A Discussion of China's Nuclear Transparency Options

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Abstract

This paper will discuss how much nuclear transparency China can afford to adopt in light of the changing international security context. The work will examine China's attitude toward nuclear transparency; the possible influence of high-resolution satellite imagery on China's position; what sorts of nuclear transparency China could accept under international arms control and nonproliferation treaties; and what kind of on-site inspections China could accept at its specific nuclear production facility and site under an FMCT.

China's Attitude toward the Nuclear Transparency

China has taken the position generally that nuclear transparency has two sides: On one hand, properly developed transparency measures can make an effective and sustained contribution to enhancing international security, because increasing transparency will help to clarify intentions, decrease tensions by reducing suspicion, increase mutual understanding, lay the ground for trust and cooperation, and avoid breaking out nuclear wars between or among states. On the other hand, greater transparency may actually erode the national security of countries reliant on nuclear deterrence, since knowledge about weapons deployments and designs would enable adversaries to improve their strategic responses and even incur nuclear attacks by diminishing the uncertainties that help maintain its nuclear crisis stability. Also there is a feeling that information of nuclear weapons and nuclear materials should be kept from nuclear proliferant states and subnational groups. Thus, before nuclear weapons are eventually prohibited, a balance always needs to be struck between the nuclear transparency and opacity based on the demand for international security and national security.

Since 1980s, China has taken a series of steps to increase its nuclear transparency in both civil and military sector. On the civil side, for example, soon after it joined the IAEA in 1984, China announced it would accept voluntary safeguards on some of its civilian nuclear facilities. Since 1992 it acceded to the NPT, China takes a much more transparent policy about its nuclear export activities and joined the Zangger Committee in 1997. In 1997 China adopted the Guidelines for the Management of Plutonium which provide information about its own policies for the management of plutonium. Also China is increasingly taking some positive nuclear transparency measures on the military side. Along with its first nuclear explosion in 1964, China declared its policy of no-first-use of nuclear weapons, i.e. not to use first nuclear weapons at any time and in any circumstances. Based on this strategy, China has developed a very limited nuclear arsenal for pure defense purpose as stated in the 2000 White Paper, "China maintains a small but effective nuclear counterattacking force in order to deter possible nuclear attacks by other countries. Any such attack will inevitably result in a retaliatory nuclear counterstrike by China. The scale, composition and development of China's nuclear force are in line with China's military strategy of active defense."[1] Moreover, China signed CTBT in September 1996, which indicates China is ready to accept related transparency

measures about its test site. However, China has a serious concern about releasing information about its small nuclear arsenal. The outside estimates indicate that China has about 400 nuclear warheads, but only approximately 20 ICBMs capable of reaching US. These liquid fueled and silo based ICBMs may take up to three hours to fuel, and the warhead and the rocket are probably stored separately. Unlike the nuclear deterrence between superpowers (US and Russia) which rely on mutual assured destruction, China's current deterrence is based on "quantitative ambiguity" regarding its nuclear force. By maintaining uncertainty over the size and nature of the Chinese nuclear arsenal, this strategy seeks to prevent an attack on Chinese nuclear forces. For example, without knowing the exact numbers and locations of those warheads, the attacker will be not able to build a very high confidence in ruling out all China's nuclear retaliation capacity after a first strike against China. Thus, the opacity of China's nuclear arsenal maintains the strategic stability between China and other nuclear superpowers. This is why China prefers to maintain limited transparency about its nuclear arsenal. However, this situation could change as China deploys more survivable nuclear forces including a mobile nuclear force.

Given the demands for greater transparency about nuclear activities including demonstrating goodwill for nuclear arms control and disarmament and giving assurance to meet treaty obligations, as well as facing the new technological developments including satellite imaging which are making information more difficult to keep secret, it is be expected China would gradually take more appropriate and feasible measures to increase its nuclear transparency under the suitable atmosphere of international security.

Nuclear Transparency and Nuclear Arms Control

China could proceed to more nuclear transparency step by step, and take specific transparency measures associated with specific treaties. Here we discuss the nuclear transparency options China could accept in the future under international arms control treaties. In particular, as a phased approach, we focus on the transparency of nuclear material production facilities, nuclear materials and nuclear warheads.

Nuclear material production facilities. The next arm control treaty China would participate soon will be the fissile material cutoff treaty (FMCT). Under an FMCT, as the first step, the NWSs should declare the facilities which produce and contain fissile materials. These would include nuclear reactors, uranium enrichment plants, nuclear reprocessing plants, uranium and plutonium fuels fabrication facilities, and fissile material stores. Under an FMCT, China would for the first time allow outsiders to access to these facilities and sites. China should be able to accept a certain level of nuclear transparency measures for treaty's verification purpose as to be discussed in detail in the next sections.

