Reducing the Risk of Nuclear War

Taking Nuclear Weapons Off High Alert

Twenty-five years after the end of the Cold War, the United States and Russia continue to keep many hundreds of nuclear weapons on high alert, ready to be launched in minutes. This alert status—frequently called "hair-trigger alert," "launch on warning" status, or other synonyms[1]—allows both countries to launch missiles quickly in response to warning of an incoming nuclear attack, before the attacking missiles hit their targets. This Cold War–era policy is dangerous because it increases the chance of an accidental, unauthorized, or mistaken launch of nuclear weapons, as historical examples of false warning and other mistakes demonstrate.

Growing tensions between the United States and Russia make it even more important to ensure that should a crisis develop—increasing the time pressure on decision makers and opportunities for misunderstandings—high alert status does not lead to a mistake that sparks an unintended nuclear exchange.

In addition, the Chinese military has recently begun to argue that China should put its nuclear weapons on alert for the first time and build an early warning system to detect an incoming attack. These steps would also increase the risk

U.S. Air Force/Josh Aycock

One of 15 missile launch control centers at Malmstrom Air Force Base in Montana. Under high alert, military personnel have only three or four minutes to decide if warnings of foreign launches are genuine.

1 The U.S. military refers to this status as "high alert," "ready alert," "day-to-day alert," "launch under attack" status, or "prompt-launch" status.

Union of Concerned Scientists

of mistaken launches, especially since history shows that false alarms are more common early in the operation of a new warning system. U.S. nuclear policy is the largest external influence on Chinese nuclear policy. As a result, a U.S. decision to eliminate prompt-launch options from its nuclear war plans and take its missiles off high alert could affect the internal Chinese debate and help influence China to refrain from taking these dangerous steps (Kulacki 2015a).

For these reasons, the United States should remove options from its nuclear plans for launching missiles on warning of an attack, and take its silo-based missiles off alert. These fixed land-based missiles are vulnerable to attack and therefore U.S. decision makers would be under the most pressure to launch them on warning. The United States also keeps submarine-based missiles at sea on high alert, but these are not vulnerable to attack so there would not be such pressure to launch them on warning.

It is important that the United States remove rapid-launch options from its nuclear plans. This change would mean that it would not return its missiles to high alert status in a time of crisis.

While it would be preferable for both the United States and Russia to take these steps, the United States should not wait for Russia to act. Taking U.S. land-based missiles off high alert and removing rapid-launch options from U.S. nuclear plans would still reduce the risk of nuclear use and thereby increase national and international security. At the same time, the United States would maintain a robust deterrent against nuclear attack.

BOX 1.

Mistaken, Accidental, and Unauthorized Launches

Under U.S. policy, only the U.S. president can order the use of nuclear weapons. If the president is incapacitated, there is a chain of command that would be followed. An *unauthorized* launch is a deliberate launch that would take place without a presidential order. It could be perpetrated by insiders (e.g., ordered by those in the chain of command with access to the launch codes) or by outsiders (e.g., through a cyberattack). A *mistaken* launch would be authorized by the president, but in response to a false warning of an incoming attack. An *accidental* launch would not be deliberate, but would occur through a system error (e.g., a computer glitch).

The Cold War Origins of High Alert

The policy of keeping nuclear weapons on high alert is a holdover from the Cold War. Both the United States and Soviet Union feared the other country might launch a first strike attack consisting of thousands of nuclear weapons in an attempt to destroy bombers and missiles before they could be launched. At that time, leaders in both nations were concerned about the vulnerability of their nuclear weapons and command and control systems to such an attack. To make clear it could launch a devastating nuclear response even after a first strike, each country kept some of its weapons on high alert so they could be launched in retaliation within minutes of an attack being detected rather than being destroyed on the ground.

> ***The United States should remove options from its nuclear plans for launching missiles on warning, and take its silo-based missiles off alert.***

In 1961, the United States began keeping nuclear-armed bombers in the air 24 hours a day so they could not be destroyed on the ground. It ended this practice in 1968 after several accidents involving the aircraft and their nuclear weapons made clear the dangers of this policy (Department of Defense 1981). The final straw was the 1968 crash in Thule, Greenland, of a U.S. bomber on airborne alert carrying four nuclear bombs, due to a fire on the aircraft. The conventional high explosives in the bombs detonated, which dispersed plutonium over a large area surrounding the wreck (Sagan 1993).

The United States developed a system of early warning radars in the late 1950s that could detect attacking missiles early in their flight and provide 15 minutes or more of warning of an attack. As a result, following the Thule accident, the United States replaced its airborne bombers with bombers kept on alert on the ground—armed and sitting on the runway ready to take off on warning of attack.

Along with the development of long-range missiles that could be launched quickly—in particular the Minuteman and Titan II missiles—the early warning system also allowed the United States to put land-based missiles on alert starting in 1962. But the capability to quickly launch missiles came with

U.S. Air Force

In another close call incident in 1961, two nuclear bombs fell to the ground in North Carolina when a bomber lost a wing. Neither bomb detonated, but multiple safety devices failed. According to Defense Secretary Robert McNamara, "By the slightest margin of chance, literally the failure of two wires to cross, a nuclear explosion was averted."

a price. Unlike bombers, missiles cannot be called back or re-targeted after launch. Nor do they carry self-destruct mechanisms to abort a mistaken launch. Once fired, the missiles will proceed to their targets.

Unlike the United States, the Soviet Union did not routinely keep armed strategic bombers on alert—either airborne or on the ground. And it did not have a warning system to allow it to place its missiles on alert until the early 1970s (Podvig 2001).

In 1991, following the end of the Cold War and with relations warming between the United States and Russia, President George H.W. Bush ordered U.S. nuclear bombers taken off alert, with their nuclear weapons stored separately from the bombers. These planes are no longer ready to take off within 15 minutes, but can still take off within 24 hours.

