CHAPTER 3

SECURING NUCLEAR ARSENALS: A CHINESE CASE STUDY

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INTRODUCTION

Nuclear warhead stockpile security has long been a concern of the major powers. Of particular concern is the potential theft of nuclear warheads and associated materials, or a breakdown in command and control authority over their use during periods of domestic instability. Since the inception of its program in the 1950s, the Chinese Communist Party (CCP) has granted nuclear warheads special political significance. The value of nuclear weapons resides not only in their international deterrent/coercive significance, but also in the domestic power and political legitimacy that a faction enjoys with control over the means of mass destruction. Domestic instability in the People's Republic of China (PRC) during the initial stages of nuclear warhead production could serve as an illustration of how one nuclear power has absorbed lessons from threats to the security of a warhead stockpile.

China's Great Proletarian Cultural Revolution, which began in 1966 and ended by 1976, is the prominent case in which political instability could have resulted in the loss of control of China's limited nuclear weapons stockpile. The domestic chaos that characterized this period coincided with a significant deterioration of relations with the former Soviet Union. Perceived domestic and external threats likely shaped the highly centralized approach to securing the

national nuclear warhead stockpile that the Chinese People's Liberation Army (PLA) continues to employ until today.

During the initial stages of China's program, its system of storage and handling nuclear warheads was relatively integrated with its civilian nuclear research and development (R&D) and production complex. Concerns over domestic stability and external threats to China's initial nuclear capabilities contributed toward the institutionalization of a highly centralized storage and handling system involving strict political control through the Central Military Commission (CMC), rather than the General Staff Department (GSD). The power of the CMC stems from its political subordination to the CCP Central Committee, rather than to legal state authority.

Furthermore, the experience of the Cultural Revolution may have contributed to a relative emphasis on security over operational effectiveness that has characterized China's nuclear strategy until today. Since the production of China's first nuclear device in 1964, warheads have been managed in peacetime through an independent organization, known as 22 Base, which is separate and distinct from operational missile bases and subordinate launch brigades. From the time of China's initial production of a nuclear device in 1964 until 1979, 22 Base, subordinate to the PLA's National Defense Science and Technology Commission, exercised control over the country's nuclear warhead stockpile. The organizations responsible for the means of delivery, primarily the Second Artillery Corps and to a lesser extent the PLA Air Force, exercised no peacetime control over the nuclear weapons stockpile. It was not until after the political chaos of the Cultural Revolution subsided that the CMC directed

the 22 Base's subordination under the Second Artillery Corps. However, even then, security considerations remained paramount. Within the Second Artillery, an organizational structure that maintained a clear division between the management of the nuclear warhead stockpile and missile operations was established and maintained until today.

Based on limited historical data, this case study outlines the potential effects that the domestic political instability the Cultural Revolution had on the security of China's nuclear weapon inventory during its initial stages. The case study begins with an overview of China's early plans for its warhead storage and handling system, then addresses the chaos of the Cultural Revolution and how security considerations may have led to a decision to move storage functions to the Qinling Mountain area south of the Shaanxi city of Baoji and west of the historic city of Xian. While the literature to date has highlighted the role of defense industrial scientists and engineers, little attention has been given to key PLA personnel responsible for the security aspects of the program. The case study then examines how the turmoil of the Cultural Revolution may have influenced the PLA's current system of warhead storage and handling.

ESTABLISHMENT OF CHINA'S INITIAL WARHEAD STORAGE AND HANDLING FACILITY

An examination of PLA units and senior officers responsible for the formation of China's warhead storage and handling system begins with Jia Qianrui [贾乾瑞], Hong Youdao [洪有道], and Yao Shumei [姚书梅]. The National Defense Science and Technology

Commission units supporting the nuclear program included 20 Base in Jiuquan, Gansu province; 21 Base in Lop Nor, Xinjiang province; and 22 Base near Haiyan, Qinghai province. Base 22 was assigned responsibility for warhead storage and handling. In 1958, Mao Zedong commissioned a little known infantry school based in Shangqiu, Henan Province, to survey sites for missile and nuclear warhead testing and storage. The Shangqiu Infantry School commandant Major General Jia Qianrui [贾乾瑞] and student affairs director Hong Youdao were responsible for the warhead storage site survey, with the former eventually becoming the father of China's warhead security.

