For almost 70 years, the United States has been committed to security on the Korean Peninsula. It has used a range of military and diplomatic tools to underscore its commitments to its treaty ally South Korea and to deter North Korean aggression. Apart from occasional crises and provocations, deterrence appears to have been robust. The risk of large-scale conflict, while ever present, has remained relatively low.

However, because of a combination of developments on the peninsula—the most important of which is North Korea’s burgeoning nuclear program—this situation may be changing. Under Kim Jong-un, North Korea has dramatically hastened the pace of nuclear weapon development—especially delivery vehicles, such as long-range missiles. At the same time, the rhetoric out of the North has become even more confrontational. Kim Jong-un’s regime appears stable, but a long series of arrests and killings of apparent rivals and the North Korean people’s growing awareness of outside events and increasing involvement in trade point to the potential for sudden volatility. In addition, South Korea’s doctrine of disproportionate response to provocations and emphasis on preemption exacerbate escalatory dangers. The recent rapprochement between the two Koreas and the bilateral and multilateral summits now under way may ease these tensions. Should those talks fail to resolve key issues, however, the military situation in Korea could remain very dangerous.

RAND Arroyo Center analysis of security issues in Korea highlights areas of growing risk that may pose sudden, unexpected demands on the Army and other branches of the U.S. armed services:

- North Korean nuclear progress
- limited wars spurred by the North’s recurrent military provocations
- the risk of state collapse and unsecured nuclear weapons.

The United States and other regional powers are already confronting North Korea’s nuclear progress. They may confront the
state collapse challenge as well, although it is unknown whether the conditions for collapse could emerge within the medium term. Limited war scenarios remain very possible, given North Korea’s history of limited aggression, but they are hardly certain—North Korea has generally attempted to avoid large-scale military clashes with a significant potential for escalation. In short, the United States already faces a mounting nuclear weapons challenge, which will become even more daunting once North Korea proves its capability to deliver reliable nuclear warheads on ballistic missiles. Before or after that point, it might need to deal with limited war scenarios and the possibility of a regime collapse.

This perspective summarizes more detailed analytical work, derived from a number of studies over a period of several years, in these three areas:

1. the growing operational and strategic implications of a large, survivable North Korean nuclear force
2. the operational challenges of North Korean artillery and related capabilities that can threaten Seoul from the Kaesong Heights
3. the operational and diplomatic issues attendant to a potential mission to secure loose nuclear weapons after a North Korean collapse.

In each case, we offer essential findings from recent RAND work and policy recommendations.

RAND work on these three strategic issues highlights the need for fresh thinking about how the United States should deter North Korea and prepare for a possible conflict on the peninsula. We analyze the risks of each contingency on its own, as well as how they might interact with one another to create exceptionally dangerous, operationally demanding scenarios. Our work also suggests that these three major challenges are complicated by two others—the logistical burden and local chaos of a noncombatant evacuation operation and the potential for third-party intervention, especially by China, in any crisis or war. Our most important finding is that the United States must develop and work with regional allies to shape a wider range of potential diplomatic and military options to deal with a nuclear-armed and potentially more-belligerent and more-unstable North Korea.

This conclusion creates particular implications for the Army. Given the demands of these three contingencies, the core missions involved—including deterring a major war, conducting localized but intensive operations short of major war, and locating and securing weapons of mass destruction (WMD) in the event of instability in the North—will each place massive, perhaps unsustainable, demands on Army capacity and specific high-demand, low-density capabilities. In addition, the North’s nuclear arsenal demands that the Army, together with senior Department of Defense (DoD) and U.S. government leaders, rethink fundamental assumptions about the strategies and concepts the United States would use in Korean contingencies.

Confronting Growing North Korean Nuclear Capabilities

Context

Over the past three to five years, North Korea’s nuclear weapons development trajectory has accelerated sharply. Pyongyang has tested numerous missiles, from short-range to submarine-launched
CONSEQUENCES OF A DPRK NUCLEAR ATTACK: NUCLEAR AIR BURST

Target: Gangnam, Seoul

Roughly half the size of Manhattan, Gangnam—a district of Seoul—is a major economic center and home to many large companies, such as Google and IBM.

With some of the most expensive real estate in the country, the district is also considered the most affluent in all of South Korea. Consequences of a single Democratic People’s Republic of Korea (DPRK) nuclear attack on Gangnam would be severe.

10–KT: Est. fatalities 90,000 / Est. casualties 330,000
100–KT: Est. fatalities 400,000 / Est. casualties 1,530,000*

*100–kt nuclear air burst damage extends beyond the Gangnam area.

DPRK DELIVERY SYSTEMS: BALLISTIC MISSILE CAPABILITIES

Ballistic missile | Est. range | Est. quantities
--- | --- | ---
TOKSA (KN-02) | 160 km | 100 (S)
SCUD (B/C) | ~300–500 km (SCUD-ER) 1,000 km | 400 (L)
RODONG (NODONG) | 1,500 km | 250 (L)
MUSUDAN | 3,000 km | 200 (L)
HWASONG 12 | 4,800 km | Unk. (L)
HWASONG 13 (KN-08) | 10,000 km | Unk. (L)
HWASONG 14 | 9,700 km | Unk. (L)
PUKKUKSONG 1* | 1,200 km | Unk. (S)

AT RISK:

U.S. BASES/INSTALLATIONS

- **TOKSA AND SCUD**
  - ROK: Camp Casey; Camp Carol; Camp Red Cloud; Camp Humphreys; Camp Stanley; Camp Walker; Osan AB; Yongsan Army Base; Kunsan AB

- **RODONG**
  - Japan: MCAS Iwakuni; U.S. Fleet Sasebo

- **HWASONG 12**
  - Malaysia, Thailand, Guam (U.S.), Alaska (U.S.)

