# WMD in Asia-Pacific

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## Chapter 5

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# Nuclear Command, Control, and Communications (NC3) in Asia-Pacific

*Peter Hayes*

## Introduction

Nuclear Command, Control, and Communications (hereafter NC3) is one of the least known but arguably most critical dimension of nuclear forces in Asia-Pacific. Put simply, NC3 combines wetware (people), hardware (sensor, communications, and control technology), and software (digital code that enables the digital elements to connect people with machines, although much of the technology is analog inherited from a pre-digital era in the older nuclear-armed states). The purpose of this combination is to enable commanders to target, operate, control, and use nuclear weapons by receiving data and advice from sensor systems and people tasked with interpreting it, to make decisions, and to send orders to nuclear forces to move, go on alert, or to strike targets. Most treatments of nuclear forces focus on nuclear warheads (type, number, megatonnage, and fissile material) and delivery platforms (type, range, accuracy, tactical versus theater versus strategic) and simply take NC3 as given. There is a reason, however, that David slung his stone into the forehead of Goliath rather than his musculature. Without a head connected to a body, a nuclear force is useless. Disregarding NC3 misses, it is perhaps the most critical element of making nuclear war. Therefore, it behooves us to pay attention to it.

Also, NC3 is arguably a potent "force multiplier" that makes a given combination of nuclear warheads with delivery systems far more lethal (if the NC3 systems are relatively robust and reliable) or—if destroyed by counter-NC3 attacks—far less able to annihilate an adversary in a first, retaliatory, or indeed, any strike at all (the "perfect" counter-NC3 strike being one that simply decapitates the nuclear forces of an adversary or vastly limits the damage incurred from its forces attacking one's own forces and/or society). Thus, more capable NC3 may substitute for additional nuclear forces at a given force level, making additional forces unnecessary even when adversarial forces expand or improve qualitatively. Or they may even offset reductions in nuclear forces.

Conversely, "improved" counter-NC3 forces may undermine such perceptions and force-enabling characteristics of NC3, and thereby increase the risk of first-strike instability between nuclear-armed adversaries. The worst case is improved NC3 forces combined with expanding nuclear forces and increasingly effective counter-NC3 forces, implemented either by one side creating an illusion of nuclear escalation and warfighting dominance; or, if implemented by both sides, increasing the perception that going first is the only option to limit damage from the inevitable first strike by a nuclear adversary given their NC3 vulnerabilities.

NC3 does not loom large in arms control or disarmament literature, with significant exceptions. In the American Cold War, use of NC3, which was distilled in the acronym NC3I for nuclear command, control, communications, and *intelligence* in standard theoretical and policy use in the mid-eighties, NC3 was indistinguishable from NC3I. That's because NC2—nuclear command-and-control—relied indispensably on communication systems—the third C in NC3—to communicate information from nuclear commanders in the command chain to and from nuclear forces and, in turn, to convey information from sensor systems that provided early warning, target identification, and damage assessment needed for nuclear commanders to make decisions, select strike options, and issue strike orders with nuclear forces.

Because these "national technical means" (NTM) were viewed as integral to sound nuclear decision making and indispensable to the operation of nuclear forces before, during, and after a nuclear war, many US-Soviet strategic nuclear arms control agreements included clauses banning "interference" with NTM. Otherwise, because NC2 and supporting communications systems are so opaque, making it impossible to verify compliance with various measures that might have been taken to control NC3 systems in these agreements, NC3 simply doesn't appear in strategic arms control agreements. And there are few tacit understandings let alone norms on behaviors related to NC3 and counter-NC3 operations.

Moreover, analysts of NC3 mostly assumed that "more NC3" is automatically better. After all, who could object to increasing negative controls over nuclear weapons (those organizational and technical measures that ensure nuclear weapons are never used by mistake) or positive controls over nuclear weapons (those organizational and technical measures that ensure nuclear weapons are always available for immediate use, the underlying basis of nuclear threat that creates the perception that nuclear retaliation is inevitable and therefore nuclear first use is never rational, the essential foundation of strategic deterrence and "stability" in nuclear threat dyads)? Thus, goes the argument, more NC3 means more bang for the buck at same or lower cost, and less risk of nuclear war due to enhanced strategic stability. So why worry about NC3-related arms control, let alone disarmament?

Unfortunately, this perspective was highly subjective, introspective, and parochial. In reality, nuclear armed states are in a conflict relationship, and a relationship is always based on communication of intention and capability—as was explained long ago by the first generation of strategic theorists. Such communication can take many forms—statements of doctrine, political threat rhetoric, back-channel messages, diplomatic demarche, changes in alert levels, force deployments, forward deployment, nuclear warhead and delivery platform testing…the nuclear practitioner's repertoire is quite extensive, even for small monadic forces, let alone "mature" triadic forces with global reach deployed by the United States, Russia, and China today. Among the most important information that is sent by one nuclear antagonist to another is that obtained by communications intelligence systems of what an adversary's nuclear command is saying to its own forces combined with direct observation via NTM of status and operations of deployed nuclear forces. Thus, sensors create information flows that continuously link adversarial forces in what is correctly termed "NC3 interdependence," thereby creating what a "tightly coupled" US-Soviet NC3 system (Paul Bracken),1 and a "gigantic interacting system" (Ash Carter)2 , although they did not analyze the resulting global dynamics of this NC3 "metasystem" even when it was relatively simple during the Cold War.

Today, with fifteen nuclear weapons and nuclear-delivery states each endowed with distinctive national and in some cases (NATO) multinational NC3, global NC3 interdependence is vastly more complicated to the point of true complexity and can no longer be ignored. It is now critical that NC3 be analyzed for its direct contribution to the increase or reduction of nuclear risk—

[1] P. Bracken, *The Command of Strategic Forces, Dissertation, Yale University,* 1982, p. 39.
[2] Ashton Carter, "Sources of Error and Uncertainty," in A. Carter, J. Steinbruner, and C. Zraket, ed, *Managing Nuclear Operations,* The Brookings Institution, Washington DC, 1987, p. 635.

depending on the contextual circumstances, and that policy measures be taken to control and disarm NC3 systems, not just the warheads and delivery systems for nuclear weapons. To not do so would be like analyzing the efficacy of global air traffic control systems without revealing the location of air traffic control towers, the frequency, procedures, and language used and harmonized by ICAO, and paying no heed to the communication systems employed to coordinate aircraft movement and to synchronize aircraft movement across whole airspaces under different routine and emergency circumstances. Anyone who proposed running air traffic control without minimal transparency, common standards and procedures, and interoperable communication systems sharing sensor data from radars and satellites would be dismissed or isolated (think airlines that assiduously avoid traversing DPRK airspace). Yet, that is the situation today with respect to NC3.

## Definition Of NC3

To proceed, we first need a working definition of NC3. There is no agreed definition of NC3, however between or within nuclear armed states. It's not even clear that all nuclear-armed states even use such a term. Or if they do, whether it captures the same meaning and scope as its dominant usage in American and allied nuclear forces.[3] The concept is most developed in the United States and its allies, and in Russia, where it has long been the subject of military and budgetary definitions, although these have varied over time.

At a basic and universal level, the NC3 system connects senior nuclear commanders with their nuclear forces and enables them to control their use at all times. Control is a critical concept when it comes to nuclear weapons given their uniquely destructive capability. It is translated by many procedures, measures, and organizational systems, some of which may work against the other when it comes to combining negative and positive controls in routine, crisis, and wartime nuclear weapons operations. Also integral to NC3 is the notion of legitimacy and authority—the nuclear

[3] For example, Fiona Cunningham reports that there is no open-source clear definition of "NC3" with Chinese characteristics, although there are various command and control concepts in the Chinese literature that relate to elements of NC3 as defined by the United States and NATO. See Fiona Cunningham, "Nuclear Command, Control, and Communications Systems of the People's Republic Of China", NAPSNet Special Reports, July 18, 2019, https://nautilus.org/napsnet/napsnet-special-reports/nuclear-command-control-and-communications-systems-of-the-peoples-republic-of-china/

commander must be accountable under domestic and international law. And there must be systems to ensure that command decisions are authenticated and that nuclear weaponeers know that commands that they receive and act on are authentic and legal.

American nuclear weaponeers have long held that NC3 systems must be as reliable, robust, and capable to deter nuclear strikes.[4]

In this view, NC3 is a system. It is made up of all the elements that enable a weapon to be deployed, including appropriately trained personnel, parts, and the systems that allow an NC3 apparatus to work all the way from commander to weapons operator. The fit between the weapon and the NC3 system is never perfect.

The United States made a clear public statement as to what is meant by NC3. The US Department of Defense's *Nuclear Matters Handbook* (2020 edition) states:

> The U.S. command and control is necessary to ensure the authorized employment and termination of nuclear weapons operations, to secure against accidental, inadvertent, or unauthorized access, and to prevent the loss of control, theft, or unauthorized use of U.S. nuclear weapons. The President's ability to exercise authorities is ensured by NC3.[5]

It then goes on to state that NC3 can only be understood with reference to NC2:

> In order to understand NC3, it is important to define nuclear command and control (NC2). NC2 is the exercise of authority and direction, through established command lines, over nuclear weapon operations by the President as the chief executive and head of state. NC2 is supported by a survivable network of communications and warning systems that ensure dedicated connectivity from the President to all nuclear-capable forces. The fundamental requirements of NC2 are that it must be assured, timely, secure, survivable,

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[4] Termed $C^3I$: Ashton B. Carter, "The Command and Control of Nuclear War," *Scientific American* 252, 1 (Jan, 1985): 32-39, 32. Carter's work on vulnerability was preceded by a seminal paper by D. Ball, *Can nuclear war be controlled?* Adelphi Papers, 1981, 21: 169, pp. 1-2, at: http://www.tandfonline.com/doi/abs/10.1080/05679328108457385

[5] US Department of Defense, *Nuclear Matters Handbook*, chapter 2, accessed October 3, 2020, at: https://www.acq.osd.mil/ncbdp/nm/nmhb/chapters/chapter2.htm

> and enduring in providing the information and communications for the President to make and communicate critical decisions throughout the crisis spectrum.[6]

Elsewhere, it states more succinctly that "NC3, managed by the Military Departments, nuclear force commanders, and the defense agencies, provides the President with the means to authorize the use of nuclear weapons in a crisis."[7]

Viewed functionally, DOD states:

> NC3 assures the integrity of transmitted information and must be survivable to reliably overcome the effects of a nuclear attack. NC3 performs five critical functions:
>
> - detection, warning, and attack characterization
> - nuclear planning
> - decision-making conferencing
> - receiving presidential orders
> - enabling the management and direction of forces[8]

This functional capacity in turn is nested in supporting communication systems:

> NC3 relies on terrestrial (e.g., land-based secure and non-secure phone lines and undersea cables), airborne relay (e.g., E-4B and E-6B), and satellite (military and commercial) sensors to transmit and receive voice, video, or data. The ability to move trusted data and advice from sensors to correlation centers, from presidential advisors to the President, from the President to the NMCC, and from the NMCC to the nuclear weapons delivery platforms depends on NC3…These encompass a myriad of terrestrial, airborne, and satellite-based systems ranging in sophistication from the simple telephone, to radio frequency systems, to government and non-government satellites. Some of these systems are expected to be able to operate through nuclear effects, while others are expected to be subject to nuclear effect disruption for periods ranging from minutes to hours.[9]

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[6] US Department of Defense, *Nuclear Matters Handbook*, *op cit*.
[7] US Department of Defense, *Nuclear Matters Handbook*, *op cit*.
[8] US Department of Defense, *Nuclear Matters Handbook*, *op cit*.
[9] US Department of Defense, *Nuclear Matters Handbook*, *op cit*.

Figure 1 shows this nesting of the various elements of NC3, starting with nuclear commanders at the center, linked to nuclear weapons systems, and linked in turn to external sensor systems by communication systems.