The regiment under 22 Base responsible for security of the 221 Factory was the 8126 Unit, with the 8122 Unit responsible for warhead storage. Originally under direct supervision of the CMC, the storage facility was near a village known as Shangwuzhuang [上五庄], which may now host the 56 Base's warhead storage regiment.[1] The first storage tunnel reportedly was completed in 1964, the same year as China's first nuclear test, and subordinated to the National Defense Science Commission in 1965. The political commissar during the 22 Base's formative years was Yao Shumei, who served in the position until the base's subordination to the Second Artillery in 1979.[2]

THE CULTURAL REVOLUTION AND NUCLEAR WARHEAD SECURITY

The PRC's modern system for storage and handling of nuclear weapons was shaped by the events of the Cultural Revolution. A key event in nuclear warhead security was the "223 Incident," an uprising in February 1967 in Qinghai Province, the center of nuclear

weapon R&D and location of initial storage facilities. The Cultural Revolution and concerns over competing loyalties within the PLA affected China's nuclear weapons program and, more specifically, warhead storage and handling.

The Cultural Revolution was launched by CCP Chairman Mao Zedong, ostensibly to broaden and deepen Socialist goals. However, Mao appeared intent upon consolidating his power in the wake of failed economic policies under the Great Leap Forward and silencing critics within the leadership. Among the most prominent of Mao's targets included Liu Shaoqi, Deng Xiaoping, and eventually Defense Minister Lin Biao, Mao's chosen successor. In May 1966, Mao called for removing "revisionists" through class struggle and appealed to youthful Red Guards, revolutionary factions within industry and other societal organizations. By early-1967, Mao's senior staff directed the Cultural Revolution to be extended into the PLA, enforced in large part by political commissars within the PLA and encouraged by Minister of Public Security Xie Fuzhi. The formal phase of the Cultural Revolution ended in 1969, but purges continued until the death of the military leader Lin Biao in 1971. Political instability continued until Mao's death in 1976.

The Cultural Revolution had direct effects on China's nuclear weapons complex during its infant stage of development. In September 1966, engineers within the nuclear weapons program, specifically, the China Academy of Engineering Physics (CAEP, or "Ninth Academy") 221 Factory near the Qinghai town of Haiyan, split into rival factions, one supporting more radical elements of the Cultural Revolution. In October 1966, the newly established Second Artillery Corps, inspired by radical calls to acceler-

ate the nuclear weapons program, conducted a risky test of a Dongfeng-2 medium-range ballistic missile (MRBM) equipped with a 12kt nuclear device. The missile and its nuclear payload overflew populated areas between Gansu and its landing zone in western Xinjiang Province.

Red Guards advanced the cause of nuclear weapons, explicitly suggesting a linkage between the creative force of radicalism and that unleashed by the atomic bomb. Although the device detonated as planned, the test demonstrated the lack of an effective command and control system at the time. By conducting what appeared to some as an unauthorized test by the Second Artillery within the confines of China, the test appeared to raise the frightening prospect of an unauthorized launch against one of China's neighbors. To quote Nie Rongzhen, the leader of the nuclear weapons program and ostensibly under pressure from radical elements within the party, "It was a somewhat risky assignment, because if by any chance the nuclear warhead exploded prematurely, fell after it was launched, or went beyond the designated target area, the consequences would be too ghastly to contemplate."[3]

By January 1967, internal strife intensified, leading to attempts at a forcible takeover of the program. One radical group from a key military institute in Harbin, led by Mao Zedong's nephew (Mao Yuanxin), attempted a forcible occupation of nuclear facilities, but was intercepted upon orders from Nie Rongzhen. In February, Xinjiang Military Region Commander Wang Enmao threatened to forcibly take control over Base 21 at Lop Nur if Mao did not act to restrain the Red Guards. In Qinghai, a radical faction within the 221 Factory accused leaders of revisionism, and par-

ticipated in the occupation of Qinghai Province's primary newspaper building in Xining. On February 23, 1967, Beijing authorized military control of newspapers and radio stations and ordered the Qinghai Military District Commander, Liu Xianquan, to occupy the provincial newspaper, *Qinghai Daily*, which had been taken over by Red Guards. Liu Xianquan's Deputy Commander, Zhao Yongfu, used armed force when seizing the building, killing 169 civilians and injuring 178. Known as the "223 Incident," the crackdown spread throughout other parts of the city the following day, with a dozen casualties at the Qinghai Ethnic College.[4]

