The Impact of U.S. NMD on Chinese Nuclear Modernization

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Chinese Nuclear Deterrence

The Chinese decision to build its own nuclear weapons was a response to the nuclear threats posed by the United States (U.S.).[1] In the 1950s, China perceived constant nuclear threats from the U.S. and felt that the threat could be negated by nuclear deterrence. China chose to develop its own nuclear force rather than accepting the Soviet nuclear umbrella because it did not want to lose its sovereignty and independence in a military alliance with the former Soviet Union. In January 1955, the Chinese leaders made a decision to develop atomic bombs to defeat the U.S. nuclear blackmail and nuclear monopoly.[2] The next year, China began to organize research on atomic bombs and the missiles that would carry them.[3] After the Soviet Union tried to constrain China from further developing Chinese nuclear weapons, China became more determined to develop an independent nuclear force.[4]

The purpose of the Chinese nuclear development is to defend its vital national security by countering possible nuclear blackmail. China worries that the superpowers would feel free to offend China's vital security interests without apprehension if China did not have nuclear weapons. It expects that its nuclear arsenal would discourage the use of nuclear weapons or the threat of using nuclear weapons against China. The Chinese leaders believed that (1) a modest nuclear force would be able to neutralize nuclear blackmail made by the superpowers and deter their nuclear attacks; and (2) nuclear weapons are not militarily usable and therefore the Chinese nuclear weapons are not for war-fighting.[5] Based on Mao Zedong's nuclear strategic thought, China made a no-first-use commitment immediately after its first nuclear test. In this commitment, China pledged not to be the first to use nuclear weapons. Since then, the no-first-use commitment has become an important part of the Chinese nuclear strategy.

To explore the impact of U.S. National Missile Defense on the Chinese nuclear deterrent, we need to quantitatively understand how the Chinese nuclear deterrent works now. The difficulty here is that the Chinese government has never explicitly

explained how to translate the Chinese nuclear strategy into quantitative requirements for its nuclear force. So we have to make some educated guesses in our analysis on the Chinese nuclear deterrent. In addition, all the discussions on the Chinese nuclear deterrence in this paper will be only in the China-U.S. context.

Chinese nuclear development may be divided into three stages. In the first stage, China had only a symbolic or existential nuclear deterrence until it acquired the capability of launching Inter-Continental Ballistic Missiles (ICBMs) in 1980.[6] After that, the Chinese nuclear deterrence entered into the second stage in which deterrence is based on the quantitative ambiguity of its nuclear force. In general, the creditability of the nuclear deterrent of a country depends on its rivals' perception about its nuclear retaliatory capability. It is widely believed that China has about twenty liquid-fuel silo-based ICBMs that can reach the U.S.[7] The two dozen land-based ICBMs that have been detected and located by the U.S. intelligence agencies would have very little chance of surviving a U.S. preemptive nuclear strike. However, because China has neither confirmed nor denied any outside estimates about the size of its long-range nuclear force, it is difficult for the U.S. to rule out some errors in its estimate. If the U.S. considers launching a preemptive nuclear strike against China, the Americans would understand that they may not know the exact number of the Chinese ICBMs. They may have some confidence that they could destroy all the two dozen detected Chinese ICBMs in a preemptive strike, but they would have to worry about a Chinese nuclear retaliation with a few undetected ICBMs. Such a worry would discourage and deter the U.S. from attempting a nuclear strike against China.

The total number of the Chinese ICBMs do not make direct contribution to the Chinese nuclear deterrence because multiplying this number does not increase the strength of the deterrence. The error or uncertainty of the American estimate about the size of the Chinese long-range nuclear force forms the perceived Chinese retaliatory capability in the U.S. and the scope of this uncertainty or error is directly relevant to the credibility of Chinese deterrence.

To deter a first nuclear strike from the U.S., the Chinese nuclear retaliation must be able to cause an intolerable amount of damage to the U.S. There are different estimations about the minimum number of nuclear warheads needed for causing intolerable damage based on different criteria.[8] The criterion used in this paper is drawn from the history of recent U.S. conventional wars. The U.S. ended two wars without winning them in the last half century: the Korean and Vietnam conflicts. There were several reasons for the U.S. withdrawing from these two wars. One important and common reason is that each war had caused tens of thousands of American casualties. So, I assume that the U.S. would choose other options rather than launching a nuclear strike against China in a crisis if the U.S. understands that the strike would initiate a Chinese nuclear retaliation and that the retaliation can cause

more American casualties than the above figures: tens of thousands. A nuclear bomb with a yield of about one megaton TNT equivalent exploded over a big city would certainly cause many more casualties than tens of thousands. So, a Chinese retaliatory strike with a few nuclear warheads should be able to deter a first nuclear attack from the U.S.

