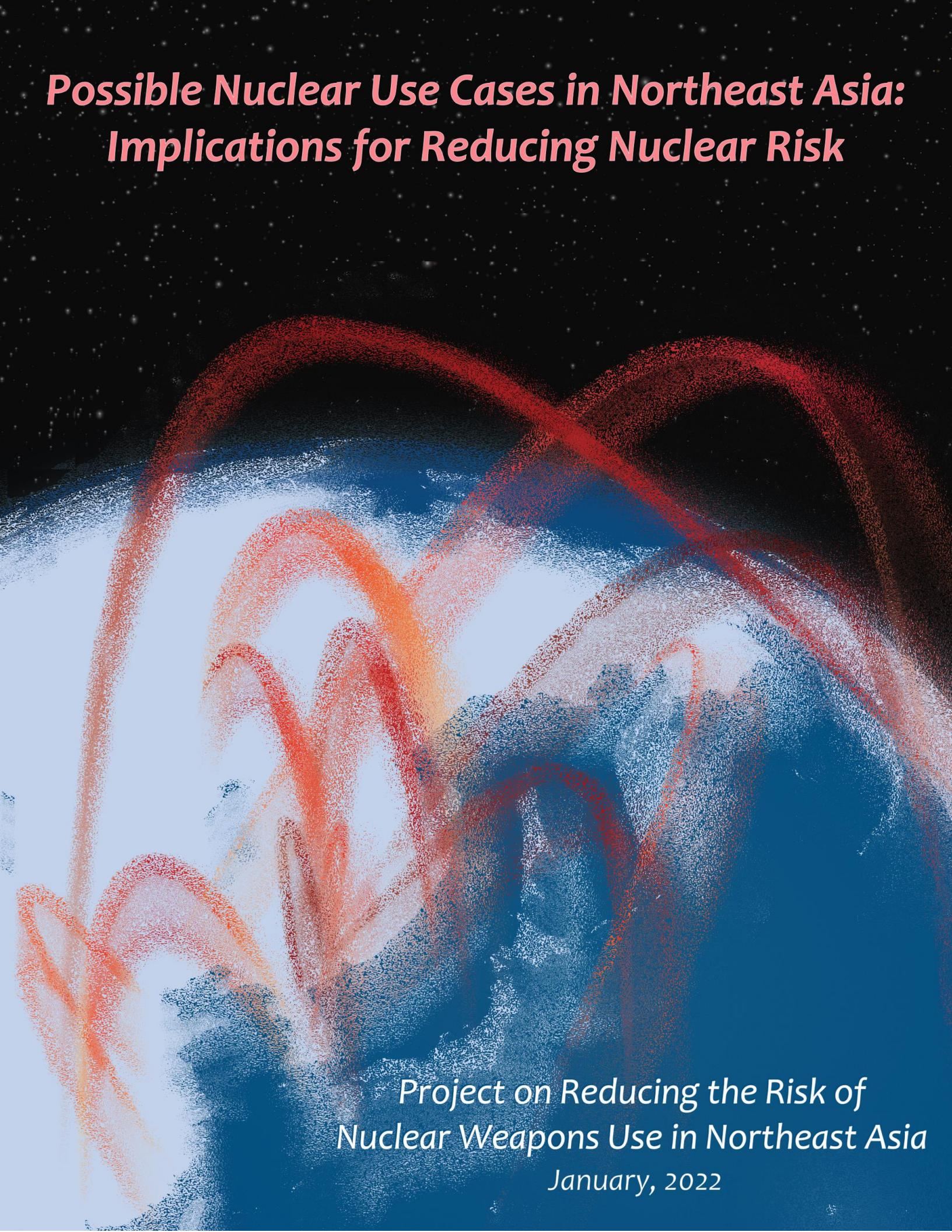
Possible Nuclear Use Cases in Northeast Asia: Implications for Reducing Nuclear Risk



Project on Reducing the Risk of Nuclear Weapons Use in Northeast Asia

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Possible Nuclear Use Cases in Northeast Asia: Implications for Reducing Nuclear Risk

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RECNA 長崎大学核兵器廃絶研究センター Nagasaki University Research Center for Nuclear Weapons Abolition

APLN ASIA-PACIFIC LEADERSHIP NETWORK FOR NUCLEAR NON-PROLIFERATION AND DISARMAMENT

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Executive Summary

The bombings of Hiroshima and Nagasaki, Japan, in 1945 remain the only instances in history of nuclear weapons detonation in a conflict. In the three-quarters-of-a-century since, nuclear weapons have been "used" primarily as tools of deterrence or coercion—deterring conventional and nuclear attacks on the nations that possess them and on the allies of those nations and coercing other nations against mounting attacks. During that interval there have also been many documented instances, and probably many that remain state secrets, when nuclear weapons use was narrowly averted, sometimes by the bravery of someone in the nuclear chain of command, and sometimes, just by luck.

Any detonation of nuclear weapons in a conflict today (or in the years to come) risks absolutely unacceptable consequences, no matter how "limited" the nuclear exchange is or will be. The premise of this report is that it is crucial to understand a range of possible nuclear weapons "use cases"—the detonation of nuclear weapons at or near the earth's surface in a conflict situation—to demonstrate the impacts of such use and to spur the development of policy options that can be deployed to reduce the potential for nuclear war in the future. The fact that these cases are posited here does not mean they are likely; it simply means they are plausible. Although some of the use cases do include only limited use, and in one case, failed use, of nuclear weapons, and lead, ultimately, to a meeting of the minds between nuclear-armed opponents and the eventual reduction of the risk of nuclear war, none of these use cases are in any way desirable in and of themselves, and all possible efforts should be made to avoid any nuclear weapons use. "Let Nagasaki be the Last!" must therefore be the goal of policymakers in international security.

The nuclear use cases posited in this Report span a range of cases, with a range of ultimate outcomes. In one case, a nuclear detonation is attempted but is not successful, and the adversary that is the recipient of the attack exercises sufficient restraint that no counterattack with nuclear weapons occurs. A variety of cases are provided where conflict involves a nuclear weapons detonation, in most cases followed by a nuclear counter-attack in which diplomacy results in the exchange being "limited" to a few targets. In some of the cases described it is hard to see how a conflict would result in anything short of global (or near-global) nuclear war.

In the use cases presented, the elements of use cases considered are "Triggering Events and First Use," "How the Conflict Evolves," "Use Case Consequences," and "Use Case Uncertainties, Ultimate Outcome, and Policy Lessons." The use cases also span the continuum from "unintended" use, in which a state or non-state actor, for example, had not planned to use nuclear weapons but does so due to an accident and/or a misperception of an adversary's intentions, to "intended" or "deliberate" use, when a party uses nuclear weapons for coercion or to gain advantage in a planned invasion. The use cases posit more numerous first use options for the DPRK and the United States as these are the principal antagonists on the Korean Peninsula, which has for many years been a primary, but hardly the only, locus of conflict in Northeast Asia. There are, however, additional first use cases that could be devised for China, and to an arguably lesser extent, Russia, and other actors.

Some of the similarities between use cases include:

- Many of the use cases involve first use in which one adversary misinterprets the actions of another.
- Many of the use cases turn on the personality of a leader and how he or she responds to a crisis involving nuclear weapons.
- Many of the use cases occur when one or more of the adversaries, or at least the leadership of same, are distracted by other issues, including domestic issues and issues abroad.
- Many of the use cases involve lack of communications, or lack of timely or clear communication between rivals and, in many cases, between allies, or even between those responsible for operating the assets of a single military.
- Many of the cases include key decision points where either escalation or de-escalation of a conflict is possible, based on the choices (or failures to choose) of military and civilian leaders at those moments.
- Many of the cases may involve large uncertainties about the outcome of the nuclear conflicts. It is difficult to foresee what would happen once a nuclear weapon is used, and nuclear use may escalate to uncontrollable nuclear conflict regardless of what decision makers want.

Key differences between use cases include:

- Although many use cases use similar delivery systems—dictated in part by the distance between adversaries as well as their arsenals—some use very different means of moving nuclear weapons to targets and thus require different sorts of policy approaches to reduce the threat of nuclear use.
- The nuclear arsenals that potential adversaries have, at this point, differ substantially in both quantity and quality, which colors the decisions to use or not use nuclear weapons.
- The nuclear weapons arsenals of the potential adversaries, and the technologies that can be used to deliver them, are not static; security challenges a few years from now may be addressed by very different weapons than are currently used.
- The adoption, or rejection, of opportunities for stopping conflict through negotiation. Different approaches to negotiation may produce significantly different outcomes to nuclear conflicts, although the effectiveness of negotiation can also vary widely.

Initial policy lessons from these use cases—to be revised and augmented based on analysis to be carried out in future years of the NU-NEA project—include:

- The need for continuously trusted and reliable open lines of communications between adversaries at multiple levels.

- To improve mutual trust and encourage transparency and consistency in describing the extent and operation of military alliances.
- Seek to separate as much as possible the operation of international relations from domestic political concerns, particularly (but hardly exclusively) in nations where leadership changes are frequent.
- Seek to insulate the operations of nuclear weapons from the personal or political vagaries of national leaders, possibly by strengthening oversight on the use of nuclear weapons.
- Seek to fully brief leaders, military and otherwise, regarding what is known, what is not known, and what is possible about the goals, concerns, and emphases of adversaries so as to allow leaders to better understand and identify, to the extent possible given typically substantial uncertainties, the ways in which opposing leaders might react in situations of stress.
- Exercise patience, and adjust expectations for results, in international negotiations, particularly those involving the DPRK.
- Equip nuclear weapons systems with redundant command and control mechanisms that help to assure that a nuclear weapon can never be launched without adequate authority and oversight.
- Work toward insulating key systems (electric power and communications among them) from high-altitude electromagnetic pulse (HEMP) bursts, and/or develop robust back-up arrangements designed to keep those systems running.
- Anticipate that potential breakdowns in communication in the nuclear command and control will occur, whether because of, for example, a HEMP detonation or cyberattack, or because of natural disasters such as earthquakes or severe "solar storms" and assure that commanders in possession/control of nuclear weapons have clear orders as to what to do in those instances.
- Encourage all nuclear weapon states to adopt a "No-first-Use" declaration policy as a step toward substantially reducing the risk of nuclear war. The declared nuclear weapons states (NWS) in the region should endorse such policies.

Contents

1 Objectives and Introduction

The risk of nuclear war—that is, the risk of attacks carried out by detonating nuclear weapons, hereafter "nuclear weapons use"—is now said to be at its highest since the end of Cold War.[1] There is growing concern in Northeast Asia that potential conflicts may trigger either planned or accidental use of nuclear weapons in the region. Even the first use of a nuclear weapon would likely bring horrific and unacceptable outcomes, and the events following from a first use of nuclear weapons could easily spin out of control, leading to an "open-ended" outcome with so much uncertainty that global catastrophic war would be a distinct possibility. The memory of the horrific loss of life and damage from the nuclear bombings of Hiroshima and Nagasaki in 1945 underscore the near-universal conviction that nuclear weapons must never again be used. At the same time, nuclear arsenals continue to grow, and nuclear "deterrence" remains a key part of military plans and geopolitics generally. Abolition of nuclear weapons remains a distant hope. In the interim, the risk of the use of nuclear weapons must be reduced. "Let Nagasaki be the Last!" must therefore be the goal of policymakers in international security.[2]

1.1 Project objectives and of use case development and analysis

The overall objective of the "Reducing the Risk of Nuclear Weapons Use in Northeast Asia" project is to reduce and minimize the risk that nuclear weapons will be used in the region by developing better understandings of the processes that could lead to the first use of nuclear weapons and the potential outcomes of such nuclear weapons use. Improved understandings of the potential paths to and impacts of nuclear weapons use will help to inform the development and implementation of policies designed to reduce the risks of nuclear weapons detonation. Our objective is to prevent any use of nuclear weapons in the region and, ultimately, to avoid armed aggression or war.

To understand the risk of nuclear weapons use and to develop policies to lower that risk, the Reducing the Risk of Nuclear Weapons Use in Northeast Asia project has as its basic objectives to address the risk of nuclear use by answering the following questions:

1) Under what conditions might nuclear weapon be used (with or without intention) in Northeast Asia (NEA) and by whom? How might such first use of nuclear weapons

[1] The "Doomsday Clock" of the *Bulletin of the Atomic Scientists*, which is set closer to "midnight" by the Bulletin's Science and Security Board when the Board deems the risks of nuclear war are greater, is as of this writing set at 100 seconds before midnight. See "This is your COVID wake-up call: It is 100 seconds to midnight, 2021 Doomsday Clock Statement," January 27, 2021, available at https://thebulletin.org/doomsday-clock/current-time/

[2] The words "Let Nagasaki be the Last!" begin the 2015 Nagasaki declaration of the Pugwash Council. See Pugwash Conferences on Science and World Affairs (2015), "2015 Nagasaki Declaration," dated November 5, 2015, and available as https://pugwash.org/2015/11/05/2015-nagasaki-declaration/

escalate to a larger scale of nuclear war? And which states might respond to a first nuclear use with nuclear weapons use of their own?

2) What are the possible consequences (fatalities, physical damages to key infrastructure, environmental damages, climate impacts, and more) of potential nuclear weapon use in Northeast Asia?

3) What are the possible measures to reduce the possibility of use of nuclear weapons in the region? That is, what lessons do analyses of use cases offer for the development and deployment of policies that will help to avoid nuclear weapons use?

It is Step 1 of this process, the development of nuclear use cases involving, though not necessarily restricted to the Korean Peninsula, that it the focus of this Report.

1.2 Summary of nuclear weapons situation on the Korean Peninsula and in NEA

Northeast Asia is home to two declared nuclear weapons states and United Nations Security Council members in the People's Republic of China (the PRC, or China) and the Russian Federation (Russia); one de-facto nuclear weapons state—the Democratic People's Republic of Korea (DPRK)—and two non-nuclear weapons states with large nuclear power programs in the Republic of Korea and Japan; and Mongolia, which has neither nuclear power nor nuclear weapons and, although it does have uranium resources, has declared itself a "nuclear weapons free zone."[3] The definition of Northeast Asia for the purposes of this Report includes Taiwan, as it is a likely flash point for potential conflict without which any consideration of nuclear use cases in the region would be incomplete. In addition to these NEA neighbors, an accounting of the presence of nuclear weapons and nuclear deterrence in the region would be seriously lacking without the inclusion of the roles of the United States in the region. The United States has a number of major military bases in the region, including in the ROK, Japan, and, to the south, Guam. Although US nuclear weapons were removed from the Korean Peninsula itself in 1991, the United States extends its "nuclear umbrella" over the ROK, Japan, and quite unofficially (although meaningfully) Taiwan.

Sketches of the nuclear weapons capabilities of these states are provided below.

- **China** is thought to possess approximately 350 nuclear weapons, with delivery systems including short and long-range land-based missiles (including intercontinental ballistic missiles, or ICBMs, that can be fired from fixed or mobile launchers, ballistic missile submarines, missiles based on ships, and bombers.[4] Most or all of these weapons are thought to be strategic nuclear weapons, that is, not developed for tactical or battlefield use. The expansion of China's nuclear forces has been underway in recent years, underscored by recent reports of large-scale development of what are thought to be new

[3] See, for example, United Nations Platform for Nuclear-Weapon-Free Zones (2020), "Mongolia's nuclear-weapon-free status", available as https://www.un.org/nwfz/content/mongolias-nuclear-weapon-free-status.
[4] See, for example, Hans M. Kristensen and Matt Korda (2020), "Chinese nuclear forces, 2020", *Bulletin of the Atomic Scientists*, Volume 76, 2020 - Issue 6 Pages 443-457, published online: 10 Dec 2020, and available as https://www.tandfonline.com/doi/full/10.1080/00963402.2020.1846432.

missile silos for ICBMs in Xinyang and Gansu provinces.[5] Starting in 1964, and ending, at least nominally,[6] with its signing of the Comprehensive Nuclear Test Ban Treaty (CTBT) in 1996, China is estimated to have conducted forty-seven nuclear tests, of which twenty-three were above-ground.[7]

- **Russia** possesses over six thousand nuclear weapons, of which 4500 are reported to be operational[8] and can be delivered via a full range of delivery systems including fixed and mobile land-based launchers, sea- and submarine-based missile systems, bombers, and air-launched ballistic missiles. Russia has on the order of 500 non-strategic (tactical) nuclear weapons in addition to its mostly high-yield strategic warheads.[9] Russia has conducted over 700 nuclear weapons tests.

- Based on its announcements and weapons demonstrations, the **DPRK** now has nuclear weapons and delivery devices designed for different ranges, including continental range. The DPRK has on many occasions announced its development and possession of nuclear weapons through its state media outlets and other channels. These announcements notwithstanding, the actual size of the DPRK's nuclear weapons arsenal is not known with any certainty. Analysts suggest the DPRK may possess sufficient fissile material for on the order of fifty nuclear weapons, although only a fraction of that material may have been incorporated into warheads as of 2021.[10] The DPRK has conducted six known nuclear weapons tests between 2006 and 2017.[11] The DPRK has been actively developing and testing missile systems, some of which are thought to be nuclear-capable, extending from short-range missiles to missiles with potential ICBM capabilities. The DPRK's delivery systems are mostly land-based, including a recently-demonstrated capability to fire ballistic missiles from a train, but the DPRK may also be developing the capability to fire ballistic missiles, and potentially nuclear ballistic missiles, from submarines.[12]

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[5] See, for example, Tong Zhao (2021), "What's Driving China's Nuclear Buildup?," Carnegie Endowment for International Peace, dated August 05, 2021, and available as https://carnegieendowment.org/2021/08/05/what-s-driving-china-s-nuclear-buildup-pub-85106

[6] Recent low-yield nuclear tests are suspected, but not proven, to have been carried out recently by China. See, for example, Julian Borger (2020), "China may have conducted low-level nuclear test, US claims," *The Guardian*, dated 15 April, 2020, and available as https://www.theguardian.com/world/2020/apr/16/china-may-have-conducted-low-level-nuclear-test-us-report-claims

[7] Atomicarchive.com (2021), "China's Nuclear Tests," available as https://www.atomicarchive.com/almanac/test-sites/prc-testing.html

[8] See, for example, Hans M. Kristensen and Matt Korda (2021), "Russian nuclear weapons, 2021," *Bulletin of the Atomic Scientists, V*olume 77, 2021, Issue 2, Pages 90-108, published online 18 Mar 2021, and available as https://www.tandfonline.com/doi/full/10.1080/00963402.2021.1885869

[9] Matt Korda (2021), *Nuclear Weapons and Delivery Systems that Might be Implicated in Nuclear Use Involving the Korean Peninsula*, paper prepared for the Reducing the Risk of Nuclear Weapons Use in Northeast Asia project, September 2021 (publication forthcoming).

[10] See, for example, 38 North, "Estimating North Korea's Nuclear Stockpiles: An Interview With Siegfried Hecker," dated April 30, 2021, and available as https://www.38north.org/2021/04/estimating-north-koreas-nuclear-stockpiles-an-interview-with-siegfried-hecker/

[11] Nuclear Threat Initiative (2020), "North Korea," last updated October 2020, and available as https://www.nti.org/learn/countries/north-korea/

[12] Korda (2021), ibid.

- **Japan** does not possess nuclear weapons, and as a signatory to the Non-Proliferation Treaty (NPT), is obliged not to develop them. Japan is, however, covered by the United States' "nuclear umbrella," an arrangement denoting the US' extended nuclear deterrence with the intent being the assurance of US protection, with nuclear weapons, if necessary, in the event of a conflict. This arrangement is also designed to prevent the development of nuclear weapons by Japan and/or by other states also covered by the US' extended nuclear deterrence.[13] Although the nuclear umbrella is not a formal legal or treaty commitment, rather a "political assurance," it has sufficed thus far, along with national laws and moral positions born out of being the only nation in history to have suffered a nuclear attack, to keep Japan and other "umbrella" states from developing nuclear weapons. That said, and as indicated in one of the use cases presented in section 3 of this Report, Japan certainly does have the technical wherewithal to develop nuclear weapons, probably in a matter of months, in the admittedly unlikely event that concerns about the reliability of the US nuclear umbrella rise to the level that compels it to do so, which would be an abrogation of its obligations as a signatory to the Treaty on the Non-Proliferation of Nuclear Weapons (NPT). Japan has tens of thousands of tonnes of cooled nuclear fuel at its reactors and other sites around the country, uranium enrichment facilities (used to produce reactor-grade uranium),[14] a full-scale plant (at Rokkasho), albeit with a checkered operating history, for reprocessing of spent fuel (extraction and purification of plutonium for use in "mixed oxide" reactor fuel), and, most importantly, ownership of over of 46 tonnes of separated plutonium (Pu), of which 8.9 tonnes are in storage in Japan, with the rest is in Europe (15.4 tonnes in France and 21.8 tonnes in the United Kingdom).[15] The amount of Pu in storage in Japan alone is sufficient to make on the order of a thousand or more nuclear warheads.[16]

- **The Republic of Korea** is also covered by US extended nuclear deterrence, is a signatory of the NPT, and is thus also unlikely for those reasons to develop nuclear weapons. It also is in possession of on the order of ten thousand tonnes of spent reactor fuel, but does not possess, as a condition of its nuclear energy agreement with the US,

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[13] Gregory Kulacki (2021), "The US Doesn't Need to Worry About Japan (or Any Other Ally) Going Nuclear," *The Diplomat*, dated February 05, 2021, and available as https://thediplomat.com/2021/02/the-us-doesnt-need-to-worry-about-japan-or-any-other-ally-going-nuclear/, described the US "nuclear umbrella" as follows: "At the dawn of the nuclear age, to encourage friendly countries to refrain from building nuclear weapons, the United States promised to protect them with U.S. nuclear weapons. This arrangement came to be called the nuclear umbrella. The experts call it extended nuclear deterrence."

[14] The World Nuclear Association (2021), "Japan's Nuclear Fuel Cycle," updated January, 2021, and available as https://world-nuclear.org/focus/fukushima-daiichi-accident/japan-nuclear-fuel-cycle.aspx

[15] Japan Atomic Energy Commission (2021), *The Status Report of Plutonium Management in Japan—2020*, Office of Atomic Energy Policy, Cabinet Office, dated July, 9, 2021, and available as http://www.aec.go.jp/jicst/NC/iinkai/teirei/siryo2021/siryo21/2_haifu.pdf

[16] Assumes about eight (8) kg reactor-grade Pu required per weapon. See, for example, Union of Concerned Scientists (2009), "Weapon Materials Basics," published July 18, 2009, and available as https://www.ucsusa.org/resources/weapon-materials-basics; and V. Fortakov (1998), Nuclear Verification: What It Is, How It Works, the Assurances It Can Provide," p. 41-51 in International Atomic Energy Agency, *Technical workshop on safeguards, verification technologies, and other related experience*, 253 p, 11-13 May 1998, available as https://inis.iaea.org/collection/NCLCollectionStore/_Public/30/050/30050964.pdf?r=1

either facilities for uranium enrichment or for spent fuel reprocessing. It has, however, attempted to obtain nuclear weapons and related delivery systems in the 1970s-early 1980s and dabbled in clandestine research on reprocessing and other "dual use" technologies in the recent past, and it has been suggested that ROK proliferation activity research has been one of the considerations that led the DPRK's to begin its pursuit of nuclear weapons.[17] The ROK, like Japan, is highly advanced technologically, and there is little doubt that it could produce nuclear weapons-capable technologies quite rapidly, in the unlikely event that it made the decision to do so.

- **Taiwan** is in a similar position to the ROK, with thousands of tonnes of spent nuclear fuel in storage and advanced technologies that could readily be used for "nuclear breakout" in the (again unlikely, unless international circumstances change markedly) event the decision was made to pursue nuclear weapons. Like the ROK, it too previously sought to develop its own nuclear weapons. Though it is not, because it is not officially a state, a signatory to the NPT or related agreements, it has said that it will abide by those agreements.[18] Taiwan is also, at least tacitly and unofficially, covered by US extended nuclear deterrence, although the United States' commitment to defend Taiwan is the subject of "strategic ambiguity."[19]

- **The United States**, though not a Northeast Asian country, has great influence in the region, both as the guarantor of security for Japan, the ROK, and (tacitly) Taiwan, and as a major and continuing military presence in the region. The United States had nuclear weapons deployed on the Korean Peninsula (in the ROK) from 1958 until 1991, when they were removed.[20] The United States also had nuclear weapons stored on Okinawa from 1954 until 1972. The presence of these weapons on territory that was returned to Japan in the 1960s was covered under a secret agreement between the United States and Japan in which neither state would publicly confirm any introduction of nuclear weapons into Japan's territory. The agreement did, however, appear to violate Japan's "three non-nuclear principles" (promises "not to process, produce, or permit the introduction of nuclear weapons into Japan") formalized in 1967.[21] The United States continues,

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[17] Anastasia Barannikova (2021), *Korean Peninsula Nuclear Issue: Challenges and Prospects*, paper prepared for the Reducing the Risk of Nuclear Weapons Use in Northeast Asia project, September 2021 (publication forthcoming).
[18] Monte Bullard (2005), "Taiwan and Nonproliferation," the Nuclear Treat Initiative, dated May 1, 2005, and available as https://www.nti.org/analysis/articles/taiwan-and-nonproliferation/
[19] David Brunnstrom (2021), "U.S. position on Taiwan unchanged despite Biden comment – official," *Reuters*, dated August 20, 2021, and available as https://www.reuters.com/world/asia-pacific/us-position-taiwan-unchanged-despite-biden-comment-official-2021-08-19/. See also Sheryn Lee (2021), *Avoiding Nuclear War in the Taiwan Strait*, prepared for the Reducing the Risk of Nuclear Weapons Use in Northeast Asia project, September 2021. On a US State Department website, the relationship is described as a "…U.S. commitment to assist Taiwan in maintaining its defensive capability" (U.S. Relations With Taiwan, Bilateral Relations Fact Sheet," dated August 18, 2018, and available as https://www.state.gov/u-s-relations-with-taiwan/
[20] See, for example, Hans M. Kristensen and Robert S. Norris (2017), "A history of US nuclear weapons in South Korea," *Bulletin of the Atomic Scientists*, Volume 73, 2017 - Issue 6, Pages 349-357, published online: 26 Oct 2017, and available as https://www.tandfonline.com/doi/full/10.1080/00963402.2017.1388656
[21] See, for example, Mercedes Trent (2019), "The History of U.S. Decision-making on Nuclear Weapons in Japan," Federation of American Scientists, dated August 21, 2019, and available as https://fas.org/blogs/security/2019/08/the-history-of-u-s-decision-making-on-nuclear-weapons-in-japan/

however, to project nuclear deterrence for the ROK and for the region as a whole from submarines, ships, bombers, and missiles based elsewhere, including on US territory and from bases in Japan and elsewhere. The United States has a full range of nuclear missile technologies, including missiles designed for both tactical and strategic delivery of nuclear warheads. The United States has all available delivery systems, and like Russia has thousands of warheads of different types and sizes. The Intermediate-Range Nuclear Forces (INF) Treaty, signed by the United States and the Soviet Union (USSR) in 1987, "required the United States and the Soviet Union to eliminate and permanently forswear all of their nuclear and conventional ground-launched ballistic and cruise missiles with ranges of 500 to 5,500 kilometers."[22] The United States, however, withdrew from the INF treaty in 2019, and implied that it might deploy intermediate cruise missiles in the Asia-Pacific Region,[23] although without nuclear warheads. It would, however, be difficult to verify whether the warheads used on these missiles are conventional or nuclear.

A map of Northeast Asia is presented for reference in Figure 1.[24]

[22] See, for example, Arms Control Association (2019), "The Intermediate-Range Nuclear Forces (INF) Treaty at a Glance," last reviewed August 2019, and available as https://www.armscontrol.org/factsheets/INFtreaty

[23] See, for example, Idrees Ali (2019), "U.S. Defense Secretary says he favors placing missiles in Asia," *Reuters*, dated August 3, 2019, and available as https://www.reuters.com/article/us-usa-asia-inf/u-s-defense-secretary-says-he-favors-placing-missiles-in-asia-idUSKCN1UT098

[24] Prepared based on a map downloaded from Google Earth, January 7, 2022. The red circles on the map show, for reference, the approximate distance from the demilitarized zone (DMZ) that divides the Korean Peninsula.

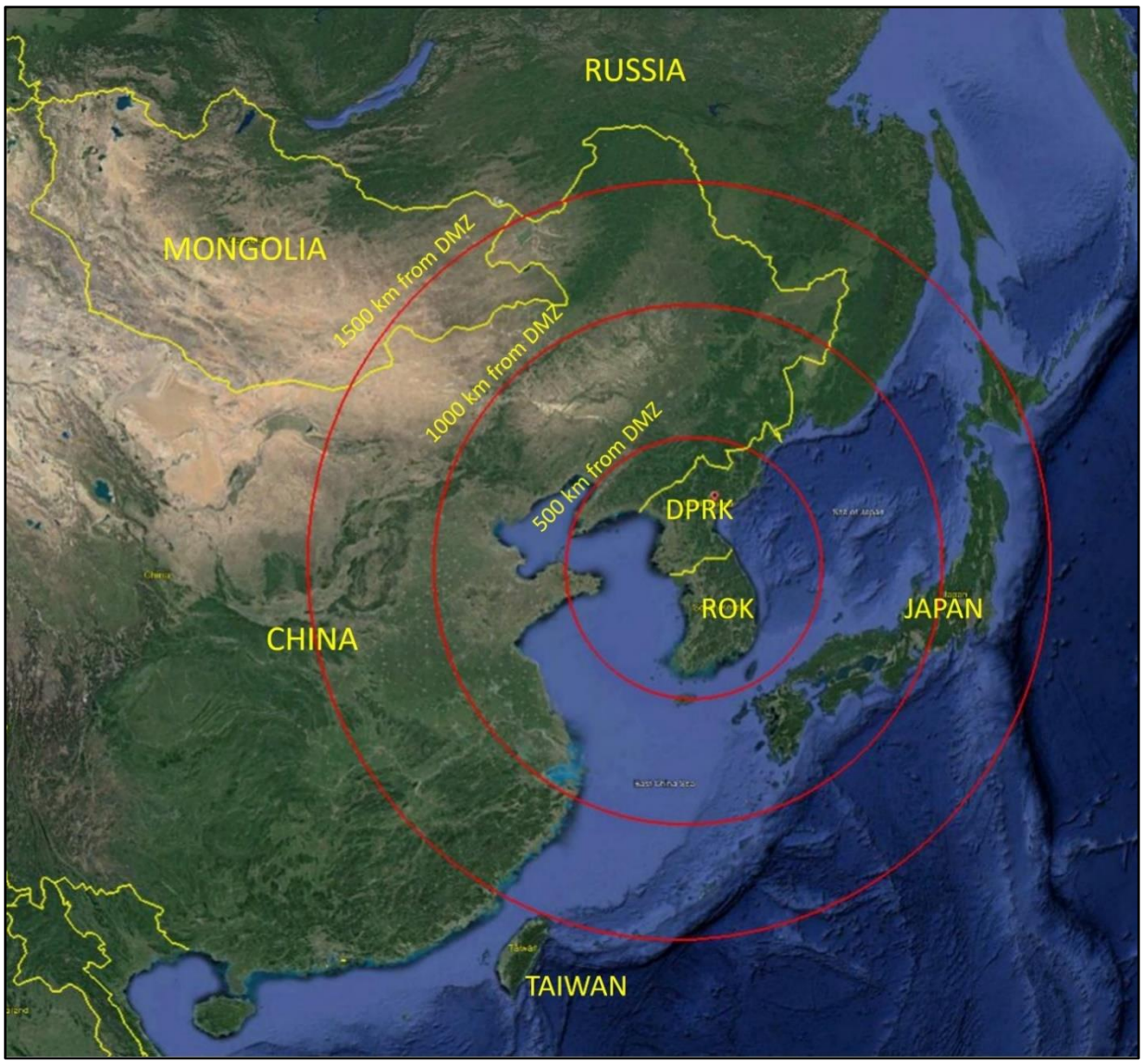

Figure 1: Map of Northeast Asia

In addition to these state "actors," it is conceivable that nuclear weapons or nuclear devices, such as weapons designed to spread radioactivity via a non-nuclear explosion, could be used in an attack in Northeast Asia by non-state groups, such as terrorist organizations. Attacks on nuclear energy facilities, including reactors and spent fuel storage facilities in the ROK, Japan, or Taiwan, could also be carried out, and such attacks might have significant consequences for nearby populations, including resulting in plumes of radioactive material capable of causing acute and chronic health impacts, depending on factors such as distance and dilution.[25]

[25] See, for example, David von Hippel and Peter Hayes (2018), *Radiological Risk from Accident or Attack at Nuclear Energy Facilities in China*, NAPSNet Special Reports, February 22, 2018, available as

In sum, the existing, under-development, and (potentially) nascent nuclear weapons capabilities of actors in Northeast Asia make it crucial to find ways to reduce the risk of nuclear weapons use, as well as of the conflicts that might precipitate nuclear weapons use. These nuclear weapons capabilities, combined with simmering territorial and other disputes, and, of course, the

https://nautilus.org/napsnet/napsnet-special-reports/radiological-risk-from-accident-or-attack-at-nuclear-energy-facilities-in-china/; and Peter Hayes (2018), *Non-State Terrorism and Inadvertent Nuclear War*", NAPSNet Special Reports, January 18, 2018, available as https://nautilus.org/napsnet/napsnet-special-reports/non-state-terrorism-and-inadvertent-nuclear-war/

longstanding state of war—albeit restrained for nearly 70 years by an Armistice—on the Korean Peninsula, make the reduction in the risk of nuclear weapons detonation a key goal for our time.