Yet both countries continued to keep nuclear missiles on high alert.

The Current Situation

The United States and Russia each deploys 1,800 to 2,000 nuclear weapons, and each maintains roughly 900 missile-launched nuclear weapons on high alert. For the United States, the alert forces include all but a few of its 450 silo-based intercontinental ballistic missiles (ICBMs), each armed with one warhead, and a comparable number of warheads on submarine-launched ballistic missiles (SLBMs) on the four to five submarines that are kept within range of their targets. The ICBMs can be launched within a couple minutes of a presidential decision to do so, and the SLBMs within 15 minutes. The United States keeps four to five additional

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submarines at sea, which could move into range of their targets and be on alert within days. Most of Russia's nuclear warheads on high alert are believed to be on its silo-based missiles (Kristensen and McKinzie 2012).

Both the United States and Russia have options in their nuclear war plans for launching missiles quickly if they receive warning of an incoming nuclear first strike. Indeed, those options drive the requirement to keep missiles on high alert.

Britain and France maintain SLBMs at sea, but they are thought to be on lower levels of alert than U.S. and Russian missiles. China currently keeps its nuclear warheads stored separately from its missiles, and therefore its forces are completely off alert. The other nuclear-armed nations—India, Israel, North Korea, and Pakistan—also keep their weapons off alert, with their warheads stored separately from their delivery systems.

BOX 2.

Launch Under Attack

While launching quickly on warning of attack is typically called "launch on warning," the United States instead calls such use "launch under attack." It states that launch under attack is based on an "attack assessment that considers and confirms warning information from multiple, independent sensors" and "also considers the apparent intent of the incoming attack in the context of the international situation" (Department of State 2015a). The implication is that the United States would launch only if it *knew* that an actual nuclear attack was under way—but this is misleading since such confidence is not possible until nuclear explosions are detected.

The Dangers of Keeping Missiles on High Alert

The current U.S. policy of keeping missiles on high alert increases the risk that one or more would be launched by accident, without authorization, or in response to a false warning of an incoming attack. Any such launch would be catastrophic and could in turn trigger a nuclear attack by Russia.

In engineered systems as complex as the U.S. and Russian early warning and nuclear command and control systems, it is common for unanticipated behaviors and failure modes to arise as a result of both technical glitches and inevitable human errors (Perrow 1984). The unexpected nature of such events can make it difficult to determine whether warnings are real, especially within the few minutes allowed by launch-on-warning options. Assessing warning can be further complicated by coincidental but unrelated events, as well as by multiple events that appear to be independent of one another but share a common underlying cause. As discussed below, numerous incidents of false warnings and other problems have occurred in both countries.

The fact that no accidental, unauthorized, or mistaken launches have occurred so far suggests that the safety measures put in place by the two countries work well enough that the probability of accidents and errors leading to a nuclear launch is small.

But the probability is not zero. And the more of these incidents that occur, the greater is the chance that, due to confusion and an unforeseen confluence of events, one of them will lead to disaster.

It is worth remembering the explosion of the space shuttle *Challenger* in January 1986. Before the accident, NASA management claimed the probability of a catastrophic accident was about 1 in 100,000. Afterward, analysis showed that the probability was instead closer to 1 in 100, as had been maintained all along by engineers in the program (Feynman 1986). This figure proved to be consistent with the actual rate of accidents that occurred: there were two fatal accidents—*Challenger* in 1986 and *Columbia* in 2003—out of 135 total flights. Yet the original unrealistic estimate of the probability shaped the thinking about risks in the program. Similarly, the actual probability of a catastrophic nuclear event may in fact be larger than is typically assumed.

SHORT DECISION TIME IS DANGEROUS

The underlying problem with retaining options to launch on warning of attack is the short time available to assess the warning, to determine whether there is an actual attack and whether it is nuclear, and to decide whether to launch a nuclear response. Short decision time is especially problematic when there is confusion and ambiguous information, and at times of high international tensions.

It takes about 30 minutes for a missile to fly between the United States and Russia. In the case of an attack by submarine-launched missiles, the flight time could be much shorter. After a missile is launched, it takes time for a country's early warning system of space-based and ground-based sensors to detect the attack, leaving even less time available to make decisions before an attack lands. The timeline in place for responding to warnings is therefore very compressed.

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In the United States, which has a very advanced early warning system, the president would have at most 12 minutes—and likely much less—to decide whether and how to respond with nuclear weapons (Global Zero 2015). The U.S. early warning system would detect a missile within three minutes of its launch; the personnel monitoring the systems would have no more than three or four minutes to determine whether the warning was genuine and to pass information up the chain of command. Senior military leaders would confer and then quickly brief the president and present him or her with options for a response. This briefing would last no more than a minute, and the president would then have to make a decision in time to transmit launch orders to launch crews before the incoming missiles hit (Starr n.d.).

History has shown, however, that the process may not fit this rushed timeline. In two past incidents involving false alarms in the United States, the personnel at the warning centers reportedly took eight minutes to sort through the confusing data they were receiving. In both cases, this led to them being relieved of duty (Global Zero 2015).

Even if the ultimate decision is not to respond immediately, maintaining the option of launching weapons before an attack lands still increases the pressure on military officers and decision makers to act quickly. Intense time pressure is not helpful for good decision making, especially in the

context of ambiguous or conflicting information. Moreover, if warning occurs during a crisis, that context may predispose those assessing the warning to see it as credible.

Retired U.S. and Russian Generals James Cartwright and Vladimir Dvorkin, both of whom have extensive experience with nuclear weapons,[2] have warned about this problem. They write, "for either side, these timelines are very compressed and the opportunities for ill-considered decisions very real. Launch-on-warning puts enormous strain on the nuclear chains of command in both countries" (Cartwright and Dvorkin 2015).