The above discussion shows that the nature of the Chinese minimum nuclear deterrence is quite different from that of the other nuclear states. In its current stage, the Chinese minimum nuclear deterrence comes from the quantitative ambiguity of its nuclear force. As long as this uncertainty is larger than a few ICBMs, the deterrence is stable. Now, Chinese nuclear development is going to enter a third stage, in which China will have credible and visible minimum nuclear deterrence. The Chinese long-range nuclear force could not be saturated by a U.S. preemptive strike, i.e., at least a few Chinese ICBMs or Submarine-Launched Ballistic Missiles (SLBMs) would be able to survive a U.S. preemptive strike and could be used in a retaliatory strike no matter how well the U.S. measures the total number of the Chinese nuclear weapons. China has two options to acquire a credible nuclear deterrence: to increase the quantity or to raise the survivability of its nuclear force. Table 1 gives the number of nuclear weapons China needs to maintain a credible minimum nuclear deterrence in different Chinese deployment modes and at different levels of the U.S. nuclear arsenal. This paper gives one estimate based on the criteria explained above and assumptions listed below. Other estimates might give quantitatively different numbers, but the general pattern would be the same and would not change the argument made in this paper.

Table 1, Nuclear Weapons Needed by China for Creditable Minimum Nuclear Deterrence under Various Assumptions

Warheads in the US at different levels	Numbers of Chinese weapons and hypothetical deployment			
	Silo-based	One-dimensionally mobile	Two-dimensionally mobile	Submarine-based
START II: Operational and hedge ICBM: 1400 SLBM: 2130	1200	167	22	30
START II: Operational only ICBM: 500 SLBM: 1680	800	112	18	30
Total: 1000	430	57	14	30

ICBM: 230 SLBM: 770				

Data from, Li Bin, "China's Nuclear Disarmament Policy", in Harold A. Feiveson ed., *The Nuclear Turning Point, A Blueprint for Deep Cuts and De-alerting of Nuclear Weapons*, Brookings Institution Press, Washington, D.C., 1999, pp.325-332. In the table, "one-dimensional mobile" means that the weapon are restricted to moving along a high-way or railway, with no opportunity to scatter in other directions; "two-dimensional mobile" means that the weapon can travel off roads. One third of the submarines are assumed at sea all the time and to be 100% survivable.

Table 1 shows that to acquire a credible nuclear deterrence, China needs a big expansion of its long-range nuclear arsenal if it does not raise its survivability beyond placing the missiles in hardened silos. If China successfully develops mobile ICBMs or SLBMs, it needs very little, if any, increase in its long-range nuclear force. It is reported that the size of the Chinese long-range nuclear force has been stable over time in the last two decades and that China is working on mobile ICBMs.[9] This suggests that China has chosen the second option, that is to build credible minimum deterrence by increasing the survivability rather than the number of its long-range nuclear weapons. If there is no missile defense, this will be the direction of the Chinese nuclear modernization. Nuclear development in this direction is very predictable and stable. This approach to nuclear modernization will increase Chinese security while without increasing the perception of threats in other countries. The National Missile Defense (NMD), if the U.S. decides to deploy it, would force China to consider incorporating approaches that would help defeat the defense and this would make the direction of the Chinese nuclear modernization diverge over a big range of possibilities.

Impact of NMD on Chinese nuclear deterrence

The effort of current U.S. missile defense development is focusing on Ballistic Missile Defense (BMD). There are five basic types of BMD: (1) pre-launch attack, meaning attacking the missiles before their launch; (2) boost-phase interception, meaning attacking the missiles while they are being accelerated by their rocket boosters; (3) exoatmospheric interception, meaning attacking the missiles or their warheads during midcourse in the upper atmosphere or above it; (4)endo-atmospheric interception, meaning attacking the missiles or their warheads during the reentry phase in the lower, denser atmosphere; (5) civil defense, meaning reducing the effects of the missile attacks by strengthening constructions on the ground or hiding personnel and facilities at safe locations. The U.S. BMD effort covers the first four approaches, which may have different impacts on Chinese nuclear deterrence.