- **HWASONG 13 AND 14**
  - Australia, Hawaii (U.S.), Canada, western CONUS

REGIONAL COUNTRIES

- **MUSUDAN**
  - Japan, China, Russia

- **HWASONG 12**
  - Japan: Misawa AB; Yokota AB; Sagami Army Base; Naval Air Facility Atsugi; U.S. Fleet Yokosuka; MCB Camp Schwab; MCB Camp Hansen; Torii Station Army Base; Kadena AB; MCAS Futenma; MCB Camp Kinser

- **HWASONG 13 AND 14**
  - AB = airbase
  - BM = ballistic missile
  - CONUS = continental United States
  - MCAS = Marine Corps Air Station
  - MCB = Marine Corps Base
  - ROK = Republic of Korea
  - SLBM = submarine-launched BM

*Our counterforce capabilities will also need to address nuclear weapons employed by submarines or covert operations.
It has conducted six nuclear tests since 2006, including a claimed hydrogen bomb in September 2017, and at the time of writing appears to have flight-tested an intercontinental ballistic missile (ICBM). There is every reason to believe that in five to seven years, the DPRK will have crossed two key thresholds: achieving a large and diverse arsenal of over 80 deployed weapons and deploying reliable nuclear delivery systems capable of hitting CONUS. By that time, it may also have crossed a third threshold: the deployment of truly survivable retaliatory systems, such as mobile ICBMs and SLBMs. The regime now appears determined to move well beyond a minimal or existential arsenal to a full-fledged, multipronged, survivable nuclear force capable of striking CONUS.

These intentions were on prominent display in the first half of 2017, when North Korea conducted multiple test launches of missile systems. In February, it flight-tested a solid-fuel, intermediate-range missile. In March, it conducted a salvo launch of five Scud Extended Range missiles, which are capable of striking much of Japan. In May, North Korea conducted what may have been a successful test of a missile that flew almost 500 miles on a steep trajectory with an apogee of over 1,300 miles, implying an ultimate range of well over 2,500 miles. In July 2017, it tested a missile known as the Hwasong-14, which possibly has an intercontinental range. Overall, the pace of missile testing has accelerated dramatically under Kim Jong-un.

As best as can be determined from open sources, it is unclear if North Korea has firmly committed to a specific nuclear doctrine or would ever do so in the formalized manner of the leading nuclear powers. Concerned about its vulnerability and that of its nuclear forces, North Korean leadership may primarily view nuclear weapons as an ultimate safeguard for regime survival before or during a war. North Korea will likely continue to use the threat of nuclear weapons to divide the United States from its allies. In the case of war, it also would seek to limit U.S. and allied military operations and to prevent regime change. One leading danger is that the perceived vulnerability of a relatively new DPRK nuclear deterrent will lead Pyongyang to adopt launch-on-warning and all-out nuclear doctrines that create the risk of massive escalation in a crisis. North Korea is already signaling an interest in such destabilizing doctrines.

At the moment, North Korea uses its current nuclear arsenal and the tests associated with it to drive wedges between the United States and South Korea, a long-term goal of its strategy. Going forward, North Korea has three goals that would pose a complex, significant threat to U.S. military operations:

1. the acquisition of a larger number of usable nuclear warheads
2. a diverse and survivable arsenal
3. delivery systems capable of reaching CONUS.

Specifically, North Korea could hold at risk bases required for warfighting and force flow; blackmail regional allies into denying the use of their facilities in a crisis or war; hold CONUS directly at risk; and promise a massive retaliation against U.S. allies in the event that U.S. or South Korean forces violate North Korean territory. There is every reason to believe that Kim Jong-un and his regime will not be satisfied until they have a demonstrated, reliable capability to achieve each of these goals.
Analysis

Our analysis points to a number of implications for U.S. and allied operational plans and posture in the region. For political and logistical reasons, the United States is in the process of relocating most of its forces in South Korea from dozens of bases to two main facilities. Although this will be administratively more convenient, it will also offer North Korea a few large, critical nuclear targets.

Beyond those specific facilities, a larger, more-accurate, more-reliable North Korean nuclear force will pose very real dangers to the bases needed for U.S. reinforcements and logistical support to operations in Korea. The coercive political effects of nuclear strikes could be even more decisive than their military effects: Even the prospect of such attacks could deter Japan from allowing the use of its facilities at all and would surely give the United States and South Korea pause when contemplating active military operations. Finally, the long-standing assumption that any major war on the peninsula would end with U.S. and South Korean forces entering North Korea may need to be reevaluated. Within five to eight years, North Korea is likely to have enough survivable nuclear capability to make any move into North Korea prohibitively costly in the absence of transformative new capabilities to neutralize the North Korean nuclear force. The United States and South Korea need not surrender long-held ultimate goals in any conflict, but they will very likely be forced to recalibrate the means and ways of achieving these goals.

In addition to posing new operational risks, its advancing arsenal creates the space for more elaborate provocations, such as large-scale harassment of South Korean maritime assets in the Yellow (or West) Sea. It remains too early to tell how significant this effect will be. North Korea has traditionally had a clear sense of how far it could go with its provocations without risking actual war, and the history of other nascent nuclear powers does not suggest an automatic connection between expanded nuclear capabilities and provocative behavior.

Regional reactions to North Korean military progress could prove dangerous as well. South Korea and Japan are becoming deeply concerned about North Korean advances and are developing new capabilities and concepts to deal with the threat. Those efforts could have significant destabilizing impacts across the region, even to the point of revising some basic strategic relationships. The specific, often unilateral actions that many states believe they must take in dealing with the North Korean threat could spark new regional tensions and even conflict. Coordinating regional responses is essential to ensure that they have the maximum leverage over North Korea and do not create new antagonisms among other regional states.

This analysis highlighted a number of potential regional reactions of particular concern. First and most obvious is the attitude of South Korea. Already some South Korean lawmakers have begun to call for an independent nuclear deterrent, even including submarine-launched missiles to match the North’s emerging SLBM capability. For some years, South Korea has been developing a “kill chain” system to launch preemptive strikes against North Korean nuclear sites in the event of war, and it appears to be accelerating this program. The desire for a preemptive capability is understandable, but the South’s accelerating programs will aggravate North
Korean threat perceptions, drive home the rationale for its nuclear program, and worsen crisis instability. This is just one example of the many dilemmas created by the North Korean nuclear program: Efforts to deal with it may end up making the North more reliant on nuclear weapons.