The short decision timeline has required the militaries of both countries to develop and practice nuclear launch procedures that can be carried out quickly and routinely. General

BOX 3.

U.S. Military Experts Endorse Taking Nuclear Weapons Off High Alert

General James Cartwright (Marine Corps four-star general, vice chairman of the Joint Chiefs of Staff, and commander of U.S. Strategic Command) chaired a May 2012 report that stated:

> *The current postures of launch-ready nuclear forces that provide minutes and seconds of warning and decision time should be replaced by postures that allow 24–72 hours on which to assess threats and exercise national direction over the employment of nuclear forces. This change would greatly reduce the risks of mistaken, ill-considered and accidental launch (Global Zero 2012).*

General Eugene E. Habiger (Air Force four-star general and commander of U.S. Strategic Command):

> *We have to find a way to move more nuclear weapons off alert status and give leaders more decision time in a crisis (Habiger 2002).*

Robert S. McNamara (U.S. secretary of defense):

> *The risk of an accidental or inadvertent nuclear launch is unacceptably high. . . . At a minimum, we should remove all strategic nuclear weapons from 'hair-trigger' alert, as others have recommended, including Gen. George Lee Butler, the last commander of SAC. That simple change would greatly reduce the risk of an accidental nuclear launch. . . .*
>
> *The indefinite combination of human fallibility and nuclear weapons carries a very high risk of nuclear catastrophe. There is no way to reduce the risk to acceptable levels, other than to first eliminate the hair-trigger alert policy and later to eliminate or nearly eliminate nuclear weapons (McNamara 2009).*

Senator Sam Nunn (U.S. senator from Georgia and chair of the U.S. Senate Armed Services Committee):

> *I do not believe that our continued Cold War operational status adds to our deterrence or enhances either side's security; it does, however, increase the chance of a catastrophic accident made from too little information and too little time. . . . Both sides could increase decision time by eliminating the prompt launch readiness requirement for as many forces as possible, getting these weapons off hair trigger (Nunn 2002).*

General William Odom (Army three-star general and director of the National Security Agency):

> *I don't see why we have the forces alert. I've never been a big enthusiast for our whole approach of being able to launch on warning or launch in a very short amount of time. Firing off 1,000 or 500 or 2,000 nuclear warheads on a few minutes' consideration has always struck me as an absurd way to go to war. . . . Therefore I think it would make a lot of sense to completely de-alert* (Frontline *1999a).*

Admiral Stansfield Turner (Navy admiral and director of the Central Intelligence Agency):

> *I think that one of the first things we should do is take every U.S. weapon off of high alert. We have an absolutely insane policy in this country. Had it now for 30 or 40 years. . . . Our missiles that count are in submarines out here at sea, and they can't see those. So we can always counterattack, no matter what they do in that attack* (Frontline *1999b).*

2 *James Cartwright is a retired Marine Corps general and former vice chairman of the Joint Chiefs of Staff (2007–2011) and commander of the United States Strategic Command (2004–2007). Vladimir Dvorkin is a retired major general and former head of the research institute of Russia's Strategic Rocket Forces (1993–2001).*

Cartwright describes this as "gearing the nuclear command-control-communications and warning system from the president on down to the individual launch commanders for rapidly executing the forces in the opening phase of a nuclear conflict" (Cartwright 2013).

Similarly, a 2015 report by more than two dozen retired and active military officers and security experts states that, "During the Cold War both sides honed procedures to send the go-code at the first signs of incoming warheads reported by early warning satellites and ground radar. Under this plan to launch on warning, which remains intact and frequently exercised on both sides today, nuclear decision-making is extremely rushed and emotionally charged. To prevent panic, it is pre-scripted, driven by checklists, and enacted by rote" (Global Zero 2015).

According to some military officers who have taken part in the procedure, these rapid-reaction procedures have the effect of biasing the process toward a decision to launch. General Lee Butler, who from 1992 to 1994 was commander of Strategic Air Command, which oversaw nuclear bombers and land-based missiles, has said the Cold War view of needing to launch quickly is still built into U.S. nuclear policy at an operational level. He states that nuclear planners "built a construct that powerfully biased the president's decision process toward launch before the arrival of the first enemy warhead . . . a move in practice to a system structured to drive the president invariably toward a decision to launch under attack," and that this dangerous prejudice continues to guide the process today (Blair 2015).

CYBERATTACKS: A NEW "KNOWN UNKNOWN"

The increased frequency and sophistication of cyberattacks on civilian and government systems in recent years has led to concerns about potential attacks on military warning systems or nuclear command and control systems, which could result in false alarms or unauthorized missile launches. Such cyberthreats are not well understood and are continually evolving, significantly complicating efforts to defend against them.

A 2013 Defense Science Board study on advanced cyberattacks on military systems noted that "most of the systems" related to U.S. nuclear forces have not been fully assessed for vulnerability to cyberattack. It goes on to say that the U.S. military has "not kept up with the cyber adversary tactics and capabilities" and concludes that "With present capabilities and technology it is not possible to defend with confidence against the most sophisticated cyber attacks" (Defense Science Board 2013).