On March 5, 1967, Premier Zhou Enlai, at the urging of CMC Vice Chairman Nie Rongzhen [聂荣臻], authorized martial law in Qinghai, and assigned the PLA to take control of the 221 Factory. Jia Qianrui was placed in charge of a five-member committee to oversee the joint military command responsible for enforcing martial law.[5] After 3 months, the situation was sufficiently stable for the test of China's first hydrogen bomb on June 17, 1967. However, localized fighting between Red Guard elements and PLA operational units continued across the country through the summer of 1967. PLA officers gradually became the dominant component of the CCP Politburo and assumed leadership positions in most of China's provinces.

While insufficient information exists to determine the specific factors influencing the decision, senior leaders in Beijing directed preparations for relocating production and storage to more secure areas inside China's interior shortly after the 223 Incident. By 1969, Jia Qianrui and Hong Youdao initiated the relocation of the 22 Base's central nuclear warhead storage functions to Taibai County, Shaanxi Province.

A number of factors may have led to the move. First, Taibai County may have been designated as the ultimate location of China's nuclear weapons stockpile as early as 1958. Taibai County had been identified as a candidate reserve storage site in the 1958 survey, and this may have been a factor in the establishment of Taibai County in the early-1960s. Taibai Mountain is the highest peak in China east of its three western-most provinces of Tibet, Qinghai, and Xinjiang. Taibai Mountain reaches 3,767 meters (12,358 feet) in height, and is formed of large granite rock.

Details regarding construction of the Taibai tunnel complex are unavailable at the current time. However, construction of underground facilities in Taibai County coincided with a PLA Rail Corps project to construct a railway linking Baoji with Chengdu and a third line of nuclear production facilities near Mianyang in the late-1950s and early-1960s. The Baoji-Chengdu Railway was completed in 1961, although work continued throughout the 1960s to electrify the system. The Baoji-Chengdu line was considered a major feat, not only because it was China's first electric rail, but because of the tunnels that sliced through the Qinling mountains south of Baoji. Of most significance was a 2.3-km tunnel passing through Qinling Mountain and a series of spiral tunnels just southwest of Baoji, the largest city near the Taibai complex. The rail also supported a major ballistic missile engine and component research, development, and production complex, known as the 067 Base, which was established in 1965 in the mountainous county adjacent to Taibai.

A second explanation could be concerns over the relative proximity to the industrial complex that was the source of unrest and the possibility of nuclear warheads falling into unauthorized hands. Located in

deep mountain valleys, the Taibai underground complex has been equipped with an advanced physical protection system. In addition to a battalion dedicated to perimeter security, security measures have become increasingly sophisticated, including real-time video monitoring, infrared security, computerized warhead accounting systems, temperature and humidity controls, firefighting equipment, fingerprint and other access control, and advanced communications linking sites within the complex. Since its establishment during the Cultural Revolution, the command center in the area of Taibai appears to serve as the operational hub of the 22 Base's warhead storage and handling system. Known as the Hongling Command Cell, the watch center likely is co-located with a storage facility, and overseen by one of the 22 Base's deputy chiefs of staff. One recent *PLA Daily* article indicated that Second Artillery underground storage facilities may double as reserve operational command centers. [6]

Another possible explanation for the move is the deterioration of relations with the Soviet Union in 1969, and concerns over the possibility of a Soviet strike against China's nuclear weapons complex.[7] Situated farther away from the Soviet border, Taibai County likely was considered more survivable than Qinghai. In addition, a larger facility may have been required to facilitate the growth in delivery platforms and initial operational capability of the DF-2 (CSS-1), which was initially tested in 1966.

