Iran's Nuclear and Missile Potential

A Joint Threat Assessment by U.S. and Russian Technical Experts

EastWest Institute
Forging Collective Action for a Safer and Better World

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The Mission

At the first meeting of the U.S.–Russia Group on Counterterrorism and Strategic Security in Moscow in October 2007, intense discussions led to a proposal to organize a U.S.–Russia joint threat assessment on Iran, with the participation of both Russian and American scientists. This kind of joint effort had never been tried before, and it would be particularly timely given the debate about the planned U.S. deployment of a ballistic missile defense system in Poland and the Czech Republic. Both the U.S. team, led by retired General James L. Jones, and the Russian team, led by Ambassador Anatoly Safonov, Special Representative of the President of the Russian Federation, agreed that this was a promising avenue to explore. As a result, EWI in cooperation with The Russian Committee of Scientists for Global Security and Arms Control put together the U.S.–Russia Joint Threat Assessment on Iran's Nuclear and Missile Potential. The resulting report is more than a year in the making. The conclusions and recommendations in the report are the group's own — EWI was pleased to convene the group and provide the space and resources for them to do their work, but did not exercise editorial control of the contents.

The Russian and U.S. members held four key meetings in 2008: in Washington, DC, on March 18–19; Moscow on May 29; Palo Alto, CA on July 10–11; and in Glion-sur-Montreux (Switzerland) on December 2–4. Fittingly, in February 2009, the key conclusions of the study were presented to the new U.S. National Security Advisor, General James L. Jones, and to Russian Foreign Minister Sergey Lavrov and Secretary of the Russian Security Council Nikolay Patrushev. The report was also shared with former U.S. Defense Secretary William Perry, another participant in EWI's continuing U.S.-Russia strategic dialogue. It is EWI's hope that this successful joint effort will contribute to a better understanding of Iran's capabilities, and thus allow both sides to determine appropriate responses.

Participants

The report that follows is a consensus document to which the following experts have contributed. They support the document in general terms, though they do not necessarily agree with everything in the report:

UNITED STATES: Philip Coyle, Senior Advisor, Center for Defense Information; Richard Garwin, IBM Fellow Emeritus, Thomas Watson Research Center; Ambassador James Goodby, Nonresident Senior Fellow, the Brookings Institution; Siegfried S. Hecker, Co-Director of CISAC and Professor (Research), Department of Management Science and Engineering, Stanford University; David Holloway, Raymond A. Spruance Professor of International History, Stanford University; Theodore A. Postol, Professor of Science, Technology, and National Security Policy, Massachusetts Institute of Technology.

RUSSIAN FEDERATION: Grigory Chernyavsky, Director of the Earth Space Monitoring Scientific Center, Correspondent Member of the Russian Academy of Sciences; General (Ret.) Viktor Koltunov, Deputy Director, Institute for Strategic Stability; Leonid Ryabikhin, Executive Secretary of the Committee of Scientists for Global Security and Arms Control and Senior Fellow, EastWest Institute; Vitaly Shyukin, Head of Lab, Russian Federal Nuclear Center "Scientific Research Institute of Technical Physics" (VNIITF); Boris Vinogradov, Professor, Moscow Aviation Institute; Nikolay Voloshin, Assistant Director, VNIITF.

In addition, other experts contributed in an ad hoc basis to the proceedings or as reviewers of the draft at different stages:

UNITED STATES: Joseph Cirincione, President, Ploughshares Fund; General Lance Lord (USAF, ret.), Distinguished Fellow, EastWest Institute; General Rick Olson (USA, ret.).

RUSSIAN FEDERATION: Vyacheslav Amirov, Senior Fellow, Institute of World Economy and International Relations; Igor Kondratsky, Councillor, Embassy of the Russian Federation in France; Artem Malgin, Advisor to the Rector of the Moscow State Institute of International Relations (MGIMO); Nikolay Morozov, Deputy Director, Earth Space Monitoring Scientific Center; Igor Neverov, Director of the Department of North America, Russian Ministry of Foreign Affairs; General (Ret.) Michael Vinogradov, former President of the Committee of Scientists for Global Security and Arms Control; Irina Zvyagelskaya, Professor, MGIMO.

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May 2009

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Generous support was provided by the Ploughshares Foundation under the leadership of Joe Cirincione and Naila Bolus. Joe Cirincione offered additional support to the working group by giving of his time by participating in discussions and reviewing drafts of the report. The Kathryn W. Davis Peace Initiatives Fund at EWI and the Francis Finlay Foundation were also generous supporters.

The authors owe special thanks to the Federal Department of Foreign Affairs of Switzerland for allowing the working group to extensively discuss the draft report with a larger group of experts from Russia, the United States, and Switzerland in Glion-sur-Montreux in December 2008.

* *The EastWest Institute does not generally take positions on policy issues. The views expressed in this publication are those of the author and do not necessarily reflect the views of the organization, its Board of Directors, or its staff.*

The EastWest Institute is an international, non-partisan, not-for-profit policy organization focused solely on confronting critical challenges that endanger peace. EWI was established in 1980 as a catalyst to build trust, develop leadership, and promote collaboration for positive change. The institute has offices in New York, Brussels, and Moscow.

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Cover photo: REUTERS/Ho New
Israel's spy satellite "Ofek 7" is launched from Palmachim, southern Israel June 11, 2007

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Contents

Foreword

A confluence of events has presented the Russian Federation and the United States with an unusual opportunity to transform their relationship. The unfortunate reality is that trust is at an exceedingly low level between the elites and publics of both nations. Building that trust requires a leap of faith that they can work together on the most difficult issues. The determination to drive such trust-building on a vexing issue was behind the decision of senior Americans and Russians brought together by the EastWest Institute in 2007 to explore if collaboration was possible on the issue of Iran's ballistic missile and nuclear program. Following a tough yet civil private debate in Moscow, the participants — including on the American side General (ret.) James L. Jones, Ambassador Henry Crumpton, and General (ret.) Lance Lord, and a senior Russian delegation led by Presidential Representative Ambassador Anatoly Safonov — agreed that EWI should convene leading scientists from both states to take up the Iran issue and make it the subject of the first JTA — Joint Threat Assessment. It would be an attempt to see if the top scientists and experts of the two states could agree on the nature of the threat posed by Iran's nuclear and ballistic missile program. Our debate in Moscow demonstrated that there was no easy agreement on Iran's intentions. A great cloud of 'smoke' hung over the policy communities of both nations — a mixing of emotions and unsubstantiated reports with facts and policies. There was no dialogue. Instead the issue generated independent monologues fraught with suspicion and distrust. The decision to move forward with a JTA was a risky one. There was no assurance that it could be done.

Indeed, most outside experts told us that the task was impossible. Relations between Russia and the United States had deteriorated to a nadir not seen in decades. Among the major causes for the severe decline were the rushed ballistic missile defense agreements between the United States and Poland and between the United States and the Czech Republic to deploy assets in these European countries to counter a potential Iranian nuclear and missile threat. The United States government viewed this as a defensive move. Was Iran developing a capacity to hit Europe? How long would it take? The Russian government countered that the ballistic missile defense deployment near its borders was surely directed against Russia — an offensive move. Russian leaders and experts dismissed the idea that Iran currently possessed an offensive ballistic missile program capable of striking Europe. The sixteen Americans and Russians who sat around that Track 2 table back in 2007 in Moscow could have stopped at that impasse — but they did not. They agreed that the heart of the issue did not start with either the United States or with Russia but rather with the need to decipher the threat — what were Iran's technical capabilities? Could the two sides analyze and come to an agreement on the nature of the threat through a joint threat assessment?