Indeed, military officers with experience overseeing U.S. nuclear forces are concerned about the vulnerability to cyberattack of missiles on high alert. The 2015 report by the Global Zero Commission on Nuclear Risk Reduction, chaired by General Cartwright, notes that missiles are "ready to launch upon receipt of a short stream of computers signals" and concludes that:

> *[G]iven so many unanswered questions and our weak comprehension of this cyber threat, we have yet another reason for concern about strategic missiles on high alert and about trends among the other nuclear weapons countries toward increased attack readiness of their nuclear forces. If we cannot fully assess the risks, it would seem prudent to keep nuclear missiles off of high alert status at all times. This would be a sure-fire way to mitigate foreseeable risks as well as those that have not yet been imagined (Global Zero 2015).*

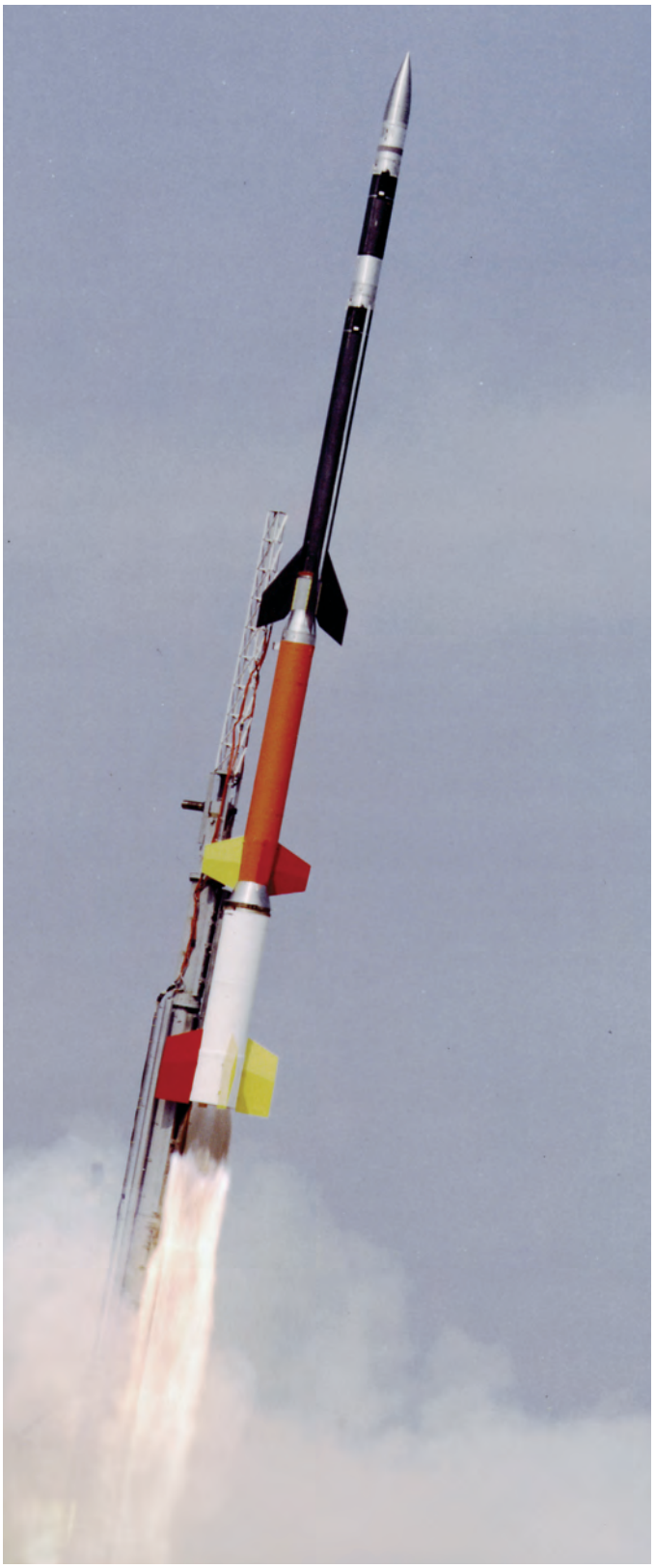
Military officers with experience overseeing U.S. nuclear forces are concerned about the vulnerability to cyberattack of missiles on high alert.

The report discusses, for example, a potential vulnerability of the command and control system of U.S. ICBMs: someone could tap into the thousands of miles of cables used by the launch control centers to communicate with the silos and control the ICBMs. If the ICBMs were not on alert and ready to be launched, they could not be launched by a cyberattacker. Generals Cartwright and Dvorkin also note that cyberattacks on warning systems could result in false alarms (Cartwright and Dvorkin 2015).

High Alert and Close Calls with Nuclear Weapons

Historical incidents that involved false alarms in both the U.S. and Russian systems remain relevant today for two reasons: they illustrate the risks to any nuclear power of maintaining missiles on high alert and thereby putting operators under pressure to make fast decisions, and they illustrate the types of incidents that can befall any complex human-engineered system.

Indeed, General Cartwright has written that, "Public reports of past experience with short time lines for decision making have shown that the process is flawed and that near



NASA

Early warning sensors can give accurate but ambiguous data that suggest an attack, such as in 1995 when the launch of a Norwegian scientific rocket (similar to the one above) was interpreted by Russian radar as a U.S. submarine-launched ballistic missile.

cataclysmic errors have been narrowly avoided but made more likely by the rushed nature of the process" (Cartwright 2013).

Nuclear weapons systems are designed so that several things have to go wrong to result in an accidental, mistaken, or unauthorized missile launch. In past incidents only one or two things went wrong, so that in most cases the incident did not ultimately pose a serious risk. However, these incidents demonstrate that system failures do occur—and can occur in unexpected and compounding ways.

Highlighted below are several incidents in both the United States and Russia that have increased the risk of nuclear disaster. They are part of a longer list of incidents in both countries that show the kinds of things that can—and do—go wrong (Union of Concerned Scientists 2015a; Schlosser 2013). Because military incidents resulting from mistakes are highly sensitive, there are likely more incidents that have not been made public and therefore remain unknown.