Some officials in Japan have signaled that the Japanese Self-Defense Forces should have their own independent preemptive capabilities, including long-range strike missiles, to take out North Korean nuclear weapons if use is threatened against Japan. Japan has also indicated a desire for improved missile defense capabilities, including maritime systems, such as improved Aegis systems. As Japan moves down this road—especially in concert with its broader effort to articulate a more assertive defense policy and posture—it is likely to aggravate tensions with South Korea, China, and perhaps other regional states. Moreover, because Seoul and Beijing view Japan, alongside North Korea, as a significant security concern, expanded capabilities and more assertive policies on the part of Tokyo will have special resonance. The risk of a regional security dilemma is very real.

These national reactions can intertwine and generate complex patterns of behavior among regional powers, a process that could have dramatic implications on the future strategic context in Asia. The most apparent set of second-order implications has to do with combined U.S.–South Korean actions to deal with the North Korean threat and the effects of these actions on China. The most obvious example is the deployment of additional missile defenses, particularly the Terminal High-Altitude Area Defense (THAAD) system, to the Korean Peninsula. China views the THAAD radar as a potentially intrusive means of observing its military activities and sees the THAAD itself as the “down payment” on a global defensive network that could threaten its relatively modest nuclear deterrent. Other current or potential U.S. and South Korean actions (expanding regional intelligence, surveillance, reconnaissance [ISR] assets; higher-tempo maritime activities near the Korea Peninsula; expanded U.S. military presence on the peninsula) could intensify Chinese concerns. Such a trend could easily exacerbate growing U.S.–China tensions, and the missile defense issue could eventually prompt Beijing to consider a significant expansion of its nuclear force, which could in turn spark new arms races and worsen instability.

Strains could grow within the U.S.–South Korean alliance if South Korea’s rising concern led it to pursue destabilizing unilateral responses to the North’s capabilities. Such a situation would provide a significant opportunity for China, which could make the case to Seoul that it is far better positioned to control North Korea; China could even offer some de facto security guarantees. While this might not end the U.S.–South Korea alliance in the short term, it would create an opening for China to offer itself as an alternative leading security provider. Such an outcome could carry both risks and opportunities for the United States, but it would certainly transform the U.S. role in Asia. This change would have to be handled very carefully to avoid overreactions and misperceptions.

Japan’s unilateral efforts to deal with the North Korean threat could set off a very different chain reaction. If Japan develops its own preemptive or defensive capabilities, the result could be tensions with both South Korea and China. Many experts believe that South Korea would find Japanese unilateral actions to deal with North Korean nuclear threats to be unacceptable.

Another set of second-order effects throughout the region could be based on China’s reactions to the situation in North
Korea. The United States has been anxious to encourage Beijing to become more active, but it should be careful which outcomes it seeks to bring about. When today’s China—more confident and determined to exercise regional leadership—decides to act more decisively, it will seek to do so in ways that reduce U.S. presence and influence in Northeast Asia. An entirely logical outcome is that China seeks to take advantage of a dangerous moment by leading a response to North Korean nuclear activities in a way that publicly reduces U.S. influence in the region, perhaps significantly so.

In sum, North Korea’s rapidly advancing nuclear capabilities could send security relationships in East Asia into new, potentially dangerous territory. The United States remains the common denominator among many of these relationships—and the key dampening factor to the second-order effects of North Korean nuclear advances. It must lead efforts to coordinate and negotiate with China to ensure that defensive efforts do not complicate ties with Beijing. It is the only state capable of playing a meaningful mediating role between South Korea and Japan. Its alliance with South Korea gives it a unique opportunity to shape Seoul’s thinking toward stable outcomes. Yet the pressure generated by North Korea’s nuclear advances, and the risk embodied by these second-order effects, is already beginning to outstrip U.S. coordinating efforts.

This analysis has not focused on the potential U.S. imperatives—both strategic and political—to take decisive action against a burgeoning North Korean nuclear force. It is unclear from public statements or our analysis when precisely the United States might reach such a point, or which specific North Korean capabilities would constitute a reason for an action such as a preemptive strike on nuclear facilities. But such an outcome is not out of the question, especially if the North’s nuclear development trajectory continues unabated. Such action could spark a larger conflict with horrific results for both North and South Korea and the wider region; the risk of such an outcome constitutes another major implication of North Korea’s nuclear development.

As a result of these considerations, the next five to ten years constitute a period of significant transitional risk. Eventually, the limited requirements of North Korean state survival may allow a fully defensive retaliatory doctrine. However, in the medium term, Pyongyang’s lack of confidence in the survivability of its deterrent, its fear of U.S. and South Korean preemption capabilities, the volatility of Kim Jong-un’s perceptions, and South Korea’s intent to impose disproportionate punishments all make for a highly unstable transitional period.

Key Findings and Recommendations

Our analysis produced several findings. First, any war plan that assumes that U.S. or South Korean forces will immediately transition from defensive actions to defeat a North Korean attack to offensive operations within North Korea, with the goal of regime change, must be reassessed. This would not be the first time that the changing nuclear capabilities of a potential adversary demanded a shift in U.S. strategies: During the Cold War, early notions of massive retaliation had to give way to flexible response options designed partly to exercise restraint in dealing with a much more-capable nuclear-armed adversary. The North Korean regime is likely to retain a nuclear reserve force that it could use to destroy South Korea’s major cities and do other damage if it believes its survival is truly at stake. Second, the U.S. Army will likely want
to develop options so that a South Korea–based force could fight largely unreinforced for some time. Such a requirement could emerge due to both political and operational barriers to force flow, keeping additional U.S. forces and supplies from reaching the Peninsula in large numbers and amounts for weeks or months.

Based on these and other findings, we recommend the following:

- DoD must provide the President with multiple options in the event of escalation or full-scale war—options that take into account nuclear escalatory possibilities. The United States and South Korea may no longer be in a position of deciding to “turn the key” on a default, elaborate war plan.
- The United States should expand bilateral crisis management links with North Korea. The risk of miscalculation in an escalatory situation is great, and the lack of reliable channels of communication significantly exacerbates that risk.

Confronting the Challenge of Limited War Scenarios

Context

North Korean conventional threats to Seoul—notably the massed artillery stationed in the Kaesong Heights area—pose the second major challenge to U.S. policy and strategy in Korea. Wars with little or no use of nuclear weapons and more limited objectives than unification of the peninsula could arise in several ways. Under the umbrella of the maturing nuclear capabilities discussed above, North Korea might escalate the scale of provocations to obtain specific political objectives, such as an unconditional return to negotiations over economic sanctions or the conclusion of a peace treaty. Alternatively, Kim Jong-un might initiate a diversionary war to forestall a coup or domestic turmoil. North Korea could mistake a U.S. decision to deploy additional forces to the peninsula to shore up deterrence as an incipient U.S.–South Korea invasion, provoking preemptive strikes on allied forces, ports, and airfields. In the wake of U.S. or South Korean preventive strikes against nuclear capabilities, Kim Jong-un might seek to restore deterrence by conducting limited artillery strikes against select military or civilian targets.

