Since the dawn of the missile age, national security decisionmakers have sought to achieve a delicate balance between having a credible nuclear deterrent and ensuring the safety of nuclear weapons from unauthorized or accidental use. During the Cold War, when the United States and Russia perceived each other as a serious threat, the balance was weighted heavily toward the credibility of the deterrent, which was seen in terms of the ability to mount a massive and immediate nuclear retaliatory strike. Nevertheless, both countries took strong steps to reduce the risk of accidental or unauthorized use to the extent their nuclear postures would allow. Today, with the Cold War over, the ideological sources of the superpower conflict gone, and growing concern about the proliferation of weapons of mass destruction, a shift in the balance toward nuclear safety seems appropriate. The attacks of September 11, 2001, have underscored the need for this shift by pointing out the nature of the new nuclear threats that both the United States and Russia are likely to face. Moreover, Russia’s reaction to the attacks and its support for the war on terrorism have demonstrated both the broad improvements that have been made in the relationship between the two former Cold War antagonists and the feasibility of pursuing such a shift.

This report provides a roadmap for how this shift toward nuclear safety could take place. First, it examines the types of scenarios that might lead to unauthorized or accidental use of nuclear weapons. It then considers contributing factors (such as nuclear forces being kept on high alert and short decision times) that might lead to unauthorized or accidental use. Finally, it develops a set of options
CONCERNS ABOUT THE CURRENT SITUATION

Today’s concerns about nuclear safety are driven by several factors, including the nature of nuclear forces in both Russia and the United States, the status of Russia’s early-warning system, Russia’s economic difficulties, and several recent geopolitical trends.

Historical Asymmetries in Nuclear Forces

The characteristics of the U.S. and Russian nuclear forces, as they have evolved historically, have contributed to concerns about safety. Russia has traditionally been a land-based power, its nuclear forces heavily emphasizing intercontinental ballistic missiles (ICBMs) based in fixed silos hardened to withstand the effects of nuclear blasts. These missiles are reportedly ready to launch within a few minutes.

During the 1980s, the U.S. ICBM force was modernized to make it more accurate and survivable. The more significant development during that period, however, was the deployment of the Trident submarine, which represented a quantum leap in capability over previous generations of submarines. Its D5 missiles were as powerful and accurate as the best ICBMs, and it carried the W-88—the U.S. arsenal’s most powerful warhead—specifically designed to attack and destroy hardened Russian silos. But the Trident also gave the United States something else: the ability to attack those hardened targets quickly. Trident missiles can reach their targets in 10 to 15 minutes if they are launched close to Russia; an ICBM would take at least 30 minutes. The Trident’s combination of accuracy, lethality, and speed gave the United States the ability to deliver not only a retaliatory strike against Russian nuclear forces, but also a devastating first strike.

Russia responded to the increased accuracy of U.S. missiles during the 1980s by boosting the survivability of its ICBM force: it deployed some of its missiles on railcars and off-road trucks. When these mobile missiles were dispersed, they became almost as survivable as
submarines. (When clustered together in their garrisons, however, they are far more vulnerable than silo-based ICBMs.) Russia also had a sizable nuclear submarine fleet, a portion of which remained at sea and thus was highly survivable. Hence, despite U.S. technological advances during the 1980s, both countries retained large and highly survivable nuclear forces.

**Russia’s Declining Nuclear Forces**

The nuclear balance that had been established was fundamentally altered during the 1990s. While Russian forces deteriorated during and after the Cold War, making them increasingly vulnerable to a first strike, the United States retained much of its counterforce capabilities and deployed more Trident submarines with D5 missiles. This situation is likely to become more pronounced as Russian nuclear forces continue to decline in the first decade of the 21st century.