Nuclear Weapons as Deterrents to Conflict

In the more than 75 years since nuclear weapons were last used in wartime, the main rationale for nuclear weapons has been in deterring conflicts, both nuclear and otherwise. In a number of historical cases since World War II, both national leaders and their key security advisors have seen the existence and positioning of nuclear weapons as having significant value in deterring conflict. Some nuclear weapons proponents argue that the existence of nuclear weapons has allowed the world to avoid significant conflicts, including avoiding a "World War III" that might have broken out during the Cold War period.[26] Such claims may have merit, but it is of course difficult to prove the role of nuclear weapons in avoiding wars that did not occur. Moreover, in many conflicts, states were already deterred by other factors and nuclear deterrence was either non-existent, at the margin, or in some instances may have undermined the stabilizing effects of non-nuclear deterrence. Also, states have used nuclear weapons for other purposes—reassurance of allies, third parties, and even their nuclear arch-enemies on occasion; and for compellence unrelated to deterrence—in ways that may have inflamed conflicts and increased the risk of war and nuclear proliferation more than would have otherwise be the case.

This study makes no claims with regard to the putative effects of nuclear weapons, stabilizing or destabilizing.

Rather, it addresses the irreducible risks that once started, a nuclear war is likely to have catastrophic results, may escalate, and may never end; that the pathways to nuclear war are manifold and under-appreciated in this region; and the risk of nuclear war are amenable to policy change at acceptable cost. On the other hand, some historians suggest that such arguments, that is, that the existence and deployment of nuclear weapons deterred major wars that would have otherwise occurred, is a "myth," and, rather, that nuclear wars were avoided not because of "nuclear deterrence" but rather because of luck or unintended events.

In short, we neither dispute nor affirm the value of nuclear weapons in deterring military conflict, rather in this Report we focus on the risks that nuclear weapons pose in the increasingly perilous nuclear security situation in Northeast Asia. Recognition of these risks demands a renewed and accelerated efforts to resolve conflicts and to reduce the role of nuclear weapons in conflict.

[26] As just three examples of this literature, see Iain King (2019), "The Future of Deterrence: Keeping Nuclear Weapons Holstered Was the Easy Part," The Modern War Institute at West Point, dated June 19, 2020, and available as https://mwi.usma.edu/future-deterrence-keeping-nuclear-weapons-holstered-easy-part/; Kenneth Waltz (1981), "The Spread of Nuclear Weapons: More May Better," *Adelphi Papers*, Number 171 (London:

1.3 Summary of project goals, approaches/methods, and organization

As noted above, the overall objective of the "Reducing the Risk of Nuclear Weapons Use in Northeast Asia" project is to reduce and minimize the risk that nuclear weapons will be used in the region. This will be accomplished by developing better understandings of the processes that could lead to the first use of nuclear weapons, and of the potential outcomes of such nuclear weapons use, of the consequences of nuclear weapons use, and of the policies that might—or rather, looking back from a case posited to happen in the future, might have—reduced the risks of nuclear weapons detonation. The cases posited for further analysis are defined to take place between 2025 and 2030.

1.3.1 Approaches and methods, by project year

The project therefore identifies three basic tasks to meet the above objectives, with each task being the primary focus of each of the three project years:

1. **Development of possible nuclear use case.** This first task, to be undertaken in year 1, and of which this Report reflects interim results, has been to develop multiple cases that involve possible nuclear weapon use in the region, including possible escalation to a larger scale of nuclear war through counterstrikes, with a focus on use cases involving the Korean Peninsula in a regional and global geo-strategic context, and thus possibly involving actual weapons use in places other than Korea. The goal has been to provide enough specificity in the definition of the use cases to sufficiently inform the estimates of the impacts of those cases that modeling of the cases can moved forward during the second year of the project.
2. **Simulation of nuclear use cases.** This second task, to be undertaken in year 2, will be to develop computer simulations, including the use of the HYSPLIT tool for estimating the movement and severity of radioactive fallout,[27] and other analysis of the nuclear use cases assembled during Task 1 and to assess potential consequences of such nuclear use cases. Task 2 will address a wide range of possible consequences, providing quantitative and qualitative results of impacts including fatalities, environmental damages, and physical damages, and will prefigure possible climate impacts of nuclear use, which will be addressed in year 3.

International Institute for Strategic Studies), available as https://www.mtholyoke.edu/acad/intrel/waltz1.htm; and Constance Baroudos (2015), "Nuclear Weapons Enable Peace," Lexington Institute, dated May 6, 2015, and available as https://www.lexingtoninstitute.org/nuclear-weapons-enable-peace/. Examples of arguments countering the contention that nuclear weapons have, in effect, secured peace are provided in David P. Barash (2018), "Nuclear deterrence is a myth. And a lethal one at that," *The Guardian*, dated January 14, 2018, and available as https://www.theguardian.com/world/2018/jan/14/nuclear-deterrence-myth-lethal-david-barash; and in Ward Wilson (2013), *Five Myths about Nuclear Weapons*, Houghton Mifflin Harcourt, published January 15, 2013.

[27] HYSPLIT is a computational model described as a tool to "… simulate the dispersion and trajectory of substances transported and dispersed through our atmosphere, over local to global scales." See United States Department of Commerce National Oceanic and Atmospheric Administration (NOAA, 2022), "HYSPLIT," available as https://www.arl.noaa.gov/hysplit/

3. **Development of policy recommendations to reduce the risk of nuclear war in Northeast Asia**. Based on the results of Task 1 and 2, Task 3 will focus on assessing current nuclear policies in the region and developing policy measures to reduce the risks that nuclear weapons will be used in the region.

1.3.2 Project organization

The Research Center for Nuclear Weapons Abolition, Nagasaki University (RECNA), Nautilus Institute (NI), and the Asia Pacific Leadership Network for Nuclear non-proliferation and Disarmament (APLN), with the cooperation of the Panel on Peace and Security of Northeast Asia (PSNA), are hosting this project. RECNA, NI, and APLN have set up a Steering Committee as a project management organization. PSNA will serve as an Advisory Group to the Project, and key members of PSNA will be involved in each task. A Consultative Group of experts in various disciplines related to the project has also been assembled to provide input to and review of use cases, with some Consultative Group members also commissioned to prepare background papers to inform the development and analysis of nuclear weapons use cases.

1.4 Summary of project activities and outputs

In the first year of the project, PSNA and the NU-NEA collaborating partners convened a virtual workshop with experts from around the world in October 2021 with the goal of reviewing the potential limited nuclear weapons use cases in Northeast Asia that are described in this Report. To prepare for this October meeting, the Project partners brought together a "Consultative Group" of approximately thirty experts to develop and provide project partners with as much of a start as possible in specifying nuclear use cases. These experts provided advice during an on-line workshop on July 20, 2021. The Consultative Group experts have been drawn from Northeast Asia, Australia, the United States, and Europe, and have expertise in global and regional security, the recent history of the Korean Peninsula and the Taiwan Straits, nuclear weapons systems of the states in the region, defining and of modeling of nuclear use cases, vulnerabilities of nuclear reactors to attack, and many other relevant disciplines. This Year 1 Consultative Group was tasked with brainstorming potential nuclear use cases within parameters specified by the project partners in order to define a set of cases for broader review and continued definition and ultimately to serve as the basis for quantitative and qualitative estimates of impacts in project Year 2.

Some of the members of the Consultative Group were commissioned to prepare background papers to inform the project as a whole, the use cases developed during the project, and the attendees at the October meeting. For the first project year, eleven papers have been commissioned and completed. A listing of the authors and titles of these papers is provided in Table 1, and abstracts or summaries of the papers received to date are provided in the ATTACHMENT 2: CONSIDERATIONS WITH RESPECT TO USE CASES—COMMISSIONED PAPERS" attachments section at the end of this Report. Citations to these papers appear throughout this Report, but the ideas provided by the commissioned authors, both within and outside of their papers, have influenced most of the elements of the Report. These Commissioned Papers have, by the time of publication of this Report, either been published already on the APLN, RECNA, and Nautilus websites, or are shortly to be published on those websites as **Special Reports** to the project.

Table 1. Papers Commissioned for Year 1 of Reducing the Risk of Nuclear Weapons Use in Northeast Asia (NU-NEA) Project.

Author	Title and Affiliation	Paper Title
Paul K. DAVIS and Bruce BENNETT	Adjunct principal researcher and senior political scientist (respectively), RAND Corporation, professors of the Pardee RAND Graduate School	**Nuclear-Use Cases for Contemplating Crisis and Conflict in East Asia**
Anastasia BARANNIKOVA	Research fellow at ADM Nevelskoy Maritime State University (Vladivostok)	**Korean Peninsula Nuclear Issue: Challenges and Prospects**
Ian BOWERS	Associate professor at the Centre for Joint Operations, Royal Danish Defence College	**The Counterforce Dilemma in East-Asia Pacific**
Van JACKSON	Professor of international relations at Victoria University of Wellington	**Reducing or Exploiting Risk?** **Varieties of US Nuclear Thought and their Implications for Northeast Asia**
Matt KORDA	Research associate, Nuclear Information Project, Federation of American Scientists, and associate researcher to SIPRI (Stockholm International Peace Research Institute)	**Nuclear Weapons and Delivery Systems that Might be Implicated in Nuclear Use Involving the Korean Peninsula**
Major LEE Sangkyu	Assistant professor, Korea Military Academy, Department of Physics and Chemistry (Formerly denuclearization policy officer, North Korea Nuclear Weapon Policy Division, Ministry of Defense, Seoul, Republic of Korea)	**Prospects for DPRK's Nuclear Use Scenarios and Deterrence Measures of the United States and ROK Alliance**
Sheryn LEE	Senior lecturer in the Division of Leadership at the Swedish Defence University	**Avoiding Nuclear War in the Taiwan Strait**
Eva LISOWSKI	MIT Graduate, Master's student at Tokyo Institute of Technology	**Potential Use of Low-yield Nuclear Weapons in a Korean Context**
James I MATRAY	Professor, Cal State University at Chico	**U.S. Entry into the Korean War: Origins, Impact, and Lessons**
Daryl G. PRESS	Associate professor of Government, Dartmouth University	**Military/Nuclear Force and Counterforce Strategies on the Korean Peninsula**
David WRIGHT	Independent missile engineer, research affiliate with the Department of Nuclear Science and Engineering at MIT	**The Role of Missile Defense in North-East Asian Nuclear Scenarios**

The NU-NEA project will span the Japanese fiscal years 2021 through 2023 (approximately April 2021- March 2024).

In the first fiscal year, outputs include development of use cases, as conveyed in this Report, presentation of use cases to PSNA members and other experts for review, revision, and finalization of the use cases and of the Use Case Report, and the Commissioned Papers listed above. Outputs in year 2 will include a Report on the results of analyses of use cases, and additional Commissioned Papers on topics, yet to be determined, designed to inform use case analysis. In year 3 of the project, outputs will include a Report on the implications of use case analysis for the design and implementation of policies to reduce the risk of nuclear war taking place in Northeast Asia, again with Commissioned Papers on topics to be determined as the needs for policy analysis dictate. In each project year, Commissioned Papers and summary versions of Project Reports will be published in the Journal for Peace and Nuclear Disarmament (J-PAND).

1.5 Road map of this report

The remainder of this Report is organized as follows:

- **Section 2** provides a description of what is meant, in the context of this project by "nuclear use cases," how they are used, and project goals and criteria for use case development.
- **Section 3** presents the use cases developed thus far for this project, including cases in which first nuclear use is carried out by a range of state and non-state actors.
- **Section 4** presents a summary of the use case results and provides initial thoughts on the policy lessons offered by the use cases as developed.
- Following these main sections of this report, a **Glossary**, including definitions of terms and acronyms that appear in use cases is provided, along with **ATTACHMENTS** that include a short summary of the surprisingly varied operating definitions of the term "kiloton" in the context of nuclear weapons explosive power, and abstracts or summaries of the papers commissioned for this project thus far.

2 Nuclear Weapons Use Cases

2.1 What Defines a Use Case?

For the purposes of this project, a "use case" is defined as starting with the detonation of one or more nuclear weapons in an attack or counterattack against a military opponent. As such, this definition excludes, the "use" that nuclear weapons have been put to in the more than 75 years since the Hiroshima and Nagasaki bombings of 1945, which is to provide deterrence of a potential enemy's attack on a state or its territories, allies, or the military assets of either using either conventional or nuclear weapons. This definition also therefore excludes the detonation of nuclear weapons as part of tests that do not involve attacks, and the detonation of nuclear explosives—so-called "peaceful nuclear explosions"—for purposes such as civil engineering, as has been discussed in the past, tested in many instances (by the United States and the Soviet Union) but actually carried out (by the Soviet Union) in only a handful of cases.[28]

Nuclear use cases as defined in this project follow the general considerations described below (section 2.5) as to when in the near future nuclear use is assumed to occur, involvement of the Korean Peninsula, and other parameters. In addition, to develop nuclear use cases that will be the basis for modeling key impacts of nuclear weapons use during Year 2 of the project, the use cases require specification of attributes for each case that include the following:

1. **Who** are the **possible** users of nuclear weapons?
    - Which state uses nuclear weapons first?
2. **Why** does the nuclear use happen? That is, what combination of events, and what political, economic, environmental, social and/or military circumstances, induce the designated actors to pursue nuclear weapons use? This would include consideration of **triggering events** such as (but certainly not limited to) accidental first use, pre-emptive strikes, or responses to terrorism (including both physical and cyber-attacks).
    - What perceived advantage and/or perceived vulnerability led to the use of nuclear weapons, and how did the situation arise? That is, what is the "back story" of the conflict that makes it potentially realistic?
3. **Which state responds** to nuclear first use with nuclear weapons and/or conventional forces?

[28] Tests of peaceful nuclear explosions "spanned 1957-75 in the USA and 1965-89 in the USSR." These tests will be banned by the Comprehensive Test Ban Treaty when the latter comes into force. See World Nuclear Organization (2018), "Peaceful Nuclear Explosions," updated December 2018, and available as https://world-nuclear.org/information-library/non-power-nuclear-applications/industry/peaceful-nuclear-explosions.aspx

4. **What and where** are the targets of nuclear weapons in each case, and **when** does the attack occur? What is the target for the first nuclear strike, including location, timing (what season of the year, and what time of day or night[29]) and type of detonation?

    - What are the targets for subsequent or retaliatory strikes, including the number of counterstrikes and the types of targets (military or civilian) involved?

5. **How** are the first strikes and subsequent nuclear attacks carried out?

    - What size (yield) and type of weapon (uranium, plutonium, hydrogen) is used in each case?[30]
    - What delivery and targeting systems are used? Information on these elements helps to determine how likely weapons are to reach their targets and to cause collateral damage.

6. How **plausible** is the nuclear use case, and how significant are its impacts likely to be?

    - In order to pose cases that are of relevance to policymakers, they should be reasonably probable within the universe of all possible nuclear use cases in the region, and
    - They should have a large enough potential impact — in terms of human lives lost, economic damage, political repercussions, and/or environmental damage — to capture the interest of policymakers.

2.2 Applications of Use Cases

In their paper prepared for this project, Paul K. Davis and Bruce Bennett list the following applications of use cases:[31]

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[29] To model dispersion of radioactive particles from a nuclear use incident, it will be necessary to specify both a location and approximate timing in order to obtain weather data representative of the time and place of weapons use. The same information will be needed to calculate other modeling results, for example, human exposure.

[30] The size of the weapon used, along with at what level (ground level or in the atmosphere) it is detonated, are inputs to determine the size and shape (height above the ground, width, and height of "cap" of the mushroom cloud resulting from the nuclear explosion, which in turn is an input to the distribution of the sources of radioactive particles that make up fallout. The location (latitude and longitude) of detonation also may play a role in the composition of fallout based on the local soil types (or water bodies) and any man-made structures destroyed in the detonation area.

[31] Paul K. Davis and Bruce Wm. Bennett (2021), *Nuclear-Use Cases for Contemplating Crisis and Conflict in East Asia*, paper prepared for the Reducing the Risk of Nuclear Weapons Use in Northeast Asia project, 9 December, 2021, and available as APLN, RECNA, PSNA, and Nautilus Institute Special Reports at https://www.apln.network/projects/nuclear-weapon-use-risk-reduction/nuclear-use-cases-for-contemplating-crisis-and-conflict-on-the-korean-peninsula, https://www.recna.nagasaki-u.ac.jp/recna/topics/29469, https://www.recna.nagasaki-u.ac.jp/recna/psnanews/29485, and https://nautilus.org/napsnet/napsnet-special-reports/nuclear-use-cases-for-contemplating-crisis-and-conflict-on-the-korean-peninsula/

- "Education [of] analysts, scholars, policymakers, military officers, staffs, students
- Communication among scholars and practitioners; with public; in negotiations
- Assessing strategic balances from different perspectives and with different assumptions
- Assessing arms control options by governments and outside groups
- Understanding potential outcomes of nuclear war in terms of relative and absolute military gains and losses, and more broadly
- Identifying problems and opportunities in avoiding or mitigating nuclear war noting particular weaknesses of deterrence and ways to improve it
- Planning force planning, operational planning, and crisis planning"

Virtually all of these roles for use cases, with the possible exception of detailed force and operational planning, factor into the applications for the use cases developed during this project, as all of these applications can be thought of as elements in developing and refining policies designed to reduce the risk that nuclear weapons use will occur.

2.3 Goals in assembling and evaluating a range of use cases

History is strewn with events that failed to be considered by those responsible for planning. In some cases, these oversights were because those events had not happened before. In other cases, the events were simply considered to be "unthinkable" for reasons varying from the events being thought to be "unlikely" to the foibles of human hubris. As such, the goal in this project has been to assemble as broad a range of use cases as is practicable. Given the many actors in Northeast Asia, and the almost limitless number of potential triggers for conflict in the region, there are a literally unlimited number of use cases that might be produced. Limits on the amount of time and human resources that can go into developing, and subsequently, evaluating such use cases mean that a limited suite of use cases can realistically be assembled and analyzed. Our goals in doing so have been to assemble a set of use cases that includes all of the potential actors in the use of nuclear weapons in Northeast Asia in general and involving the Korean Peninsula in particular, that include multiple modes of nuclear weapons use, for example, against different types of targets, in different types of detonations, and at different levels of yield, and to explore a range of triggering events. The goal in assembling and, subsequently, analyzing this breadth of use cases is to be able to identify and test policy solutions resulting in reducing the risk of nuclear war from a range of different angles in order to find policy solutions that can be used to address—and are "robust" responses to—different ways in which nuclear war might arise.

2.4 Criteria for developing and selecting from use cases

In seeking to address the goals in assembling and evaluating nuclear weapons use cases as described above, we applied and continue to apply the following criteria in developing and selecting use cases for further analysis. **Diversity**: The group of cases chosen for further analysis should show diversity in several respects (although they need not be "normally distributed" in any one sense):

a. State (or non-state) first using nuclear weapons

b. Nuclear detonation (NUDET) targets

c. Drivers/triggering events for nuclear use

d. Modes of attack and weapons used

e. Potential lessons for policy from cases [although we can't know this fully before we do our year 2/year 3 analysis, we can project some key lessons based on initial qualitative consideration of the cases]

f. Loss of control of nuclear weapons, including failure of positive control—the organization and technological measures that allow commands to use weapons to be relayed reliably—and loss of negative control, that is, controls that keep nuclear weapons from being used by mistake

2. **Divergence**: The group of cases span a range of outcomes with respect to, for example:

    a. Spread of nuclear use among states

    b. A range of different outcomes of nuclear cases, likely from limited or just-avoided first or counterattack detonations to runaway nuclear war

3. **Impact** of the nuclear weapons use on, for example:

    a. Politics in each state, including domestic and international, for both the users of nuclear weapons and those suffering the direct consequences

    b. The physical world—the environment and human infrastructure

    c. International relations and trade

    d. Military infrastructure, doctrine, and strategy, both in the near and more distant future

4. **Plausibility**—each case should be considered the plausible result of the sequence of circumstances and triggering events that spawn it. "Plausible" here does not mean the same as "likely or unlikely," which is typically a judgement based on a reviewer's particular perspective or experience, or "probable," which in most cases regarding nuclear weapons use is impossible (or very difficult) to assess. To demonstrate plausibility, the use case should be elaborated in a way that is backed up by arguments or evidence, except in totally unexpected cases, and even in those case there may be precedents in history. Possible criteria for this might include (but are not limited to):

    a. Do the actors involved—militaries, states, leaders—have the capacity to carry out the actions that are posited in the use case?

    b. What indications of intentions would be expected in each case before use (or response), and is it plausible that with those indications absorbed by other actors, the NUDET would still take place?

c. Does the use case include elements that have happened (or almost happened) before, that is, is there a historical precedent?

d. Is there a path from the global, regional, and national situations in 2021 and those in the day in 2025 to 2030 that NUDET occurs that one could see happening, probably, again, because something like it has happened before?

e. Is there any consideration of international legal implications by the state or states using nuclear weapons under, for example, the Additional Protocol of the Geneva Convention?

f. Are any reactions by other states in the international community—those not involved, or not immediately involved, in the conflict—plausible?

2.5 Common considerations for use cases (scale of weapons use)

For the purposes of this project, we define nuclear weapons use cases within the following parameters and constraints:

- Nuclear weapons use cases are designed to occur in the latter half of this decade—2025–2030. This places the use far enough into the future that some of the events that might trigger nuclear weapons use have time to develop, but not so far into the future as to be (A) outside of the realm of near-term concern for current policymakers, or (B) affected by, for example, the development of disruptive technologies that are not yet on the horizon.
- Nuclear weapons are assumed to be used in relation to a Korean conflict, or in a conflict that might arguably expand to or from the Korean peninsula, either intentionally or perhaps inadvertently, by one or more of the DPRK, the United States, the People's Republic of China, or the Russian Federation.
- State actors are the primary focus of these nuclear use cases, in large part because a major goal of the project is to develop policy approaches for application by state actors that reduce the risk that nuclear weapons will be used, but use of nuclear or other weapons by non-state actors could serve as a triggering event for a nuclear weapons use case.
- Nuclear weapons use in the cases considered involves Korean peninsula issues and actors (directly or indirectly) but could involve targets elsewhere.
- The nuclear weapons and delivery systems considered as candidates for application in the use cases are similar to those found in current stockpiles, although use of weapons currently in advanced development, such as hypersonic ballistic missiles, could also be considered.
- The overall ultimate extent of the nuclear war in the cases to be developed largely focuses on cases that at least have the potential to remain limited, and not to escalate to a global or major regional conflict. We do, however, consider uncertainties associated with the consequences of nuclear exchange in the region that may escalate to nuclear exchanges involving other parts of the world. Impacts of these escalated cases, including

those outside the Northeast Asian region, will NOT be considered in the simulations of nuclear weapons impacts to be carried out in the second year of the project. We take this focus in part because the modeling of impacts of a substantial regional or global nuclear war, as we as planning for year 2 of the project, is both very difficult and, to a large extent, pointless/unnecessary, as it is clear that civilization as we know it would not survive such an event, and thus the policy lessons offered by such use cases are generally likely to be few. Some of the cases presented below, however, do escalate beyond a limited exchange of weapons because we feel that it is implausible that those particular cases will not escalate significantly and the cases appear likely to offer valuable lessons for policy.

2.6 Information needed from use cases for future modeling

The ultimate goal of this project is to reduce the risk that nuclear war will occur by demonstrating the ways that it might be triggered and evolve, evaluating the impacts of such events, and identifying policies that could be pursued to reduce, minimize the risk of, and ultimately prevent nuclear weapons use. To achieve these goals, nuclear use cases must be developed in sufficient specificity that they case be used to inform modeling of nuclear weapons use.

These considerations therefore affect how use cases are specified under this project. For example, to model dispersion of radioactive particles it will be necessary to specify both a location and approximate timing of each use of nuclear weapons to obtain weather data representative of the time and place of weapons use. The same information will be needed to calculate other modeling results, for example, human exposure to radioactivity, or direct deaths and damage to infrastructure resulting from nuclear blasts. In addition, the size of the weapons used, along with at what level (ground level or in the atmosphere) they are detonated, are inputs to determine the size and shape (height above the ground, width, and height of "cap" of the mushroom cloud resulting from the nuclear explosion, which in turn is an input to the distribution of the sources of radioactive particles that make up fallout. The location (latitude and longitude) of detonation also may play a role in the composition of fallout based on the local soil types (or water bodies) affected and any man-made structures destroyed in the detonation area. These are but some examples of the information that will be extracted—sometimes with the application of additional assumptions—from use cases such as those specified below.

3 Use Cases

Below we present at set of nuclear weapons use cases, which will, as noted above, be further elaborated and ultimately used to evaluate use case impacts in year 2 of our project and to inform potential policy initiatives to reduce the risk of a nuclear war in year 3. The cases shown have been assembled from a wide variety of inputs. Some were suggested by participants in the July 2021 expert Consultative Group meeting. Some are based on ideas presented in the papers commissioned for this project, or elsewhere in the literature. All cases have been elaborated and/or modified in some way by NU-NEA project staff to provide the information needed to move the use case forward for further analysis in year 2 of the project. As such, these cases reflect a range of inputs and should not be ascribed to any one person. Also, it should be emphasized that while these cases, as noted above, are designed to be plausible, **none of these cases reflect the views of the authors or anyone else as to how the future is expected or likely to unfold**. Rather, they are, essentially, thought experiments **prepared to see what we can learn from them with regard to how nuclear weapons use can be avoided**. This is particularly because there is little that can be done to effectively prepare for a nuclear attack, and the consequences of any nuclear attack would be, as demonstrated in Hiroshima and Nagasaki in 1945, unspeakably tragic for the human race and for the planet we all live on. As the computer controlling the US nuclear arsenal concluded, in the climactic scene of an early threat-of-nuclear-exchange-escalation-and-annihilation film concluded about nuclear war, "A strange game. The only winning move is not to play."[32]

In addition, two things about these use cases should be emphasized. First, as noted above, the number of unique use cases that could potentially be specified is essentially infinite, given the vast array of parameters and timing that might change from case to case, so we have endeavored to provide a set of use cases that is limited enough to work with but that span the main set of possibilities for nuclear weapons use in Northeast Asia. That said, we may well have missed important cases that should be further studied, and we welcome input on additional cases the project should consider. Second, the cases below remain subject to revision, and we encourage reviewers of this document to suggest modifications to the cases to make the cases either more **plausible**, given what reviewers know about the situation in the region (and their own points of view) and/or more **useful** in terms of the policy lessons that might be derived from them.[33]

We organized the presentation of use cases below as follows. First, the use cases are divided into subsections denoting which regional actor is the first user of nuclear weapons in a conflict. The

[32] The 1983 (and thus Cold War era) movie in which a NORAD (North American Aerospace Defense Command) computer intones the quoted phrase after cycling through all possible nuclear US/USSR nuclear exchange scenarios is "WarGames," and is described (for example) in Wikipedia (2021), "WarGames," last updated December 1, 2021, and available as https://en.wikipedia.org/wiki/WarGames

[33] In addition, the NU-NEA project team will be further elaborating and possibly modifying these use cases as we develop the inputs for the analytical modeling of use case impacts in Year 2 of the project.

actors we consider are the DPRK, the United States (including the combined conventional forces of the ROK and the UN Command in the ROK and Japan), China, Russia, and an "Other Actors" category that may include both states that do not currently have nuclear weapons and potential non-state actors, such as terrorist groups. We further divide the narrative in each use case into four parts:

1. Triggering events and first use of nuclear weapons.
2. The evolution of military or other conflicts, including counterattacks and any further nuclear between combatants, after the first use.
3. The further regional consequences of the use case, including notes on potential impacts/actions by on other countries and the plausibility and significance of the use case.
4. Thoughts on the uncertainties associated with the use case, how the use case might or might not lead to situations beyond limited nuclear war, and initial lessons from the use case for policy.

Within these categories, we reflect on aspects of each use case including:

- **Who** is **first to use** nuclear weapons—whether a state or non-state actor? Note that we have, for purposes of this exercise, considered high-altitude nuclear explosions designed to produce a disrupting electromagnetic pulse (HEMP) to **not** constitute first use of a nuclear weapon, but rather a triggering event, because the nuclear explosion itself is not at or near the earth's surface, though we recognized that this distinction is somewhat artificial. As such, "first use" is defined as the detonation of a nuclear weapon on an adversaries' territory or to attack its assets as sea. The narratives below are organized based on the designation of the first use state (or non-state actor) responding to the triggering events with a first nuclear use in a conflict.
- What **triggering event** caused first use, that is, **why** did the first user intentionally or accidentally detonate a weapon (also under 1, above)?
- **What** and **where** are the targets of first use, and **when** does it happen (included in 1, above)?
- Which State **responds** to the first use? This designation is included in (2), above.
- **What** and **where** are targets, and **when** does the response (counterattack use) of nuclear weapons happen (part of 2, above)?
- **How** are the **first use** and **counterattacks** carried out (parts of 1 and 2, above)?
- What is the **plausibility** and **significance** of the use case (part of 3, above)?
- What do the **other nuclear actors**—those not directly, or at least immediately—involved in the conflict—**do, and why** (parts of 2 and 3, above)?
- How is the war **brought to an end** while keeping the nuclear exchange limited, if indeed the war is contained to a regional and limited conflict (parts of 3 and 4, above)?

As such, there are many different ways that a conflict involving the use of nuclear weapons in Northeast Asia (or elsewhere) could be triggered and evolve. A vast range of possible events, ranging from immediate attacks on territory (with conventional weapons) to perceived political slights to the need to maintain domestic political leverage could serve as triggers for nuclear first use. Further, these use cases are not **predictions** of what **will** happen, rather, they illustrate **what could happen**. These illustrations are made with the full understanding that any conflict, especially nuclear conflicts, could proceed along any number of escalatory pathways, as well as a possibly smaller number of de-escalatory pathways.

Nuclear first use by a nation or non-state actor could fall along a range of uses ranging from **"unintended,"** where nuclear use was not the initial intent of the first party to use nuclear weapons, but the result, for example, of a misperception of the threats posed by an adversary or of the intentions of an adversary, to **"intended"** or **"deliberate"** use, in which an actor with an understanding of the threats it faces seeks to gain military or other advantage over an opponent by using nuclear weapons. The accidental use of nuclear weapons, in which a technical or command-and-control failure or mistake, for example, results in nuclear first use, is arguably a special case of "unintended" nuclear use and could occur during either peacetime or as tensions rise toward wartime.[34]

With the exception of purely accidental nuclear weapons use, every use of nuclear weapons in fact represents a decision by either a human or a machine to launch, drop, or otherwise deploy and detonate a nuclear bomb. As such, the distinction between "unintended" and "intended" rests more on how the decision to use nuclear weapons came about and thus is subjective and spans a range of different circumstances. For example, Davis and Bennett list "unintended escalation in conflict (matters getting out of hand)" as potentially including instances of

- "Operational failures; necessity
- Pressures of "chicken" game[35]
- Command and control events
- Accidents
- Consequences of artificial intelligence"

Unintended nuclear first use, and unintended escalation of nuclear war once first use has occurred, are perhaps the class of nuclear use least well-understood by policymakers, and thus most important to illustrate and to devise policies to address. In addition to the categories offered

[34] The typologies of accidental, unintended, and intended use are described in section 2 and Figure 2 of Davis and Bennet (2021), ibid, as prepared for the NU-NEA project.

[35] A game of "chicken" occurs when two adversaries, neither of which actually wants to enter a conflict, approach each other as if intending a conflict, hoping and assuming that the other will back down (or "turn chicken"), and thus the conflict will be avoided. A classic use of this vernacular is when two cars speed at each other head on, each assuming the other will swerve at the last minute, but the term is equally applicable to other forms of conflict.

by Davis and Bennet, as described above, the prospects for inadvertent nuclear use might be exacerbated by:

- Confusion on the part of one or both adversaries as to the military tactics of the other, perhaps enhanced by fake mobilizations designed to confuse the enemy, which brings an overreaction in the form of nuclear use.
- The rapidly growing capabilities of new weapons systems (for example, super-hypersonic or space-based weapons, or advanced missile defense systems), and, perhaps as importantly, adversaries' fears (justified or not, and enhanced by lack of robust intelligence) about the advanced capabilities of and advantages conveyed by those systems, which could trap a state into believing that a first nuclear strike is necessary to ensure its survival.