In its history, the U.S. tried several times to acquire a capability to counter ICBM attacks. The U.S. first developed nuclear-armed anti-ballistic missiles (ABMs) in the 1960s but abandoned them later. In the 1980s, the U.S. attempted to develop layered missile defenses with directed energy and kinetic energy weapons under the Strategic Defensive Initiative (SDI), which was believed later to be too ambitious. Because the SDI technology was far from ready and East-West relations improved in the late 1980s and the early 1990s, the SDI program shrank. In the Bush Administration, it was changed to a more limited program referred as Global Protection Against Limited Strikes (GPALS). In the first Clinton Administration, the SDI program officially died and then it was revived in the current BMD programs.

The current U.S. BMD effort can be divided into two major parts. The first is the project to develop Theater Missile Defense (TMD), for which the declared goal is to defend U.S. military bases abroad or its allies against attacks by missiles with ranges less than 3,500 kilometers. The second is the project to develop a National Missile Defense (NMD), for which the declared goal is to defend the U.S. territory against ICBM attacks. To defend the entire United States, the U.S. would have to use exoatmospheric or boost-phase interception. Exoatmospheric defense is the emphasis of the current U.S. NMD project as designed by the Clinton Administration, while boost phase defense has also been proposed for discussion.[10] The current TMD project includes lower-tier, upper-tier and boost phase systems. The lower-tier systems, e.g., the Patriot antimissiles, are endo-atmospheric defense systems that can defend only small areas. The upper-tier systems, especially the Navy Theater Wide (NTW) system, could defend a big area in principle, so they could be used to supplement the U.S. NMD if needed.

Before President Clinton decided to leave the decision on NMD deployment for the next president, the Ballistic Missile Defense Organization (BMDO) had designed an NMD architecture, calling for initial deployment of interceptors in Alaska. Many Republicans are pushing for a more robust NMD system, while others oppose the idea of NMD based on mid-course interception. At the same time, US-North Korean relations are improving and the perceived DPRK missile threat is declining. All these factors may fundamentally change the structure of NMD. This paper will only consider the Clinton Administration's NMD architecture and analyze its impact on China's nuclear deterrence. This analysis will also be valid if the main technology and structure of the NMD system remains similar in the next administration.

According to the Clinton Administration's NMD system design, the U.S. would deploy ground-based launchers and interceptors at two locations. The interceptors would be equipped with Exoatmospheric Kill Vehicles (EKVs) that kill incoming warheads by hitting them at high speed (hit-to-kill). The NMD system is designed to work as follows: the early-warning satellites of the NMD systems detect the launch of

a missile by seeing the hot and bright plume from its engine. Once the missile is detected, the control center tells different sensors to track the missile or the warhead and decoys it releases and discriminate them. These sensors include some early-warning radars that would be upgraded to have a tracking capability accurate enough to guide interceptors, some X-band tracking and discrimination radars, and satellite-based infrared tracking sensors. The trajectory information obtained by these sensors would be used to launch and guide interceptors toward the target warhead. After the EKV is released, the infrared sensors on the EKV would guide it to approach the target. To increase the kill probability, several interceptors may be launched towards each target warhead.

According to the current plan, the U.S. would deploy NMD in several phases. In the first development phase, sometimes referred to as capability 1 (C1), the U.S. would deploy one hundred interceptors in Alaska, upgrade existing early warning radars, and deploy a new X-band tracking radar. The goal of this phase is said to be to defend against an attack by a few tens of missiles with simple or no countermeaures. It is noticeable that C1 system was originally designed to have twenty interceptors and to deal with a few ICBMs. Its proposed size and capability was subsequently enlarged to its current level. In the later phases, the U.S. would deploy more radars, low-orbit and high-orbit missile-tracking satellites, more interceptors and would add a new launch site. The stated goals of these phases are to defend against a few tens of missiles with complex countermeasures.

