



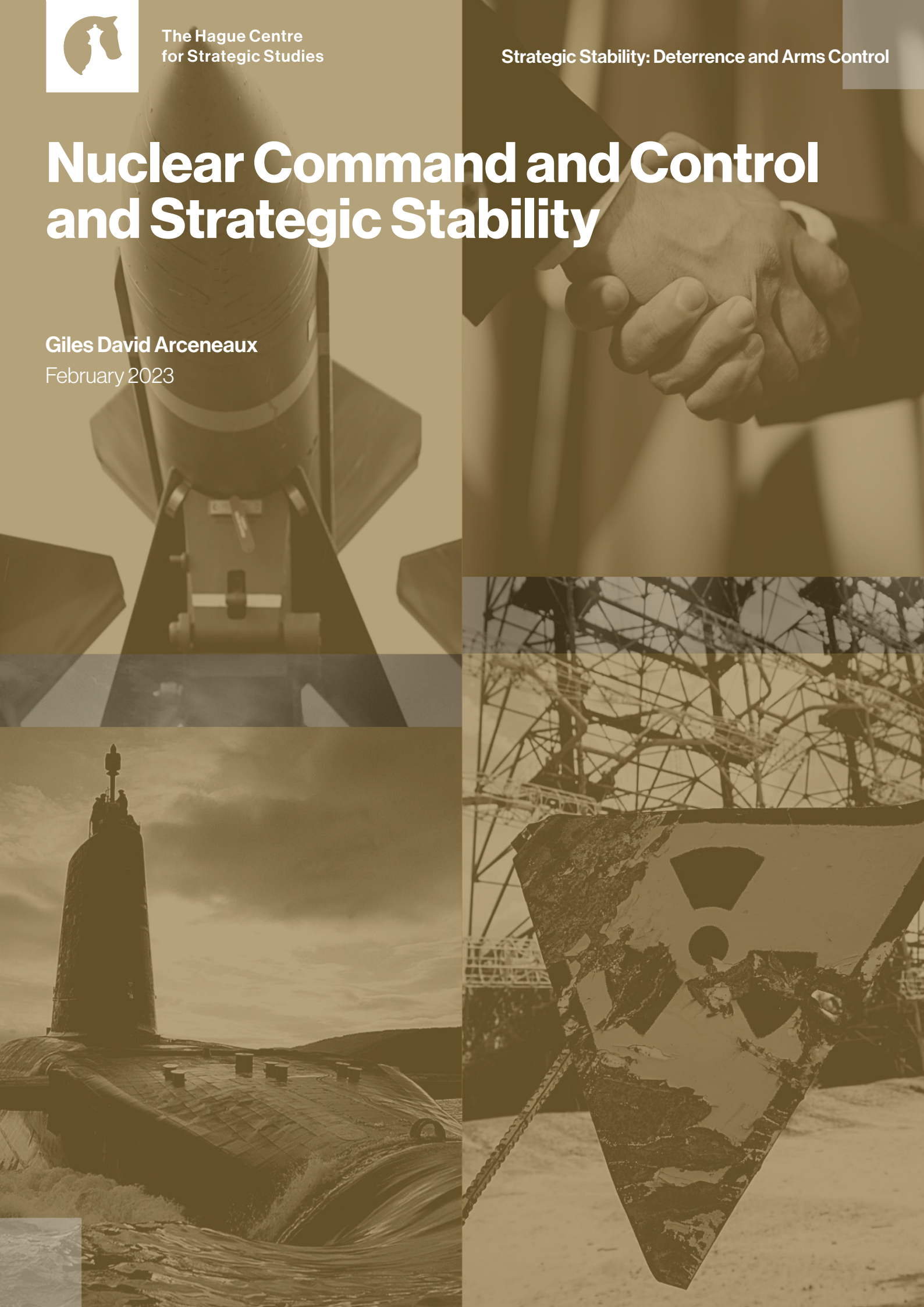
The Hague Centre
for Strategic Studies

Strategic Stability: Deterrence and Arms Control

Nuclear Command and Control and Strategic Stability

Giles David Arceneaux

February 2023





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Author:

Giles David Arceneaux

Editors:

Paul van Hooft and Tim Sweijjs

This paper is part of the HCSS programme on Strategic Stability: Deterrence and Arm Control.

Cover photo:

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February 2023

The research for and production of this report has been conducted within the PROGRESS research framework agreement. Responsibility for the contents and for the opinions expressed, rests solely with the authors and does not constitute, nor should be construed as, an endorsement by the Netherlands Ministries of Foreign Affairs and Defense.

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Strategic stability refers to the ability of states to interact during crises without escalating diplomatic and conventional military disputes to the use of nuclear weapons. This essay evaluates the effects of nuclear command and control systems on strategic stability in crisis scenarios. The essay argues that states with command and control systems that delegate the ability to use nuclear weapons to lower-level commanders early in a crisis create conditions that endanger strategic stability and risk unintended nuclear escalation. Concerningly, such nuclear command and control arrangements increase the likelihood that nuclear weapons are used in conflict, even if neither side in a crisis formally crosses an established red line beforehand. This study defines the concept of nuclear command and control, details the challenges that command and control systems pose for strategic stability, identifies challenges to strategic stability in Europe and East Asia, and discusses opportunities for policymakers to reinforce strategic stability in those regions. Although nuclear command and control systems are difficult to shape directly, policymakers can promote strategic stability by engaging in near-term efforts to strengthen nuclear deterrence and long-term efforts to achieve limited arms control agreements between countries.