Despite these substantial escalatory risks, some historical evidence suggests that even after substantial military casualties have been taken, relatively immature nuclear powers are still capable of limiting the scope of conflict. Thinking through how to keep a conflict over limited objectives limited in scope before the crisis occurs is an important responsibility that policymakers and planners need to address.

Analysis

RAND Arroyo Center analysts have considered a limited war scenario in which hostilities began with intermittent long-range artillery strikes by North Korea against a constrained set of targets in the Seoul metropolitan area—strikes employed as a coercive measure to extract concessions from South Korea and the United States. Even without nuclear weapons, open-source estimates of the North’s artillery capabilities suggest that in a single ten-minute barrage, North Korea could fire close to 5,000 long-range artillery rounds into downtown Seoul and 25,000 artillery
The DPRK’s Range of Fire:

Collectively, the DPRK’s artillery systems can project large volumes of fire. In the map below, the range of fire is depicted from only one exemplar point of fire origin at Kaesong.

Mid-Range Artillery:

<table>
<thead>
<tr>
<th>System</th>
<th>est. # of systems</th>
<th>range</th>
</tr>
</thead>
<tbody>
<tr>
<td>107-mm MRL</td>
<td>500</td>
<td>8 km</td>
</tr>
<tr>
<td>122-mm MRL</td>
<td>900</td>
<td>20 km</td>
</tr>
<tr>
<td>122-mm T-ART</td>
<td>1,440</td>
<td>15 km</td>
</tr>
<tr>
<td>152-mm T-ART</td>
<td>400</td>
<td>17 km</td>
</tr>
<tr>
<td>122-mm SP-ART</td>
<td>700</td>
<td>24 km</td>
</tr>
<tr>
<td>152-mm SP-ART</td>
<td>700</td>
<td>17 km</td>
</tr>
<tr>
<td>130-mm SP-ART</td>
<td>400</td>
<td>24 km</td>
</tr>
</tbody>
</table>

Long-Range Artillery:

Millions of South Koreans and foreign nationals in communities located within 200 km of the DPRK’s powerful arsenal of long-range artillery (LRA).

<table>
<thead>
<tr>
<th>System</th>
<th>est. # of systems</th>
<th>range</th>
</tr>
</thead>
<tbody>
<tr>
<td>170-mm KOKSAN M1989</td>
<td>432</td>
<td>40–60 km</td>
</tr>
<tr>
<td>240-mm MRL M1991</td>
<td>432</td>
<td>60 km</td>
</tr>
<tr>
<td>KN-02 TOKSA (close-range BM)</td>
<td>100</td>
<td>125 km</td>
</tr>
<tr>
<td>300-mm MRL</td>
<td>36</td>
<td>200 km</td>
</tr>
</tbody>
</table>

ART = artillery  
MRL = multiple rocket launcher  
OLED = organic light-emitting diodes  
SP = self-propelled  
T = towed

AN LRA ATTACK ON SEOUL:

162 170-mm guns could fire 1 round every 3 min
162 240-mm MRL could fire 2 volleys (44 rockets) within 1 hour

AN LRA ATTACK ON PYEONGTAEK:
The DPRK could fire up to 288 300-mm rockets in a single volley

AN ATTACK ON PAJU:
Paju is within range of up to 1,000 artillery systems that could unleash ~25,000 rounds in a ten-minute volley

$14.4B Samsung semiconductor fabrication facility, located in Pyeongtaek, is within range of 300-mm MRLs

LG P10 is the world’s largest OLED panel plant, located in Paju within 9 km of the DPRK border
The DPRK Artillery Threat:

Vulnerable Populations in ROK

Even without using nuclear weapons, North Korea has the capacity to unleash a devastating level of violence against a significant portion of the ROK population through some mix of conventional artillery and possibly chemical munitions. DoD has estimated that a DPRK artillery barrage could inflict 250,000 casualties on Seoul alone.

ROK POPULATION VULNERABILITY BY RANGE

- 107-mm MRL 8 km: ~40,000
- 122-mm MRL 20 km: ~910,000
- 170-mm Koksan M1989 40 km: ~7,680,000
- 240-mm MRL M1991 60 km: ~19,810,000
- 300-mm MRL 200 km: ~32,540,000

Total ROK population (2015): ~51,000,000

ROK POPULATION BY COUNTY

- >500,000
- 300,000–500,000
- 100,000–300,000
- 50,000–100,000
- <50,000

VULNERABILITY IS INCREASING OVER TIME

As of a result of the ongoing growth in the ROK’s population between 2000–2015, the estimated number of people vulnerable to DPRK artillery increased by:

>12,000,000

Over the past several decades, urbanization has caused population clusters to extend from Seoul to the north along the lengthy Dongducheon and Cheorwon valleys. As a result, the DPRK artillery located near Pyonggang can reach population centers and cause extensive destructive effects. Compounding the threat to civilian population centers is the DPRK heavy fortification along the border, creating a challenge for allied counterfire, air strikes, and a ground invasion.
Cheorwon Valley

1ST EXEMPLARY POINT OF FIRE ORIGIN (DPRK V Corps)

1,000 artillery systems could fire 25,000 rounds during a 10-minute barrage on depicted districts

Total threatened population: ~180,000

2ND EXEMPLARY POINT OF FIRE ORIGIN (DPRK II Corps)