Russia and the United States have been in dispute over the timeframe involved for Iran to acquire nuclear warheads and delivery vehicles, on the means needed to prevent that from happening, and — in the worst case that it cannot be prevented — the military operational responses available to both sides to defend against Iran's potential use of nuclear armed missiles. It was agreed that only after capabilities are ascertained can productive political conversations about motives and policy responses follow. Therein lay the mandate for the two teams of scientists, who worked independently and in a series of joint meetings that more often than not lasted well into the night.

Though the Iranian nuclear program has been the subject of detailed forensic public analyses, much less detailed attention has been paid, in public at least, to the Iranian missile program. Claims and counterclaims abound and defy easy understanding by the non-specialist. This report aims to fill that gap by providing a detailed examination of Iranian nuclear and missile capabilities. When might Iran be capable of deploying nuclear warheads? Assuming that Iran can develop that capability, would the proposed missile defenses be able intercept Iranian missiles? What are the possibilities of U.S.-Russian cooperation in this area? These are the vital questions that this report examines and makes its assessments.

The EastWest Institute, for thirty years a bridge in U.S.-Russian and earlier, U.S.-Soviet relations, is proud to present the product of this remarkable team of Russian and American scientists and experts on the subject. That compelling gap — both in terms of independent analysis and in confidence building on Iran's weapons programs — now has its first bridging document. That it deals successfully with a joint assessment on such an important issue as Iran's nuclear and missile potential is a tribute to its authors and to the willingness of both governments to enable their scientific communities to cooperate.

EWI worked closely with partner organizations in both Russia and the United States: the Russian Committee of Scientists for Global Security and Arms Control; The Massachusetts Institute of Technology's Program in Science, Technology, and Society; and the Center for International Security and Cooperation at Stanford University — all of which offered vital support and leadership. This Track 2 effort by prominent American and Russian specialists should provide a way out of the counter-productive and unnecessary friction that has arisen over Iran's nuclear military potential and responses to it. After all, as both sides have taken pains to point out, a nuclear Iran is in neither state's interest.

For more than a year, intense discussions have taken place on this first bilateral JTA between Russian and U.S. scientists, some of who are close advisors to high-level government officials. The drafting of this report was in itself a unique experience of building trust between experts who shape future strategic decisions. We all have learned important lessons through this experience and the EastWest Institute is keen to actively rely on them to expand the model of joint independent expert groups to contribute to finding solutions to pressing threats around the globe. Additional JTAs will be undertaken. To operationalize the findings of this JTA, we are preparing to launch a Joint U.S.-Russia Policy Assessment, as suggested by William Burns, Under Secretary of State for Political Affairs (and formerly the U.S. ambassador to Russia). Such a study would offer consensus recommendations on the policy options available to the United States and Russia on the potential Iranian nuclear and missile threat as well as suggest a global regime for dealing with ballistic missile proliferation.

In February 2009, key conclusions of the study were presented to the U.S. National Security Advisor James Jones, Russian Foreign Affairs Minister Sergey Lavrov, and Secretary of the Russian Security Council Nikolay Patrushev. The first reaction to the draft report from both U.S. and Russian government officials was positive, and provides the basis for hope that both countries will be able to develop constructive policies of cooperation in addressing existing nuclear and missile threats. We are pleased that in recent bilateral meetings between Secretary Clinton and Minister Lavrov the importance of doing joint U.S.-Russia threat assessments has been recognized.

EWI's mission is to forge collective action for a safer and better world — this joint threat assessment gives policymakers the ability to do just that. We are grateful for the dedicated efforts by those involved on both the U.S. and Russian sides, who put politics and other commitments aside to offer their impressive analytical skills to this venture. As well as being scientists they were diplomats and skilled negotiators as they worked together to produce this consensus document. Special thanks and recognition are due to David Holloway and Leonid Ryabikhin, who led the U.S. and Russian sides, respectively, in this unique endeavor. A complete listing of scientists and experts engaged in this process is found on the list of contributors. We thank each of them for their diligent work and contributions. It is in no small measure thanks to the patient and determined leadership of Professor Holloway and Dr. Ryabikhin that the diverse teams were able to prepare and present the consensus document that follows. I would also like to extend a special thanks and recognition to Greg Austin, Vice President of Policy Innovation, who began the initial joint threat assessment process at EWI.

EWI is indebted to our funders — especially the Ploughshares Foundation under the leadership of Joe Cirincione and Naila Bolus, the Kathryn W. Davis Peace Initiatives Fund at EWI, the Francis Finlay Foundation, and the Federal Department of Foreign Affairs of Switzerland — who provided EWI the resources to independently pursue this project. And, finally, we are all grateful to the governments of the United States and the Russian Federation for their receptiveness to consider the conclusions of this assessment as they seek to find a way to move one of the most important bilateral relationships forward. To offer comments or receive additional information on this or any of EWI's work, please contact us at communications@ewi.info.

Sincerely yours,

John Edwin Mroz
President and CEO
EastWest Institute
May 2009

"While acknowledging that differences remain over the purposes of deployment of missile defense assets in Europe, we discussed new possibilities for mutual international cooperation in the field of missile defense, taking into account joint assessments of missile challenges and threats, aimed at enhancing the security of our countries, and that of our allies and partners."

Joint Statement by President Medvedev and President Obama, April 1, 2009[1]

1. Introduction

1.1 Does Europe face a military threat from Iran, and if so what is the nature of that threat? What is Iran's nuclear capability today and what might it be in the future? What ballistic missile capability does Iran have today and what might it have in the future? If Europe had a missile defense system, would that system protect Europe?

1.2 These questions have been widely discussed in the popular media, often on the basis of misleading information. This report, which has been written by a group of U.S. and Russian specialists, provides an assessment of the Iranian nuclear and missile programs and an evaluation of the European Missile Defense system proposed by the Bush administration. It is not yet clear what the Obama administration's policy on missile defense will be.

Iran's nuclear program

1.3 The Iranian nuclear program has been a matter of great concern to the international community for several years. Iran signed the Nuclear Nonproliferation Treaty (NPT) in 1968 and has claimed consistently that its nuclear activities are directed to peaceful purposes. In 2003–2005, following revelations by an Iranian opposition group about secret nuclear sites, the International Atomic Energy Agency (IAEA) conducted intensive inspections, which revealed that for almost twenty years Iran had engaged in a range of undeclared nuclear activities, including uranium enrichment and plutonium separation efforts.[2]

1.4 In September 2005 the IAEA Board of Governors found Iran to be in noncompliance with its NPT Safeguards Agreement and in February 2006 it reported Iran's case to the UN Security Council. On July 31, 2006, the Security Council adopted Resolution 1696, demanding that Iran cease its enrichment and reprocessing activities.[3] The Security Council has passed three subsequent resolutions imposing sanctions on Iran for its failure to comply with Resolution 1696. On September 15, 2008, the IAEA concluded that Iran was continuing to resist efforts to respond to allegations of military-related work. Two months later it reported that, contrary to the decisions of the Security Council, Iran had not suspended its enrichment related activities.