Introduction: Nuclear Operations and Strategic Stability

Strategic stability refers to the ability of states to interact during crises without escalating diplomatic and conventional military disputes to the use of nuclear weapons.¹ The ongoing war in Ukraine serves as a reminder that strategic stability is not guaranteed, and the dangers of nuclear weapons remain considerable. Indeed, Russian leaders have made increasingly concerning nuclear threats throughout the course of the war,² leading U.S. President Joe Biden to state that the “prospect of Armageddon” is currently more likely than it has been at any point since the 1962 Cuban Missile Crisis.³

This essay evaluates the effects of nuclear command and control systems on strategic stability in crisis scenarios. Command and control systems are the operational means by which a state manages its nuclear forces during peacetime and crises. When states develop these systems, they must make trade-offs between increasing the readiness of their nuclear

1 The concept of strategic stability has many different definitions and interpretations. For a survey of the conceptual landscape, see Elbridge Colby, “Defining Strategic Stability: Reconciling Stability and Deterrence,” in Elbridge A. Colby and Michael S. Gerson, eds., *Strategic Stability: Contending Interpretations* (Carlisle, P.A.: U.S. Army War College Press, 2013), pp. 47-87.

2 Harry Fletcher, “A Timeline of Putin’s Nuclear Threats Against the West as He Claims He’s Not ‘Bluffing,’” *Indy100*, September 21, 2022.

3 Katie Rogers and David E. Sanger, “Biden Calls the ‘Prospect of Armageddon’ the Highest Since the Cuban Missile Crisis,” *New York Times*, October 6, 2022.

arsenal in preparation for potential conflict and barriers against unwanted nuclear use that increase arsenal safety and security. Command and control systems therefore directly shape the conditions under which conventional crises might escalate to nuclear use and have profound effects on strategic stability.

My central argument is that states with command and control systems that enable lower-level commanders to use nuclear weapons early in a crisis create conditions that endanger strategic stability and risk unintended nuclear escalation. In practice, such nuclear command and control arrangements increase the likelihood that nuclear weapons are used in conflict, even if neither side in a crisis formally crosses an established red line. This pathway to crisis escalation exists because the actions a state must undertake to guarantee that its nuclear forces are always prepared for use during crises necessarily reduces the barriers to nuclear use, thereby increasing the likelihood of nuclear escalation. Ultimately, this observation suggests that rapid crisis de-escalation is essential to promoting strategic stability and reducing the likelihood of nuclear weapons use, especially when engaging with countries that delegate the ability to use nuclear weapons to lower-level military commanders early in crises, thereby weakening political oversight of nuclear decision-making.

The essay proceeds in four sections. First, I define the concept of nuclear command and control, identify the challenges that states face when developing operational nuclear doctrine, and provide a framework for classifying nuclear command and control systems. Second, I detail the distinct challenges that each pattern of nuclear command and control poses to strategic stability. Third, I discuss the ways in which nuclear command and control arrangements pose challenges to strategic stability in Europe and East Asia, with specific attention to potential crises involving Russia, China, and North Korea. Fourth, I conclude by discussing the policy implications of my research to identify opportunities for policymakers to reinforce strategic stability.

Nuclear Command and Control

Nuclear command and control systems are the operational means by which a state conducts the management, deployment, and potential release of nuclear weapons.⁴ These systems directly impact critical dimensions of nuclear strategy. For example, although a significant portion of the literature on nuclear strategy views secure second-strike capabilities—referring to a state's ability to survive an adversary's first strike and respond with nuclear weapons—as easily obtainable, vulnerabilities in nuclear command and control frameworks undermine this assumption.⁵

4 Vipin Narang, *Nuclear Strategy in the Modern Era: Regional Powers and International Conflict* (Princeton, N.J.: Princeton University Press, 2014), p. 4.

5 For examples of such arguments, see: James Acton, "Managing Vulnerability," *Foreign Affairs*, Vol. 89, No. 2 (March/April 2010), p. 147; Michael S. Gerson, "No First Use: The Next Step for US Nuclear Policy," *International Security*, Vol. 35, No. 2 (Fall 2010), pp. 7-47; Charles L. Glaser, *Analyzing Strategic Nuclear Policy* (Princeton, N.J.: Princeton University Press, 1990), pp. 95-97, 320; Charles L. Glaser and Steve Fetter, "Should the United States Reject MAD? Damage Limitation and U.S. Nuclear Strategy toward China," *International Security*, Vol. 41, No. 1 (Summer 2016), pp. 49-98; Robert Jervis, *The Meaning of the Nuclear Revolution: Statecraft and the Prospect of Armageddon* (Ithaca, N.Y.: Cornell University Press, 1989); Jan Lodal, "The Counterforce Fallacy," *Foreign Affairs*, Vol. 89, No. 2 (March/April 2010), p. 146.

States with command and control systems that enable lower-level commanders to use nuclear weapons early in a crisis create conditions that endanger strategic stability and risk unintended nuclear escalation.