Regardless, the Cultural Revolution and national political turmoil that could have affected control over the nuclear warhead stockpile came to a head in 1969. Since 1967, Mao had increasingly relied upon the PLA to re-establish order and consolidate his continued control over the party. Claiming the need to be pre-

pared for a potential Soviet attack, Lin Biao, defense minister and anointed successor to Mao in April 1969, issued an independent order to move the PLA into a higher state of readiness on October 18, 1969, ostensibly without clearance from Mao. The move, viewed as tantamount to a coup, infuriated Mao, who had relied heavily on the PLA as a guarantor of his position. Any move to take control of nuclear weapons and leverage their political value as the basis for usurping Mao's power may have been a disturbing prospect. The ensuing political competition between Mao and Lin Biao ended when Lin was killed in a plane crash in Mongolia in September 1971.

CHINA'S NUCLEAR WARHEAD STORAGE AND HANDLING SYSTEM TODAY

China's nuclear weapons program had a powerful patriotic, political, and revolutionary appeal during the opening phase of the Cultural Revolution. In order to salvage the program from the political chaos of the time, Zhou Enlai and Nie Rongzhen relied heavily upon isolation of 22 Base from other parts of the PLA, even the force responsible for ballistic delivery of nuclear weapons (the Second Artillery Corps). A premium was placed on political integrity and loyalty.

Political upheaval in China, at least on the scale similar to the Cultural Revolution, is unlikely, yet possible. The Cultural Revolution shaped China's approach to nuclear warhead storage and handling, including extraordinarily stringent personnel reliability standards, direct reporting to CMC authority (especially the civilian Chairman and Vice Chairman) rather than General Staff Department, and continued centralization of nuclear warhead storage.

Since its relocation to Taibai and subordination to the Second Artillery in 1979, the 22 Base has continued to serve as the CMC's custodians for the national central nuclear warhead stockpile. The base's mission includes warhead reliability and safety; storing and transporting warhead components; training missile base personnel in warhead storage, maintenance, assembly, and mating; maintaining a support infrastructure for warhead management; and operating a communications system that supports its mission.

Each of the Second Artillery's six army-level missile bases replicates 22 Base functions on a smaller and perhaps modified scale. Missile bases, separate and distinct from 22 Base, possess only a limited number of warheads at any given time. The emphasis on centralized security, a legacy of the Cultural Revolution, makes the mobility of nuclear warheads critical to the Second Artillery's nuclear deterrent and warfighting capability. A separate regiment under the 22 Base is responsible for circulating warheads back and forth between the central storage complex in Taibai and six smaller storage facilities subordinate to each missile base. Only a relatively small handful of warheads appear to be maintained at each base's storage regiment for any extended period of time.[8] Given the Second Artillery's high degree of reliance on the nation's rail and highway system for its nuclear deterrent, a failure in the transport network is cause for concern. Transfer units conduct armed escort missions and rely on dedicated communications and surveillance networks for security.[9]

Although the Taibai nuclear warhead facility has existed for 40 years, Second Artillery engineering units have been engaged in a national engineering project in the Qinling Mountain region between

Taibai and the western foothills adjacent to Tianshui City (Gansu Province) over the past 10 to 15 years. The storage complex is supported by a Second Artillery civil engineering regiment subordinate to the 308 Engineering Command, based south of Taibai in the city of Hanzhong, and by an installation engineering group in Luoyang. At least one 22 Base study implied a requirement for upgrades to older underground facilities for health reasons. Other engineering projects also have been taking place in the area.