Today, Russia keeps all but a few of its mobile missiles in garrison, where they can be easily destroyed. Only one or two regiments (nine to 18 missiles) of its 360 road-mobile missiles are dispersed in the field at any one time. Its rail-based missiles are restricted to garrison by an order President Yeltsin issued in 1994. To boost the survivability of the mobile missiles it has in garrison, Russia could launch them through doors in the roofs of their garages before U.S. missiles arrive. As for Russia’s ballistic missile submarines, only a small fraction of them (perhaps one or two) are kept at sea. The rest are in port, where they are very vulnerable to attack—one nuclear warhead can destroy most of the submarines at a base. Probably to improve their survivability, Russia’s modern submarines are capable of quickly launching missiles from pier side that can hit targets in the United States. The final piece of Russia’s nuclear triad, its bomber force, has always been kept at relatively low levels of readiness and is rarely used today. In the event of a significant surprise attack, few bombers are likely to survive.

By contrast, the United States retains a large and survivable nuclear force divided roughly equally among ICBMs, bombers, and submarines. Like Russia, the United States keeps its ICBMs (all based in silos) at high levels of alert, ready to launch within a few minutes. During the Cold War, the United States also kept its bombers on high alert, a portion of them either airborne or ready to take to the air.
within a few minutes. But since 1991, U.S. bombers have been taken off alert. Although roughly half of them still retain their nuclear mission, they spend much of their time training for or participating in nonnuclear conflicts. U.S. ballistic missile submarines provide the most survivable force for the United States and cause the most discomfort for Russia. Unlike Russia, the United States keeps a large portion of its submarines—roughly 60 percent—at sea, even today. This provides a large survivable force capable of delivering at least 1,000 warheads to targets in Russia.

In sum, whereas the United States has a large, survivable nuclear force with some 1,300 warheads deployed at sea, Russia has very few nuclear forces that could survive a surprise U.S. attack—only about 20 to 200 warheads—if it rode out the attack before launching a retaliatory strike. Although we do not know for certain, Russia may regard this number of nuclear forces as insufficient to deter the United States in a crisis, and may therefore be relying on a launch-on-warning strategy—a standard approach for maximizing the size of a retaliatory attack—that would allow it to retaliate with some 3,000 warheads. The launch-on-warning approach to nuclear warfare is, however, very destabilizing, because its proper execution requires an extremely rapid reaction—probably within 10 or 15 minutes. This means there is very little time to verify that early-warning information from satellites and land-based radars is correct.

Russia’s Internal Problems

Three distinct internal problems, associated with Russia’s economic collapse during the 1990s, exacerbate the concerns inherent in a nuclear strategy based on retaining forces on high alert and launching on warning:

1. Russia’s social and economic problems have caused a substantial decline in its conventional force capabilities. Russia perceives its conventional forces as no match for the modern high-tech forces the West has demonstrated in the Persian Gulf, Kosovo, and Afghanistan. As a result, Russia increasingly relies on nuclear weapons to counter the West’s conventional superiority and to deter its southern neighbors.
2. Russia’s early-warning system has deteriorated significantly. Like the United States, Russia relies on a combination of satellite-based infrared sensors and ground-based radars to provide early warning of an attack and to reduce the chances of mistakes. Satellites provide the earliest warning of an attack; they detect the hot exhaust from missiles as they streak into space. Radars track the missiles as they get closer to the target. The problem is that both Russia’s satellite and radar networks have holes in them today. Analyses by the Congressional Budget Office (CBO) and others have shown that Russian satellites currently have little, if any, ability to detect missiles launched from U.S. Trident submarines.\(^1\) The satellite network observing U.S. ICBM fields has only one or two of its six satellites working today, which provides coverage for only about six hours a day. As for Russia’s radar network, it, too, is incomplete: It has a large gap to the east and a smaller gap to the west through which Trident missiles could fly all the way to Moscow without being seen. The implications of Russia’s blindness to nuclear attack are extremely troubling when combined with the compressed decision time required to execute a launch-on-warning strategy.

3. The general disorder in Russia today creates much uncertainty about the security and control of nuclear forces and materials. The far-flung deployments of Russia’s nuclear forces and materials, the existence of separatist and terrorist groups, and the strong presence of organized crime in Russia combine to make this situation particularly dangerous.

