Chapter 4
Probabilistic Risk Assessment

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Probabilistic risk assessment (PRA) can provide a quantitative estimate of risk for catastrophes that have not yet occurred by analyzing sequences of events that can lead to that event—in our case a major nuclear war. PRA is also useful for reducing that risk by identifying potential paths to nuclear weapons use that otherwise might escape attention. While PRA has been embraced in nuclear power, spaceflight, and other engineering fields, there are significant challenges to transferring that experience to the risk of nuclear deterrence failing. In-depth PRA of nuclear deterrence holds promise but requires significant further research. Fortunately, a simple approach can be used to show that the risk of nuclear deterrence failing currently appears to be on the order of 1 percent per year. It is hoped that this surprising result will cause society to invest in the larger efforts required for in-depth analysis, both to estimate and to reduce the risk of a major nuclear war.

The debate over our nation's nuclear posture has been carried out largely in a fashion inconsistent with the issue's importance. On the one hand, former secretary of defense James Schlesinger stated that we will need to depend on nuclear deterrence "more or less in perpetuity," while former secretary of defense Robert McNamara claimed that doing so "will destroy nations."

This chapter addresses the role that probabilistic risk analysis, or PRA, can play in the nuclear posture debate.

Can Probabilistic Risk Analysis Be Applied to Nuclear Deterrence?

By fostering a culture of risk awareness, PRA (also known as quantitative risk analysis, or QRA) has improved safety and illuminated previously unforeseen failure mechanisms in areas as diverse as nuclear power

reactors, space systems, and chemical munitions disposal.[1] In a more embryonic form, it also has been applied to nuclear proliferation[2] and nuclear terrorism.[3] It is therefore surprising that PRA has only recently been applied to nuclear deterrence[4] and has not yet been seriously considered when formulating US nuclear strategy.

Of course, PRA as applied to a nuclear power plant cannot be directly applied to a potential failure of nuclear deterrence. A cooling pump in a nuclear power plant can usually be assigned a binary value: either it is functioning properly or it has failed. In contrast, the crises that are part of many accident chains leading to nuclear war take on a continuum of values, and it is often difficult to assess which of two crises created more risk. Another difficulty in applying the standard PRA approach to nuclear deterrence is the large number of human factors affecting the risk of a nuclear war.

Even so, PRA is very useful for deciding whether McNamara[5] or Schlesinger[6] was right, and this chapter illustrates how to use PRA to do just that.

The problem becomes more manageable when it is recognized that even crude estimates, to just one or two orders of magnitude, can be useful. If the failure rate of nuclear deterrence were 1 in 100,000,000 per year—comparable to the probability of an extinction-level asteroid hitting Earth—then that level of risk would be acceptable. But, if the failure rate were 1 percent per year, there would be worse-than-even odds that a child born today would experience a nuclear war over their expected lifetime of approximately eighty-five years. As this extremely wide range of possible failure rates shows, even an order-of-magnitude estimate might be useful for refining the debate.

Definitions and Models

Before proceeding, a few definitions and comments on modeling are in order.

First, for ease of exposition, this chapter will use the terms *failure of nuclear deterrence*, *nuclear war*, *major nuclear war*, and *full-scale nuclear war* interchangeably, even though a nuclear war could stay limited.

Second, risk is usually defined as a function of both consequences and probability, whereas this chapter will use *the risk of a major nuclear war* to mean its annualized probability. While the latter phrase is more

correct from a technical perspective, it is a bit cumbersome. Further, the consequences of a full-scale nuclear war would be so catastrophic that, for its risk to be at an acceptable level, its annualized probability would have to be acceptably small. While this chapter uses *the risk of a nuclear war* as an abbreviation for its annualized probability, it will never use the imprecise phrase *the probability of a nuclear war*. That phrase makes no sense unless it is referenced to a specific period of time, such as one year in the case of the annualized probability.

Third, this chapter defines the era of nuclear deterrence as starting in 1955, when it is estimated that the Soviet Union had almost 3,300 warheads and the United States over 2,400.[7] A slightly earlier or later date could be chosen but will not change the substance of the arguments that follow. With that convention, we have lived in the nuclear deterrence era for the last sixty-six years, a figure that will be used henceforth.

Fourth, this chapter uses a time-invariant model. Looking to the past reveals significant variations in the risk of nuclear deterrence failing, with the worst month of the 1962 Cuban missile crisis likely encompassing more than 10 percent of all the risk over the last sixty-six years, even though that one month accounts for only 0.13 percent of that era. But, looking to the future, we have little or no idea when such periods of high risk might occur, necessitating a time-invariant model. Even so, past history is useful for estimating future risks. For example, the events in appendix A indicate that the risk associated with a major crisis, comparable to the one in 1962, is such that the world would have to be extremely lucky to survive more than a few such crises, a possibility that will be treated later in this chapter.

Fifth and last, models can only approximate reality and that caveat applies to everything said here. But models are still useful for resolving whether McNamara or Schlesinger was right about the risk of nuclear deterrence failing. A reasonable model is a much better guide for developing our nuclear strategy than a guess or a gut-level reaction.

A Teetering Nuclear Coin

At first, it might seem that there is inadequate information for estimating the risk of nuclear deterrence failing since nuclear weapons have not yet been used in a war in which more than one nation possessed them. However, PRA can glean more information from the available data than might first appear possible.

One can think of each of the sixty-six years in the nuclear deterrence era as a coin toss, with tails meaning that a nuclear war did not occur that year and heads meaning that one did occur. To date, we have seen sixty-six tails in a row, making it difficult to estimate the probability of heads—the annualized probability or risk of a nuclear war.

But it is possible to reclaim valuable information by looking not only at whether each toss showed heads or tails but also at the nuances of how the coin behaved during that toss. If all sixty-six tosses immediately landed on tails without any hesitation, that would be evidence that the coin was more strongly weighted in favor of tails and, thus, additional evidence that Schlesinger was right. Conversely, if any of the tosses teetered on the coin's edge, leaning first one way and then the other before finally showing tails, that would be evidence in favor of McNamara's position.

In 1962, the nuclear coin clearly teetered on its edge, with President John F. Kennedy later estimating the odds of war during the Cuban missile crisis at somewhere between one in three and even.[8] Other nuclear near misses are less well known and had smaller chances of ending in a nuclear disaster. But even a partial hesitation before the nuclear coin lands on tails provides useful information. Appendixes A, B, and C enumerate a number of times that the nuclear coin hesitated before landing on tails, with appendix A listing events during the Cuban missile crisis; appendix B, other events during the Cold War; and appendix C, events that occurred after the Cold War ended.

PRA Explained via the Concorde SST Crash

While, as noted above, there are major differences between PRA as applied to physical systems and as applied to nuclear deterrence, the July 2000 crash of the Concorde SST (short for supersonic transport) is useful for demonstrating some similarities. Just as the success to date of nuclear deterrence might be used to justify Schlesinger's belief that we will need to depend on that strategy "more or less in perpetuity," before its fatal crash the Concorde appeared infinitely safer than the subsonic fleet, with absolutely no fatalities. But, because there were so few Concorde flights, a *Washington Post* article noted that the one fatal crash, "transformed the supersonic aircraft from the safest plane on earth to the most dangerous, statistically speaking."[9]

Of course, hindsight is 20-20, and the real question is whether the Concorde's risk could have been foreseen before the crash. As intimated in the previous section, PRA gleans information from the available data by looking not only at catastrophic failures but also at partial failures—excursions into accident chains that have the potential to result in catastrophe. The fatal Concorde crash involved a four-step accident chain:

1. A tire blew out after striking debris on the runway.
2. The exploding tire ruptured a fuel tank.
3. The leaking fuel caught fire.
4. The fire led to the crash.

Although no Concordes had crashed before July 2000, the fleet had experienced tire failures at a rate between one and two orders of magnitude greater than that of the subsonic fleet, and more than 10 percent of those tire failures resulted in the penetration of a fuel tank.[10] While the above accident chain had never led all the way to a crash, this high rate of excursion down its first two steps should have been a red flag. If a PRA had been performed, it might well have resulted in grounding the Concorde before the crash.

Of course, a PRA would have included other accident chains that could have resulted in a crash, with some examples given in an *Air & Space* magazine article:

> The very day before the crash, Air France discovered cracks in the wings of four of its six aging Concordes. . . .
>
> . . . Aircraft belonging to both companies [Air France and British Airways] had lost parts of their elevons and rudders several times in flight but were able to land safely. In 1998, the Olympus 593 engines were found to have 152 problems in hardware design or other factors, 55 of which were considered "significant risks," and BA and Rolls-Royce initiated a plan to remedy them.[11]

The union of all the accident chains that can result in the catastrophe is called an *event tree*. As the Concorde's example shows, there is often significant, valuable, empirical data about excursions down various accident chains, even before any one of them is traversed all the way to a catastrophe, and a similar situation currently exists for a major nuclear war.

Using PRA to Estimate the Risk of a Nuclear War

The Concorde crash illustrates how the probabilities of steps in an accident chain that have not yet occurred might be approximated from related data. For example, before the fatal crash, the probability that a fuel leak would cause a fire on the Concorde could have been approximated from data from the subsonic fleet or from supersonic military aircraft. Those estimates could be improved by analyzing airflow and ignition sources for those aircraft as well as for the Concorde, and then modifying the first approximations to account for the differences.

A similar approach could have been used to estimate the probability that step four in the accident chain would be traversed if reached, namely that a fire would lead to a crash.

Similarly, we have traveled significant distances into accident chains with the potential to produce a nuclear war, and some of those events are described in the appendixes.