Figure 2 illustrates a small sampling of triggering events from the use case narratives below and charts the possible flow of actions resulting from those events through the continuum of unintended to intended nuclear use, and through the evolution of conflict to the ultimate consequences as conflicts involving nuclear use play out. For each of the use cases described, below, we also indicate where, in our view, the first use described in a use case appears on the continuum from unintended to intended, although that assessment is, as indicated above, necessarily rather subjective.

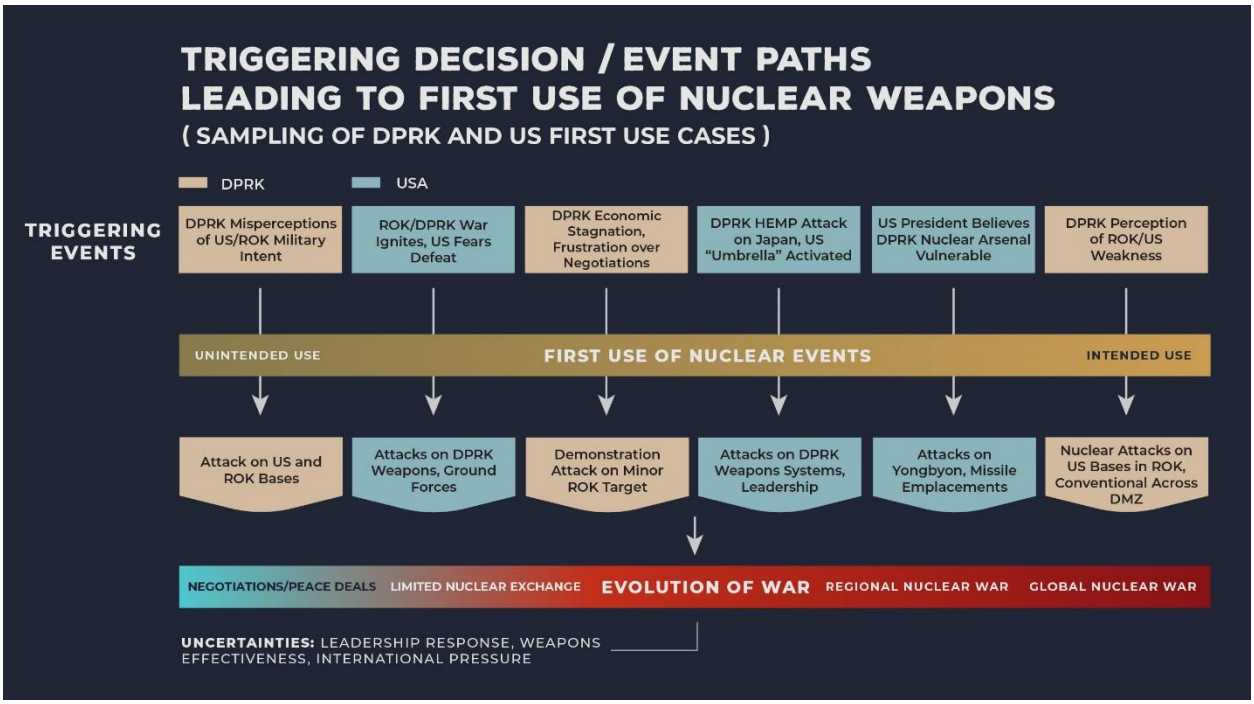

Figure 2. Triggering Events and the Genesis of Nuclear Use Cases

Table 2 provides an overview of the key elements of the use cases presented in this report, and of how they are related. Details of each use case are provided in the sub-sections below.

Table 2: Summary of Use Cases Considered

Use Case Title	Triggering Events and First Use	How the Conflict Evolves	Use Case Consequences	Uncertainties, Ultimate Outcome, Policy Lessons
"We're Still Here" Variant 1	Frustrated by lack of progress in negotiations, **DPRK** demonstrates a nuclear weapon on a low-value, non-military ROK target	**US/UN Command** conventional attack on DPRK forces near DMZ, US nuclear attack on nuclear weapons targets in DPRK	High-level US mission reassures China and Russia, engagement keeps exchange limited, leads to diplomacy, DPRK opening	Would US/ROK be able to refrain from attacking DPRK leadership? Close call leads to renewed efforts at arms control Lessons: Need to take stock of DPRK intentions before firing back, be ready to deploy high-level delegations to DPRK and China
"We're Still Here" Variant 2	As above, but **DPRK** attack not carried out due to malfunction or timely, successful negotiation	**US/UN Command** develop counterattack plan, but do not implement because of successful diplomacy	China and Russia support DPRK engagement with international community, diplomacy re-starts	
"We're Still Here" Variant 3	As in Variant 1, but DPRK attacks a US naval battle group offshore of the ROK with a nuclear missile fired from DPRK territory	**United States** uses nuclear and conventional (with ROK) weapons on DPRK military and nuclear targets, in part at insistence of ROK and Japan	Scale of US counterattack leads DPRK to begin conventional war on ROK, nuclear attacks on United States and Japan. United States attacks DPRK troops with low-yield weapons	Would Russia and China be willing to stay out of the war? Would the Europe and others in the international community be able to mediate a crisis of this magnitude?
"The Best Defense is a Good Offense" Variant 1	Changes in United States and ROK behavior leave **DPRK** leadership convinced that an attack is imminent, and it launches what is effectively a preemptive strike on United States and ROK bases	**US** responds with conventional attacks on military installations, nuclear weapons on ICBMs and other nuclear sites and on Pyongyang command bunker	Remaining DPRK leadership offers terms for ceasing military conflict with international access to and control over DPRK's nuclear weapons in exchange for "Marshall Plan" for the DPRK China and Russia stay out of war, but demand say in governing DPRK, maybe through UNSC	DPRK nuclear mines on DMZ might leave Peninsula divided and badly damaged Defeated DPRK leadership could inflict pain to ROK civilian populations, leaving Korea uninhabitable Lessons: Importance of leadership, US attention, understanding between allies
"The Best Defense is a Good Offense" Variant 2	As above, but with fraying of US/ROK Alliance	As above, with **US** nuclear attack depending on analysis of DPRK ICBM capability at the time		

Use Case Title	Triggering Events and First Use	How the Conflict Evolves	Use Case Consequences	Uncertainties, Ultimate Outcome, Policy Lessons
"The Best Defense is a Good Offense" Variant 3	As in Variant 1, but with triggering events including additional DPRK challenges on the domestic front, and with DPRK first use in the form of a covert attack on an ROK nuclear power plant to cause chaos in the ROK	**United States/ROK leaders** conclude broader DPRK attack is imminent, ROK/US troops needed in ROK, so attack DPRK troops near DMZ, DPRK leadership with air bombardment, then nuclear weapons	With its remaining arsenal, the DPRK uses conventional artillery and/or nuclear weapons on Seoul area, uses ICBMs on United States if operable Russia and China stay out of war, may respond to overflight of missiles, planes	Additional to the above, lessons related to reactor security, provision of backup power for reactors, military, civilians that is separable from the main grid
"Last Option for Survival" Variant 1	United States/ROK responds to social unrest in DPRK with troop incursion, **DPRK responds with nuclear** attack on ROK	**US/UN Command counterattack** on nuclear weapons and other military sites in DPRK	China and Russia mass troops at DPRK border, with some incursion by China, but no nuclear response	May not be probable that USFK/ROK refrain from attacking DPRK leadership Will China be compelled to protect DPRK? Lessons: Monitor conditions in DPRK, offer humanitarian support (international community)
"Last Option for Survival" Variant 2	Perceived or actual DPRK provocation spurs US/ROK conventional attack on DPRK leadership, induces **DPRK nuclear use on ROK**	As above, but could include attack on DPRK leadership in Pyongyang if US casualties substantial	Attack on Pyongyang causes China to at least threaten United States with ICBMs	
"We've Got Them Where We Want Them"	**DPRK** takes advantage of slow-moving talks to invade ROK, **nuclear attack on US bases in ROK, Okinawa**	**ROK asks United States** to use nuclear weapons on DPRK nuclear facilities, troop concentration, leadership bunkers	China, Russia go on high alert, Japan comes into conflict, humanitarian crisis at DPRK/China border	Would DPRK attack while negotiations underway? Would DPRK discount US counterattack possibility? Could US counterattacks be mistaken for attacks on China or Russia?
"Help Not Wanted"	As DPRK leadership loses control of its Northern areas due to bad economy and disasters/crop failures, Chinese forces enter to stabilize, and fearing being overrun, **DPRK launches nuclear attack on China**	**China** launches counterattacks aimed at DPRK weapons systems, including with nuclear missiles on deeply buried targets	US/ROK and Russian troops go on alert, but do not move into DPRK while China is there, United States seeks treaty on northern Korean peninsula governance with China, Russia	Would DPRK fear China enough to attack with nuclear weapons? Would US/ROK troops come to the aid of northern DPRK rebels? Would Chinese nuclear strikes be mistaken by United States/Japan?

Use Case Title	Triggering Events and First Use	How the Conflict Evolves	Use Case Consequences	Uncertainties, Ultimate Outcome, Policy Lessons
"The Best Defense is a Good Defense"	A ground war starts across the DMZ, and the **United States**, distracted by conflicts elsewhere, fears losing, mounts conventional (PGM) and nuclear strikes on DPRK weapons systems	Fearing an attack on its leadership, the **DPRK** launches a nuclear attack on a US base in the ROK and/or Okinawa/Guam	As in other cases above, China/Russia are eager to see the United States weakened but do not want to enter conflict themselves, accept US assurance that conflict limited to DPRK, future Korea governance deal	Could US PGM weapons be deployed in time? Would the particular US president in power at the time use nuclear weapons first?
"US Leadership Hubris"	Overconfident **US** president is convinced that DPRK nuclear weapons can be destroyed without counterattack, **so attacks DPRK nuclear weapons systems**	**DPRK** uses remaining nuclear weapons, counterattacks **ROK/Japan**, possibly by land or sea, to cause major damage and sue for peace Possible DPRK attack on a Japanese reactor to cause chaos, induce truce	China attacks with conventional weapons to keep US/ROK south of DMZ. If DPRK leadership attacked, China might attack United States with nuclear weapons	Lack of communication by US/ROK with China/Russia might cause them to use nuclear weapons, trending toward global conflict Lessons: Maintain secure procedures for war authorization that include those outside of leader's inner circle; consult with both allies and potential adversaries
"Response to DPRK Proliferation"	Proliferation of DPRK nuclear technologies leads to NUDET elsewhere, **United States** blames DPRK and attacks **DPRK nuclear infrastructure**	**DPRK** assumes attack on its leadership imminent, strikes US bases in ROK, other military targets, and possibly US targets if ICBMs advanced enough and survive attack	If US attack seem as "unprovoked", China might come to DPRK aid, but probably with conventional forces designed to contain US/ROK on peninsula	Would ROK condone attack on DPRK? Could nuclear forensics lead the United States to conclude that DPRK was responsible for original attack?

Use Case Title	Triggering Events and First Use	How the Conflict Evolves	Use Case Consequences	Uncertainties, Ultimate Outcome, Policy Lessons
"Tripped at the Finish Line"	Engagement and diplomacy with the DPRK going well, but tripped up by change of US leadership or unforeseen event, US miscalculation of DPRK reaction leads United States to attack DPRK nuclear missiles with PGM and nuclear missiles	**DPRK** conventional bombardment of Seoul, **uses remaining nuclear weapons on US bases in region**, leading to full-scale war on the Peninsula	China and Russia mass troops at border but stay out of conflict Japan may become involved if DPRK attacks Okinawa	How would DPRK respond to late-game change in US diplomacy? Would China join if fallout damaged NE China? Would United States correctly identify DPRK brinksmanship and seek to reduce tensions?
"A Promise is a Promise" Variant 1	After worsening relations with Japan, DPRK launches HEMP over Tokyo, Japan demands **United States** respond with nuclear attack targeting DPRK leadership to remove possibility of counterattack	With initial US attack on its leadership unsuccessful, **DPRK attacks Japan or ROK populations with nuclear weapons** so as to cause pain, possibly also using ICBMs on US territory US renews attack on leadership with larger, penetrating weapons	Original DPRK HEMP attack allows China to consider US nuclear attack "provoked" China (and Russia) go on alert, but do not directly intervene	Could US attack modes (missiles from bombers, submarines, ships) be mistaken by China, Russia, for attacks on them? Major refugee crisis in the region likely (ROK and DPRK) Would Japan or ROK consider HEMP vs. chemical/biological attacks sufficiently different as to change whether they ask for US use of nuclear? Lessons: Build HEMP-resilient infrastructure, discuss with allies what kinds of attacks require nuclear response, work to avoid DPRK conditions that would trigger attack
"A Promise is a Promise" Variant 2	As above, but ROK is focus of DPRK HEMP			
"A Promise is a Promise" Variant 3	As in Variant 1, but DPRK delivers chemical and/or biological weapons to Japan			
"Not Going Well in Taiwan"	Pro-independence government in Taiwan, trouble at home leads **China** to attack Taiwan, which is aided by US, but war goes poorly, so China launches nuclear attacks on US bases	**US** attacks Chinese military sites threatening Taiwan with conventional weapons, attacks hardened nuclear sites in China (such as ICBM bases) **with nuclear weapons**	Russia may stay out of conflict, but China likely counterattacks United States might ask NATO to come to its aid, involving Europe War may go global	Unclear with the DPRK would do as it would likely be surrounded by fallout, but its survival (as with everyone else) would be in jeopardy

Use Case Title	Triggering Events and First Use	How the Conflict Evolves	Use Case Consequences	Uncertainties, Ultimate Outcome, Policy Lessons
"Threats to Russian SSBN Bastions"	Higher tensions over territorial disputes put Russian submarine corps on maximum alert, increased tempos, leads to a sub mistaking exercise or missile test for an attack, and launches nuclear missiles on US base on Okinawa	**United States, encouraged by Japan, attacks Russian Pacific Fleet headquarters and other Russian bases in the East Russia attacks US Bases in ROK, elsewhere**	Absent extraordinary and timely communications, nuclear war expands to ICBM launch by both United States and Russia on each other's territory	What standing orders would Russian Federation (RF) submarine commanders revert to in times of crisis? Lessons: Raise awareness Communications among militaries about interpretation of perceived actions
"Dead Hand Error"	At a time of high tensions between Russia and the West, communications interruptions caused by a severe solar storm puts some Russian early warning radars offline, leads automated nuclear launch system to mistake ROK space launch for nuclear attack on Russian bases, leading to launches on several US bases in ROK	**United States** nearly counterattacks Russia with nuclear weapons, but is persuaded not to by feverish diplomacy both by parties inside the US and by Russian officials and diplomats, Russian military concessions, and Russian offers of compensation payment to ROK	Arms control talks are reinvigorated, as are security talks with the DPRK DPRK economic reform initiated, Russian political and military reform begins	Could a solar storm really affect Russian systems sufficiently to cause error? Could a US president be convinced to refrain from a counterattack? Lessons: Use extreme caution in using artificial intelligence in nuclear launch systems and improve nuclear-related communications between nuclear weapons states
"Broken Promises Leads to Breakout" Variant 1	New, hawkish leadership and loss of faith in US umbrella leads **Japan** to develop nuclear weapons and use them in response to DPRK provocations **on DPRK missile and nuclear infrastructure**	**DPRK** replies with nuclear missile attack on **Japanese infrastructure** or with smuggled-in warhead to Japan if the DPRK's missile infrastructure isn't operable	Attack fractures ROK/Japan relationship, United States caught in middle China intervenes to slow flow of DPRK refugees with Chinese troops in DPRK ROK takes lead in rebuilding the Korean peninsula if not too badly damaged	ROK breakout also possible under similar conditions Lessons: Unwise to think that entire DPRK nuclear arsenal can be destroyed by a targeted attack Also may be unwise to expect DPRK population will embrace ROK as victor
"Broken Promises Leads to Breakout" Variant 2	For similar reasons to the above, the **ROK** develops nuclear weapons, uses low-yield warheads to strike at DPRK leadership	As above, but with attacks focused on **ROK infrastructure**		

Use Case Title	Triggering Events and First Use	How the Conflict Evolves	Use Case Consequences	Uncertainties, Ultimate Outcome, Policy Lessons
Terrorist Nuclear Weapons use Potential Variant 1	Domestic or international terrorist organization detonates warhead in Tokyo—9/11-type event	Terrorist group claims responsibility, but evidence points to DPRK proliferation**, United States** attacks DPRK nuclear sites as in "Promise is a Promise," at **Japan's request**	Renewed attention on nonproliferation and antiterrorist initiatives If DPRK blamed, series of nuclear exchanges United States to DPRK, DPRK to region and/or to United States	Would terrorist group be intercepted before detonation of device? If so, more emphasis on non-proliferation efforts, disruption of nuclear black market worldwide Would domestic terrorists in China have organization, skills, money to carry out such an attack? Would Chinese punishment of ethnic groups spur Western countries to intervene on Chinese soil or pursue economic and political sanctions? Or lead instead to a joint response by the great powers? Policy lessons include: Intensify work on nonproliferation Improve international nuclear materials control Establish or strengthen hotlines to allow immediate reporting of hacked or accidental nuclear launches to targeted states
Nuclear Weapons use by Terrorists, Potential Variant 2	Domestic terrorist organization detonates warhead in Chinese city	**China** attacks ethnic enclaves within China, possibly with nuclear weapons, might assume United States was behind attack and launch at a US carrier group sailing in the region	China could obtain sympathy from international community, depending on whether it decides upon harsh collective punishment	
Nuclear Weapons use by Terrorists, Potential Variant 3	Cyberwarriors attack nuclear command-control, launches nuclear missile from China, Russia, or United States	**Varying evolution** depending on when launch is detected, whether hacked nation warns targets, whether targeted nation assumes attack to have been launched on purpose by nation owning missiles	If attack was assumed deliberate by targeted nation(s), result is probably an escalating series of exchanges Other paths of evolution yield frantic diplomacy, more attention on safeguards, disarmament	

Figure 3 provides a representation of two particular elements of each of the use cases described below, namely, the degree to which attacks qualify as intentional or unintentional (vertical axis), and whether nuclear weapons use focuses on urban or limited civilian or limited or large military targets (horizontal axis). Each use case is marked with its title and with the flag of the nuclear weapons state that is the first user. For the few use cases where the first user is not now a nuclear weapons state or is a non-state actor, colors but not flags are used (orange for terrorist organizations, grey for non-nuclear-weapons states). The groupings of these use cases provide indications of which types of nuclear use appear to be of particular concern, and thus require particular attention to develop policies to avoid such use cases.

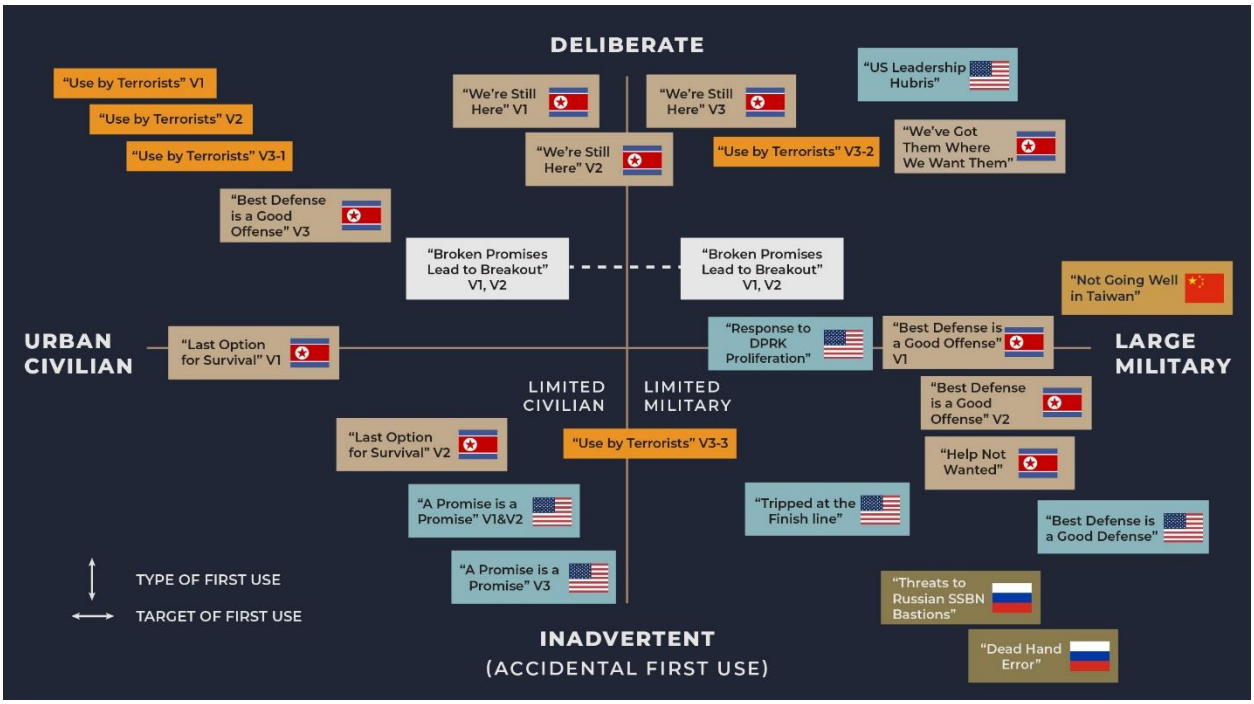

Figure 3. Plot of Use Cases versus Intent and Type of Target

Each of the use case descriptions below chart the evolution of the case from triggering event through first use, responses to first use, and further evolution of the conflict. Each elaborates on the summaries included in Table 2 and touches on key uncertainties in how the use case might evolve, potential ultimate outcomes of the case (in the range from the rapid declaration of ceasefire and ultimately peace between the adversaries in the conflict to, in effect, global nuclear war), and initial policy lessons of the cases.

Figure 4 provides an example of how the evolution of a use case might be charted as a flow diagram. The case shown is one of the DPRK first use cases described below. One element this figure underscores is that nuclear weapons use may be the result of triggering events, but that

how the holder of nuclear weapons responds to those events (paths taken versus paths not taken) makes considerable differences in the use case outcomes.

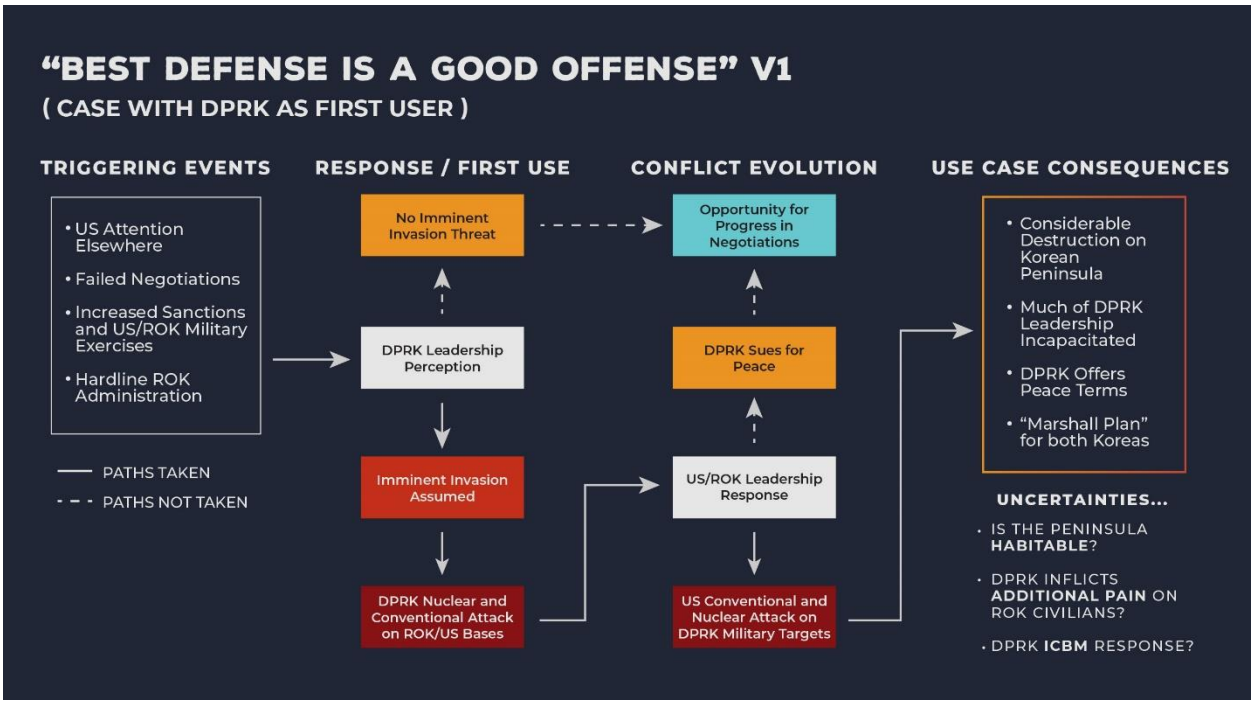

Figure 4. Example of Use Case Evolution

3.1 DPRK as First User

For several of the actors with concerns about security in Northeast Asia—in particular, the ROK, Japan, and the United States, the DPRK is perceived as key threat. Its array of conventional armaments not far from the DMZ, coupled with its growing nuclear arsenal, continue to be a concern. That said, a number of authors view the DPRK being the first to use nuclear weapons as highly unlikely, given that it is understood that DPRK military and civilian (to the extent that they are separable) leaders realize that the DPRK faces at close range a much stronger, nuclear-armed adversary (the United States, together with the conventional forces of the ROK and the UN Command), which is much of the reason why the DPRK has developed nuclear weapons in the first place.[36] Many experts in the field evaluate the DPRK's actions over the decades as indicating that it is a rational actor simply responding to the circumstances in which it finds itself. Still, there are a number of potential situations in which the DPRK might conceivably feel forced into being a first user of nuclear weapons. Five such cases, and variants of several of them, are presented below.[37] Four of these cases involve conflicts between the DPRK and the United States/ROK and/or Japan, and one between the DPRK and China.[38]

3.1.1 "We're Still Here"

In the three "We're Still Here" variants described below, the DPRK undertakes what can be thought of as a "demonstration" nuclear attack for the main purpose of driving the United States/ROK and the international community to the bargaining table. In assuming that a demonstration attack will spur the United States into a diplomatic process, the DPRK may be banking on the belief (which is probably not wrong) that US actions can be more easily influenced by public opinion than those of other countries, and that the United States could therefore be pressured into a deal if the DPRK's attack were limited. As such, these first nuclear uses can be labeled as "intentional," along the continuum of intentionality presented above, but are not intended by the DPRK to induce broader nuclear conflict. The first two variants, both of which might be described as "optimistic" among the suite of use cases involving the DPRK, vary with respect to success of attack and to the US (and UN Command for conventional weapons) response. The third variant, an attack on a US Navy battle group at sea, draws a more rapid and comprehensive response, thus rendering timely diplomacy unlikely. In each case, the DPRK

[36] See, for example, Anastasia Barannikova (2021), *Korean Peninsula Nuclear Issue: Challenges and Prospects*, paper prepared for the Reducing the Risk of Nuclear Weapons Use in Northeast Asia project, September 2021 (publication forthcoming).

[37] Several of the cases of DPRK first use of nuclear weapons described below draw in part on cases described in Lee Sangkyu (2021), *Prospects for DPRK's Nuclear Use Scenarios and Deterrence Measures of the US and ROK Alliance*, paper prepared for the Reducing the Risk of Nuclear Weapons Use in Northeast Asia project, September 2021 (publication forthcoming).

[38] Although many (though hardly all) of the cases in which the DPRK is the first user of nuclear weapons involve attacks on ROK territory, a fair point has been made that the DPRK has greater incentives to attack areas outside the Korean Peninsula. These incentives include, for example, maintenance of ROK infrastructure (for example, for use in a reunified Korea under DPRK rule) and reduced risk of radioactive fallout drifting North. The DPRK would need to weigh these incentives against, for example, the risk that attacks on US bases in the ROK with only conventional weapons will leave too much of the US on-peninsula war-fighting capabilities intact.

attacks are attempts at coercion by the DPRK, and thus fall at the "intentional" or "deliberate" end of the spectrum of attacks indicated in Figure 2 and Figure 3. In each case, DPRK use of nuclear weapons would probably be preceded by at least veiled or non-specific threats of nuclear weapons use, perhaps not so different than has occurred in the past.[39]

Triggering Events and First Use

Variant 1: Frustrated by lack of attention from the international community in general and the United States in particular, the DPRK "ups the ante" and "demonstrates" a nuclear weapon on a not-particularly-valuable target in the ROK. The attack consists of the DPRK firing a short-range missile with a low-yield warhead at a low-value target, perhaps one of the islands south of the Northern Limit line on the West Coast, or perhaps a small coastal community not far south of the DMZ on the East Coast. The target community could be one that hosts a Coast Guard or similar small military facility. The DPRK's attack is designed **not** to cause significant damage or massive casualties and is possibly detonated at a relatively high altitude to further reduce damage and the possibility of damage in DPRK territory.[40]

The neglect the DPRK perceives may have been brought about by a combination of events distracting US leadership, which, in combination with domestic problems within the DPRK, goad the DPRK into acting. Examples of potential distractions for US leadership include, for example, a hotly-contested presidential election in which fraud is alleged, and/or evidence that Afghanistan has once more become a terrorist hotbed, and/or a humanitarian crisis in Afghanistan or elsewhere, and/or a resurgence in COVID-19, and/or "culture wars" in the United States coming to a breaking point, all of which either have analogs in recent history or are readily imagined based on what is happening in the United States today. Some of the domestic problems that could contribute to increasing the impatience of DPRK leadership with the lack of attention it is getting from the international community could include a COVID-19 outbreak in the DPRK, increasingly difficult economic conditions due to UNSC sanctions (coupled with more effective enforcement of same) and/or natural disasters, and a population growing, perhaps quietly, restive, and with more visibility into conditions in the ROK and the rest of the world. It is possible that DPRK forces might fake a small attack on DPRK territory, making it look like an ROK attack, in order to justify its own attack to its own people and/or international observers. Although this type of use case would nominally violate the DPRK's stated policy of no first use,[41] because the use is of low yield and focused on a "low-value" target, and especially if the

[39] As in, for example, 2020, when the DPRK "threatened to employ nuclear weapons against the United States, saying such drastic action represents the only remaining way to counter the threat it perceives from the Trump administration." Paul D. Shinkman (2020), "North Korea Threatens U.S.: Nuclear Attack 'The Only Option Left'", *US News and World Report*, dated, June 26, 2020, and available as https://www.usnews.com/news/world-report/articles/2020-06-26/north-korea-threatens-us-with-nuclear-attack

[40] Parts of this case are similar to elements in one of the cases proposed by Paul Davis and Bruce Bennett (2021, ibid), including the use of an "innocuous target." Triggering event and drivers for DPRK first use are along the lines of those proposed by Van Jackson (2021), in *Reducing or Exploiting Risk? Varieties of US Nuclear Thought and Their Implications for Northeast Asia*, paper prepared for the Reducing the Risk of Nuclear Weapons Use in Northeast Asia project, September 2021 (publication forthcoming).

[41] See, for example, Richard Smart (2016), "North Korea will not use nuclear weapons first, says Kim Jong-un," *The Guardian*, dated 8 May 2016, and available as https://www.theguardian.com/world/2016/may/08/north-korea-

use comes with some advanced warning (no more than hours, for example), the DPRK might see it not as "crossing the nuclear threshold" but rather only a small step beyond the combination of missile tests, nuclear weapons tests, and small-scale military provocations that have been part of its repertoire for a number of years.

The DPRK's first use might take place in the late winter, coinciding with a period when prevailing winds are north to south, and thus (on average) would tend to blow radioactivity to the south and away from DPRK territory. Late winter also corresponds with a period when food supplies in the DPRK are likely to be at a low point, and electricity supplies are likewise likely to be more sporadic than usual because rivers and thus hydroelectric output are low.

Variant 2: The drivers/triggering events and activities for Variant 2 of this use case are the same as those of Variant 1, but in Variant 2 either (a) the missile's warhead does not function (either by actual malfunction or by DPRK design), leaving the target community with some damage but few casualties; (b) the DPRK warns of the attack an hour in advance, but does not show where the missile is (or deploys multiple decoys leaving US/ROK forces too unsure of where the missile is to fire on any locations), leaving time for residents to get out, but the attack continues and causes damage to infrastructure; or (c) the DPRK warns of the attack and demonstrates readiness to move ahead with it, perhaps using a civilian human shield around the missile to keep US/ROK forces from attacking it, but allows a high-level negotiator from the US/ROK alliance—perhaps the sitting president(s) or a respected interlocutor from the past, to "talk them out" of firing with the promise of prompt and fruitful negotiations on a ceasefire/peace-and-compensation deal.