108 LRA systems could fire 1,500 rounds during a 10-minute barrage on depicted districts, excluding Seoul

Total threatened population: ~1,000,000

DPRK FORTIFIED DEFENSE

- The DPRK has an immediate 2:1 advantage over ROK infantry and fires
- **Hardened facilities**: LRA and other types of artillery can be sheltered from allied fires in self-contained underground facilities, and Hardened Artillery Sites (HARTS) provide added protection by housing artillery in bunkers of precast concrete covered with earth
- With collocated barracks near the Demilitarized Zone (DMZ), a large DPRK ground force could be deployed rapidly
- **Fighting in a chemical warfare environment**: South Korea’s Ministry of Defense estimates that the DPRK has between 2,500 and 5,000 metric tons of chemical weapons, including sarin and VX nerve agents that could be employed
rounds on the Seoul metropolitan area. Given that 50 percent of South Korea’s population and 70 percent of its economic activity are in the Seoul metropolitan area, this is a potentially catastrophic threat to South Korea, and given the associated risks of nuclear escalation, to the United States and its regional allies. DoD has estimated that artillery barrages could inflict 250,000 casualties on Seoul.\textsuperscript{12}

Alternatively, North Korea might seek to minimize escalation risk and limit the attrition rate of its long-range artillery by firing only a limited number of salvos each day, while still maximizing the political effect by extending attacks over a longer time horizon and counting on their remaining capacity to dramatically increase attack intensity to deter an asymmetric allied response (e.g., decapitation strikes on North Korea). For instance, if North Korea had 100 240-mm MRLs within range of Seoul, each day they could have five MRLs shoot one volley of 110 rockets. Even if all were destroyed after firing, the DPRK could sustain this rate of fire for 20 days. Because the open-source estimates indicate that North Korea possesses more than 10,000 artillery systems south of the Pyongyang-Wonsan line, this strategy could be pursued almost indefinitely. The 2006 conflict between Israel and Hezbollah demonstrated the disproportionate political effect that even quite limited rocket strikes on civilian targets can have.\textsuperscript{13}

North Korea has many strategies it might select against militarily, politically, and economically sensitive targets. Samsung is building a $14.4 billion semiconductor fabrication facility in Pyeongtaek, within range of North Korea’s KN-09 300-mm MRLs, while LG’s P10 in Paju is the world’s largest OLED panel plant and is within range of North Korea’s 122-mm MRLs.

We explored two options for responding to such North Korean limited aggression:

1. a counterfire operation conducted with air and artillery strikes against North Korean long-range artillery, supplemented by air and missile defenses

2. a “limited” ground invasion to seize the Kaesong Heights, the region north of the DMZ from which North Korean long-range artillery can hit Seoul.

These options have been explored in a range of RAND studies through wargames, high- and low-resolution combat modeling, and historical case studies.

Both options proved to be deeply problematic. U.S. and South Korean counterfire operations to halt North Korean coercive fires could take several weeks or longer, depending on North Korea’s strategy. In the meantime, South Korea could suffer tens of thousands of civilian casualties (hundreds of thousands if chemical munitions are employed), millions of internally displaced persons and refugees, and significant economic costs. Ground operations to destroy North Korea’s long-range artillery would risk North Korean nuclear escalation and might not succeed prior to the arrival of additional U.S. forces. The ROK Army would have to commit at least two corps’ equivalents of infantry and mechanized forces to seizing the Kaesong Heights. In our wargames, it was not unusual for the equivalent of a corps to be destroyed in one week’s fighting to achieve a single penetration, translating to tens of thousands of casualties.\textsuperscript{14} Casualties at this scale would likely exhaust the South Korean military’s capacity for follow-on missions, such as unifying the peninsula or securing WMD sites.
Analysis of the first response option—an extended air and artillery campaign—demonstrated that it would prove very difficult to destroy North Korean long-range artillery before South Korea incurred significant casualties. During a conflict, these long-range artillery would typically be sheltered from allied fires in underground facilities, with fire missions requiring they be exposed less than 15 minutes. North Korea would likely seek to further complicate U.S. and South Korean counterfire efforts by striking counterbattery radars, jamming unmanned aerial system (UAS) controls, spoofing the Global Positioning System guidance of precision weapons, and making extensive use of decoys. Open sources indicate that a North Korean forward corps may possess as many as 4,000 trucks, creating an opportunity for North Korea to create a very expansive shell game to complicate strikes on long-range artillery. Given the expressed concerns of U.S. Forces Korea about the U.S. inventory of preferred munitions, the cumulative effect of these challenges could pose a sharp dilemma for planners considering follow-on missions.

If South Korea and United States were unable to quickly halt North Korean artillery fire on civilian targets in South Korea, there could be a high level of political pressure to conduct a ground invasion well before most reinforcing U.S. ground forces could arrive from the United States. A ground assault to seize the Kaesong Heights would encounter defenses that North Korea has spent over 60 years preparing, characterized by supporting bunkers; counter-mobility obstacles (drop blocks, antitank “dragon’s teeth,” barbed wire, landmines, and the natural obstacle of the Imjin River); and terrain that armored vehicles cannot traverse while rice paddies are flooded for much of the year. North Korea is known to possess extensive stocks of chemical munitions and presumably would employ nuclear weapons in a defensive mode somewhere south of Pyongyang if it sensed the regime’s survival were imperiled. North Korean equipment is dated, but it is functional, there is a lot of it, and it is hidden and protected by extensive underground fortifications. In contrast, during the 2003 invasion of Iraq, Saddam Hussein had only one division appropriately orienting its defense against the U.S. advance from Kuwait and no deliberate system of counter-mobility obstacles. Any assault against North Korea thus would not be a simple replay of the opening weeks of Operation Iraqi Freedom.

Open-source estimates indicate that North Korea has a roughly two-to-one advantage in both infantry and artillery units among immediately available forces. For our analysis, we posited that the defenses would be manned by a regular North Korean infantry corps, including approximately five infantry divisions and two long-range artillery brigades. These forces could quickly be reinforced from nearby reserves, including armored, mechanized, and artillery divisions. Because political pressure to reduce civilian casualties would likely reduce the time available for preparatory fires to “soften” up North Korean defenses—and in our scenario North Korea did not initiate the conflict with a ground offensive—North Korea’s Korean People’s Army (KPA) was assumed to be largely intact.

**Key Findings and Recommendations**

This analysis produced a number of key findings. First, limiting the conflict’s scope to preclude a nuclear exchange is challenging, given the difficulty North Korea could have in discriminating between limited allied operations and the opening moves of a campaign
for regime change (an obsessive security concern of Pyongyang). Second, South Korean and U.S. air and artillery counterfire strikes could take several weeks or more to destroy North Korean artillery in range of the Seoul metropolitan area, leaving significant numbers of South Korean civilians at risk. Third, by 2022, South Korea’s personnel end-strength reductions may leave it with insufficient forces to seize the Kaesong Heights. Finally, after conducting operations to seize the Kaesong Heights, South Korean forces will likely have insufficient capacity to conduct follow-on missions—such as reunification or counter-WMD—until they reconstitute their forces with reserves.