States with vulnerable command and control systems face pressures to use nuclear weapons early in a crisis before an adversary can negate the state's ability to retaliate with nuclear force.⁶ During crises, these pressures can result in the deliberate or inadvertent escalation of hostilities that significantly increases the likelihood of nuclear use.⁷ Command and control systems therefore fundamentally underpin core concepts of nuclear strategy such as deterrence and strategic stability by shaping the ability of a state to credibly deter its adversaries and creating pathways through which nuclear escalation may occur.

Challenges and Trade-Offs: The Always/Never Dilemma

When developing command and control systems, all nuclear states face a fundamental problem known as the always/never dilemma. This dilemma holds that nuclear weapons should *always* launch when ordered, but *never* without proper authorisation.⁸ The always/never dilemma suggests that efforts to ensure the reliability of a nuclear arsenal can challenge the safety and security of a nuclear arsenal, whereas attempts to increase arsenal safety and security very likely reduce arsenal reliability.

A pair of examples illustrate the nature of the dilemma. Political leaders can favour the always side of the always/never dilemma by pre-delegating the ability to use nuclear weapons to lower-level military commanders to reduce the time required to respond to an attack, but this arrangement requires fewer layers of authorisation to use nuclear weapons and increases the likelihood of unwanted nuclear use. Alternatively, leaders can favour the never side of the always/never dilemma by implementing robust administrative oversight over the mobilisation and employment of nuclear forces to protect against unwanted nuclear use, but these measures increase the time required to respond to an attack and the arsenal becomes more vulnerable to pre-emption and decapitation. Leaders can adopt a mixture of such measures, but the always/never dilemma ultimately forces trade-offs between arsenal reliability, safety, and security for all nuclear states.

Patterns of Nuclear Command and Control

Command and control systems represent a state's institutional approach to resolving the always/never dilemma.⁹ Although a state might prefer to centralise political control over nuclear weapons, lower-level military operators are ultimately required to deliver nuclear weapons, and all states must eventually delegate control to use nuclear forces.¹⁰ The appro-

6 Bruce G. Blair, *Strategic Command and Control: Redefining the Nuclear Threat* (Washington, D.C.: Brookings Institution Press, 1985); John D. Steinbruner, "National Security and the Concept of Strategic Stability," *Journal of Conflict Resolution*, Vol. 22, No. 3 (September 1978), pp. 411-428; Charles A. Zraket, "Strategic Command, Control, Communications, and Intelligence," *Science*, Vol. 224, No. 4655 (June 1984), pp. 1306-1311.

7 Caitlin Talmadge, "Would China Go Nuclear? Assessing the Risk of Chinese Nuclear Escalation in a Conventional War with the United States," *International Security*, Vol. 41, No. 4 (Spring 2017), p. 52. For other important perspectives on the risk of nuclear escalation, see: James M. Acton, "Escalation through Entanglement: How the Vulnerability of Command-and-Control Systems Raises the Risks of an Inadvertent Nuclear War," *International Security*, Vol. 43, No. 1 (Summer 2018), pp. 56-99; Barry R. Posen, *Inadvertent Escalation: Conventional War and Nuclear Risks* (Ithaca, N.Y.: Cornell University Press, 1991); Steinbruner, "National Security and the Concept of Strategic Stability."

8 Peter Douglas Feaver, *Guarding the Guardians: Civilian Control of Nuclear Weapons in the United States* (Ithaca, N.Y.: Cornell University Press, 1992), pp. 3-28.

9 Peter D. Feaver, "Command and Control in Emerging Nuclear Nations," *International Security*, Vol. 17, No. 3 (Winter 1992/93), p. 168.

10 Giles David Arceneaux and Peter D. Feaver, "The Fulcrum of Fragility: Command and Control in Regional Nuclear Powers," in Vipin Narang and Scott D. Sagan, eds., *The Fragile Balance of Terror: Deterrence in the New Nuclear Age* (Ithaca, N.Y.: Cornell University Press, 2023), pp. 182-208.

The always/never dilemma holds that nuclear weapons should always launch when ordered, but never without proper authorisation.

appropriate question for classifying command and control systems is therefore not simply *whether* states delegate nuclear use capability to lower levels of command, but rather *when* such delegation occurs.¹¹

The timing of delegation is most significant with respect to the onset of a crisis. States possess three options for when to delegate the ability to use nuclear weapons: during peacetime, before a crisis emerges; early in a crisis, when political tensions become severe and military forces mobilise; or late in a crisis, after significant conventional or even nuclear warfighting. Classifying command and control systems according to the timing of delegation yields three analytically distinct arrangements: delegative, conditional, and assertive control.¹² Table 1 summarises the key features of each nuclear command and control arrangement.

First, delegative control refers to the peacetime delegation of nuclear use capability. At all

Table 1. Nuclear Command and Control Arrangements



	Timing of Delegation	Administrative Controls	Physical Controls	Technical Controls
Delegative Control	Peacetime delegation	Decentralised use capability	Components assembled and mated	Absent or minimal
Conditional Control	Early-crisis delegation	Peacetime centralisation, crisis decentralisation	Components highly proximate	Bypassable, if present
Assertive Control	Late-crisis delegation	Centralised use capability	Components dispersed and de-mated	Extensive use-control technologies

times, lower-level military operators possess physical control of the nuclear warheads and delivery platforms required to conduct a nuclear strike. These platforms are typically unconstrained by use-control technologies such as permissive action links.¹³ Administratively, military operators possess the ability to use nuclear weapons at any time, even if not the authority.