For example, during the Cuban missile crisis, American destroyers attacked Soviet submarines that, unbeknownst to them, were armed with nuclear torpedoes. In the case of one submarine, it was reported (but not until 2002) that the captain gave orders to arm the nuclear torpedo, but was talked down by another officer on board. While it is impossible to assign a precise probability to those events resulting in the use of the nuclear torpedo, if these reports are correct, a number in the 25 percent range would not be unreasonable since one of the two Soviet officers involved wanted to use the weapon.[12] While the nuclear torpedo was not used, the 25 percent estimate is useful for estimating the probability that the Cuban crisis could have gone nuclear due to this one accident chain.

A second major risk was that American decision-makers who advocated invading Cuba did not know—or even give much thought to the possibility—that the Soviets had battlefield nuclear weapons on Cuba to repel such an attack.[13] This was not revealed until 1992[14] and Secretary of Defense Robert McNamara later said, "If the president had gone ahead with the air strike and invasion of Cuba, the invasion forces almost surely would have been met by nuclear fire, requiring a nuclear response from the United States."[15]

While, again, it is impossible to assign a precise probability to a hypothetical American invasion being repelled by Soviet tactical nuclear

weapons, the following factors should be included when formulating an estimate.

- Early in the crisis, most of the participants, including President Kennedy, favored air strikes on the missiles to be followed by an invasion of Cuba. Fortunately, Kennedy was able to keep the crisis secret for a week by pressuring newspapers to keep stories from running. As he and his advisors thought things through without public pressure "to do something," some of them, including the president, recognized the danger inherent in military attacks and instead moved to supporting a naval quarantine or embargo. Would today's much more diffuse media bow to such pressure?
- On November 16, 1962, more than two weeks after Khrushchev had agreed to remove his missiles from Cuba, the Joint Chiefs of Staff (JCS) sent a memorandum to President Kennedy stating that they were "glad to report that our Armed Forces are in an optimum posture to execute CINCLANT OPLANS 312-62 (Air Attack in Cuba) and 316-62 (Invasion of Cuba)."[16] Earlier, during the crisis, the JCS had met and recommended air strikes to be followed by an invasion of Cuba.[17]
- There are two versions of Kennedy's televised speech in which he told the American people of the crisis and his response. Having eventually chosen a naval quarantine or embargo of Cuba, his speech as delivered[18] told of that action. But another version[19] of the speech also was prepared, which told the nation that air strikes had been carried out and intimated that an invasion of Cuba was imminent to prevent new missiles from being deployed. It read in part:

> With a heavy heart, and in necessary fulfillment of my oath of office, I have ordered—and the United States Air Force has now carried out—military operations, with conventional weapons only, to remove a major nuclear weapons build-up from the soil of Cuba. . . . Further military action has been authorized to ensure that this threat is fully removed and not restored.

Another Cold War example of an accident chain that could have led to nuclear war is the October 1961 Berlin crisis. A US Army history states that, "tensions . . . nearly escalated to the point of war."[20]

Appendix C shows that we continued dangerous excursions down such accident chains even after the Cold War ended. During the 1999 Pristina Airport crisis in Kosovo, a British three-star general refused to follow an order from an American four-star that he feared might lead to combat between NATO and Russian troops. Their accounts agree that a heated argument ended with the British general telling the American, "Sir, I'm not starting World War III for you."[21]

A PRA would also consider nuclear wars with smaller, though still catastrophic, consequences. For example, India and Pakistan combined have approximately three hundred nuclear weapons,[22] which some studies[23] have indicated could kill up to a billion people through ash and dust interfering with photosynthesis for an extended period of time on a worldwide basis. India and Pakistan have traversed the early steps of accident chains repeatedly, fighting wars in 1947, 1965, 1971, and 1999; India suffered a major attack by Pakistani-based terrorists in November 2008; and Kashmir is experiencing a renewed wave of violence.

Further, a nuclear war between India and Pakistan would create an international crisis that would increase the risk of a war involving the United States and either Russia or China. This illustrates yet another advantage of applying PRA to the risk of a major nuclear war. It would highlight the coupling between that risk and lesser risks such as a limited nuclear war, nuclear terrorism, and conventional war. Yet, many Americans think that our conventional superiority would allow us to prevail in a war with Russia or China. President Obama even referred to Russia as "a regional power."[24]

Another similarity between the PRA that could have been performed before the Concorde disaster and the one that could be performed now concerning nuclear deterrence relates to estimating the probabilities of accident chain steps that have not yet been traversed.

Just as subsonic and military fires and crashes due to fuel leaks could have provided some information about the probability of the last two steps in the Concorde's fatal four-step accident chain, a nuclear deterrence PRA could look at how frequently non-nuclear deterrence failed, with one possible example being the start of World War I. (Some elements within Russia wrongly thought that backing Serbia would deter the kaiser from

coming to Austria-Hungary's aid.) While that occurred before the nuclear era, the effect on the czar and his family was equally catastrophic.

War games that ended badly also could be used to provide data for estimating the probabilities of the last, as yet untraversed steps of accident chains leading from a crisis or conventional war to nuclear war. Appendix A lists one such war game (Proud Prophet in 1983), while appendix C includes several such unintended escalations. Most recently, in 2018, then USSTRATCOM commander US Air Force General John Hyten described a war game that ended badly, "meaning it ends with global nuclear war."[25] It would help if the results from more of these war games were declassified, either directly or through a Freedom of Information Act request.

Accident chains that stopped short of a full-blown crisis can sometimes be used to estimate the risk of such a crisis or of a conventional war. For example, during the 1999 Pristina Airport crisis described in appendix C, the British three-star refused an order that risked combat with Russian troops. Given that the American four-star giving the order thought the risk was worth taking, one might assign an initial rough estimate of 50 percent to the probability that the three-star would have thought similarly to the four-star. (Of two high-ranking NATO officers, one thought that way, which is 50 percent.) Additional analysis would be needed to estimate the probability that taking that action would have resulted in combat and a full-blown crisis.

Using PRA to Reduce the Risk of a Nuclear War

The Concorde provides another lesson for nuclear deterrence: even without estimating the probability of a catastrophic failure, accident chains can highlight risks that are currently being overlooked or inadequately considered. Using PRA to reduce the risk of a nuclear war is at least as important as using it to estimate the risk of that catastrophe.

In the case of the Concorde, the high failure rate of tires should have attracted more attention than it did, with or without an estimate of the overall risk. Similarly, we should be working harder to detect and correct misinformation about adversaries, especially those with nuclear weapons or which might acquire them. For example, in 2008, vice presidential candidate Sarah Palin said that we should be prepared to go to war with Russia over its invasion of Georgia, even though it was later established that Georgia fired the first shots.[26] A more recent example is Timothy

Morrison's testimony at President Trump's first impeachment trial, where he said, "The United States aids Ukraine and her people so that they can fight Russia over there, and we don't have to fight Russia here."[27] The risk of having to fight Russians on American soil seems remote, yet there has been little questioning of Morrison's statement. Worse, it has been repeated as if it were an established fact.

There are a number of other risks that a PRA would highlight that should be reduced if possible, including the following.

Alliances. Alliances played a major role in escalating the 1914 assassination of Archduke Ferdinand from a relatively minor incident into a catastrophic world war. NATO has the same potential; the former head of the policy and planning staff in the German Ministry of Defense, Vice Admiral Ulrich Weisser, warned in 2007 that, "Moscow also feels provoked by the behavior of a number of newer NATO member states in central and Eastern Europe. Poland and the Baltic states use every opportunity to make provocative digs at Russia; they feel themselves protected by NATO and backed by the U.S."[28]

A careful analysis should be undertaken to strengthen aspects of America's alliances that reduce risk while curtailing those that increase it.

Delegation of authority. In the 1964 dark comedy *Dr. Strangelove*, a rogue American Air Force general orders his bomber wing to attack the Soviet Union. When the president learns of this, he objects, saying "I was under the impression that I was the only one in authority to order the use of nuclear weapons." He is told that, while he is the only one with the *authority* to launch a nuclear strike, the *ability* to do so is possessed by others further down the chain of command "to discourage the Russkies from any hope that they could knock [you] out . . . and escape retaliation." That decapitation-strike dilemma still exists today.

The delegation-of-authority problem is present in conventional conflicts as well. During the 1961 Berlin crisis, when Soviet and American tanks faced off at Checkpoint Charlie, each tank commander had the ability to start a firefight that would have increased the risk of war, including escalation to nuclear war. And, during the 1999 Pristina Airport crisis mentioned earlier, a three-star general refused an order from a four-star because he feared following the order might start World War III. In both cases, conventional actions that could be taken by a military officer had some risk of escalation to nuclear war.

Domestic politics. On October 16, 1962, the first day that President Kennedy and his advisors learned that Soviet nuclear missiles were being deployed to Cuba, Secretary of Defense Robert McNamara admitted that, "I don't think there is a military problem . . . This is a domestic, political problem."[29] President Kennedy said much the same thing that day: "It doesn't make any difference if you get blown up by an ICBM flying from the Soviet Union or one from 90 miles away."[30]

Similar problems exist today, and their associated risks should be minimized.