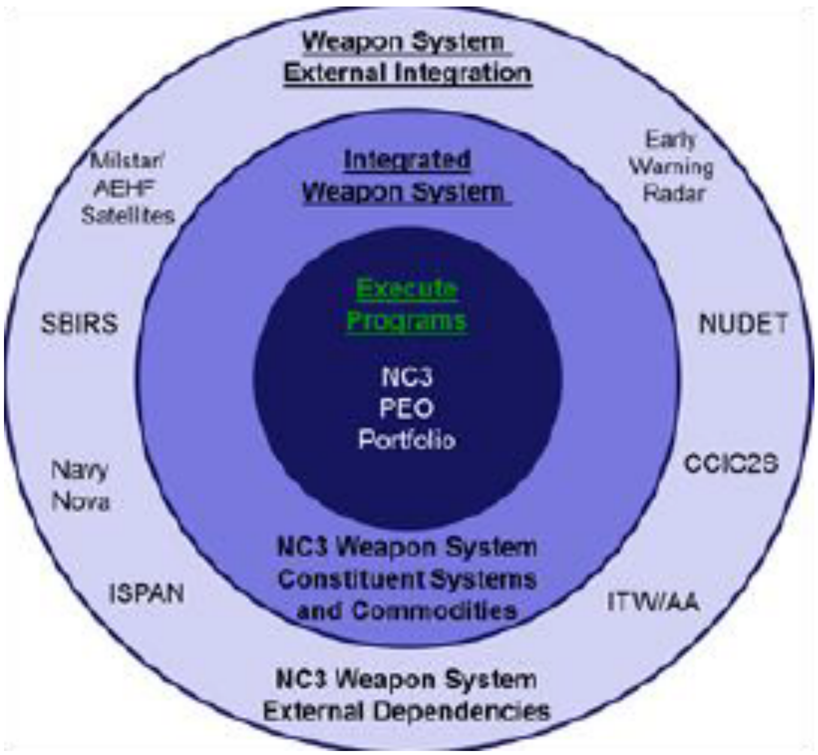


**Figure 1.** Nested NC3 Systems.

**Source:** Figure 2.2. NC3 Weapon System and AFPEO/NC3 & AFNWC/NC Responsibilities, in "Special Management Nuclear Materiel Management," Air Force Materiel Command Instruction 90-204, 4 May 2016, p. 10 released under US FOIA request to Nautilus Institute.

These generic definitions of the elements of US NC3 are translated into binding directives by military combatant commands. The US Air Force, for example, states:

> **NC2.**—Nuclear Command and Control, NC2, is the exercise of authority and direction by the President, as Commander in Chief of U.S. Armed Forces, through established command lines, over nuclear weapon operations by military forces; as Chief Executive over all Government activities that support those operations; and as Head of State over required multinational actions that support those operations.

> **NC3.**—Nuclear Command, Control, and Communications, NC3, is the collection of activities, processes, and procedures performed by appropriate commanders and support personnel who, through the chain of command, allow for decisions to be made based on relevant information, and allow those decisions to be communicated to forces for execution. NC3 is a system of systems, stretching across services, combatant commands, and other DoD entities.[10]execution. NC3 is a system of systems, stretching across services, combatant commands, and other DoD entities.[11]

This reference to a "system of systems" is important. A system of systems is inherently complex. The US NC3 system is a sprawling patchwork of systems operated by each service, much of which is not inter-operable. And because the US military has three nuclear weapons forces run by its air force (missiles and bombs) and navy (submarine), each with global reach, it really operates three global NC3 systems, plus the fusion of these systems in the decision-support systems that extend to the Joint Chiefs and the US president, and then back to nuclear forces who must act on decisions. This very complexity is subject to the Byzantine Generals problem and may result in unanticipated cybernetic feedbacks, logical flow errors, and inadvertent outcomes.

A simplified, functional definition of the complete meaning of NC3 in terms of supreme commander control of nuclear weapons is provided in Table 1. Arguably, however achieved, these functions are universal among all nuclear-armed states in one way or another.

[10] US Air Force, "Air Force Nuclear Command, Control, and Communications (NC3), US Air Force Instruction 13-550, October 2, 2014, p.21, released under US FOIA request to Nautilus Institute.

[11] US Air Force, "Air Force Nuclear Command, Control, and Communications (NC3), US Air Force Instruction 13-550, October 2, 2014, p.21, released under US FOIA request to Nautilus Institute.

**Table 1: Critical NC3 Functions**

- detection, warning, and attack characterization
- nuclear planning and targeting
- decision-making
- receiving orders
- enabling the management and direction of forces

Source: Based on US Department of Defense, *Nuclear Matters Handbook*, chapter 2, accessed October 3, 2020, at: https://www.acq.osd.mil/ncbdp/nm/nmhb/chapters/chapter2.htm

Before turning to practical, plausible, and desirable NC3 policy measures, we need to first survey the uneven terrain of NC3 in the Asia-Pacific region that captures seven of the nine nuclear-armed states (Russia, China, the United States, Israel, Pakistan, India, North Korea) that are inextricably linked by mutual nuclear threat relationships.

Before analyzing what must be done with respect to NC3 to reduce the risk of nuclear war and to resume nuclear disarmament in the current context, we first describe the NC3 systems of each nuclear-armed state in this region.

## NC3 Systems in Asia-Pacific

### *US NC3*

NC2 (defined above as nuclear command and control) is conducted in nuclear command posts, the most important of which are in the White House, the National Military Command Center at the Pentagon, at Strategic Command HQ in Omaha, and at the unified command HQs in Hawaii and NATO HQ in Brussels. These are supplemented by a variety of mobile command posts, including presidential and the Air Force E-4 National Airborne Operations Center, the Navy's E-6 Mercury TACOMO aircraft, and various lang-based mobile backup centers (see figure 2).

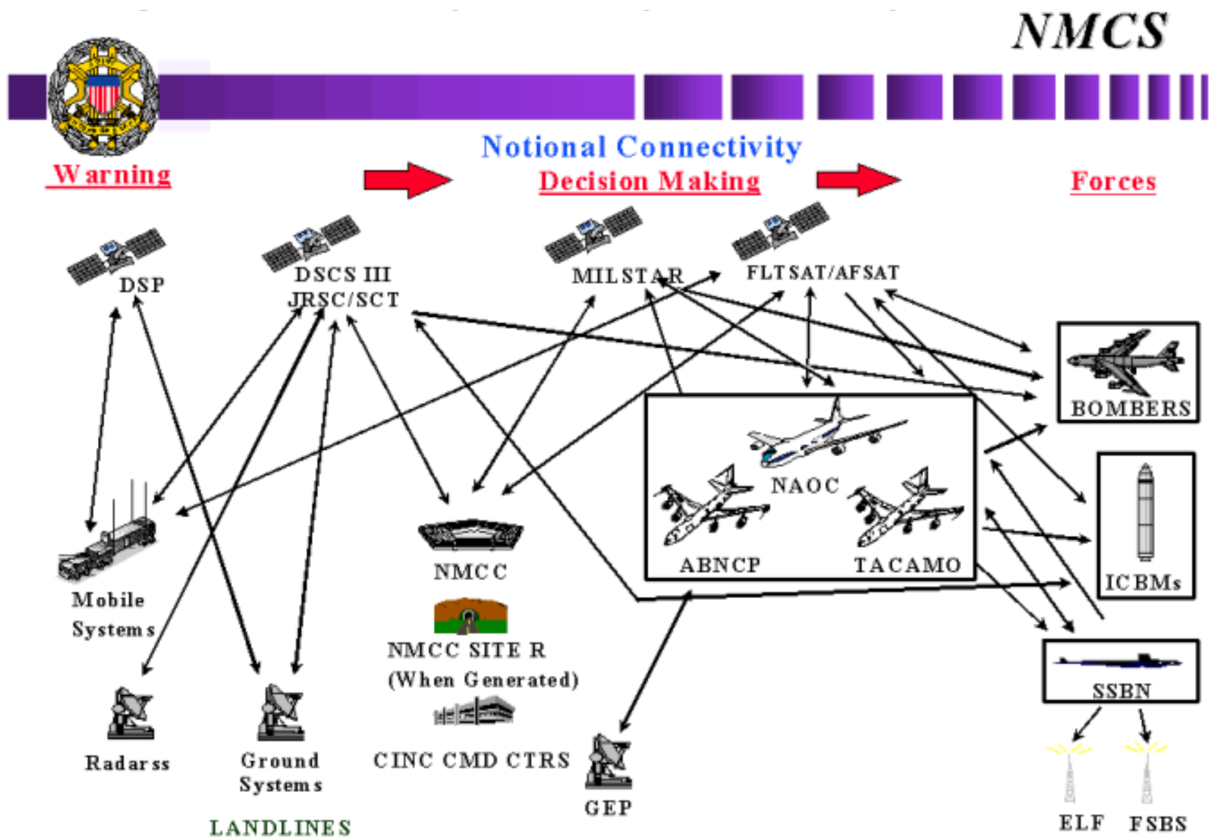


**Figure 2.** National Military Command System Connectivity to the Forces (2001).

**Source:** Robert Critchlow, *Nuclear Command and Control: Current Programs and Issues*, Congressional Research Service, RL33408, May 3, 2006, p. 7.

NC2 is supported and connected across nodes and with sensor and early warning systems on the one hand, and nuclear forces on the other, by a range of communications systems, adding the third C to NC3. These systems provide connectivity to NC2 whereby data and messages are sent via wireless and cable, some dedicated to nuclear forces, some shared with non-nuclear forces. The wireless networks use the entire spectrum from extremely low to ultra-high frequencies. Some are line-of-sight, some wrap around the Earth, and some are directed at satellites and are then sent back down to ground receivers or sideways to other satellites before being sent back to Earth. Some frequencies are hard to interfere with, while some work better in an atmosphere "perturbed" by nuclear detonations. Some have been hardened against the electromagnetic pulse emitted by a nuclear detonation while many have not, and some are able to penetrate the surface layer of the ocean to reach submarines. Antenna size and weight determines which delivery platform can use with which frequency-based system. In the digital era, NC3 now includes computer and cyber systems that are integral to computation, fusion, and transmission of data and messages over connectivity provided by digitized communications systems.

Over seven decades of nuclear warfare, each military service has developed its own communications systems, many of which are not able to be received by those of the other service. That is, they are not interoperable. The same problem arises with regard to nuclear allies within NATO and other US nuclear umbrella states such as Japan and the ROK. Figure 3 shows the NC3 systems operated primarily by the US Air Force. Figure 4 shows the NC3 systems operated primarily by the US Navy.