1 http://www.whitehouse.gov/the_press_office/Joint-Statement-by-President-Dmitriy-Medvedev-of-the-Russian-Federation-and-President-Barack-Obama-of-the-United-States-of-America/.

2 IAEA Board of Governors, "Implementation of the NPT Safeguards Agreement in the Islamic Republic of Iran," IAEA: GOV/2004/83, 23, http://www.iaea.org/Publications/Documents/Board/2004/gov2004-83.pdf.

3 UN Security Council Resolution S/2006/1696, http://www.un.org/News/Press/docs//2006/sc8792.doc.htm.

1.5 There has been a consensus in the international community — especially in the United States, Europe, and Russia — that Iran should not acquire nuclear weapons. It would be a serious blow to the NPT if Iran were to do so. It might provoke other states in the Middle East (Saudi Arabia, Egypt, and Syria, for example) to pursue nuclear weapons, thereby further destabilizing an already volatile region. Iranian policies, as well as belligerent statements by President Mahmoud Ahmadinejad and other Iranian leaders, suggest that Iranian nuclear weapons would pose a particular danger to Israel. In the longer run, if Iran acquired nuclear weapons and long-range ballistic missiles, it could pose a nuclear threat to Russia, Europe, and the United States.

1.6 No consensus exists, however, on the ways to prevent Iran from acquiring nuclear weapons or the capacity to make them. The United States and Russia view the situation in Iran differently. The United States has pressed for tougher sanctions than other governments have been willing to support and it has not ruled out the use of military force. Russia has been skeptical of the utility of sanctions and is opposed to military action; it has put more stress on developing ties with Iran. It is, for example, rebuilding the nuclear power reactors at Bushehr, notwithstanding strong U.S. objections, especially during the Clinton administration.

1.7 It is not surprising that the United States and Russia have taken different approaches to Iran, even while agreeing that Iran should not have nuclear weapons. The United States has not had diplomatic relations with Iran since the hostage crisis of 1979-1981 and has tried to isolate the Iranian regime; Iran has consistently supported Hezbollah and Hamas, which the United States regards as terrorist organizations; and Iran has been an outspoken enemy of Israel, which is an important ally of the United States. Russian perspectives on Iran have been shaped by different factors: Russia and Iran are close neighbors; Russia is concerned about Iranian activities on its southern border; Russia wants to draw closer to Iran to show that Iran is not a threat, thereby deflecting U.S. sanctions and possible military action; and Russia is also interested in developing trade with Iran, particularly in high-tech areas such as nuclear reactors and associated technologies.

Ballistic missile defense and the threat from Iran

1.8 The United States is proposing to deploy a missile defense radar in the Czech Republic and ten interceptor missiles in Poland. The Bush administration initiated this proposal with the aim of defending the United States and Europe against a possible ballistic missile attack from Iran. It proposed also that another radar be established closer to Iran, perhaps in eastern Turkey. In addition to the interceptors proposed for Poland, land- and sea-based interceptors might also be deployed closer to both Iran and Russia. The European missile defense system would form part of the larger missile defense system the United States has already begun to deploy to defend itself against ballistic missile attacks. (See the Technical Addendum for a description of the system — available at www.ewi.info.[4])

1.9 On July 8, 2008, the United States and the Czech Republic signed an agreement "on establishing a United States missile defense radar site in the Czech Republic." This agreement needs to be ratified by the Czech parliament. On March 17, 2009, the Czech government withdrew the agreement from consideration by the lower house of parliament, fearing that it would be voted down. The United States and Poland agreed on August 15, 2008, to establish a missile defense base in Poland with ten interceptor missiles; this agreement too has to be ratified by parliament before it enters into effect.

1.10 The stated purpose of U.S. missile defense policy is to defend the United States and its allies against missile attacks from North Korea and Iran, both of which have programs to develop long-range ballistic missiles. North Korea tested a nuclear device in October 2006. In spite of its protestations to the contrary, Iran is assumed by the U.S. government to be intending to acquire nuclear weapons or, at the very least, to develop the capacity to produce such weapons in a short time.

1.11 Not everyone accepts the U.S. government's assurances that its missile defense policy is directed against Iran and North Korea. On May 23, 2008, Presidents Hu Jintao and Dmitry Medvedev signed a joint statement condemning the deployment of missile defenses: "Both sides believe that creating a global missile defense system, including deploying such systems in certain regions of the world, or plans for such co-operation, do not help support strategic balance and stability, and harm international efforts to control arms and the non-proliferation process."[5]

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4 The technical addendum is the contribution of Dr. Theodore Postol, Professor of Science, Technology, and International Security at the Massachusetts Institute of Technology. This addendum does not necessarily represent the views of the other members of the study group.

5 BBC News, "Presidents condemn US shield plan," March 23, 2008, http://news.bbc.co.uk/2/hi/asia-pacific/7416734.stm.

1.12 When the United States and the Soviet Union signed the Anti-Ballistic Missile (ABM) Treaty in 1972, they regarded it as the cornerstone of strategic stability. They understood that, under the circumstances of the time, it was impossible to build an impenetrable defense against strategic ballistic missiles. They feared that deployment of such systems could upset strategic stability (i) by making the side that deployed them (or the side against which they were deployed) believe that the defenses could be effective against a retaliatory strike, thereby increasing the temptation to strike first in a crisis, and (ii) by prompting the other side to deploy more missiles and more warheads and to develop countermeasures, thereby provoking a new round of the arms race.

1.13 In the Russian view, the strategic relationship with the United States continues to rest on nuclear deterrence, even if the prospect of a nuclear war between the two countries is more remote than it was during the Cold War. Consequently the deployment of missile defenses still has the capacity to upset strategic stability, leading possibly to a new arms race and certainly damaging the prospects for further reductions in strategic nuclear forces.

1.14 The Russian government has been particularly outspoken on the subject of the proposed missile defense deployments in Europe. After the signing of the U.S.-Czech agreement, President Medvedev declared that "we will not be hysterical about this, but we will think of retaliatory steps."[6] On November 5, 2008, he warned that short-range missiles would be deployed in Russia's Kaliningrad province in order to neutralize the missile defense systems. This is just one of a number of measures that Russia might adopt to ensure that U.S. missile defenses do not threaten Russian strategic forces in a crisis.

1.15 The United States has taken a different approach, arguing that new and potential missile threats against the United States and its allies make missile defenses necessary. It has stated that U.S. missile defenses are not directed against Russia and pose no threat to it and has taken the view that Russian opposition to U.S. missile defenses is unreasonable. Missile defense has become one of the most contentious issues in U.S.-Russian relations.

This report

1.16 This report provides an assessment of the Iranian nuclear and missile programs and an evaluation of the proposed European missile defense system. It does not assume that Iran is planning to attack Europe or the United States with nuclear-armed ballistic missiles. It would indeed be suicidal for Iran to do so, since such an attack would inevitably elicit a massive response. Ballistic missiles, after all, have return addresses. Even if Iran did develop intermediate-range ballistic missiles (IRBMs) or intercontinental ballistic missile (ICBMs) armed with nuclear weapons, missile defense would not be the only, or even necessarily the best, response.