Lack of critical thinking. Also on October 16, 1962, President Kennedy expressed shock at Khrushchev's recklessness in deploying nuclear-armed missiles so close to our shores. Forgetting that he had deployed similar missiles in Turkey just months earlier, JFK argued, "It's just as if we suddenly began to put a major number of MRBMs in Turkey. Now that'd be goddamn dangerous." Kennedy's national security advisor, McGeorge Bundy, had to remind him that we had done exactly that. Then, instead of seeing Khrushchev's move in a new light, Kennedy and his advisors used tortured logic to portray the Soviet's nuclear missile deployment in Cuba as fundamentally different from ours in Turkey.[31]

A 1995 USSTRATCOM report, *Essentials of Post-Cold War Deterrence*, even recommended that

> it hurts to portray ourselves as too fully rational and cool-headed. The fact that some elements may appear to be potentially "out of control" can be beneficial to creating and reinforcing fears and doubts within the minds of an adversary's decision makers. This essential sense of fear is the working force of deterrence. That the US may become irrational and vindictive if its vital interests are attacked should be part of the national persona we project to all adversaries.[32]

Mental instability in leaders. Potential instability in leaders of nuclear-armed nations has a long history; for example, James Forrestal died of an apparent suicide on May 22, 1949, less than two months after he stepped down as secretary of defense.

Along with a number of other celebrities, President Kennedy received massive doses of amphetamines from Dr. Max Jacobson.[33] Potential side effects of amphetamine use include euphoria, anxiety, aggression, grandiosity, and paranoia. In chronic or high doses, such as Kennedy

received, amphetamine psychosis is also possible. In 1969, a Jacobson patient died of "acute and chronic intravenous amphetamine poisoning," according to the medical examiner. Jacobson's medical license was revoked in 1975.[34]

President Nixon had a drinking problem. For example, on October 11, 1973, British prime minister Edward Heath requested a phone conversation with Nixon during the crisis produced by the Yom Kippur War. A formerly secret telephone conversation shows Nixon's national security advisor, Henry Kissinger, telling his assistant, "Can we tell them no? When I talked to the president, he was loaded."[35]

In his memoirs, Tony Blair admits that while he was prime minister of Great Britain his daily alcohol consumption was "definitely at the outer limit. Stiff whiskey or G&T before dinner, couple of glasses of wine or even half a bottle with it."[36] Boris Yeltsin also had a drinking problem.[37] Someone who could not legally drive a car should not be able to start a nuclear war.

Appendix C's entry for January 8, 2021, details actions that Bob Woodward and Robert Costa's book, *Peril*, claims were taken by General Mark Milley, chairman of the JCS, to ensure that President Trump could not launch a nuclear war as part of an effort to stay in power. As noted in that entry, a spokesman for Milley confirmed most of what is disclosed in the book. Currently the president of the United States has the sole authority to order an American nuclear strike, a power that has been questioned by former secretary of defense William Perry among others.[38]

Preexisting orders. At the height of the Cuban missile crisis, US Air Force Captain Chuck Maultsby became disoriented on a U-2 mission over the Arctic and accidentally strayed deep into Soviet airspace. Soviet MiGs were scrambled to intercept him, while American F-102s from Alaska were sent to protect him. Because of the heightened DEFCON condition, the F-102s' only air-to-air missiles were Falcon missiles with nuclear warheads.[39] Fortunately, Maultsby was able to exit Soviet airspace before he and the nuclear-armed F-102s came in contact with the MiGs.

The risk of preexisting orders can be seen twice in this incident: first, from Maultsby's mission proceeding despite the heightened tensions as a result the crisis; and second, from the F-102s being armed with Falcon missiles out of a concern that they might have to shoot down Soviet aircraft on nuclear bombing missions aimed at our nation.

Some First Steps For Risk Analysis of Nuclear War

A simple, but very useful, first step in applying PRA to a potential failure of nuclear deterrence is to estimate the risk only to an order of magnitude, rather than trying for greater precision. A paper I published in the March 2021 issue of the *Bulletin of the Atomic Scientists*[40] outlines why I estimate that probability is on the order of 1 percent per year.[41]

This order-of-magnitude estimate of 1 percent per year includes a range from a third of a percent to 3 percent per year, but the risk is likely to be upper bounded by 10 percent per year since we have survived sixty-six years of nuclear deterrence without any use of nuclear weapons in war, much less a major exchange.[42]

Similarly, 0.1 percent per year is likely to be a lower bound on the risk since that would imply that current policies could be continued for approximately one thousand years before there would be a significant probability of civilization being destroyed.[43] Over that time period, a simple statistical argument would predict fifteen major crises since there has been one in the last sixty-six years,[44] namely the Cuban missile crisis of 1962, and 1,000/66 = 15 after rounding. In light of the risks during that crisis that are detailed in appendix A, it is likely that at least one of fifteen such crises would result in a nuclear war.

If 10 percent per year is too high and 0.1 percent per year is too low, then the order-of-magnitude estimate for the risk of a major nuclear war is 1 percent per year. As noted above, this incorporates a range from approximately a third of a percent to 3 percent per year, but even a risk of a third of a percent per year would correspond to a 25 percent lifetime risk over the approximately eighty-five-year life expectancy of a child born today. And 3 percent per year would subject that child to a 92 percent lifetime risk.

Several refinements to the above approach are possible.

First, expert elicitation, discussed in detail in chapter 3, could be used to estimate a probability distribution on the rate of occurrence of major crises as opposed to the simple statistical argument used above.

Second, expert elicitation could be used to estimate the probability that such a major crisis results in a nuclear war.

Third, lesser crises could be incorporated into the model. Looking at the past two decades, we had crises in

- 2016, Russian meddling in the US election, resulting in very tense Russian–American relations down to the present day;
- 2014, Ukraine, again extending to the present day;
- 2008, the Georgian War;
- 2011, NATO's attack on Libya;
- 2003, the invasion of Iraq; and
- 2001, al-Qaeda's September 11 attack.

Expert elicitation could be used to estimate the relative severity of these crises, their risk of escalation to major crises, and their expected rate of occurrence.

However, all by itself, the order-of-magnitude approach seems adequate for concluding that McNamara was right when he said that "the indefinite combination of human fallibility and nuclear weapons will destroy nations."[45]

How My Approach Has Evolved

The approach suggested in the last section for estimating the risk of a major nuclear war has much in common with that used in my 2008 paper, "Risk Analysis of Nuclear Deterrence,"[46] but there have been several changes in my thinking that should be highlighted.

One change involves using more complex probability estimates than just intervals—for example, probability distributions derived by expert elicitation.

Another change is that, in my 2008 paper, I estimated the rate of occurrence of potential initiating events for a major crisis and I then estimated the conditional probability that such a crisis would occur, given that the initiating event had occurred. Combining the two quantities into a single estimate of the rate of occurrence of major crises seems more appropriate at this early stage in the risk analysis of nuclear war. With fewer parameters there is less chance for error or unconscious bias to set in.

Another change is to be as accurate as possible, as opposed to using conservative estimates to avoid appearing alarmist. The use of probability distributions instead of intervals helps in that endeavor. For example, in

my 2008 paper, I used the interval from 0.01 to 0.5 as my estimate for the conditional probability that a major crisis leads to the use of a nuclear weapon. Just saying that that probability is somewhere in the interval between 0 and 1 conveys no information, while using a probability distribution that extends from 0 to 1 and that was derived from expert elicitation does provide useful information.

Another possible change would be to focus on estimating and reducing just the rate of occurrences of major crises, as opposed to estimating and reducing the annualized probability of a major nuclear war. That approach would eliminate any objections that the analysis is being applied to events that have not yet occurred. The Cuban missile crisis of 1962 provides one data point for estimating the rate of occurrences of major crises and it provides significant data for reducing their frequency.

Concluding Remarks

This chapter has outlined ways that PRA can be used to bring greater objectivity to the debate over nuclear deterrence, as well ways that PRA can reduce the risk of nuclear war.

It presented evidence that the risk of a major nuclear war is on the order of 1 percent per year, so that former secretary of defense James Schlesinger appears to have been dangerously wrong when he said that we will need to depend on nuclear deterrence "more or less in perpetuity." Instead, Robert McNamara appears correct in stating that doing so "will destroy nations."

It should be noted that this chapter is a beginning, not an end point. MIT professor and former Nuclear Regulatory Commissioner George Apostolakis noted that in every application of PRA that he has observed, there is a process.[47] At first, there is skepticism that PRA is of any use. But, as that application of PRA improves over time, skepticism gives way to increased acceptance.

Currently, we are at the beginning of that process for PRA to be applied to nuclear deterrence, and I hope that this chapter will help society realize that the danger it faces is even greater than that from pandemics, where warnings also were largely ignored. Once society recognizes that reality, resources hopefully will become available for more in-depth analyses that can sand off the many rough edges on what was presented here.

I also hope that society will then see the immense opportunity that rethinking national security presents.[48] In 1946, soon after Hiroshima

and Nagasaki, Albert Einstein warned that "the unleashed power of the atom has changed everything save our modes of thinking and we thus drift toward unparalleled catastrophe."[49]

Not only can we avoid that unparalleled catastrophe, but we can also build a world that we can be proud to pass on to future generations if we will change our mode of thinking to make it consistent with the realities of the age in which we live. Nuclear weapons, along with other technological advances, have given a new, global meaning to the biblical injunction, "I have set before you life and death, blessing and curse; therefore choose life that you and your descendants may live" (Deuteronomy 30:19).

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Appendix A. Some Events That Heightened the Risk of the Cuban Missile Crisis

The events described in this appendix are helpful in estimating the level of risk that our nation faced during the Cuban missile crisis, and that it would face if a similar crisis should reoccur.

This is particularly important since participants in the crisis have expressed highly divergent estimates of the level of risk. ExComm[50] member C. Douglas Dillon stated, "we didn't think there was any real risk of a nuclear exchange"[51] and Kennedy's national security advisor McGeorge Bundy estimated that risk at "one in 100."[52] At the other extreme, Kennedy speechwriter Theodore Sorensen quotes the president as saying the odds of war were "somewhere between one out of three and even,"[53] and Secretary of Defense McNamara remembers thinking he might not live out the week.[54]

Estimates made at the time of the crisis also need to be reevaluated in light of information that only became known afterward, such as the first two items below.