Variant 3: In this third variant, the DPRK chooses an offshore target, for example, a US Navy carrier battle group. Here, once again, the drivers and triggering events/activities that induce the DPRK to first nuclear use are the same as those in Variant 1, but the DPRK fires a nuclear-tipped short-to-medium-range missile such as the KN-23 at a carrier battle group located in ROK waters north and east of Busan. The combination of the weapon's accuracy (good to approximately 100-200 m when using conventional warheads[42]) and the size, spread during travel, and movement of the battle group mean that the bulk of the ships in the group avoid serious damage, but blast-overpressure damage to superstructures and radiation exposure to the sailors on most ships is substantial.[43] As a rationale for attack, the DPRK could claim that US ships were carrying nuclear weapons—which is not inconceivable, given past practices and changes in nuclear-weapons-at-sea policy changes under the administration of former US President Donald Trump—and thus the strike was to preempt imminent nuclear weapons use by the United

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will-only-use-nuclear-weapons-if-sovereignty-is-threatened. As noted above, however, other statements by the DPRK over the years on the topic of first use have sometimes appeared to take different positions.

[42] See, for example, Michael Elleman (2019), "North Korea's New Short-Range Missiles: A Technical Evaluation," 38 North, dated, October 9, 2019, and available as https://www.38north.org/2019/10/melleman100919/

[43] A discussion of the use of nuclear weapons by the DPRK for attacks on ships is provided in David Wright (2022), *The Role of Missile Defense in North-East Asia*, paper prepared for the Reducing the Risk of Nuclear Weapons Use in Northeast Asia project, January 12, 2022, and available as https://www.apln.network/projects/nuclear-weapon-use-risk-reduction/the-role-of-missile-defense-in-northeast-asia as well as on the RECNA and Nautilus websites.

States.[44] And/or, the DPRK could claim that the presence of the battle group was interpreted to mean that the United States and ROK had plans to attack the DPRK within days.

Given the frequent presence of carrier battle groups in the region, and the historical presence of US nuclear weapons on ships at sea, such claims by the DPRK could be considered mostly as means to justify its attack to its own people, whereas the main reason for the attack, as with the other variants above, is to renew international attention on the DPRK's security and economic situation.

How the Conflict Evolves

Variant 1: Convinced that the nuclear attack on a low-value ROK target is the first salvo of what will be a more extensive attack, the US/UN Command focus a conventional attack on the DPRK's artillery units near the DMZ, but the United States also uses one or more nuclear weapons on known buried targets thought to conceal ICBMs and other nuclear-tipped missiles thought to be capable of threatening the United States and its allies. The US nuclear attack uses weapons designed to destroy exposed and hidden nuclear facilities, but avoid heavily populated areas and non-military targets, including DPRK leadership, and uses low-yield and low-fallout weapons when possible,[45] in part at the request of the ROK.

Variant 2: The US/UN Command/ROK begins deployment and issues preliminary orders for a counterattack with conventional forces to defend Seoul, with a planned US nuclear counterattack targeted on known nuclear assets, but neither are ultimately carried out due to successful and speedy diplomacy.

Variant 3: The attack on the US Navy carrier battle group, with its attendant damage to ships and radiological impact on sailors would likely be enough to induce the United States to use nuclear weapons on military targets in the DPRK to augment the use of the ROK's conventional-weapon-based "WMD Response System."[46] The US president in the White House at the time of the attack may also, like Harry Truman at the outset of the Korean War, believe that not responding to an attack on US warships would result in an unacceptable setback to the United States' military and leadership standing internationally.[47] In addition, the proximity of the attack

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[44] See, for example, Robert S. Norris & Hans M. Kristensen (2016) "Declassified: US nuclear weapons at sea during the Cold War", *Bulletin of the Atomic Scientists*, 72:1, 58-61, https://www.tandfonline.com/doi/pdf/10.1080/00963402.2016.1124664

[45] For a discussion of the possible roles for use of these low-yield weapons, see Eva Lisowski (2021), *Potential Use of Low-Yield Nuclear Weapons in a Korean Context*, paper prepared for the Reducing the Risk of Nuclear Weapons Use in Northeast Asia project, October 2021 (publication forthcoming). An additional reference on tactical or non-strategic nuclear weapons, many of which are low-yield weapons, is US Congressional Research Service (2021), *Nonstrategic Nuclear Weapons*, updated July 15, 2021, and available as https://sgp.fas.org/crs/nuke/RL32572.pdf

[46] The ROK's "WMD Response System" is described by Lee Sangkyu (2021, ibid) as "consisting of a 'strategic strike system' and the 'Korean Air and Missile Defense (KAMD)' to secure autonomous deterrence and response capabilities."

[47] The history of Truman's decision to respond to the DPRK's attack in 1950, and surrounding events, is provided in James I. Matray (2021), *U.S. Entry into the Korean War: Origins, Impact, and Lessons*, paper prepared for the Reducing the Risk of Nuclear Weapons Use in Northeast Asia project, December 16, 2021, and available as https://www.recna.nagasaki-u.ac.jp/recna/psnanews/29548 as well as on the APLN and Nautilus websites.

to both the ROK and Japan, and probable radiological fallout in parts of one or both countries (and/or damage to ships and impacts on mariners from ROK and Japanese ships in the region) cause the ROK and Japan to insist that the United States retaliate. The United States does so, with a combined nuclear and conventional attack focused on known nuclear facilities in the DPRK, largely as in Variant 1.

Use Case Consequences

Variant 1: Assured by an immediate, high-level diplomatic mission that the United States has no intention to either take over the DPRK or to advance militarily in Northeast Asia, and facing internal struggles of its own, China deploys some additional troops to the region near the DPRK border but refrains from either invading or significantly menacing an invasion. Russia likewise goes on somewhat higher alert, but largely remains an observer, as does Japan. The broader international community, lea by the EU and perhaps Southeast Asian states and Australia/New Zealand, immediately calls for a ceasefire on both sides and offers to mediate the conflict, which helps to induce the combatants to consider diplomacy.

When the dust clears from the nuclear exchange, all parties, suitably shaken by the close call with regional/global disaster, agree, for the first time in many years, to undertake negotiations in earnest, starting with a deal for the DPRK to allow the IAEA (International Atomic Energy Agency) in to inspect damaged and undamaged nuclear facilities in exchange for international support,[48] first for the clean-up of the damage caused by the US attacks plus massive humanitarian assistance for its population, and later for assistance in rebuilding its economy. Over time, this exchange leads to a gradual opening of the DPRK, for which Chairman Kim Jong Un takes credit, and more economic and social interaction with the ROK, leading, eventually (perhaps by 2045) to *de-facto* economic integration of the Peninsula.

Variant 2: Challenged by internal issues, possibly including an upwelling of support for protesters in Hong Kong and/or continued disputes with Taiwan, with conflicts relating to its territorial disputes in Southeast Asia continuing to simmer, and thus hoping to reduce tensions on at least one front, China supports renewed negotiations between the DPRK and the international community, and Russia, quietly assured that it will have a chance to trade with the DPRK, possibly by electricity to the DPRK and through the DPRK to the ROK, in a new regional cooperation arrangement, also supports negotiations, as does the international community.

Variant 3: The scale of the US counterattack convinces the DPRK that attacks, either conventional or nuclear, on its leadership and ground troops are imminent. As a result, the DPRK begins an all-out conventional war on the ROK, and successfully launches a few of its remaining missiles on targets in Japan and the United States, resulting in extensive damage and rendering

[48] Although the IAEA currently has roles in inspecting civilian (or at least nominally civilian) nuclear facilities around the world to help assure that proliferation of nuclear weapons does not occur, it does not currently, as we understand it, have the specific authority or mandate to inspect or safeguard nuclear **weapons** or weapons production facilities themselves. It is therefore only our assumption, at this time, that the IAEA or another international agency, presumably tasked by the United Nations Security Council or a treaty organization, would be deputized to watch over nuclear weapons systems in the DPRK as a part of an agreement on the DPRK's nuclear weapons program.

some areas uninhabitable. The DPRK attacks on Japan and the United States described above in turn induce the United States to use tactical nuclear weapons on DPRK ground troops and missile launchers North of the DMZ, and to attempt to focus attacks on DPRK leadership as well. Again, China and Russia, depending on how far North the war spreads, may choose to wait out the war rather than support the DPRK. Europe and the rest of the international community attempts to mediate the crisis, but with attacks and counterattacks happening rapidly, fails to induce the combatants to relent in time to significantly reduce the war's damage.

Use Case Uncertainties, Ultimate Outcome, and Policy Lessons

A key uncertainty in this use case is whether the United States (with nuclear and non-nuclear forces) and UN Command and the US-ROK Combined Forces Command (with conventional forces) would be able, given existing military doctrine and procedures, to refrain in the first two variants from attacking DPRK leadership, or at least command-and-control facilities, which may by definition necessarily include DPRK leadership. If such an attack does occur, whether or not it is successful, a significant DPRK nuclear counteroffensive may also be anticipated.

Assuming the use case plays out along the lines of one of the first two variants above, the actors involved, and onlooking powers, could take heed from what could have evolved into a more serious unclear exchange and make additional efforts at nuclear arms control beyond the Korean Peninsula.

Early policy lessons from this case include the need, in the event of a DPRK incursion or attack, to take stock of DPRK intentions before firing back, and to be ready to deploy high-level delegations to the DPRK and China when needed.

3.1.2 "The Best Defense is a Good Offense"[49]

In the three "The Best Defense is a Good Offense" variants described below, changes in United States and ROK behavior leave DPRK leadership convinced that an attack in its territory is imminent, and it launches what is effectively a preemptive strike. The first two variants provided vary with respect to both the degree to which the ROK/US Alliance remains intact and to the US response. The third variant, which involves an attack on a nuclear power reactor in the ROK, is designed to sow sufficient chaos within the ROK that the United States and ROK are distracted from mounting an invasion, and the DPRK has time to both plan an effective defense and sue for peace. Of these, the first two fall at the "unintentional" end of the unintentional-to-intentional nuclear weapons use spectrum because they arguably are based on a DPRK misunderstanding of the ROK/US intent to invade. The third variant, although still based on a misunderstanding of adversary intent by the DPRK, invokes more elements of coercion in its design to create a chaotic situation, and can thus be considered more toward the intentional end of the spectrum than the first two variants.

Triggering Events and First Use

Variant 1: Perhaps due to recent leadership changes, leadership in both the United States and the ROK reject engagement with the DPRK, instead doubling down (placing additional emphasis) on the use of economic sanctions, building up of conventional armaments (and possibly troops) near the DMZ and in the ROK generally, increased tempos of war games, and installation of increasingly numerous and more modern ROK anti-ballistic missile (ABM) batteries and/or other deterrents. A sub-variant here might include compliant US leadership acceding to the demands of a new and hardline ROK administration to redeploy nuclear warheads and delivery systems to the Korean Peninsula.[50] The intent is to get the DPRK to negotiate through applying maximum pressure, short of direct military incursion, but the tactic backfires. Unable to sustain investments in new armaments to compete in the "arms race" with the ROK and the United States, and facing increasing pressure domestically due to lack of basic necessities, **the DPRK leadership becomes convinced that invasion by ROK/US/UN forces is imminent** and becomes even more overwhelmingly convinced that **they both are unlikely to win in a conventional war and unlikely to be treated fairly if they engage in diplomacy**. Feeling the possibility of regime collapse due to domestic hardships, and calculating that it will be possible to sue for peace if sufficient US casualties are incurred—that is, betting that the United States will have no "stomach for war" when it actually happens, the DPRK uses one or more nuclear weapons on a major US base in the hope of prevailing. Fearing that (additional) threats of nuclear use in its current situation will simply result in a pre-emptive strike on its territory by the

[49] Ideas for this case came from several Consultative Group members and are also similar to variants in the Davis-Bennett (2021, ibid) paper.

[50] See, for example, Yonhap News Agency (2021), "Yoon says he will request redeployment of U.S. tactical nukes in case of emergency," dated September 22, 2021, and available as https://en.yna.co.kr/view/AEN20210922005300320

United States and/or reduce the effectiveness of its strike, the DPRK uses its nuclear weapons without a specific warning of use.

The DPRK thus targets one or more major USFK (United States Forces in Korea)/ROK bases in the ROK (such as Camp Humphreys, south of Seoul), or perhaps a base in Guam with one or more nuclear weapons, seeking to cause significant casualties. The timing of this attack might be relatively random by year within 2025-2030, triggered by a particular piece of news or intelligence (true or false) reaching DPRK leadership regarding ROK/USFK capabilities or intentions, or could be specifically chosen to strike while the ROK and/or United States are otherwise engaged, such as late in an election cycle or as new leadership takes office that is expected to be unfavorable to engagement with the DPRK. If it has a choice, the DPRK might, to lessen the probability of a cloud of radioactivity traveling north from a target in the northern part of the ROK, choose to attack in the winter, though the timing during the year of an attack on, for example, Guam, would not presumably matter much to the DPRK.

The DPRK would likely use the KN-23 missile for the attack, a look-alike to the Russian "Iskander-M."[51] Detonation would be designed to inflict major casualties on a specific area as well as disable/render inoperable (due to radiation) significant military infrastructure, especially ABM batteries and aircraft.

Variant 2: With leadership in the United States and ROK distracted by domestic issues, no progress is made on engagement, sanctions continue in place and become more effective due to improved enforcement, and the DPRK leadership feels that its population is close to the breaking point due to lack of food and supplies, possibly exacerbated by increasingly frequent extreme weather. In this case, distractions for United States and DPRK leadership might include the sweeping effects of the highly transmissible COVID-19 "Omega-Delta" variant,[52] more active domestic extremism in the United States, an economic downturn (perhaps due to COVID) and/or a rupture in the ROK/US relationship due to the ROK being found to be working on nuclear weapons[53] because its confidence in the US nuclear umbrella is failing, as it perceives the United States to be increasingly focusing inward and on other parts of the globe, and less on Korea. As the DPRK sees the army defending the ROK getting smaller (due, for example, to the effects of COVID-19 measures, budget cut-backs in the ROK/US, or a US military refocusing elsewhere), **the DPRK leadership becomes convinced that its international situation and domestic standing offer an opportunity to move on the ROK, and that it can only do so successfully by attacking a US base with a nuclear weapon**, which, it feels, would leave the United States suing for peace and put the DPRK in a favorable position for negotiations. As a result, the DPRK takes the initiative to attack the ROK's 12 airfields, with missile defense systems also being

[51] See, for example https://missilethreat.csis.org/missile/kn-23/

[52] Although this naming and timing for a COVID-19 variant is of course for expository purposes only, the probability sadly seems high, given recent (2020-2021) experience, that the number of COVID-19 variants the world will have experienced will outstrip the number of letters in the Greek alphabet by the time this variant is posited to occur, during the 2025-2030 timeframe.

[53] The ROK has previously, and in violation of its agreements with the IAEA, undertaken experiments in extraction and reprocessing of plutonium. See, for example, GlobalSecurity.org (undated, but after 2004), "Weapons of Mass Destruction (WMD), Nuclear Reprocessing," available as https://www.globalsecurity.org/wmd/world/rok/nuclear-reprocessing.htm, and Anastasia Barannikova (2021), ibid.

potential targets for special forces to attack, as well as ports and other military facilities. Although the DPRK could do significant damage to the bases with conventional rockets, Jungang and other ROK bases have underground shelters that would be hard to render ineffective with conventional missiles. Disabling these bases would require nuclear weapons to either destroy them or to make them inaccessible due to fallout.

Variant 3: The circumstances outlined in Variant 1, perhaps enhanced by some of the DPRK domestic-front challenges described for Variant 2, convince the DPRK that it will be possible to avert a perceived ROK/US invasion and set the stage for a diplomatic "win" through a covert attack on the ROK. Having noted the chaos visited on Japan during the Fukushima reactor accident in March of 2011—caused and exacerbated, of course, by the terrible damage from the Tohoku earthquake and subsequent tsunami—DPRK leadership dispatch teams of Special Forces units, possibly including "sleeper" units prepositioned in the ROK as well as units arriving through undiscovered DMZ tunnels and by sea via, for example, disguised ships and submarines.[54]

These teams coordinate to attack one or more reactor sites in the ROK (each of which hosts multiple reactor units), focusing on relatively vulnerable ancillary systems, such as power supplies, cooling equipment, control systems, and spent fuel pools.[55] ROK reactors are well-defended, and given ROK experience with previous covert attacks by DPRK infiltrators, will have explored and be ready deal with many possible attack routes. It is possible that, recognizing this, the DPRK teams will either attack multiple sites, or will coordinate attacks such that a first attack or a nearby diversionary attack depletes the security forces/defenses around the reactor, while one or more other teams attack the plant itself. To assure enough damage to a reactor site to cause significant chaos and upheaval in the ROK, this use case posits that the DPRK Special Forces teams attempt to deploy and detonate nuclear weapons carried into vulnerable power plant locations by hand and/or in small and maneuverable vehicles.

Alternatively in Variant 3, in recognition of the strength of ROK defenses around reactors, the DPRK may use a nuclear-tipped cruise missile to attack an ROK reactor.[56] These missiles are maneuverable, potentially accurate to within a few meters (although the full capabilities of the DPRK's cruise missiles are probably not yet clear), and may be able to evade ABM defenses

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[54] One account of the activities of DPRK operatives in the ROK is found in Laura Bicker (2021), "Drugs, arms, and terror: A high profile defector on Kim's North Korea," *BBC News*, dated 11 October 2021, and available as https://www.bbc.com/news/world-asia-58838834

[55] The vulnerabilities of nuclear reactor systems to accident or attack, and measures to reduce those vulnerabilities, have been studied for decades, and are described in a variety of books and articles in the open literature. See, for example, Robert Alvarez, Jan Beyea, Klaus Janberg, Jungmin Kang, Ed Lyman, Allison Macfarlane, Gordon Thompson, and Frank N. von Hippel (2003), "Reducing the Hazards from Stored Spent Power-reactor Fuel in the United States," *Science and Global Security*, 2003, vol. 1, no. 1, pp 1-60, available as https://scienceandglobalsecurity.org/archive/sgs11alvarez.pdf; and Mark Holt and Anthony Andrews (2014), *Nuclear Power Plant Security and Vulnerabilities*, United States Congressional Research Service RL-34331, available as https://sgp.fas.org/crs/homesec/RL34331.pdf

[56] See, for example, Ankit Panda (2021), "Why North Korea's cruise missile launch could worry other nations," *BBC News*, dated 17 September 2021, and available as https://www.bbc.com/news/world-asia-58592308

placed near reactor sites, even if their launch was detected, particularly given the short flight time between the DPRK and the ROK.

Whichever attack mode is used in Variant 3, depending on how effective the attack is in targeting the nuclear plant, the result could couple the immediate release of radiation from the nuclear detonation with a perhaps slowly-evolving meltdown of spent reactor fuel, if one or more spent fuel pools are affected and lose cooling and/or if one or more reactor cores are breached and/or lose cooling by some other means. The combination would likely create a crisis in the ROK, with large populations attempting to move to get away from the fallout resulting from both the NUDET and reactor fuel damage,[57] with chaos compounded by the likely partial shut-down of the ROK electricity grid.

How the Conflict Evolves

Variant 1: The United States responds with conventional missile (and bomber) attacks on military installations, but it also uses one or more nuclear weapons on sites that are thought to house ICBMs or other nuclear-tipped missiles and at least one weapon on a site in or near Pyongyang thought to house a command bunker. The United States would have to weigh the probability of an attack on its own territory and/or additional bases in responding, but in this instance would face pressure both domestically and from allies (the ROK, likely Japan, and possibly Europe) to respond, and might conclude that the DPRK's ICBM and medium-range missile technologies, at least when mated to nuclear warheads, have not evolved to the point where they are likely to be effective. This conclusion would probably be easier for the United States to reach in 2025 than in 2030, assuming no or limited engagement takes place between now (early 2022) and then, and that as a result the DPRK's weapons technology development (and/or acquisition) continues. Nuclear weapons to be used by the United States would be missiles expected to be accurate enough to hit small and often hardened targets, including weapons designed to "bust bunkers" and deployed to do so.

Variant 2: The US/UN Command targets for conventional weapons in retaliation are as above.[58] The likelihood of the United States using nuclear weapons would be increased if US leadership became convinced that it would be possible to reliably destroy the DPRK's nuclear arsenal and/or nuclear missile systems. A sub-variant could be that the United States and allied forces explicitly stop short of destroying the DPRK's leadership, and possibly stop short of destroying all of the DPRK's nuclear arsenal (those elements for which locations are known) in order to offer the DPRK a peace deal that stops short of the destruction of the DPRK state and to assure that an intact DPRK government exists as a counterpart for negotiations. As noted in the

[57] Most of the ROK's reactor sites are located in the southern half of the country. Depending on prevailing winds at the time of the attack, mass movements of populations north toward Seoul from southern or eastern areas of the ROK could result from the attack, either to avoid the real danger of a radioactive plume and/or as a result of panic at the potential evolving impacts of the reactor damage and resulting plume.

[58] It has been noted that although there was a UN role in the Korean War and is a UN role in defending the ROK, the UN is unlikely to be involved in the use of nuclear weapons, so any counterattacks on the DPRK (or others) using nuclear weapons—of first use of nuclear weapons in some of the cases below—will be carried out under US, not UN, command.

previous use case, however, such restraint may run counter to US/USFK/ROK forces doctrine and programming.

Variant 3: Faced with the immediate and evolving fallout threats to the ROK population, ROK and US military and civilian planners are forced to make a choice as to whether to offer some sort of a truce deal to the DPRK, or to assume that the attack on the reactor was a DPRK preamble to a much broader offensive by the DPRK that could be expected immediately, and/or that the DPRK would reject, delay implementation of, or fail to honor a truce, and an immediate counter-offensive against the DPRK would thus be needed. In this instance, it is assumed that US/ROK leaders conclude that the DPRK plans to attack within hours or days, and that with much of the ROK (and its military) occupied with managing the upheaval resulting from the attack on the reactor (probably with US soldiers helping ROK troops and organizing massive air and sea evacuations out of the ROK), the only way to avoid an all-out invasion of the ROK would be to target DPRK troop concentrations and leadership with air power delivering conventional bombs and then with nuclear weapons delivered with bombers and ground and sea-launched missiles.

Use Case Consequences

Variant 1: Through a combination of successful attacks on the DPRK's nuclear and military infrastructure and some luck—perhaps Kim Jong Un and his inner circle are killed or leave the country, perhaps some of the missiles, most notably the ICBMs, fail to operate—the DPRK leadership, to the extent it remains, is obliged to offer peace terms that feature IAEA or UN access to and control over the DPRK's nuclear weapons facilities in exchange for the equivalent of a "Marshall Plan" for the DPRK (and the damaged areas of the ROK), paid for by an international group of donors led by the United States and Japan. Once the DPRK's nuclear weapons are secured, and reconstruction/redevelopment is underway, a formal peace treaty is signed between the parties to the Korean War. The DPRK and ROK remain separate, but a process of "nation (re)building," on a Western model, begins in the DPRK.

Variant 2 (and sub-variants): Consequences could possibly evolve as above, but in the sub-variant where the US and allied forces explicitly stop short of destroying the DPRK's leadership, perhaps the ROK/US alliance (in the sub-variants where it remains intact or is repaired by the necessity of war) reaches out to DPRK leadership in a way that allows the latter to save face, offering the combination of peace and significant investment in rebuilding the DPRK economy in exchange for placing the DPRK's nuclear and missile infrastructure under international control as a first step in negotiating a nuclear free zone on the peninsula. A similar endgame could occur if Kim Jong Un is killed or leaves the country, but a replacement group, with a more open ideology, manages to quickly consolidate power.

In both cases, eager to see the United States weakened by (another) war but unwilling to enter one themselves, China and Russia accept US assurances that the US goal in using nuclear weapons in response is limited to reducing/removing further DPRK nuclear weapons threats, and removing DPRK leadership, but require a deal in advance for significant roles in the governance of a defeated DPRK, perhaps through the UNSC.

It seems likely, however, that China in particular, but perhaps both China and Russia would be less willing to exercise restraint if, in fact, the United States had brought nuclear weapons back to the ROK, or would at least require their re-removal to sign off on a deal to end the conflict. As a consequence, if the United States and/or the ROK balk at removing US nuclear weapons from ROK territory, the plausibility of China and/or Russia staying out of the conflict may decrease.

Variant 3: In this Variant, the chaos that the DPRK had hoped to sow with an attack on a ROK reactor backfires for the DPRK because the United States becomes trapped into using nuclear weapons to thwart a DPRK invasion, as well as targeting DPRK leadership. The resulting exchange of weapons leaves the southern part of the DPRK impassable and the ROK population trapped between the DMZ and the smoldering reactor complex in the south. To the extent that its conventional artillery and/or nuclear weapons survive US/ROK air attacks, DPRK shelling and/or nuclear use on the Seoul area would compound the misery on the Peninsula. If the DPRK has operable ICBMs, after (or during) US/ROK attacks, it might well decide to use them to attack the United States, with shorter-range weapons targeting US bases and probably civilian areas in Japan.

As in the variants above, Russia and China might decide to nervously remain on the sidelines, at least with regard to nuclear weapons use, and let the war play out, but if the United States targets the DPRK via overflights of Russian or Chinese territory with missiles or bombers, concern that the United States may be targeting Russian or Chinese territory may cause those nations to launch nuclear weapons at the United States, resulting in essentially global nuclear war as the United States responds to Russian and/or Chinese launches.

Use Case Uncertainties, Ultimate Outcome, and Policy Lessons

In the first two variants above, the DPRK might deploy nuclear demolition mines in key corridors along the DMZ to block invasion by a US/ROK army and might detonate them if invasion seemed inevitable. Depending on how many weapons were deployed and detonated, the result might be an effectively permanent division of the Koreas, at least by land. Alternatively, DPRK leadership, if not checked by military officers or others in the DPRK, may decide to inflict additional pain on the United States and the ROK through attacks on civilians, possibly leaving both the ROK and DPRK sufficiently damaged and contaminated as to be partially or largely uninhabitable in the short term. Such a result would, in effect, underscore a fundamental problem—if the US/ROK "win" a war on the Peninsula it might in fact, in some circumstances, be worse than losing.

Avoiding this use case (and its variants) underlines the importance of leadership and consistency or leadership, and of mutual understanding between allies (United States/ROK, United States/Japan) as to what to expect from each other in different cases. For the United States, this also means developing and sustaining an emphasis on maintaining attention on multiple fronts and on close coordination/cooperation with allies, as well as obtaining a better understanding of the points of view of its adversaries.

The third variant here, positing an attack on a nuclear reactor, calls attention to particular lessons as to technology and security planning. These include the need to make spent fuel pools as secure as possible, provide multiple alternative power sources for reactor cooling, and maintain

vigilant security measures at reactor complexes, including imagining and figuring out how to thwart a comprehensive range of potential attack that might be visited on a nuclear power site.

Although it is very hard to plan how to ameliorate a crisis where a large part of the ROK population may be on the move, one way to provide at least some mitigation of the situation may be to assure that electricity can be provided in emergency shelters and elsewhere throughout the ROK on an ongoing basis independent of the central grid, probably through a combination of distributed renewable generation and electricity storage, such as in "microgrids."

3.1.3 "Last Option for Survival"

In the two "Last Option for Survival" variants, the DPRK regime finds itself in a position where it is losing power over its citizens, albeit for different reasons in the two variants, and lashes out on non-military ROK and US targets with nuclear weapons. In each case, the DPRK attacks are (or are described as) attempts at self-preservation and can be thought of as falling toward the "unintentional" end of the spectrum of attacks.

Triggering Events and First Use

Variant 1: Social unrest in the DPRK, brought on by a combination of increasingly unbearable deprivations due to a combination of economic isolation, sanctions, natural disasters (and related crop failures), the unwillingness of the regime to accept help, rampant (if unacknowledged) COVID-19 infections, and an ever-increasing understanding, through the leakage of news and popular culture across the border, that life is better in the ROK, causes the DPRK government to fight back in a way that causes further unrest. Seeing a partial collapse of DPRK government, US and ROK forces come in, nominally to protect DPRK populations, and are only lightly resisted by DPRK troops, who have also become aware of the stark difference between North and South and are suffering from lack of food, heat, medicines, and other necessities themselves. **Fearing for its survival, the DPRK leadership orders a nuclear launch**.

The DPRK nuclear attack focuses on populated areas, meaning either key areas of government and/or culture in Seoul. These could include the Blue House and environs, key ministries not yet moved to the Sejong area, City Hall, and/or a US military base in the Seoul area, with targets chosen in an attempt to break the conviction of the ROK. The DPRK's perceptions of the accuracy of its weapons might influence its choice of targets. For example, the DPRK might avoid attacking Seoul City Hall due to its proximity to the Deoksugung Palace, if the latter was considered a cultural keepsake by DPRK leadership. The DPRK might alternatively focus on attacking a nuclear reactor with a nuclear-tipped missile, calculating that a nuclear disaster that unfolded like Fukushima would distract the ROK and its allies from pursuing war with the DPRK, and, because most ROK reactors, as they are mostly located in the Southern part of the ROK, are relatively distant from the DPRK border, reducing the DPRK's exposure to the resulting fallout. An attack on an ROK reactor, if effective, might cause a mass migration of ROK refugees in the direction of Seoul, perhaps complicating efforts to defend the city.

In its attack, the DPRK would again use the KN-23 missile. This SRBM (short-range ballistic missile) is designed to follow a relatively low trajectory, and thus be difficult for systems like the THAAD (Terminal High Altitude Area Defense) missile defense systems deployed in the ROK.[59] The KN-23 can be fitted with either conventional or nuclear warheads, thus potentially

[59] See, for example, Missile Defense Advocacy Alliance (undated, but probably 2019 or 2020), "KN-23", available as https://missiledefenseadvocacy.org/missile-threat-and-proliferation/todays-missile-threat/north-korea/kn-23/ See also Matt Korda (2021), *Nuclear Weapons and Delivery Systems that Might be Implicated in Nuclear Use Involving the Korean Peninsula*, paper prepared for the Reducing the Risk of Nuclear Weapons Use in Northeast Asia project, September 2021 (publication forthcoming).

causing uncertainty on the part of USFK/ROK defenders, and potentially increasing the possibility of a nuclear response once a launch is detected. Detonation in this case would be designed to inflict major casualties on a specific area for effect on ROK morale. Weapons to be used by the United States to be determined, but probably would be weapons designed for highly targeted impacts and limited fallout due to the presence of coalition troops.

In the case where the DPRK's artillery, anti-aircraft, and other defenses had been depleted during a conflict, where DPRK leadership saw ROK/US troops coming across the border, and where leadership saw no other way of stopping the invasion, it is possible that it might use nuclear weapons on oncoming troops and south-north invasion corridors north of the DMZ, thereby using nuclear weapons on its own territory to cut off a land invasion and, perhaps, give DPRK leaders time to retrench, retreat, or leave the country.

Variant 2: In this second variant, **the DPRK carries out a provocative attack triggered by DPRK leadership feeling embattled for reasons including those in Variant 1**. Candidates for the provocation include DPRK Special Forces attacking an ROK government facility or attempting an attack at a nuclear power plant with a special forces contingent (see above—although, as noted, nuclear plants are well-guarded in the ROK), or the DPRK initiating another naval encounter, or an attack along the DMZ as a result of a mistake by the DPRK in communicating orders, or a suspected DPRK drone attack on an individual in leadership in the ROK or USFK. The provocation—possibly one of these or possibly a limited conventional attack by the DPRK, leads the ROK/USFK to conclude that a broader DPRK attack is imminent, and those forces follow the typical recent game plan of US attacks in such situations in other conflicts, which is to disable the DPRK's command and control infrastructure with conventional weapons. **The attack on DPRK command and control infrastructure leads the DPRK, and in particular Kim Jong Un, to conclude, perhaps mistakenly (as it is possible that the intent of an ROK/USFK military incursion might not, in fact, be to topple the Kim regime), that the aim of the ROK/USFK attack is regime change in the DPRK**, and that **the survival of the regime in a continuing conventional war is improbable**. As a result, DPRK leadership launches a nuclear weapon against a target in the ROK, likely focusing on types of targets identified in Variant 1.

How the Conflict Evolves

Variant 1: Due to the presence of ROK/USFK/UN Command troops in the DPRK, and wishing to limit civilian casualties, the United States would be obliged to use mostly conventional weapons, and to use limited, possibly low-yield nuclear strikes focused on known DPRK nuclear missile and other nuclear facilities, and on command-and-control operations not located within population centers (or near where invading troops are located). It is likely that Yongbyon would be a target, although it could probably be as easily destroyed with conventional-tipped missiles or a bombing campaign with conventional munitions. Weapons assumed to be used by the United States in its counterattacks are yet to be defined, but probably would be weapons designed for highly targeted impacts and limited fallout due to the presence of ROK/USFK/coalition troops in the DPRK.