Nuclear material stockpile. Perhaps the most vexing political challenge likely to confront the FMCT negotiations will be how to deal with the question of previously produced stockpiles of fissile materials for weapons. The NWSs have shown their reluctance for including such an issue within the FMCT. Nuclear materials exist in various isotopic compositions and chemical and physical forms such as plutonium and HEU that can exist as fabricated weapon components, either in assembled warheads or separately in storage; as bulk metals, oxides and other chemical forms; in fresh or irradiated reactor fuel; and in various wastes. Thus it will be difficult to achieve a multilateral transparency of NWSs' nuclear material stockpile under the FMCT without a

multilateral commitment of nuclear weapons reductions. In essence, the material stockpile issues have a close link to the deep reduction of nuclear warheads. However, as nuclear arsenals are reduced, the transparency of stockpile would be next logical step in nuclear arms control. So far nuclear materials have not been subject to declarations. The nuclear arms control treaties between the United States and Russia focus on limiting or eliminating nuclear delivery vehicles and their launchers, but they do not control nuclear warheads and nuclear materials.

As the process of nuclear reduction moves forward, it will be necessary to take phased or step-by-step approaches to transparency of nuclear material inventory.[2] For example, as the first step, states could make a voluntary declaration about their total inventories of nuclear materials. Then, it could disaggregate its inventories by type and facility, and ultimately move to declarations that list each item. In the later stages, as declarations become more detailed, states could allow inspections or other procedures to verify the accuracy and completeness of the declaration. At the same time, the total inventory should be reduced by dismantling warheads and transferring nuclear materials from military to civilian stockpiles. To arrive at this goal, China would insist that the United States and the Russia must take the lead because of their huge nuclear inventories. Although both countries have, in fact, already declared excess significant quantities of HEU and plutonium, their stockpiles remaining after the reductions will still be huge.[3] Thus, at the moment, China would reluctant to declared its total inventory. Since the size of the material stockpile places an upper limit on the number of nuclear weapons it can manufacture, such a declaration would damage China's current deterrence strategy reliant on "quantitative ambiguity". This is also the reason why China is reluctant about the FMCT including existing stockpiles. However, when the superpowers' inventories reach the level comparable to China's, at which point further reductions would also require the commitments of additional NWS to both stockpile transparency and reductions, China would join the deep cut and adopt those transparency measures. In fact, China's participation in FMCT will limit China's nuclear arsenal at levels much lower than that of US and Russian under the START-3.

Nuclear warhead stockpile. The current START treaties between US and Russia limit only the number of deployed strategic warheads, however, there is no limit on the number of non-deployed or reserve warheads. As process of further cut of nuclear weapons, it is important to increase transparency regarding the total warhead stockpiles, such as initial and comprehensive data exchanges covering all deployed and stored warhead. It would need to take a phased approach, moving from the simple declaration of total inventory to more comprehensive exchange of information as stockpiles decrease. Also it will need the establishment of an effective verification regime for these reductions at later stages.[4]

Although the US, the United Kingdom and France have released some information related to their warhead stocks, none of the nuclear weapon states have revealed the precise number of nuclear warheads in their current stockpiles. Since the United States and Russia have much larger stockpiles, both would take the lead, at an early stage, in declaring their stockpile as well as some more details. Meanwhile, other smaller NWSs might voluntarily make general declarations of their total warhead number. However, China could be unwilling to make such a declaration at that moment. Unlike other four nuclear states, which maintain submarines at sea (and, in the case of Russia, mobile ICBMs) that cannot be targeted and destroyed, as mentioned before China's deterrent rests on the quantitative uncertainty of its nuclear warheads. China would be concerned