American destroyers attacked Soviet submarines that, unbeknownst to them, were armed with nuclear torpedoes. On October 27, at the height of the crisis, American destroyers intercepted a Soviet submarine near the quarantine line and forced it to surface by dropping "practice depth charges." Forty years later, we learned that this and two other Soviet submarines that also were forced to surface carried nuclear torpedoes.[55]

The presence of these nuclear weapons was unknown to the submarine's attackers or to any other Americans at that time.

According to a member of the submarine crew, its captain was under severe physical and psychological pressure; mistook the practice depth charges for regular depth charges; believed that World War III might already have started; and gave orders for the nuclear torpedo to be armed.[56] Fortunately, according to this same crew member, the captain was talked down and admitted a humiliating defeat by surfacing.

American decision-makers who advocated invading Cuba did not know that the Soviets had deployed battlefield nuclear weapons to repel such an attack. While President Kennedy eventually decided on a naval blockade, he and almost all the other American decision-makers initially favored air strikes against the missiles, to be followed by an invasion.[57] None of these decision-makers knew that the Soviets had deployed nuclear-capable battlefield weapons and mating warheads on Cuba to deter and, if need be, to repel such an invasion.[58]

An October 28, 1962, a Top Secret memorandum for the secretary of defense from the Joint Chiefs of Staff concluded "that the only direct action which will surely eliminate the offensive weapons threat is air attack followed by invasion and is, in the long run, the best course of action."[59]

At the height of the crisis, an American U-2 strayed into Soviet airspace, creating a risk that nuclear air-to-air missiles would be used. On October 27, which became known as Black Saturday, a U-2 piloted by US Air Force Captain Chuck Maultsby[60] became lost on an intelligence-gathering mission over the Arctic and accidentally flew into Soviet airspace. MiG fighters tried to intercept Maultsby, while F-102s from Alaska were sent to protect him and escort him home. Because of the crisis, the F-102s' conventional air-to-air missiles had been replaced with nuclear-armed missiles. As noted by Stanford professor Scott Sagan, "the only nuclear weapons control mechanism remaining was the discipline of the individual pilots in the single seat interceptors. The critical decision about whether to use a nuclear weapon was now effectively in the hands of a pilot flying over Alaska."[61] Fortunately, the MiGs never reached Maultsby's U-2 or the nuclear-armed F102s.

An American U-2 was shot down over Cuba. Approximately one hour after Maultsby became lost and penetrated Soviet airspace, US Air Force Major Rudolf Anderson was shot down and killed by a Soviet surface-to-

air (SAM) missile while on a U-2 reconnaissance mission over Cuba. Four days earlier, JFK and his advisors had agreed that, if a SAM downed a U-2, the offending SAM site would be attacked.[62] But, when Major Anderson's U-2 was shot down, Kennedy had second thoughts, possibly because our killing Soviet personnel would put Khrushchev in the same escalatory bind in which Kennedy now found himself. Kennedy's reversal infuriated the military.[63]

The United States gave numerous indications that it intended to invade Cuba, causing Castro to tell Khrushchev to launch his missiles preemptively. The goal of a two-week American military exercise involving tens of thousands of military personnel, which started the day before the crisis erupted, was to execute an amphibious assault on a Puerto Rican island whose fictitious dictator was named Ortsac—Castro spelled backward.[64] In the months before the missiles were discovered, representatives, senators and the American media excoriated Kennedy for allowing the Soviet military buildup in Cuba, many demanding an invasion. The September 21 cover story in *Time* magazine argued, "The only possibility that promises a quick end to Castro . . . is a direct U.S. invasion of Cuba."[65] Castro became convinced that an invasion was imminent and, knowing of the Soviet battlefield nuclear weapons, he believed that a nuclear war would follow. He therefore suggested that Khrushchev "should launch a preemptive [nuclear] strike against United States."[66]

Seven months before the crisis, the Joint Chiefs of Staff (JCS) suggested blowing up an American ship in Guantanamo Bay and blaming Cuba to create support for an invasion. In March 1962, the chairman of the Joint Chiefs, Army General Louis Lemnitzer, sent Defense Secretary Robert McNamara a list of proposals known as Operation Northwoods, outlining ways to generate American public support for an invasion of Cuba. One suggestion was to "blow up a US ship in Guantanamo Bay and blame Cuba." Another read: "We could foster attempts on lives of Cuban refugees in the United States even to the extent of wounding [them]."[67]

On the first day of the crisis, at a meeting of President Kennedy and his key advisors, Attorney General Robert F. Kennedy similarly suggested: "We should also think of whether there is some other way we can get involved in this through Guantanamo Bay . . . you know, sink the *Maine* again or something."[68] RFK had made similar proposals at least twice before, on April 19, 1961, and August 21, 1962.[69]

The Joint Chiefs advocated similar proposals during the crisis. In an October 28, 1962, Top Secret memorandum[70] for the secretary of defense, they suggested "a series of provocative actions," including having US destroyers "inadvertently" violate Cuba's three-mile limit; "harass Cuban shipping;" and "incite riots on Cuban side of Guantanamo fence . . . [to] justify our providing military assistance to laborers." The memorandum stated that "the purpose of these actions is to induce the Cubans to fire on US elements, or make some mistake which would make politically acceptable and justify subsequent US air strikes or invasion."

While the above incidents might be hard to comprehend as serious proposals from today's perspective, they fit the pattern of that time, including covert sabotage operations against Cuban targets and assassination attempts on Castro's life. These incidents help explain why Castro and Khrushchev were so fearful of an American invasion.

President Kennedy took actions that extended the crisis for months after the public thought it had ended. After Khrushchev agreed to remove his missiles from Cuba, Kennedy seized on a wording ambiguity[71] to expand his list of demands beyond removal of just the missiles. This kept the crisis simmering out of public view.[72]

When a minor part of the deal fell apart, Kennedy also questioned whether our pledge not to invade Cuba was still effective, even though that commitment was comparable in importance to the Soviets' promise to remove their missiles.[73] American invasion plans peaked on November 15, three weeks after the public thought the crisis had ended,[74] and plans for assassination attempts on Castro's life continued until at least 1963.[75]

In the month before the crisis erupted, Kennedy and Khrushchev each drew lines in the sand that later boxed them in. Under pressure from Congress and the press over the Soviet buildup, on September 4, President Kennedy warned the Soviets that "the gravest issues would arise" if they introduced "offensive ground-to-ground missiles" into Cuba.[76] When the Cuban missiles were discovered in mid-October and nuclear war seemed imminent, Kennedy noted that "it doesn't make any difference if you get blown up by an ICBM flying from the Soviet Union or one from 90 miles away," and regretted his earlier ultimatum by stating, "Last month I should have said we don't care."[77]

On September 11, Moscow drew its own line in the sand when it warned that "one cannot now attack Cuba and expect the aggressor will be free

from punishment. If this attack is made, this will be the beginning of the unleashing of war."[78]

Predictions of disaster were ignored. In the spring of 1962, nuclear-armed American missiles became operational in Turkey, adding to Khrushchev's motivation to base similar Soviet weapons in Cuba.[79] A risk of this nature had been foreseen several years earlier by President Eisenhower, when the Turkish deployment was first being considered. Minutes of a 1959 meeting quote Eisenhower as seeing a parallel to a possible Soviet deployment in Cuba:

> If Mexico or Cuba had been penetrated by the Communists, and then began getting arms and missiles from [the Soviets], we would be bound to look on such developments with the gravest concern and in fact . . . it would be imperative for us [even] to take . . . offensive military action.[80]

Despite recognizing this danger, Eisenhower set in motion events that resulted in our missiles being deployed to Turkey.

Appendix B. Some Other Cold War Nuclear Risks

April 17–19, 1961, the Bay of Pigs invasion. Planning to overthrow Castro's regime started under the Eisenhower administration, was inherited by Kennedy, and came to a head in this failed invasion attempt. It and subsequent US covert actions aimed at regime change in Cuba played a role in Khrushchev's offering, and Castro's accepting, Soviet nuclear weapons to prevent a second invasion attempt. America's feeling of humiliation contributed to public support for a second invasion, but this time with a large American force.

October 22–28, 1961, Berlin crisis. West Berlin was a symbol of freedom to the United States and a thorn in the side of Moscow. A 2009 US Army history notes that, in October, "tensions . . . nearly escalated to the point of war,"[81] with Soviet and American tanks facing off at Checkpoint Charlie. In addition to other risks associated with this standoff, each of the tank commanders—both Soviet and American—had the ability, though not the authority, to start a firefight that would have increased the risk of war.

November 22, 1963, JFK's assassination. According to a National Security Archive publication, "fears that Moscow might have masterminded the president's killing rose sharply when the CIA was unable to locate

Soviet Premier Nikita Khrushchev for 24–48 hours afterwards."[82] That same publication quotes CIA officials as fearing that Khrushchev might be "either hunkering down for an American reprisal, or possibly preparing to strike the United States."

June 5–10, 1967, Six-Day War. This Mideast war engendered many risks, including an allegation by former secretary of defense Robert McNamara that the United States and the Soviet Union "damn near had war" as a result of the Soviets misinterpreting actions by a US aircraft carrier.[83]

October 1969, Nixon's "madman nuclear alert." As related by Professor Scott Sagan and Professor Jeremi Suri, President Nixon ordered a military alert for the ostensible purpose of responding "to possible confrontation by the Soviet Union."[84] But, it was a ruse designed to try and end the Vietnam War on favorable terms. Nixon's chief of staff H. R. Haldeman recounts Nixon telling him:

> I call it the Madman Theory, Bob. I want the North Vietnamese to believe that I've reached the point that I might do *anything* to stop the war. We'll just slip the word to them that "for God's sake, you know Nixon is obsessed about Communism. We can't restrain him when he is angry—and he has his hand on the nuclear button"—and Ho Chi Minh himself will be in Paris in two days begging for peace.[85]

Despite efforts by Nixon and Kissinger to minimize the chances of an accidental escalation, Sagan and Suri detail a number of dangerous military activities that occurred.