1.17 This report argues that the threat against which the European missile defense system is intended to provide protection is not imminent and that in any event the system currently proposed would not be effective against it. The much more urgent problem is to seek a resolution of the crisis over Iran's nuclear program by finding means to enable Iran to reassure the international community that its nuclear program is directed only toward peaceful purposes. That is a project on which the United States and Russia need to cooperate more closely. The European missile defense system is an impediment to greater cooperation.

1.18 This report is based on open sources. There are many stories in the press about assistance Iran has received, or might have received, in the development of nuclear weapons and ballistic missiles. This report does not attempt to investigate those stories; it focuses on what appears to be reliably known about Iran's scientific, technological, and industrial capabilities. Where extrapolations are made from existing Iranian capabilities for the purposes of analysis, it is made clear that this is what is being done.

1.19 The conclusions of this report could be undercut if Iran were to receive extensive help from abroad in the development of nuclear weapons or ballistic missiles. This is an important caveat. It is true that technology transfer is not a simple process and that external assistance will be useful to the recipient only to the extent to which the recipient is capable of making use of it. Technology transfer has nevertheless been important to the Iranian nuclear and missile programs in the past and may prove to be so again.

6 Andrew E. Kramer, "Czechs See Oil Flow Fall and Suspect Russian Ire on Missile System," *New York Times,* July 12, 2008, http://www.nytimes.com/2008/07/12/world/europe/12czech.html?fta=y.

2. The Iranian Nuclear Program

2.1 This assessment of Iran's capacity to develop nuclear warheads is based on reports submitted by the IAEA Director General to the IAEA Board of Governors from 2004 to 2009 on Iran's implementation of its NPT Safeguards Agreement. These reports show that Iran has extensive programs in nuclear research and nuclear power engineering: it has uranium mines; it has been using centrifuge technology to produce low enriched uranium (LEU); it has three research reactors; it is constructing a new heavy water research reactor, which is due to be completed in 2009 though it seems unlikely to meet that deadline; and it has done research on the production of plutonium-239 and polonium-210.

2.2 Iran has been installing and testing centrifuge cascades at two plants. As of November 17, 2008, the total amount of uranium hexafluoride (UF6) fed into the cascades at the Fuel Enrichment Plant (FEP) since the beginning of operations was 9,956 kg, and a total of 839 kg of low enriched uranium hexafluoride had been produced; between November 18, 2008, and January 31, 2009, Iran produced a further 171 kg of low-enriched uranium (LEU), giving a total production of 1,010 kg of LEU.

The possible military dimensions of Iran's nuclear program

2.3 Iran denies that it has a nuclear weapons program: "the Islamic Republic of Iran has not had and shall not have any nuclear weapons program," it told the IAEA in May 2008.[7] Iran has rejected the evidence presented to it by the IAEA about alleged military-related research. It claims that the evidence provided by the IAEA does not show that Iran has been working on — or has worked on in the past — a nuclear weapon.

2.4 The evidence presented to the Iranian government by the IAEA about alleged military-related research has been based on intelligence received from IAEA member states about work at Iranian research and military organizations pointing to a possible nuclear weapons program. Among these activities are studies of high explosives (HE); conversion of uranium dioxide into uranium tetrafluoride (which might indicate work on the preparation of uranium metal for a bomb); testing of high-voltage equipment for activation of HE detonators and devices for simultaneous activation of several detonators; development of guidelines for assembling and operating a detonation system; plans for the organization of underground tests; testing of a multipoint system for initiation of an HE unit of hemispheric shape; biographical data showing the involvement of an Iranian expert in calculations of the radius of a nuclear explosion ball using the Taylor-Sedov equation, etc.

2.5 Iran has denied engaging in most of these activities, and where it has admitted some of them — such as work on high explosives — it has claimed that these were undertaken in the context of work on nuclear power or conventional weapons. Because of restrictions imposed by member governments, the IAEA has not been able to make available to Iran most of the documents that form the basis for the claims that Iran has been engaged in weaponization and military-related research; nor has it made the documents accessible to experts from other countries who could evaluate their authenticity and reliability.

2.6 The Iranian government has not provided satisfactory answers to the questions raised about possible military dimensions of the Iranian nuclear program. In November 2008 the IAEA reported that it had made no progress with Iran in resolving the issues it had raised about possible military dimensions of the Iranian program. Although it is evident that Iran has taken the decision to develop the full nuclear fuel cycle, it is not clear whether it has taken the decision to produce nuclear weapons.

General assessment of the Iranian Nuclear Program

2.7 From publicly available information about the Iranian nuclear program, the following conclusions can be drawn:

a. Iran has the raw materials, equipment, technologies, and qualified staff to produce fuel based on uranium-235 enriched up to around five percent for use in nuclear power reactors. Recent reports suggest, however, that Iran's supply of uranium is declining, and this may pose problems for Iranian plans to develop nuclear power.[8]

7 IAEA Board of Governors, "Implementation of the NPT Safeguards Agreement," IAEA: GOV/2008/15, 4, http://www.iaea.org/Publications/Documents/Board/2008/gov2008-15.pdf.

8 David Albright, Jacqueline Shire, and Paul Brannan, "Is Iran running out of yellowcake?" Institute for Science and International Security, Washington, DC, February 11, 2009, http://www.isis-online.org/.

b. Further development of the centrifuge enrichment technology and further equipment build-up would enhance Iran's capacity to produce not only LEU, but also weapon-grade highly enriched uranium (HEU) with enrichment to ninety percent and more. It has taken Iran about a year to accumulate enough LEU to produce sufficient HEU for a bomb. Future rates of production will be determined by the number of cascades Iran builds and by the introduction of new types of centrifuges.
c. Although the possibility cannot be discounted entirely, there is no basis for assuming either that Iran has already accumulated — and is secretly storing — weapon-grade fissile material or that it has undeclared LEU in the form suitable for further enrichment or in the amount needed for obtaining significant quantities of uranium-235. Radioisotope measurements performed by the IAEA inspectors have not revealed unexplained traces of U-235 or Pu-239 at the locations they have examined.
d. Iran has acquired technologies not only from Pakistan but also from several European countries in contravention of export control regulations, and Iran could receive external help again in the future. This shows how important it is for nuclear suppliers to take joint measures to tighten control over the export of dual-use technologies, including more efficient exchange of intelligence data on attempts by non-nuclear countries to acquire illegally sensitive technologies and equipment.

The path to a bomb

2.8 Taking into account all the existing data on the military potential of the Iranian nuclear program, one can conclude that Iran is moving toward the capability to develop and manufacture nuclear fission explosive devices. It is important to note that in order to realize this potential, Iran would *either* have to remove IAEA control and monitoring of the uranium enrichment process and of the possible accumulation of plutonium in the heavy water reactor *or* have to produce fissile material and make a bomb in a secret location using the knowledge and expertise gained in the civilian program.