Because of their extremely destructive nature, nuclear warheads require strict safety, reliability, and security measures to guarantee that they are never accidently or intentionally detonated without the authorization of the most senior political authorities.[10] Along these lines, the 22 Base bears the responsibility for engineering analysis and environmental testing to ensure the safety and reliability of China's nuclear weapon stockpile. The reliability and safety of nuclear warheads and materials have become sensitive issues in Chinese politics. Veterans from four units associated with the testing, storage, and maintenance of nuclear warheads in the 1960s and 1970s have submitted legal claims to the government related to radiation-linked health problems.[11] Located in Taibai County, the 22 Base's training regiment appears to train not only base personnel, but also the missile base warhead units.[12]

Today, the specific regimental-sized organization under the 22 Base's authority that is responsible for warhead reliability and safety is the 96411 Unit, also known as the "Equipment Inspection Institute." Since at least 2005, the institute has focused on improving its warhead surveillance capabilities. Engineers regularly "pulse" components inside the 22 Base storage complex to ensure safety and reliability.[13] The insti-

tute also works with the China Aerospace Science and Technology Corporation (CASC) and PLA General Armaments Department (GAD) warhead-related laboratories housed in CAEP facilities.[14] In the past, 22 Base engineers have worked with their CAEP counterparts to extend the service life of warheads associated with DF-2 (CSS-1), DF-4 (CSS-3), and DF-5 (CSS-4) ballistic missiles.[15]

Furthermore, since the end of the Cultural Revolution, the CMC has had a dedicated command, control, and communications network for warhead management and directing nuclear strikes. It is unknown if the 22 Base communications regiment is responsible for only internal communications related to central storage and handling or if it plays a role in the overall command and control for China's nuclear operations.

CONCLUSION

A preliminary examination of the 1967-69 crisis within the nuclear industry and political-military system more broadly indicates that the Cultural Revolution shaped Beijing's contemporary approach to nuclear warhead storage and handling. With the bulk of its nuclear warhead stockpile nestled deep in secure mountain palaces, the 22 Base's physical protection system appears to be founded upon more than "guns, gates, and guards." The legacy of the Cultural Revolution may have influenced the establishment of one of the most secure warhead stockpile in the world. However, any stockpile is only as secure as the broader political system that it supports. No amount of physical security can shelter a nuclear arsenal from political chaos at the highest levels of government. Beyond this, the centralization of the stockpile forces man-

agers to rely heavily on the nation's rail system and other means of transportation. With warheads most vulnerable to theft or accident during transportation, the system's reliance on mobility creates opportunities for incidents and terrorist action.

Based on the experience of chaos during the Cultural Revolution, the CMC prioritizes security and safety over operational readiness in its nuclear warhead storage and handling system. A centralized warhead management system has clear benefits. One advantage is reduced vulnerability to the loss of political control over a given region. However, assuming China's nuclear strategy remains one of minimal deterrence and retaliation, centralized storage and handling also can be vulnerable to a disarming first strike. As a result, China's warhead storage and handling system is designed to survive a first strike and retain sufficient operational capability for retaliation. Deterrence relies upon ambiguity surrounding the precise locations of the base-level storage facilities and launch sites and the numbers of warheads maintained at any given time.

The experience of the Cultural Revolution led toward the separation of civilian industry and the storage and handling functions of 22 Base. A cost of doing so may have been problems with warhead safety and reliability associated with the lack of follow-up support after delivery of new warheads to the Second Artillery. In a 1991 assessment, Second Artillery Equipment Department analysts lamented the excess prioritization of missiles over nuclear warhead stockpile management. In addition to inadequate launch battalion training on live warheads, few engineers from the Second Artillery unit tasked with stockpile reliability had hands-on experience in inspecting warheads. Analysts have recommended a major program

to improve China's nuclear stockpile management, especially as a new generation of warheads would be entering the operational inventory.[16] In 2006, 22 Base began contracting with senior warhead designers and specialists in at least 10 nuclear-related institutions throughout China, including the CAEP, China Institute of Atomic Energy, and China Institute of Radiation Protection (CIRP).[17]

The legacy of the Cultural Revolution and the relative emphasis on security over operational effectiveness could result in self-imposed constraints on the size of China's arsenal. The precise size of China's nuclear warhead inventory is unknown. However, a highly centralized system for warhead storage and handling could lead toward a preference for a smaller arsenal. The Second Artillery's missile brigade infrastructure has expanded significantly over the past 15 to 20 years, including the engineering of an expanded number of underground facilities supporting missile brigade operations. A Project 2049 Institute survey of the specific units responsible for the warhead storage and handling system offers no clear sign of a significant increase in China's nuclear stockpile.