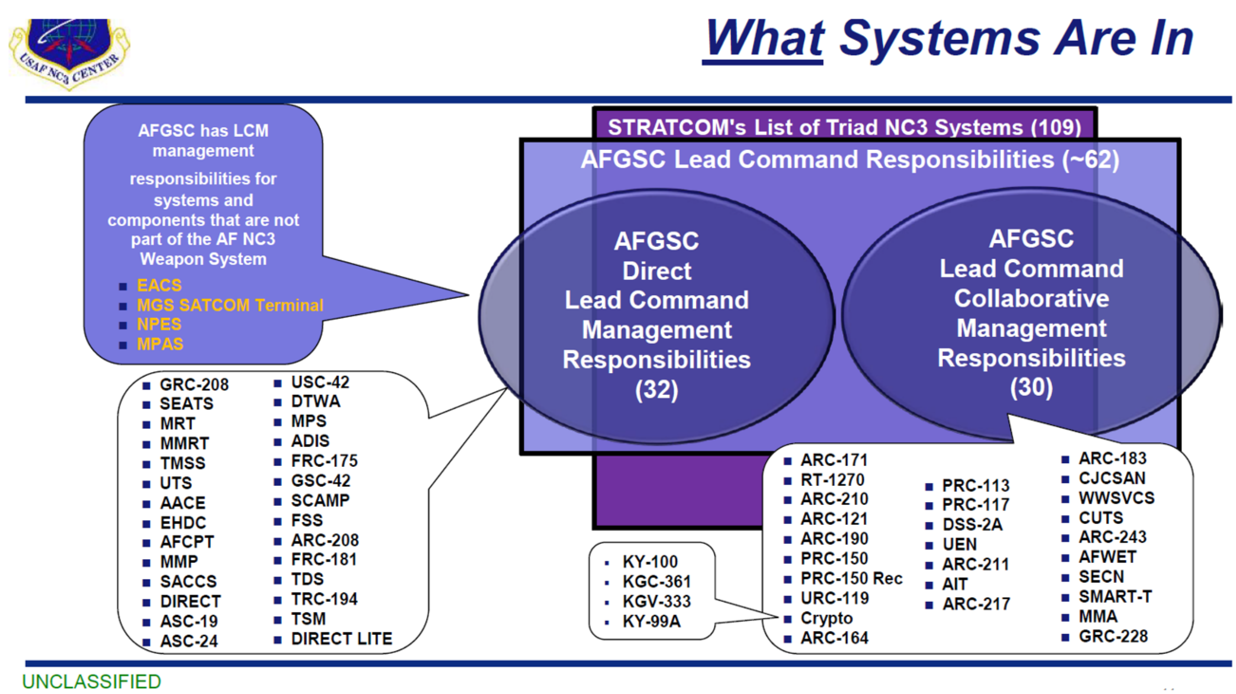


**Figure 3.** US Air Force and Other NC3 systems.

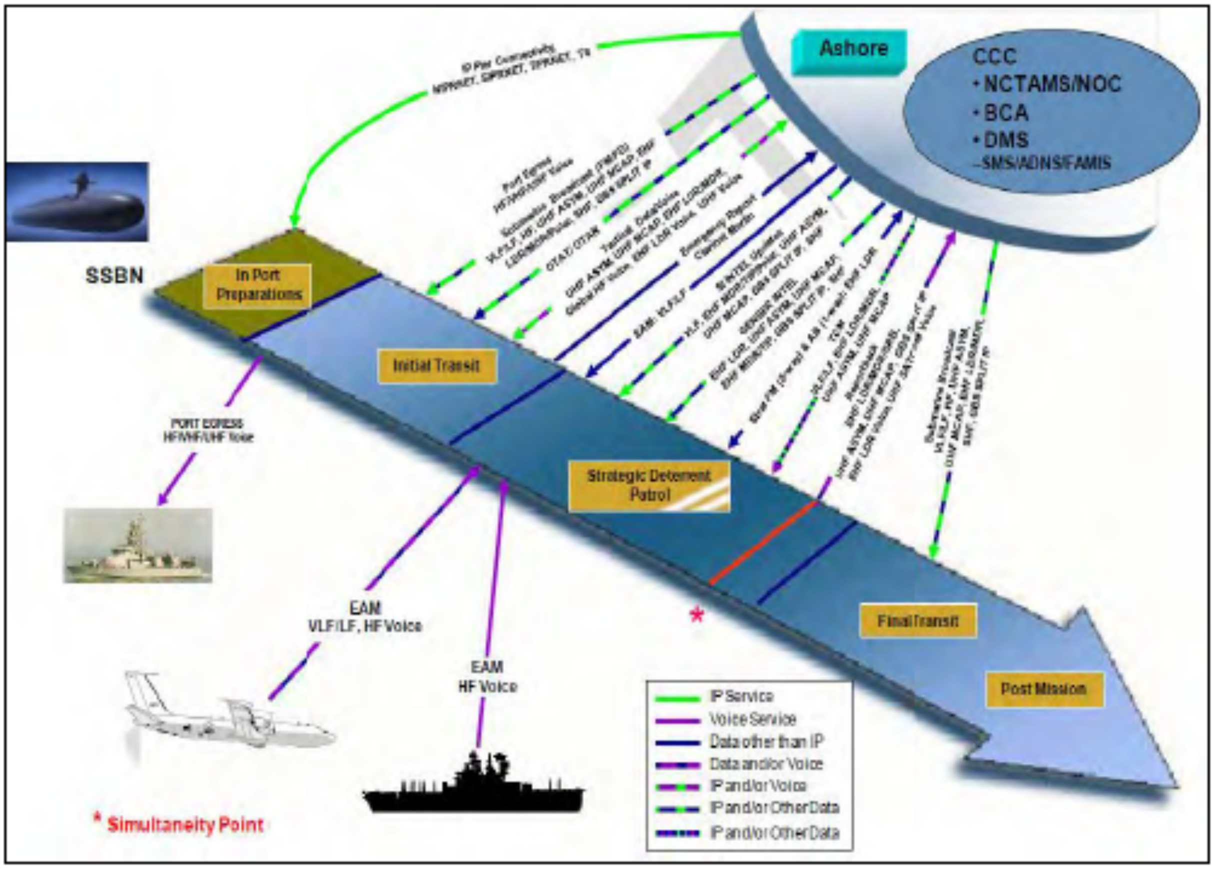


**Figure 4:** US Navy Strategic Communication Systems.

**Source:** "Figure 13 depicts the nuclear command, control and communications (NC3) infrastructure needed for mission communications while performing a strategic deterrent patrol. The BCA [broadcast control authority] provides the interface to the NC3 system for delivery of EAMs. Take charge and move out (TACAMO) aircraft and surface ships relay EAMs [emergency action messages] if there is a failure of the primary reception paths. The simultaneity point indicates when multiple communications paths will be available for use." M. Seime, Common Submarine Radio Room: A Case Study of a System of Systems Approach, thesis, Naval Postgraduate School, 2014, p.33, at: https://calhoun.nps.edu/handle/10945/43998

This global nuclear decision-making and communications apparatus would be useless without the ability to sense via many means the state of the world. The most important US nuclear sensors are those that provide early warning of nuclear attack. The earliest warning of missile attack comes from satellite-based infra-red sensors that see the heat of missile launch and exhaust. From forward-deployed radars, it would get the earliest confirmation by a physically disparate sensor if in range. If not, arcs of long-range radars in Alaska, Greenland, the UK, and on the three coasts of continental United States, supplemented by ballistic missile defense and NATO radars plus radars monitoring space, serve to identify missile launches and against whom they are targeted.12 A nuclear detonation detection system also operates in the United States to confirm actual nuclear attack on the United States. All this warning from 24/7 monitoring converges on ground stations where it is assessed continuously for false alarms or discounted as non-missile events, notably in the National Military Command Center in Washington, DC, the Global Operations Center at Offutt AFB, NE, and the headquarters of the North American Aerospace Defense Command and Cheyenne Mountain in Colorado.

When the nuclear communications infrastructure is combined with the nuclear command system, it is truly vast—so much so that it exceeds the ability of managers to grasp. As the Defense Information Systems Agency—the entity within the US Department of Defense responsible for integrating all these elements to ensure that nuclear command-and-control provided the necessary connectivity between national command authorities and nuclear forces—stated in 2010, “There is no one NC3 system. The NC3 system as it exists today is a patchwork of disparate systems, each with its own characteristics. There is no one operating system or coding language.[13] The true complexity is revealed in the evolution of estimates of the number of systems that constitute NC3. In 2017, for example, US General Robin Hand stated that “There are a huge number—107 different systems to get our hands around.”[14] In 2019, a STRATCOM official estimated that there were 109 such systems.[15] At the same workshop, Jeffrey Larsen stated, “ Depending on who you ask and how they count, the US NC3 system consists of as many as 160 different systems: satellites, aircraft, command posts, communication networks, land stations, radio receivers, and so on—a system of systems perhaps too complex for any one

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[12] Jeffrey Larsen, "Nuclear Command, Control, and Communications: US Country Profile", NAPSNet Special Reports, August 22, 2019, https://nautilus.org/napsnet/napsnet-special-reports/nuclear-command-control-and-communications-us-country-profile/

[13] Answer to Question 1 at: Nuclear Command, Control, and Communications System Operational Assessment Program, Solicitation Number: HC104710R4009, Agency: Defense Information Systems Agency, Office: Procurement Directorate Location: DITCO-NCR, August 4, 2010, at: https://www.fbo.gov/index?s=opportunity&mode=form&id=ca9ed977f427844fb095c1e170a579ee&tab=core&_cview=1

[14] S. Magnuson, “Exclusive: Interview with Gen. Robin Rand, Head of Air Force Global Strike Command,” *National Defense Magazine*, November 14, 2017, at: http://www.nationaldefensemagazine.org/articles/2017/11/14/global-strike-command-tackles-atrophying-nuclear-command-control-systems

[15] Presentation at NC3 and Global Stability, workshop, Stanford University, January 22-23, 2019. See Peter Hayes, Binoy Kampmark, Philip Reiner, Deborah Gordon, "SYNTHESIS REPORT–NC3 SYSTEMS AND STRATEGIC STABILITY: A GLOBAL OVERVIEW," NAPSNet Special Reports, May 05, 2019, https://nautilus.org/napsnet/napsnet-special-reports/synthesis-report-nc3-systems-and-strategic-stability-a-global-overview/

person to totally understand. "[16] By 2020, US Under Secretary of Defense Ellen Lord testified, "The NC3 portfolio comprises a complex architecture of more than 200 systems that allow detection of threats, support decision making, and enable force direction."[17] As a senior commander in charge of US NC3 systems stated in 2019, "I am confident that the NC3 system will work. I just don't know how and why it works.[18]

***Russian NC3***

NC2 in the former Soviet Union, now Russia, is dominated by the need to command and control the long-range nuclear missiles that constitute the bulk of its nuclear forces. A substantial fraction of these missiles is located in Siberia, far from the high command in Moscow. Russia also operates missile firing submarines but generally keeps them close to home-based anti-submarine forces to provide some cover against US forces tracking Russian submarines from air and sea. It also has long-range bombers that—like their American and Chinese counterparts—need communication systems at long-range. In the past, Russia based intermediate range rockets in the Far East, but these were removed under the Intermediate Nuclear Forces treaty, leaving only shorter-range missiles along the border with China, some bombers, and a strategic missile submarine force that has been reconstituted in Kamchatka after a long period at the end of the Cold War, when no such forces operated in the Russian Far East/Pacific region.

Russia's primary modern nuclear command post, the National Defense Command and Control Center, was opened in 2014 and contains within it the Nuclear Strategic Forces Command and Control Center. This Center manages nuclear weapons operations as directed by Russia's

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[16] Jeffrey Larsen, "Nuclear Command, Control, and Communications: US Country Profile," NAPSNet Special Reports, August 22, 2019, https://nautilus.org/napsnet/napsnet-special-reports/nuclear-command-control-and-communications-us-country-profile/

[17] Statement of The Honorable Ellen M. Lord Under Secretary of Defense for Acquisition and Sustainment Before the Strategic Forces Subcommittee Committee on Armed Services United States Senate U.S. Nuclear Weapons Policy, Programs, and Strategy in Review of the Defense Authorization Request for Fiscal Year 2020 and the Future Years Defense Program May 1, 2019, at: https://www.armed-services.senate.gov/download/lord_05-01-19

[18] At the NC3 Systems and Strategic Stability: A Global Overview workshop, January 22, 2019, under Chatham House Rule. A month later, General John Hyten stated in testimony that he "I really can't effectively explain" why the NC3 systems works. In US Strategic Command, "U.S. Strategic Command and U.S. Northern Command SASC Testimony," March 1, 2019, at: https://www.stratcom.mil/Media/Speeches/Article/1771903/us-strategic-command-and-us-northern-command-sasc-testimony/

political and military leaders.[19] Russia has two, possibly three underground nuclear command and control bunkers, one at Kosvinsky Kamen in the Northern Ural Mountains, and another at Mt. Yamantau in the Southern Ural mountains (the latter may have shut down and likely was a government continuity relocation site similar to the US Rock Raven facility outside of Washington, DC). Each of the military services (Strategic Rocket Force, Navy, Airspace Force, and the Army has its own command post with communications and computing support. In November 2020, Russian President Putin revealed that Russia has activated a new underground nuclear command bunker and, like the United States, also has stationary and mobile command posts spread across the country.[20] How many of the dispersed nuclear command posts around Moscow (said to be about eighty in the early 1980s) remain today is unknown.[21]

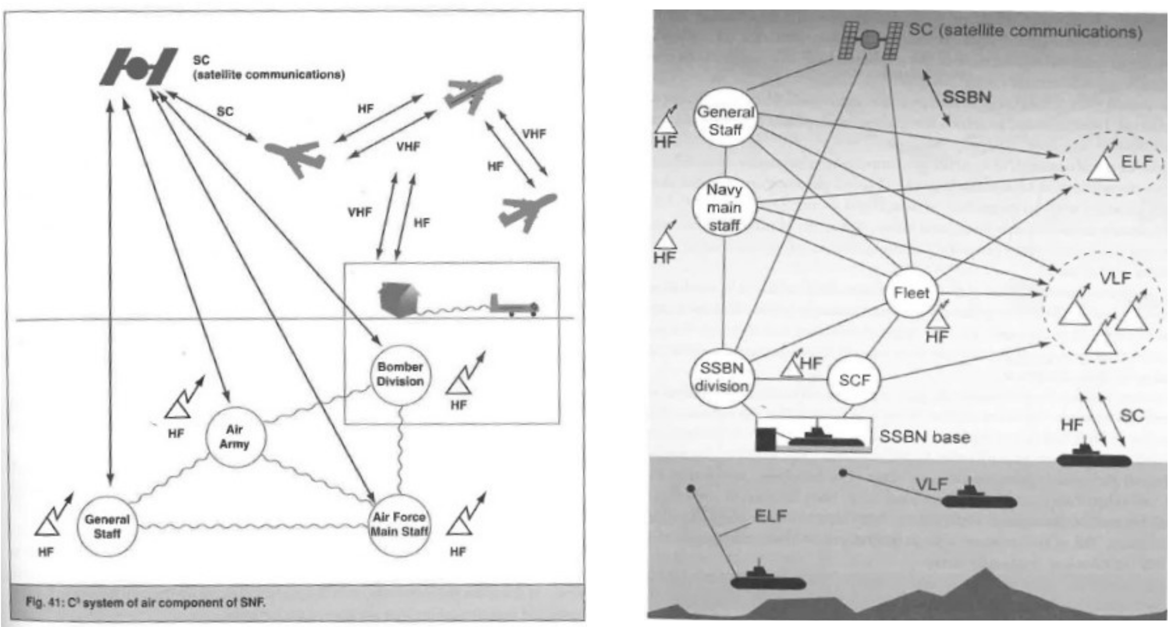


**Figure 5.** Former Soviet Union Strategic Communications Systems (Airborne Left, SSBN Right).
**Source:** V. Yarynich, *C3I: Nuclear Command, Control Cooperation*, Center for Defense Information, Washington DC, 2003, p. 135 *et passim*, at: https://www.scribd.com/doc/282622838/C3-Nuclear-Command-Control-Cooperation