October 6–25, 1973, Yom Kippur War. As with the 1967 Six-Day War, there were a number of nuclear risks in 1973. As one example, on October 24, the Israeli army was poised to capture the 22,000-man Egyptian Third Army and its large cache of Soviet military equipment. Soviet general secretary Leonid Brezhnev sent a letter[86] to President Nixon suggesting that a joint US–Soviet force be sent to enforce UN Security Council Resolution 338[87] that called for a cease-fire, and that had been supported by both the United States and the USSR.

On receipt of Brezhnev's letter, a National Security Council meeting was immediately called. Probably seeing a joint Soviet–American military effort as infeasible, the meeting focused on Brezhnev's warning "that if you find it impossible to act jointly with us in this matter, we should be faced with the necessity urgently to consider the question of taking appropriate steps

unilaterally." In response, the council ordered US forces to DEFCON 3, an action that the Soviets saw as "irresponsible."[88]

The crisis ended the next day when Kissinger successfully applied strong pressure on Israel not to capture or destroy the Egyptian Third Army.[89]

November 9, 1979, false alarm due to training tape. According to former secretary of defense Robert Gates:

> [President Carter's National Security Advisor Zbigniew] Brzezinski was awakened at three in the morning by [General William] Odom, who told him that some 220 Soviet missiles had been launched against the United States. . . . Brzezinski was convinced we had to hit back and told Odom to confirm that the Strategic Air Command was launching its planes. When Odom called back, he reported that he had further confirmation, but that 2,200 missiles had been launched—it was an all-out attack. One minute before Brzezinski intended to telephone the President, Odom called a third time to say that other warning systems were not reporting Soviet launches. Sitting alone in the middle of the night, Brzezinski had not awakened his wife, reckoning that everyone would be dead in half an hour. It had been a false alarm. Someone had mistakenly put military exercise tapes into the computer system.[90]

December 25, 1979, Soviet invasion of Afghanistan. This invasion was seen ominously in the United States, with *Time* columnist Strobe Talbott referring to it as "the Soviet army's blitz against Afghanistan"[91] and warning that "the Soviet jackboot was now firmly planted on a stepping stone to possible control over much of the world's oil supplies."[92]

The day after the invasion, President Carter's national security advisor, Zbigniew Brzezinski, stated in a memo to the president, "the Soviet intervention in Afghanistan poses for us an extremely grave challenge."[93]

The British ambassador to Moscow from 1988 to 1992, Sir Roderic Braithwaite, saw the invasion very differently:

> The Russians did not invade Afghanistan in order to incorporate it into the Soviet Union, or to use it as a base to threaten the West's oil supplies in the Gulf, or to build a warm water port on the Indian Ocean. They went in to sort out a small, fractured and murderous clique of Afghan

> Communists who had overthrown the previous government in a bloody coup and provoked chaos and widespread armed resistance on the Soviet Union's vulnerable Southern border.[94]

Whoever is right, and there may well be some truth in both perspectives, the Soviet invasion produced a crisis. President Carter embargoed US shipments of grain to the Soviet Union and boycotted the 1980 Moscow Summer Olympics. Some of the rebels whom we aided added risk by crossing from Afghanistan *into the Soviet Union* to carry out acts of sabotage and propagandize the local Muslim population.[95]

President Reagan even referred to them as freedom fighters: "To watch the courageous Afghan freedom fighters battle modern arsenals with simple hand-held weapons is an inspiration to those who love freedom."[96] The reality was very different, and our aiding those rebels helped lay the foundation for 9/11 since many of the Afghan rebels, including Osama bin Ladin, later turned against the West. Thus, the nuclear risk attributable to 9/11 and subsequent events is traceable in part to these much earlier events.

Pakistan's nuclear arsenal is another risk that can be traced in part to the Soviet invasion of Afghanistan. Brzezinski's memo cited above went on to say, "we must both reassure Pakistan and encourage it to help the rebels. This will require a review of our policy toward Pakistan, more guarantees to it, more arms aid, and, alas, *a decision that our security policy toward Pakistan cannot be dictated by our nonproliferation policy*" (emphasis added; see page 3, item B, of the memo).[97]

June 20, 1983, Proud Prophet war game escalated uncontrollably. The outcome of war games is usually classified, so it was unusual—and helpful in assessing risk—when Professor Paul Bracken was able to detail the results of this 1983 war game in which he was involved:

> This wasn't any ordinary war game. . . . Proud Prophet [used] actual decision makers, the secretary of defense and the chairman of the Joint Chiefs of Staff. To make it as realistic as possible, actual top-secret U.S. war plans were incorporated into the game. . . .
>
> American limited nuclear strikes were used in the game. The idea behind these was that once the Soviet leaders saw that the West would go nuclear they would come to their senses and accept a cease-fire. … But that's not what happened. The

> Soviet Union . . . responded with an enormous nuclear salvo at the United States. The United States retaliated in kind. . . .
>
> A half billion human beings were killed in the initial exchanges and at least that many more would have died from radiation and starvation. . . . This game went nuclear big time, not because Secretary Weinberger and the chairman of the Joint Chiefs were crazy but because they faithfully implemented the prevailing U.S. strategy, a strategy that few had seriously thought about outside of the confines of a tight little circle of specialists. I have played other games that erupted, and they shared this common feature, too. A small, insulated group of people, convinced that they are right, plows ahead into a crisis they haven't anticipated or thought about, one that they are completely unprepared to handle. The result is disaster.[98]

We know that some later war games ended similarly as detailed in appendix C's entries "2004, war games escalated uncontrollably" and "2018, war games escalated out of control."

September 1, 1983, South Korean airliner shot down by the Soviets. Korean Air Lines (KAL) flight 007 was shot down by a Soviet SU-15 interceptor over Sakhalin Island, killing all 269 aboard, including Georgia congressman Lawrence McDonald. The airliner went off course and strayed into Soviet airspace over the Kamchatka Peninsula, where a Soviet missile test was scheduled for that day. The plane left Soviet airspace, but reentered a second time over Sakhalin Island, where it was shot down. President Reagan characterized this tragedy as a "crime against humanity [that] must never be forgotten. . . . He went on to say, "It was an act of barbarism, born of a society which wantonly disregards individual rights and the value of human life and seeks constantly to expand and dominate other nations."[99]

This tragedy occurred during a time of heightened tensions between the United States and the USSR, and it created additional risk.

Five years later, on July 3, 1988, the USS *Vincennes* shot down Iran Air 655, killing all 290 people on board. The next day, when President Reagan was asked about a possible comparison between that tragedy and KAL 007, he replied that "there was a great difference. . . . There's no comparison."[100] Later evidence shows that the president was relying on

incorrect information.[101] Analysis, therefore, might uncover additional risks that were present in the KAL 007 tragedy owing to misperceptions.

November 1983, Able Archer exercise. I include this incident even though there is disagreement surrounding the level of risk that it entailed. In fact, I felt it important to include because of those disagreements, so that any readers who are familiar with only one perspective will become aware of the other as well.

On the one hand, former secretary of defense Robert Gates has characterized Able Archer as "one of the potentially most dangerous episodes of the Cold War."[102] On the other hand, Harvard professor Mark Kramer dismisses such assertions as "a mere myth."[103]

Whichever side is right, and again there may well be elements of truth in both perspectives, relations between the superpowers were very poor during the early 1980s, heightening the risk of war. Able Archer occurred just two months after KAL 007 had been shot down and less than eight months after President Ronald Reagan's "Star Wars" speech that greatly alarmed the Soviets.

Gates wrote that Soviet leader Yuri Andropov developed a "seeming fixation on the possibility that the United States was planning a nuclear strike against the Soviet Union" and "that such a strike could occur at any time, for example, under cover of an apparently routine military exercise."[104] Able Archer was just such an exercise, simulating the coordinated release of all of NATO's nuclear weapons.

Appendix C. Some Post–Cold War Nuclear Risks

By enumerating a number of post–Cold War nuclear risks, this appendix questions the belief that the nuclear threat ended with the fall of the Berlin Wall. It is worth noting that many of these events occurred during the 1990s, a decade that is usually thought of as having little nuclear risk.

1991 Soviet coup attempt. In August 1991 a coup attempt was mounted against Soviet president Mikhail Gorbachev. While the coup failed, the chaos and uncertainty surrounding control of the Soviet nuclear arsenal[105] increased nuclear risk.

1993 Russian constitutional crisis. This was a small civil war between parties loyal to Yeltsin and others loyal to the Russian parliament. The Russian parliament building was shelled, and there were over 600 casualties,

including 187 dead. The first twenty seconds of a Radio Free Europe/Radio Liberty video[106] graphically depicts the chaos.

1995–1996, Third Taiwan Straits crisis. Taiwan's declaring its independence would be so intolerable to the People's Republic of China (PRC) that it could precipitate a war that could drag in the United States. In 1995, over the strenuous objections of the PRC, Taiwan's pro-independence president, Lee Teng-hui, was granted a visa to visit the United States. The PRC was incensed and conducted missile tests to express its anger. A *New York Times* book review starts off, "The possibility of a shooting war between the United States and the People's Republic of China was suddenly made real to Bill Clinton in early March 1996."[107]

This crisis has repercussions to the present day. China's current aggressive stance is partly a response to the humiliation[108] that it felt when Clinton, in a show of military force, sent two aircraft carrier battle groups to the area in March 1996.