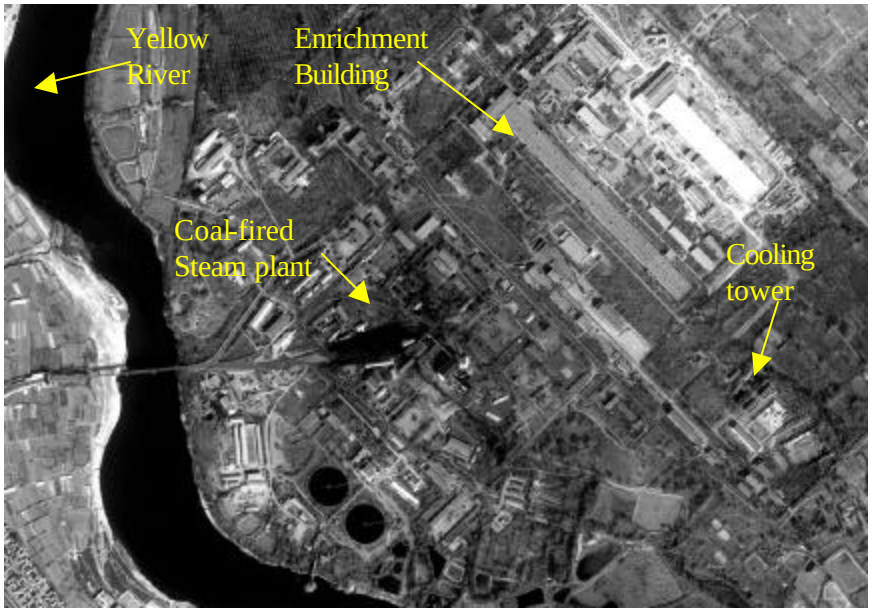
that such a declaration would decrease the survivable capacity of its nuclear force. However, after China acquires more survivable nuclear weapons such as through deploying mobile ICBMs and SLBMs, the Chinese retaliatory capability would rely mainly on geographical ambiguity instead of quantitative ambiguity. Then China could feel less concerned about its arsenal size. Countries such as China could wait until after the U.S. and Russia had negotiated reductions to a lower level (such as 500-1,000 warheads) before getting involved in nuclear weapons reductions negotiations. While waiting for joint a multilateral deep cut agreement, it might be possible for China to undertake certain measures to show its political support for nuclear disarmament while having little impact on the credibility of its deterrent. For example, one such measure might be for China to make a declaration that it would not build up its nuclear force above either its current level or some stated level while US and Russia are proceeding their warhead reductions. Such a symbolic act would possibly reduce the superpowers concerns about China's build-up.

Commercial Satellite Imagery and Nuclear Transparency

On 24 September 1999, the US firm Space Imaging launched the first high-resolution satellite—IKONOS—with a 1 m resolution. Also, the Russian firm Sovinformsputnik has started recently to sell 1 meter resolution satellite images to customers all over the world. It is expected that about a dozen such satellites from several different countries will be in orbit over the next few years. Although still less capable than military imaging satellites, the capabilities of these high-resolution commercial satellites are good enough to detect and identify the major characteristics of nuclear production facilities. And, unlike classified spy satellite photos limited to few countries, commercial satellite imagery is commercially available for a broad range of purchasers including governments, international agency, NGOs, and even individuals. Also images from satellite offers unique global coverage as they operate beyond the limits of national borders. Thus, commercial satellites are playing a leading role in expanding transparency on a global scale, and is opening new opportunities for monitoring nuclear activities and verifying compliance with non-proliferation agreements.

To produce fissile materials for weapons, a country needs plutonium-production reactors and associated reprocessing plants or uranium enrichment plants. These plants have characteristic features visible on 1-meter resolution satellite images. Figure 1 shows IKONOS image of the Chinese Lanzhou gaseous diffusion plant (GDP) taken in February 2000. The Lanzhou GDP is located on the bank of the Yellow River near Lanzhou. It has been reported that China's GDPs stopped HEU production in 1987 and is to be decommissioned. In the image, the enrichment building (approximately 600m by 60m), the cooling tower, the coal-fired steam plant and the water treatment facility are clearly seen. Also a declassified CORONA satellite image (about 2m-resolution) in 1972 clearly shows the plutonium production reactor and reprocessing facility at China Jiuquan.[5] The physical structure of the six cooling towers associated with the reactor can be seen clearly. Even their size can be estimated.

Fig.1 A 1m-resolution IKONOS Satellite Image of Lanzhou GDP (February 2000). Credit: "spaceimaging.com"



Along with the analysis of these new released 1m- resolution IKONOS images of other nuclear facilities, such as those in Russia, India, and Pakistan, it is concluded that the nuclear facilities and sites would be easily identify by high resolution satellite imagery through their infrastructure signatures as listed in Table1. Also the thermal infrared satellite imager can verify whether these facilities are operating or not.[6] However, smaller-scale operations, such as gas centrifuge plants, have fewer obviously observable characteristic than a GDP. In addition, some states may learn to take deceptive anti-satellite imaging measures to hide their dedicated nuclear facilities, such as taking the operations underground. However some observable characteristics are still visible on high-resolution satellite imagery, such as the case of Israel Dimona nuclear complex.[7] High-resolution commercial satellite imagery is playing a valuable role in identifying the nuclear material production facilities. Thus it can be use to confirm the accuracy and completeness of a declaration of nuclear production facilities under a FMCT and to provide information for further on-site inspections.