Second, conditional control delegates the ability to use nuclear weapons early in a crisis. During peacetime leaders centralise administrative authority, physically disperse nuclear components, and often implement at least modest technical controls. Early in a crisis—as conventional force mobilisations begin or some other escalatory measures ensue—these states rapidly assemble deliverable nuclear weapons, remove technical control barriers, and delegate nuclear use ability to lower-level military commanders and the custodians of nuclear weapons.

Third, assertive control delegates nuclear use capability late in a crisis. These states promote highly centralised administrative control over nuclear operations and often physically de-mate and disperse nuclear weapons to guarantee political control over nuclear decisions throughout

11 This conceptual framework differs starkly from the primary conceptual framework employed during the Cold War, which was temporally static and only asked whether states delegated nuclear use capability to lower-level commanders, rather than when such delegation occurred. This original framework is most clearly presented in Feaver, *Guarding the Guardians*.

12 For an extended discussion of this conceptual framework and the importance of emphasising the temporal aspects of delegation, see Giles David Arceneaux, "Beyond the Rubicon: Command and Control in Regional Nuclear Powers," Ph.D. dissertation, Syracuse University, 2019.

13 On permissive action links, see Peter Stein and Peter Feaver, "Assuring Control of Nuclear Weapons: The Evolution of Permissive Action Links," CSIA Occasional Paper No. 2 (Cambridge, M.A.: CSIA Publications, 1987).

the crisis. Typically, assertive control is the result of political distrust in the military and demonstrates an unwillingness to involve powerful military organisations in nuclear decision-making.¹⁴ Assertive control systems often include technical controls such as permissive action links to separate the administrative control of nuclear forces from the physical possession of nuclear weapons, thereby allowing leaders to maintain centralised control deeper into a crisis.¹⁵

Nuclear Command, Control and Crisis Escalation

Because each pattern of nuclear command and control requires different trade-offs in accordance with the always/never dilemma, these different frameworks also produce different pressures on strategic stability. This section details why delegative and conditional control arrangements merit greater concern during crises, while assertive control reduces pressures for crisis escalation.

Delegative control incurs two major risks to strategic stability: accidental and unauthorised use.¹⁶ Accidental use refers to the unintentional launch of nuclear weapons due to mishandling, poor design, or some other unintended cause. Unauthorised use refers to when the custodians of nuclear weapons use those weapons without proper authorisation from political leadership, whether because a lower-level commander purposefully circumvents the chain of command or elects to use nuclear weapons during a crisis without requesting political authorisation in order to prevent being overrun by an enemy's military forces. Strategic stability may be undermined if lower-level commanders unilaterally elect to use nuclear forces, or if those commanders experience battlefield pressures to use nuclear weapons before losing them.

Conditional control systems face three challenges to strategic stability. First, the process of increasing arsenal readiness early in a crisis may signal malign intent to an adversary and increase the likelihood of crisis escalation. Second, the rapid inclusion of military influence in nuclear decision-making weakens political oversight of nuclear operations and creates opportunities for national policy and military operations to diverge as a crisis begins, which makes crisis de-escalation more difficult. Third, the transition from centralised to decentralised control occurs as actors begin to face pervasive uncertainty, thereby increasing the likelihood of misperception. Combined, these challenges for conditional control can undermine strategic stability by creating distinct pathways that increase the likelihood of conflict escalation.

Assertive control is the least dangerous form of command and control for crisis escalation and strategic stability. Because delegation occurs late in a crisis, assertive control systems are resilient against accidental and unauthorised use during peacetime and escalatory spirals during crises. Assertive control strengthens strategic stability, but at a cost to the state employing such arrangements. Specifically, states employing assertive control must accept vulnerabilities that might inhibit their ability to respond to an adversary's first strike with nuclear forces.

14 Arceneaux, "Beyond the Rubicon," pp. 38-53.

15 Donald R. Cotter, "Peacetime Operations: Safety and Security," in Ashton B. Carter, John D. Steinbruner, and Charles A. Zraket, eds., *Managing Nuclear Operations* (Washington, D.C.: Brookings Institution Press, 1987), p. 46.

16 Feaver, *Guarding the Guardians*, pp. 13-18.

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Nuclear Risks in Europe and East Asia

NATO's 2022 Strategic Concept focuses on three nuclear-armed actors that pose a range of threats to NATO interests,¹⁷ including Russia, China, and North Korea.¹⁸ In this section, I discuss the nuclear command and control systems of each country and identify how those systems affect strategic stability.¹⁹ Specifically, I show that Russia and North Korea employ conditional control arrangements that increase the likelihood of conventional crises escalating to nuclear use, while China employs assertive control measures that limit—although do not eliminate—the pathways to nuclear escalation.

Russia

Russia employs conditional control over its nuclear forces. During peacetime, Russia appears to manage its nuclear forces in ways that mitigate the risks of accidental and unauthorised use. Russian military doctrine clearly specifies centralised administrative control, stating that “the decision to use nuclear weapons shall be taken by the President of the Russian Federation.”²⁰ The procedures to authorise use nuclear weapons reinforce centralised control by requiring the joint collaboration of the president, defence minister, and chief of the General Staff.²¹ Physically, warheads are kept de-mated from ballistic missiles during peacetime.²² Early in a crisis, though, Russia would likely transfer warheads from one of its twelve central storage sites to base-level facilities with delivery systems.²³ Technically, Russia possesses permissive action links that serve as barriers to unauthorised nuclear use during peacetime, but these technical controls would likely be removed during mobilisation to prepare nuclear forces for use early in a crisis.²⁴

Russia's war in Ukraine provides the most concerning example of how nuclear command and control systems create pressures on strategic stability. In addition to the prospect of Russian President Vladimir Putin purposefully deciding to use nuclear weapons in conflict, Russia's conditional control systems create risks of unintended nuclear use. These pathways to unintended escalation underscore an important point: simply approaching Russia's red lines—even without crossing them—increases the likelihood of nuclear use.