Based on these findings, we recommend the following:

- U.S. and South Korean responses to North Korean fires should carefully align military operations with broader crisis management strategy. Given the difficulty differentiating ground operations to seize the Kaesong Heights from operations to seize Pyongyang, U.S. and South Korean operations may have to accept additional military risk to reduce the strategic risk of North Korean use of nuclear weapons against civilian targets. This might entail deliberate deviations from standard practice to send a more credible signal of limited objectives. As an example, this might entail limiting destruction of enemy air defenses to those that can directly influence South Korean and U.S. operations in the Kaesong Heights, rather than destroying all North Korean air defense capabilities, as would be expected in a regime change scenario.
- To enhance South Korean and U.S. ability to respond to limited provocations, the two countries should continue to enhance their counterfire capabilities on the peninsula, including command, control, communications, computers, and ISR (e.g., UAS and counter-battery radar), preferred munitions inventory (e.g., Multiple Launch Rocket System, rockets), and active air and missile defenses (e.g., Israel’s Iron Dome system). Active defenses are not a silver bullet, as they likely would only help against very limited North Korean strikes and become overwhelmed in larger barrages.
- The U.S. military should be prepared to take on additional tasks if South Korean forces incur significant casualties and their reserves lack sufficient readiness for complex missions, such as breaching the DMZ or counter-WMD operations.

### Confronting the Challenge of Instability and Loose Nuclear Weapons

#### Context

A third major policy challenge would emerge if North Korean instability threatened the security of its nuclear arsenal. While the current regime could gracefully fail and be replaced by a more cooperative successor that retained control over North Korea’s nuclear arsenal, regime collapse could also usher in a chaotic and unstable period, as North Korea became a failed state engulfed in a civil war.\(^{17}\) In this case, the threat posed by the North’s nuclear arsenal would shift partly, from one of operational use and political coercion to one of finding and controlling warheads and material.

The North Korean nuclear program has made considerable strides in the past decade, which, in turn, has greatly increased the difficulty of securing nuclear weapons and material if Kim Jong-un’s regime fails, in addition to increasing the consequences
of failing to do so. Given the growth in its stockpile, the risks of nuclear proliferation posed by a failed North Korean state have grown significantly.

Analysis

In an instability scenario, the U.S. military could be confronted with many different possible missions, but because of the potentially dire consequences of loose nuclear weapons, securing North Korea’s nuclear weapons is one of the most important. To explore this issue, we ran several wargames that examined whether the U.S. military could secure these nuclear weapons and material after a breakdown of the North Korean state, set in early 2018.

Our wargames posited that in late 2017, Kim Jong-un died unexpectedly, precipitating a civil war between three North Korean factions. These North Korean groups were competing with each other to control North Korean territory and resources, including nuclear weapons, nuclear facilities, and missile delivery systems (from short-range missiles to ICBMs). These capabilities offered a means for the three factions to achieve their objectives—the primary one for each faction being survival—and they viewed their nuclear capabilities as an essential element to their survival. In the scenario developed for the wargame, the international community at first warily watched the civil war slowly unfold, but remained on the sidelines because the conflict remained confined to North Korean territory. Then, however, a ship interdicted in the Philippines was found to be carrying special nuclear material that was traced back to North Korea.

Our scenario posited that these moves prompted the U.S. President to decide that the risks of the weapons being smuggled out of the country were too great and, thus, to order the U.S. military to secure North Korean nuclear weapons and material. An ultimatum was issued to the North Korean factions to turn over their nuclear arsenals or face the consequences, and U.S. reinforcements, including a heavy joint task force, were rapidly deployed in the event that the U.S. demand was not heeded.

Arguably, the United States could conceivably leave such an important mission to others, but we presumed no U.S. President would be willing to take the risk that unsecured nuclear weapons would be transferred to the hands of terrorists or others who might use them against the U.S. homeland. The games also assumed that South Korea would be overwhelmed with the general requirements of dealing with North Korea’s collapse and would have little spare capacity for a large-scale mission to secure nuclear weapons. Even if it did, as a signatory to the Nonproliferation Treaty, South Korea would be limited in the roles it could to play in the handling of nuclear weapons. In the wargame scenario, when the deadline on the U.S. ultimatum passed in January 2018, U.S. and South Korean forces entered North Korea with the objective of finding and securing nuclear weapons and special nuclear material before they disappeared or were used or proliferated.

Key Findings and Recommendations

The games offer a number of findings. One highlights a central challenge: Any U.S. intelligence on the size and location of the North Korean nuclear arsenal, no matter how accurate, will be highly perishable in the event of a regime collapse. Even North Korean groups not loyal to Kim Jong-un’s regime are likely to want to retain control over nuclear materials, which are intrinsi-
cally valuable and the ultimate guarantor of security. Given time, they would likely disassemble some of their weapons and relocate their nuclear materials in an effort to ensure that they maintain control over them. If the nuclear weapons were broken down, the difficulty of locating them would then exponentially increase: A detached nuclear warhead could be transported in the back of a normal pickup truck or van, while a removed nuclear pit—the core of an implosion nuclear weapon—could be carried in a backpack. U.S. forces must reach key North Korean nuclear sites, then locate weapons and special nuclear material within hours or days to prevent them from being used, moved, or proliferated.

A second main finding is that airpower alone cannot accomplish the mission of securing loose nuclear weapons and other related material in North Korea. While aviation assets are essential for ISR and interdiction missions, they are unlikely to be able to find and locate all North Korea’s nuclear weapons. Even if North Korea’s nuclear weapons were loaded on transporter erector launchers (TELs)—the best-case scenario—the United States is unlikely to be able to find and destroy all these vehicles from the air. In past operations, U.S. forces have struggled to positively identify TELs both before and after launch; in this instance, post-launch would be too late because a nuclear weapon would have been employed.