The number of missiles the C1 system is intended to defend against is comparable to the reported size of the whole Chinese long range nuclear force and is obviously larger than the number of the Chinese retaliatory ICBMs. As discussed in the last section, only a few Chinese ICBMs would survive a first U.S. strike and constitute a retaliatory capability if China does not expand the size of its long range nuclear force. So, even a very thin NMD system with very few interceptors would pose a serious threat to the Chinese retaliatory capability. No matter how the U.S. government clarifies its intentions in deploying NMD, many Americans still believe that a NMD designed for "rogue states" would have an inherent capability to defend against Chinese ICBMs.[11] Chinese nuclear deterrence depends directly on American perceptions about the Chinese nuclear retaliatory capability. The deployment of NMD would change these perceptions and therefore significantly undermine the Chinese deterrent. Without the backup of NMD, the Americans would always worry about a Chinese retaliation with the few Chinese nuclear weapons that might survive a U.S. first nuclear strike against China. The deployment of a NMD system would provide the American public with an illusion that the several surviving retaliatory Chinese ICBMs would be intercepted by the NMD system - since it is both designed and said to be able to defeat attacks by small numbers of missiles. If the Americans tended to

believe that a first nuclear strike plus a NMD system would be able to disarm the Chinese nuclear retaliatory capability, the U.S. could become incautious in risking nuclear exchanges with China in a crisis. It would therefore disturb the strategic stability between China and the U.S and increase the danger of war between the Chinese and American peoples.

China has realized these dangers and its arms control representative, Ambassador Sha Zukang stated that it is evident that the U.S. NMD will seriously undermine the effectiveness of China's limited nuclear capability from the first day of its (NMD) deployment. This can not but cause grave concerns to China."[12]

The structure of the NMD system designed for the Clinton Administration is obviously East Asia-oriented, especially in its first deployment phase, C1. In the C1 phase, the only new missile tracking radar will be deployed on Shemya, an outpost well located to watch missiles from East Asia, including Russian Siberia, Korea, and China. The only NMD launch site in the C1 and C2 phases would be in Central Alaska, which is much closer to East Asia than to the Middle East or the European part of Russia. This geographical structure provides more time and less required defense range for the interceptors in defending against missiles from East Asia than from other places in the world. This may help the U.S. take a strategy of "shoot-look-shoot" in defending against missiles from East Asia. This strategy could raise the kill probability of the NMD system and allow it to operate in a more efficient way. The East-Asia-emphasized structure of the NMD system could leave the Americans with a strong impression that missiles from East Asia would have little chance to penetrate the U.S. defense.

The above analyses show that the U.S. NMD system proposed by the Clinton Administration, based on its number of interceptors and geographical structure, would have an inherent potential capability to threaten the Chinese retaliatory nuclear force. This would reduce American perceptions of China's nuclear retaliatory capability and undermine Chinese nuclear deterrence. Besides the problem of the designed capability of NMD, the intention behind NMD in the U.S. is also worrying. As the relations between North and South Korea are improving, the voices in the U.S. calling for aiming the NMD at China are getting stronger. This will cause serious concerns in China and the Chinese will have to explore possible responses in their nuclear development if the U.S. decides to deploy NMD.

Requirements for Chinese responses

China is now using its diplomatic resources to influence the U.S. on the NMD matter. The hope is that the U.S. would take China's security concerns into account when it considers NMD deployment. But there is a danger that the U.S. would ignore China's

concerns when making its deployment decision. If this happens, China will certainly seek possible approaches that help maintain the effectiveness of its nuclear deterrent. As Ambassador Sha Zukang stated, "China has not and will not participate in an arms race with anybody. But neither will we sit on our hands and allow our legitimate security interests to be compromised by any one."[13] When China considers the approaches to protect the effectiveness of its nuclear deterrence, it is necessary to apply some requirements to these approaches. Our research indicates that four such requirements are fundamental.

(1) The approaches China takes should be FEASIBLE in helping defeat the U.S NMD. This is a requirement that takes precedence over all others. Judging the feasibility of proposed approaches is sometimes difficult because of the following four reasons: (a) The BMDO has declared that the NMD system would be able to defeat simple and complicated countermeasures as its development proceeds. It is not clear how the NMD would do this based on all the proposed technology; (b) although the technology of the NMD plan proposed by the Clinton Administration is clear, the plan itself is still uncertain. For example, the Republicans are pushing for a stronger missile defenses; (c) China needs to worry about any scientific surprises in NMD development; (d) different organizations in the Chinese defense industry may have different assessments of the feasibility of different approaches. Due to the uncertainty about the feasibility of various approaches, the Chinese government may want to pursue more than one set of approaches in case one does not work.