[19] Leonid Ryabikhin, "Russia's NC3 and Early Warning Systems", NAPSNet Special Reports, July 11, 2019, https://nautilus.org/napsnet/napsnet-special-reports/russias-nc3-and-early-warning-systems/

[20] J. Trevithick, "Putin Reveals Existence Of New Nuclear Command Bunker, November 11, 2020, The War Zone, at: https://www.thedrive.com/the-war-zone/37569/putin-reveals-existence-of-new-nuclear-command-bunker-and-says-its-almost-complete?mkt_tok=eyJpIjoiWVRObE5tTmlPR00wTURCbCIsInQiOiI4eWhUa3E4d2x6amRaeVBOQnVlK0lrcEJRSTNlY1JidUhtVEZJU2xUSUU2T05vSm1HZTNEVmx0XC9uajE4MWpWSVwvM0ZuWjJSR2xQWHZWXC9jNEs3eUtGV3o1SVNOd2RcL3F1TlpcL2YyT3E3VVdKREl4ekI4YmNOaSs2ZTdubWlibU1EIn0%3D

[21] K. Lippold, *U.S. and Soviet Strategic Command and Control: Implications for a Protracted Nuclear War*, thesis, US Naval Postgraduate School, Monterey, March 1989, p.124, at: https://calhoun.nps.edu/handle/10945/26326

Russia's strategic communications relied on an extensive array of radio and cable communications across frequencies and media to link these command posts with nuclear forces located across eleven time zones. Communications included landlines, radiotelephone, microwaves, and satellites. The mainstay of connectivity was long-haul HF communications which was then supplemented by satellites operating in low orbit and in elliptical orbits during the Cold War.

The system also reportedly has an automated launch system as well as a rocket. These were to be fired as a last resort and were dedicated to transmitting fire orders in extremis to nuclear forces should Russia's nuclear command posts be incapacitated or destroyed in a war.

As American nuclear forces shifted from bomber to missiles in the early 1960s, the former Soviet Union developed its early form of missile-detection radar. These became operational in 1970 in the form of two "Dnepr" radars near Murmansk and Riga and the Command Post near Moscow. The former Soviet Union {FSU] also began to develop its early warning satellites, although these remained far behind American satellite capabilities to provide a two-echelon missile tracking system that provided 360-degree monitoring along all borders. At the end of the Cold War and throughout the 1990s, the now-Russian early warning system more or less collapsed. For a period, Russia operated its forces without any operating early warning satellites, and the radars were also degraded by age, lack of funding, and de-staffing. In 2014, the decaying legacy satellite system was down completely,[22] leaving Russia solely reliant on its old radars.

Today, Russia has deployed two new modern Voronezh radars and a new constellation of early warning satellites known as the United Space System, or EKS, that have restored Russia's ability to detect early and confirm missile attack. However, by admission of the experts contracted to construct the system, it remains error-prone, especially the ground components.[23]

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[22] "Russia's satellite nuclear warning system down until November," *The Moscow Times*, June 30, 2015, at: https://www.themoscowtimes.com/2015/06/30/russias-satellite-nuclear-warning-system-down-until-november-a47799

[23] Sergei Boev, the lead designer, explained in 2015, "The system's ground echelon…is a uniquely complicated technical system and malfunctions cannot be excluded. Here a lot depends on how the system's various components interact with one another: the false alarms that can occur in one station must be quickly analyzed and verified by the command post." In "Revealed: Russia's ambitious new ICBM early warning system," Sputnik News

Overall, the Russian system is far flung but highly centralized and top down compared with the relatively flat and distributed American nuclear command and control system. During the Cold War, the former Soviet Union's (hereafter FSU) pyramidal structure made the Russian system prone to an error made at the top and center that is propagated quickly throughout the whole system, whereas the American system, being more devolved into regional commands, tends to not propagate errors across different parts of the world. Whether this remains the case today is an interesting question.

***Chinese NC3***[24]

Like Russia, China's NC3 imperatives are dominated by its small land-based nuclear missile force. Unlike the United States and Russia that sport a triad, China has been a monad until recently when it began to develop a naval (strategic missile submarines) leg,[25] and a possible dual-capable long-range aerial (bomber) leg. China's NC2 system is Chinese Communist Party-controlled. They make nuclear weapons decisions in conjunction with the People's Liberation Army (PLA), which operates the Second Artillery Force since 1966 that fielded nuclear missiles, renamed the PLA Rocket Force in 2016. Their leading policy that shaped its NC3 system was to field a small nuclear force sufficiently robust to retaliate after absorbing a first strike from a nuclear adversary, such as the United States, and after 1969, the FSU.

In 1986, the PLA established the Central Emergency Command Center (CECC) for continuity of government under attack. The primary underground hardened site built inside a mountain under Yuquanshan in Xishan outside Beijing, with two sub-centers reportedly at Wuwei (Langzhou military region) and Mianyang (Chengdu military region, later increased to five nodes with the addition of Taiyuan (Beijing military region), Luushan (Jinan military region), and Weining

(19 August 2015, at: https://sputniknews.com/russia/201508191025927540-russia-nuclear-early-warning-system-development/

[24] This section draws on F. Cunningham, "Nuclear Command, Control, and Communications Systems of the People's Republic Of China," NAPSNet Special Reports, July 18, 2019, https://nautilus.org/napsnet/napsnet-special-reports/nuclear-command-control-and-communications-systems-of-the-peoples-republic-of-china/

[25] T. Zhao, *Tides of Change: China's Nuclear Ballistic Missile Submarines and Strategic Stability*, Carnegie Endowment for International Peace, October 24, 2018 at: https://carnegietsinghua.org/2018/10/24/tides-of-change-china-s-nuclear-ballistic-missile-submarines-and-strategic-stability-pub-77490

(Chengdu military region). Other military command bunkers reportedly existed in Inner Mongolia Autonomous Region along with another 29 hardened bunkers connected by cables.[26]

In the early decades of nuclear armament, China used primarily radio communications and telephony to connect nuclear commanders with forces. Starting the 1990s, the PLA laid much fibre-optic cable and integrated microwave communications. Starting the early 1990s, China used DFH commercial satellites for military communications, and deployed its first military FH-1 military communications satellite in 2000, now supplemented by fiber-optic cables laid in the 1990s, and satellites.[27]

China's communication systems are dual use, supporting conventional and nuclear traffic between nuclear commanders and forces. Since 1998, China has semi-automated the issuance of nuclear strike orders and related messages to mobile missile brigades housed in underground tunnels or on the move, allowing central commanders to monitor movements and launches. Once China sends its strategic missile and nuclear attack submarines into the open ocean, it will use low frequency radio towers and transmissions to communicate orders, supplemented by airborne relay systems and satellite downlinks. Mobile missile launch units moving freely on the surface may be assumed to have field communication networks including telephone, videoconferencing, and command networks over wireless and satellite networks.

Because China's nuclear forces are configured to launch only after nuclear attack, it has historically had only minimal early warning radar coverage. As Cunningham explains:

> China has three phased array ground-based radars, similar to U.S. PAVE PAWS radars, located in Heilongjiang province in the country's northeast, Fujian province in its southeast, and Xinjiang in its northwest. Improving China's strategic warning capabilities was an explicit priority for the PLA in China's most recent 2015 defense white

[26] Ta-chen Cheng, "China's nuclear command, control and operations," *International Relations of the Asia-Pacific*, no 7, March 5, 2007 pp. 169-170, at: https://www.jstor.org/stable/26156651?seq=1. Stephen Polk states that as of early 2000s, China's NC2 is located at three sites: in Beijing, at the Central Military Commission office in the Ministry of Defense, the General Staff Directorate hardened bunker in western Beijing where the PLA controls its nuclear forces and issues orders, and the Second Artillery now PLA Rocket Force headquarters nearby in Qinghe. S. Polk, "China's Nuclear Command and Control," in Lyle J. Goldstein, ed, with Andrew S. Erickson, *China's Nuclear Force Modernization*, Newport Paper Twenty-two, Center for Naval Warfare Studies, 2005 at: https://digital-commons.usnwc.edu/cgi/viewcontent.cgi?article=1021&context=newport-papers

[27] S. Polk, op cit, p. 17.

> paper. China has no space-based missile attack early warning system but is likely to be developing one. A space-based early warning system would enable China to shift to a launch-under-attack alert status if it chose to do so in the future. A Chinese space-based early warning system is, however, unlikely to be operational for approximately another decade.[28]

The same retaliatory doctrine of launch-after-or-under-nuclear attack only requires China to be able to detect a nuclear attack. This reportedly was built starting in 1974 and is a national reporting network of enormous significance to the credibility of China's nuclear force. [29]

### *DPRK NC3*

In comparison with the great powers that are nuclear-armed, DPRK's nuclear command and control system is relatively simple, as is its current force structure and supporting connectivity.

DPRK law states clearly that Kim Jong Un is the supreme nuclear commander of the DPRK. In 2014, the Strategic Rocket Command was renamed and became the Strategic Forces Command. This change was to create a direct chain of command from Kim Jong Un to nuclear forces via automated missile launch systems to ensure that his orders are followed.[30] Having only land-based intermediate and largely untested long-range missiles capable of delivering nuclear weapons, the DPRK has a nuclear monad, although it has begun to develop submarine-launched missiles that could carry nuclear weapons in the future.

The DPRK has likely built an NC3 system that is dedicated solely to nuclear forces, both to preserve Kim Jong Un's sole control and to avoid any risk of loss of control due to organizational cybernetics or confusion arising from dual use communications and weapons systems that pose issues of queuing and priorities for message delivery. Although the high

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[28] Cunningham, *op cit*.
[29] *Ibid.*
[30] This section relies on Myeongguk Cheon, "DPRK'S NC3 SYSTEM", NAPSNet Special Reports, June 06, 2019, https://nautilus.org/napsnet/napsnet-special-reports/dprks-nc3-system/

echelons of the DPRK military at the Joint Chiefs and Corps-level commands reportedly use computer-based C3 systems, this does not extend to lower echelons in the conventional military, which relies mostly on telephone, radio, cable, and couriers, with fiber optic extending to forward echelons. However, fiber optic cable is likely to have been laid between the supreme command and missile and warhead bases, and from these bases to preselected sites for transporter erector launchers, to wait and receive orders that may be dispatched with very short time frames from decision to launch, given the complete lack of long-range early warning systems in the DPRK that would identify and respond to a US nuclear attack.

Similar to China, the DPRK's NC3 system includes a party control element at each critical point to ensure political loyalty and compliance with directives from above. It is likely that the DPRK's warheads are not mated to its missiles most of the time and are kept under the control the Korea Worker's Party's Central Military Committee. When ordered, a nuclear ordnance unit would receive warheads under party control and transfer them to missile units for mounting them. This transfer is a particularly fraught and perilous aspect of control in the DPRK NC2 system, and political commissars surely play a key role in ensuring that this integration is achieved during exercises and would do so in wartime.

### *Indian NC3*

Not much tangible may be said in this section for the simple reason that there is almost no country-specific data about the NC3 architecture in India.

NC3 in India is understood to support the Nuclear Command Authority that manages its nuclear and missile forces and would authorize use of nuclear weapons with an operational command base established as early as 1998 on the outskirts of New Delhi.[31] But the command post locations, nodal-network structure, and its multiple, service-based[32] and likely non-interoperable communication systems have not been described in any detail in open source.