The Taiwanese independence movement is still active,[109] and in a 2018 statement Lieutenant General Ben Hodges (US Army, Retired) noted that he thinks that "in 15 years—it's not inevitable, but it is a very strong likelihood—that we will be at war with China."[110]

1999–present, NATO expansion. Before the breakup of the Soviet Union, Russia had a large buffer between it and NATO—a buffer that it felt it needed in light of Hitler's devastating 1941 invasion. That buffer shrank considerably in 1999 when Poland, Hungary, and the Czech Republic were admitted to NATO, and disappeared in 2004 when Estonia, Lithuania, and Latvia became members.

Russia feels not only threatened but also cheated because, in a February 9, 1990, meeting, Soviet president Mikhail Gorbachev was assured by US secretary of state James Baker that, if Gorbachev allowed the reunification of Germany within NATO, "NATO's jurisdiction would not shift one inch eastward."[111] Even though this was not a legally binding guarantee and Gorbachev later took actions[112] that raised questions about whether Baker's assurance still applied, Russia feels cheated, thereby creating nuclear risk.

A 2019 RadioFreeEurope/RadioLiberty dispatch quoted NATO secretary-general Jens Stoltenberg as saying that it was "clearly stated that Georgia will become a member of NATO," even though that article describes "the Kremlin's fierce opposition" to such a move.[113]

1999 Pristina Airport crisis. In June 1999, as NATO peacekeeping troops moved into Kosovo, American general Wesley Clark ordered British lieutenant general Sir Mike Jackson to take actions that Jackson feared could lead to combat between NATO and Russian troops at the Pristina Airport. Clark's and Jackson's accounts agree that a heated argument ended with Jackson telling Clark, "Sir, I'm not starting World War III for you."[114]

Clark states that he gave that order to Jackson because, "I didn't want to face the issue of shooting down Russian transport aircraft if they forced their way through NATO airspace. . . . [and] I expected that when NATO met the Russians with determination and a show of strength, the Russians would back down."[115] Clark was probably right about the Russians backing down, but to assess the risk we would have to quantify *probably*, and then analyze what might happen if the Russians' response differed from the one Clark expected.

2002–present, North Korean nuclear crisis. North Korea and the United States came close[116] to fighting a second Korean War in June 1994, over the North's nuclear program. Intervention by former president Jimmy Carter resulted in the 1994 Agreed Framework[117] that averted war and was in place until 2002. North Korea did its first nuclear test four years later in 2006, in 2018 was estimated to have a nuclear arsenal of ten to twenty warheads,[118] and in 2021 was estimated to have enough fissile material for forty to fifty warheads.[119]

Relations have been extremely tense in recent years, including White House pressure early in 2018 to develop plans for attacking a North Korean missile on its launchpad.[120] Should the United States and North Korea go to war, there is some risk of losing one or more American cities, either by a missile attack or a smuggled weapon. If China became involved in the war, our risk would increase markedly.

Fortunately, President Trump's June 2018 Singapore summit with Kim Jong-un resulted in a halt to North Korea's nuclear and long-range missile tests, something that is still true as of October 2021. However, a lack of sanctions relief and other American policies may contribute to a resumption of North Korean tests.

2004, war games escalated uncontrollably. Echoing appendix B's entry about the 1983 Proud Prophet war game escalating uncontrollably, a 2008 RAND Project Air Force report noted:

> In 2004, Director of Air Force Strategic Planning Major General Ronald J. Bath sponsored a war game in which uncontrolled escalation occurred, surprising players and controllers alike. . . . this experience was just one in a series of escalatory events occurring in major war games over the past several years.[121]

See also this appendix's entry "2018, war games escalated out of control."

2008 Cuban bomber mini-crisis. In July 2008, elements within the Russian military threatened to deploy nuclear-capable bombers to Cuba.[122] This threat was in response to the United States planning an eastern European missile defense system that Russia felt threatened its nuclear deterrent.[123]

In his confirmation hearings as US Air Force chief of staff, General Norton Schwartz testified that this would cross "a red line."[124] Fortunately, other elements in Russia prevailed and the threat did not materialize. If the Russians had based nuclear-capable bombers on Cuba, a crisis comparable to 1962's might have resulted.

2008 Georgian War. In August 2008, Russia invaded Georgia after the latter tried to reclaim its breakaway region of South Ossetia, resulting in attacks on a Russian peacekeeping force.[125] The danger was compounded because most Americans were unaware that an EU investigation concluded that Georgia fired the first shots, "which was followed by a disproportionate response of Russia."[126] Reflecting the mood of many Americans at the time, vice presidential candidate Sarah Palin said that the United States should be ready to go to war with Russia if the conflict flared up again.[127]

2012–present, Senkaku-Diaoyu Islands. An ongoing dispute between Japan and China over the Senkaku-Diaoyu Islands heated up in 2012[128] when the governor of Tokyo took actions that riled China. According to a 2015 *New York Times* article, "At least once every day, Japanese F-15 fighter jets roar down the runway, scrambling to intercept foreign aircraft, mostly from China,"[129] and the risk is ongoing.[130]

This dispute puts the ability to start a firefight in the hands of individual pilots and ship captains who often engage in aerial and naval games of chicken. Should war break out between China and Japan, the 1960 US–Japan Security Treaty commits us to come to Japan's aid.

2014–present, Ukrainian crisis. The Ukrainian crisis coupled with Russia's conventional inferiority has led Vladimir Putin to make nuclear

threats.[131] The risk of further escalation is increased because the United States and Russia each see the other party as solely to blame.

2015, Turks shot down a Russian jet. The Syrian civil war could have produced a major crisis in November 2015, when Turkish F-16's shot down[132] a Russian SU-24 near Turkey's border with Syria, and Turkmen Syrian rebels killed the pilot. If Russia had retaliated against Turkey, which fortunately it did not, Turkey could have cited our NATO commitment to treat an attack on Turkey the same as if we had been attacked.

This event would be even more dangerous if allegations prove true that the Turks ambushed the Russian jet. Pierre Sprey,[133] a longtime defense analyst and a member of the team that developed the F-16, is among those making such accusations.[134]

2018, war games escalated out of control. At a July 2018 conference, US Air Force general John Hyten, then USSTRATCOM's commander, described a war game that ended "bad." He clarified that, "bad meaning it ends with global nuclear war."[135] This bears a dangerous resemblance to earlier war games escalating out of control as detailed in appendix B's entry "June 20, 1983, Proud Prophet war game escalated uncontrollably" and this appendix's "2004, war games escalated uncontrollably."

January 8, 2021, chair of the JCS took action to prevent a possible rogue nuclear attack by Trump. Woodward and Costa's book, *Peril*, states that two days after the January 6, 2021, attempt by supporters of President Trump to prevent congressional certification of the election, the chairman of the Joint Chiefs, General Mark Milley, spent an hour and a half trying to reassure his Chinese counterpart, General Li Zuocheng, that Chinese fears of a US attack were unfounded.[136] Woodward and Costa also state:

> Milley had misled General Li when he claimed that the United States was "100 percent steady" and the January 6 riot was just an example of a "sloppy" democracy. To the contrary, Milley believed January 6 was a planned, coordinated, synchronized attack on the very heart of American democracy, designed to overthrow the government to prevent the constitutional certification of a legitimate election won by Joe Biden. It was indeed a coup attempt and nothing less than "treason," he said, and Trump might still be looking for what Milley called a "Reichstag moment."[137]

They go on to state that:

> [Milley] immediately summoned senior officers from the National Military Command Center (NMCC) . . . [to go over] the procedures and process for launching nuclear weapons. Only the president could give the order, he said.
>
> But then he made clear that he, the chairman of the JCS, must be directly involved. . . . [He told them that if there was] Any doubt, any irregularity, first, call me directly and immediately. Do not act until you do.[138]

A September 16, 2021, *Washington Post* article states that, "Col. Dave Butler, a spokesman for Milley, issued a statement Wednesday largely confirming what's disclosed in the book."[139]

Notes

1. George Apostolakis, "How Useful Is Quantitative Risk Assessment?," *Risk Analysis* 24, no. 3 (2004): 515–520, https://doi.org/10.1111/j.0272-4332.2004.00455.x.
2. David James Caswell, "Analysis of National Strategies for Combating the Proliferation of Nuclear Weapons" (PhD. diss., Stanford University, 2010), https://www.proquest.com/dissertations-theses/analysis-national-strategies-combating/docview/2449822805/se-2?accountid=11752.
3. Matthew Bunn, "Reducing the Greatest Risks of Nuclear Theft & Terrorism," *Daedalus* 138, no. 4 (2009): 112–123, https://www.amacad.org/publication/reducing-greatest-risks-nuclear-theft-terrorism.
4. Martin E. Hellman, "Risk Analysis of Nuclear Deterrence," *The Bent of Tau Beta Pi* 99, no. 2 (2008): 14–22, https://ee.stanford.edu/~hellman/publications/74.pdf; and Seth D. Baum, Robert de Neufville, and Anthony M. Barrett, "A Model for the Probability of Nuclear War" (working paper 18-1, Global Catastrophic Risk Institute, 2018), http://gcrinstitute.org/papers/042_nuclear-probability.pdf.
5. Transcript of *The Fog of War: Eleven Lessons from the Life of Robert S. McNamara*, directed by Errol Morris (Sony Pictures Classics, 2003), http://www.errolmorris.com/film/fow_transcript.html.
6. Melanie Kirkpatrick, "Why We Don't Want a Nuclear-Free World," *Wall Street Journal*, July 13, 2009, https://www.wsj.com/articles/SB124726489588925407.
7. Federation of American Scientists, "Status of World Nuclear Forces," lasted updates October 7, 2021, https://fas.org/issues/nuclear-weapons/status-world-nuclear-forces/.
8. Theodore C. Sorensen, *Kennedy* (New York: Harper & Row, 1965), 705.