2.9 If Iran were to decide to convert its LEU into HEU, how long would it take to produce a nuclear device? The answer depends on several factors, among them: the speed with which the Iranians could convert their centrifuge configuration to the production of HEU; the speed with which they could then convert the highly-enriched uranium hexafluoride into metal; and their possession of — and confidence in — a workable design for a nuclear device. Under the most favorable circumstances, it might take Iran one year from the date of deciding to do so to make a simple nuclear device: three to six months to convert the LEU into HEU and perhaps another six months to convert the HEU into uranium metal. If the circumstances are not so favorable — if Iran encounters difficulties in perfecting these processes — it could take two or three years to produce a simple device. The Russian members of this JTA group have concluded that this is a more realistic estimate than one year.

2.10 It could take Iran perhaps five years — and additional nuclear tests — to move from the first test of a simple nuclear device to the development of a nuclear bomb or warhead with a yield of several tens of kilotons capable of being fitted onto existing and future Iranian ballistic missiles. Such a warhead would most likely weigh more than 1,000 kg, unless substantial help were obtained from abroad in the design and development of the warhead.[9] The technological challenges lie not only in the design of the nuclear charge, but in the design and engineering of the warhead as well.

2.11 The possibility was raised in our discussions that Iran could opt to use HEU to make a lightweight gun-type warhead like the 203-mm artillery shell first deployed by the United States in 1957 with a mass of only 110 kg. Several members of the group regard this as much more challenging than simpler but heavier designs, and believe that Iran would not be able to develop such weapons in the foreseeable future.

2.12 Neither the IAEA nor the U.S. intelligence community has published data proving that Iran is developing, manufacturing, or testing any nuclear devices (although U.S. intelligence has concluded that Iran carried out exploratory weapons-related work in the past). There is no seismic or radiation-monitoring data to indicate that nuclear tests have taken place in Iran.

Conclusions on the Iranian Nuclear Program

2.13 This analysis points to the following conclusions:

a. Iran has the scientific and technological potential to develop nuclear weapons.
b. There are no data on Iran's capabilities to develop a thermonuclear explosive device (a hydrogen bomb).

9 We are treating warhead and payload as equivalent in respect to weight.

c. Iran has not conducted any nuclear tests. It therefore does not at present possess any nuclear munitions whose operability has been verified in a nuclear test and that could be used as weapons of mass destruction. It should be noted, however, that a "gun-assembled" nuclear weapon of highly enriched uranium could be stockpiled with some confidence, without testing.

d. Assistance from abroad with nuclear designs and test data could aid Iran in creating a nuclear arsenal.

2.14 Taking into account the existing scientific, economic, and manufacturing potential of Iran and the availability of open publications on nuclear weapons, it seems reasonable to assume that:

- Iran will be able to develop, manufacture, and test a nuclear device of the simplest design within two or three years of deciding to do so. We do not know whether Iran has already taken such a decision. Under the most favorable circumstances, based on the assumptions listed in paragraph 2.9 above, Iran might be able to produce a simple device within one year of deciding to do so.
- It could take Iran perhaps five years to move from a simple nuclear device to the development of a nuclear warhead with a yield of several tens of kilotons capable of being fitted onto a ballistic missile.
- Unless Iran has an enrichment program separate from the one being monitored by the IAEA, there would be warning that Iran intended to make nuclear weapons. It would have to end IAEA containment and surveillance of the nuclear material and all installed cascades at the Fuel Enrichment Plant. (The same would apply to the heavy water reactor when it comes into operation.)
- To conclude that Iran could make a nuclear device in two to three years is not to say that Iran has decided to make such a device or that it will do so. If Iran has decided to make nuclear weapons, or decides in the future to do so, it is not clear that it would make sense for it to produce just one; it might be more likely to wait until it had enough material for several warheads.
- It cannot be taken for granted that Iran's nuclear program could proceed steadily from expulsion of the IAEA to a nuclear test, and then to the development of a missile warhead. Expulsion of the IAEA would be a matter of grave concern to the international community because it would be an indication that Iran had decided to go ahead with the development of nuclear weapons. The international community together, or individual countries acting on their own, might take forceful action against Iran before it could carry out such plans.

Recommendations

2.15 On the basis of this analysis, we make the following recommendations:

a. The IAEA should continue to inspect nuclear sites and monitor nuclear research in Iran within the framework of the NPT Safeguards Agreement.

b. All UN member states should reinforce their efforts to ensure obligatory implementation of the UN Security Council resolutions imposing sanctions on Iran, including prohibitions on the export of technologies and materials that could help Iran in the production of fissile materials.

c. Every effort should be made to strengthen IAEA safeguards and verification, in particular by securing Iranian implementation of the Additional Protocol. The IAEA Director General has asserted that implementation of the Additional Protocol "is a prerequisite for the Agency to provide credible assurance about the absence of undeclared nuclear material and activities."[10]

d. The development and creation of proliferation-resistant nuclear technologies must be continued so that all countries have broad opportunities to develop peaceful nuclear programs.

e. The nuclear fuel cycle should be internationalized through the creation of international nuclear fuel centers.

3. Iran's Ballistic Missile Program

3.1 The origins of the Iranian ballistic missile program go back to the Iran-Iraq war, in the course of which Iraq launched a large number of SCUD missiles against Iran. Iran has made considerable efforts to acquire ballistic missiles and related technologies from foreign sources and has started an ambitious indigenous missile program of its own.

3.2 Iran has developed at least four different liquid-propellant ballistic missile systems, the Shahab-1, Shahab-2, Shahab-3, and the Ghadr-1 Kavoshgar (which is also called the Shahab-3M). The Shahab-3 has been operationally deployed in small numbers since 2003. The continuing efforts to improve its range, payload, and ac-

10 IAEA Board of Governors, "Implementation of the NPT Safeguards Agreement," IAEA: GOV/2009/8, 4, http://www.iaea.org/Publications/Documents/Board/2009/gov2009-8.pdf.

Table 1: [11]

Missile Type	Launch Gross Weight (kg)	Empty Weight (kg) (Without Warhead)	Full Weight (kg) (Without Warhead)	Structure Factor	% Residual Fuel	Specific Impulse (sec) Sea Level / Vacuum	Range (km)	Warhead Weight for Quoted Range(kg)
Shahab 1	5900	1100	4900	0.23	0.05	230 / 253	315	1000
Shahab 2	6400	1100	5400	0.20	0.05	230 / 253	375	1000
Shahab-3	15200	1800	14200	0.13	0.04	220 / 247	930	1000
Shahab3M	17785	1885	16785	0.11	0.04	220 / 247	1100	1000

curacy have had relatively modest results, as evidenced by the Shahab-3M. These are all single-stage missiles. Iran has also developed the liquid-propellant two-stage Safir space launch vehicle (SLV), which was used to put the Omid satellite into space on February 2, 2009.

3.3 There are reports that Iran has developed solid-propellant missiles with a range of 2,000 km. There is, however, no reliable information at present on the state of Iran's efforts to develop solid-propellant rocket motors and therefore no basis on which to make an assessment in this report.