During Operation Desert Storm, for example, the United States did not conduct a confirmed successful strike on a single TEL, despite the fact that coalition aircraft flew almost 2,500 sorties searching for Iraqi Scuds.19 The Iraqis TELs only briefly exposed themselves to fire their missiles, moved to avoid detection, and used decoys with a similar signature, such as tanker trunks, to great effect.20 U.S. forces did succeed at destroying six TELs immediately prior to and during Operation Iraqi Freedom,

Loose Nukes:
Securing WMD Sites and Nuclear Weapons in the Event of a Regime Collapse

In the event of a North Korean regime collapse, U.S. forces will face the incredible challenge of rapidly securing nuclear sites, weapons, and special nuclear material to reduce risks of nuclear proliferation posed by a failed state.

The sheer number of sites that would need to be secured, some not yet identified, would make WMD-Elimination (WMD-E) a massive, time-consuming effort. The United States and its allies must ensure that adequate numbers of U.S. and ROK forces are allocated to this mission, and are appropriately resourced and trained to perform it.

DPRK POTENTIAL WMD SITES
~141 DPRK WMD and missile sites are identified to be of potential interest for U.S. military WMD-E operations.

| NUCLEAR | 39 |
| CHEMICAL | 38 |
| BIOLOGICAL | 15 |
| MISSILE | 49 |

Miniaturized DPRK nuclear warhead measures approximately 60 cm in diameter

RISKS OF PROLIFERATION
One possible scenario includes a loose nuke in the hands of hostile actors, who could extract the fissile material from a warhead for easy long-term concealment and transport it out of the country via a merchant ship or even a small backpack.
POSSIBLE INTERVENTION
After a DPRK collapse, China might establish a buffer zone as deep as 200 km southward from its border to allow Chinese forces to stabilize areas closest to China and secure WMD and ballistic missile sites in the north.

A NORTHERN GATEWAY
Kaesong acts as a gate into a northerly strategic corridor for ground forces entering DPRK; this corridor is a central artery leading into China. During the Korean War, China’s intervention began when U.S. and ROK forces advanced north through it in October 1950.

REAR MISSILE BELT
The medium-range ballistic missiles are thought to be located in an area that runs the entire width of the country.

THE "SCUD BELT"
After missiles, nuclear, biological, or chemical weapons are deployed, DPRK artillery systems may relocate within the missile belt, located approximately 50–90 km north of the DMZ, creating an area of uncertainty for U.S. forces to target.

DPRK Facilities:

NUCLEAR
- Nuclear facilities
- Uranium enrichment
- Nuclear reactor
- Launch facility

MISSILE
- Missile base
- Ballistic missile, nuclear, biological, or chemical
- Strategic missile belt
- SRBM
- DPRK air base

DPRK SRBMs
Both the SCUD C and the KN-02 are short-range ballistic missiles (SRBMs) capable of carrying high explosive, cluster, chemical, and possibly biological warheads, putting all of the ROK’s population, U.S. military, and infrastructure at risk.

KN-02 SRBM ~160 km
SCUD C ~500 km
but efforts to find, distinguish, track, and destroy TELs remain incredibly challenging.\textsuperscript{21} Moreover, North Korea’s mountainous terrain is even less hospitable to finding such equipment, and the KPA has prioritized camouflage, concealment, and deception, especially for its missile forces.\textsuperscript{22} Furthermore, in a collapse scenario, some North Korean nuclear warheads may be de-mated from their missiles or disassembled entirely, making detection from the air nearly impossible.

Third, the mission of securing North Korean nuclear weapons requires U.S. maneuver forces to seize the nuclear weapons sites, establish a cordon, and hold them, while highly specialized units locate and secure the weapons. However, reaching these sites is extremely difficult, as is finding the weapons. The mountainous, channelized terrain along the DMZ is defended by dug-in North Korean forces. If these units actively defend their positions, analysis found that U.S. forces would not arrive at the first nuclear site for almost two weeks, and then only after suffering substantial combat losses. Even when wargames posited weak-to-nonexistent North Korean resistance—allowing U.S. forces to quickly reach the closest sites—locating nuclear weapons and material took a considerable amount of time, tying up both large maneuver units and the highly specialized units that locate and safely eliminate nuclear weapons.\textsuperscript{23} Moreover, in the wargames, analysts playing the role of North Korean factions impeded the U.S. search efforts by sabotaging the facilities, blowing up tunnels, and contaminating the sites with radiological waste.

The sheer number and dispersion of North Korean nuclear and missile facilities, including both aboveground and underground locations, compounded this problem in the wargames.\textsuperscript{24} Information about North Korean nuclear facilities is limited and likely incomplete. Moreover, because the KPA’s missile and nuclear forces have an active concealment, camouflage, and deception program, hidden or previously unidentified facilities likely exist.\textsuperscript{25} Recent developments have compounded this problem, as Kim Jong-un has increased the number and dispersion of North Korea’s missile test sites, which now number more than a dozen and span from the Sohae Satellite Launching station on the northwestern coast near China to Kaesong, which is centrally located near the DMZ.\textsuperscript{26}

While many of North Korea’s research, development, and educational nuclear facilities are concentrated in Yongbyon County north of Pyongyang, KPA ballistic missile bases and nuclear test facilities are spread out through other parts of the country. For instance, the expansive Punggye-ri nuclear test facility is situated in North Hamgyeong Province in the northeast. Open-source estimates suggest that North Korea’s missile division has at least 18 ballistic missile bases with several additional launch pads located near the missile storage sites.\textsuperscript{27} Many of the short-range ballistic missile bases are believed to be located in a so-called “SCUD belt” approximately 50–90 kilometers north of the DMZ, while the medium-range ballistic missile brigades are thought to be located in a rear missile belt, which is centrally located more than 175 kilometers from the DMZ and runs from west to east covering nearly the entire width of the country.\textsuperscript{28}

Moreover, the wargames focused exclusively on securing the nuclear weapons and material, which is only one part of the challenge. To prevent proliferation, the United States also will need to locate the scientists who have the nuclear know-how.

The essential finding of the wargames was that rapidly securing North Korea’s nuclear arsenal in a regime collapse is an exceedingly difficult task that is well beyond current U.S. capabilities. In such
a scenario, the United States will not have the ability to prevent nuclear weapons or material from escaping the Korean Peninsula.