- **False alarm due to warning sensors being fooled:** On September 26, 1983, a Soviet early warning satellite reported five U.S. missiles attacking the Soviet Union. The alert came at a time of high tension between the two countries, due in part to the U.S. military buildup in the early 1980s and President Ronald Reagan's anti-Soviet rhetoric. In addition, earlier that month the Soviet Union shot down a Korean Airlines passenger plane that strayed into its airspace, killing nearly 300 people. The Soviet officer in command of the early warning center had only minutes to decide whether or not the satellite data was a false alarm. Since the satellite was found to be operating properly, following procedures would have led him to report an incoming attack. Going partly on gut instinct and also believing the United States was unlikely to launch an attack with only five missiles, he told his commanders that it was a false alarm before he actually knew that to be true. Later investigations revealed that the reflection of the sun on the tops of clouds had fooled the satellites into thinking it was detecting missile launches (Schlosser 2013; Hoffman 1999).

  In this case, high tensions between the two countries added significantly to the credibility of the warning. In the end, the short timeline did not allow enough time to determine that the warning was false before a decision was needed. In this case the strongest, and one of the few, safety links in the chain was the judgment of the officer in command of the early warning center. One important lesson: a different officer on duty that day may well have made a different—and tragic—decision.

- **False alarm due to accurate but ambiguous warning data:** On January 25, 1995, a Russian early warning radar detected a missile launch off the coast of Norway. Fearing that it could be an SLBM launch intended to blind Russian radars as the first move in a larger attack, Russia quickly put its nuclear forces on full alert. Fortunately, Russian satellites did not show any additional launches, and Russian leaders declared the incident a false alarm. What the radars had detected was actually the launch of a Norwegian scientific rocket. Although Norway had notified countries, including Russia, in advance of the launch, the notification did not prevent a nuclear alert (Schlosser 2013).

  This example illustrates how coincidences can give rise to false alarms. In this case, the upper stages of the sounding rocket coincidentally had similar speeds and altitudes to those of a U.S. Trident SLBM, so that a Russian computer identified it as a Trident missile.

> ***On October 23, 2010, a launch control center at Warren Air Force Base, WY, lost contact with the 50 Minuteman III ICBMs under its control. The incident lasted for nearly an hour. The missiles were on high alert and carrying nuclear warheads.***

  Moreover, the launch location and path of the rocket coincidentally made it appear to be well suited to blinding Russian radars. Fortunately, this false alarm happened at a time of low tension between the two countries, which led to skepticism that the launch was part of an attack.

- **False alarm due to human error:** On November 9, 1979, computers at the headquarters of NORAD (North American Aerospace Defense Command) indicated a large-scale Soviet attack on the United States. NORAD relayed the information to Strategic Air Command (SAC) and other high-level command posts, and top leaders convened to assess the threat. The data showed all the signs of a nuclear attack. Within minutes, U.S. ICBM crews were notified, nuclear bombers prepared for takeoff, at least 10 fighter-interceptor planes were launched, and the president's airborne command post (the National Emergency Airborne Command Post) took off (but without the president). After six minutes, communication with U.S. radar sites indicated that the radars were not detecting an attack, leading officials to decide no immediate action was necessary. Investigators later discovered the incident was caused by a technician mistakenly inserting a training tape containing a scenario for a large-scale nuclear attack into an operational NORAD computer (Sagan 1993).

  Fortunately, tensions between the United States and Soviet Union were low in 1979, so there was some skepticism about the warning. Within months, however, tensions spiked when the Soviets invaded Afghanistan, and continued to rise through President Reagan's first term. Moreover, had communication systems been down or had the radars detected unrelated missile launches (or phenomena that appeared similar to missile launches), the situation would have been much more serious.

- **False alarm due to technical problems with the warning system:** On June 3, 1980, U.S. early warning systems indicated a large incoming Soviet missile attack, triggering a response by both SAC and other command centers. Bomber crews were ordered to their stations and started their engines, and the National Emergency Airborne Command Post prepared for a rapid takeoff. The alerts were suspended when warning systems showed no further evidence of an attack. The U.S. Department of Defense later attributed the false alert to a failed computer chip. However, this problem created at least one more false alarm before it was identified (Comptroller General 1981).

- **Technical problems with command and control systems:** On October 23, 2010, a launch control center at Warren Air Force Base, Wyoming, lost contact with the 50 Minuteman III ICBMs under its control. The incident, known as "launch facilities down," lasted for nearly an hour. The missiles were on high alert and carrying nuclear warheads. According to at least one report, there may have been previous communication problems at the site that had not been corrected. A spokesperson said the launch control center was still able to monitor the missiles but "We've never had something as big as this happen . . . we've never lost complete command and control functionality of 50 ICBMs." The cause of the problem was later found to be an electronic circuit card that had

been improperly installed in one of the computers during routine maintenance (Ambinder 2010).

While much of the discussion of this latter incident focused on whether or not it had affected the *readiness* of the ICBMs, Bruce Blair, an analyst and former ICBM launch officer, noted that, "The more important concern should be that for the better part of an hour, the safeguards that protect against unauthorized launch of America's missiles were compromised" since "the remote underground launch centers that control them lost their ability to detect and cancel any unauthorized launch attempts" (Blair 2010).

- **Problems caused by personnel who did not follow proper procedures:** On August 29, 2007, six nuclear-armed cruise missiles were mistakenly loaded onto a B-52 bomber at Minot Air Force Base in North Dakota. Although there were multiple instances when the crew should have verified that the cruise missiles were not armed, no one followed required protocol to check for live weapons. The plane sat overnight on the tarmac at Minot, unguarded. On August 30, it flew 1,500 miles to a base in Louisiana where it sat unguarded for another nine hours until a maintenance crew realized that the weapons were live. In total, 36 hours passed before anyone in the U.S. Air Force realized that six live nuclear weapons were missing (Schlosser 2013).