Variant 2: Here the response of the United States (and conventionally-armed partners) may possibly be as in Variant 1, although depending on the character of the US president at the time,

on whether the DPRK has targeted US citizens in its NUDET, and/or whether the US president becomes convinced by advisors that the DPRK can and will launch an ICBM on US territory, the United States might seek to remove DPRK leadership with a targeted attack on Pyongyang.

Use Case Consequences

Variant 1: Worried about US/UN troops presence in the DPRK, and by nuclear use by the United States as far north of the DMZ as Yongbyon, and about the flow of refugees from the DPRK into Northeast China, China masses troops on its border with the DPRK and in some places, including, probably, around Dandong/Sinuiju, moves into the DPRK to establish forward positions, mostly to deter flight north by DPRK citizens, but also to establish a line that US/UN troops are not to cross. China warns US/UN troops not to move further north, but refrains from attack, nuclear or otherwise, while the US/UN forces remain south of Yongbyon. Russia moves troops to its limited border with the DPRK as a precaution, and to deter refugees, but prefers to remain out of the conflict for as long as possible.

Variant 2: If the US attacks Pyongyang, China may be obliged to come to the DPRK's aid. Given the danger from fallout, aid might not be in the form of Chinese troops on the ground on the peninsula, but rather in the form of threatened use of ICBMs to US soil. Russia might retaliate in a limited way for the loss of its citizens in Pyongyang or consider attacks on US bases in Japan or in Europe, though it might not go through with attacks, particularly attacks outside of Northeast Asia, for fear of starting a global war.

Use Case Uncertainties, Ultimate Outcome, and Policy Lessons

It may be improbable that the US/ROK refrains from attacking out DPRK leadership, based on general war-fighting strategy in recent years, and also highly probable that the DPRK leadership would expect the US/ROK to refrain from attempting to attack leadership, which would compel the DPRK to respond in defense of its leadership, even if a US/ROK attack on leadership was in fact not planned. Also uncertain is the extent to which China would feel compelled to back up the DPRK with its own nuclear weapons, particularly if the DPRK was responsible for the provocation that started the war.

Policy lessons here may be for the international community to try and “keep an eye” on conditions in the DPRK that may affect the stability of the DPRK regime with respect to its standing among DPRK citizens, and to offer and supply humanitarian aid (food, medicines, and fertilizer, for example) in such a way as to keep conditions in the DPRK from becoming too dire and thus unstable.

3.1.4 "We've Got Them Where We Want Them"

In "We've Got Them Where We Want Them," the DPRK regime comes back to the bargaining table for talks about its nuclear program and related issues, and although progress in negotiations appears from the perspective of the international community to be positive, if slow, the true intent of the DPRK is to reunify the Peninsula under DPRK rule, by force, if necessary, and it waits for a moment when it feels that the US and ROK military forces on the Peninsula are weakened and off-guard to mount a full scale attack on the ROK. The long-term planning involved in this use case puts it at the deliberate/intentional portion of the range of reasons for nuclear first use.

Triggering Events and First Use

Playing the long game and taking advantage of inadequate communications between a distracted United States that is trying to reduce its international exposure to conflict and an ROK administration focused on making progress through diplomacy, the DPRK engages in negotiations on its nuclear program for 2-3 years. These negotiations offer sufficient hope to the United States of a long-term solution that the United States reduces military exercises with the ROK and begins to deploy troops formerly part of USFK to conflict zones elsewhere. The DPRK, however, although offering sufficient concessions (though all easily reversible) to keep the United States and others at the negotiating table, remains focused on a Korean Peninsula united under DPRK rule. As US forces are called to a conflict elsewhere—perhaps in the Taiwan Strait, perhaps in the Middle East, or both—**the DPRK takes advantage of the situation by rapidly expelling (or possibly detaining as hostages) international nuclear weapons/facilities inspectors, attacking US bases in the ROK and the region with nuclear weapons, and simultaneously launching a full-on conventional offensive across the DMZ, albeit focusing on military targets**.

With a focus on winning a war and being left with usable ROK infrastructure after the war, the DPRK focuses its nuclear attacks on military targets—major US bases, including in Okinawa (it perhaps targets Guam as well, but the missile headed for Guam malfunctions or is intercepted), ROK mobile forces, resupply infrastructure, and especially ROK/US air power. It uses weapons designed to inflict damage on military installations, but limit damage to key civilian infrastructure, and limit fallout damage, for example, to agriculture. It may plan the attack for a season when winds blow north to south, such as in the winter, to reduce fallout on the DPRK and to avoid the growing season for agriculture (although that may or may not help to render a greater area of the next year's crops radiologically safe).

How the Conflict Evolves

Caught off-guard, and fearful of being overrun, the ROK reluctantly asks the United States to use nuclear weapons in response. The United States reluctantly agrees and uses nuclear weapons, likely fired from ships at sea, submarines, or from land-based installations further afield, to attack known nuclear facilities and weapons systems in the DPRK, as well as conventional missiles and bombs in an attempt to slow the progress of the DPRK offensive. The US counterattack would probably also target suspected DPRK leadership bunkers and areas where

additional forward-deployed troops and armaments are stationed, north of the DMZ, but probably would spare civilian areas to the extent possible.

Use Case Consequences

Because the DPRK is the aggressor in this use case, China would go to high alert, watching for US military incursions that might threaten Chinese territory or threaten Chinese nationals or businesses in the DPRK, but it would not use its nuclear weapons against US or ROK targets. Russia would do likewise. The result would be a nuclear war largely contained to the Korean Peninsula and Okinawa, but likely resulting in the deaths of millions of people, and hundreds of billions of dollars in property damage. The attack on Okinawa brings the Japanese Defense Forces into the conflict, probably in areas of the DPRK not affected by fallout, which are close enough to the Chinese border that China's alert status rises further, and it deploys troops to the border to guard against a military incursion and to stem the flow of DPRK refugees, which mounts rapidly as a humanitarian crisis in the DPRK unfolds.

Use Case Uncertainties, Ultimate Outcome, and Policy Lessons

This case offers a number of uncertainties that may call its plausibility into question. For example, would the DPRK really attack the ROK unprovoked while negotiations were continuing? Would DPRK leadership have sufficient "hubris" to believe the United States wouldn't counterattack, or be somehow sufficiently convinced by DPRK military leaders that no counterattack would be forthcoming? Also, is it reasonable to assume that the DPRK can develop low-yield or specialized nuclear weapons by 2030, and if it doesn't have them, would it be willing to accept contaminating ROK infrastructure to the degree that non-specialized warheads would tend to do?

Further, with respect to China and Russia, US ship- or submarine-launched counterattacks on the DPRK could, given the very limited flight time of missiles to their targets, trigger Chinese or Russian counterattacks on the United States, as China and Russia might not be able to know that the missiles are not targeted at them, or if Chinese and/or Russian military doctrine call for a response to any ballistic missile launch from the United States at sea. And if Japan joins US troops on (less- or uncontaminated) parts of the Korean Peninsula, would it bring China into the war as an active participant? It seems possible that China's considerable economic interests in the ROK, Japan, and the United States would make Chinese leadership reluctant to join a war that it did not start and does not seem to be affecting its territory, but that is certainly not a given.

Initial policy lessons from this case might be to include sufficient inducements, both positive and negative, in negotiations and incremental agreements as to make the interruption of the process of diplomacy unattractive for all parties, and to maintain attention on ongoing negotiations and commitments despite other distractions.

3.1.5 "Help Not Wanted"

The "Help Not Wanted" case varies considerably from the other DPRK-as-first-user cases above in that the target of DPRK nuclear weapons are not in the ROK or US military assets elsewhere in the region, but are in China, and designed to combat what it sees as a takeover of the DPRK by China. In this case the DPRK nuclear weapons use, as it is in response to an unexpected invasion (whatever its purpose) by China, falls at the "unintentional" end of the spectrum of reasons for nuclear first use.

Triggering Events and First Use

The joint impacts of UNSC sanctions, increased international vigilance toward sanctions-breaking "unofficial" imports of energy and other goods (and exports of coal), natural disasters/crop failures, and perhaps a wave of a new COVID-19 variant cause DPRK governance to begin to fray. This is manifested first by a loss of control in the northern DPRK provinces, including the defection from their posts (if not from the DPRK itself) of a significant number of troops stationed in the area, possibly with a renegade army officer becoming a kind of "warlord" in the region. Fearing a total collapse of the DPRK government, and already seeing much-increased flows of refugees across its border, Chinese forces begin to move into the northern DPRK to keep the peace. **Fearing being overrun, unable, unwilling, or afraid to redeploy troops from the DMZ, and with no control over their troops in the North, the DPRK leadership responds with the use of nuclear weapons in an attack on China**.

In this attack, one or more DPRK nuclear weapons are used on military targets in the Shenyang Military Region,[60] although that Command has been superseded by the Northern Theater Command.[61] Targets might include military bases in the area,[62] but could also include key roads leading to bridges into the DPRK, with a goal of making the border less passible to ground troops. There is, for example, a military airfield in Dandong, close to the bridge across the Yalu. But it would seem that attacking that location—or probably any location in China—would pretty much mean the DPRK had given up on China as a partner, as it would almost certainly mean cutting off the DPRK's major source of crude oil as well.

How the Conflict Evolves

China's response focuses on eliminating nuclear weapons and delivery systems that would continue an attack on China, mostly through conventional attacks, but possibly with tactical nuclear weapons to address deeply-buried and critical targets. China is aided in this effort by its inventory of on-the-ground intelligence on the DPRK's nuclear arsenal, information that it has

[60] See, for example, "Shenyang Military Region, Shenyang Military Area Command," ascribed (by Wikipedia) to John Pike (2006), https://www.globalsecurity.org/military/world/china/shenyang-mr.htm
[61] Wikipedia (2016), "Northern Theater Command", available as https://en.wikipedia.org/wiki/Northern_Theater_Command
[62] A summary of the air bases in the area is provided at Wikia.org (undated), "List of People's Liberation Army Air Force airbases," available as https://military.wikia.org/wiki/List_of_People%27s_Liberation_Army_Air_Force_airbases

gathered during its business and other dealings with DPRK actors, but which it has not shared with other nations. China does not seek to overthrow the Kim regime using nuclear weapons due to (A) fear of fallout on its own territory (if summer and prevailing wind patterns are south to north) and/or (B) not wishing to subject the ROK to fallout and bring the ROK and the United States (and allies) into the conflict, probably resulting, at best, in the long-term economic isolation of China. Instead, Chinese army finds and "detains" Kim Jong Un and his inner circle, taking them to Beijing for "consultation."

Use Case Consequences

USFK/ROK troops go on heightened alert along the DMZ, and Russian troops mass at their short border with the DPRK, but neither crosses the line, at least while China has a military presence in the DPRK. Rather, the United States seeks a negotiated treaty with China and Russia regarding self-governance of the northern part of the Korean peninsula, or at least of the eventual stationing of USFK troops no further north than Yongbyon (for example). One could maybe see a scenario where if the DPRK troops defending the DMZ pull back, lay down their arms, and/or defect, or in which the ROK, in fact, opens its border to incoming refugees, and effectively works with them to open the DMZ (for example, to demine it and remove razor wire). The ROK government would probably at that point seek aid from the United States and EU to allow it to absorb the refugees.

Use Case Uncertainties, Ultimate Outcome, and Policy Lessons

Key uncertainties in the evolution of this case include:

- Whether the DPRK leadership truly fears a Chinese invasion enough to attack China with nuclear weapons, or, alternatively, would trust China to help DPRK leadership bring restive areas of the DPRK back under central control, and then, having done so, depart, rather than making the DPRK a de-facto client state of the PRC. This uncertainty might be thought of as how the balance plays out between China's considerable recent economic role in the DPRK and shared socialist philosophies and the DPRK's reported rhetoric, in "ideological study sessions," describing China as "the enemy of the last 1000 years."[63]
- Whether the US/ROK would come to the aid of rebels in the North of the DPRK, leaving troops in harms way when China counterattacks, and possibly triggering a response with US nuclear weapons on China, in all likelihood then leading to a broader nuclear exchange.

[63] An AsiaPress.org article entitled "'The Enemy of a Thousand Years': Anti-Chinese Public Sentiment Constrains Cross-border Cooperation," dated July 9 2019, described "harsh rhetoric targeting China [as being] used frequently [during the Kim Jong Un era] by citizens at ideological study sessions, such as 'If Japan is the enemy of the last 100 years, then China is the enemy of the last 1,000 years' and 'We should not have any illusions about China.'" Article available as https://www.asiapress.org/rimjin-gang/2019/07/society-economy/the-enemy-of-a-thousand-years-anti-chinese-public-sentiment-constrains-cross-border-cooperation/

- Whether the United States, ROK, or Japan would mistake the firing of nuclear weapons by China, possibly from bases in North China or from submarines or ships, to be the start of attacks on their territory, and follow with nuclear and conventional attacks of their own on Chinese soil.

3.2 United States/ROK as First User

In the following three cases (some with variants), the United States is the first user of nuclear weapons on or near the Korean Peninsula. Although the United States has a nominal (if not explicit) no first use policy,[64] in most of the cases below, a provocation by or attributed to the DPRK induces a United States that, due to its position at the time, perceives (rightly or wrongly) few viable non-nuclear options, to use nuclear weapons. If the US policy on first use changes in the near future, and particularly if it appears that change would survive in future administrations, the plausibility of some of the cases below might be reduced. In one case the use of nuclear weapons hinges mostly on the personality of the US president— though it can easily be argued that any use of nuclear weapons, anywhere, depends on the personality of the US president, and on those who provide information and advice to him or her. Many of the cases presented below draw upon or have elements of ideas developed in a paper prepared for this project by Daryl Press.[65]

3.2.1 "The Best Defense is a Good Defense"

In response to a spreading ground war across the DMZ and feeling in danger of US/ROK/UN Command troops being overrun, the United States resorts to nuclear weapons use to stem a DPRK attack. Given that this action is in response to an evolving and uncontrolled situation, US first use in this case can be considered at the unintended end of the range of reasons for nuclear first use.

Triggering Events and First Use

A ground war breaks out between the DPRK and the ROK, perhaps because, due to lack of inter-military communications, the DPRK mistakes ROK/US exercises for an imminent attack, and/or perhaps because DPRK internal politics are coming to a head and the DPRK leadership needs a diversion, and/or for some other reason, which could be an accidental missile launch into the DPRK from the ROK, or an ROK patrol boat being sunk by a DPRK submarine in disputed waters (to give just two examples). With the United States distracted by wars elsewhere and/or contentious elections and/or natural disasters/pandemic and/or governed by a president unable or unwilling to commit additional troops to the Peninsula, the ROK/USFK is unable to bring reinforcements to the Peninsula in a timely fashion as DPRK troops stream across the DMZ,

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[64] In a recent summary, the US Congressional Research Service (CRS) noted, with respect to the US Joseph Biden Administration's consideration of a change in first use policy, that a 'no first use' policy would represent a change from current policy, where the United States has pledged to refrain from using nuclear weapons against most non-nuclear weapon states, but has neither ruled out their first use in all cases nor specified the circumstances under which it would use them." CRS (2021), *U.S. Nuclear Weapons Policy: Considering "No First Use"*, updated October 13, 2021, and available as https://sgp.fas.org/crs/nuke/IN10553.pdf

[65] Daryl G. Press (2021), *The Deliberate Employment of U.S. Nuclear Weapons: Escalation Triggers on the Korean Peninsula*, paper prepared for the Reducing the Risk of Nuclear Weapons Use in Northeast Asia project, January 6, 2022, available as https://www.apln.network/projects/nuclear-weapon-use-risk-reduction/the-deliberate-employment-of-united-states-nuclear-weapons-escalation-triggers-on-the-korean-peninsula and on the RECNA and Nautilus Institute websites.

possibly taking ROK hostages as they go. As a consequence, at least initially, the ground war goes well for the DPRK, perhaps aided by adroit and timely work by DPRK Special Forces cells prepositioned in the ROK to disable much of the ROK/USFK air power. **Fearing being overrun, the United States first threatens nuclear use on DPRK territory, but when that threat apparently goes unheeded, the United States/ROK resorts to a targeted nuclear attack to decimate second-echelon forces (troops, tanks, and artillery) stationed north of the DMZ**.

US nuclear attacks focus on DPRK military units located North of the DMZ and staging for invasion of the ROK, as well as key batteries of missile launchers threatening Seoul, although some of the latter could be carried out with conventional missiles or aircraft. The United States might feel obliged at the same time to try and remove as much of the DPRK's nuclear threat as possible. There may be enough uncertainty in the efficacy of conventional first strikes on facilities in the DPRK that the United States might decide it couldn't be sure of disabling key DPRK threats without using nuclear weapons.

How the Conflict Evolves

Fearing an attack on its leadership, in addition to its military units, the DPRK launches a nuclear attack on a major US base in the ROK, and/or on US bases in the region (Okinawa or Guam) where the DPRK calculates US nuclear attacks might originate. Examples of military targets for the DPRK might include the Jinhae US naval base near Busan (to limit the rate at which reinforcements can arrive), the ROK's mobile forces, or Pyongtaek/Camp Humphreys, south of Seoul.

Use Case Consequences

Perhaps as in some of the cases above—that is, eager to see the United States weakened by (another) war but unwilling to enter one themselves—China and Russia accept US assurances that the US goal in using nuclear weapons is limited to reducing/removing further DPRK nuclear weapons threats, and removing DPRK leadership, but China and Russia require a deal in advance for significant roles in the governance of a defeated DPRK, perhaps through the UNSC. China and/or Russia might alternatively (or in addition) insist on the survival of the Kim regime as a quid pro quo to staying out of the conflict and consider that to be fulfillment of their obligations (formal or otherwise) for defense of the DPRK.

Use Case Uncertainties, Ultimate Outcome, and Policy Lessons

Although recent military doctrine suggests that the United States would tend to rely on precision-guided conventional weapons to repel a conventional DPRK attack, the United States would need mobilization and deployment of those weapons, and of the troops trained to use them, to be able to use precise weapons. There could be a number of circumstances—for example, the United States being busy fighting wars elsewhere, or having been thrown off guard by a peace process, in which it would take too long to deploy precision-guided weapons to the Korean theater (that is, a DPRK attack would be too far advanced by the time the US weapons were deployed), and thus a nuclear option might look attractive. A major determinant of whether the United States would use nuclear weapons in this case would be the personalities and points of view of US leadership, and, in particular, the US president. If the president is informed and

supported by advisors and a constituency that is strongly against the use of nuclear weapons, it lessens the likelihood that the president will direct US forces to use them. If the president is informed by groups that see value in nuclear weapons use (beyond their deterrence value), and the president (and his/her advisors) believe that a nuclear war on a distant continent is unlikely to be of grave concern to their constituency, the odds of US nuclear weapons use in response to a situation like that above would rise.

3.2.2 "US Leadership Hubris"

As the title implies, this use case starts with overconfidence—in both offensive nuclear weapons and in the systems meant to defend against incoming missiles—on the part of a US president and the advisors that envelop him or her. In part to divert the electorate from difficult issues at home and abroad, the president orders an attack on the DPRK's nuclear and missile systems, but with only partial success.[66] A key element in this case, although also very important in other cases, is what group of nuclear weapons advisors have primacy in the White House at the time a nuclear use (or non-use) decision is made. In his paper prepared for this project, Van Jackson identifies "four schools of thought comprising the US nuclear policy epistemic community" as "Arms-controllers," "Nuclear traditionalists," "Nuclear primacists," and "future-of-war strategists."[67] As some (not all) of these groups of advisors are associated primarily with the US Democratic or Republican political parties, the likelihood is high that a president's party will in large part determine his or her administration's nuclear doctrine and play a large role in determining his or her decisions on nuclear use.

The type of first use described in this case would fall at the intentional end of the spectrum of reasons for nuclear weapons use.

Triggering Events and First Use

A US president, isolated from experienced advisors and balanced and fact-based information, comes to believe and/or is convinced that it would be possible to destroy the DPRK nuclear arsenal (and its related missile inventory) in a set of targeted nuclear attacks. It is possible that the availability of a new weapon or type of weapon also emboldens and seduces the president into thinking that an effective attack can be carried out with little possibility of reprisal. An example might be the under-development (as of 2021) hypersonic (capable of traveling at Mach 6, or about 7000 km/hour) SR-72, an unmanned aircraft that could be launched from a US base in the region, and reach the DPRK in minutes, and virtually without warning, or fly from a base on US territory.[68] In addition, the president receives and believes assurance that the missile defense systems it has deployed on US territory and around allies such

[66] Alert readers will doubtless recognize that this use case has commonalities with very recent history, including the story of the worries of the US Joint Chiefs of Staff Chairman, General Mark Milley, regarding the possibility of then-President Donald Trump starting a war with China in the waning days of the Trump Administration. See, for example, Martin Pengelly (2021), "Top general feared Trump would launch nuclear war, Woodward book reports," *The Guardian*, dated September 14, 2021, and available as https://www.theguardian.com/books/2021/sep/14/mark-milley-donald-trump-bob-woodward-nuclear-war-

[67] Van Jackson (2021), ibid.

[68] See, for example, Dario Leone (2021), "All you need to know about the SR-72 Son of Blackbird: from its conception to its possible cancellation," dated April 13 2021, and available as https://theaviationgeekclub.com/all-you-need-to-know-about-the-sr-72-son-of-blackbird-from-its-conception-to-its-possible-cancellation/

as the ROK and Japan will be effective in eliminating any DPRK weapons that do manage to escape destruction.[69]

The public justification for the attack by the United States is nominally concern that a much-publicized DPRK test of a not-before-demonstrated ICBM proves that the DPRK now has the ability to threaten US soil, but the underlying rationale for the attack is that the president, having largely alienated US allies in Northeast Asia, having increasingly involved the United States in an expensive and widely unpopular trade war with China, and facing mounting domestic problems, is seeking to divert public attention within the United States and bolster his (or her) popularity by starting a war. Although the attack is preceded by a series of bellicose but non-specific warnings of military action, the United States does not provide a specific warning of impending nuclear attack.

US attacks in this case could be with a combination of conventional precision-guided weapons first on easy-to-locate targets, such as Yongbyon, but would use penetrating nuclear weapons to remove buried missile silos and/or enrichment facilities or to destroy missiles sequestered in mountains. The attacks would probably not target Pyongyang, as US leadership (in particular the president) is convinced that the destruction of the nuclear arsenal will be enough to get the DPRK to the bargaining table and wants to avoid contaminating potential future real estate investments. This case assumes that virtually all of the attacks on known nuclear weapons and delivery system facilities are successful, but that not all DPRK warheads are destroyed, as some are hidden both deep and in otherwise unremarkable locations, such a railway tunnel through a mountain, perhaps close to the Chinese border where the United States would be reluctant to attack even if the location was known to contain a missile. The DPRK may also use deception to make the United States believe it knows where its missiles are, such as providing harder-to-hide liquid-fueled missiles with camouflage that it knows US technical means can see through, while hiding solid-fueled missiles in locations more impenetrable to US or international detection.

How the Conflict Evolves

The DPRK, which assumes that the US attack has been carried out with the tacit permission of the ROK and Japan, though the ROK and/or Japan might not know about it in advance, counterattacks with an assault on the ROK and/or possibly Japan. Although the US attack has rendered most of the DPRK's delivery systems for nuclear warheads disabled or inaccessible due to fallout, the DPRK has sequestered several nuclear warheads in hard-to-find locations, possibly

[69] See, for example, David Wright (2022), *The Role of Missile Defense in North-East Asia*, paper prepared for the Reducing the Risk of Nuclear Weapons Use in Northeast Asia project (ibid). Some of the key lessons of studies of current missile defense systems are that those systems may not be as capable of intercepting incoming missiles under real-world circumstances as they are advertised to be, may not have been thoroughly tested under field conditions, may only work on certain types and trajectories of incoming missiles, and may be relatively easily defeated by countermeasures incoming missiles could employ, such as tumbling or twisting flight, or the use of multiple munitions or warheads. In addition, although an adversaries' knowledge of the presence of missile defense systems may cause it to think twice about attacking, it may also cause a change in attack strategy or induce the use of multiple missiles to overcome the potential effectiveness of and ABM system.

either deep underground and/or surrounded by civilian dwellings, and, while appearing to be considering suing for peace, marshals these remaining weapons for a counterattack.

For its counterattack, strike groups of DPRK Special Forces rig remaining warheads with remote detonators[70] and bring them by sea to a major ROK (or Japanese?) port. Conveyance could be in one of the many small DPRK submarines, or in, for example, a stolen ROK or Japanese fishing boat or in a DPRK vessel disguised as such. It is possible that this sort of attack would be unlikely to succeed due to vigilant and well-organized ROK coastal defenses, but one or more groups might slip through. Japan, with a much longer coastline facing the DPRK, might be harder to defend against such attacks. Land-based attacks on the ROK, through tunnels under the DMZ, are also possible, although presumably a US nuclear attack on the DPRK would place DMZ patrols on high alert, unless they were forced to retreat due to cross-border fallout from US attacks. Fallout might also affect a cross-border DPRK incursion, but a DPRK attack squad might be less concerned about radiation exposure.

The target of the counterattack could be a place where the NUDET would damage multiple important infrastructure installations, such as LNG (liquified) storage facilities, roads to a major city, or airports. For example, a weapon hidden among small ships/boats at Incheon, could, depending on the size of the weapons, damage the road/bridge to ICN and maybe the airport itself, nearby oil tankage and LNG import facilities, the Port of Incheon itself, the city of Incheon, coal storage, a small ROK naval facility, and much more, all of which are within a 10-km radius.[71] If much or all of that were destroyed or rendered inoperable, it might significantly cripple the ROK economy.

An alternative (or perhaps concurrent) type of counterattack might be for a DPRK Special Forces team to mount a similar attack on Japanese infrastructure, including energy and port facilities and/or a nuclear power plant near Tokyo. In this case, the DPRK would be seeking to force Japan to use its Self Defense Forces to deal first with the resulting crises in its own country (which, given the experience of the Fukushima reactor disaster of 2011, could take months or years) before aiding the US/ROK in a war on the Korean peninsula and could serve to divide the coalition arrayed against the DPRK

Use Case Consequences

If it sees the US attack as "unprovoked," China will possibly feel obliged to come to the aid of the DPRK, though probably with conventional weapons designed to keep US and ROK conventional forces south of the DMZ. Russia probably stays out of the fray, waiting to see what will happen, and happy to see adversaries otherwise engaged. If a DPRK counterattack on the ROK or Japan did indeed occur, it seems likely, however, that one or both of Japan and the ROK would demand that the US follow up with an attack on DPRK leadership, which might cause China to attack the United States, leading to a full-scale nuclear conflict.

[70] Note that it is possible that this type of bomb could be detonated either remotely or via a suicide mission by DPRK Special Forces.

[71] For example, a location along the docks at Incheon centered at latitude and longitude coordinates 37.446332, 126.607192.

Use Case Uncertainties, Ultimate Outcome, and Policy Lessons

Perhaps more than some of the other use cases above, this particular use case offers many uncertainties, or decision points, in which miscalculation (or the wrong decision) could easily cause the conflict to spread to a nuclear conflagration. If the US launch was from a submarine, for example, and not communicated in advance to Chinese and Russian military leaders, it is possible that one or both of those powers might mistake the US launch for an attack on their territory and trigger launches of nuclear ballistic missiles from their own submarines on US bases in the region and/or the US mainland itself. Those launches, in turn, would likely spur the United States to counterattack China and/or Russia with ICBMs and cause the launch of ICBMS from China and/or Russia on the US mainland and possibly US allies. Armageddon would be the result of such an exchange.

Key policy lessons from this case might include making sure that nations where a single leader is (or can be) virtually omnipotent have procedures for war authorization that force inclusion of individuals outside of the leader's inner circle, and the need to consult with both allies and not-directly-involved adversaries to limit opportunities for misunderstanding of intent (although even such consultations may be inadequate absent trust). In addition, leaders should receive accurate information about the effectiveness of weapons systems, particularly missile defense systems, against adversaries' offensive weapons, so as not to be deluded by the potential of such systems to solve problems that should be addressed through diplomacy.

3.2.3 "Response to DPRK Proliferation"

In this use case, it is not the DPRK's own direct provocations that spurs the United States to use nuclear weapons on the DPRK, but rather the results of DPRK proliferation of nuclear technologies and/or nuclear materials. This use case would be categorized somewhere in the middle of the unintentional to intentional range of first use because the United States is using nuclear weapons in response to perceptions of proliferation rather than to gain military advantage.

Triggering Events and First Use

The DPRK proliferates nuclear technologies to other countries or to non-state actors, such as Middle Eastern jihadists, who use their weapons on US assets. The DPRK's motivations in proliferating nuclear weapons include earning money to support its weapons programs, testing (through others) the technologies it develops and sells, and creating a degree of disorder and confusion regionally or globally in order to induce its adversaries to offer concessions.[72] The proliferation could result in a nuclear detonation in the Middle East, or the deployment of a dirty bomb in a US-allied country (or in the United States itself), or a threatened use of a nuclear weapon by a state or non-state actor that the **United States and its allies foil but trace to a DPRK origin. Stating that the DPRK has "crossed a red line," the United States threatens a nuclear attack on the DPRK unless the DPRK agrees to immediate denuclearization and to dismantle its proliferation networks. When the DPRK responds with more strident rhetoric, the United States attacks Yongbyon and other known nuclear-infrastructure targets in the DPRK but does not attack DPRK leadership directly**.

US attacks could be with a combination of conventional weapons first and/or use of penetrating weapons to remove buried missile silos and/or enrichment facilities or missiles sequestered in mountains.

How the Conflict Evolves

The DPRK could reply with conventional weapons, for example, targeting US bases, but it might also assume that an attack on leadership is imminent and thus launch a nuclear strike.

The DPRK strike could be on a US military target in the ROK, possibly in the Seoul area. Or, if the DPRK considers fallout floating north—such as with prevailing summer wind patterns—to be a concern, an attack on a southern ROK city or on Sejong might be considered. In either case, the intention would be to inflict heavy damage and sue for peace. This assumes that one or more short/medium range missiles, which would be relatively easy to hide, escape US actions.

[72] See, for example, Toby Dalton (2021), "The Most Urgent North Korean Nuclear Threat Isn't What You Think," Commentary, Carnegie Endowment for International Peace, dated April 15, 2021, and available as https://carnegieendowment.org/2021/04/15/most-urgent-north-korean-nuclear-threat-isn-t-what-you-think-pub-84335

If DPRK ICBMs are sufficiently reliable (or maybe even if not) AND if they survive what would probably be an intense US effort to destroy them, retaliation with an ICBM on the United States, or with a medium-range missile on Japan, might also be considered by the DPRK.

Use Case Consequences

As in cases above, if it sees the US attack as "unprovoked," China will possibly feel obliged to come to the aid of the DPRK, though probably with conventional weapons designed to keep US and ROK conventional forces south of the DMZ. If the US attacks are aimed (or stray) too far north in the DPRK, or bombers or missiles overfly or come too close to Chinese territory, China may believe that an attack on their territory is underway or imminent and may launch a retaliatory nuclear attack. Russia again probably stays out of the fray, waiting to see what will happen and happy to see adversaries otherwise engaged.

Use Case Uncertainties, Ultimate Outcome, and Policy Lessons

Would the ROK condone such as response, or would it ask the United States to hold off on retaliation for proliferation? A variant of this case might be one in which the United States is unable to determine who carried out the nuclear (or dirty bomb) attack, but it uses nuclear forensics to trace the origin of the nuclear material to the DPRK, and concludes, perhaps erroneously, the DPRK has in fact carried out the attack and thus responds, 9/11-style, with a counterattack of its own.[73]

[73] This is something to check, but it seems an open question whether, if the DPRK does proliferate nuclear weapons technologies, it would also sell some of its fissile materials for another state or a non-state actor to use in their own weapons. Presumably, nuclear forensics would look to identify the source of the fissile material, but it's possible that material could be (or could have been, years ago) smuggled out or Russia, the United States, Europe, or Japan, from stocks of reprocessed plutonium or weapons-grade uranium. If so, would nuclear forensics trace that material to the DPRK? Would the isotopic signature from a nuclear detonation or a dirty bomb be enough to both trace the origin of the nuclear material and the weapons technology used?

3.2.4 "Tripped at the Finish Line"

In this use case, what appears to be a major deescalating win for the international community on the Korean Peninsula goes awry at the last minute, as negotiations between the DPRK and the United States/ROK break down over an unexpected event, causing the DPRK to redouble its threat to target the ROK with nuclear weapons, and the United States, mistaking DPRK brinksmanship for actual intent, to launch a pre-emptive nuclear strike. This use case would be categorized closer to the unintentional end of the unintentional to intentional spectrum of first use.