Russia appears to have two core interests which, if challenged, could prompt nuclear use: first, threats to the physical security of Russia, potentially including the illegally annexed

Russia's war in Ukraine provides the most concerning example of how nuclear command and control systems create pressures on strategic stability.

17 For a discussion of European interests in East Asia that merit attention from defence planners, see Paul van Hooft, Benedetta Girardi, and Tim Sweijts, “Guarding the Maritime Commons: What Role for Europe in the Indo-Pacific,” Hague Centre for Strategic Studies, February 2022.

18 North Atlantic Treaty Organization, “NATO 2022 Strategic Concept,” June 29, 2022.

19 Command and control arrangements in other countries are beyond the scope of discussion for this policy analysis, but those cases provide additional context for understanding the severity of the challenges posed by the Russian and North Korean cases, in particular. For a description of nuclear command and control arrangements in the other seven current nuclear powers, see Arceneaux and Feaver, “The Fulcrum of Fragility.”

20 Russian Federation, “The Military Doctrine of the Russian Federation,” December 25, 2014, para. 27.

21 Jeffrey G. Lewis and Bruno Tertrais, “The Finger on the Button: The Authority to Use Nuclear Weapons in Nuclear-Armed States,” Occasional Paper No. 45 (Monterey, C.A.: James Martin Center for Nonproliferation Studies, February 2019), p. 10.

22 Amy Woolf, “Russia's Nuclear Weapons: Doctrine, Forces, and Modernization,” Congressional Research Service, April 21, 2022, p. 23.

23 Ibid.; Pavel Podvig and Javier Serratt, “Lock Them Up: Zero-Deployed Non-Strategic Nuclear Weapons in Europe,” UNIDIR, 2017, pp. 14-19.

24 Lewis and Tertrais, “The Finger on the Button,” pp. 3, n. 3; 10-12.

portions of Ukraine; and second, threats to the survival of Putin's political regime.²⁵ If an adversary such as Ukraine or NATO approaches these red lines, Russia's conditional control arrangements suggest that it is possible Putin would begin preparing his arsenal for use before his adversaries can cross those red lines.

Russia's early-crisis delegation of nuclear use capability would create a pair of significant challenges to strategic stability.²⁶ First, by mating nuclear warheads to missiles and placing those fully assembled weapons in the hands of lower-level Russian military operators, the risk of accidental and unauthorised use would immediately increase. Even if lower-level operators did not yet have the authority to use nuclear weapons, this step would grant them the ability to do so if they viewed nuclear use as operationally necessary. Second, the process of increasing arsenal readiness could create pre-emptive strike incentives. If Western intelligence observed clear indicators of Russia beginning to prepare its nuclear arsenal for use, Western officials could view such mobilisation as a cause for pre-emptive strikes against Russia's nuclear forces to prevent Russia from using those nuclear weapons against Ukraine. Whether NATO forces conducted the attack or shared intelligence to support a Ukrainian attack against mobilising Russian nuclear forces, the direct targeting of Russia's nuclear forces would encourage Russia to use those nuclear weapons before losing them in combat. Ultimately, this effort to prevent Russian nuclear use could directly cause the nuclear exchange that attacking forces hoped to avoid in the first place.

China

China has historically exercised highly assertive control over its nuclear forces.²⁷ Administratively, all nuclear operations occur under the authority of the chairman of the Central Military Commission (CMC).²⁸ China's political leaders have historically prioritised political control over nuclear forces. John Lewis and Xue Litai note this emphasis on centralised administrative control, stating: "A launch will automatically be aborted if any step violates the verification requirements."²⁹ Furthermore, unlike other services in the People's Liberation Army (PLA), the CMC directly commands the PLA Rocket Force to guarantee political oversight of nuclear operations.³⁰ Physically, nuclear warheads are de-mated from delivery platforms and geographically dispersed to guarantee that lower-level military actors cannot use nuclear weapons without political approval.³¹ A political commissar oversees nuclear warheads at China's nuclear storage facilities and only releases these warheads to the PLA's missile units upon the direction of CMC and Politburo leaders.³² Technical use-control

25 For a discussion of navigating Russia's red lines, see Dan Altman, "The West Worries Too Much About Escalation in Ukraine," *Foreign Affairs*, July 12, 2022.

26 This discussion of pathways to unwanted nuclear escalation builds on the argument made in Giles David Arceneaux and Rachel Tecott, "Nuclear Risks: Russia's Ukraine War Could End in Disaster," *National Interest*, July 31, 2022.

27 Fiona Cunningham, "Nuclear Command, Control, and Communications Systems of the People's Republic of China," NAPSNet Special Reports, July 18, 2019.