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[31] M.V. Ramana and Lauren J. Borja, "Command and Control of Nuclear Weapons in India", NAPSNet Special Reports, August 01, 2019, https://nautilus.org/napsnet/napsnet-special-reports/command-and-control-of-nuclear-weapons-in-india/

[32] Rakesh Kumar, Indian Nuclear Command and Control Dilemma, thesis, Naval Postgraduate School, Monterey, September 2006, pp. 31-32 at: https://calhoun.nps.edu/handle/10945/2639?show=full

Given that India has an advanced scientific and engineering infrastructure and a globally competitive IT sector, one can safely infer that its current NC3 system relies heavily on cable, especially fibre-optic cable, microwave links, and radio links, including non-dedicated satellite links between nuclear warhead sites, sufficient to support dispersed missile launcher sites and fighter-bomber units on various airfields.33 However, how effective such communications for mobile nuclear weapons has become remains an open question.34 According to former advisor to India's Prime Minister, Shyam Saran, India's nuclear command authority is connected to forces with radiation hardened, redundant, and secure nuclear communications systems with "back-up" facilities.35 Indian Cabinet Committee on Security reportedly has approved the construction of alternate chains of command, implying multiple command sites and communications systems for the contingency of loss of the primary nuclear command and control system.36 India's Strategic Forces Command, according to one blogger, "provisions the primary and alternative command posts, operations rooms, and communication.[37]

India also now operates missile-launching submarines and, in 2014, activated a naval very low frequency (VLF) transmission station for communicating with the deployed submarine at Kattabomman in Tamil Nadu on the southern tip of India.[38] In 2017, the Indian navy announced it would build a second VLF transmitting facility at Pudur in central India.[39]

India has two potential nuclear adversaries to monitor, Pakistan and China. In 2002, India acquired missile warning radars from Israel and reportedly deployed two of these units, which

[33] S. Smith, Assessing the Risk of Inadvertent Nuclear War Between India and Pakistan, thesis, Naval Postgraduate School, Monterey, December 2002, p. 47, at: https://calhoun.nps.edu/handle/10945/3272
[34] R. White, "Command and Control of India's Nuclear Forces," *The Nonproliferation Review*, 21:3-4, 2014, p. 270, at: https://www.tandfonline.com/doi/abs/10.1080/10736700.2014.1072994?tab=permissions&scroll=top
[35] S. Saran, "Is India's Nuclear Deterrent Credible?" India Habitat Centre, New Delhi, April 24, 2013, p. 11, at: http://krepon.armscontrolwonk.com/files/2013/05/Final-Is-Indias-Nuclear-Deterrent-Credible-rev1-2-1-3.pdf
[36] A. Ahmed, "Indian Nuclear Command and Control," *Indian Defence Review*, part 2, July 13, 2011, at: http://www.indiandefencereview.com/spotlights/indian-nuclear-command-and-control--ii/
[37] A. Ahmed, "Indian Nuclear Command and Control," *Indian Defence Review*, part 1, July 12, 2011, p. 2, at: http://www.indiandefencereview.com/spotlights/indian-nuclear-command-and-control-i/
[38] "VLF Transmitting Station Commissioned at Tamil Nadu," Indian Navy, Press Release, no date, at: https://www.indiannavy.nic.in/content/vlf-transmitting-station-commissioned-tamil-nadu
[39] K. Mahesh, "Navy to reach ships and subs from Pudur," Times of India, December 27, 2017, at: http://timesofindia.indiatimes.com/articleshow/62261258.cms?utm_source=contentofinterest&utm_medium=text&utm_campaign=cppst

have been upgraded to support ballistic missile defenses.[40] Given range limitations and the extremely short flight times of missiles fired from Pakistan, these radars have limited utility of providing meaningful early warning to India of attack from either Pakistan or India. India's satellite capabilities provide enhanced strategic warning but are limited in their technical capacity. Electronic, communications, and human intelligence will factor into India's decision-making calculus more than long-range sensor systems, although its expanding space program may shift this balance in its NC3 system.

### *Pakistani NC3*

As with India, little is known publicly about Pakistan's NC3 system. Like India, the NC2 or nuclear high command organizational structure is reasonably understood. As Feroz Khan summarizes this system:

> At JSHQ [ Joint Service Headquarters], the communication systems of the three services, along with civilian and military intelligence agencies inputs, are integrated to produce a net assessment of threats that is available to the highest civilian and military leadership. JSHQ is responsible for the organization and functioning of the National Command Center (NCC), which links the conventional force military operations, naval operations, and air force operations into an integrated system (CC3). After SPD was formed, its C2I2 SR Directorate evolved a dedicated nuclear (strategic) communication system (NC3). At NCC, a common operational picture (COP) is available that merges all national surveillance and reconnaissance capabilities, integrating satellite, drones, and other information means from all three services. The communication system is backed with several redundancies and is a secure, dedicated communication system with procedures that are updated as the information age evolves and new innovations in cyber, space, and information technology domains are introduced.[41]

However, the actual physical infrastructure of command centers, communication nodes and networks, and early warning systems has not been described in open sources in recent history.

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[40] J. Yogesh, F. O'Donnell, "India and Nuclear Asia: Forces, Doctrine, and Dangers," Georgetown University Press, 2019, Kindle Edition, p. 55.

[41] Feroz Hassan Khan, "Nuclear Command, Control and Communications (NC3): The Case of Pakistan", NAPSNet Special Reports, September 26, 2019, https://nautilus.org/napsnet/napsnet-special-reports/nuclear-command-control-and-communications-nc3-the-case-of-pakistan/

Shaun Gregory provides the best—albeit very dated—description of the communication system that supports Pakistani NC2:

> Pakistan relies on a variety of space and land-based communication systems to assure nuclear connectivity and the continuity of centralized control. Some of these systems are commercial and others dedicated military networks. System robustness is underpinned by redundancy, the simple idea that if one or more systems fail others will be available to take their place. Pakistan's PASCOM network provide peacetimes army-wide land-line and, for GHQ and corps HQ, mobile phone connectivity; the DEFCOM and PATCOM networks provide satellite, fibre-optic, microwave and switching system connectivity; while the SATCOM network enables corps connectivity through VHF vehicle radio sets, field exchanges and faxes. Pakistan has also been the recent beneficiary of US tactical communications system upgrades – most notably Falcon II, to enable better US–Pakistan interoperability in the war on terror. Despite these arrangements, connectivity through the stages of conflict escalation to the nuclear level is not assured. At least four factors undermine system robustness in Pakistan: (1) the high costs of ensuring full-network redundancy; (2) the technical fragility of communication systems; (3) the vulnerability of the nuclear communication networks and nodes to electronic counter-measures, physical assault, technical dependency; and (4) the particularly rigorous demands of mobile basing.[42]

Pakistan's satellite capacities are also feeble[43] and the entire network appears highly vulnerable to disruption, counter-measures, and physical attack. At least part of its commercial fiber-optic network traverses India although it has dedicated military fiber-optic cables to support conventional forces. Even with codes, radio is considered unsafe for strategic communications, so it is likely used only for routine communication for NC2 purposes, if at all.

[42] S. Gregory, "Nuclear Command and Control in Pakistan," *Defense & Security Analysis*, 23:3, 315-330, 2007, at: https://doi.org/10.1080/14751790701573907

[43] G. Mujaddid, "The Next Decade of Nuclear Unlearning: Command and Control and Management of Pakistan's Nuclear Weapons," in F. Khan et al, edited, *Nuclear Learning in South Asia: The Next Decade,* Naval Postgraduate School, Monterey, June 2014 at: https://calhoun.nps.edu/handle/10945/45142

Like India, Pakistan has deployed a missile firing submarine and built a VLF station at Hameed near Karachi to communicate with it at sea.[44] The vulnerability of this facility and the demanding communications requirements of mobile missiles and possible deployment of tactical, forward-deployed nuclear weapons near the border with India raises the troubling possibility of early delegation of use authority to forward commanders in a crisis.[45]

Likewise, Pakistan's early warning system has limited range and is fragile. It has access to commercial satellite photography but for military purposes, depends almost entirely on the United States and China for strategic satellite support in a crisis. Its air defense radars are short range and provide limited warning of incoming aircraft or cruise missiles aimed at disabling its NC3 nodes and networks.[46]

## Key NC3 Issues

The preceding sections defined NC3 as a critical dimension of nuclear forces, and outlined the NC3 systems, including early warning systems, of the five nuclear-armed states in the Asia-Pacific region. This section introduces six key NC3 issues: (a) the contribution of NC3 to the risk of nuclear war; (b) NC3 modernization and disruptive technology; (c) nuclear decision-making and commander accountability under international law pertaining to NC3; (d) complexity and the global NC3 system; and (e) the pandemic-nuclear nexus and NC3.

### *NC3 and Nuclear Risk*

In section 2, we noted that NC3 is a force multiplier that represents a threat to a targeted state due to its ability to enhance the lethality of nuclear forces and to fight nuclear wars that are less than all-out global paroxysms of nuclear violence that end human existence. NC3 missions in this limited nuclear war context include precision targeting of adversarial NC3 sites and systems to stun and degrade its ability to retaliate with nuclear attacks, retargeting weapons on new

[44] U. Ansari, "Pakistan Unveils VLF Submarine Communications Facility," Defense News, Nov 16, 2016, at: https://www.defensenews.com/naval/2016/11/16/pakistan-unveils-vlf-submarine-communications-facility/
[45] F.H. Khan, Going Tactical: Pakistan's Nuclear Posture and Implications for Stability, IFRI Security Studies Center, Proliferation Papers 53, Paris, 2015, at: https://www.ifri.org/sites/default/files/atoms/files/pp53khan_0.pdf
[46] J. Yogesh, F. O'Donnell, *India and Nuclear Asia, op cit,* p. 320.

targets based on intra-war intelligence (reallocating weapons from already empty silos and already annihilated targets onto new targets such as missiles on the move), terminating nuclear war operations, and reconstituting own forces to prepare for the next war. These NC3 attributes lead to two types of operational problems.

The first is the vulnerability of many parts of the NC3 system. Although nodes can be buried in mountains and network hardware can be hardened against nuclear effects such as electro-magnetic pulse frying of electrical circuits and electronics, nuclear detonations are so powerful that once nuclear war begins, no-one knows if and for how long nuclear command and control will continue, or if it will continue at all.

Nuclear-armed states responded to vulnerability with a combination of hardening and proliferation of transmitting and repeater sites and redundant networks to make it impossible for a rational adversary to entertain the idea that a disabling strike on NC3 was a practical option. All that a nuclear-armed state has to do is to create a sufficiently resilient system that it can get out some nuclear strike orders to forces to "rip off an arm," that is, cause sufficient damage to an adversary to deter it from ever attacking—even if it has already destroyed its enemy with a first strike. Nonetheless, the reality is that for all the billions of national treasures invested in NC3 hardening, the sheer explosive, thermal, and radiative power of nuclear detonations is likely to rapidly degrade even the best NC3 system.

For this reason, many NC3 practitioners argue that the primary concern for nuclear risk is not the vulnerability of NC3 systems, but their propensity to cause errors of two types.[47] The first is a false negative error, that is, the nuclear commanders are told by early warning systems that they are not under attack, when in fact they are, and they fail to launch in retaliation. The corrective for this type of error is to invest heavily in strategic and tactical surveillance and reconnaissance sensors and reporting systems, which nuclear-armed states have done in different and highly uneven ways. The failure to notice that the former Soviet Union had emplaced nuclear armed missiles in Cuba was a slow-motion version of this error as the Cuban Missile Crisis might have been avoided if this activity had been flagged before the missiles arrived or were installed.

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[47] Ashton Carter, "Sources of Error and Uncertainty," in A. Carter, J. Steinbruner, and C. Zraket, ed, *Managing Nuclear Operations,* The Brookings Institution, 1987, pp. 611-640.

The second is a false positive error wherein nuclear commanders are told or come to believe that they are under attack when in fact they are not, but they go ahead and launch anyway against another state. There are many examples of this kind of error in the historical performance of US and Russian NC3 systems. Often these false positives are based on hardware or software failure, or human error.[48] In other cases, they are inadvertent due to organizational cybernetics and procedural flaws whereby even a perfectly performed sequence of actions still leads to failure due to the sequencing of the steps between different parts of the organization, or its interaction with the adversary in an unanticipated way.[49] An especially pernicious variant on the false positives that may afflict NC3 systems is the problem of third-party catalysts who set out to induce a nuclear war between two or more other nuclear-armed states in the hope that they will come out unscathed or on top after a nuclear war. (There is a non-state version of this problem, which is the apocalyptic terrorist entity that seeks to end the world for a religious or other reason[50]).