Triggering Events and First Use

Early in 2022, the Biden Administration in the United States begins the process of re-engaging with the DPRK, and a well-behind-the-scenes diplomatic effort gradually brings the DPRK to the negotiating table. In May, President Biden himself flies to Pyongyang to meet Chairman Kim Jong Un, with an Air Force C-17 cargo plane in tow packed with emergency food rations and medicines for humanitarian use in the DPRK. Their summit goes well and sets a framework for the beginning of talks between the nations. In late 2022 a third-party, cooperative threat reduction (CTR) project is launched emphasizing pilot application and capacity building in energy efficiency and renewable energy in the DPRK, with tacit approval of the governments (ROK, United States, EU) involved and perhaps some indirect government funding, but carried out by a coalition of non-governmental agencies, government think-tanks, academics, and others. This project is resoundingly successful in providing images of cooperation for both DPRK and US leaders and leads to more cooperation on energy sector activities in the DPRK, accompanied in parallel by progress on nuclear weapons issues, including the DPRK freezing its nuclear weapons work and admitting IAEA (International Atomic Energy Agency) inspectors into the country to view some (but perhaps not all) nuclear-related sites.

Productive negotiations and gradual opening of the DPRK economy, with lifting of UNSC sanctions, continue through the re-election of Biden in 2024 (or maybe the election of President Harris?) and for the ensuing four years, with high-profile engagement such as the rebuilding of a rail line across the DMZ between Pyongyang and Seoul, the use of the rail line to facilitate visits between separated families, further cooperation on energy and on DPRK minerals production, and other initiatives. By 2028, the DPRK is ready to start negotiating on actual removal of some (not all) of its weapons in exchange for security promises by the United States. But then one of two things happen. Either:

1. A new US administration with a more ideological bent takes office and comes into its first meeting with the DPRK delegation with additional demands not consistent with the steps that the parties had been following. This could be, for example, a return to a demand for immediate and full DPRK "denuclearization," or a demand that the DPRK immediately adopt Western levels of human rights guarantees. OR
2. An unexpected event completely derails negotiations. An example of such an event might be if Kim Yo-jong, who has been growing in power in the DPRK and by then has been fully

deputized by her brother Kim Jong Un to oversee negotiations with the United State/ROK,[74] is assassinated in Seoul during a visit to her ROK counterpart by what appears to be a soldier in an ROK army or USFK uniform, but is actually an agent of a right-wing ROK or US group in disguise, or perhaps just an individual with mental health issues who has been indoctrinated into a terrorist group.

In either case, the DPRK accuses the United States of duplicity in negotiations (and, in the latter case, murder), expels IAEA inspectors via the rail line between Seoul and Pyongyang, blows up the portion of the rail line in the DMZ, and overtly begins to set up and fuel a set of nuclear missiles, as well as placing its conventional forces closer to the DMZ and massively increasing exercise tempos. **Mistaking this brinkmanship on the part of the DPRK (which is looking for an abject apology from the United States/ROK) for an actual intention to attack, the United States first threatens attack, then, faced with a strident reply from the DPRK (which thinks the United States is probably bluffing) attacks the missiles it can see with conventional PGM and deeply protected locations where it believes warheads are stored with bunker-busting nuclear-tipped missiles, although it does not (yet) target DPRK leadership**.

How the Conflict Evolves

The DPRK responds with a conventional bombardment of Seoul and uses some of its remaining weapons (hidden in remote railway tunnels) to target US bases in the ROK, including those near Seoul and the resupply bases in the southern part of the ROK. The United States responds, and a full-scale war on the Peninsula ensues.

Use Case Consequences

As in many of the cases above, China and Russian forces go on high alert and mass near the DPRK border but do not get involved in the conflict. If Japan sends troops to aid the United States/ROK in the war, which it might, the DPRK may respond with a nuclear strike on a populated area of Japan with a nuclear weapon, or it may try to target the US base on Okinawa—but the latter is a smaller target. The war results in the near-complete destruction of the Korean Peninsula, possible damage in Japan, and possible fallout damage in Northeast China, which might or might not bring China itself into the war.

Use Case Uncertainties, Ultimate Outcome, and Policy Lessons

Major uncertainties in this case include how the DPRK might respond to the United States throwing a "curveball" at an advanced point in negotiations, which might have more to do with how secure DPRK leadership feels at home than what the United States actually says and does. In addition, there is a question of whether the US delegation would be able to identify DPRK brinkmanship for what it is and would be able to defuse the situation (or rather, whether the

[74] Such a designation does not seem, as of this writing, outlandish. See, for example, Laura Bicker (2021), "Kim Yo-jong says North Korea open to ending war if conditions met," *BBC News*, dated September 24, 2021, and available as https://www.bbc.com/news/world-asia-58675703

individuals in or advising the delegation who **DID** recognize the situation and have solutions that would actually be listened to.

Key policy lessons here would be to work to stay the course of negotiations even in times that look desperate and to be ready to give the other side what they need to look good to their own constituency.

3.2.5 "A Promise is a Promise"

As noted earlier in this Report, the United States' extension of nuclear deterrence to the territories of Japan, the ROK, and (perhaps less formally) Taiwan are key elements in the security systems and doctrines of those states. In the three variants of the case described below, it is keeping the promise of the "nuclear umbrella" that drives the United States to use nuclear weapons first. This type of use case appears to have elements of both intentional and unintentional nuclear first use, as the United States is drawn reluctantly into nuclear use, without originally intending to attack the DPRK, but does so as a direct outgrowth of its promises, that is, to re-establish deterrence.

Triggering Events and First Use

Variant 1: Following a period of worsening DPRK relations with Japan, potentially exacerbated by more strident leadership in Japan, and further economic decline in the DPRK due to sanctions, the DPRK launches a nuclear HEMP (High Altitude Electromagnetic Pulse) shot over Tokyo that causes major infrastructure damage through its effects on electronics. Note that in this case we consider the DPRK HEMP attack, though it is in fact a use of a nuclear weapon, to be a "triggering event," not a "first use," because it is not a detonation on or near the surface of the earth. We recognize, however, that this could be considered a somewhat artificial distinction.

Fearing a DPRK attack on its populations, either conventional or nuclear, while its sensor, missile defense, and other systems are offline, Japan asks the United States to respond with nuclear weapons, and the United States reluctantly agrees, possibly with arguments in one or both directions (for and against attack) from the ROK. The United States considers offering the DPRK an ultimatum before using nuclear weapons on the DPRK, but reasons that the DPRK leadership must be removed to simultaneously resolve the problem and assure that there will be no nuclear counterattacks on the ROK, Japan, or US territory (although that assurance may not be particularly solid), and thus must strike without first threatening nuclear use in order not to give DPRK leadership more time to go deep underground or to initiate a strike of their own. A sub-variant of this case could be one in which the triggering event is a widespread cyber-attack traced to DPRK state-sponsored hackers. In this case the cyber-attack might shut down electricity supplies, water supplies, and/or gas or oil pipelines, and/or disrupt official and civilian transportation and communications channels sufficiently that, as above, Japan finds and fears itself vulnerable due to the widespread disruption, fears a DPRK military attack, and presses the United States to respond.

Variant 2: This variant follows the same pattern as above, but the ROK is the focus. Following a period of worsening DPRK relations with the ROK and the United States, potentially exacerbated by more strident leadership in the ROK and/or the United States, and further economic decline in the DPRK due to sanctions, the DPRK launches a nuclear HEMP shot over the DMZ that causes major infrastructure damage in the ROK and significantly degrades ROK/USFK communications and control capabilities. **Fearing a DPRK assault on its populations, including a massive ground assault, while its sensor, missile defense, and other systems are offline, the ROK asks the United States to respond with nuclear weapons, and the United States reluctantly agrees**. The United States reasons that the DPRK leadership must

be removed to simultaneously resolve the problem and assure that there will be no nuclear counterattacks on the ROK, Japan, or US territory (although that assurance may not be particularly solid). A cyber-attack by the DPRK on ROK infrastructure could, as in Variant 1, result in the ROK pleading for US nuclear assistance.

Variant 3: This variant largely follows the narrative of Variant 1, but in this case **the DPRK uses chemical and/or biological weapons**, delivered either though a Special Forces attack or by missiles each designed to distribute multiple "charges" of these weapons over a large area. Due to worsening relations with Japan, potentially exacerbated by more strident leadership in Japan, further economic decline in the DPRK due to sanctions and other challenges, and possibly as a reaction to the beginnings of dissent in the general DPRK population, the DPRK leadership attacks, or possibly is believed to have attacked, Japan and/or the ROK with chemical and/or biological weapons. Fearing continued DPRK stealth attacks on its populations, Japan asks the United States to respond with nuclear weapons, and the United States reluctantly agrees, likely with arguments in one or both directions (for and against) from the ROK. (DPRK chemical or biological weapons attacks on the ROK could alternatively be the trigger in this case, with corresponding negative or positive reactions from Japan). As above, the United States reasons that the DPRK leadership must be removed to simultaneously resolve the problem and assure that there will be no nuclear counterattacks on the ROK, Japan, or US territory (although that assurance may not be particularly solid).

How the Conflict Evolves

With its leadership threatened, and possibly attacked, but unsuccessfully, the DPRK responds with a nuclear weapons attack. The DPRK attack is designed to inflict pain, possibly on the US mainland, if its ICBMs survive US preemptive strikes, and possibly in Japan or (perhaps less likely, in this case) Seoul. The United States concludes that the DPRK leadership has probably moved into deep underground, thus requiring the use of nuclear weapons to effectively reach the leaders. Bunkers in Pyongyang and other locations indicated by US and ROK intelligence as likely hiding places—perhaps in Wonsan, on the DPRK's East Coast, where the Kim family reportedly goes on holidays—are identified and targeted. The United States uses a new (50 kt) penetrating weapon to retaliate against DPRK leadership and possibly buried missile systems or those concealed in mountain tunnels.

Use Case Consequences

The HEMP shot over Japan, which probably affects some Chinese infrastructure as well, allows China to categorize the US attack as "provoked," and thus it is not obliged to come to the aid of the DPRK, though it would probably extract some sort of deal as to governance of the DPRK and/or the degree of northern deployment of US troops on the Peninsula, possibly through the UNSC. Russia watches what happens carefully, and probably deploys submarines to key positions around the Peninsula but does not directly intervene.

Use Case Uncertainties, Ultimate Outcome, and Policy Lessons

Although this use case offers the possibility that some areas of the globe could be spared—assuming that Russia and China stay out of the conflict—that is certainly not a given, particularly if, for example, US attacks on the DPRK from ships, planes, or submarines are mistaken by

automated security systems as potential attacks on Russia, and/or China. And even if the ROK is not targeted directly by the DPRK, it seems likely that some fallout from attacks on the DPRK will make areas of the ROK unusable, and the ROK, as well as China and possibly Russia, will face a major refugee crisis as DPRK citizens who have escaped the bombing flow toward and across borders.

Another uncertainty is whether the use of chemical and/or biological munitions in Variant 3 is sufficiently different, from the point of view of Japan (or the ROK), to an attack by a HEMP that it causes either party to either more or less forcefully argue for a US nuclear response.

Potential policy lessons include:

- Build redundant, HEMP-resistant communications infrastructure/procedures for use in the event of a HEMP attack, particularly for critical communications equipment, including for both civilian and military leadership.
- Discuss and reach agreement with allies on what types of attacks would and would not necessitate activation of nuclear reprisals under nuclear umbrella arrangements.
- Work to make sure that DPRK conditions do not reach a level of desperation sufficient to cause the types of triggering events above to happen.

3.3 China as First User

A decade ago, most observers of China would probably have rated just about any case in which China was the first user of nuclear weapons in a conflict to be highly implausible. Since then, however, China's military build-up, including of its naval and missile forces (including, recently, what appear to be hundreds of added ICBM silos), appear to indicate a greater emphasis by China on its nuclear deterrence. Still, as the global manufacturing and trade powerhouse, China would have much to lose in entering, and certainly in starting, a nuclear conflict.

3.3.1 "Not Going Well in Taiwan"

Most of the plausible cases in which China might be a first user of nuclear weapons involve its claims on Taiwan, or are arguably associated with its position on sovereignty over Taiwan, including conflicts at sea related to its projection of naval force and territorial claims. As such, there are probably a number of different use cases that could be devised in which China ends up a first user of nuclear weapons, and a much greater number of cases in which it focuses on the use of its conventional forces (in part due to wishing to avoid nuclear counterattacks on its own territory, as well to avoid attacks on Taiwan, which it considers its own territory). One illustration of a case where China is the first user of nuclear weapons is provided below. This nuclear use can probably be considered midway between unintended and intended on the intentionality continuum due to being in response to conventional attacks by a strong group of antagonists.

Triggering Events and First Use

A more assertively international, pro-independence government takes office in Taiwan, and massive protests erupt in Hong Kong over PRC control of the SAR (Special Administrative Region). Protests in Hong Kong start to swing public opinion on the Chinese mainland, worrying the Chinese government. With the United States re-engaged in Middle Eastern conflicts in Afghanistan and Iran, China attacks Taiwan's perimeter defenses, but suffers significant setbacks, including the loss of airfields in Fujian Province[75] and the loss of significant naval ships, when the United States and its allies, including forces from the ROK and Japan, come to the aid of Taiwan.[76] **Worried about further involvement of US forces in the Taiwan conflict, China first threatens, then when threats appear to have little effect, and convinced that conventional defeat is imminent, attacks US bases in the region, and probably US ships at sea, with one or more nuclear weapons**. Some of the issues that the allies and adversaries in

[75] See, for example, Keoni Everington (2021), "China expands its 2 air force bases closest to Taiwan: PLA expanding its Longtian and Huian air force bases in Fujian Province", *Taiwan News*, dated 2021/03/08, available as https://www.taiwannews.com.tw/en/news/4145038

[76] Variants of this type of use case involving China are provided in, for example, Mike Sweeny (2021), *Why a Taiwan Conflict Could Go Nuclear*, Defense Priorities, dated March, 2021, and available as https://static1.squarespace.com/static/56a146abb204d5878d6f125a/t/603e4a8572604252495449c0/1614695047482/DEFP_Why_a_Taiwan_conflict_could_go_nuclear.pdf

this use case grapple with are related to the counterforce issues discussed in a paper prepared for this project by Ian Bowers.[77]

How the Conflict Evolves

The United States responds with conventional missile attacks on a number of military targets in China (and at sea) that threaten Taiwan, with nuclear attacks focusing on remote, hardened military targets away from population centers to forestall China's use of ICBMs on either Taiwan or on the United States itself. Examples of remote, hardened targets for US nuclear missiles might include the recently-built nuclear missile bases in Xinyang Province and in Gansu province.[78] Given an attack on Okinawa, the United States would be expected to consult with Japan regarding a counterattack on China.

Use Case Consequences

If this use case somehow (see below) remains a limited conflict, Russia, happy to see its rival the United States (and part-time rival China) engaged and likely weakened, remains on the sidelines during the conflict, but probably takes the opportunity, after the conflict winds down, to forge stronger military ties with China.

It seems implausible, however, that China would tolerate a nuclear attack on its territory without launching an attack on US territory, which would probably have to be met with a counterattack from the Unite States. It seems unlikely that that the exchange of weapons would end without scores of weapons being exchanged, which would amount to global nuclear war. The United States, through NATO, might ask European nuclear powers (United Kingdom and France) to respond to China as well, which would involve the EU in the conflict. Whether, at that point, Russia would also remain outside the conflict is hard to predict. This case thus appears hard to conceive of as ending in anything but near-global nuclear war, with catastrophic and long-lasting repercussions for survival of human society as we know it, as well as on the natural processes that we depend on.

Use Case Uncertainties, Ultimate Outcome, and Policy Lessons

This case thus appears hard to conceive of as ending in anything but near-global nuclear war, with catastrophic and long-lasting repercussions for survival of human society as we know it, as well as on the biosphere and other natural processes that support life on earth.

Surrounded on both of its major land borders by areas affected by nuclear weapons, and possibly affected by fallout, from those areas and/or from Japan, it is unclear what the DPRK would do in

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[77] Ian Bowers (2021), Counterforce Dilemmas and the Risk of Nuclear War in East Asia, paper prepared for the Reducing the Risk of Nuclear Weapons Use in Northeast Asia project, October 2021 (publication forthcoming).
[78] See, for example, Al Jazeera (2021), "China is building a 2nd base for nuclear missiles, say analysts," dated 28 July, 20201, and available as https://www.aljazeera.com/news/2021/7/28/china-is-building-a-second-missile-silo-field-say-us-researchers; and Joby Warrick (2021), "China is building more than 100 new missile silos in its western desert, analysts say," *Washington Post*, dated June 30, 2021, and available as https://www.washingtonpost.com/national-security/china-nuclear-missile-silos/2021/06/30/0fa8debc-d9c2-11eb-bb9e-70fda8c37057_story.html

this case. It seems unlikely that it would get involved in the war itself, and the survival of its people, whose current lack of food and (especially) oil would be compounded by isolation caused by ongoing wars to the North and South.

3.4 Russia as First User

Most (but not all) of Russia's economic and military assets and the vast bulk of its population are located in the western part of the country, many thousands of kilometers from Northeast Asia. The Russian Far East, the vast and lightly populated-—about 8 million people in a region nearly the size of the contiguous United States, and 40 percent larger than the EU–part of Russia that is within Northeast Asia, is largely a land in which economic opportunities (such as energy exports) depend on cooperation with neighbors. Thus, Russia has arguably every reason to avoid entering a nuclear war in Northeast Asia. As such, few use cases come to mind in which Russia would be a first user in a nuclear conflict in the region in general, and on the Korean peninsula in particular. Those that do come to mind tend to be associated with either mischaracterization of another actor's nuclear intentions, command and control errors, and/or or conflict at sea regarding Russia's military assets, as posited in the use case below. Due to their elements of command-and-control and/or technical failure, these nuclear weapons uses can be categorized as being in the "accidents in peacetime" category described by Davis and Bennett, or, if these Russian nuclear uses happen during a period when war is arguably not far off, at least firmly at the unintentional use end of the spectrum.

3.4.1 "Threats to Russian SSBN Bastions"

In this use case, a Russian submarine commander finds himself or herself confused by what is perceived to be a nuclear attack but is actually a weapons test or an exercise, and, unable to corroborate the situation with Pacific Fleet command, follows existing rules of engagement (ROE) and fires nuclear weapons on a US base in the region.

Triggering Events and First Use

A renewal—or rather, heating up—of the simmering dispute over the islands at the north end of the Japanese archipelago results in a significant increase in patrols in the Sea of Japan and nearby waters by Russian submarines from their base near Vladivostok. During one of those patrols, the crew of a Russian nuclear powered (and nuclear-armed) submarine finds itself in a situation where it believes a nuclear attack on its base has or will imminently occur, and, unable to corroborate that belief by communication with commanders onshore or in the Pacific Fleet, the sub commander follows his or her standing orders and fires nuclear-tipped ballistic missiles. There are several possibilities, albeit some of them straining plausibility, for why the crew of the submarine might believe a nuclear attack is underway. It could find itself in the middle of an ongoing US/ROK joint exercise involving ships and submarines, and, not having been briefed on the exercise, assumes that it is an attack that is headed toward Russian territory. It might mistake a DPRK missile test—or, in fact, a "demonstration" DPRK nuclear detonation at sea—that occurs in the vicinity of the Russian sub to be an attack on the sub itself or on a nearby Russian carrier group, or on its base in Vladivostok. It could be that by the time of the incident, continued friction and mistrust in the relationship between Russia and the United States have increased the level of military alert among all Russian military forces. **In any case, lacking corroboration, but following orders during a period of heightened alert, the Russian sub fires a sortie of nuclear-tipped ballistic missiles on their designated target, which in this case is the US military base in Okinawa**.

How the Conflict Evolves

The United States, perhaps encouraged by Japan, launches an attack in reprisal on the Russian Pacific Fleet headquarters (and nearby airfields) in and near Vladivostok, and on the Kamchatka Peninsula. These attacks destroy the airfields there and much of the land-based fleet infrastructure, but most of the submarines and ships normally based there are at sea, and thus survive the attack. In response, Russian submarines and ships fire conventional and nuclear missiles on other US bases in the region, including navy bases and airfields in the ROK.

Use Case Consequences

Assuming, as above, that this incident occurs during a period of already heightened tensions between the United States and Russia, it is difficult to see the nuclear war being confined to Northeast Asia, at least without extraordinary and virtually instant communications and diplomacy between US and Russian leaders. Absent those communications, it seems likely that ICBMs will be launched between the United States and Russia. China might well mistake missile launches by the United States to be aimed at its territory and thus launch its own ICBMs. The result would be a nuclear calamity involving much of the northern hemisphere immediately, with the rests of the hemisphere affected eventually though the fallout and resulting environmental damages and/or through global economic collapse.

Use Case Uncertainties, Ultimate Outcome, and Policy Lessons

A key uncertainty in this use case is how the crew of a Russian submarine could be expected to react in a situation such as that outlined above, and whether its standing rules of engagement, absent communications with its command, would include launching on a US base even without firm evidence that the United States was behind the perceived attack.

Relatedly, a policy lesson from this case would be to raise awareness within the militaries operating in the region as to how adversaries (and, for that matter, allies) are likely to interpret various situations and perceived actions, as well as to maintain military-to-military communications at the highest levels, even during times of heightened tensions. If it is found that there are standing orders that could easily invoked in a situation such as this, where an exercise or test is mistaken for an attack, those standing orders should be modified so that mistaken launches of nuclear weapons do not happen.

3.4.2 "Dead Hand Error"

The capabilities of artificial intelligence (AI) in both the civilian and military spheres have grown rapidly in recent decades, and development and deployment of AI systems have grown exponentially. Nuclear weapons states are increasingly turning to AI to aid in nuclear command and control. Russia—and previously, the Soviet Union—have been one of the leaders in deploying AI in the context of nuclear weapons control, starting in the 1980s with a system called the "Dead Hand" part of a project called "Perimeter," which would enable the launch of nuclear weapons in the event of a Soviet (now Russian) leadership decapitation.[79] The following use case posits an accidental use of nuclear weapons when the AI system relied upon (in part, at least) by Russia to launch a retaliatory nuclear strike becomes convinced that enemy weapons are incoming and launches nuclear weapons in response. Note that although this use case identifies Russia as the accidental first user, related risks of accidental launch exist to at least some degree in the nuclear command, control, and communications systems of at least the United States and China.[80] By the late 2020s or 2030, the penetration of AI into these systems in all states is likely to be greater than today.

Triggering Events and First Use

The "Dead Hand Error" nuclear use case occurs when automated elements of Russia's nuclear weapons control system is "fooled" by a combination of events. First, a "solar storm" whose impacts are most severe in the Russian Far East temporarily blinds some Russian early warning radar facilities and knocks out key communications links. At the same time, a space launch takes place at the Naro Space Center in the southern part of the ROK. The rocket launched by the ROK resembles a nuclear-tipped missile, and its trajectory is such that the remaining Russian radar facilities mistake the rocket for a nuclear-tipped missile launched from a US base in the ROK toward the submarine bases around the Sea of Okhotsk. The launch had been moved up at the last minute to take advantage of a favorable weather window, and though an announcement of the launch was relayed, as per protocol, to all of the states in the region, communications interruptions caused by the solar storm mean the message was not received by the Russian nuclear command. Communications interruptions by the solar storm also trigger responsibility for Russian nuclear missile launches to devolve to the AI system, and before human operators can intervene, several missiles have been launched from Russia Pacific Fleet assets toward US

[79] See, for example, Valery E. Yarynich (2003), *Nuclear Command, Control Cooperation*, published by the Center for Defense Information, dated May 2003, and accessible at https://archive.org/details/c3nuclearcommand00vale/mode/2up

[80] Little is known about the DPRK's nuclear command, control, and communications (NC3) system, but it is thought that little or no automation is currently used in the DPRK's NC3. See Myeongguk Cheon (2019), *DPRK'S NC3 System*, NAPSNet Special Reports, dated June 06, 2019, and available as https://nautilus.org/napsnet/napsnet-special-reports/dprks-nc3-system/. Descriptions of China's efforts to incorporate AI into their nuclear command and control systems can be found in Fiona Cunningham (2019), *Nuclear Command, Control, and Communications Systems of the People's Republic of China*", NAPSNet Special Reports, dated July 18, 2019, and available as https://nautilus.org/napsnet/napsnet-special-reports/nuclear-command-control-and-communications-systems-of-the-peoples-republic-of-china/; and Elsa B. Kania (2019), Emerging Technologies, Emerging Challenges—The Potential Employment of New Technologies in Future PLA NC3", NAPSNet Special Reports, dated September 05, 2019, and available as https://nautilus.org/napsnet/napsnet-special-reports/emerging-technologies-in-future-pla-nuclear-command-control-and-communications/

bases in the ROK. Although Russian human operators are able to reestablish communications and control in time to intervene to stop imminent launches toward US bases in Japan and Guam, the missiles headed toward the ROK cannot be stopped by the Russians. Russian warnings, issued minutes before the missiles arrive, are not in time to allow the missiles to be intercepted and missile defense systems in the ROK are either not activated in time or are ineffective in stopping the missiles, so several major areas within the ROK receive heavy damage from nuclear detonations.

Although this accidental first use occurs in late 2029, the political setting between the US and Russia is, if anything, worse than in 2022. The Russian military, after having gradually drawn down troops from the areas surrounding Ukraine in the mid-2020s, are heading back towards the border in significant numbers as a new, decidedly more pro-Western parliament takes office in the Ukraine following elections in 2029. Russian oil and gas exports have started to dwindle due to greenhouse gas emissions reduction measures in Europe, and United States exports continue to grow. As a result, the Russian economy is in the doldrums, and political protests in Russia have continued. Nuclear and non-nuclear arms control talks between the United States and Russia have gone nowhere, and China has refused to join the talks. A new US president is elected who favors a generally more hawkish, less trusting approach to Russia than had been the case in the preceding years.

How the Conflict Evolves

The initial inclinations of the US military and the new US president are to assume that Russia's assertion that the launch was in error are a tactic to constrain the US response. That is, US leadership does not initially believe that the launch was an accident. The combination, however, of immediate apologies by the Russian president and every Russian ambassador to the West, pledges of Russian monetary assistance, though its Reserve Fund, to rebuild the damaged areas of the ROK, and, crucially, a presidential advisor in the United States who is ultimately able to persuade the US president to hold off on a nuclear exchange for 48 hours to gauge the Russians' sincerity and response, convince US leadership to hold off on reprisal attacks, although the US nuclear forces go on high alert, causing Chinese nuclear forces to do the same. Within those 48 hours after the launches, round-the-clock intensive diplomacy between Russia and the United States results in an agreement: all Russian nuclear forces will de-target their weapons, all Russian nuclear-armed submarines will return to port immediately, and measures that allow the United States and its allies to assure that Russian nuclear weapons are not currently targeted and cannot be targeted without warning are to be worked out between the parties. In addition, all Russian troops in Europe will stand down and return to their barracks. In exchange, the United States gradually takes its own nuclear weapons off high alert.

The ROK, reeling from the damage caused by the nuclear detonations, monitors the UN negotiations with Russia, but finds it necessary to use its armed forces to focus on rescue operations at home. Japan looks on nervously but takes no military action; China does the same. Europe and other international actors demand the Russia stand down militarily around the world, and Russian social activists, both inside and outside Russia, demand reform of both the Russian military and political system.

Use Case Consequences

Paradoxically, the accidental use of nuclear weapons in this case, by providing a vivid demonstration of the impacts of nuclear weapons to the post WWII generations (meaning almost all of the earth's population by 2029), results in a widespread and renewed focus on nuclear safety and disarmament. Talks on nuclear force reductions, this time including China, resume and within a few years make significant progress. A gradual shift towards diplomacy rather than military saber-rattling occurs and continues, even between the United States and China. On the Korean peninsula, the damage sustained by the ROK is interpreted by the DPRK as an opportunity for diplomacy, and within a few years economic, if not political, integration between the DPRK and ROK begins, and the DPRK hosts enclaves that become commercial free trade zones near but north of the DMZ for ROK residents displaced by the nuclear blasts and resulting fallout. The DPRK does not immediately give up its nuclear weapons but agrees to a moratorium on testing of nuclear devices and missiles, resulting in the international community easing sanctions and restarting negotiations of nuclear weapons safeguards with the DPRK.

Use Case Uncertainties, Ultimate Outcome, and Policy Lessons

Key uncertainties in this use case are admittedly many, and include (but are not limited to):

- Whether Russian command-and-control systems can indeed be damaged or blinded by a solar storm in the way that the use case suggests;
- Whether a US president would actually be convinced to exercise restraint after such an accident;
- Whether channels of communication between Russia and the United States could be ramped up rapidly enough to address the crisis before it spins out of control;
- Whether Russia would really agree to stand down its military as suggested above; and
- Whether the DPRK would seize on the opportunity provided by the accident to make progress with its neighbors and the international community on security issues on the Korean peninsula, as opposed to, for example, pressing a military advantage.

Policy lessons from this use case start with ensuring that NC3 systems, whether controlled by AI or not, provide overrides to automatic launches, and that protocols for communications between leadership in world capitals be set up to manage the type of launch scenario described above (to the extent they do not exist already). Also, and very specifically to this case, United States assurances, perhaps backed by independent review, that it keeps no nuclear weapons on ROK territory might allow potential adversaries to safely assume that launches from ROK territory are non-nuclear, and program automated launch systems to take that distinction into account.

3.5 Non-Nuclear Weapons States and Non-State Actors as First Users

3.5.1 "Broken Promises Leads to Breakout"

The United States provides implicit and explicit promises to use its nuclear weapons in defense of Japan, the ROK, and other states, should those states be attacked with nuclear weapons. The cases below posit situations where eroding trust in the United States and internal politics lead the Japan and the ROK, respectively, to "breakout" and develop their own nuclear weapons and delivery systems.

For the Japan variant, a combination of a shift to non-pacifist, right-wing leadership in Japan, and leadership in the United States that focuses on other problems, leads Japanese leaders to conclude that the US nuclear umbrella can no longer be trusted to defend Japan from the DPRK or other potential adversaries, and Japan secretly builds its own nuclear weapons and delivery systems.[81] At some point, sure that a DPRK nuclear attack on Japan is at hand, Japanese leaders authorize the previously unthinkable and use nuclear weapons on the DPRK.

In the ROK, a right-wing, anti-DPRK administration comes to power amidst a global economic recession, perhaps due to a resurgence of a COVID-19 variant. With resulting economic problems at home, and the United States reducing its military footprint in the region for a combination of cost reasons and to focus on the Middle East or Eastern Europe, and with the DPRK looking more assertive, well-armed, and disinclined to resume negotiations, ROK hawks press the argument that the ROK needs nuclear weapons as well.

In the case of both variants, first nuclear use, being premeditated, is likely closer to intentional than unintentional.

Triggering Events and First Use

Variant 1: The combination of a series of high-profile provocative events by the DPRK inflame the Japanese public, and a right-wing Japanese administration demands that the United States punish the DPRK. The provocations might include a resurgence in kidnappings, and/or DPRK pirate attacks on fishing boats and ships carrying goods in the Sea of Japan/Korea East Sea, and/or a series of DPRK test missile launches going over Japanese territory, or possibly a long-range DPRK test missile carrying an actual warhead that overflies Japan and detonates in the Pacific. When the United States declines to do so—possibly out of fear of the DPRK's ICBMs, or possibly because of distractions/limitations at home or in other regions, Japan resolves (but not openly) to develop its own nuclear weapons, which it accomplishes in a matter of months via

[81] A variant of this case might be that, under intense Japanese lobbying (and beset by other problems at home and abroad), the United States sees merit in allowing Japan to build its own nuclear weapons and relents to agree that Japan can develop its own nuclear weapons. Such an "official" agreement would be highly likely to have destabilizing implications for the region, as the ROK would likely demand similar rights, the DPRK would be incensed, and China and Russia would likely be extremely concerned about Japan's intentions.

a clandestine program.[82] Japan becomes sufficiently convinced that the DPRK is about to attack Japanese territory that it decides it must launch a pre-emptive strike against the DPRK, which it justifies under new security laws. Guided by Korean-Japanese agents who have infiltrated the DPRK, as well as by advanced remote sensing technology, **Japan becomes sufficiently confident of its ability to locate the DPRK's leadership and nuclear arsenal that it launches conventional and nuclear (when needed) attacks on both**. Japan's targets therefore include DPRK missile bases and factories, nuclear production and warhead storage facilities, and leadership homes, offices, and bunkers. Japan's attack would presumably be with guided missiles.