**U.S. Contributions to Nuclear Risk**

The risk of accidental or unauthorized nuclear use is not created by Russia alone. The United States exacerbates the risk by continuing to posture its nuclear forces in a manner suitable to a nuclear damage limitation strategy—i.e., able to destroy a large portion of Russia’s

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nuclear forces before they can retaliate against the United States. This strategy involves having a large number of counterforce weapons deployed at the ready—in other words, ready to be launched within a few minutes or perhaps hours—in order to rapidly destroy a high percentage of Russia’s nuclear forces. Similarly, the United States continues to patrol its attack submarines near the home bases and operating areas of Russia’s increasingly vulnerable ballistic missile submarine force, where they can track the few of these submarines that Russia manages to put at sea. Furthermore, U.S. conventional forces in Iraq, Yugoslavia, and Afghanistan have demonstrated the ability to destroy hardened targets with nonnuclear, precision-guided weapons. Many Russian analysts are concerned that such weapons could be used against Russian nuclear targets. On the diplomatic and political side, the United States has shown a willingness to build a large national missile defense system even if doing so means abandoning the Antiballistic Missile Treaty. Russians remain concerned that a future U.S. national missile defense system, along with a large number of U.S. counterforce weapons (both nuclear and conventional), could severely limit, if not eliminate, Russia’s nuclear deterrent.

OPPORTUNITIES FOR IMPROVING NUCLEAR SAFETY IN AN ERA OF IMPROVING RELATIONS

Fortunately, the end of the Cold War and the corresponding improvement in U.S.-Russian relations have created an opportunity for both countries to take steps to improve nuclear safety. Some steps in this direction have already been taken, such as sharp reductions in forces and the sharing of early-warning information, and further improvements in relations will make other measures possible as well. Moreover, steps taken to improve nuclear security can improve U.S.-Russian relations by reducing the relevance of nuclear weapons to the relationship.

The improvements in U.S.-Russian relations that have taken place so far are clearly indicated by both nations’ reactions to the attacks of September 11, 2001. For the first time since the Second World War, the United States and Russia find themselves allied against a common foe. Russia’s role in the war on terrorism has been substantial: encouraging the use of former Soviet bases in Central Asia, arming
Background and Motivation for Improving Nuclear Safety

and funding Afghani groups opposed to the Taliban regime, and actively supporting U.S. initiatives in the international community. For the first time, it is possible to see a future in which Russia is a full-fledged member of the Euro-Atlantic community.

This new geostrategic environment poses difficult questions for U.S. and Russian strategists about deterrence requirements in the future and the appropriate size, posture, command and control infrastructure, and strategy for each nation’s nuclear arsenal.

During the Cold War, the primary U.S. security goal was to deter a Soviet/Warsaw Pact invasion of Europe and a nuclear strike by the Soviet Union. The United States pursued this goal by building and deploying tens of thousands of nuclear weapons. Today, the greatest threat from Russia comes not from its strength but from its weakness. Russia’s dysfunctional economy and eroded security systems have undercut its control of the vast stockpile of weapons, materials, and know-how accumulated during the Cold War, thereby increasing the risk that they could flow to terrorist groups or other hostile forces.

As Russia and the United States begin to explore the form and structure of their new deterrence postures, several features are likely to carry over from their Cold War postures. First, both nations are

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2We have attempted to avoid prejudging what nuclear strategy and posture are appropriate for the new strategic era. While not taking a stance on nuclear strategy issues, we do highlight nuclear safety options that do and do not require a change in nuclear strategy and posture. It is also important to point out that many steps can be taken to improve nuclear safety in the absence of a wholesale change in U.S. nuclear strategy.