Table 1. Physical Characteristics of Nuclear Facilities and Sites

Reactors	Reprocessing Plants	Gaseous Diffusion Plants
• an isolated site; security perimeter • cooling towers or a nearby river or lake • a high narrow stack • railroads, roads, etc.	• a reprocessing building • a very high stack • holding ponds / reservoirs for waste or sludge • an isolated site; security perimeter • railroads, roads, etc.	• large-area (roof) process buildings • cooling towers or a nearby river or lake • a nearby fossil fuel power plant • large electric switchyard • waste management and disposal facilities • an isolated site; security perimeter

Transparency Measures and On-Site Inspections under an FMCT

An FMCT will entail a credible verification scheme about the related nuclear material facility and activities. A certain level of transparency of these facilities is a primary requirement for any effective FMCT verification. Thus it is necessary to examine what sort of verification and transparency measures China could adopt for its nuclear facility without compromising its national security interest. China would generally consider that the FMCT verification system for facilities in the eight nuclear-armed nations would have to be different from the IAEA safeguards verification for NNWSs. For IAEA safeguards verification, the main target nations are NNWS, and these states have confirmed that their nuclear facilities will not produce fissile material for weapons. However, for the eight nuclear nations, an FMCT is likely to permit their holding of undeclared stockpiles (from past production) and their using or processing of already produced fissile material for sensitive military activities. These allowed sensitive production facilities and activities could be collocated with facilities (such as reprocessing and enrichment plants) requiring verification. Some states subject to inspections would worry about potential loss of sensitive information at those defense-related nuclear processing sites. Thus, less intrusive verification measures including satellite remote sensing would be preferable. However, in any event, some on-site verifications would have to conducted for FMCT verification purpose.

China is believed to have produced fissile materials for weapons at four locations.[8] HEU was produced at two GDPs at Lanzhou and Heping. Plutonium was produced at two reactors located, together with associated reprocessing facilities, at the Jiuquan and Guangyuan weapon-manufacturing complex. Under an FMCT, these military nuclear facilities as well as some other facilities in the civilian sector would be subject to verification. China would have no objection to placing civilian nuclear facilities, such as centrifuge enrichment plants (CEP), under IAEA-type safeguards. However, it would have some concerns about the disclosure of sensitive information from inspection of those previous military facilities.

Reprocessing plants. As the first plutonium production complex, Jiuquan Atomic Energy Complex began its plutonium production since the late of 1960s. This complex also house facilities for manufacturing HEU and Plutonium and assembling weapons. Since middle of 1970s, China built the second plutonium production complex at Guangyuan as part of China's duplicate Third Line of nuclear weapon manufacturing facilities.[9] Both complexes stopped Plutonium production around 1991. Also it is expected that under FMCT, they would be keep their shutdown status. Here we will focus on the case study of the Jiuquan reprocessing plant.

Under an FMCT, it is necessary to confirm the shutdown or decommissioning status of the reprocessing plants. For such case, off-site sampling of Krypton-85 would be applied. However, some kinds of on-site inspections will also be required. To monitor the status of a reprocessing plant, the most effective verifications would be on-site environmental sampling, such as taking samples from gloveboxes or HLW tanks.[10] However, China may worry such on-site sampling analysis could disclose sensitive information about their past plutonium production activities, such as the power level at which production reactors had operated and how much plutonium they had produced, data that will probably not have to be declared under an FMCT. However we find that sampling analysis at the reprocessing facility need not reveal sensitive information relating to past production of plutonium at former military plutonium production facilities. Sampling cannot be used to discover such information as long as inspectors are not able to measure total quantities of

Cs-137 and Sr-90 from HLW produced at former military plutonium production facilities. States that do not wish to reveal the quantities of military plutonium that they have produced need not worry about such on-site sampling analysis and should be willing to permit a verification agency to conduct it. Other on-site inspection activities at the reprocessing site, such as visual observation which shows there are no activities at the spent fuel cask portal, would also be allowed.

One major concern about the on-site verification of the Jiuquan complex could be the issues of collocated facilities which involve activities such as the fabrication of weapons components and the final assembly of weapons. Some sensitive information, for example, chemical composition information from these activities might be divulged through sampling and analysis around the facilities. Therefore, it is necessary to explore whether conducting on-site sampling around reprocessing facilities could also get such sensitive information, which might depend on how far away such information is detectable from the sensitive manufacturing facilities and how close such facilities to the reprocessing plant. For such collocated sites, managed access approach will be vital to the FMCT verification.