  The failure of Air Force personnel to know or follow proper procedures raises concerns about whether similar problems could exacerbate a crisis situation. In response to this incident, retired Air Force General Eugene Habiger, commander of U.S. Strategic Command from 1996 to 1998, said, "I have been in the nuclear business since 1966 and am not aware of any incident more disturbing" (Warrick and Pincus 2007).

- **Increased risk due to an unstable individual high in the chain of command:** In August 1974, President Richard M. Nixon was in his last weeks in office during the Watergate crisis. He was clinically depressed, emotionally unstable, and drinking heavily. U.S. Secretary of Defense James R. Schlesinger instructed the Joint Chiefs of Staff to route "any emergency order coming from the president"—such as a nuclear launch order—through him first. Fortunately, this precaution was not needed (Schlosser 2013).

These and other incidents make clear that unexpected things happen that increase the risk of a nuclear launch, and occur frequently enough to be a concern. And they show that events that are considered highly unlikely, or are completely unanticipated, do in fact occur. Indeed, the probability of an unintended catastrophic nuclear event may be larger than is typically assumed.

Taking ICBMs Off High Alert

Taking an ICBM off high alert so that it can no longer be launched on a moment's notice can be done in many different ways. How it is done would affect the amount of time it would take to prepare the missile to launch and the ability of another country to verify that the missile is not on alert.

Some options, such as removing the warheads from the missiles and storing them separately, or putting a barrier over each silo that would have to be removed before the missile could be launched, could be relatively easy to verify, and would require a relatively long time to undo in preparation to launch. Other options, such as "safing" missiles by using the safety switch in each silo that prevents the missile from being launched when maintenance workers are in the silo, would be more difficult to verify, but could be done (and undone) relatively quickly.

The option chosen could depend on whether the United States removes its missiles from alert independently or in conjunction with Russia. Safing missiles could be the first step in a process to negotiate a bilateral or multilateral agreement to keep missiles off high alert that would include verification measures.

Taking ICBMs off high alert by safing has the advantage that it requires no additional equipment since it uses a switch that is part of all Minuteman III silos. Moreover, safing has been used in the past for this very purpose.

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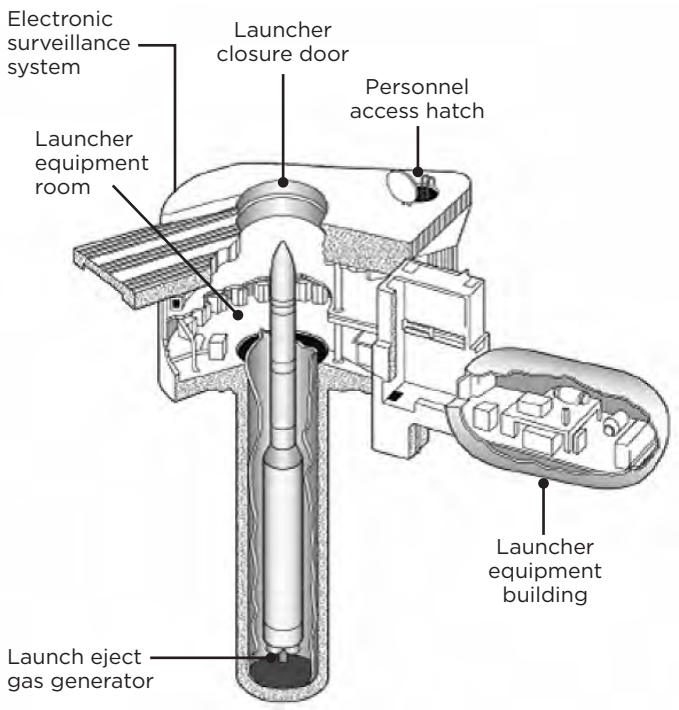
"SAFING" U.S. ICBMS

The launch crews for Minuteman III ICBMs are not located at the missile silos. Instead, two launch officers are stationed in a hardened, underground launch control center several miles from the silos. Each of these 45 centers monitors and controls a group or "flight" of 10 missiles. The 10 missiles are distributed over an area that is typically 10 to 20 miles on a side, with individual silos separated from one another by at least three miles. Each control center sits at a facility that includes a ground-level building housing six members of a security force (Ahlborn et al. 2007).

Maintenance workers visiting a silo complex enter through a hatch and go to the launcher equipment room. This room contains the electronic equipment that connects the missile to its launch control center and monitors the missile's status. One of the first things the workers do is to activate the safing switch that is part of this equipment; at that point the missile is manually safed (Union of Concerned Scientists 2015b). The switch opens a circuit that prevents a launch command from causing the missile's first-stage motor to ignite, but still allows the missile launch crew in the launch control center to monitor the missile's status (Blair 2008).

Minuteman III Launch Facility



As this schematic shows, the launch facility is fully housed underground with a hatch at ground level that allows a crew to enter the facility.

SOURCE: AHLBORN ET AL. 2007.

U.S. Air Force

Safing a Minuteman III is one option for taking these missiles off high alert. The safing process, which is already routinely performed by maintenance workers, requires simply activating an existing switch in the launch control room. This switch prevents the missile's first-stage motor from igniting, and can eliminate the risk of mistaken launch.

Safing missiles in this way would eliminate the risk of mistaken launch and reduce the risk of accidental or unauthorized launch.

Taking ICBMs off high alert by safing has the advantage that it requires no additional equipment since it uses a switch that is part of all Minuteman III silos. Moreover, safing has been used in the past for this very purpose: when President George H.W. Bush ordered 450 Minuteman II missiles immediately removed from high alert in 1991, it was done by safing the missiles using this switch.

Estimates vary on how long it would take to safe all 450 U.S. ICBMs. Maintenance crews needed no more than two days to safe the 450 Minuteman II missiles in 1991 (SAC Office of the Historian 1991).