9. Don Phillips," With One Crash, Concorde Ranks Last in Safety," *Washington Post*, July 30, 2000, https://www.washingtonpost.com/archive/politics/2000/07/30/with-one-crash-concorde-ranks-last-in-safety/39f473a9-0609-4520-adc7-6bab42cc0299/. After the fatal Concorde crash, its hull loss per million flights was more than ten times that of the 737 fleet. The cited article notes that, "because there are so few Concordes and because each flies fewer than 1,000 hours a year, the Tuesday crash boosted the hull loss per million flights figure to 11.64." It goes on to say that "the Boeing 737, by contrast, has had 77 crashes but still has an excellent safety record, ranging from 1.25 per million to .43 to zero hull losses for different versions of the plane, because it is the world's most common airliner. The huge 737 fleet flies more hours in one week than the Concordes have flown in their entire existence."
10. BEA (Bureau Enquêtes-Accidents), "Accident on 25 July 2000 at La Patte d'Oie in Gonesse (95) to the Concorde registered F-BTSC operated by Air France," January 2002, https://www.bea.aero/uploads/tx_elydbrapports/f-sc000725a.pdf. This report is the official accident report. Page 93 states, "there are fifty-seven cases of tyre bursts/deflations . . . of which six led to penetration of the tanks," which is more than 10 percent. Page 146 states: "As of 25 July 2000, it appears that the rate of tyre deflation/destruction on Concorde was on average one occurrence per 1,500 cycles (or 4,000 flying hours). This rate fell over time and the proportion was no more than one occurrence per 3,000 cycles (or 8,000 flying hours) between 1995 and 2000. By way of comparison, on long-haul aircraft, such as the Airbus A340, this rate is of the order of one occurrence per 100,000 cycles." Those two numbers produce tire failure rates that are sixty-seven and thirty-three times greater than that of the A340.
11. Joseph Harriss, "The Concorde Redemption," *Air & Space Magazine*, September 2001, https://www.airspacemag.com/flight-today/the-concorde-redemption-2394800/.
12. If each officer had an independent 50 percent probability of deciding to use the nuclear torpedo, the probability that two of them would agree to use it would be 25 percent. Some accounts maintain that three officers were involved in the decision and two of the three wanted to use the weapon, which, if true, might result in a probability estimate of $0.67^3 = 30\%$ for use of the weapon. These numbers assume that the weapon would be used only if all the officers involved agreed to its use, and that assumption needs to be carefully examined.
13. The Soviets had deployed nuclear-capable battlefield weapons on Cuba. Evidence indicates that the nuclear warheads were not mated to the weapons, but were readily accessible.
14. Mark Kramer, "Tactical Nuclear Weapons, Soviet Command Authority, and the Cuban Missile Crisis: A Note," *International History Review* 15, no. 4 (1993): 740–751, https://doi.org/10.1080/07075332.1993.9640662.

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18. John F. Kennedy, "Cuban missile crisis address to the nation," October 22, 1962, American Rhetoric, transcript and MP3 audio, https://www.americanrhetoric.com/speeches/jfkcubanmissilecrisis.html.

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33. Robert Dallek, *An Unfinished Life: John F. Kennedy, 1917–1963* (New York: Little Brown & Co., 2003), 398–399, 581–582. These pages indicate that Kennedy may even have been on amphetamines *during* the Cuban crisis.
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36. Tony Blair, *A Journey: My Political Life* (New York: Knopf, 2010), 613.
37. Paul Thompson, "Drunk Boris Yeltsin Was Found Outside White House in Underpants Trying to Hail Cab 'Because He Wanted Some Pizza,'" Daily Mail, September 22, 2009, http://www.dailymail.co.uk/news/article-1215101/Drunk-Boris-Yeltsin-outside-White-House-underpants-trying-hail-cab-wanted-pizza.html.
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39. Scott D. Sagan, *The Limits of Safety: Organizations, Accidents, and Nuclear Weapons* (Princeton, NJ: Princeton University Press, 1993), 136–137.
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41. Former secretary of defense William Perry, who holds a doctorate in mathematics, agrees with that estimate and has given me permission to state that publicly.
42. A former high-ranking defense official who served in the Trump administration told me that he would not rule out 10 percent per year. While he may have been thinking only in terms of the risk he perceived during the Trump administration, 10 percent per year cannot be ruled out based solely on the fact that sixty-six years of nuclear deterrence has not resulted in a nuclear war. There would be roughly one chance in a thousand of our being that lucky, which would be a rare, but not a miraculous, event. And, at 3 percent per year, which would be the lower end of his 10 percent per year order-of-magnitude estimate, there would be a 13 percent chance of no nuclear wars occurring in the last sixty-six years.
43. Although the risk will change significantly over such a long time period, I am only trying to estimate the annualized risk over at most the next few decades.
44. Some might count other crises as comparable, or near comparable—for example the 1961 Berlin crisis.
45. Transcript of *The Fog of War*.
46. Hellman, "Risk Analysis of Nuclear Deterrence."
47. Apostolakis, "How Useful Is Quantitative Risk Assessment?"
48. Martin Hellman, *Rethinking National Security* (Washington, DC: Federation of American Scientists, April 2019), https://ee.stanford.edu/~hellman/publications/78.pdf.
49. Albert Einstein, telegram to prominent Americans, May 24, 1946; published in the *New York Times* on May 25, 1946, with the headline "Scientist in Plea for $200,000 to Promote New Type of Essential Thinking."
50. Early in the crisis, President Kennedy formed a high-level executive committee to advise him. It is frequently abbreviated as ExComm.
51. James G. Blight and David A. Welch, *On the Brink: Americans and Soviets Reexamine the Cuban Missile Crisis* (New York: Hill and Wang, 1989), 72.
52. Thomas Blanton, "Annals of Blinksmanship," reproduced from *Wilson Quarterly*, summer 1997, in Laurence Chang and Peter Kornbluh, eds., *The Cuban Missile Crisis, 1962* (Washington, DC: National Security Archive, GWU, 2002), https://nsarchive2.gwu.edu/nsa/cuba_mis_cri/annals.htm.
53. Sorensen, *Kennedy*, 705.
54. Robert S. McNamara, *Blundering Into Disaster* (New York: Pantheon Books, 1986), 11.
55. For an English translation of the crew member's recollection of the captain's wanting to use the nuclear torpedo, see William Burr and Thomas S. Blanton,

eds., "The Submarines of October: U.S. and Soviet Naval Encounters During the Cuban Missile Crisis," in *National Security Archive Electronic Briefing Book No.* 75 (Washington, DC: National Security Archive, GWU, October 31, 2012), https://nsarchive2.gwu.edu/NSAEBB/NSAEBB75/.

56. Burr and Blanton, "Submarines of October."

57. Sheldon M. Stern, *The Week the World Stood Still: Inside the Secret Cuban Missile Crisis* (Stanford: Stanford University Press, 2005), 40–41, 67–69, 87–90. Stern was the historian at the John F. Kennedy Presidential Library from 1977 to 1999 and is often regarded as the world's leading expert on deciphering the low-quality audio tapes JFK secretly made of many meetings during his presidency. Stern's book is derived from those tapes and can therefore be considered primary source material.

58. Aleksandr Fursenko and Timothy Naftali, *One Hell of a Gamble* (New York: W. W. Norton & Company, 1997), 212.

59. Secretaries to the Joint Chiefs of Staff, "Alternative Actions if Build-up in Cuba Continues Despite Russian Acceptance of the Quarantine (U)," in *The Nuclear Vault* (Washington DC: National Security Archive's Nuclear Documentation Project), http://www2.gwu.edu/~nsarchiv/nukevault/ebb457/doc%201A%20 10-28-62%20from%20Air%20Force%20files.pdf. The suspicions of the joint chiefs were not unwarranted since the Soviets earlier had lied about the presence of the missiles. However, unknown to the chiefs, the Soviet battlefield nuclear weapons increased the risk that their proposed solution would lead to nuclear war.

60. Some accounts refer to Maultsby as a major in the Air Force, while others call him a captain. I have used the latter since it comes from the usually reliable National Security Archive website. [See Michael Dobbs, "One Minute To Midnight: Kennedy, Khrushchev and Castro on the Brink of Nuclear War" (Washington DC: National Security Archive, GWU, June 11, 2008), https:// nsarchive2.gwu.edu/nsa/cuba_mis_cri/dobbs/maultsby.htm.] I suspect that the references to him as a major were written after he had attained that rank.

61. Sagan, *The Limits of Safety*, 136–137.

62. Sheldon Stern, on p. 30 of *The Cuban Missile Crisis in American Memory: Myths versus Reality* (Stanford: Stanford University Press, 2012), notes: "[JFK] rejected ExComm demands to implement his earlier decision to destroy the SAM site that had fired the fatal missile." As noted earlier, Stern is one of the top scholars on these matters. A slightly "noisy" transcript of the tapes appears in Naftali, May, and Zelikow, *Presidential Recordings,* vol. 3, 115. On p. 124 Kennedy refers to "this plan we just agreed on this morning" and the editors add in brackets "for retaliation if a U-2 were shot down."

63. See "Chronology 1, October 26, 1962 to November 15, 1962" in Chang and Kornbluh, *Cuban Missile Crisis*, p. 377, column 1, first paragraph of 4:00 P.M. entry, https://nsarchive2.gwu.edu/nsa/cuba_mis_cri/621026_621115%20 Chronology%201.pdf.