Finally, the CMC likely has relied on the Second Artillery as its exclusive custodians of the national nuclear warhead stockpile. Unlike the Air Force, Navy, and Military Regions, the Second Artillery reports directly to the party's CMC rather than through the General Staff Department. The Chairman and Vice-Chairman of the CMC have authority due to their positions within the party, and not necessarily to senior state positions.

For added security, warheads are mated with missiles assigned to brigades only in elevated readiness conditions and perhaps, on occasion, for training

purposes. The Cultural Revolution legacy of centralizing the storage and handling of nuclear weapons, as well as the practice of keeping warheads separate from delivery vehicles, raises questions regarding a new generation of nuclear submarines that are to be equipped with a JL-2 submarine-launched ballistic missile that would patrol with armed warheads. Whether or not 22 Base, and perhaps regional bases, would manage warheads to be mated with JL-2 missiles for use on Navy Type 094 submarines remains unknown. In addition, warheads appear to have been managed separately from China's civilian fissile material protection, control, and accounting system. Who manages China's fissile material remains unknown.[18]

Given nuclear warheads' status as a liability, their safety and security is a common interest of the United States and the PRC, and one of the few practical issues worthy of cooperation between our two defense establishments through the Cooperative Threat Reduction (CTR) or other programs. Most public discussion on nuclear safety and security to date appears limited to the civil nuclear energy sector, despite efforts to place the issue on the defense agenda.[19]

ENDNOTES - CHAPTER 3

1. Among various sources, see "Retired Soldiers of China's Nuclear 22 Base" [中国核军事二十二基地退役战士], *Petition to the Dazu County Government*, June 21, 2007. Also see "Regarding the Problem of Health Support for 1972 Military Retirees" [关于72年退伍军人生活保障问题], Chongqing City Government website, September 14, 2006, available from *www.cq.gov.cn/PublicMail/Citizen/ViewReleaseMail.aspx?intReleaseID=17027*. For reference to the 1958 Shangqiu test site survey team, see John Wilson Lewis and Xue Litai, *China Builds the Bomb*, Stanford, CA: Stanford University Press, 1988, p. 175. For an account of soldiers involved during the early stages of China's nuclear weapons program experienc-

ing radiation sickness in their later years, see Michael Sheridan, "Revolt Stirs among China's Nuclear Ghosts," *Times Online*, April 19, 2009, available at *www.timesonline.co.uk/tol/news/world/asia/article6122338.ece*. Not covered, however, are court cases introduced by 22 Base soldiers involved in warhead storage and handling.

2. Declassified U.S. intelligence community reporting from 1971 indicates that a central storage facility for warheads was located "in a ridge about 12nm from the Koko Nor weapons fabrication complex." See *Communist China's Weapons Program for Strategic Attack*, NIE 13-8-71 (declassified), October 28, 1971. This reporting added that "some of this space is probably used for nuclear weapons inspection and retrofit." The report suggested that launch bases included facilities for the checking out and mating of the warhead, as well as possibly for "separate or temporary storage." It was uncertain if the Chinese would keep nuclear warheads stored at launch bases or in a central stockpile, then transporting them to the bases only in a crisis situation. A logistics system would be able to rapidly deploy warheads from base-level storage sites to launch positions as the missiles were being readied. The reporting notes that warheads could be stored near launch sites or even on missiles.

3. Nie Rongzhen, "How China Develops Nuclear Weapons, *Beijing Review*, April 29, 1985, pp. 15-19.

4. Roderick MacFarquhar and Michael Schoenhals, *Mao's Last Revolution*, Cambridge, MA: Harvard University Press, 2006, pp. 179-180.

5. For additional background about the impact of the Cultural Revolution on the nuclear weapon development program, see John Wilson Lewis and Xue Litai, *China Builds the Bomb,* Stanford, CA: Stanford University Press, 1988, pp. 202-206. In addition to a brief discussion of the warhead storage base functions, one account asserts that the Taibai storage complex had been planned as early as 1960, with Taibai County formed in 1961 for the nuclear storage mission. See "The Leaker: Cruise Missiles Point toward Hainan Target Zone, Target is Obvious" [漏斗子：巡航導彈劍指海南靶區，針對性太明顯了], *China.Com Blog*, December 28, 2009, available from *big5.china.com/gate/big5/zzh1125.blog.china.com/200912/5644340.html*.

