby be able to protect against those effects. Space weather “predictions” are based on fundamental scientific research on solar-terrestrial physics. Finally, discussions on civil Global Navigation Satellite Systems (GNSS) focus on navigation satellite systems with global coverage, including the U.S. Global Positioning Satellites (GPS), the Russian GLONASS system, and the expanding Chinese BeiDou system. It is in U.S. interests to assure that China integrates BeiDou with other systems rather than having BeiDou incompatible with other systems. If China were to integrate only BeiDou into the myriad of commercial products that utilize GNSS and that China produces, thereby requiring a different receiver than currently used by GPS, that would wield significant negative economic impacts on the U.S. Additionally, non-integration could also create a more chaotic environment for GNSS use. Therefore, the United States is not merely doing China a favor by participating in these talks or by considering expanded areas of space cooperation, as is sometimes characterized. It is the United States acting in its own best interest. While ideally the U.S. could tie space cooperation to other contentious issues between the U.S. and China – cyber attacks, for example – that is unlikely to happen. Expecting and waiting for that unlikely link to be made allows critical space issues to go unaddressed. There are some fundamental questions about the U.S.-China relationship that might prove useful in guiding future policy. Does it support or go against U.S. interests to keep its friends close and enemies closer? If the answer to that is “yes,” then either way, the U.S. should pursue expanded opportunities to work with China in space. Is in the best interests of the United States to have China stable, or imploding? If the answer is stable, then we inherently must learn to work with China in areas of mutual interest. Is the sustainability of the space environment in the interests of the United States? If it is, there is no choice but to work with China on a variety of space issues. A second meeting is scheduled for 2016 in Washington, D.C. Hopefully real progress will be made in advancing cooperation in at least one of the areas initially broached at the recent September meeting. Space cooperation between the U.S. and the Soviet Union was judiciously used as a mechanism to build broader areas of trust during the Cold War, and Post-Cold War years. The United States knows how to successfully conduct space diplomacy. It is an aberration that today it has to be done in secret so as not to draw the sensationalist ire of politicians and pundits. Fostering cooperation is an integral part of the Space Act that created NASA. Ironically, perhaps through the continued, unintended help of Hollywood the public will recognize the wisdom of allowing NASA, OSTP and the State Department to do their jobs, and begin to take an active role in demanding inclusive space cooperation.

#### US-Sino ties key to de-escalate tensions in the South China Seas

Shambaugh, GWU political science professor, 2015

(David, “Sino-US relations: Divorce is not an option”, Straits Times, 6-12, http://www.straitstimes.com/opinion/sino-us-relations-divorce-is-not-an-option)

Despite this overall macro climate in the relationship, the US and China still have to coexist, and to do so peacefully if at all possible. We have business to do with each other - both commercial and diplomatic business. Perhaps the most immediate opportunity - and one that would give an enormous boost to the relationship - would be the conclusion of a bilateral investment treaty. But negotiating this treaty is hung up in the queue behind the Trans-Pacific Partnership agreement. Given the difficulty the White House is having getting that agreement finalised and through Congress, there may be little appetite in Washington to conclude an investment treaty with China this year. Also high on the agenda at present is the real need to forge practical cooperation on a number of so-called "global governance" issues, including North Korea, Iran, the Islamic State in Iraq and Syria, Afghanistan, counterterrorism, anti-piracy, climate change, maritime security, economic stability, energy security, sea-lane security, and setting global rules for cyber activity. To date, China has been extremely reluctant to collaborate openly with the US on such global governance issues, but now it possibly seems more feasible. This is because President Xi has personally endorsed more "proactive diplomacy" by China in the global governance arena. This will not solve the problems in US-China relations, but it will help. The upcoming Strategic and Economic Dialogue and Mr Xi's September state visit to Washington are golden opportunities to discuss these issues, try to forge tangible cooperation, and arrest the negative dynamic in the relationship. The question is whether it will be temporary again, or a real "floor" can be put beneath the relationship. If the past is any indicator, we should not expect too much. What worries me is that in this increasingly negative and suspicious atmosphere, "tests of credibility" will increase. The best we can probably hope for over the next two to three years - as President Obama becomes a lame duck and the election cycle stimulates more heated rhetoric about China - is tactical management of the relationship, with sensitivity to each side's "red lines" and "core interests", while hoping that no "wild card" events occur. This could include another military incident in the air or at sea, or renewed tension over Taiwan. Even the current situation in the South China Sea has real potential to haemorrhage, as China is not going to stop its island- building activities and hence will not meet American demands that it do so. Or if China, having fortified the islands, proclaims an air defence identification zone over the South China Sea. What is Washington to do then? The potential for military confrontation is not insignificant. So, looking to the future, the key responsibility for both countries is to learn how to manage competition, keep it from edging towards the conflictual end of the spectrum, while trying to expand the zone of practical cooperation.