Even more alarmingly, in all the wargames, at least one of the North Korean factions employed a nuclear weapon during the conflict. While the United States may believe that securing North Korea’s nuclear arsenal is a limited mission, some North Korean factions in the wargames tended to view U.S. intervention as the prelude to unification and thus an existential threat to North Korea as an independent entity. This put them in the situation of using their nuclear weapons—the ultimate guarantor of their security—or losing them. The resulting nuclear use could target key U.S. and ROK logistics nodes, such as airbases and ports, or civilian centers.

Finally, the wargames highlighted a very real risk of confrontation with China; specifically, the People’s Liberation Army entered North Korea to secure its border and the northern nuclear weapons facilities. In a real contingency, Beijing’s posture toward the United States could vary significantly. If it is most concerned about stability, it might cooperate with the United States and openly or tacitly divide up responsibility for securing North Korea’s nuclear facilities. Conversely, Beijing could see the entry of U.S. forces into the North as a serious threat and could treat them as hostile. Even in a cooperative scenario, Beijing and Washington would need to develop mechanisms for sharing information about the nuclear elimination mission. These risks are manageable, but only with careful preplanning.

On the basis of these findings, we recommend:

- South Korean forces are limited in their ability to assist with the nuclear elimination mission by the Nonproliferation Treaty, thus the United States and South Korea need to work out what South Korea’s role will be in locating, securing, and exploiting nuclear materials, and to plan closely for this demanding mission.

- The United States should accelerate discussions with China on this scenario. China’s significant interests in North Korea raise the risks that misperception or inadvertent contact between forces could lead to escalation. To avoid these outcomes, the U.S. and Chinese governments should seek stronger understandings and rules of engagement governing mutual actions in this scenario.

**Conclusion**

RAND’s analysis of North Korea’s nuclear weapons program, the potential for loose nuclear weapons in the event of instability, and the potential character of a limited conflict over the Kaesong Heights area point to rising threats that will pose significant demands on the U.S. Army. No easy operational or strategic solutions are available to any of these three challenges.

RAND is now investigating a fourth Korea-related challenge—the problem of a noncombatant evacuation operation in a major crisis or war. While that analysis remains under way, it is already apparent that this potential mission poses significant demands on U.S. and Army resources. In particular, it has reinforced the general assessment that large-scale civilian flight from the greater Seoul metropolitan area—home to 25 million South Korean citizens and over a million foreign nationals—will severely complicate military operations if there is a conflict. Civilians fleeing southward
to avoid North Korean artillery or other threats, for example, will
clog the main highways that South Korean and U.S. forces would
need to employ to move north to meet the threats. The interaction
of all four of these challenges—nuclear weapons, loose nuclear
materials, limited conflict, and noncombatant evacuation—poses
severe operational dilemmas for U.S. and South Korean forces. The
context is then further complicated by the potential for political
or military intervention in any crisis or conflict by third parties,
especially China.

More than anything, therefore, this analysis suggests a need
to think in new ways about U.S. military missions in Korea,
especially by the Army. The United States needs to adjust its
assumptions about the default nature of conflict we expect in
Korea. For nearly 70 years, we have worked with South Korea and
other allies and friends to perform the dominant military mission
on the peninsula—deterring large-scale North Korean aggression.
That risk has not disappeared, but the forms that conflict might
take have become more complex. North Korea is not likely to
send tank divisions streaming southward, for example; instead, it
might use its burgeoning nuclear arsenal to cover new provoca-
tions or employ limited artillery fire from the Kaesong Heights
area as a form of escalation dominance.

This requirement implies a need to develop a broad and
innovative set of diplomatic, economic, and military options for
deterring North Korea, dealing with provocations and crises, and,
if necessary, fighting a major conflict on the peninsula. Existing
plans and operational concepts may not align with the changing
nature of the North Korean threat. In the process, the United
States will need to fight the tendency to throw resources and
planning at reinforcing existing ways of doing business, which
may be unsustainable, and instead consider new ways of achieving
U.S. and South Korean objectives.

As such, the United States needs to change how it conceives
of potential conflict on the Korean Peninsula, the military mis-
sions it will have to perform, and—most of all—how it intends
to perform those missions. The Army may need to reassess long-
standing assumptions about the timing and role of reinforcements,
the structure of logistical support, and the role of the U.S. forces
on the peninsula. The Army and the wider U.S. national security
establishment, in consultation with our South Korean and Japa-
nese allies, will need to devise new approaches to escalation and
escalation control to cope with the more complex conflict scenarios
outlined in this analysis. More than building or deploying new
capabilities, the United States and the Army need a determined
effort to think differently about sustaining the important and
longstanding U.S. commitment to the security of South Korea.
Endnotes


3 John Schilling, “North Korea’s SLBM Program Progresses, But Still Long Road Ahead,” 38North, August 26, 2016; Kwanwoo Jun, “North Korea Launches Missile from Submarine,” Wall Street Journal, April 24, 2016. Whether all or even some of these systems could reliably reach CONUS is a separate question from their survivability.


13 For 32 days, Hezbollah was able to shoot an average of 170 rounds per day at targets in northern Israel. Unable to stop the attacks with artillery or air strikes, Israel was forced into an unpopular ground war that achieved few of its original objectives. Benjamin S. Lamber, Air Operations in Israel’s War Against Hezbollah, Santa Monica, Calif.: RAND Corporation, MG-835-AF, 2011.

14 In the wargame, we assumed that South Korea’s armed forces enjoyed adequate chemical protection; in reality, significant gaps are believed to exist.


23 For example, Bonds et al. estimate that it would take a WMD-E task force 30 days to seize, secure, and exploit a large site and be ready to begin on another location (2014, pp. 39–40).

24 For an open-source overview of the facilities, see Nuclear Threat Initiative, “North Korea Facilities, Nuclear Map,” undated.


28 Bermudez, 2011.

29 China’s major interests in this scenario are likely to be ensuring that the instability does not spill over the border and preventing a large number of North Korean refugees from entering its country. Bonnie Glaser, Scott Snyder, and John S. Park, *Keeping an Eye on an Unruly Neighbor: Chinese Views on Economic Reform and Stability in North Korea*, United States Institute of Peace Working Paper, Washington, D.C., January 3, 2008, p. 19.

**Infographic Sources**

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