6. Base-level storage facilities for nuclear and probably conventional warheads, missiles, associated subsystems, components, and fuels are generally referred to as "equipment inspection" regiments. Each regiment oversees at least three battalion-level facilities, known as "equipment inspection sites," which conduct testing and diagnostics of warheads in underground facilities, usually in mountainous regions. Each site can have as many as seven subordinate subunits, indicating that a missile base's warhead inspection and missile depot system could have as many as 21 sites. Companies subordinate to battalions are responsible for tasks such as missile management, security, and site management. Among various sources, see Liang Pengfei and Xia Hongping, "Second Artillery Technical Service Regiment Support Battalion Studies Practical Developments"［第二炮兵某团技术勤务营学习实践科学发展观活动见闻］, *PLA Daily*, November 17, 2009, available from *chn.chinamil.com.cn/2009jbzsc/2009-11/17/content_4080730.htm*.

7. See the declassified "Memorandum for the President from Secretary of State William Rogers, The Possibility of a Soviet Strike against Chinese Nuclear Facilities," September 10, 1969, in William Burr, ed., *The Sino-Soviet Border Conflict, 1969: A National Security Archive Electronic Briefing Book*, June 12, 2001, available from *www.gwu.edu~nsarchiv/NSAEBB/NSAEBB49/sino.sov.19.pdf.*

8. For an explicit reference to the centralization of warhead storage, see Yu Jixun, ed., *Second Artillery Campaign Science*, Beijing, China: PLA Press, 2004, pp. 242-244. Each missile base also has regiments responsible for training, transportation, warhead storage and inspection, repair and maintenance, and communications. A specialized 13-member warhead expert working group assists The Second Artillery's leadership in stockpile management policy. The Second Artillery Headquarters Department also oversees a Nuclear Security and Control Bureau.

9. For a reference to the transportation infrastructure and the rail battalion of the special transportation regiment, see Larry M. Wortzel, *China's Nuclear Forces: Operations, Training, Doctrine, Command, Control, and Campaign Planning*, Carlisle, PA: Strategic Studies Institute, U.S. Army War College, May 2007, p. 22; and Xia Hongqing, "Second Artillery Service Regiment Rail Transport Company: Growing Up with the Flag" [第二炮兵某勤务团铁运

连：党旗伴我成长], *PLA Daily*, July 1, 2002, available from *www.pladaily.com.cn/gb/pladaily/2002/07/01/20020701001045_army.html*.

10. For a comprehensive overview of warhead reliability, safety, and security issues, see Richard L. Garwin and Vadim A. Simonenko, "Nuclear Weapon Development without Nuclear Testing?" paper prepared for the Pugwash Workshop on Problems in Achieving a Nuclear-free World, October 25-27, 1996, London, England.

11. See "Retired Soldiers of China's Nuclear 22 Base" [中国核军事二十二基地退役战士], Petition to the Dazu County government, June 21, 2007. Also see "Regarding the Problem of Health Support for 1972 Military Retirees" [关于72年退伍军人生活保障问题], Chongqing City Government website, September 14, 2006, available from *www.cq.gov.cn/PublicMail/Citizen/ViewReleaseMail.aspx?intReleaseID=17027*.

12. The 96423 Unit's political commissar, Feng Danli [冯丹利], was associated with a Second Artillery training regiment "deep in the mountains," probably in Qilichuan village. See Zhang Guangtian, "96401 Unit Helps Establish a New Farming Village in Qilichuan" [96401 部队援建七里川村新农村建设], *PLA Daily*, June 18, 2008; and Zhu Weishe, "Picture" [图片], *PLA Daily*, April 18, 2009, available from *www.chinamil.com.cn/site1//zbxl/2009-04/18/content_1730645.htm*.

13. The institute is directed by Wang Guoqing [王国庆], with Dr. Kong Xiangyu [孔祥玉] also playing a major role. Wang Yongxiao and Wang Feng, "Inspection and Transportation on Target: China's Strategic Missile Unit's Special Operations Troops" [装检押运报靶:中国战略导弹部队的特种兵], *China News Network*, June 21, 2006.