#### SCS goes nuclear

Wittner, NYU history professor, 2011

(Lawrence, “Is a Nuclear War With China Possible?”, 11-28, www.huntingtonnews.net/14446)

While nuclear weapons exist, there remains a danger that they will be used. After all, for centuries national conflicts have led to wars, with nations employing their deadliest weapons. The current deterioration of U.S. relations with China might end up providing us with yet another example of this phenomenon. The gathering tension between the United States and China is clear enough. Disturbed by China’s growing economic and military strength, the U.S. government recently challenged China’s claims in the South China Sea, increased the U.S. military presence in Australia, and deepened U.S. military ties with other nations in the Pacific region. According to Secretary of State Hillary Clinton, the United States was “asserting our own position as a Pacific power.” But need this lead to nuclear war? Not necessarily. And yet, there are signs that it could. After all, both the United States and China possess large numbers of nuclear weapons. The U.S. government threatened to attack China with nuclear weapons during the Korean War and, later, during the conflict over the future of China’s offshore islands, Quemoy and Matsu. In the midst of the latter confrontation, President Dwight Eisenhower declared publicly, and chillingly, that U.S. nuclear weapons would “be used just exactly as you would use a bullet or anything else.” Of course, China didn’t have nuclear weapons then. Now that it does, perhaps the behavior of national leaders will be more temperate. But the loose nuclear threats of U.S. and Soviet government officials during the Cold War, when both nations had vast nuclear arsenals, should convince us that, even as the military ante is raised, nuclear saber-rattling persists. Some pundits argue that nuclear weapons prevent wars between nuclear-armed nations; and, admittedly, there haven’t been very many—at least not yet. But the Kargil War of 1999, between nuclear-armed India and nuclear-armed Pakistan, should convince us that such wars can occur. Indeed, in that case, the conflict almost slipped into a nuclear war. Pakistan’s foreign secretary threatened that, if the war escalated, his country felt free to use “any weapon” in its arsenal. During the conflict, Pakistan did move nuclear weapons toward its border, while India, it is claimed, readied its own nuclear missiles for an attack on Pakistan. At the least, though, don’t nuclear weapons deter a nuclear attack? Do they? Obviously, NATO leaders didn’t feel deterred, for, throughout the Cold War, NATO’s strategy was to respond to a Soviet conventional military attack on Western Europe by launching a Western nuclear attack on the nuclear-armed Soviet Union. Furthermore, if U.S. government officials really believed that nuclear deterrence worked, they would not have resorted to championing “Star Wars” and its modern variant, national missile defense. Why are these vastly expensive—and probably unworkable—military defense systems needed if other nuclear powers are deterred from attacking by U.S. nuclear might? Of course, the bottom line for those Americans convinced that nuclear weapons safeguard them from a Chinese nuclear attack might be that the U.S. nuclear arsenal is far greater than its Chinese counterpart. Today, it is estimated that the U.S. government possesses over five thousand nuclear warheads, while the Chinese government has a total inventory of roughly three hundred. Moreover, only about forty of these Chinese nuclear weapons can reach the United States. Surely the United States would “win” any nuclear war with China. But what would that “victory” entail? A nuclear attack by China would immediately slaughter at least 10 million Americans in a great storm of blast and fire, while leaving many more dying horribly of sickness and radiation poisoning. The Chinese death toll in a nuclear war would be far higher. Both nations would be reduced to smoldering, radioactive wastelands. Also, radioactive debris sent aloft by the nuclear explosions would blot out the sun and bring on a “nuclear winter” around the globe—destroying agriculture, creating worldwide famine, and generating chaos and destruction.