64. Chang and Kornbluh, *Cuban Missile Crisis*, 370-371. Note that the page numbers are for the 1998 edition, not an earlier one.

65. "The Presidency: The Durable Doctrine," *Time* 80, no. 12 (September 21, 1962): 17–20; Dallek, *An Unfinished Life*, 539–540; and Richard Ned Lebow and Janice Gross Stein, *We All Lost the Cold War* (Princeton, NJ: Princeton University Press, 1994), 20–21.

66. Jerold L. Schecter (trans. and ed.), with Vyacheslav V. Luchkov, *Khrushchev Remembers: The Glasnost Tapes* (Boston: Little Brown & Co., 1990), 176–177: "Castro suggested that in order to prevent our nuclear missiles from being destroyed, we should launch a preemptive strike against United States. He concluded that an [American] attack was unavoidable and that this attack had to be preempted. In other words, we needed to immediately deliver a nuclear missile strike against the United States." After being removed from office, Khrushchev put these memoirs on tape and smuggled them out of the Soviet Union. This is a translation of those tapes. Their authenticity was initially questioned, but after censorship was lifted, Khrushchev's son Sergei vouched for their authenticity.

67. "Memorandum for the Secretary of Defense: Justification for US Military Intervention in Cuba (TS)," March 13, 1962, posted on the National Security Archive website, https://nsarchive2.gwu.edu/news/20010430/northwoods.pdf. This is a copy of the originally Top Secret document, signed by General L. L. Lemnitzer, chairman of the Joint Chiefs of Staff, clearly showing the authenticity of these otherwise hard-to-believe facts. The quotes used in this chapter are in "Annex to Appendix to Enclosure A: Pretexts to Justify US Military Intervention in Cuba." They are easier to find in a searchable version of the document on Cryptome's website, http://cryptome.org/jcs-corrupt.htm.

68. Naftali, May, and Zelikow, *Presidential Recordings*, vol. 2, 452; and Stern, *The Week the World Stood Still*, 50.

69. Stephen G. Rabe, *The Most Dangerous Area in the World: John F. Kennedy Confronts Communist Revolution in Latin America* (Chapel Hill: University of North Carolina Press, 1999), 207n19.

70. Secretaries to the Joint Chiefs of Staff, "Alternative Actions if Build-up in Cuba Continues."

71. Instead of promising to remove the missiles, Khrushchev said he would remove "the arms which you described as offensive" [Edward C. Keefer, Charles S. Sampson, Louis J. Smith, and David S. Patterson, eds., *Foreign Relations of the United States, 1961–1963, Volume XI, Cuban Missile Crisis and Aftermath* (Washington, DC: US Department of State, 1996), https://history.state.gov/historicaldocuments/frus1961-63v11.] Khrushchev probably used these words to drive home the point that he regarded the missiles as defensive, intended not to attack the United States but to prevent a second American invasion of Cuba. But Kennedy seized on this wording ambiguity to demand the removal of a number of additional weapons systems that he thought might be regarded as offensive.

72. Chang and Kornbluh, *Cuban Missile Crisis*, 394, 396–398. On November 5, 1962, Khrushchev warned Kennedy that his "additional demands . . . [risk bringing] our relations back again into a heated state in which they were but several days ago."
73. Lebow and Stein, *We All Lost the Cold War*, 345.
74. David G. Coleman, "The Missiles of November, December, January, February . . . : The Problem of Acceptable Risk in the Cuban Missile Crisis Settlement," *Journal of Cold War Studies* 9, no. 3 (2007): 5–48, https://doi.org/10.1162/jcws.2007.9.3.5.
75. US Senate Report No. 94-465, *Alleged Assassination Plots Involving Foreign Leaders: An Interim Report of the Select Committee to Study Governmental Operations with respect to Intelligence Activities* (Washington, DC: US Government Printing Office, November 20, 1975), 85.
76. Chang and Kornbluh, *Cuban Missile Crisis*, 367.
77. Naftali, May, and Zelikow, *Presidential Recordings*, 441, 433.
78. Richard K. Betts, *Nuclear Blackmail and Nuclear Balance* (Washington, DC: Brookings Institution, 1987), 112.
79. Fedor Burlatsky, *Khrushchev and the First Russian Spring* (New York: Charles Scribners Sons, 1991), 171.
80. Barton J. Bernstein, "Reconsidering the Missile Crisis: Dealing with the Problem of the American Jupiters in Turkey," 55–129, in James A. Nathan, ed., *The Cuban Missile Crisis Revisited* (New York: St. Martin's Press, 1992). The Eisenhower quote is on p. 58.
81. Melancon, "Tensions Ran High at Checkpoint Charlie."
82. Jeffrey T. Richelson, ed., *National Security Archive Electronic Briefing Book No. 493* (Washington, DC: National Security Archive, GWU, November 20, 2014; originally posted June 4, 2013), https://nsarchive2.gwu.edu/NSAEBB/NSAEBB493/.
83. "McNamara Says U.S. Russia Close to War in 1967," *Spokane Chronicle*, September 15, 1983, http://news.google.com/newspapers?nid=1345&dat=19830915&id=61dOAAAAIBAJ&sjid=oPkDAAAAIBAJ&pg=3052,2764299.
84. Scott D. Sagan and Jeremi Suri, "The Madman Nuclear Alert Secrecy, Signaling, and Safety in October 1969," *International Security* 27, no. 4 (2003): 150–183, https://fsi-live.s3.us-west-1.amazonaws.com/s3fs-public/sagan_is_spr03.pdf.
85. H. R. Haldeman with Joseph DiMona, *The Ends of Power* (New York: Times Books, 1978), 83. Emphasis is in the original.
86. Douglas E. Selvage, Melissa Jane Taylor, and Edward C. Keefer, eds., "Letter from Soviet General Secretary Brezhnev to President Nixon," Document 146 in *Foreign Relations of the United States, 1969–1976, Volume XV, Soviet Union, June 1972–August 1974* (Washington, DC: Office of the Historian, 2011), https://history.state.gov/historicaldocuments/frus1969-76v15/d146.

87. UN Security Council, Resolution 338, Cease-Fire in the Middle East, October 22, 1973, https://peacemaker.un.org/sites/peacemaker.un.org/files/SCR338(1973).pdf.
88. Victor Israelian, "Nuclear Showdown as Nixon Slept," *Christian Science Monitor*, November 3, 1993, https://www.csmonitor.com/1993/1103/03191.html. The author of the cited article was a visiting professor at Pennsylvania State University when he wrote it, but in 1973, he worked at the Soviet Foreign Ministry and attended the Politburo meeting held in response to the United States moving to DEFCON 3. Israelian states, "Brezhnev expressed his indignation at the fact that the Americans had prepared their troops for military action. He and his colleagues characterized Nixon's decision as irresponsible."
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92. Talbott later served President Bill Clinton as deputy secretary of state. Talbott's appraisal is disputed by Lieutenant General (US Army, Retired) Karl Eikenberry, commander of the American-led coalition forces in Afghanistan from 2005 to 2007 and our ambassador to that country from 2009 to 2011. In a private communication Eikenberry told me, "Given the geographic constraints and geopolitical realities, it is not at all clear why Talbott thought this was so."
93. Brzezinski memo to Carter, "Reflections on Soviet Intervention in Afghanistan," December 26, 1979. This memo is included in a large collection of documents on The Wilson Center website (https://www.wilsoncenter.org/sites/default/files/media/documents/publication/AfghanistanV1_1978-1979.pdf), which fortunately appear to be in chronological order. This memo is on pp. 221–223 in my saved PDF version.
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99. Ronald Reagan, "Address to the Nation on the Soviet Attack on a Korean Civilian Airliner," September 5, 1983, Ronald Reagan Presidential Library and Museum, https://www.reaganlibrary.gov/research/speeches/90583a.
100. Federal News Service Archives, "Questions and Answers with President Reagan Regarding: USS Vincennes Shooting Down of Iranian Aircraft White House South Lawn 12:00 p.m. EDT Monday, July 4, 1988." The full text of Reagan's answer is only accessible through the Federal News Service, but a Washington Post article has some of President Reagan's answer; see Bill McAllister and Chris Adams, "Reagan Terms Incident 'Understandable Accident,'" *Washington Post*, July 5, 1988, https://www.washingtonpost.com/archive/politics/1988/07/05/reagan-terms-incident-understandable-accident/34df4e88-a753-44b5-8480-d84463520d57/.
101. As one example of incorrect information on which President Reagan relied, he said, "the plane [Iran Air 655] began lowering its altitude. And so I think it was an understandable accident to shoot and think that they were under attack from that plane" (McAllister and Adams, "Reagan Terms Incident 'Understandable Accident'"). While initial reports from the *Vincennes* incorrectly stated that Iran Air 655 was descending, in an August 19, 1988 press briefing, the chairman of the Joint Chiefs of Staff, Admiral William J. Crowe, corrected that error: "One of the [*Vincennes*] radar operators reported at 11 miles that the aircraft [Iran Air 655] was no longer climbing and that the altitude had commenced to decrease, a report that was not supported by a subsequent review of the Aegis tapes." Admiral Crowe's statement is document 259 on p. 458 of Nancy L. Golden and Sherrill Brown Wells, eds., *American Foreign Policy Current Documents, 1988* (Washington, DC: Department of State, 1989).
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105. Patrick E. Tyler, "After the Coup: Whose Finger Was on the Nuclear Trigger?," *New York Times*, August 24, 1991, https://www.nytimes.com/1991/08/24/world/after-the-coup-troubling-question-whose-finger-was-on-nuclear-trigger.html.
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