(2) Some of the approaches should be VISIBLE to the U.S. It is necessary but not sufficient if the Chinese approaches can defeat the U.S. NMD. The reason is that the Chinese deterrence depends on the American perception about the Chinese retaliatory capability rather than its real capability. Thus, some of the Chinese approaches should be visible to the Americans so that they will know that their NMD system will not be able to counter the Chinese retaliatory capability.

(3) The approaches should be AFFORDABLE and not constitute a financial burden on China. China is now concentrating on economic development. It does not want a sharp expansion of military expenditure that would disturb its economic progress. The Chinese government's policy takes economic development as its priority and the policy has strong support from the Chinese people.

(4) The approaches should be MODERATE and not increase perceptions of a "China threat" in other countries. China is now in the process of fully participating in the international community and it needs a peaceful environment for its economic development. In order to continue this peaceful profile, China would prefer approaches that avoid negative consequences in arms control or that would lead to new tensions.

In addition to the above four key requirements, there are some additional factors that could also influence decision-making in selecting possible approaches. These factors are not as critical as the four above, but sometimes they can be important when the potential approaches are assessed in different Chinese organizations. These factors are the following:

(5) The decision makers will prefer approaches that are COMPATIBLE with each other. All approaches applied to the missile defense problem must be compatible with each other. On the other hand, decision makers sometimes prefer competition in the early part of the development process, so incompatible approaches may not be excluded in the early Chinese plans.

(6) Some PRECAUTIONARY approaches are needed. The U.S. BMDO declares that NMD will defeat simple and complicated countermeasures in different development phases. It is not clear how the current NMD technology will do this. So the Chinese would have to worry about some possible scientific surprises. On the other hand, some people in the U.S. are pushing for stronger missile defenses or even a revival of part of the SDI program. The Chinese may want to have some technical preparation for the approaches that can also deal with a stronger missile defense.

(7) Approaches based on CHALLENGING technology could obtain more support. China worries that one of the intentions behind the U.S. NMD is to acquire preemption in military technology in the new century. Chinese scientists would hope that their work could narrow the technical gap between China and the U.S., although some approaches may not be the best option to respond to the U.S. NMD.

The above list is not an exhaustive one. There may be some other factors which could sometimes play a role in determining Chinese responses. For example, if an approach has traditional bases in the Chinese defense industry or dual-use industry, it would have more of a chance to be recognized and recommended by the scientists in those industries. Therefore, it would have a better chance to be chosen by the government. However, these factors may not be as important as the seven described above.

The U.S. development of missile defenses is forcing China to consider taking approaches to protect its nuclear deterrent. This poses some new requirements and challenges for Chinese nuclear development. As discussed in the first section, if there is no missile defense, China needs to worry only about survivability, reliability and safety in its further nuclear development. The appearance of missile defenses would disturb the process and introduce many uncertainties. The next section will comment on different Chinese approaches based on the above listed seven factors.

Comments on possible Chinese responses

Many approaches that could help defeat NMD have been discussed.[14] These approaches may be divided into four groups. The first group aims to overwhelm the defense. This could be done by (A) building more ICBMs; (B) MIRVing the Chinese ICBMs to multiply the number of warheads; (C) releasing decoys from the missiles; or (D) dispersing chaff to fool the sensors of the defense. The second group aims to lower the observability of the warheads by applying stealth technology. This group includes: (E) radar stealth, meaning that the radar reflection from the warhead is reduced; and (F) infrared stealth, meaning that the infrared radiation emitted by the warheads is reduced. The third group creates a rivalry between the warheads and the interceptors during the flight, for example, (G) by making the warheads maneuver. The fourth group raises the survivability of the Chinese ICBMs by (H) deploying mobile ICBMs and/or SLBMs; (I) building a missile defense; or (J) putting the Chinese nuclear weapons on hair-trigger alert.

There are two very different scenarios in which more ICBMs are built to overwhelm the defense. In the first scenario, China builds more silo-based ICBMs; and in the second scenario, China builds more survivable ICBMs or SLBMs. These two scenarios give very different results.