28 Bates Gill and Evan S. Medeiros, "China," in Hans Born, Bates Gill, and Heiner Hänggi, eds., *Governing the Bomb: Civilian Control and Democratic Accountability of Nuclear Weapons* (New York, N.Y.: Oxford University Press, 2010), p. 137.

29 John Wilson Lewis and Xue Litai, *Imagined Enemies: China Prepares for Uncertain War* (Stanford, C.A.: Stanford University Press, 2008), pp. 198-199.

30 Cunningham, "Nuclear Command, Control, and Communications Systems of the People's Republic of China."

31 Mark A. Stokes, *China's Nuclear Warhead Storage and Handling System*, Project 2049 Institute Monograph, March 12, 2010.

32 *Ibid.*, p. 5.

devices likely exist on China's current nuclear weapons and are either indigenously developed or the product of Russian assistance.³³

China's reliance on assertive control is largely a positive for strategic stability and clearly stands in contrast to the Russian command and control design. In the event of a crisis between China and Western states, China is unlikely to prepare its nuclear arsenal for use until late in the crisis, likely only after extensive conventional military warfighting has occurred. This late-crisis delegation significantly reduces the likelihood of accidental and unauthorised use, as military operators would not have fully assembled nuclear weapons to use in combat. Additionally, the lack of nuclear mobilisation would avoid potential crisis escalation caused by misperception of intentions during the mobilisation process. The likelihood of nuclear escalation does not drop to zero because of China's assertive control arrangements, but strategic stability is much more robust as a result, especially when viewed in comparison to examples such as Russia and North Korea.³⁴

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North Korea

Although limited, the available evidence suggests that North Korea (DPRK) employs conditional command and control systems. Administratively, the chairman of the Workers' Party exercises the final authority over nuclear use decisions. A recent North Korean statement on its nuclear doctrine demonstrates this principle, stating that "the president of the State Affairs of the DPRK shall have all decisive powers concerning nuclear weapons."³⁵ North Korea institutionalised centralised peacetime control in 2012 by creating the Strategic Rocket Forces Command, a military body with equal status to the other KPA services that reports directly to the supreme leader.³⁶ At the same time, North Korea's state-run Korean Central News Agency emphasises that nuclear weapons must remain "on standby so as to be fired any moment."³⁷ Given North Korea's doctrinal emphasis on pre-emptive strikes,³⁸ it appears likely that Kim Jong Un would rapidly decentralise control early in a crisis and delegate nuclear use capability to lower level commanders.³⁹ Physically, the Central Military Committee (CMC) of the Workers' Party of Korea manages nuclear warheads during peacetime. Once the supreme leader authorises the release of nuclear weapons, military operators can obtain warheads from the CMC and mount the warheads to their delivery platforms.⁴⁰ Technically, no evidence exists to suggest that North Korea employs use-control technologies on its nuclear weapons.⁴¹ The absence of such technical controls allows North Korea to more rapidly prepare its

33 Cunningham, "Nuclear Command, Control, and Communications Systems of the People's Republic of China."

34 For works on the prospects for crisis escalation resulting in nuclear use with China, see: Talmadge, "Would China Go Nuclear?"; Wu Riqiang, "Assessing China-U.S. Inadvertent Nuclear Escalation," *International Security*, Vol. 46, No. 3 (Winter 2021/22), pp. 128-162.

35 Supreme People's Assembly of the DPRK, "DPRK's Law on Policy of Nuclear Forces Promulgated," September 9, 2022.

36 Andrew O'Neil, "North Korea's Dangerously Rudimentary Nuclear Command-and-Control Systems," *Interpreter*, August 14, 2017.

37 "Kim Jong Un Guides Test-Fire of New Multiple Launch Rocket System," Korean Central News Agency, March 4, 2016.

38 Léonie Allard, Mathieu Duchâtel, and François Godement, "Pre-Emptying Defeat: In Search of North Korea's Nuclear Doctrine," Policy Brief, European Council on Foreign Relations, 2017, p. 7. North Korea's official nuclear doctrine also identifies several conditions under which North Korea would use nuclear weapons first, including threats of attacks "on the horizon." See Supreme People's Assembly of the DPRK, "DPRK's Law on Policy of Nuclear Forces Promulgated."

39 Nathan Beauchamp-Mustafaga, "North Korea's Weak Nuclear C2 Challenges Korean Crisis Stability," Pacific Forum Brief No. 22, March 14, 2017.

40 Myeongguk Cheon, "DPRK's NC3 System," NAPSNet Special Reports, June 6, 2019.

41 Beauchamp-Mustafaga, "North Korea's Weak Nuclear C2 Challenges Korean Crisis Stability."

arsenal for use early in a crisis without the additional layer of technical control over its nuclear weapons, further indicating conditional control arrangements.

Like Russia, North Korea's conditional control systems create challenges to strategic stability. North Korea's conventional military inferiority with respect to U.S. and South Korean forces and fears of regime change encourage the delegation of nuclear use capability early in a crisis. As a result, actions aimed at reassuring allies and maintaining military capability could cause North Korean leadership to proactively prepare their nuclear arsenal for use to defend against a preventive attack that might neutralise North Korea's nuclear arsenal. For example, if North Korea perceives the resumption of large-scale military exercises between the United States and South Korea as the precursor to an attack, Supreme Leader Kim Jong Un could order an increase in North Korea's nuclear readiness. Delegating nuclear use capability to lower-level military commanders and providing them control over fully assembled nuclear weapons would reduce the barriers to use and increase the likelihood of accidental or unauthorised use. Furthermore, if U.S. intelligence observes efforts to prepare North Korea's nuclear forces for use, the United States would have to decide whether that mobilisation indicates an imminent attack against U.S. and allied forces. Even if North Korean nuclear mobilisation was purely defensive in nature, U.S. policymakers could very well view mobilisation as imminently threatening and elect to target North Korean capabilities with conventional or nuclear weapons. In this scenario, North Korea would be expected to use any surviving nuclear weapons in retaliation, thereby guaranteeing a nuclear exchange through a crisis in which neither side originally intended to use nuclear weapons.