3.4 Iran's liquid propellant rocket program depends on the use of two rocket motors. One is the motor from the SCUD-B ballistic missile; the other is the motor used in the North Korean Nodong missile. Both rocket motors use the same low-energy rocket propellants. The Nodong motor is bigger than the SCUD-B motor and has more than twice the thrust. The Nodong rocket motor has provided the foundation for Iran's indigenous liquid-propellant ballistic missile program.

3.5 Table 1 gives estimates of the launch weights, empty and full body weights, payloads, residual fuel, and ranges of the Iranian liquid-propellant missiles. These estimates are not exact, but assessments based on these estimates are likely to be qualitatively correct.

3.6 The Shahab-1 is identical to the North Korean SCUD-B, the Shahab-2 to the North Korean SCUD-C, and the Shahab-3 to the North Korean Nodong missile. The Shahab-3M (Ghadr-1 Kavoshgar) is a variant of the Shahab-3 that carries more propellant.

3.7 Iran's efforts to increase the range and payload of its ballistic missiles beyond that of the Shahab-3 take advantage of the higher thrust of the Nodong rocket motor. Since the Nodong rocket motor has sufficient excess thrust to lift missiles that are heavier than the original Nodong, Iran has followed a strategy of gradually increasing the length of the fuel and oxidizer tanks of the original Nodong so that it can carry more propellant. This strategy of increasing the fuel load is ultimately limited to rockets that weigh less than the thrust of the Nodong rocket motor. Iran's exploitation of the increased lift capability of the Nodong rocket motor is now essentially at the end of the line. Further advances in Iran's ability to produce rockets of greater range and payload will require new and major technological advances beyond those it has so far demonstrated.

Technical details of Iran's Ballistic Missiles

3.8 The Shahab-1 ballistic missile is identical to the North Korean SCUD-B. The SCUD-B was originally designed by the Soviet Union as a short-range tactical ballistic missile. The Shahab-2 (SCUD-C) uses exactly the same rocket motors, turbopumps, fuel and oxidizer lines, airframe, and guidance system as the SCUD-B, but its fuel and oxidizer tanks are stretched so that it can carry about thirteen to fourteen percent more fuel and oxidizer than the SCUD-B.

3.9 The Pakistani Ghauri 1 and the Iranian Shahab-3 are essentially the same as the North Korean Nodong missile. The body of the Nodong missile is a near exact replica of the SCUD-B, except that all its major structural components are scaled to a larger size.[12] The SCUD-B body diameter is 0.88 m, while the Nodong body diameter is close to 1.25 m. Thus the Nodong is larger than the SCUD-B in every dimension by a factor very close to 1.4 (we use the factor reported by Schiller and Schmucker of 1.25/0.88=1.42).

11 We wish to thank Marcus Schiller and Robert Schmucker for sharing their estimates of the empty dry and wet weights of the Shahab 1, Shahab2, and Shahab3 missiles. Another source of the dry and wet weights of the SCUD-B we have used is from "Missile Exploitation Data (Section IV-A Through IV-D) (U)," Volume 4, July 1980, AMA-1060X-010-80-Vol-4 DIA, TASK NO. PT-PTX-01-01L, Classified by: DIA/DT, Review: 1 July 2000.

12 This was first pointed out by Robert Schmucker in "3rd World Missile Development - A New Assessment Based on UNSCOM Field Experience and Data Evaluation," paper for the 12th Multinational Conference on Theater Missile Defense: Responding to an Escalating Threat, June 1-4, 1999, Edinburgh, Scotland.

3.10 The evolution of the Shahab-3 to the Ghadr-1 Kavoshgar (Shahab-3M) follows exactly the evolution of the SCUD-B to SCUD-C. The larger Nodong rocket motor associated with the Shahab-3 has sufficient "excess" thrust to lift the stretched and heavier Shahab-3M. The Shahab-3M has the same overall dimensions as the Shahab-3, except that the guidance section has been moved forward into the payload section. This change makes it possible to stretch the propellant tanks further without increasing the overall length of the missile or drastically changing the mass distribution. The resulting missile has increased range and payload relative to the Shahab-3.

The Iranian space program and its implications for ballistic missile development

3.11 On February 2, 2009, Iran used the liquid-propellant Safir space launch vehicle (SLV) to send the Omid earth satellite into low earth orbit. By launching an earth satellite, Iran has demonstrated that it can exploit low-thrust rocket motors to build a two-stage rocket, and that it has qualified engineers who are able to make good use of the technology that is available to them. It does not show, however, that Iran has made a fundamental technological breakthrough.

3.12 The first stage of the Safir SLV is derived from the Shahab-3 motor and airframe, with fuel and oxidizer tanks extended beyond those of the Shahab-3. In other words, the first stage of the Safir SLV is still based on the North Korean Nodong missile. The Safir SLV upper stage placed a satellite weighing about 27 kg into low-earth orbit. The Safir SLV upper stage appears to be nearly optimally designed to launch a small satellite into orbit.

3.13 Fears have been expressed that the two-stage Safir SLV can serve as the prototype of a long-range Iranian ballistic missile. The Safir SLV upper stage placed a satellite weighing 27 kg into low earth orbit, but any nuclear warhead will be much heavier than that. The Safir upper stage is not likely to be suitable for carrying a nuclear warhead of roughly 1,000 kg weight because the thrust of its rocket motor may be too low and because its structure may not be strong enough to support such a heavy payload during flight.

3.14 The launch of the Omid satellite provides new information about the way in which Iranian rocket technology is developing. Iranian engineers have demonstrated a high level of competence and ingenuity in rocket design. The Safir SLV can be regarded as a step in the development of ìstagingî technology, which is critical for the construction of two- and three-stage ballistic missiles and space launch vehicles.

Prospects for ballistic missile development in Iran: major technological obstacles and barriers

3.15 The Soviet Union and the United States started their ballistic missile programs with artillery rockets, surface-to-air missiles, and simple ballistic missiles. Iran started its ballistic missile program in the same way. Unlike Russia and the United States, however, Iran does not have the infrastructure of research institutions, industrial plants, or the scientists and engineers that are needed to make substantial improvements in the basic rocket components it has used from the start.

3.16 SCUD missiles use relatively low-energy propellants, rocket motors with materials and designs that are very hard to upgrade to more energetic propellants, and primitive guidance systems. SCUD technologies impose important limitations on the expansion of range and payload. Reports about the development of new ballistic missiles — the Shahab-4, Shahab-5, and even the Shahab-6 with a range of 5,000-6,000 km and more — have not been supported by any information, much less video or photographic evidence. The various modifications of the Shahab-3 constitute the main missile threat from Iran today.

3.17 The path that Russia, China, and the United States followed in developing modern IRBMs and ICBMs required new technologies, advanced materials, sophisticated technical solutions, large numbers of personnel with a high level of experience and skill, and a highly developed R&D and manufacturing infrastructure.[13] Iran is trying to build up its own indigenous R&D and production base, but it lags very far behind the leading missile countries. It has made skillful use of rocket components imported from other countries, and it will continue to rely for a considerable time on outside help in extending the payload and range capabilities of its ballistic missiles.