As discussed in the first section, the current Chinese nuclear deterrent is based on quantitative uncertainty in the minds of its rivals. The NMD would strengthen U.S. confidence about being able to counter Chinese retaliatory capability. If China wants to overwhelm the defense by developing more warheads, the size of its retaliatory force should be larger than the sum of the number of warheads intercepted by the defense and the number of warheads that can produce "intolerable damage". Here we assume that two interceptors are used to kill one warhead, so that a C1 system with 100 interceptors is able to kill 50 warheads. Table 2 gives the number of warheads China needs to overwhelm a C1 or C2 system.

Table 2, Nuclear Weapons Needed by China to Maintain Credible Minimum Nuclear Deterrence in Case of C1

Warheads in the U.S. at different level	Numbers of Chinese weapons and hypothetical deployment			
	Silo-based	One-dimensionally mobile	Two-dimensionally mobile	Submarine-based
START II: Operational and hedge ICBM: 1400 SLBM: 2130	1250	217	72	80
START II:	850	167	68	80

Operational only ICBM: 500 SLBM: 1680				
Total: 1000 ICBM: 230 SLBM: 770	480	107	64	80

All the numbers in Table 2 are larger by 50 than those given in the same positions of Table 1. However, if there is no missile defense, China could maintain its nuclear deterrence by keeping some quantitative ambiguity about its nuclear force before it deploys survivable nuclear weapons. If there is a missile defense, the effect of the quantitative uncertainty would be eliminated by the defense. China would then have to seek a credible deterrent. The conclusion is that it is not economic or efficient for China to enlarge its silo-based nuclear force in response to a U.S. NMD deployment. It would be a more reasonable option for China to overwhelm the defense with fully mobile ICBMs or very survivable SLBMs when these technologies are ready. A key problem here is the timing: If China wants to overwhelm the defense with an enlarged nuclear force, China needs to raise the survivability of its nuclear force before the U.S. finishes the deployment of NMD. If Chinese technology cannot be ready in time, or if China chooses to deploy combined modes of its long-range nuclear force, the number of nuclear warheads China needs to overwhelm the defense varies from one hundred to several thousands. This would create a big uncertainty about the future of Chinese nuclear forces.

Enlarging Chinese nuclear forces to overwhelm the defense may have some significant costs for China: (1) it may not be good for China's peaceful profile; (2) it may involve a big financial burden if China chooses to enlarge the silo-based nuclear force; (3) China may need to produce additional fissile materials for the new warheads, especially if China chooses to add silo-based ICBMs. This factor would make China reluctant to join a Fissile Materials Cut-off Treaty (FMCT) if it wants to keep open the option of such a buildup. Although the costs could be large, the buildup option cannot be ruled out. The reason for this is that the buildup option is so mathematically simple to understand and so certain to work. So, in the Chinese debate this idea would easily win some support from non-technical people. Another advantage is that the buildup would be visible to the outside and would therefore help discourage any first strike against China.

An efficient way to enlarge a nuclear force is to deploy Multiple Independently-targeting Re-entry Vehicles (MIRVs) if the technology is available. In U.S. efforts to persuade Russia to revise the ABM treaty, one inducement has been to allow Russia to keep its MIRVs. This could encourage China to think about this option. However, for China, MIRVing the silo-based ICBMs is not a good idea because its nuclear force

is much smaller than Russia's. MIRVing the survivable ICBMs could be better. But this depends on whether the technology is mature.

Some Chinese articles mention multiple-warheads as countermeasures,[15] but they do not always refer to real warheads. So, multiple warheads in these articles could also mean one real warhead plus many decoys. As discussed in a report made by a group of American scientists (UCS/MIT),[16] the proposed NMD sensors cannot differentiate the real warhead from anti-simulation decoys during the midcourse of the flight. This technology is not too complicated for China. This means that the deployment of decoys is a much more efficient and simple way than MIRVs for China to defeat the NMD system.

If some metal chaff strands are dispersed around the warheads, they can fool the radars of the defense. This technology should not be difficult for China.

Stealth technology can be used to make the warheads less observable during their flights. For example, the radar reflection of a warhead can be reduced by putting the warhead in a reentry vehicle with a pointed cone-sphere shape or painting the reentry vehicle with radar absorbing materials. This countermeasure is based on not too complicated technology and can reduce the effectiveness of the defense. Another stealth technology, which is discussed in UCS/MIT report, is to reduce the infrared radiation of the warhead by cooling the skin of the warhead. This countermeasure is also based on not-too-complicated technology and can completely defeat the defense.