The final way that nuclear risk is affected by NC3 is by malevolent or disloyal elements that may disrupt nuclear operations. The former is exemplified by non-state actors such as terrorists seeking to wrest control of nuclear weapons or delivery platforms as has occurred multiple times in Pakistan already. The latter refers to the possibility of coups in which nuclear weapons are not centrally controlled as may have happened with the attempted coup during the Algerian war in which nuclear warheads were vulnerable to seizure at the French testing site in the Sahara[51] and during the attempted coup against former Soviet President Mikhail Gorbachev when it was not clear who controlled the nuclear codes.[52] These are examples of the Byzantine General problem wherein network dynamics and individual components generate random control failures that

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[48] Scott Sagan, *The Limits of Safety, Organizations, Accidents, and Nuclear Weapons*, Princeton, New Jersey 1993
[49] P. Bracken, *The Command of Strategic Forces,* Dissertation, *Yale University,* 1982, p. 39.
[50] Gary A. Ackerman, "The Non-State Dimension of Nuclear Command, Control and Communications," NAPSNet Special Reports, August 29, 2019, https://nautilus.org/napsnet/napsnet-special-reports/the-non-state-dimension-of-nuclear-command-control-and-communications/
[51] See the account of the coup and disputes related thereto in Benoît Pelopidas, "France: Nuclear Command, Control, and Communications," NAPSNet Special Reports, June 10, 2019, https://nautilus.org/napsnet/napsnet-special-reports/france-nuclear-command-control-and-communications/
**[52]** M. Dobbs, “During the Soviet Coup, Who Held Nuclear Control? Gorbachev Lost Command, Probers Say,” New York Times, August 23, 1992, at: https://www.washingtonpost.com/archive/politics/1992/08/23/during-the-soviet-coup-who-held-nuclear-control-gorbachev-lost-command-probers-say/a4732610-679e-4f6e-be69-f0cf3f9eba85/ and C. Bohlen, “Gorbachev Lost Nuclear Control, Russians Report,” *New York Times*, August 23, 1992, at: https://www.nytimes.com/1992/08/23/world/gorbachev-lost-nuclear-control-russians-report.html

cannot be anticipated in advance nor controlled in the moment. In the NC3 system, this problem is one in which one of the command elements controlling nuclear weapons is traitorous to the supreme command, but no-one knows which, making coordination dangerous. The most extreme version of this problem is when a supreme commander turns out to be an agent of a hostile state or becomes insane but retains formal command over nuclear forces. President Trump may have been the first example of this version of the Byzantine General problem turned on its head.

***NC3 modernization and disruptive technology***

All the nuclear-armed states in the region are modernizing their nuclear forces, whether they are recent arrivals or originate in the mid-twentieth century. The nuclear great powers, especially the United States, China, and Russia, combine old analog with digital computer and communications systems and an array of platforms for transponders and sensors on Earth and in Space. Onto this combination of modern digital-legacy analog, they are superimposing and grafting on rapidly emerging technologies including drones, cyberwarfare, and highly automated data processing now moving into artificial intelligence and early applications of quantum computing and communications.[53] These new technologies have the potential to disrupt existing NC3 systems.

By enhancing NC3 operations, these new technologies may reduce negative and positive errors, thereby reducing nuclear risk; but they can also potentially reduce confidence in the resilience and robustness of NC3, stimulating notions of early first use of nuclear weapons to limit damage in the face of apparent nuclear attack by an adversarial nuclear-armed state. To the extent that these new technologies are driven to enhance conventional military forces, they also create an increased risk of nuclear-conventional entanglement whereby an adversary sees conventional operations as nuclear and feels obliged to act first to avoid being pre-empted.

A new dimension of NC3 is the way that commanders, especially the supreme commander, is not only supported by the classified, vertically compartmentalized and official NC3 systems but is also embedded in social media, which may be used for official signaling of nuclear threat and is

[53] Elsa B. Kania, "Emerging Technologies, Emerging Challenges—The Potential Employment of New Technologies in Future PLA NC3", NAPSNet Special Reports, September 05, 2019, https://nautilus.org/napsnet/napsnet-special-reports/emerging-technologies-in-future-pla-nuclear-command-control-and-communications/ and Peter Hayes, "Nuclear Command-and-Control in the Quantum Era", NAPSNet Blue Peter, March 29, 2018, https://nautilus.org/napsnet/nuclear-command-and-control-in-the-quantum-era/

linked to early warning systems that monitor social media for indicators of nuclear threat such as mobile unit movements, etc., with obvious potential to enhance false positive errors in the interpretation of nuclear attacks.[54]

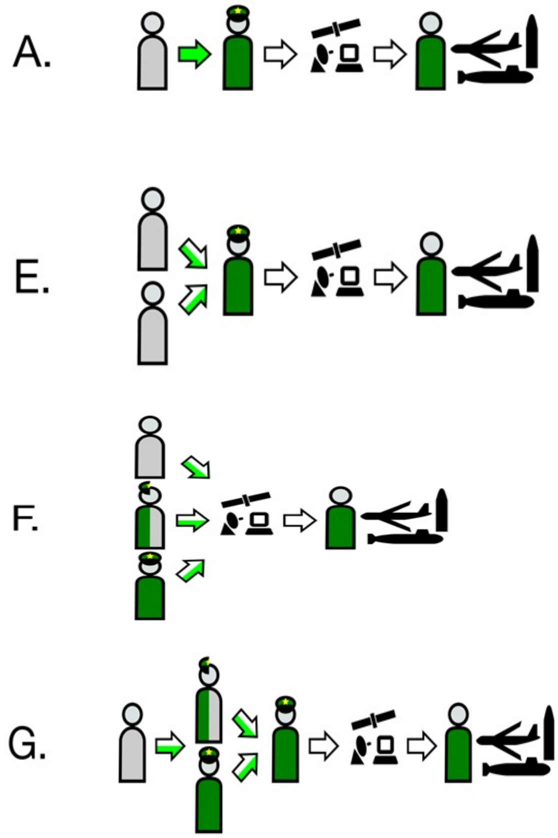
### *Nuclear Decision-Making and Commander Accountability*

All organizations, including militaries armed with nuclear weapons, are made up of individuals interacting in patterned behaviors that becomes routines, standard operating procedures, and often guided by historical lessons such as how the last war was fought. They all have commanders at the top that make the ultimate decision on whether to use nuclear weapons—or not. Apart from different cultural orientations and historical trajectories, however, the individuals that rise to the top implement very different versions of what may be called the "n-person" rule, that is, how many people must participate in the decision, how that final decision is made, and who, if anyone, has veto power.

Table 2 below shows representations of simplified decision-making agents produced by Alex Wellerstein. Each diagram portrays who makes the ultimate decision to fire nuclear weapons (see notes to Table for detailed explanation) Diagram A shows how the system works in the United States and likely also in the DPRK. In this absolute nuclear rule model, only the president and the DPRK's Supreme Leader (currently Kim Jong Un) can order a nuclear strike, which then goes to the top military officials who send the order out to nuclear forces. There is no military or civilian authority or figure who must first sign off or who can countermand this order. A manifestly illegal order may be disobeyed under international law, but that may not stop a determined supreme commander from circumventing an official who says no

[54] See Nautilus Institute, Technology for Global Security, Preventive Defense Project, "Social Media Storms and Nuclear Early Warning Systems: A Deep Dive and Speed Scenarios Workshop Report," NAPSNet Special Reports, January 08, 2019, https://nautilus.org/napsnet/napsnet-special-reports/social-media-storms-and-nuclear-early-warning-systems-a-deep-dive-and-speed-scenarios-workshop-report/ and H. Williams and A. Drew ***Escalation by Tweet: Managing the New Nuclear Diplomacy,*** Centre for Science & Security Studies, Kings College, London, July 15, 2020, at: https://www.kcl.ac.uk/csss/assets/10957%E2%80%A2twitterconflictreport-15july.pdf

**Table 2: Nuclear Command Authority Decision Models**




**Notes:** The diagrams in this text are meant to illustrate several real and hypothetical ways in which nuclear command authority might be transmitted and translated into action. The characters on the far left are civilian state authorities (in gray). The character with the star on their hat is a top-level military authority (in green). The satellite/radar/computer represents the human and technical complexities of the command, control, and communications systems that transmit orders to, finally, the lower-level military figure (in green, no hat) who represents the officers who actually carry out the order with regards to the “shooters” (bombers, submarines, missiles, etc.).

Green arrows represent the ability to give positive or negative authority, whereas white arrows, in principle, are meant to be implementations of orders. Half-green arrows indicate the order only contains part of the necessary authority (one full green arrow is necessary for an order to be authenticated, so two half-arrows). One can ask whether every white arrow will flow naturally or whether there is the possibility of “push back” of some sort (e.g., a “veto,” whether sanctioned or as either deliberate disobedience or just failing to convey orders forward), but in principle the white arrows are not intended to be “vetoes.”

**Source:** Alex Wellerstein, "NC3 Decision Making: Individual Versus Group Process", NAPSNet Special Reports, August 08, 2019, https://nautilus.org/napsnet/napsnet-special-reports/nc3-decision-making-individual-versus-group-process/

According to Wallerstein, this same one-person rule may also operate in India and Pakistan:

> In India, this authority resides in the Prime Minister as head of the Political Council of the Nuclear Command Authority. In Pakistan, the nuclear capability was initially vested in the President of Pakistan as head of the National Command Authority, but it transferred (first procedurally, then legislatively) to the Prime Minister in 2010. It is unclear if these systems look like the flow in diagram "A," but they may.[55]

In China (see Diagram E) the heads of two civilian committees are required to initiate nuclear use. As the same person (President Xi) is currently the head of both committees, this system of checks reduces to a variant of A, absolute nuclear authority.

In Russia, paraphrasing Alex Wellerstein, three people (the president, the minister of defense, and the chief of general staff) carry the codes that enable them to authorize a nuclear strike. And at least two "votes" are necessary, portrayed by one full green arrow). States Wellerstein:

> Whether any one of these votes is privileged (e.g., is the President always required?), is unknown. Note that the Minister of Defense frequently has military rank, but this is not required (and several have not been military personnel), hence their ambiguous representation here. The Chief of General Staff has always been a high-ranking military officer. The activation of the "chegets" [nuclear codes] appears to go directly into the communication systems without an intervening officer.

It's possible that the Russian president may have special voting powers in this schema such that only that figure can initiate the order, but at least one of the others must concur, in which case some form of veto exists over the absolute power to fire nuclear weapons. (See Diagram D).

President Trump's turbulent and uneven use of nuclear threat has raised the issue of whether absolute power to start nuclear war should lie with only one person. As is evident from this

[55] A. Wellerstein, "NC3 Decision Making," *op cit.*

overview, however, the n-person question is universal, and some international consensus to generate a new norm on this score is badly needed. Moreover, the laws of armed conflict and other international law that define commander accountability on when and if use of nuclear weapons is ever legal demand that procedures that are universally agreed to should be implemented in all NC3 systems. This will ensure a minimum of accountability in the form of checks and balances to block manifestly illegal and insane strike orders from being implemented, ever. It is for this reason that the Treaty for the Prohibition of Nuclear Weapons includes NC3 systems in its scope, although it has yet to develop a practical set of recommendations that would allow NC3 systems to align with the core values of this treaty, even during the disarmament period when NC3 becomes more important than ever due to the vulnerability associated with holding small nuclear forces that reduces the assured ability of a nuclear-armed state to retaliate against a pre-emptive strike.

### *Complexity and the Global NC3 System*

None of these NC3 systems, including their early warning and decision-making structures, exist in splendid isolation. Each is part of at least one nuclear-prone relationship constituted in part by the projection of mutual nuclear threat.

During the Cold War, this global threat and NC3 system was relatively simple, being either two or three way, depending on when China entered the picture (and subsuming the UK and France into the anti-Soviet bloc). At the time, Paul Bracken argued that the two NC3 systems were inextricably linked and tightly coupled, and the activities of one could generate spastic or pathological responses in the other, in a series of spiraling, interdependent effects whereby NC3 could be both cause and effect of the risk of nuclear war (see Figure 6). Nuclear weapons have become integral to Russia's reclamation of its major power role after the collapse of the former Soviet Union. It began a nuclear modernization program in the late 1990s, which is still ongoing. According to President Vladimir Putin's report in late 2019, modernized equipment now accounts for eighty-two percent of Russia's nuclear triad.[56] Russia's declaratory policy is to

[56] Russian Federation Defence Ministry, "Supreme commander-in-chief of the Russian Federation Attends Extended Session of the Russian Defence Ministry Board Session." *Press Release*, December 18. 2018, http://eng.mil.ru/en/news_page/country/more.htm?id=12208613@egNews

develop and deploy nuclear weapons to deter and, if necessary, prevail in a regional war—a strategy known as "escalate to de-escalate."