Variant 2: The combination of a new, anti-DPRK administration in Seoul, perceived United States lack of attention as the US administration focuses on other parts of the world and on severe domestic problems, and continuing and increasingly strident DPRK belligerence lead the ROK to start a clandestine bomb program. The technological and scientific capabilities in the ROK would allow it to rapidly assemble all of the components needed to assemble nuclear weapons, as well as missile systems for delivery. Although, unlike Japan, the ROK lacks both stocks of weapons-grade fissile material and both plutonium reprocessing and uranium enrichment capacity,[83] it does have nearly twenty thousand tonnes of spent fuel in storage containing on the order of hundreds of tonnes of plutonium, with much the fuel cool enough to reprocess, and could, conceivably, undertake a clandestine or open-breakout reprocessing program. And/or the ROK could seek to purchase fissile material on the nuclear black market, though given the ROK's standing in the global economy, that would seem like a major political and economic risk.

With a nuclear weapon in hand, the ROK becomes convinced, perhaps by DPRK troop movements, perhaps by DPRK announcements of new nuclear weapons or weapons systems, that it is about to be attacked by the DPRK, and assurances of support by the United States

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[82] The authors fully recognize that Japanese development of nuclear weapons would be highly antithetical to its constitution and national post WWII identity. Nonetheless, there are groups in Japan for whom the prospect of building nuclear weapons is attractive, and Japan possesses the full suite of technologies and raw materials that would allow bomb production to rapidly move forward. It is possible that nuclear breakout by a country like Iran would be a further spur for those voices in Japan agitating to revise its pacifist approach. See, for example, Patrick Winn (2019), "Japan has plutonium, rockets and rivals. Will it ever build a nuke?" Public Radio International, dated March 14, 2019, available as https://interactive.pri.org/2019/03/japan-nuclear/index.html. Given the possibility, however remote, of nuclear breakout by Japan, we feel it is worth considering in this Report to make sure that policy options to prevent it from happening are fully explored.

[83] See, for example, Stimson Center (2020), "Fact Sheet: Spent Nuclear Fuel Storage in South Korea," dated June 2, 2020, and available as https://www.stimson.org/2020/spent-nuclear-fuel-storage-south-korea/). The ROK has apparently dabbled in uranium enrichment and Pu separation from spent fuel, at least at a small scale, in the past—and has long proposed to undertake a variant of reprocessing called pyroprocessing, which, if undertaken for its nuclear reactor program, would leave the ROK a relatively small step away from being able to produce weapons grade plutonium in large quantities. See respectively, for example, GlobalSecurity.org (undated, but probably mid-2000s), "Weapons of Mass Destruction (WMD): [ROK] Nuclear Reprocessing," available as https://www.globalsecurity.org/wmd/world/rok/nuclear-reprocessing.htm; and Jungmin Kang and Frank von Hippel (2017), "Reprocessing policy and South Korea's new government," *Bulletin of the Atomic Scientists*, dated, May 15, 2017, and available as https://thebulletin.org/2017/05/reprocessing-policy-and-south-koreas-new-government/

appear insufficient to allow the ROK to prevail in a conventional war. **Confident of its intelligence north of the DMZ, the ROK therefore resolves a lighting nuclear strike using a small number of short-range missiles armed with small, low-yield nuclear warheads**, with the intent to remove the DPRK's military and civilian leadership. Key to this tactic is an ROK assumption that DPRK citizens are sufficiently primed for regime change and that civilians and the rank-and-file military will welcome reunification on the ROK's terms once DPRK leadership is removed.

How the Conflict Evolves

In both variants, assuming that DPRK leadership and some nuclear capability survives, as seems likely, as Japan's or the ROK's nascent arsenal will be limited and the DPRK's nuclear sites are likely to be many, the DPRK counterattacks. Similar to the "US Leadership Hubris" case, depending on what fraction of its nuclear arsenal remained, the DPRK might respond with a medium-range nuclear-tipped missile targeting Japan's leadership, or it could plan a NUDET delivered by Special Forces that would damage multiple, important infrastructure installations, such as LNG storage facilities, or a nuclear reactor (as in other cases above), or a port near a major city. The latter type of DPRK counterattack could be using a weapon smuggled across the DMZ or the Sea of Japan/Korea East Sea in a disguised fishing boat or brought in via submarine.

Use Case Consequences

Whether Japan or the ROK breaks out first, the resulting attack on the DPRK likely fractures the ROK/Japan relationship, as the ROK would be incensed about nuclear attacks on the Korean Peninsula by Japan, and Japan would presumably be apoplectic about ROK breakout. In either case, Japanese or ROK breakout and use of nuclear weapons puts the United States in a quandary as to what to do. Depending on where the Japanese attacks take place and associated fallout, it also becomes unclear who picks up the pieces in the DPRK, though presumably the ROK would take the lead in rebuilding the Peninsula if it were the aggressor, and not too badly damaged by subsequent hostilities (though that seems unlikely), reaching out to the international community for help in doing so. Perhaps in either case, absent leadership from the United States, China would play a key role to keep North Korean refugee flows into Northeast down, which could presumably lead, if not accompanied by explicit agreements between the US/China/Russia, to further conflict due to having Chinese troops along the DMZ.

Use Case Uncertainties, Ultimate Outcome, and Policy Lessons

Uncertainties include whether Japan has, or could have within a very few years, the guided missile technologies needed to carry out such attacks. The likely answer is yes, given Japan's advanced space program. How quickly the ROK could produce or acquire fissile material is also a key question.

Policy lessons here include the lesson offered by several use cases, which is that it is likely to be unwise to assume that the entire DPRK nuclear arsenal or most of its leadership can be destroyed by any kind of attack, short of actually killing the greater part of the DPRK population and thus most of the military, and in the process making most of the northern part of the Peninsula (at least) uninhabitable. It may also be unwise to underestimate the degree to which the DPRK population is convinced by the domestic narrative about the outside world offered by DPRK

leadership, and thus to overestimate the degree to which the DPRK population might accept ROK (or, for that matter, Chinese or international) control over DPRK territory.

3.5.2 Nuclear Weapons Use by Terrorists

Whether using nuclear weapons and/or weapons production technologies and nuclear materials and/or nuclear weapons delivery systems obtained from the DPRK or from other sources, nuclear weapons detonations by terrorist groups could happen in Northeast Asia or elsewhere, likely with global consequences. (Note that the detonation of a nuclear weapon in the Middle East by a terrorist group is a triggering event for the "Response to DPRK Proliferation" first use by the United States, above.) Three discrete use cases started by first use of nuclear weapons by a terrorist organization are outlined below as "variants," but these case hardly exhaust—and perhaps do not even scratch the surface of—options for such use cases.

In addition, it has been argued that the many types of possible terrorist attacks involving nuclear weapons could be, particularly as time goes on, compounded and confounded by the use of artificial intelligence and cyber-warfare technologies that have increasing capabilities to make the causes and groups behind a given attack murky. Confusion of this type may cause nuclear-armed states to erroneously identify the source of an attack, enhancing the possibility for escalation.

Each of the variants, below, involving terrorist first nuclear use, being premeditated, is likely closer to intentional than unintentional. The designation of the third variant is a little more difficult, as a state's weapon is being co-opted, and therefore the launch certainly qualifies as accidental from the point of view of that state, if not from the point of view of the terrorist or hacker.

Triggering Events and First Use

Variant 1: A terrorist organization causes a "9/11 type" event[84] in Tokyo. This occurs when a smuggled-in rudimentary nuclear warhead (or maybe one stolen or sold from Russia or sold by the DPRK) is detonated by either an Al Qaeda affiliate to punish Japan for its support of the United States, by a domestic terrorist group (perhaps a scion of Aum Shinrikyo),[85] or by a terrorist group in Japan sponsored in part by another state, possibly the DPRK.[86] A terrorist attack on a nuclear reactor spent fuel pool in Japan is also possible, but wouldn't seem to be as much in keeping with the goals of a terrorist organization as an attack on a city.

Variant 2: A terrorist attack, again with a smuggled nuclear weapon, results in a NUDET in a Chinese city, possibly Beijing. The attack is carried out by a domestic Chinese group possibly claiming to represent Xinyang or Hong Kong, and with the stated aim of bringing international

[84] That is, an event designed to cause many civilian casualties and thus to focus world attention and outrage, as in the attack on the World Trade Center towers and other targets using civilian planes as weapons carried out on September 11, 2001.

[85] See, for example, Counter Extremism Project (undated, but apparently 2021), "Japan: Extremism and Terrorism,, available as https://www.counterextremism.com/countries/japan

[86] See, for example, Bruce Bechtol (2010), "North Korea and Support to Terrorism: An Evolving History," Journal of Strategic Security, Volume 3, Number 2: Summer 2010, available as https://www.jstor.org/stable/pdf/26463130.pdf

attention to the plight of the Uighurs. The source of the nuclear weapon could be a former Soviet republic in Central Asia, a device purchased in the Middle East through intermediaries, possibly even of DPRK origin, or even (though perhaps less likely) a weapon stolen or diverted from a Chinese nuclear armory.

Variant 3: A cyberattack in which hackers working for a terrorist organization, or possibly just hackers, somehow gain internet access to a nuclear weapon, are able to ready a nuclear-tipped missile for launch and are ultimately able to actually launch it. The missile belongs to one of the United States, China, or Russia, although it may (or may not) be more reasonable to assume that the missile is Chinese or Russian rather than American, as most of the US missiles in the region are likely to be on ships and submarines.[87] If the hackers are also terrorists, they may attempt to aim the missile at a target offering maximum potential for damage, such as dense populations in Seoul or Tokyo (labeled "Use by Terrorists V3-1" in Figure 3), or may aim at a major US base in the region (Okinawa or one of the bases in the ROK—"Use by Terrorists V3-2" in Figure 3). If the missiles co-opted are Chinese or Russian ICBMs, they could possibly be targeted at the United States. If the hackers are just hackers, they may not actually try to target the missile, and just accept its default targeting, which would probably, for US or Russian missiles, mean an open ocean target (a change made after the end of the Cold War—"Use by Terrorists V3-3" in Figure 3), but it is apparently not clear whether Chinese nuclear missiles likewise have default open-ocean targets.[88]

How the Conflict Evolves

Variant 1: Although the terrorist group claims responsibility for the attack on Japan, evidence gathered at the scene of the attack, follow-up forensic work, and/or criminal investigations lead Japanese authorities to assume or perhaps provide proof of DPRK involvement as a proliferator and ask the United States to respond, thereby invoking the "nuclear umbrella" as in the "Promise is a Promise" cases above.

Variant 2: Several options exist for evolution of this variant. If convinced (or if it is convenient to assume) that Uighurs are involved, China might adopt a "scorched-earth" response on its own territory, with or without nuclear weapons (if the latter, maybe calling it a "failed nuclear test"?) after giving Han Chinese residents of Xinyang time to evacuate, that might bring the United States and the broader "West" into the conflict. The question is whether it is plausible, given Chinese security and what is probably the limited means of Muslim terrorists in China, whether they could mount such an attack. Possibly not.

Alternatively, China might assume the United States was behind the attack, or supported it, if relations between the United States and China were sufficiently eroded by then. China might

[87] It is assumed that DPRK missiles cannot be "hacked" because there is no international internet access to military command and control in the DPRK and/or systems for launching nuclear-tipped missiles—if any, nuclear missiles, in fact, are kept fully assembled—are likely to be more manual than in other nations.

[88] Sico van der Meer (2018), "Reducing nuclear weapons risks: A menu of 11 policy options" Clingendael/ Netherlands Institute of International Relations, Policy Brief dated June 2018, available as https://www.clingendael.org/sites/default/files/2018-06/PB_Reducing_nuclear_weapons_risks.pdf

decide to counterattack with nuclear weapons on for example, a US aircraft carrier group, which would probably precipitate a conventional and nuclear war at sea between the two navies. It is also possible that the attack could be ascribed to Taiwan or to protestors in Hong Kong, again with United States involvement. In the former case, which might induce China to use nuclear weapons in the waters off of Taiwan (but not on Taiwan itself, wishing, at a minimum, not to contaminate the real estate and infrastructure there) as a prelude to an invasion of Taiwan with conventional weapons. In the latter case, it would probably mean a military lockdown on Hong Kong. Either case would see millions of refugees, if they could get out of China and a likely confrontation between China and the United States that could go nuclear as a result of brinksmanship by one side or the other. If China finds evidence of DPRK involvement in providing the weapon, it might choose not to attack the DPRK, not wishing to provoke a flow of refugees into its Northeastern provinces, but would likely close the border, and cut off energy supplies and other aid and trade to express its displeasure.

Variant 3: A wide range of case evolution pathways are possible here. After launch of the hijacked missile, several case variants are possible. When the missile launch is detected, adversaries (assumedly the US) could assume that the launch was on purpose and launch a retaliatory strike while attempting to engage ABM batteries to shoot the missile down (which would likely fail, per the analysis provided in the paper provided for this Project by David Wright, particularly if the target was relatively close to the point of launch). This would be followed by retaliatory strikes from the nation whose missile was hacked.

Alternatively, the hacked nation could quickly realize what has happened and contact the adversary nation to provide a warning and explain, which may or may not be in time if the missile is traveling within the region. Or, depending on the type of missile hijacked, the hacked nation could regain control of the missile and blow it up in flight, perhaps causing some damage on the ground, but avoiding a nuclear detonation—though it seems that this option does not exist, at least, for nuclear ballistic missiles.[89]

Use Case Consequences

Variant 1: A terrorist attack on Japan or the ROK with a nuclear device, unless traced to the DPRK or blamed on another state, could be expected to be followed with renewed attention on nonproliferation and antiterrorist initiatives, which might ultimately result in a more secure world, albeit one with more surveillance and fewer freedoms. If traced to/blamed on the DPRK or another state, nuclear punishment of the DPRK or other state is possible, likely leading to extended exchanges for as long as both combatants have serviceable weapons. Redoubled pressure on the DPRK (or other state) to yield to international demands and begin to negotiate on nuclear safeguards and disarmament is another possible outcome.

Variant 2: As noted below and above, key uncertainties exist as to how this use case might play out. It is possible that, if China treats it as a purely domestic matter, it will gain some sympathy from the international community for being targeted, as the United States did after the 9/11

[89] Union of Concerned Scientists (2015), "Frequently Asked Questions about Taking Nuclear Weapons Off Hair-Trigger Alert," Fact Sheet, dated January 2015, and available as https://www.ucsusa.org/sites/default/files/attach/2015/01/Hair-Trigger%20FAQ.pdf

attacks, and receive help in rebuilding from abroad. If China opts for harsh collective punishment of the Uighurs or other minorities, this goodwill could rapidly evaporate.

Variant 3: In instances where the targeted nation assumes intent to fire the weapon on the part of the hacked nation, this Variant probably results in escalating exchanges of warheads between at least the two nations involved, and possibly, depending on alliances and other factors, nuclear weapons use on targets elsewhere in the world as well. In cases where the hacked nation warns the targeted nation, or the missile is somehow aborted before it reaches its target, a period or frantic diplomacy would ensue, with some in the targeted nation believing that the strike was intentional and calling for retaliation, and others trying to get the parties to stand down. It is not yet clear to us how this case would fully play out. If the "stand down" contingent prevails, but the incident captures public attention, much more attention to nuclear safeguards and disarmament could ensue, with the possibility for significant progress in nuclear threat reduction as a result. That outcome is hardly a given, however.

Use Case Uncertainties, Ultimate Outcome, and Policy Lessons

For ***Variant 1***, a key uncertainty is whether the terrorist group would be interdicted before it is able to detonate a nuclear device. If it is, in addition to incandescent attention being focused worldwide on the terrorist group itself, enhanced global efforts to prevent proliferation might result, with proliferating operatives (including state and non-state actors) more likely to be seized and punished. For some attacks (particularly if carried out in Japan or the ROK, but also in the United States), it is possible that blame could fall on the DPRK, changing the dynamic for any ongoing negotiations or conflicts.

For ***Variant 2***, in addition to whether domestic terrorists within China would have the wherewithal to carry out such an attack, it is uncertain whether any collective punishment China would carry out on implicated ethnic groups would rise to a level that some international force, probably led by the United States and Europe, would feel obliged to invade Chinese territory. It seems more likely that economic and political sanctions—ratcheting up pressure that has been building for a number of years and is, as of this writing (January 2022), manifesting in a political boycott of the Beijing Winter Olympics by the United States and a number of other nations—would be applied.

For ***Variant 3***, key uncertainties lie in the attribution of blame for the attack. If it is recognized that it was a non-state group that caused the missile to be launched, and that group is swiftly brought to justice, it is possible that a post-9/11-like period of focus on preventing such attacks, and on controlling nuclear weapons, could ensue.

Key initial policy lessons from these three cases could include:

- Intensify work internationally to identify and foil nuclear proliferation networks.
- Work internationally to improve control of all nuclear devices and fissile material, possibly including the creation of international oversight authorities to enhance protection of nuclear material, although it may well be difficult to get any nuclear weapons states to

agree to inspections, let alone states like the DPRK (or Israel, for example).[90] International cooperation to reduce stocks of fissile materials should be encouraged.

- Establish or enhance communications facilities between nuclear states, possibly even including the DPRK, such that if a nuclear launch from a nuclear weapons state occurs through the actions of a terrorist or hacker, other states can know about the launch immediately, take any applicable defensive measures, and refrain from retaliation against the state where the weapon is launched.

[90] Although it would in theory be possible for the nations of Northeast Asia to agree upon and implement a regional nuclear inspection authority, perhaps modeled on Euratom, China so far has refused to agree to the development of such an international authority in Asia. Euratom, the European Atomic Energy Community, was established in 1957 to govern markets and movement of nuclear goods and expertise in Europe. See, for example, Institute for Government (2020), "Euratom," dated February 24, 2020, and available as https://www.instituteforgovernment.org.uk/explainers/euratom

3.6 Other Potential Use Cases and "Wild Cards"

As indicated above, we certainly do not mean to suggest that the use cases above even begin to exhaust the reservoir of nuclear weapons use cases that could affect the Northeast Asia region. A small sampling of other cases that might be considered might include:

- Taiwan, faced with an impending military threat from China, and unsure of support from a distracted United States, attempts to bring Russia and its nuclear weapons into the conflict.
- A shooting war that erupts between China and India in their contested border region heats up to the point of nuclear weapons use, and regional powers are soon embroiled in the conflict.[91]
- A nuclear conflict between India and Pakistan spills across other borders, with effects on Northeast Asia's environment, security situation, and policy choices.
- The potential of a "rogue general" in one of the nuclear weapons states deciding to launch nuclear weapons (and the degree to which doing so might or might not be technically impossible in each of the states holding nuclear weapons.

Although we have not (and do not plan to) elaborate these cases in our work, consideration of these "wild card" eventualities should be part of the calculus when working to establish policies to reduce the threat of nuclear use in Northeast Asia.

[91] The longstanding, but mostly non-violent, border dispute between China and India has taken a turn toward military conflict and been in the news of late. See, for example, Saheli Roy Choudhury (2021), "India and China's border dispute will not end anytime soon, former ambassador says," CNBC, dated, November 2, 2021, and available as https://www.cnbc.com/2021/11/03/india-china-border-dispute-unlikely-to-end-anytime-soon-nirupama-rao.html

4 Summary of Use Case Development and Initial/Provisional Policy Lessons

Just over 76 years ago, as of this writing, the United States, in what was described at the time as an attempt to bring the Second World War to an abrupt end, dropped nuclear bombs, within an interval of three days, on the Japanese cities of Hiroshima and Nagasaki. The bombings reduced massive parts of the cities to rubble and caused horrific suffering and loss of human life.[92] Since those terrible August days in 1945, eight more nations have joined the United States in the "nuclear weapons club,"[93] with several nations either having had nuclear weapons and given them up, having tried to acquire nuclear weapons, or appear, in the case of Iran, to be heading along the path toward the acquisition of nuclear weapons.

The bombings of Hiroshima and Nagasaki (a memorial to "ground zero" in Nagasaki is shown in エラー! 参照元が見つかりません。) remain the only instances in history of nuclear weapons detonation in a conflict. In the three-quarters-of-a-century since, nuclear weapons have been "used" primarily as tools of deterrence—deterring conventional and nuclear attacks on the nations that possess them and on the allies of those nations. That said, there have been, during that interval, many documented instances, and probably many that remain state secrets, when nuclear weapons use was narrowly averted, sometimes by the bravery of someone in the nuclear chain of command, and sometimes, just by luck.[94]

Any detonation of nuclear weapons in a conflict today (or in the years to come) risks absolutely unacceptable consequences, no matter how "limited" the nuclear exchange is or will be.[95] That said, the premise of this report is that it is crucial to understand a range of possible nuclear weapons "use cases"—the detonation of nuclear weapons at or near the earth's surface in a conflict situation—to demonstrate the impacts of such use, and to spur the development of policy options that can be deployed to reduce, minimize, and ultimately eliminate the risks of nuclear war occurring in the future. We must stress that the mere fact that these cases are posited here does not mean that they are likely; just that they are plausible. And although some of the use cases do include only limited use, and in one case, failed use, of nuclear weapons, and lead,

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[92] See, for example, Masao Tomonaga (2019) "The Atomic Bombings of Hiroshima and Nagasaki: A Summary of the Human Consequences, 1945-2018, and Lessons for Homo sapiens to End the Nuclear Weapon Age," *Journal for Peace and Nuclear Disarmament*, 2:2, 491-517, available as https://www.tandfonline.com/doi/full/10.1080/25751654.2019.1681226

[93] This count includes Israel, which is widely believed to possess nuclear weapons but has a policy of "deliberate ambiguity" regarding its nuclear weapons status.

[94] See, for example, Union of Concerned Scientists (UCS, 2015), *Close Calls with Nuclear Weapons*, Fact Sheet, dated April 2015, and available as https://www.ucsusa.org/sites/default/files/attach/2015/04/Close%2520Calls%2520with%2520Nuclear%2520Weapons.pdf

[95] Even in the event that a nuclear detonation was successfully configured to avoid causing casualties or significant destruction, such use would be a breaking of the international taboo against the use of nuclear weapons in a conflict, and would risk escalation of the conflict to additional use of nuclear weapons.

ultimately, to a meeting of the minds between nuclear-armed opponents and the eventual reduction of the risk of nuclear war, none of these use cases are in any way desirable in and of themselves, and all possible efforts should be made to avoid any nuclear weapons use.

Figure 5. Memorial to "Ground Zero" in Nagasaki.[96]

4.1 Summary of Use Cases

The nuclear use cases posited above span the range of cases where a nuclear detonation is attempted but is not successful, and the adversary that is the recipient of the attack exercises sufficient restraint that no counterattack with nuclear weapons occurs, through a variety of cases where conflict involves a nuclear weapons detonation, in most cases followed by a nuclear counter-attack, but in which diplomacy results in the exchange being "limited" to a few targets, to cases where it is hard to see how a conflict would result in anything short of global (or near-global) nuclear war. The reader should not, however, take our definition of a range of cases as

[96] Image obtained as free download from the website of Nagasaki Prefecture Convention and Tourism Association, Nagasaki Prefecture. https://www.discover-nagasaki.com/en. Downloaded on January 14, 2022.

meaning that nuclear war of any kind is acceptable or preferred in any sense. Nuclear war of any kind is a human and ecological (and economic) tragedy, no matter what, and virtually any use of nuclear weapons risks reactions by other states that could plunge the world into a global nuclear conflict. This tragedy occurs whether nuclear use is intended or unintended, including the use of nuclear weapons for so-called "escalation control."[97] It is therefore not particularly important whether one case has lesser or greater consequences compared to another, as any case could, given possible changes in events or leadership decisions, end up as a "worst case" global conflagration with a likelihood that is essentially unknowable, and thus sets a floor on the types of policies that must be implemented to reduce the risk that nuclear war will happen.

In the examples above, we have broken the elements of use cases into "Triggering Events and First Use," "How the Conflict Evolves," Use Case Consequences," and "Use Case Uncertainties, Ultimate Outcome, and Policy Lessons." This breakdown is to some extent artificial as some of the categories overlap. Moreover, any use case could go in a different direction at multiple points and result in different outcomes. The use cases above posit more numerous first use options for the DPRK and the United States, as these are the principal antagonists on the Korean Peninsula, which has been for many years a primary, but hardly the only, locus of conflict in Northeast Asia. There are, however, certainly additional first use cases that could be devised for China, and to an arguably lesser extent, Russia and other actors. Below we list some of the key similarities, as well as differences, between the use cases considered above.

The similarities between use cases include:

- Many of the use cases involve first use in which one adversary **misinterprets** the actions of another. These misinterpretations include underestimating an opponent's capabilities, resolve, or reaction to a provocation.
- Many of the use cases turn on the **personality of a leader**, and how he or she responds to a crisis involving nuclear weapons.
- Many of the use cases occur when one or more of the adversaries, or at least the leadership of same, are **distracted** by other issues, including domestic issues and issues abroad.
- Many of the use cases involve **lack of communications**, or lack of timely or clear communication, between rivals and, in many cases, between allies, or even between those

[97] The use of nuclear weapons for escalation control implies their use in such a way as to force an adversary to the negotiating table, and thus to end (or at least limit) escalation. The argument here, however, is that an application of nuclear weapons for escalation control remains so uncertain in terms of its outcome as to be as unacceptably risky as other uses of nuclear weapons. See, for example, Mark B. Schneider (2017), "Escalate to De-escalate," *U.S. Naval Institute Proceedings*, dated February 2017, and available as https://www.usni.org/magazines/proceedings/2017/february/escalate-de-escalate; and Kevin Ryan (2020), "Is 'Escalate to Deescalate' Part of Russia's Nuclear Toolbox?" *Russia Matters*, Harvard Kennedy School Belfer Center for Science and International Affairs, dated January 8, 2020, and available as https://www.russiamatters.org/analysis/escalate-deescalate-part-russias-nuclear-toolbox

responsible for operating the assets of a single military. The latter includes establishment of clear expectations as to the operation and limits of the US nuclear umbrella over its allies in the region.

- Many of the cases include key decision points where either escalation or de-escalation of a nuclear conflict is possible, based on the choices (or failures to choose) of military and civilian leaders at those moments.
- Many of the cases may involve large uncertainties with regard to the outcome of the nuclear conflicts. It is difficult to foresee what would happen once a nuclear weapon is used, and any nuclear weapons use could escalate to an uncontrollable nuclear conflict regardless of what of decision makers want or intend.

Key differences between use cases include:

- Although many use cases use similar delivery systems—dictated in part by the distance between adversaries as well as their arsenals—some use **very different means of moving nuclear weapons to targets**, and thus require different sorts of policy approaches to reduce the threat of nuclear use.
- The nuclear arsenals that potential adversaries have, at this point, **differ substantially in both quantity and quality**, which colors the decisions to use or not use nuclear weapons.
- The nuclear weapons arsenals of the potential adversaries, and the technologies that can be used to deliver them, are not static. Security challenges a few years from now may be addressed by very different weapons than are currently used.
- The adoption, or rejection, **of opportunities for stopping conflict** through negotiation. Different approaches to negotiation may produce significantly different outcomes to nuclear conflicts, although the effectiveness of negotiation can also vary widely.

4.2 Initial Policy Lessons

As noted earlier in this report, the development of use cases in this year of the Reducing the Risk of Nuclear Weapons Use in Northeast Asia Project is to be followed by the evaluation of use cases next year, and the development of policy options (and communications to policymakers) in project year 3. That said—and being exquisitely conscious of the existential risk that nuclear weapons pose and the need for the international community to move swiftly on devising and implementing policies to reduce those risks—we offer the following initial thoughts about the ramifications of the use cases above for policies that may serve to reduce the risk of the occurrence of nuclear weapons use. Some of the policy lessons below are derived from particular use cases—see notations in Table 2—and some are the result of the consideration of multiple use cases.

- Open trusted and reliable lines of communications between adversaries at multiple levels and keep them open. This would include communications between national leaders, military leaders, and working-level military commanders.[98]
- Specifically, with respect to reducing the potential for military exercises on either side of the DMZ (or, by extension, in the waters around Taiwan or elsewhere) to inadvertently convince an adversary that an attack was imminent (a potential triggering event for several use cases above), specific polices encouraging observers from the adversary side to be involved in all exercises should be encouraged. Exercises close to the territorial boundaries of potential adversaries should be avoided. These types of policy measures could help to counteract the expanding role of "stealth" submarines and aircraft, which are less visible to adversaries and thus more of concern.
- To improve mutual trust, for both allies and adversaries, encourage transparency and consistency in describing the extent and operation of military alliances.
- Further identify reasons and modes for accidental or unintended use of nuclear weapons and make changes to command-and-control procedures to minimize those uses.
- Seek to separate as much as possible the operation of international relations from domestic political concerns, particularly (but hardly exclusively) in nations where leadership changes are frequent.
- Relatedly, seek to insulate the operations of nuclear weapons from the personal or political vagaries of national leaders, possibly by strengthening oversight on the use of nuclear weapons by other government leaders, as well as the military.
- Seek to fully brief leaders, military and otherwise, regarding the possible goals, concerns, and emphases of adversaries, to allow leaders to better understand and, to the extent possible, predict or offer options as to how opposing leaders might react in situations of stress. This will also involve obtaining a full (or as full as an outsider can achieve) understanding of the history of an adversary's military position and role of nuclear weapons within it.
- Impress upon policymakers that, particularly in an arena like Northeast Asia where many potential adversaries are nuclear armed, maximum restraint should be exerted to avoid even a conventional war or "limited" nuclear war. Given existing tensions and differences between the states of the region, relatively small and often unforeseen events, miscalculations, or misunderstandings can result in the rapid escalation of conventional conflicts into extensive nuclear conflicts, and what may have been intended to be limited, specific-purpose use of nuclear weapons can also rapidly escalate.
- For each state, institute policies to brief the political and military leadership of potential adversaries with regard to the state's goals and intentions, and encourage other states,

[98] See, for example, BBC News (2021), "North and South Korea restore hotline after a year," dated July 27, 2021, and available as https://www.bbc.com/news/world-57979937

including adversaries, to do the same. Signals of goals and intentions can take form of both public declarations and private bilateral strategic dialogue.

- Exercise patience, and adjust expectations for results, in international negotiations, particularly those involving the DPRK. Specifically, although this will be difficult for many leaders to hear, do not expect, even if negotiations with the DPRK seem to be progressing very positively, that the DPRK will give up its nuclear weapons within a few years. A decade is more likely, and even then, stringent international oversight of a frozen DPRK nuclear weapons program is a more achievable goal.

- Equip nuclear weapons systems with redundant command and control mechanisms that help to assure that nuclear weapons can never be launched without adequate authority and oversight.

- Work toward insulating key systems (electric power and communications among them) from HEMP bursts, and/or develop robust back-up arrangements designed to keep those systems running.

- Anticipate that potential breakdowns in communication in the nuclear command and control will occur, whether because of, for example, a HEMP detonation or cyberattack, or because of natural disasters such as earthquakes or severe "solar storms,"[99] and assure that commanders in possession/control of nuclear weapons have clear orders as to what to do in those instances.

- Build awareness of the various and serious threats posed by the current nuclear weapons situation in the region, of the arguably eroding security situation, and thus, of the urgent need to address these threats. A metaphor for the nuclear (and, for that matter, conventional) weapons security situation in the region might be that the people of the region are collectively standing on the very edge of a sandstone cliff, battered by the forces of wind, rain, and waves, looking down at a growing pile of rubble at its base, and unsure where and when further erosion will take place. That is, the nuclear precipice might give way in any number of ways that we can't anticipate, but with consequences starting with devastation and ratcheting up from there. In addition to those failure modes that we can guess at (including those above), it is thus crucial to develop policies that halt erosion and enable a safe retreat from the cliff's edge for all parties—that is, devise ways forward to reduce the nuclear threat—before irreparable harm is done.

- Engage civil society to help to both devise policies to reduce nuclear threats and to pressure governments to implement threat-reduction policies. This might include seeking to amplify the voices of both non-governmental groups and of governments at the sub-

[99] "Solar storms" is a general term for events such as solar flares, ejections of solar energetic particles (protons), coronal mass ejections, and other solar phenomena that can cause geomagnetic storms on earth. These events can include emissions of X-rays, radio waves, and particles that can disrupt and/or damage space-based (such as global positioning systems) and other electronics and communications systems, and geomagnetic storms can induce "extra currents in the ground that can degrade power grid operations." See, for example, Space Weather Prediction Center, National Oceanic and Atmospheric Administration (United States, 2022), "Space Weather Impacts", available as https://www.swpc.noaa.gov/impacts

national level, such as stakeholders in the major cities that might become targets for nuclear use in some of the use cases explored above.