The only countermeasure mentioned by the Chinese defense industry is the use of a maneuvering warhead.[17] To defeat the interceptor, the maneuver capability of the warhead should be comparable to that of the interceptor. So, the warhead needs to detect the approaching interceptor and start its maneuver at an appropriate time; otherwise, the warhead needs to carry a lot of fuel so that it can maneuver continuously. Either option is a challenge to the designers of the warhead. The first option needs very capable sensors on the warhead that can search for approaching interceptors from all possible directions while the latter needs to reduce considerably the weight of the nuclear device so that the re-entry vehicle can carry additional fuel and an engine. To match the maneuver capability of the interceptor, the warhead may need a new design to tolerate off-axis accelerations during maneuvers. This may require new nuclear tests and therefore create difficulties for China to ratify the Comprehensive Test Ban Treaty (CTBT). The result of the competition between the warhead and interceptor is dependent on the competition of technologies of the defensive and offensive sides, and thus difficult to assess.

Raising the survivability of the Chinese nuclear weapons cannot directly defeat the U.S. NMD system; however, it can make some other approaches much more effective

and efficient. For example, China would need many fewer nuclear warheads to overwhelm the defense if China can deploy survivable ICBMs rather than silo-based ICBMs. If there is no missile defense, it is the main goal of the Chinese nuclear modernization to build a survivable mobile or/and a sea-based nuclear force. This goal is still important for China even if the factor of a missile defense is added.

So-called 'point' missile defenses protecting missile silos may also help raise the survivability of Chinese ICBMs. However, the technology is very challenging and the cost is very high.

Another approach to increasing nuclear weapon survivability is to put the Chinese nuclear weapons on hair-trigger alert. This would mean that China would need to launch its nuclear weapons after it detects a nuclear attack but before the incoming nuclear weapons arrive. This strategy is called "launch on warning" and was cited as a destabilizing factor by American negotiators to their Russian counterparts in their consultations on the ABM Treaty.[18] This approach requires advanced and reliable early-warning systems, which China may not currently possess.

The above discussions show that there is not one simple choice for China in responding to U.S. NMD deployment. All approaches discussed above and maybe some others would be considered by Chinese decision-makers. An assessment of the priorities of different options for China would be very difficult because the very strict and different requirements listed in the last section may produce different judgements. The competition among these approaches would lead to a big range of uncertainties in China's nuclear modernization.

Possible Arms Control Responses

China is making diplomatic efforts to dissuade the U.S. from deploying NMD in both bilateral and multilateral forums. In bilateral exchanges, China has expressed its concerns over NMD through official visits and "track two" meetings that include both governmental and non-governmental officials. These bilateral dialogues have helped the two countries understand each other's positions and concerns and are laying the base for possible resolution of the dispute over the NMD issue.

China has also spoken out against NMD at two major multilateral meetings. The first was at the First Committee of the United Nations (UN), where China endorsed the Russian proposal to sustain the ABM treaty, a proposal that won the overwhelming support of the UN members. The second forum is the Conference on Disarmament (CD), where China is trying to initiate a negotiation on the prohibition of weapons targeting outer space. In addition to the UN and CD, China also outlines its concerns over NMD (or TMD that could supplement NMD) at several regional

forums.[19] Chinese diplomats have talked more and more with the western news media, thereby providing more transparency on China's positions to the American people.

If this diplomatic effort fails, however, China would make some responses in the area of arms control in addition to its responses in nuclear development.

NMD deployment would harm Chinese confidence in arms control. Before China gradually opened its door to the world in the early 1980s, it was skeptical of the utility and effectiveness of international efforts in global arms control and it did not believe that the superpowers would be faithful to their commitments when they feel that they have the power to break them. As it has been involved more and more in international arms control regimes and negotiations, China has learned the importance of participation in international cooperation on arms control and has become very active in this area. U.S. attempts to modify or withdraw from the ABM treaty are reviving old doubts in China about whether the U.S. will be faithful to its arms control commitments and about the sustainability of international arms control cooperation. The Chinese would worry that participating in arms control would reduce, not strengthen, China's self-defense capabilities. In conclusion, China could become less cooperative with the U.S. in the area of arms control and non-proliferation if the U.S. finally revises or abandons the ABM treaty.