However, we feel it important to say that the long-running U.S. nuclear strategy of damage limitation (i.e., the requirement to destroy as many Russian nuclear weapons as possible before they can be used to retaliate against the United States) would be a serious impediment to improving nuclear safety. A damage limitation strategy necessitates a nuclear posture that includes a large number of counterforce weapons ready to launch within minutes to rapidly destroy Russia’s nuclear forces. For example, a Trident submarine must be within a certain distance of its designated targets with its missiles prepared to fire within minutes if it is to destroy Russian ICBM forces before they can be launched. This posture is directly at odds with attempts to assure Russia it can move to a more relaxed nuclear posture and thereby decrease the risk of an unauthorized or accidental nuclear launch.

Whether a damage limitation nuclear strategy is necessary today to deter Russia from attacking the United States is a point of serious contention among nuclear strategists both within and outside the U.S. government. Some strategists contend that
likely to retain some kind of retaliatory deterrent. Although the new strategic environment is vastly different from that of the Cold War, nuclear weapons remain the ultimate deterrent against nuclear attacks against the homeland or important regional allies. Second, the historical asymmetries in Russian and U.S. nuclear forces and operating practices are likely to persist for the foreseeable future.

Despite the likely persistence of these Cold War features, however, new factors are creating the potential for a very different and greatly improved nuclear relationship. The most important of these new factors is the improving and increasingly cooperative nature of U.S.-Russian relations. Ten years after the Cold War, it seems highly anachronistic that both nations retain thousands of nuclear weapons on high alert and tolerate the associated risk of unauthorized and accidental nuclear use. Another important factor is the changing nature of the strategic threat confronting the United States as a result of the September 11 terrorist attacks. Although the current crisis does not represent the full spectrum of strategic issues the United States is likely to face during the 21st century, it will probably cause strategic thinkers to reevaluate the role of nuclear weapons in this new geo-strategic era.

At the same time, the obstacles to reducing the role of nuclear weapons in the U.S.-Russian relationship remain formidable. Despite recent cuts in their nuclear arsenals, both countries retain very large numbers of nuclear forces. Even if all reductions recently agreed to in a more flexible nuclear doctrine is more appropriate today, one that emphasizes countervalue attacks in the event of hostility with another nuclear-armed state, which could be Russia, China, or a rogue state. These analysts argue that a damage limitation strategy is inappropriate because of the vastly improved relations between the United States and Russia and because many features that led to the introduction of a counterforce strategy in the first place disappeared with the end of the Cold War. For example, the possibility of conventional war between Russia and the United States is now regarded as such a remote possibility that the Pentagon has completely removed it as a planning scenario for sizing and modernizing U.S. conventional forces. The analysts suggest that nuclear planning should be similarly altered, directed away from specific scenarios focused on Russia and toward more general nuclear scenarios. Public statements by officials in the Bush administration suggest that the 2001 Nuclear Posture Review took steps in this direction.

We do not know at this time whether the United States still retains a damage limitation strategy. However, U.S. forces have been designed and operated for such a strategy, and demonstrating a retreat from that strategy will be difficult in the absence of overt changes to the postures or the forces themselves.
the Moscow Treaty are achieved by 2012, the United States and Russia will still retain around 2,000 strategic nuclear weapons each. In addition, a deep level of mistrust remains from the Cold War confrontation and is stoked by continuing disagreements about important security issues, such as NATO expansion, the role of the two powers in Central Asia, and the future of Iraq. These disagreements are unlikely to dissipate quickly, although recent events indicate a willingness on the part of the United States and Russia to explore a new framework for their relationship.

STUDY APPROACH

Our study approach entailed defining a series of phased steps for improving nuclear safety that begin today and go out to roughly 2020. The approach provides both an overall strategy for improving nuclear safety and specific policy steps, on a timeline, to minimize the risk of accidental or unauthorized nuclear use. We also sought to integrate our proposed Nuclear Safety Initiative with two major strategic policies of the United States: improving U.S.-Russian relations and redefining U.S. deterrence needs in light of a rapidly evolving geostrategic environment. At the beginning of the timeline are immediate and near-term steps that could be taken to improve nuclear safety unilaterally or through rapid mutual agreement. These initial steps are designed to build confidence and trust between the two nations. If these steps are successful, more-extensive steps could be taken, in the medium term, to build toward a long-term goal of significant improvements in nuclear safety coupled with a cooperative U.S.-Russian relationship.