Policy Implications and Recommendations

The proceeding discussion shows how nuclear command and control systems can strengthen or weaken strategic stability, depending on the operational nature of a state's command and control systems. Most concerningly, the analysis shows that countries that delegate the ability to use nuclear weapons to lower-level military commanders early during a crisis create pathways through which the likelihood of unwanted nuclear use and crisis escalation increases. Policymakers have three broad options for how to address this challenge and promote strategic stability during crises.

First, policymakers can attempt to shape the ways in which potential nuclear-armed adversaries manage their nuclear forces. Despite the intuitive appeal of this approach, there are important reasons to doubt its effectiveness. Most notably, the factors that most decisively shape nuclear command and control systems—including conventional military threats, domestic political instability, and patterns of civil-military relations—are largely resistant to change by outside actors.⁴² Furthermore, even more limited objectives at shaping another state's approach to nuclear command and control have historically failed.

For example, the United States has previously attempted to share permissive action link technology with other nuclear powers to provide those states with use-control technology that would reduce the likelihood of unwanted nuclear use. These attempts, however, have

⁴² For an explanation of how these variables interact to produce discrete patterns of nuclear command and control, see Arceneaux, "Beyond the Rubicon."

failed in multiple instances. U.S. policymakers attempted to share permissive action link technology with Pakistan to address fears of domestic extremism and Pakistan's first-use nuclear doctrine, but Pakistan rejected the offer due to concerns that the United States was attempting to embed technology that would render Pakistan's nuclear weapons inert.⁴³ The United States also failed to transfer permissive action links to the United Kingdom, which declined the technology in favour of a reliance on military organisational professionalism and a trust that the military would not use nuclear weapons without political authorisation.⁴⁴ It is telling that, even in the most likely case for sharing use-control technology—between the United States and its close partner, the United Kingdom—efforts to shape the constitution of other states' nuclear command and control systems have largely failed.

Second, policymakers can attempt to shape the strategic environment of nuclear-armed adversaries to reduce their incentives to delegate nuclear use capability early in a crisis. This would entail reducing conventional military threats to the security of an adversarial state, as well as reducing threats to the ruling regime of the state. North Korea, for example, fears both threats and explicitly includes imminent attacks against the country and Kim Jong Un as justifications for nuclear use.⁴⁵ Given the United States' superior conventional military, vast nuclear arsenal, possession of ballistic missile defence, and significant technological advantages, North Korea must plan for early-crisis delegation that helps to protect against the risk of a first-strike by the United States that would render North Korea's nuclear deterrent powerless.⁴⁶

Reducing such concerns, however, may not be simple. An easy adjustment is to reduce political rhetoric that explicitly threatens the survival of a political regime. For example, former U.S. National Security Advisor John Bolton in 2018 stated that the United States was considering a "Libya model"—in reference to the U.S. supported overthrow of Muammar Qaddafi in 2011—during its negotiations with North Korea about North Korea's nuclear weapons programme.⁴⁷

Reductions in verbal threats will likely have a limited effect in reassuring adversaries of benign intent. To more credibly signal a promise not to threaten an adversary's state or political regime, policymakers would need to reduce the presence of military forces near an adversary's border. This approach would reduce the likelihood of states delegating nuclear use capability early in a crisis, as those states would have more time to negotiate during the process of military build-up. Doing so, however, entails further risks.

Drawing down forces too dramatically can prevent Western allies from deterring aggressive action that threatens their interests and enables states with revisionist aims to pursue their objectives through military force. Especially as Russia continues its war in Ukraine and reports of China's ambitions to seize control of Taiwan in the near-term emerge, it will likely be

43 Brigadier General (ret.) Feroz Hassan Khan, interview by author, February 20, 2019. Pakistan has instead developed an indigenous equivalent to permissive action links, but those permissive action links may be bypassed during times of crisis. Christopher Clary, *Thinking about Pakistan's Nuclear Security in Peacetime, Crisis and War* (New Delhi: Institute for Defense Studies and Analyses, 2010), p. 15; Narang, *Nuclear Strategy in the Modern Era*, p. 89.

44 UK Ministry of Defence, "Nuclear Weapons Security – MoD Statement," November 17, 2007.

45 Supreme People's Assembly of the DPRK, "DPRK's Law on Policy of Nuclear Forces Promulgated."

46 For a discussion on how some of these changes and imbalances affect strategic stability, see Keir A. Lieber and Daryl G. Press, "The New Era of Counterforce: Technological Change and the Future of Nuclear Deterrence," *International Security*, Vol. 41, No. 4 (Spring 2017), pp. 9-49.

47 Megan Specia and David E. Sanger, "How the 'Libya Model' Became a Sticking Point in North Korea Nuclear Talks," *New York Times*, May 16, 2018.