As discussed in the last section, some approaches may add difficulties for Chinese participation in arms control. For example, China may need some additional fissile materials to saturate the defense by building more nuclear weapons, especially silo-based ICBMs. It will be difficult for China to accept a Fissile Material Cut-off Treaty, one that puts a ceiling on the size of the Chinese nuclear force and makes China lose an option for countering the NMD, even though China may not take such an option immediately. Another concern would add to the difficulty of ratifying the Comprehensive Test Ban Treaty. In China, there have been some voices arguing that China lost too much in signing the CTBT.[20] If some Chinese feel that a few more nuclear tests are required to develop countermeasures like the maneuvering warhead discussed above, the voices opposing the CTBT would certainly become stronger in China.

In the non-proliferation area, China would become less interested in legally accepting the MTCR, including its annexes, as China's export control law if the U.S. does not respond to China's concern over NMD. The U.S. would become less influential in dissuading China to cut its cooperation with some countries if China believes that such cooperation is consistent with existing international law. In the area of nuclear disarmament, NMD will become a new and serious obstacle that blocks China from considering joining global nuclear reduction efforts.

FOOTNOTES

1. John Lewis and Xue Litai, "China Builds the Bomb," Chinese Translation, Atomic Energy Publishing House, Beijing, 1990. Pp.34-35.
2. Song Renqiong, "Chairman Mao Guided Us in Creating Our Atomic Energy Industry", in China National Nuclear Corporation edited, "Mao Zedong and The Chinese Atomic Industry, In Memory of Mao Zedong on His 100th Birth Date," Atomic Energy Publishing House, Beijing, December, 1993. Page 33.
3. Nie Rongzhen, "Nie Rongzhen's Memoir," Volume 3, Liberation Army Publishing House, Beijing, 1984, page 788.
4. Liu Jie, "Mao Zedong's Thought on Nuclear Strategy," in "Mao Zedong and The Chinese Atomic Industry, In Memory of Mao Zedong on His 100th Birth Date," page 43.
5. See, for example, Mao, page 9, 11, 13. And Liu Jie, page 42. in "Mao Zedong and The Chinese Atomic Industry, In Memory of Mao Zedong on His 100th Birth Date."
6. Xie Guang eds., Contemporary Chinese Science and Technology for National Defense, Contemporary China Publishing House, 1972, Beijing, pp.327-338.
7. See, for example, NRDC Nuclear Notebook, in *The Bulletin of Atomic Scientists*, Nov./Dec., 2000. Vol. 56, No.6, pp.78-79.
8. Harold Feiveson ed., "The Nuclear Turning Point", Brookings Institution Press, Washington D.C. (1999), pp.47-62.
9. See, for example, the NRDC Nuclear Notebook.
10. Richard Garwin, "Boost Phase Intercept, A Better Alternative," *Arms Control Today*, Sept 2000, Vol. 30., No. 7, pp. 8-11.
11. See for example, David C. Gompert and Jeffery A. Issaacson, "Planning a Ballistic Missile Defense System of Systems," RAND Issue Paper, http://www.rand.org/publications/IP/IP181/.
12. Sha Zukang, "The Impact of the U.S. Missile Defense Programme on the Global Security Structure", CPAPD/ORG Joint Seminar on Missile Defense and the Future of the ABM Treaty, March 13-15, 2000, Beijing.
13. Ibid.
14. See for example, Duan Baojun, "American TMD Program in My View," ConMilit Vol. 24, No. 4, April 2000, pp.17-18." And A. M. Sessler et al., "Countermeasures," Union of Concerned Scientists and MIT Security Studies Program, April 2000.
15. See for example, Ge Lide, "$100M Undershoot," Military Weekly, Jan 18, 2000, No. 544.
16. A. M. Sessler et al., "Countermeasures."

17. "Launch Gives China Boost-U.S. Defense Easier to Avoid, Says Paper," The Seattle Times, November 22, 1999.
18. "ABM Treaty Coverage, The Bulletin of the Atomic Scientists,"http://www.thebulletin.org/issues/2000/mj00/treaty_doc.html.
19. See, for example, the Speech of PRC Delegation to the ASEAN Forum on TMD, March 5, 1999. Bangkok.
20. Sun Xiangli, "The Implication of the CTBT for China's Security," CISAC Working Paper, Stanford University, 1997.