Gaseous diffusion plants. Under the FMCT, both of China's GDPs at Lanzhou and Heping would be shutdown or decommissioned. As a case study, the verification of Lanzhou GDP is discussed. Satellite imagery would be desirable as the least intrusive approach to confirm the shutdown status of Lanzhou GDP since the telltale signatures of the GDP operation -- the water-vapor plume coming from the cooling tower associated to the plant and the hot roof of the enrichment buildings -- would be detectable by satellites .[11] However, to further confirm the plant shutdown status, some on-site inspections should be allowed, including 1) site visual observation, such as no plume from the cooling towers, no treatment of cooling water, no electrical service for the enrichments, no heat and noise inside the enrichment building, 2)continuous surveillance monitor and tamper-proof seal, such as sealing the high-voltage disconnect switches; sealing the valves on the supply and return headers of the Recirculating Cooling Water system; sealing the inlet and outlet block valves for the cascade piping; and putting vibration and or/temperature sensors on the process equipment. All these measures would have little impact on China's security interest. The major concerns on such site would be the information about diffusion barrier technology that most countries take it as industrial secrets. However, this would be easily protected by some preventive measures. Finally, environmental sampling at the site would release the composition of the feeds, products and tails of uranium, which could provide information to further estimate the amount of HEU produced by the plant. It is not clear whether China would consider such information sensitive. However, sampling would be not so necessary to confirm the GDP shutdown status.

Finally, an FMCT verification regime would have to be designed to detect undeclared nuclear facilities. Such verification measures could include challenge inspection. However, China will be unwilling to see the abuse of such kind of inspections at its sensitive and non-proscribed military and nuclear activities. To protect its national security sensitivities, it is essential to have an appropriate managed access mechanism. For example, at the nuclear weapons assembly facility, the sensitive information -- weapons component, or process machinery that provided design information-- might be vulnerable to the visual access. Thus it had to take measures including shrouding and masking of sensitive equipments or other obvious method to prevent the visual access.

Conclusions

Based on this initial analysis, it is concluded that the next important arms control treaty China would be involved is the FMCT, and a multilateral commitment of further deep cut of nuclear weapons could be relatively far way for China. Thus it is expected that the next major steps in nuclear transparency that China would adopt would focus on its nuclear material production facilities and sites under the FMCT verification. Under the FMCT, appropriate verification and transparency measures would be feasible to monitor China's nuclear production facilities without compromising China's sensitive information. China should have fewer concerns about allowing international inspectors to conduct some kind of on-site inspections at its nuclear facilities and sites. China's willingness to take transparency of its nuclear materials and warheads would be encouraged by further deep cuts by US and Russia and more active disarmament policies such as the no-first use strategy of nuclear weapons. However, the US NMD plans, which could further decrease China's deterrence, would complicate China's transparency attitudes.

Reference

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[1] Information Office of the State Council of the People's Republic of China: *China's National Defense in 2000,* October 17,2000,China Daily.

[2] See, e.g. Frans Berkhout and William Walker, "Transparency and Fissile Material," *UNIDIR Disarmament Forum* , no.2 (1999); Steve Fetter, "Stockpile Declarations," in Nicholas Zarimpas, ed., *Building a Nuclear Stockpile and Warhead Dismantlement Transparency Regime: Issues and Options* (forthcoming).

[3] Frank von Hippel, "The FMCT and Cuts in Fissile Material Stockpiles," *UNIDIR Disarmament Forum* , no.2 (1999).

[4] See, for example, Harold A. Feiveson and Steve Fetter, "Verifying Deep Reductions in Nuclear Forces," in Harold A. Feiveson, Ed., *The Nuclear Turning Point* (Washington, D.C.: Brookings, 1999), pp. 215-241.

[5] http://fas.org/nuke/guide/china/facility.

[6] Hui Zhang, "Uses of Commercial Satellite Imagery in FMCT," *The Nonproliferation Review*, no. 2, 2000.

[7] http://fas.org/nuke/guide/israel/

[8] Robert S. Norris, et al., *Nuclear Weapons Databook Volume V: British, French, and Chinese Nuclear Weapons*(Westview Press, 1994).

[9]David Albright, et al., *Plutonium and Highly Enriched Uranium 1996* (Oxford, 1997).

[10]Hui Zhang, " Detecting Undeclared Reprocessing Activities Through Sampling Activities," in *Proceedings of the INMM 41st Annual Meeting, July 16-20, 2000, New Orleans, Louisiana*. Northbrook, Illinois: INMM, 2000.).

[11] Hui Zhang and Frank N. von Hippel, " Using Commercial Imaging Satellites to Detect the Operation of Plutonium-Production Reactors and Gaseous-Diffusion Plants," *Science & Global Security* 8, no. 3 (2000).