Russia's strategic modernization program has three elements. First, it is routinely replacing aging warheads and delivery systems with new, more advanced ones. Russia's nuclear triad consists of land-based international ballistic missiles (ICBMs), submarine-launched ballistic missiles (SLBMs), and strategic bombers. The land-based component of the strategic triad includes two versions of the SS-27: Mods 1 and 2. The focus of the current and larger phase of Russia's modernization is the SS-27 Mod 2 ICBM (known in Russia as RS-24 Yars), which is equipped with four multiple independently targetable reentry vehicles (MIRVs). Russia is also developing the heavy multiple-warhead ICBM (SS-X-29), known as Sarmat, which will replace the SS-18 in 2021.57 As for the sea-based component of its nuclear triad, Russia has already announced a plan to build five and purchase two more new Borei class submarines (Project 955A) to replace the older Delta IV SSBNs (Project 667BDRM) after 2023.[58] Russia has also resumed production of the Tu-160 aircraft in 2019 and is expected to field the first ten Tu-160M2s before 2027.

Second, Russia has begun to modernize its tactical nuclear weapons. As of early 2020, Russia is estimated to have a stockpile of about 4,310 nuclear warheads that are assigned to long-range strategic launchers and shorter-range tactical nuclear forces.[59] Of these, about 1,870 are nonstrategic warheads.

Third, Russia has begun to develop, test, and produce new "exotic" types of nuclear weapons. In March 2018, President Putin listed five new nuclear-capable weapons systems:

1. a nuclear-armed, maneuvering hypersonic glide vehicle (the Avangard), currently carried by a modified SS-19, and soon to be carried by an SS-29
2. a nuclear-powered, nuclear-armed cruise missile of "unlimited" range (the Burevestnik) to penetrate an adversary's missile defense systems
3. an air-launched ballistic missile purportedly intended to target ships (the Kinzhal)

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[57] RIA Novosti, *Russia to Develop New Heavy ICBM by 2020,* December 20, 2010, https://sputniknews.com/russia/20101220161856876/

[58] Hans M. Kristensen & Matt Korda, "Russian nuclear forces 2020," *Bulletin of the Atomic Scientists*, 2020, Vol.76, No.2, pp.102-117.

[59] Hans M. Kristensen & Matt Korda, "Russian nuclear forces, 2020," *Bulletin of the Atomic Scientists*, Vol.76, No.2, pp.102-117.

4. an SS-18 follow-on ICBM with modern features to penetrate missile defenses (the Sarmat)
5. a deep-diving, unmanned, nuclear-powered and nuclear-armed underwater delivery vehicle (the Poseidon) that is scheduled for delivery in 2027[60]

In February 2019, President Putin announced an additional nuclear-powered anti-ship hypersonic cruise missile (the Tsirkon) to the Russian nuclear weapons inventory. All these programs illustrate that Russia is determined to continue its reliance on nuclear weapons as a key element of its national security strategy. The new and "exotic" nuclear weapons provide means to augment existing nuclear forces with systems that are not counted under the New Strategic Arms Control Treaty (New START), now extended by the United States and Russia for five years by Presidents Biden and Putin.

These dynamics of Russian nuclear arms replacement, modernization, doctrine, and deployment—along with those of the United States—converge to suggest the new nuclear arms race between the United States and Russia will be different from that of the Cold War. In the late 1960s and early 1970s, the Soviet Union and the United States had approximate parity in the number of deliverable weapons in their nuclear arsenals. Their key strategic nuclear objectives were to obtain sufficient capacity to inflict a certain level of assured damage to the other one in a retaliatory strike. Driven by the reality of assured retaliation and near certainty of mutual annihilation in a nuclear war, the two nuclear superpowers had little incentive to pre-emptively strike the other's strategic nuclear forces. During the second half of the Cold War, Soviet leaders became uncertain of being able to indefinitely maintain a posture of guaranteed retaliation and mutual annihilation.[61] Three decades after the Cold War ended, we find the principles which guide the numbers or size of nuclear weapons have changed. On the one hand, the United States re-emphasized nuclear deterrence, boosted its nuclear modernization, and acted skeptically towards arms control measures. Thus, the guiding principles that shape the size and type of US nuclear forces have shifted from preserving strategic stability between the nuclear great powers to countering strategic threats from nuclear adversaries, whether they be small, medium, or great powers. Conversely, Russia's nuclear

[60] President of Russia, *Presidential Address to Federal Assembly*, March 1, 2018, http://en.kremlin.ru/events/president/news/56957
[61] Brendan R. Green and Austin Long, "The MAD Who Wasn't There: Soviet Reactions to the Late Cold War Nuclear Balance," *Security Studies*, 2017, Vol.26, No.4, pp.606-641.

modernization is still motivated in part by Moscow's strong desire to maintain overall numerical parity with the United States. For the Russian leadership the US ballistic missile defense system constitutes a real future risk to the credibility of Russia's retaliatory capability. Consequently, Russia began to research and develop new nuclear systems to counter deployment of US missile defenses. This unrestrained nuclear competition between the United States and Russia may complicate future bilateral arms control negotiation and potentially affect China's cognition of its own nuclear retaliatory capabilities.[62]

Apart from the major powers, more regional states have undermined efforts to restrain missile-proliferation by acquiring the scientific, technological, and industrial capabilities to produce both ballistic and cruise missiles.[63] The DPRK, India, and Pakistan have declared their possession of nuclear weapons and demonstrated their ability to use ballistic missiles. The DPRK test-fired an inter-continental range ballistic missile, which can reach at least the US West Coast, some 8,000 kilometers distant. India flight-tested a system with a range of 3,500 to 5,000 kilometers. Pakistan also has intermediate-range ballistic missiles able to carry nuclear warheads over 2,750 kilometers.[64] Evidently, states will continue developing or acquiring missiles and related technologies, despite interdiction, international condemnation, sanctions, and asymmetric efforts to limit them.

## The "Post-INF" Capabilities and Major Powers' Strategic Interactions

The Intermediate-Range Nuclear Forces Treaty (INF) ended in 2019, but the issue of INF-range missiles remains. Russia's alleged treaty violations and China's increasing conventional and nuclear armed missile capabilities drove the United States to withdraw from the treaty. The former Trump Administration held that if the United States remained bound by the INF treaty limits, then it would be increasingly at a disadvantage with respect to Russia and China. American analysts argued that China has deployed thousands of land-based intermediate-range ballistic and cruise

[62] Charles L. Glaser, C. L., and Steve Fetter. 2016. "Should the United States Reject MAD? Damage Limitation and US Nuclear Strategy toward China," *International Security* 41 (1), pp.49–98.
[63] Nuclear Threat Initiative, "The Delivery Systems Threat," *Nuclear Threat Initiative*, December 30, 2015, http://www.nti.org/learn/delivery-systems/
[64]Missile Threat, Missile Defense Project. Lasted updated July 31, 2021, https://missilethreat.csis.org/missile/shaheen-3/

missiles, and ninety-five percent of them would violate the INF if China was party to it—which, of course, it is not.[65] After the US INF withdrawal, Russia decided to suspend its obligations under the INF treaty as a countermeasure. The current Biden Administration remains greatly concerned with Russia and China's potential employment of nuclear and conventional armed intermediate-range ballistic and cruise missiles and may try to seek negotiations on a global treaty to ban them.[66] The termination of the treaty means that the Asia-Pacific has entered into a "post-INF" era in which, as explained below, "post-ballistic" capabilities become a priority in military planning of these states and tripolar great power strategic interactions become more complex.

The "post-ballistic" capabilities arise from emerging technologies such as advanced guidance and stealth technology. Enhanced by these new technologies, a new generation of cruise missiles and tactical (shorter-range) ballistic missiles gained greater accuracy, reliability, and affordability than the long-range ballistic missiles. Modern cruise missiles can fly at low altitudes, which make them less visible to radars coverage and more difficult to detect and defend against. Shorter-range ballistic missiles, with their accuracy measured in meters, have become effective tools for taking out high-value, well-defended targets inside an adversary's territory.

These attributes, however, leave target nations with very limited ability to counter the new generation of missiles in wartime. Hypersonic vehicles with speeds of Mach 5 and above, for example, can drastically reduce the timelines for attack and response. The further proliferation of hypersonic missiles and the related technologies may cause miscalculation and misperception. Hypersonic weapon systems are divided into hypersonic glide vehicles and hypersonic cruise missiles. The United States, Russia, France, Japan, China, and India are all pursuing these weapons. Russia has already deployed early versions. Furthermore, the growing popularity of dual-capable missiles, when equipped with either conventional or non-conventional warheads, are also destabilizing and could lead to devastating deterrence failures because the payload ambiguity increases uncertainty in a crisis and, thereby, the stakes of not striking first.

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[65] Jacob Stokes, "China's Missile Program and US Withdrawal from the Intermediate-Range Nuclear Forces (INF) Treaty," *US-China Economic and Security Review Commission Staff Research Report*, Feb.4,2019, p.2.
[66] Sharon Squassoni, "How the Biden Administration can Secure Real Gains in Nuclear Arms Control," *Bulletin of the Atomic Scientists*, March 30, 2021, https://thebulletin.org/2021/03/how-the-biden-administration-can-secure-real-gains-in-nuclear-arms-control/

Russia has tested and fielded a new ground launched cruise missile system (9M729) that the United States claimed violated the INF treaty since May 2013.[67] Over the last two decades, China has deployed several new models of land-attack and anti-ship conventional cruise missiles, which are viewed by the United States as providing what it calls "Anti-access/Area-denial" (A2/AD) capability. On 3 August 2019, the day after the United States withdrew from the INF Treaty, then US Secretary of Defense Mark Esper revealed that the United States aims to deploy INF-range missiles in the Asia-Pacific to counter China's "A2/AD" capabilities.[68] At the same time, the Pentagon initiated a study to evaluate whether the United States needed new military capabilities to offset any advantage Russia and China might acquire by deploying a ground-launched cruise missile of INF range (between 500 and 5,500 kilometers). The potential US Army and/or Marine Corps options to deploy land-based intermediate-range missiles in this region include the intermediate-range ballistic missile (IRBM) with hypersonic glide vehicle, with a range of 4,000 km; the Tomahawk ground-launched cruise missile (GLCM), with a range of less than 2,500 km; the Improved Army Tactical Missile System (ATACMS), with a range of less than 700 km; and the Precision Strike Missile (PrSM), with a range of 499 km.[69]

The potential deployment of the previously prohibited ground-based INF-range missiles by the United States in the Asia-Pacific region, especially in the western Pacific, may increase the complexity of trilateral great power strategic interactions. In response, some Chinese scholars have suggested that China should increase the survivability of its nuclear forces by deploying multiple warheads on missiles and experiment with hypersonic boost-glide vehicles.[70] Some analysis outside China even speculated that Beijing might change its longstanding no-first-use (NFU) commitment and the minimum nuclear deterrence posture.[71] Yet to date, China has upheld its NFU

[67] US Congressional Research Service, Russian Compliance with the Intermediate Range Nuclear Forces (INF) Treaty: Background and Issues for Congress, 8 February 2019.
[68] Robert Kobza, "Another Tool in the Toolbox: Using Intermediate-Range Missiles to Counter A2/AD in the Pacific," *Georgetown Security Studies Review*, 2 December 2019: 11.
[69] Tanya Ogilvie-White, "Post-INF Arms Control in the Asia-Pacific: Political Viability and Implementation Challenges," *The International Institute for Strategic Studies,* 30 June 2020: 3.
[70] Tong Zhao, "China in a world with No US-Russia Treaty-Based Arms Control," *Carnegie-Tsinghua Center for Global Policy*, 1 April 2019.
[71] Andrey Baklitskiy, "What the End of the INF Treaty Means for China," *Carnegie Moscow Center Commentary*, 2 December 2019, https://carnegie.ru/commentary/80462

commitment to non-nuclear states, in spite of the speculation of some in Washington that it would amend its NFU policy in the near future.

As for Russia, President Putin announced Russia will deploy new missile systems and augment its missile defenses in its eastern regions.[72] Russia also took other countermeasures that enhance Sino-Russian military ties and help China to boost its own missile defensive systems.[73] The Sino-Russian military cooperation between their respective missile defense systems can be traced back to US withdrawal from the Anti-Ballistic Missile Treaty (ABM) in 2002. Driven by the potential development of the aforementioned missiles by the United States, Sino-Russian relations gained a new momentum recently, which was named a "comprehensive strategic partnership" by China[74] and "an allied relationship" by Russia.