One of the difficulties in designing a set of strategies and policies for improving nuclear safety is the broad, cross-cutting nature of the problem. Nuclear safety for Russia and the United States touches on such pivotal and controversial issues as nuclear strategy, the readiness and posture of U.S. and Russian nuclear forces, and the changing nature of U.S.-Russian relations. It also involves multiple federal agencies. Addressing the problem of nuclear safety will therefore require direct Presidential leadership and commitment. Within the U.S. government, this could be accomplished two ways. First, it could be done through a National Security Council (NSC) process initiated by a Presidential Directive (PD). The Appendix of this report
outlines what might be included in such a PD if President Bush decided to make nuclear safety a priority of his administration. Second, it could be accomplished by the President and a few key advisors making the decisions, thereby avoiding the interagency process altogether—much like the former President Bush did with the unilateral reductions in 1991. Each model has advantages and disadvantages.

What we have done in this report is to present a limited version of the analyses that the Department of Defense and other agencies (or Presidential advisors) might perform to provide the President with various options for reducing the risk of accidental or unauthorized nuclear use. The first item the advisors or agencies would have to consider is the scope of the problem: What is the range of possible scenarios that might lead to accidental or unauthorized nuclear use? Chapter Two covers this first step, exploring the possible scenarios in which an incident of nuclear use might begin. It then goes on to the next step: Identify and assess the underlying factors that might contribute to possible nuclear use (e.g., launch readiness of nuclear forces, perceived vulnerability of nuclear forces or command and control systems to a nuclear first strike, adequacy and reliability of early-warning information, and the amount of time leaders have to decide whether or not to respond to a perceived nuclear attack).

The next step in the process is to define the criteria to be used in evaluating the possible approaches for improving nuclear safety. Because of their uniquely destructive properties, nuclear weapons have both a military and a symbolic role in global affairs, which implies that nuclear safety options (particularly those that change the size, readiness, and operation of nuclear weapons) will affect a broad range of issues. Therefore, an evaluation of the pros and cons of a particular nuclear safety approach should include its effect on U.S.-Russian relations, efforts to prevent the proliferation of weapons of mass destruction, and current U.S. strategies and targeting plans. Chapter Three defines such criteria, as well as criteria directly related to the goal of improving nuclear safety.

Chapter Four examines a wide range of potential approaches, or options, for improving nuclear safety. We selected 10 options for detailed investigation. Each is discussed in a separate section, which includes background on the particular nuclear risks the option is de-
signed to help solve, as well as an introduction to the option itself. Specific technical and operational details on the option are outlined, and the option is evaluated using the criteria established in Chapter Three.

Chapter Five sets forth those 10 options we recommend as the most promising and provides a phased timeline for implementing them. Our recommendations include possible immediate and near-term steps to reduce nuclear dangers and to build confidence and trust in U.S.-Russian relations. Additional steps, in the medium and long term, that move toward the twin long-term goals of a strengthened and cooperative U.S.-Russian relationship and a significantly reduced risk of accidental or unauthorized use, are then described.

All of the potential options are at best only steps toward an ultimate solution of the nuclear safety problem: a U.S.-Russian relationship where neither country views the other as a nuclear threat and postures its nuclear forces accordingly. The current relationship between Britain and France illustrates this end state. Both of these countries are nuclear powers, and they do not have the same interests on all issues. However, neither country would ever consider using nuclear weapons or even military force against the other to settle a dispute. Although this possibility seems remote today for the United States and Russia, the end of the Cold War and the corresponding improvements in relations have created the opportunity for both countries to start the process that might lead to this end state.