However, Bruce Blair, who served as a missile control officer and has written extensively about this process, estimates all 450 missiles on alert today could be safed in as little as "about one-half day," depending on the number of crews available (Blair 2008). Conversely, that is also the amount of time it could take to return the 450 safed missiles to alert following a decision to do so. Safing the entire missile fleet could also be done over a longer period of time simply by having the maintenance crew leave the switch in the safe position after visiting a silo.

The launch control door from a Cold War–era Minuteman II launch site in South Dakota.

Why the Arguments for Retaining High Alert Are Not Credible

Some administration officials and other advocates have advanced various arguments for maintaining rapid-launch options. Below we show those arguments are not credible.

A "RE-ALERTING RACE" COULD NOT OCCUR

The primary reason the administration gives for not taking missiles off alert is that the process of putting them back on alert in the event of a crisis could lead to a "re-alerting race"—that is, a situation in which each side feels pressure to put its missiles back on alert before the other can. Such a race could itself increase tensions and exacerbate a crisis (Department of State 2015a). Some argue it could even create a destabilizing window in which one country might think it could carry out a first strike against the other.

This argument is based on the fallacy that missiles on high alert and options for launching on warning are needed for deterrence. If that were true, it would require missiles to be put back on alert during a crisis. However, as discussed below, missiles on high alert are not required for deterrence.

Instead, options to launch under attack should be completely removed from U.S. war plans. In that case the United States would not need to put its missiles back on alert in a crisis. Indeed, it is especially important that missiles be kept off alert during a crisis, because that is when the risk of a mistaken launch would be greater. With options for launch under attack removed, there would be no re-alerting in a crisis. With no re-alerting, there could be no re-alerting race.

HIGH ALERT STATUS IS NOT NEEDED FOR DETERRENCE

Deterrence is based on the concept that if a country launched a nuclear attack on another country, it would still face the possibility of a devastating retaliatory nuclear strike. If that situation is clear to the potential attacker, then it would be irrational for it to launch a first strike attack.

Because silo-based missiles are at known locations, they are vulnerable to a first strike. Keeping these missiles on high alert is intended to strengthen deterrence by making clear they could be launched in retaliation before they could be destroyed by a first strike. However, neither the United States nor Russia relies on silo-based missiles for deterrence.

The United States has spent many years developing its submarine fleet to provide a secure second strike capability.

U.S. submarines are stealthy and cannot be detected at sea; they could not be targeted by Russia. The United States has also put significant effort into making the command systems for these submarines survivable. Indeed, the administration recently stated, "Our command and control system and submarines at sea would survive a surprise attack and enable a devastating response" (Department of State 2015a). Similarly, a classified 2012 Pentagon study released in redacted form states that Russia would not be able to achieve a significant military advantage "primarily because of the inherent survivability of the planned U.S. strategic force structure, particularly the OHIO-class ballistic missile submarines, a number of which are at sea at any given time" (Office of the Secretary of Defense 2012). The U.S. nuclear force is designed to be able to ride out a first strike nuclear attack and be able to retaliate.

Russia has developed both submarine-launched missiles and mobile land-based missiles, which are less vulnerable than are silo-based missiles that sit at known locations. Such second strike forces on both sides would allow retaliation after incoming missiles land.

Therefore, if Russia is rational and thus can be deterred, it will be, whether or not U.S. missiles are on high alert and whether or not the president has the ability to launch on warning. If it is irrational and cannot be deterred, then the high alert status of U.S. ICBMs is equally irrelevant.

Some might argue that the ability to launch on warning is just icing on the deterrence cake to make excessively clear that the United States can retaliate following a first strike. If there were no security costs associated with maintaining this option, then doing so might make sense. But that is not the case, as the discussion above about the dangers of high alert makes clear.

HIGH ALERT STATUS IS NOT RELEVANT TO EXTENDED DETERRENCE

Some analysts argue that changes to U.S. nuclear policy, such as taking missiles off alert, can be problematic because they may lead U.S. allies to question the U.S. commitment to extended deterrence. Under extended deterrence, the United States would respond to a nuclear attack on an ally with a retaliatory nuclear strike against the attacker. This policy is designed to deter such an attack in the first place. There is ongoing tension over how to make a U.S. commitment to extended deterrence credible. For example, Japan has raised concerns in the past about the credibility of the U.S. assurance it would respond with nuclear weapons to a nuclear attack on Japan, since such a response could lead to a nuclear attack on U.S. territory.[3]

The U.S. nuclear force is designed to be able to ride out a first strike nuclear attack and still be able to retaliate.

However, concerns about credibility do not depend on whether or not U.S. missiles are on alert; the issue is whether the United States would be willing to launch a retaliatory strike, not how quickly it would do so. Moreover, recent UCS discussions with a range of Japanese officials show that there is broad support among the Japanese public and policy makers for having the United States and Russia take their missiles off alert (Kulacki 2015b; Kulacki 2015c).

HIGH ALERT STATUS IS NOT NEEDED FOR "NUCLEAR WARFIGHTING"

In addition to the role nuclear weapons play in deterring attacks, the U.S. nuclear war plan contains options for using nuclear weapons in response to a nuclear attack, or in response to a conventional, chemical, or biological attack by countries that have nuclear weapons. Using nuclear weapons in this way is typically called "nuclear warfighting" (Kristensen and McKinzie 2012).

Regardless of whether one believes such options make sense, nuclear warfighting does not require having ICBMs on high alert. SLBMs have an accuracy comparable to or better than that of ICBMs and could therefore be used to attack the same targets (Cartwright 2013). These missiles would be available to launch if a decision was made to use them.