14. The specific CASC institute responsible for warhead and re-entry vehicle structural design is the China Academy of Launch Technology (CALT, or CASC First Academy) 14th Research Institute, or Beijing Institute of Special Electro-Mechanics [北京特殊机电研究所]. For background on CIRP, see *www.cirp.org.cn/*. CAEP hosts five PLA GAD laboratories that focus on issues such as shock wave and detonation physics [冲击波物理与爆轰物理], computational physics [计算物理], high-density, high-

temperature plasma [高温高密度等离子体], and surface physics and chemistry [表面物理与化学].

15. See "CMC and State Council Invites High Tech Expert to Beidaihe—Yang Weixin [中央、国务院邀请到北戴河休假的高技能人才—杨维新], *Government Labor Bureau*, August 6, 2004, available from *www.lm.gov.cn/gb/training/2004-08/06/content_42314.htm*. Presumably working in conjunction with CAEP's Institute of Electronic Engineering, Yang developed a fuze control system [引控系统] and advanced "synchronous detonation" components. The 524 warhead design for the DF-3 was allegedly first tested in 1968, the 515 design for the DF-21/JL-1 in 1974, and the 506 warhead design for the DF-5 were first tested in 1976.

16. See *Lessons from the Gulf War for Second Artillery Force Development* [海湾战争对二炮武器装备建设的启示], Beijing, China: Second Artillery Headquarters Equipment Department, May 1991.

17. For reporting on efforts to advance the educational level of institute engineers, see Han Haifeng, Wei Cunren, and Wang Yongxiao, "Second Artillery Equipment Inspection Institute Overcomes Difficulties to Promote Doctoral Candidates to Grasp Core Control Issues" [二炮装检所破格提拔博士攻克核心控制领域难题], *PLA Daily*, February 8, 2008, available from *mil.news.sina.com.cn/2009-02-07/0805541171.html*. Senior CAEP advisors to the 22 Base include Xu Zhilei [徐志磊]. As a senior figure in the development of China's second-generation nuclear warheads, Dr. Xu was a recipient of one of China's highest prizes for defense science and technology (S&T) achievement for design and manufacturing of the fissile core of a nuclear device, known as the "pit." In the 1980s, Xu was appointed as chief designer for the miniaturized warhead subsystem on two new intercontinental ballistic missiles (ICBMs). Concurrently, Xu functioned as deputy chief designer for the DF-31 program. Other key CAEP engineering consultants include Peng Xianjue [彭先觉] and Tang Xisheng [唐西生]. Liu Senlin [刘森林] from the China Institute of Atomic Energy has also served as a warhead safety and reliability consultant. Cooperation between the Second Artillery 22 Base and the civilian nuclear industry would appear to be a departure from extreme stovepiping in the past. For a discussion of bureaucratic barriers to cooperation, see Nathan Busch, "China's Fissile Mate-

rial Protection, Control, and Accounting: The Case for Renewed Collaboration," *Nonproliferation Review*, Fall/Winter 2002, p. 170.

18. For an excellent summary of China's SSBN development, see Andrew S. Erickson and Michael S. Chase, "China's SSBN Forces: Transitioning to the Next Generation," Jamestown Foundation *China Brief*, Vol. 9, Issue 12, June 12, 2009.

19. At least one potential area of discussion could be the International Atomic Energy Agency (IAEA) initiative regarding "design basis threat." For one discussion on China's physical protection system, see Tang Dan, Yin Xiandong, Fang Ni, Guo Cao, "Physical Protection System and Vulnerability Analysis Program in China," presented to the International Seminar on Disarmament and the Resolution of Conflict (ISODARCO), Beijing, China, October, 2002. The authors are from CAEP's Institute of Electronic Engineering. Also see Busch, "China's Fissile Material Protection, Control, and Accounting"; and Hui Zhang, "Evaluating China's MPC&A System," paper presented at the INMM 44th Annual Meeting, Phoenix, Arizona, July, 13-17 2003.