- Bring parties in the region to the table to discuss the acceptable outlines of nuclear weapons free zones (NWFZ), including, for example, one on the Korean Peninsula.
- Encourage all nuclear weapon states to adopt a "No-First-Use" declaration policy as a step toward substantially reducing the risk of nuclear war. The declared nuclear weapons states (NWS) in the region should endorse such policies. A recent statement by the leaders of the NWS affirms that a "nuclear war cannot be won and can never be fought," and that "nuclear weapons…should serve defensive purposes, deter aggression, and prevent war", but does not go so far as to endorse No-First-Use policies.[100] Declaration and adoption of No-First-use policies, if undertaken by all parties holding nuclear weapons, would help to reduce the risk of nuclear war in Northeast Asia, and would likely also open the door to further discussions on threat reduction and disarmament.
- Implement stronger international efforts to secure and possibly reduce stocks of fissile materials and/or to discourage further production of fissile materials.

4.3 Outstanding and Unresolved Questions

Our findings above, including the initial policy lessons offered, are of necessity limited by our research and input from commissioned authors and others in the first year of the NU-NEA project. Work to date has identified areas in which additional project team and commissioned research will be needed in the second and third years of the project.

An initial list of key remaining and/or unresolved questions that need to be addressed as use cases are developed and evaluated include:

- Additional research by the project team, likely augmented by commissioned papers, will be needed to determine how standing rules of engagement will likely be interpreted under different use cases by different militaries, that is, which weapons would likely be used, and under what circumstances.
- Relatedly, additional research will be needed as to the scope for and entry points for policies that might make such standing orders to the hands that control nuclear weapons more flexible, such that opportunities for diplomacy can be offered and accepted before weapons are fired.
- Additional research may be needed to better understand the current and evolving military doctrines, including under new administrations, in the United States, China, and Russia.

[100] See, for example, The White House (United States, 2022), "Joint Statement of the Leaders of the Five Nuclear-Weapon States on Preventing Nuclear War and Avoiding Arms Races," dated January 03, 2022, and available as https://www.whitehouse.gov/briefing-room/statements-releases/2022/01/03/p5-statement-on-preventing-nuclear-war-and-avoiding-arms-races/

- Information needs to be compiled regarding the vulnerability of key infrastructure, including nuclear power plants and their ancillary facilities, to HEMP bursts, and as to whether those vulnerabilities vary substantially by country.

Some of the types of Year 3 NU-NEA project research on the policy implications of the use cases explored in this Report include (but are not limited to) the following. Note that the Project is unlikely to be able to pursue all of these research options.

- Policies that might address accidental and cyber-attack risks of nuclear weapons use.
- Research into pre-emptive strike doctrines in use among the nuclear actors in Northeast Asia and policies designed to address problems with existing pre-emptive strike doctrines.
- Research into technologies, plans, and policies for deployment of tactical nuclear weapons in the region and on policies to address issues related to tactical nuclear weapons deployment.
- Research into nuclear weapons confidence-building measures to reduce nuclear weapons risks that are in use globally and on the possible deployment of such measures in Northeast Asia.
- Research into and development of the diplomatic and negotiation steps that would be associated with reducing and ultimately eliminating the role of nuclear weapons in maintaining the security of Northeast Asia.
- Research into international legal opinions on the lawfulness of nuclear weapons use, including whether legal work on the topic has reflected the environmental/climate consequences of nuclear use, and if not, how that consideration might (or might not) change legal perspectives.
- Research to characterize the nuclear weapons debates in each of the states of the region, including those what do not yet have them (especially the ROK and Japan, but possibly Taiwan and other nations as well), and to evaluate how those debates might affect the prospects for addressing nuclear security issues in the region.
- Consider the different impact of nuclear weapons "reduction and removal" versus "reduction and elimination" strategies, as these strategies may have different impacts on security and deterrence. Reduction and removal could include removing weapons, either fully intact or with their fissile material intact, from a state or a region, and either placing them in storage elsewhere under the authority of the country that owns the weapons or placing them in storage under some sort of international authority. Reduction and elimination denotes dismantling the weapons and diluting (or using in civilian reactors) the fissile material so that it cannot be directly used in a weapon.
- Explore how and why the growing US/China "cold war" might affect nuclear weapons deployment, nuclear weapons use prospects, and regional governance needs, opportunities, and challenges in Northeast Asia.

- Explore and evaluate how perceptions of US behavior (and changes in same) in the international arena in recent years has affected NEA perceptions of the United States from the point of view of international security in general, and nuclear security in particular, and how those changing perceptions may change the prospects for addressing nuclear weapons issues in the region. (Similar research could be undertaken focusing on China and Russia as well.)
- Consider how the current asymmetries of armaments—including nuclear weapons, delivery systems, and missile defense systems—between the powers in Northeast Asia affect both the prospects for nuclear weapons use and the opportunities, approaches, and challenges that might be used in the region to enhance nuclear security.
- Research into how developing military hardware and software technologies (the latter including applications of artificial intelligence) might shift considerations for how a nuclear conflict might come about and what policies might be developed and implemented to address nuclear security.
- Study security arrangements in other regions, such as the Association of Southeast Asian Nations (ASEAN) and Europe, for applicability (and non-applicability) to the reduction of nuclear weapons threats in Northeast Asia.
- Explore futures for the region (and the broader international community) that do **not** involve nuclear conflict, identify how those futures might come about, and evaluate these non-use cases to derive additional policy lessons for avoiding nuclear weapons use.
- Explore the roles that other regions—particularly Europe—might play in helping to reduce nuclear threats in Northeast Asia—including evaluating how policymakers and other stakeholders in other regions view conflicts in Northeast Asia and what changes might help them to play a useful role in improving the nuclear (and general) security environment in the region.

Glossary

ABM	Anti-ballistic missiles are systems used to attempt to intercept incoming missiles, either while those missiles are rising (boost phase interceptors) in space or falling and nearing their target.
AI	Artificial intelligence (applied to automate of nuclear weapons launch systems).
ASEAN	Association of Southeast Asian Nations.
Cold War	The Cold War was a conflict in the aftermath of World War II through 1989 between competing blocs led by, respectively, the United States and USSR, in which there were few active military engagements but significant build-up of armaments and global tension regarding potential nuclear conflicts.
CTBT	Comprehensive Nuclear Test Ban Treaty.
Deterrence	"Deterrence [is a], military strategy under which one power uses the threat of reprisal effectively to preclude an attack from an adversary power,"[101] such as using the threat of use of nuclear weapons to deter an attack by another with conventional or nuclear weapons.
Dirty Bomb	"A 'dirty bomb' is one type of a radiological dispersal device…that combines conventional explosives, such as dynamite, with radioactive material. The terms dirty bomb and RDD are often used interchangeably. Most RDDs would not release enough radiation to kill people or cause severe illness….However, depending on the situation, an RDD explosion could create fear and panic, contaminate property, and require potentially costly cleanup."[102]
DPRK	Democratic People's Republic of Korea.
EMP	Electromagnetic pulse. See also HEMP.
Enrichment	The process of raising the proportion of the uranium-235 isotope in natural (or already enriched) uranium by separating U-235 from U-238, typically by a process of centrifugation of uranium hexafluoride (UF_6) gas.
EU	European Union.

[101] Brittanica.com (probably 2017), "Deterrence, political and military strategy," available as https://www.britannica.com/topic/deterrence-political-and-military-strategy

[102] US Nuclear Regulatory Commission (2020), "Backgrounder on Dirty Bombs," last updated August 29, 2020, and available as https://www.nrc.gov/reading-rm/doc-collections/fact-sheets/fs-dirty-bombs.html

Fallout	"Fallout is the radioactive particles that fall to earth as a result of a nuclear explosion. It consists of weapon debris, fission products, and, in the case of a ground burst, radiated soil."[103]
HEMP	High Altitude Electromagnetic Pulse. A 2008 Report by the United States Congressional Research Service (2008), for example,[104] defines HEMP as "Electromagnetic Pulse (EMP) an instantaneous, intense energy field that can overload or disrupt at a distance numerous electrical systems and high technology microcircuits, which are especially sensitive to power surges."
IAEA	International Atomic Energy Agency.
ICBM	Intercontinental ballistic missile.
INF	Intermediate-Range Nuclear Forces Treaty. "The 1987 Intermediate-Range Nuclear Forces (INF) Treaty required the United States and the Soviet Union to eliminate and permanently forswear all of their nuclear and conventional ground-launched ballistic and cruise missiles with ranges of 500 to 5,500 kilometers."[105] The United States withdrew from the INF treaty in 2019.
Isotopes	Species of an element with different numbers of neutrons in their nuclei and therefore different atomic weights, such as U-235 and U-238.
Kiloton	A measure of the explosive power of a nuclear detonation, and nominally denoting the amount of explosive force achieved by detonating 1000 tons of 2,4,6-Trinitrotoluene, or TNT. Typically defined as one teracalorie (10^{12} calories, or 4.184 x 10^{12} Joules), but definitions do vary by country and even by organization within each country—see attachment on this topic for more detail.
Kim Jong Un	Chairman and hereditary Supreme Leader of the DPRK. His father, Kim Jong Il, until his death in 2011, served as the DPRK leader following the 1994 death of his own father, Kim Il Sung, who founded the DPRK state in 1948.
KPNI	Korean Peninsula nuclear issue.
Megaton	A measure of the explosive power of a nuclear detonation equal to 1000 kilotons.

[103] Atomicarchive.com (2020), "Radioactive Fallout," available as https://www.atomicarchive.com/science/effects/radioactive-fallout.html

[104] Clay Wilson (2008), *High Altitude Electromagnetic Pulse (HEMP) and High Power Microwave (HPM) Devices: Threat Assessments*, US Congressional Research Service, updated March 26, 2008, and available as https://www.wired.com/images_blogs/dangerroom/files/Ebomb.pdf. A more recent publication by the US Air Force Civil Engineer Center (AFCEC, 2020), "High Altitude Electromagnetic Pulse (HEMP) Effects and Protection," updated 08-07-2020, and available as https://www.wbdg.org/resources/high-altitude-emp-effects-protection, provides a description of the effect and of ways to protect equipment from EMPs.

[105] Arms Control Association (2019), ibid.

NC3	Nuclear command, control, and communications.
NEA	Northeast Asia.
NORAD	North American Aerospace Defense Command.
NPT	Treaty on the Non-Proliferation of Nuclear Weapons.[106]
"Nuclear Umbrella"	Extension of nuclear deterrence by a nuclear weapons state that is in effect an implicit or explicit guarantee to defend a non-nuclear allied state.
NUDET	Detonation of a nuclear weapon or other nuclear explosive device that derives its explosive power, at least mostly, from nuclear fission and/or fusion reactions.
NWFZ	Nuclear Weapons-Free Zone.
NWS	Nuclear Weapons States (declared).[107]
PGM	Precision-guided munitions, or precision guided missiles, are guided munition (or missiles) intended to precisely hit a specific target. PGM are also sometimes called smart weapons, smart munitions, or smart bombs.
Plutonium	Element (symbol, Pu) found very seldom in nature, but produced by nuclear fission reactions when Uranium-238 reacts with a neutron to produce (mostly) Pu-239, which can be used to produce nuclear explosives (and in nuclear energy reactors).
PRC	People's Republic of China (China).
Reprocessing	The processing of spent nuclear fuel to remove and separate out the plutonium (Pu-239) produced when neutrons from nuclear fission collide with uranium-238. The resulting plutonium can be used in "mixed oxide" fuel for nuclear energy reactors, but it can also be used to make nuclear weapons.
RF	Russian Federation (Russia).

[106] See, for example, United Nations Office for Disarmament Affairs (undated, but between 2015 and 2020) "Treaty on the Non-Proliferation of Nuclear Weapons (NPT)," available as https://www.un.org/disarmament/wmd/nuclear/npt/

[107] Wikipedia (2022), "List of States with Nuclear Weapons," last updated January 6, 202, and available as https://en.wikipedia.org/wiki/List_of_states_with_nuclear_weapons, includes the following: "Five [states that have announced having nuclear weapons] are considered to be nuclear-weapon states (NWS) under the terms of the Treaty on the Non-Proliferation of Nuclear Weapons (NPT). In order of acquisition of nuclear weapons these are the United States, the Soviet Union (now Russia), the United Kingdom, France, and China".

ROE	Rules of engagement: "military directives meant to describe the circumstances under which ground, naval, and air forces will enter into and continue combat with opposing forces.[108]
ROK	Republic of Korea.
SAR	Special Administrative Region (of China, such as Hong Kong and Macao).
THAAD	Terminal High Altitude Area Defense—a ground-based missile defense system deployed by the United States in the ROK and elsewhere.
Thermonuclear	A device that derives explosive energy from nuclear fusion reactions, sometimes in combination with fission reactions.
TNT	2,4,6-Trinitrotoluene, a high-explosive chemical whose yield of energy when detonated is the basis for the definition of a "kiloton" of nuclear explosive yield.
UN Command	The United Nations Command (UNC or UN Command) is the multinational (conventional) military force that supported and supports the Republic of Korea during and after the Korean War.[109]
UNSC	United Nations Security Council.
Uranium	Natural element (U) found fairly widely in the earth's crust. The isotopic composition of natural uranium is about 0.7 percent uranium-235, which is radioactive, with almost all of the rest being U-238, which is stable.
US	United States of America.
USFK	United States Forces Korea—the name of the US military force stationed in the ROK.
Use Case	For the purposes of this report, a description of a case of nuclear weapons use starting with the detonation of one or more nuclear weapons in an attack or counterattack against a military opponent.
Weapons-grade U	Uranium-235 (typically) of a purity sufficient for use in a nuclear weapon, typically 90 percent U-235 or greater.

[108] Britannica, The Editors of Encyclopaedia (2016), "Rules of engagement." *Encyclopedia Britannica*, last edited 2016, available as https://www.britannica.com/topic/rules-of-engagement-military-directives

[109] See, for example, UN Command (undated) "Under One Flag," available as https://www.unc.mil/About/About-Us/

Yongbyon	Location of the DPRK's main nuclear weapons complex, including (at least) a "5 MW" reactor for producing plutonium, facilities for separating plutonium from spent fuel, a small research reactor, a uranium enrichment facility, and a recently built, but apparently not-yet used, experimental light-water reactor (ELWR) with an estimated capacity of about 25-30 MW (electric).

ATTACHMENTS

ATTACHMENT 1: TECHNICAL DEFINITION OF "A KILOTON" AS USED IN IDENTIFYING THE EXPLOSIVE POWER OF A NUCLEAR DEVICE[110]

As a measure of the explosive power of a nuclear device, the term "kiloton" has a number of definitions. In fact, nations possessing nuclear weapons are free to define this term in different ways, and as a consequence, weapons described as having a 10 kilotons of yield in two different nations may have significantly explosive power, and thus will have different impacts when detonated. In the second year of the NU-NEA project, the project team will be exploring the potential impacts of nuclear weapons use—in terms of explosive and radiological impacts, health impacts, and impacts in infrastructure, for example—in the contexts of the use cases described in the preceding report. As such, it will be necessary to understand how the rated kilotons of the weapons produced by each nation translate into actual ability to do damage when the weapons are used. The discussion that follows explores what is known about the definition of a kiloton in different places and contexts, and will be used to guide the project team's interpretation of kiloton ratings of weapons for the purposes of project modeling efforts in year 2.

Since the days of the Manhattan Project, when the use of US Customary Units was still common in science and engineering in the United States, the definition of the nuclear "kiloton" has remained slightly ambiguous. Here follows a summary of the various definitions used and some potential consequences of this ambiguity.

The original authoritative source on nuclear weapons, *The Effects of Nuclear Weapons* by Glasstone and Dolan, published by the US Department of Defense and US Department of Energy in 1977, defines "kiloton energy" as "10^{12} calories. This is approximately the amount of energy that would be released by the explosion of 1 kiloton (1,000 tons) of TNT." Furthermore, "the basis of the TNT equivalence is that the explosion of 1 ton of TNT is assumed to release 10^9 calories of energy."[111]

Table 1.45 from that source (reproduced below) summarizes various equivalences to one kiloton of TNT. According to Glasstone and Dolan, "the calculations are based on an accepted, although somewhat arbitrary, figure of 10^{12} calories as the energy released in the explosion of this amount of TNT.[112]

[110] The definition of kiloton" presented here draws from Appendix A in the paper "Potential Use of Low-Yield Nuclear Weapons in a Korean Context," by Eva Lisowski, as prepared for the Reducing the Risk of Nuclear Weapons Use in Northeast Asia project, September 2021.

[111] Samuel Glasstone and Philip J. Dolan, *The Effects of Nuclear Weapons, Third Edition*, pdf, available as https://www.dtra.mil/Portals/61/Documents/NTPR/4-Rad_Exp_Rpts/36_The_Effects_of_Nuclear_Weapons.pdf, pages 644, 649.

[112] Glasstone and Dolan, ibid, p. 13.

Table 1.45: Equivalents of 1 Kiloton of TNT

- Complete fission of 0.057 kg (57 grams or 2 ounces) fissionable material
- Fission of 1.45 x 10^{23} nuclei
- 10^{12} calories
- 2.6 x 10^{25} million electron volts (MeV)
- 4.18 x 10^{19} ergs (4.18 x 10^{12} joules)
- 1.16 x 10^{6} kilowatt-hours
- 3.97 x 10^{9} British thermal units

Glasstone and Dolan explain the origin of some ambiguity surrounding these definitions:

> The majority of the experimental and theoretical values of the explosive energy released by TNT range from 900 to 1,100 calories per gram. At one time, there was some uncertainty as to whether the term "kiloton" of TNT referred to a short kiloton (2 x 10^{6} pounds), a metric kiloton (2.205 x 10^{6} pounds), or a long kiloton (2.24 x 10^{6} pounds). In order to avoid ambiguity, it was agreed that the term "kiloton" would refer to the release of 10^{12} calories of explosive energy. This is equivalent to 1 short kiloton of TNT if the energy release is 1,102 calories per gram or to 1 long kiloton if the energy is 984 calories per gram of TNT.[113]

Despite the formal definition equating one kiloton to a tera-calorie, Lawrence Livermore and Los Alamos National Laboratories in the United States, for example, despite being two of the major laboratories undertaking research and development on matters nuclear in the United States, have debated the kiloton definition[114] based on the immediate versus delayed fission yield of nuclear weapons. The total energy released is equivalent to about 240 MeV per fission. However, a fraction of this fission energy is carried away in neutrinos and delayed radioactive decay (fallout). Therefore, some consider the true definition of a kiloton to be equivalent to the immediate explosive yield of 180 MeV per fission.

In practice, there a number of ways in which a given nuclear weapons program might define "kiloton" for the purposes of determining the yield of the weapons it produces. Possibilities include calculations of yield based on the Einstein equation of nuclear energy release, $\boldsymbol{E = mc^2}$, where E is the energy released in Joules when fission (or fusion) occurs with loss of mass m (in kilograms), and c is the speed of light (3 x 10^{8} meters/second), and the calculating the yield as its equivalent in high explosives (HE). These two measures may be as much a factor of two different (for example, 2 kilotons of yield measured based on nuclear energy release required to produce the same explosive energy as 1 kiloton of high explosives).

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[113] Ibid.

[114] Walter Pincus (1978), "2 Labs Battle To Be No. 1", *Washington Post*, dated December 12, 1978, and available as https://www.washingtonpost.com/archive/politics/1978/12/12/2-labs-battle-to-be-no-1/20a1a894-4867-4f9d-97d0-183c6c6d844e/

Acknowledgments: The text above incorporates ideas and comments from Siegfried Hecker, Joseph Martz, Tom Knuckle, and Bob Brownlee.

ATTACHMENT 2: CONSIDERATIONS WITH RESPECT TO USE CASES—COMMISSIONED PAPERS

The following presents titles, authors, and abstracts (or in some cases summary introductions) for the papers commissioned for the NU-NEA project that have been commissioned and completed in the first project year. These papers have served to inform the development and discussion of the use cases presented above and have been or will shortly be published by the NU-NEA project partners as Special Reports.

Nuclear-Use Cases for Contemplating Crisis and Conflict in East Asia

Paul K. Davis, senior principal researcher, RAND (retired, adjunct), and professor, Pardee RAND Graduate School.

Bruce Wm. Bennett, professor, Pardee RAND Graduate School, and international defense researcher, RAND (retired, adjunct).

Abstract

This paper motivates and sketches a set of nuclear-use cases involving conflict on the Korean peninsula. The cases reflect a wide range of ways that nuclear weapons might be brandished or used in a Korean crisis. We identify possible cases by using two different lenses: a "logical" or taxonomic lens and a decisionmaking lens that asks how an actual national leader might decide to use nuclear weapons first. We then select cases from the space of possibilities to reflect that range usefully. The use cases consider mistakes, unintended escalation, coercive threats, limited nuclear use to reinforce threats, defensive operations, and offensive operations. They also consider the potential role of fear, desperation, responsibility, grandiosity, indomitability, and other human emotions. Some use cases are far more plausible than others at present, but estimating likelihoods is a dubious activity. The real challenge is to avoid circumstances where the use cases would become more likely.

Korean Peninsula Nuclear Issue: Challenges and Prospects

Anastasia Barannikova, research fellow, ADM Nevelskoy Maritime State University.

Abstract

For the last three decades the Korean Peninsula nuclear issue (KPNI) has been considered as one of the most serious threats to security and stability in NEA (Northeast Asia). To date, none of the efforts by the international community – including Six-party talks, pressure and diplomatic efforts, and more recently, activity started by the Democratic People's Republic of Korea

(DPRK) in 2018-2019, have yielded tangible results in addressing the issue. This puts into question the viability of the existing approaches to the DPRK and the feasibility of achieving a KPNI solution.

Counterforce Dilemmas and the Risk of Nuclear War in East Asia

Ian Bowers associate professor at the Centre for Joint Operations, Royal Danish Defence College.

Abstract

The discovery of new Chinese nuclear missile silos, a seemingly escalating nuclear-conventional arms competition between the Democratic People's Republic of Korea (DPRK) and the Republic of Korea (ROK), and the announcement that Australia, in concert with the United States and United Kingdom, is pursuing nuclear-powered attack submarines are events that collectively indicate a worsening security environment in East Asia. Using geostrategic, operational, and technological factors as the basis for analysis, this paper contextualizes these and other developments and assesses the potential for nuclear war in East Asia in general and on the Korean Peninsula in particular.

The most dangerous threat to strategic stability is a counterforce dilemma where the conventional weapons of the United States, China, and regional East Asian actors may create strategic instability by their intentional or inadvertent entanglement or use to target the nuclear forces of another state, resulting in pursuit of more secure second-strike capability by the countries of the region, and forming the heart of conventional warfighting and deterrence strategies. The many different conflictual or competitive relationships across the region make arms control initiatives unlikely to succeed, but the maritime nature of the geostrategic environment and the lack of existential threat that the United States and China pose to each other make offer fewer natural pathways to the use of nuclear weapons for either China or the United States than there were for the adversaries in the Cold War.

Nuclear Weapons and Delivery Systems that Might be Implicated in Nuclear Use Involving the Korean Peninsula

Matt Korda. senior research associate and project manager, Nuclear Information Project Federation of American Scientists.

Abstract

It is highly unlikely that the Democratic People's Republic of Korea (DPRK) would intentionally launch nuclear weapons in the absence of an existential threat to the continued survival of the state and its political leadership. However, in the event of such a scenario—for example, the prospect of an imminent US invasion or regime change operation—it is possible that the DPRK

would use some of its estimated forty to fifty nuclear weapons in an attempt to forestall US action. In that case, the DPRK could use its short- and medium-range ballistic missiles early in a conflict to strike political and military targets in the Republic of Korea (ROK) and Japan, and it could potentially use its intermediate-range and intercontinental ballistic missiles to strike US military targets on Guam and Hawaii. The DPRK could also hold some nuclear weapons in reserve to strike the continental United States with intercontinental ballistic missiles, in the event that its initial nuclear strikes did not prevent an existentially-threatening conventional invasion of the DPRK. First nuclear strikes by the United States (and its allies), or by China or Russia, are also highly unlikely in the absence of an overwhelming provocation, but the nuclear weapons and launch systems available to these states are also considered.

Reducing or Exploiting Risk? Varieties of US Nuclear Thought and Their Implications for Northeast Asia

Van Jackson, professor of International Relations at Victoria University of Wellington.

Abstract

This paper argues that there is no monolithic "United States perspective" on nuclear weapons in Northeast Asia. Instead, the propensity of US policymakers to use nuclear weapons there is heavily conditioned by their political and ideological orientation. Although this may seem obvious, it means that the US response to change—whether induced by military aggression, shifts in adversary nuclear policy, or trends in conventional weapons technology, depends substantially on the internalized causal beliefs about stability of those in power at the time of a decision because events will be interpreted differently by different constituencies within the US policy community.

Although there has always been a rough ideological divide between nuclear hawks (those tending to favor military action) and doves (those generally opposing the use of force) in the United States, the past several decades have seen more diversity in the types of views and preferences expressed in policy circles about strategic stability and the (dis)utility of nuclear weapons. Arms-controllers, who are found almost entirely in the Democratic Party today, seek to reduce risks to strategic stability and view advanced conventional weapons as heightening the risks of nuclear use. Nuclear traditionalists exist in both major political parties and accept the logic of mutually assured destruction (MAD). Nuclear primacists, who are located solely within the Republican Party, believe stability derives from nuclear superiority, escalation dominance, and the willingness to launch damage-limiting nuclear first-strikes. And future-of-war (FoW) strategists, a trans-partisan group, de-center the role of nuclear weapons in US strategy in favor of a focus on precision-guided conventional munitions and delivery systems. These categorical distinctions matter because the scope for US nuclear weapons use—and the propensity to engage in actions that trigger adversary nuclear weapons use—narrows and widens depending on whose logic and preferences prevail in moments of crisis or shock.

Prospects for DPRK's Nuclear Use Scenarios and Deterrence Measures of the US and ROK Alliance

Sangkyu Lee, assistant professor, Korea Military Academy.

Abstract

The purpose of this paper is to develop cases for the DPRK's use of nuclear weapons. As background, firstly, the deterrence and countermeasure strategies of the US-ROK alliance in the face of the increasingly sophisticated DPRK nuclear threat is examined. Then, the DPRK's nuclear capabilities and nuclear strategy are investigated, and nuclear use cases are presented in detail based on those strategies. The relative priorities and feasibility of the different DPRK nuclear use cases were analyzed using parameters evaluating their military effect, the potential for US nuclear retaliation, and the level civilian casualties. Among the expected cases, it was evaluated that attacking the ROK Mobile Corps would be the most probable scenario, and that the benefits that the DPRK would gain from such an attack would be high. Within that case, there is a danger of nuclear provocation due to the asymmetry between the DPRK's nuclear possession and ROK's possession of only conventional forces. The importance of providing extended deterrence by the United States on the Korean Peninsula to maintain the nuclear balance are emphasized, therefore, and measures to strengthen the credibility of US extended deterrence are also suggested.

Avoiding Nuclear War in the Taiwan Strait

Sheryn Lee, senior lecturer in the Division of Leadership at the Swedish Defence University.

Introduction

Since the unresolved ending of the Chinese Civil War (1949), the Communist Party of China's (CCP) unwavering view has been that Taiwan is a part of China and must be unified with the mainland. The delicate status quo that resulted—Taiwan's de facto status as an independent nation and the United States' informal role guaranteeing Taiwan's security—has led to varying approaches from Beijing to achieve unification by 2049. Following the establishment of the People's Republic of China (PRC), the use of force was Beijing's strategy, but a military campaign by the PRC to invade and control Taiwan in the 1950s was derailed by insufficient training and the onset of the Korean War. The two "offshore crises" in 1954/5 and 1958 when the PRC attacked Taiwan-controlled islands demonstrated Beijing's willingness to threaten force. And Beijing's live-fire exercises during the 1996/7 Taiwan Straits crisis in response to then-President Lee Teng-hui's visit to the United States showed China's willingness to curtail Taiwan's creeping democratization.

The ambivalence in China's no first use of nuclear weapons policy, the deteriorating "strategic ambiguity" policy of the United States since the Trump administration, and the increasing identification of Taiwan as an independent polity raises the prospect of conflict over Taiwan. But the use of nuclear weapons in the Taiwan Straits would happen only under extreme

circumstances. Beijing is increasing its use of grey zone tactics with conventional and non-military means below the level of nuclear provocation to tip the cross-straits military balance in its favor. Its tactical nuclear weapons are coercive—to prevent Taiwanese political support for a declaration of de jure independence.

This report will first examine China's aim to achieve unification with Taiwan via its use of threat and use of force in both the nuclear and conventional domains with a close examination of the three cross-strait crises. Second, it will outline the geostrategic and geopolitical rationale for continued American support for Taiwan's de facto independence in an era of US-China competition. Lastly it will examine the role of Taiwan's consolidating democracy and how Taipei responds to Beijing's coercion. It will then conclude with how the Taiwan Straits case may affect the possibility of nuclear weapons use in Northeast Asia, including in Japan and on the Korean peninsula.

Potential Use of Low-Yield Nuclear Weapons in a Korean Context

Eva Lisowski, MIT Nuclear Engineering Graduate and Master's student at Tokyo Institute of Technology.

Abstract

This report explores the potential uses of low-yield nuclear weapons in the context of a possible conflict on the Korean Peninsula. It starts with a definition of low-yield weapons—typically, weapons with yields of ten kilotons or less that are designed to be nonstrategic or "tactical" weapons used with shorter-range delivery systems, prepared for the purpose of attacking troops or battlefield infrastructure. The paper then reviews the history of United States legislation regarding low-yield weapons and describes three generic scenarios in which foes possessing low-yield weapons might choose, or not choose, to use them during a military conflict. Examples of radioactive fallout maps are provided based on HYSPLIT modeling for explosions of 0,3 and 10 kilotons at a location on the Korean demilitarized zone at different times of the year. The arsenals of low-yield weapons in the states possessing nuclear weapons in Northeast Asia, as well as the United States, are compared, and seven possible "use cases" for low-yield nuclear weapons involving the Korean Peninsula are put forward.

U.S. Entry into the Korean War: Origins, Impact, and Lessons

James I. Matray, California State University, Chico.

Abstract

This article describes the reasons for the outbreak of the Korean War and US entry into the conflict. At the end of World War II, the United States and the Soviet Union divided Korea into two zones of military occupation. Cold War discord between the two nations blocked agreement to end the division, resulting in formation of two Korean governments each bent on reunification.

Soviet Premier Joseph Stalin reluctantly supported the Democratic People's Republic of Korea's (DPRK) invasion of the Republic of Korea (ROK) on 25 June 1950 after Kim Il Sung persuaded him that victory would be quick and easy. President Harry S. Truman immediately saw the attack as the first step in a Soviet plan to use military means to achieve global dominance, but he initially ordered limited US military intervention, maintaining a prewar policy of qualified containment in Korea. When the ROK failed to halt the invasion, he sent US ground forces to prevent the Communist conquest of the peninsula. Truman wanted to avoid another world war and did not consider use of atomic weapons until China intervened. This article concludes that resumption of the Korean War is unlikely because of the US treaty commitment to defend the ROK and the weakness of the DPRK.

The Deliberate Employment of U.S. Nuclear Weapons: Escalation Triggers on the Korean Peninsula

Daryl G. Press, associate professor of Government, Dartmouth College.

Abstract

This paper focuses on the conditions under which the United States might use nuclear weapons in the context of war on the Korean peninsula. It identifies circumstances that might trigger such a decision, the purposes of US nuclear use, and the plausible targets of US nuclear strikes. Attention is focused on the roles that nuclear weapons may continue to play in US military operations and geopolitical strategy despite US steps to reduce their saliency since the end of the Cold War. This paper argues that because the United States (and its allies) have a strong preference against using nuclear weapons, it would only consider doing so if (1) the mission being performed via the nuclear strike was of critical importance, (2) the mission could not be accomplished with sufficient certainty or speed with non-nuclear weapons, and (3) the use of nuclear munitions significantly increases the probability of mission success. This paper identifies a range of circumstances that could arise during a war on the Korean Peninsula that might satisfy all three of these criteria, and it identifies the pathways that are most likely to trigger US nuclear employment. Examining these conditions can help US allies and other partners identify and resolve disagreements about nuclear employment, enhance deterrence against regional adversaries, and shed light on the logic driving important decisions about US nuclear force structure and modernization.

The Role of Missile Defense in North-East Asia

David Wright, Laboratory of Nuclear Security and Policy, Department of Nuclear Science and Engineering, Massachusetts Institute of Technology.

Summary

This paper discusses specific types of missile attacks the Democratic People's Republic of Korea (DPRK) might launch in a conflict, and it identifies the key sources of uncertainty that US and allied political and military leaders must take into account in assessing how effective defense systems might be in stopping these attacks. A key finding is that while missile defenses might be able to blunt some kinds of attacks, the DPRK will have options for retaliatory missile attacks that can reach their targets despite the presence of defenses, and Pyongyang will know which options those are. The existence of this second set of cases is crucial for United States and allied leaders to recognize if they are considering taking actions under the assumption that defenses will be effective in protecting US and allied populations.