THE "WARHEAD SPONGE" IS PRESERVED

Some analysts argue that even if U.S. ICBMs are never launched, they are necessary to serve as what is sometimes called a "warhead sponge"—meaning that Russia would need to devote a large fraction of its arsenal to targeting them if it were considering a first strike, making it less likely to undertake such an attack. Regardless of the merits of this argument, the ICBMs would continue to serve as a warhead sponge as long as they are in their silos (with or without warheads)—

3 This situation is a key reason that the United States does not acknowledge nuclear vulnerability with respect to China, since such vulnerability is the basis of Japan's concern.

their alert status is irrelevant. Any adversary planning a first strike would still need to target them so that they could not be used in a retaliatory strike. So even off alert, U.S. ICBMs would still act as a warhead sponge.

REDUCING PRESIDENTIAL OPTIONS IS GOOD

Another argument sometimes made for keeping land-based missiles on alert is that all options should be kept available to the president, including options for launching under attack.

But if the risks of an option outweigh the benefits, then that option should not be on the table. Launching under attack is not an option that either the U.S. or Russian president should have.

Moreover, some military officials see the time constraints imposed by retaining options to launch under attack themselves as needlessly and dangerously constraining to presidential options. General Cartwright testified to the Senate that, "The current posture, which exerts pressure on the President to make a nuclear choice rapidly, is a far greater constraint [than removing launch under attack options]. Launch-under-attack pressure severely hobbles presidential decision making. It deprives our leaders of the time necessary for deliberation and of the tools needed to direct U.S. power to coherent national purpose" (Cartwright 2013).

BUREAUCRATIC POLITICS SHOULD NOT TRUMP NATIONAL SECURITY

One of the strongest motivations to keep missiles on alert appears to result from bureaucratic politics. The Air Force operates the U.S. ICBM force. Some analysts argue that if silo-based missiles are taken off alert, it could be the first step to eliminating such missiles altogether, which would get the Air Force out of the nuclear missile business (although it would still oversee the nuclear bombers). There is, in fact, ongoing discussion about whether the United States should

No longer part of the U.S. arsenal, the Titan II was a type of ICBM developed during the Cold War and kept on high alert.

eliminate its ICBMs and go from a triad of land-based missiles, submarines, and bombers to a dyad of submarines and bombers. The accuracy of SLBMs has increased to the point that they can cover the same target set as ICBMs.

Independent of the military utility of ICBMs, the Air Force might well fight to retain these missiles for bureaucratic reasons alone, and push to keep the missiles on alert as a way of implying their importance. Such parochial interests should not be allowed to take precedence over a decision to remove the missiles from high alert and thereby increase national and international security.

The Evolving Strategic Environment

As a candidate and early in his first term, President Obama stated that policies to keep missiles on high alert are "unnecessary" and "increase the risk of catastrophic accidents or miscalculation," and he pledged to "take our nuclear weapons off hair-trigger alert" (Union of Concerned Scientists 2015c). In completing its 2010 Nuclear Posture Review of U.S. nuclear policies, however, the Obama administration decided to maintain those rapid-launch options.

But the strategic environment has changed since 2010 in ways that require the administration to reassess this issue.

Tensions between the United States and Russia are considerably higher, which could increase the risk of a mistaken launch, especially if the tensions escalate to a crisis. Indeed, in December 2015, former U.S. Secretary of Defense William Perry declared, "today we now face the kind of dangers of a nuclear event like we had during the Cold War, an accidental war." He argued that the biggest threat is from ICBMs, which "are simply too easy to launch on bad information" (Mehta 2015).

And General Cartwright has warned that:

> *The current launch-ready postures of the United States and Russia are major sources of instability. They not only would generate pressure on leaders to make a premature decision on the use of nuclear weapons in a crisis, but they also run a risk of unintentional strikes. The postures pose an existential threat to the very survival of the United States, and Russia perceives no less cause for concern (Cartwright 2013).*

In addition, Russia no longer has operational early warning satellites and thus relies exclusively on ground-based radars for warning (Podvig 2015). Such reliance significantly reduces the amount of warning time Russia would receive of an incoming attack, which in turn reduces the time allowed for assessment and a launch decision, further rushing these processes. It also eliminates the possibility of Russia gaining confidence in its warning data by receiving input from two independent sets of sensors (radars and satellites).

Moreover, it is possible that China will decide to place its nuclear-armed missiles on alert for the first time. There is now a discussion within Chinese military circles about this issue, which appears to stem from concerns on the part of the military about retaining a credible nuclear retaliatory capability in the face of U.S. missile defenses and accurate nuclear weapons, and the development of high-precision conventional weapons. The Chinese military appears to believe that putting its own missiles on high alert would be a step toward ensuring its ability to retaliate against a nuclear attack, in addition to other steps it is taking including developing more survivable mobile missiles and submarine-launched missiles (Kulacki 2015a).

If China does decide to put nuclear missiles on high alert this would increase the risk of accidental, unauthorized, and mistaken launches at the United States. The United States should therefore make it a priority to persuade China's political leaders, who will ultimately make this decision, to not put their weapons on alert. Since the nuclear weapon policies of the United States are the most prominent external factor influencing Chinese advocates of raising the alert level of China's nuclear forces, an announcement that the United States is ending its own practice of keeping missiles on high alert could have an impact on the Chinese debate.

If China decides to put its nuclear missiles on high alert this would increase the risk of accidental, unauthorized, and mistaken launches at the United States. The United States could help persuade China's political leaders not to take this step by ending its own practice of keeping missiles on high alert.

This report shows that the risk of accidental, unauthorized, or mistaken launch of nuclear missiles is real, and that there is no reason for the United States to continue to accept this risk. By taking its land-based nuclear missiles off high alert and removing rapid-launch options from its nuclear war plans, the United States would enhance both U.S. and international security.

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