## Will China Join the Trilateral Arms Control Negotiation?

In early 2019, the Trump Administration began to push for a trilateral arms control that would include the United States, Russia, and China. Then-president Trump noted that "Russia and China and us are all making hundreds of billions of dollars' worth of weapons which are costly and ridiculous."[75] In April 2020, the US State Department released a report titled, "US Priorities for Next-Generation Arms Control," which outlined US priorities for "next-generation arms control" involving both Moscow and Beijing.[76] The United States tended to cite China's participation as a pre-condition of the extension of the New START. The treaty limits deployed US and Russian strategic nuclear forces. Additionally, it facilitates inspections and exchanges of information on the status and movements of their intercontinental ballistic missiles and heavy bombers.

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[72] Stephen Blank, "After the INF: Russia's Propaganda and Real Threats," *Eurasia Daily Monitor*, 6 September 2019, https://Jamestown.org/program/after-the-inf-russias-propaganda-and-real-threats/

[73] "Russia is Helping China Build a Missile Defence System, Putin Says," *Guardian*, 4 October 2019.

[74] "China and Russia," Ministry of Foreign Affairs of the People's Republic of China, online, https://www.fmprc.gov.cn/mfa_eng/wjb_663304/zzjg_663340/dozys_664276/gjlb_664280/3220_664352/

[75] Sonne P. and J. Hudson, "Trump Orders Staff to Prepare Arms-control Push with Russia and China," *The Washington Post*, April 25, 2019, https://www.washingtonpost.com/world/national-security/trump-orders-staff-to-prepare-arms-control-push-with-russia-and-china/2019/04/25/c7f05e04-6076-11e9-9412-daf3d2e67c6d_story.html

[76] Christopher A. Ford, "US Priorities for Next-Generation Arms Control," *Arms Control and International Security Papers*, Volume 1, Number1, April 06, 2020.

At the time, US proposals to trilateralize New START appeared disingenuous given that the relatively small Chinese nuclear forces are not equivalent to those of the United States and Russia.[77] Leaving aside the quantitative and qualitative differences of China's nuclear force, its warheads and relevant delivery systems are stored at separated locations, which means the existing counting rules in New START are not suitable to China.[78] Several Chinese spokespersons rejected the Trump administration's calls officially, arguing that the two nuclear superpowers should bear the main responsibility of reducing their arsenals to lower levels.[79] From Beijing's perspective, any request for a trilateral arms control dialogue from the United States is more a litmus test of its campaign of maximum pressure towards China on a range of policy issues and an excuse for its withdrawal from the treaty for non-substantive reasons. China is also worried that verification of its forces under a trilateral treaty could help to detect and weaken Beijing's limited nuclear retaliatory capabilities, which rely in part on opacity and ambiguity to compensate for its limited nuclear force.

China's negative attitude towards trilateral strategic arms control negotiation doesn't mean that China does not support the international disarmament and non-proliferation process. As a permanent member of the U.N. Security Council and a nuclear-weapon state, China has played constructive roles in other multilateral nuclear-related negotiations. In the 1990s, China actively led negotiations on military-to-military confidence building and risk reduction. It signed the multilateral 1996 Comprehensive Nuclear-Test-Ban Treaty and participated in the international monitoring systems being set up to detect nuclear explosions around the world. China pushed for a treaty preventing an arms race in outer space.[80] China also played a supportive role in negotiations leading to the 2015 multilateral Iran nuclear deal aimed at limiting that country's pathways to developing nuclear weapons. In the non-proliferation of missiles and their technologies, although it has not participated in any of the world's major export control

[77] According to Kristensen's assessment, Russia and the United States each maintain approximately 4,000 operational nuclear weapons, while China has around 300, cited from Kristensen H. M. and M. Korda, "Status of World Nuclear Forces", *Federation of American Scientists*, April, 2020, https://fas.org/issues/nuclear-weapons/status-world-nuclear-forces/

[78] Leanne Quinn, "China's Stance on Nuclear Arms Control and New START," *Arms Control Now*, 23 August 2019, https://www.armscontrol.org/blog/2019-08-23/chinas-stance-nuclear-arms-control-new-start

[79] Director-General FU Cong's Interview with Kommersant, Ministry of Foreign Affairs of the People's Republic of China, Oct.16, 2020, https://www.fmprc.gov.cn/mfa_eng/wjbxw/t1824545.shtml

[80] Nancy Gallagher, "China on Arms Control, Nonproliferation, and Strategic Stability," *CISSM Working Paper*, August 2019: 2.

mechanisms except for joining the Nuclear Suppliers Group in 2004, China joined the Hague International Code of Conduct against Ballistic Missile Proliferation (HCOC) and pledged to halt missile exports in 1992, 1994, 1998, and 2000. In August 2002, China promulgated its own missile export control regulations and lists that corresponded closely to the Missile Technology Control Regime (MTCR) guidelines.[81] In 2003, China applied to join in the MTCR but was blocked by the United States.

When the United States shifted its China policy from engagement to containment under the Trump Administration—a posture likely to be maintained under the Biden administration—China became even more sensitive to the United States' trilateral arms control initiative. Nonetheless, China embraces dialogue underpinned by fair, equitable, and concrete principles. China will participate in negotiations when involved in a broader set of negotiating partners such as France and the United Kingdom with similar levels of nuclear forces rather than being singled out. All five officially recognized nuclear weapon states (the so-called "P5") have convened and collaborated successfully on the Iran negotiations. From Beijing's perspective, the P5 format might be more appealing than the prospect of negotiating alone with only the two nuclear superpowers. The P5 will be a good place for Beijing to negotiate confidence building measures such as the No First Use (NFU) principle. Some Chinese scholars even support the notion that China should enter into nuclear arms control dialogues rather than nuclear arms reduction negotiations because the concept of arms control is more comprehensive than arms reduction.[82]

## Reducing the Risks of Dangerous Strategic Arms Races

The rapidly worsening global security environment now exacerbated by the global pandemic has led to several missile control treaties or agreements being abandoned or facing an uncertain future. The ABM Treaty and the Conventional Forces in Europe (CFE) Treaty collapsed. The termination of the INF Treaty highlights that bilateral arms control ultimately would not curb the geographical spread and technological advancement of missiles. The former Trump administration announced

[81] Robert J. Einhorn and Gary Samore, "Ending Russian Assistance to Iran's Nuclear Bomb," *Survival*, Vol. 44, No. 2 2002: 12.
[82] Wu Riqiang, "Trilateral Arms Control Initiative: A Chinese Perspective," *Bulletin of the Atomic Scientists*, 4 September 2019, https://thebulletin.org/2019/09/trilateral-arms-control-initiative-a-chinese-perspective

its withdrawal from the Open Sky Treaty. The 2010 New START, the only remaining treaty on limiting strategic ballistic missiles and strategic bombers, was going to expire in February 2021 and was saved only at the last moment by its extension by the Biden administration. Under Trump, even nuclear testing was put back on the agenda with unfounded American claims of the resumption of Chinese nuclear testing—which would have contravened the Comprehensive Nuclear Test Ban's "zero-yield" standard.[83] This reinforces just how far the negative trend went in the United States. Although many observers hope the Biden administration will reverse this trend, structural trends at the global level involving the nine nuclear-armed states, and the chaotic state of American domestic politics and nature of its foreign policy, mean that no-one can predict its stance on these issues for longer than a few years.

China opposes arms racing outright due to its cost and potential strategic risks. From the Chinese perspective, the situation could be improved by the following measures. First, states should strengthen and enlarge the existing institutions of missile control. A combination of deteriorating great-power relations, uncertainties about the impact of emerging technologies, and the fact that some "post-INF" missiles are inherently attractive to states, with low political and legal barriers to acquisition and use, has undermined controls on missile proliferation. There is no universal norm, treaty, or agreement which governs the development, testing, production, acquisition, possession, transfer, deployment, or use of missiles. Apart from the bilateral missile control treaties, the relevant mechanisms include unilateral (export controls), coordinated among exporting states as the MTCR, or multilateral but not legally binding and far from universal measures such as the HCOC. Despite its imperfections, the MTCR—the only existing multilateral arrangement covering the transfer of missiles and missile-related equipment, material, and technology relevant to weapons of mass destruction (WMD)—has brought a significant degree of order to containing the spread of ballistic missiles. The HCOC, an offspring of the MTCR and a useful set of voluntary confidence building measures, refers only to one category of missiles.

The existing regulations covering missiles fall far short of those that would avoid a costly and potentially deadly arms competition. For those concerned and responsible states in this region, it

[83] US State Department, "Executive Summary of Findings on Adherence to and Compliance with Arms Control, Nonproliferation, and Disarmament Agreements and Commitments," *Bureau of Arms Control, Verification and Compliance*, April. 2020, https://www.state.gov/wp-content/uploads/2020/04/Tab-1-EXECUTIVE-SUMMARY-OF-2020-CR-FINDINGS-04.14.2020-003-003.PDF

is time to act now, or we will find ourselves bested by a destabilizing missile arms race. These existing instruments should give proper priority to cruise missiles and hypersonic missiles and even missile defense. The scope and number of their participants should be enlarged. A regional missile-limitation regime that provides prior notice of missile and satellite launches to enhance transparency and predictability would also offer great strategic benefits to all states in the region.[84]

Second, all states—but especially the great power nuclear armed states—must do everything possible to avoid the risk of war and nuclear war. States that possess nuclear-armed missiles must ensure that no accident or incident ever happens. All the nuclear-armed states should take the famous saying “a nuclear war cannot be won and must never be fought” as a common understanding and restrain their development and employment of any nuclear ballistic or cruise missiles. Nuclear-armed states should be divided into three levels according to the quantity or quality of their nuclear weapons. Each level should have different responsibilities.

The first level is Russia and the United States which, as nuclear superpowers, have more than ninety percent of the world’s nuclear warheads. The deterioration of great power relationships has increased the possibility of a nuclear arms race. Their negative attitudes toward arms control have become a major barrier to the progress of international non-proliferation. The nuclear superpowers should reduce the role of nuclear weapons in their military doctrines by rejecting preemptive nuclear strikes or declaring that the sole use of nuclear weapons is as “the last resort” to defend their national security.

The second layer includes France, Great Britain, and China, the other three permanent members of the U.N. security council. It is imperative to encourage these states to make more contributions to the international arms control process.

The third layer involves the four *de facto* nuclear states, India, Pakistan, the DPRK, and Israel, who are neither members of the P5 nor parties to the NPT. Their rights to exploit nuclear energy peacefully should be respected. Meanwhile, every effort should be made to limit and reduce the

[84] Kurosaki Akira, “Moving Beyond Deterrence and Missile Defense,” *INESAP Briefing Paper,* No.13, November 2004, http://www.inesap.org/sites/default/files/Briefing13_04_0.pdf

risk of a nuclear war or conflict between India and Pakistan to boost the denuclearization process of the DPRK, while guaranteeing their national security.

Last, but not the least, the new arms control and disarmament dialogue must directly address the new factors that could increase the risk of accidental or inadvertent nuclear conflict, most important, the potential destabilizing effects of new non-nuclear weapon technologies such as ballistic missile defense, anti-satellite weapons, and precision-strike missile technology. The emerging advanced technologies supplement and even enhance nuclear weapons while offering non-nuclear states capabilities with which to offset the projection of conventional and nuclear forces by the great powers. With the widespread applications of emerging technologies, non-nuclear military facilities and platforms may degrade nuclear decision-making and increase the risk of an accidental nuclear war. Thus, Track 2 dialogues on emerging technologies and some non-nuclear weapon systems might develop workable proposals to reduce the resulting risks.

The continued high alert levels of American, Russian, British, and French warheads to support "launch on warning" is another risk that deserves urgent attention. Moreover, Russia and the United States each possess huge counterforce capabilities, which threatens not only each other but lesser nuclear adversaries with a decapitating and disarming first-strike. In contrast, China, India, and Pakistan reportedly keep their nuclear weapons un-deployed at central storage facilities on low alert levels. Their retaliatory strike capabilities are based on the principle of "launch under attack," not "under warning." Already in 1994, China proposed that the P5 should agree to adopt NFU, which could lay the foundation of developing codes of conduct to decrease the risks.[85] Recognizing the NFU principle could lessen the risk arising from misperception and misunderstanding of the preemptive strike posture on the one hand and sustain the taboo against nuclear employment on the other.

[85] Zhengqiang Pan, "A Study of China's No-First-Use Policy on Nuclear Weapons," *Journal for Peace and Nuclear Disarmament*, 1, No.1, 2018: 115-136.