3.18 The history of truly indigenous ballistic missile development programs shows that every new phase of development requires tremendous intellectual and

13 The standard classification is used here: medium-range ballistic missiles (MRBMs) are those with a range of 1,000 to 3,000 km; intermediate-range ballistic missiles (IRBMs) have a range of 3,000 to 5,500 km; and intercontinental ballistic missiles (ICBMs) are those with a range of 5,500 km or more.

material efforts and many years to achieve results. The development and production of modern ballistic missiles requires an advanced R&D and industrial infrastructure, which in turn depends directly on the general level of a country's scientific, technological, and industrial resources. More specifically, it requires: access to the world market for high-tech equipment, materials, and components; a general, diverse, and specialized system of educational, research, and training institutions; a highly developed R&D and industrial base; and a sufficiently large force of highly qualified and skilled scientists, engineers, and industrial workers.

3.19 The leading missile countries have hundreds of research organizations and industrial enterprises cooperating in the development and manufacture of ballistic missiles. In Russia, for example, hundreds of entities participate in production of the "Topol" ICBM. The total number of employees in the Chinese missile and space industry exceeds 200,000, even though China has rather modest achievements in missile technologies compared with the United States and Russia. Iran does not have such an infrastructure; neither do North Korea or Pakistan.

3.20 The major scientific, technological and production problems that have to be solved in building an IRBM or an ICBM are as follows:

- **a.** The development of powerful rocket motors;
- **b.** Flight control, guidance systems, and telemetry;
- **c.** Reentry vehicle heat protection;
- **d.** Construction materials;
- **e.** Flight testing.

Each of these areas would pose major scientific, technological, and production problems for Iran. (These are discussed in the Technical Addendum, available at www.ewi.info.)

Ballistic missiles with existing technologies

3.21 Iranian officials have claimed that Iran has missiles with a range of 2,000 km.[14] Such missiles would be capable of striking targets in the Middle East, southern Russia, and southern Europe. Iran, however, does not now have a missile capable of delivering a 1,000 kg payload to a range of 2,000 km. Table 1 shows that with such a payload the longest range of an Iranian missile for which we have technical data (i.e., the Shahab-3M) is 1,100 km. Nevertheless, on the basis of the technologies available to it, Iran could develop a ballistic missile capable of delivering a nuclear warhead weighing 1,000 kg to a range of 2,000 km. The time it would take for Iran to do this is determined primarily by the time it would take to build a nuclear warhead that is small enough and light enough for an Iranian missile to deliver — that is, six to eight years. (This is based on the estimates of the time it would take Iran to produce a simple nuclear device and then to develop a nuclear warhead.)

3.22 With the components and technologies it now has, Iran could hypothetically build missiles with a range of 3,000 km or more. Such missiles would possibly need a first stage consisting of a cluster of rocket motors, along with the associated turbopumps, control systems, and airframe. (The United States and the Soviet Union used rocket motor clusters in rocket development.) Along with the development of "staging" technology, Iran would have to learn to cluster rocket motors of limited thrust, since they are the only rocket motors currently available to it. These are both serious challenges, requiring extensive research and development and testing to gain the proper results and experience. Iran would also have to make significant advances in turbopump-related and airframe manufacturing technologies, as well as in system integration and component reliability. It would also need to solve difficult problems in flight control and guidance technology, and it would face particular problems in controlling the thrust vectors of the motors in the various stages. The design of warheads able to withstand the heat of reentry into the atmosphere would also present problems. Mastering the necessary technologies without external assistance would be a major undertaking, requiring perhaps ten years of concerted and visible effort.

3.23 IRBMs and ICBMs built in this fashion would have a serious disadvantage from Iran's point of view. They would be large, visible, and cumbersome, and they would have to be launched from above ground, not from silos. They would be anchored to their launch sites and would take days to prepare for launch and hours to fuel. The launch sites could be monitored from space, and launch preparations would be visible. Preparation for the launch of such missiles would be vulnerable to preemptive strikes. Because they would not be survivable, missiles of this kind would not provide effective deterrence of an attack on Iran — indeed they might invite an attack — while their use would inevitably elicit

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14 For example, former President Hashemi Rafsanjani claimed in October 2004 that Iran had missiles with a range of 2,000 km. See BBC News, "Iran increases missile range," October 5, 2004, http://news.bbc.co.uk/2/hi/middle_east/3716490.stm. In November 2007 Iranian Defense Minister Mostafa Mohammad-Najjar reported the building of the Ashura missile, with a range of 2,000 km. NTI, "Iran: Missile Chronology," http://www.nti.org/e_research/profiles/Iran/Missile/chronology_2007.html.

a devastating response. If Iran decides to develop IRBMs or ICBMs, it would make sense for it to develop missiles that are mobile and thus hard to find, or based in silos and thus hard to destroy. That would require more advanced technologies than Iran now possesses and would take longer than the development of IRBMs or ICBMs on the basis of existing technology.

The Missile Technology Control Regime (MTCR) and the Iranian Ballistic Missile program

3.24 The MTCR Control Lists identify a wide variety of technologies, goods, materials, components, and equipment that have critical importance for the development and production of modern ballistic missiles. Iran is unable to develop or produce most of the listed items domestically. That is why access to these items is critically important for further Iranian ballistic missile development. The numerous Iranian attempts to acquire the controlled items abroad are clear evidence in support of this assessment and demonstrate Iran's lack of important ballistic missile technologies and its inability to produce them in Iran.

3.25 The Rumsfeld Commission Report on the ballistic missile threat to the United States assumed that the newly-emerging missile states could achieve a significant ballistic missile capability quickly by using the experience — and avoiding the mistakes — of the traditional missile states. This assumption is not supported by developments since the Commission published its report in 1998.[15] This is probably because the Commission failed to give adequate weight to the enormous diversity and complexity of the specialized technical problems associated with each of the seemingly simple and small steps in the development of ballistic missiles.

3.26 Without direct foreign assistance, new missile states must, on their own, simultaneously address and solve numerous problems and overcome many obstacles during each stage of the development process. The Rumsfeld Commission assumed that foreign technical assistance was the "wild card," but North Korean assistance to Iran would not solve all the technical problems Iran now faces. Missile development requires diverse and specialized expertise that must typically be drawn from a wide range of institutions in a society. North Korea and Iran face barriers that are much greater and more significant than those the United States, the Soviet Union, and China confronted on the path to the development of ballistic missiles.

3.27 Foreign sources of critical ballistic missile technologies and goods are limited and well known. Iran is reported to have obtained a great deal of technology and know-how from North Korea, for example, and the two countries' missile programs should not be treated as unconnected. When the international community determines that there are legitimate concerns about nuclear and missile proliferation, strict adherence by all states, not only the member-states, to the MTCR provisions will be of the utmost importance for preventing Iran — and other states where there are legitimate concerns about nuclear and missile proliferation — from acquiring the capacity to advance such national agendas.

3.28 The nonproliferation regime for missiles and related technologies is based mainly on the MTCR, the Hague Code of Conduct against Ballistic Missile Proliferation (which was adopted by the MTCR members and some non-MTCR states on November 26, 2002), and the Proliferation Security Initiative, which focuses on interdiction of the transfer of banned weapons and weapons technologies. The UN Panel of Governmental Experts on missiles, which was established in 2000, can also be considered a significant international move towards a comprehensive missile control regime. Other initiatives on missile control such as the Russian proposal for a Global Control Regime and Global Monitoring System on missile technology have not so far made progress; nor has the proposal to convert the U.S.-Russian treaty on intermediate-range nuclear forces into a global treaty.