An easy adjustment is to reduce political rhetoric that explicitly threatens the survival of a political regime.

politically difficult for a state to reduce its military presence in theatres of interest.⁴⁸ Limited unilateral threat reduction could strengthen strategic stability by reducing pressures on an adversary's nuclear command and control systems, but it could also undermine strategic stability by encouraging aggressive behaviour by nuclear-armed states. Policymakers considering this option must carefully evaluate thresholds at which these concerns might emerge.

Third, policymakers can pursue arms control agreements that reduce pressures on nuclear command and control systems. Specifically, an agreement to limit tactical nuclear weapons would strengthen strategic stability by removing capabilities from the battlefield that require the delegation of nuclear use capability to lower-level military commanders early in a crisis. Russia currently possesses these weapons and envisions them as a force equaliser to offset its conventional military inferiority.⁴⁹ North Korea is also pursuing tactical nuclear weapons that would generate significant pressures on nuclear command and control.⁵⁰ Ideally, an arms control agreement would be able to remove such capabilities from the battlefield and guarantee that nuclear weapons are only used as a last resort to protect state security or regime survival.

In practice, however, such agreements are difficult to reach and enforce. The 1987 Intermediate-Range Nuclear Forces Treaty between the United States and Soviet Union—which foreswore either side from deploying ground-launched missiles with ranges of 500 to 5,500 kilometres—fell apart in 2019 when the United States and Russia formally withdrew from the treaty, largely due to accusations from both sides that the other state was in violation of the treaty.⁵¹ Furthermore, for countries such as Russia and North Korea that face superior conventional militaries, tactical nuclear weapons may appear necessary to deter and defend against threats to their security and survival. The payoff for a successful treaty to limit such nuclear forces would hugely benefit strategic stability, but the current prospects for such a treaty appear low.

Policymakers face significant challenges for bolstering strategic stability through changes to an adversary's nuclear command and control systems. In many respects, the factors that determine a state's nuclear command and control systems are resistant to external change. The prospects for change, though, are nevertheless possible. In the near-term, the most effective strategy will likely be to jointly reduce rhetorical threats to the political survival of ruling regimes in adversarial states, while simultaneously strengthening deterrence through clearer communication of threats and capabilities to convince any potential adversary that nuclear use would be a self-defeating proposition.⁵² In the long-term, verifiable arms control agreements remain a worthwhile goal, as they would most tangibly reduce operational pressures for states to use nuclear weapons early in a crisis. The road to reaching such agreements might be long, but major nuclear arms control agreements have occurred before, and a new agreement would be a significant win for strategic stability.

48 Reports of China's intent to seize Taiwan are thinly substantiated, but have recently been made by senior U.S. military and intelligence officials. John Culver, "How We Would Know When China Is Preparing to Invade Taiwan," Carnegie Endowment for International Peace, October 3, 2022.

49 On the makeup of Russia's nuclear arsenal, see Hans M. Kristensen and Matt Korda, "Russian Nuclear Weapons, 2022," *Bulletin of the Atomic Scientists*, Vol. 78, No. 2 (February 2022), pp. 98-121.

50 Ankit Panda, "North Korea's Tactical Nuclear Plans Are a Dangerous Proposition," *Foreign Policy*, April 28, 2022.

51 For example, former U.S. President Donald Trump stated in 2018 that Russia had "been violating [the treaty] for many years." "President Trump to Pull US from Russia Missile Treaty," *BBC*, October 21, 2018.

52 On the role of deterrence in promoting strategic stability, see Paul van Hooff, Lotje Boswinkel, and Tim Sweijts, "Shift Sands of Strategic Stability: Towards a New Arms Control Agenda," Hague Centre for Strategic Studies, February 2022.

In the long-term, verifiable arms control agreements remain a worthwhile goal, as they would most tangibly reduce operational pressures for states to use nuclear weapons early in a crisis.

More broadly, these challenges to promoting strategic stability illustrate the continued importance of clear signalling and communications between nuclear-armed states, especially during crises. A common threat to strategic stability—especially prominent in countries with delegative and conditional control systems—is the chance for misperception to produce unwanted escalation. To reduce the likelihood of misperception causing unwanted nuclear escalation, policymakers can rely on two well-established tools. First, states can engage in bilateral discussions, such as track-1.5 dialogues that allow intellectual leaders and political decision-makers to communicate their concerns and intentions more clearly during peacetime. Second, states can establish and maintain “hotlines” that enable timely and direct communications between political leaders during crises to deescalate ongoing crises and reduce the likelihood of nuclear escalation.⁵³ More ambitious objectives such as a return to extensive nuclear arms control treaties and future denuclearisation remain laudable, but in the meantime, bilateral engagement and crisis hotlines are tried and true methods of promoting strategic stability that offer viable pathways to reducing the risk of nuclear weapons in international politics.

These challenges to promoting strategic stability illustrate the continued importance of clear signalling and communications between nuclear-armed states, especially during crises.

53 Steven E. Miller, “Nuclear Hotlines: Origins, Evolution, Applications,” Stanley Center for Peace and Security, October 2020.



The Hague Centre
for Strategic Studies

HCSS

Lange Voorhout 1
2514 EA Hague

Follow us on social media:

@hcssnl

The Hague Centre for Strategic Studies

Email: info@hcss.nl

Website: www.hcss.nl