The North Korean test and its implications for Iran

3.29 On April 5, 2009, North Korea launched the Unha-2 rocket, which, it claimed, successfully carried a communications satellite into earth orbit. There is no evidence that a satellite was in fact put into orbit, and while the first two stages performed successfully, it appears that the third stage, which would have placed the satellite into orbit, failed. The launch of the Unha-2 thus failed to achieve its ostensible purpose.

3.30 The launch of the Unha-2 nevertheless provides information about the level of rocket and missile technology in North Korea. The first stage of the three-stage rocket appears to use a cluster of four Nodong rocket

15 "Report of the Commission to Assess the Ballistic Missile Threat to the United States," July 15, 1998, http://www.fas.org/irp/threat/bm-threat.htm.

motors to generate about 120 tons of thrust. The second stage can generate about 26 tons of thrust. The second stage of the North Korean launch landed about 3,000 km from the launch-site close to the designated impact range.

3.31 The Unha-2 represents a significant advance in North Korean rocket technology. The first stage shows that North Korea can now cluster four Nodong rocket motors, providing four times the thrust and lift capacity of a single Nodong motor, and demonstrates that North Korea has the technology that will eventually enable it to deliver larger payloads to longer ranges. (The North Korean test of the Taepodong 2 in July 2006 appears to have used a similar first stage — four clustered Nodong rocket motors — but it failed 40-42 seconds after launch.) The success of the second stage of the Unha-2 shows that North Korea has also advanced its ability to build multi-stage ballistic missiles with upper stages that are lighter and more efficient than those based on SCUD technology. It should be noted, however, that converting a space launch vehicle into a nuclear-armed IRBM or ICBM would require a third stage of a different design, mastery of flight control and guidance technology, reentry vehicles that could withstand the heat of reentry into the atmosphere, and the development of nuclear warheads that are rugged, light, and compact.

3.32 A missile based on the first two stages of the Unha-2 could in principle deliver a payload of 1,000-2,000 kg to a much further range than any previous North Korean or Iranian missile. Such a missile would most likely have the characteristics listed in paragraphs 3.22 and 3.23 above — characteristics that would make it provocative and dangerous. Like the Unha-2, it would require days to prepare for launch and hours to fuel, and these activities could be monitored from space.

3.33 Iran has benefited from the North Korean missile program in the past. It cannot be ruled out that the latest North Korean technology will be transferred to Iran. (See the Technical Addendum for a full discussion of the North Korean program.) If that happened, it could speed up the Iranian ability to produce IRBMs and ICBMs of the kind discussed in paragraphs 3.22 and 3.23.

Conclusions

3.34 Iran has demonstrated a serious interest in rocketry and ballistic missiles. It has shown that it can modify rocket airframes built with SCUD technology and utilize rocket motors obtained from North Korea or elsewhere. It has developed a two-stage space launch vehicle and launched a satellite into earth orbit. The main emphasis of its missile program thus far has been on missiles that are evidently aimed to strengthen Iran's role as a regional power. Iran faces security challenges on all its borders and is seeking to counter Western, and especially American, influence in the region.

3.35 In chapter 2 a very provisional estimate was given that Iran could produce a nuclear warhead for a ballistic missile within several years — perhaps six to eight — of a decision to develop and produce such a warhead. (The figures are derived from the estimates of the time it would take Iran to produce a simple nuclear device and then to develop a nuclear warhead.) These estimates are provisional because a nuclear warhead might be developed more quickly with foreign help and might take longer to develop if Iranian programs were disrupted by political and economic factors.

3.36 Iran's ability to threaten the whole of Europe would depend on its ability to build an IRBM that has at least twice the launch weight of the Shahab-3. There is no evidence that Iran is pursuing the development of such a missile. The development of missiles that could strike targets throughout Europe would require either the production of large and vulnerable systems or major advances beyond the technologies Iran has so far demonstrated.

3.37 It is virtually impossible to predict with any precision how long it might take Iran to produce a modern, credible ICBM. The length of time depends on the growth of Iran's economy and its industrial and scientific base, on the availability of external help, on Iran's political commitment to this objective, and also on the state of Iran's foreign relations. Without a significant influx of additional technology, it does not appear that Iran would be able to build a modern, silo-based, rapid-launch ICBM for at least ten to fifteen years, even if it decided now to do so. There is no evidence that Iran has taken such a decision.

3.38 The key to controlling the advance of Iran's ballistic missile program lies in vigorously enforced and enforceable diplomatic agreements among the small number of states that have the appropriate specialized critical rocket technologies not to transfer these technologies to Iran and North Korea. There appears to have been some success in recent years in improving the MTCR. It is important that this improvement be maintained and strengthened.

3.39 The analysis given here suggests the following conclusions:

- **a.** Iran has demonstrated the ability to modify rocket airframes built with SCUD rocket technology and to utilize rocket motors obtained from North Korea or elsewhere.
- **b.** Iran could develop, in perhaps six to eight years, a missile capable of carrying a 1,000 kg warhead to a range of 2,000 km, although its longest-range missile at present has only about half that range.
- **c.** Iran will not be able, for at least ten to fifteen years, to master independently the "critical technologies" for advanced mobile or silo-based IRBMs and ICBMs because it does not have the scientific, economic, and industrial infrastructure for developing these critical technologies. (The same holds true for North Korea.)
- **d.** On basis of the technology currently available to it, Iran could hypothetically build IRBMs and ICBMs. These would be large, visible, and cumbersome systems with serious drawbacks as military missiles; in particular, they would be vulnerable to preemption. Missiles that are neither mobile (and thus hard to find) nor based in silos (and thus difficult to destroy) could lessen rather than enhance Iranian security.
- **e.** Foreign sources of ballistic missile technologies and components are critical for further advancing the Iranian ballistic missile program.
- **f.** North Korea's test of the Unha 2 opens new possibilities for building larger ballistic missiles than the Shahab 3. Technology transfer from North Korea to Iran could help the Iranian ballistic missile program substantially.
- **g.** Every effort should be made to restrict the flow of foreign missile technologies to Iran and other states of concern, especially North Korea.

4. Defense against Iranian Ballistic Missiles

The U.S.-European Integrated Missile Defense

4.1 The European missile defense system is designed to provide missile defense components to complement and enhance defense of the continental United States against an attack by Iranian long-range ballistic missiles, and to extend U.S. ballistic missile defense coverage to Europe. (See the Technical Addendum.)

4.2 The components proposed for deployment in Europe are: a giant (750 m² antenna) low-frequency (UHF) early warning radar at Fylingdales in England; a large (105 m² antenna) high-frequency X-band radar called the European midcourse radar (EMR) in the Czech Republic; a much smaller (9.2 m² antenna) forward based X-band (FBX) radar in an unspecified location near the borders of Iran, possibly in eastern Turkey or the Republic of Georgia; and a launch site with ten ground-based interceptors in northern Poland, near the border with Kaliningrad.

4.3 The overall missile defense system includes other UHF radars positioned closer to the United States that are used exclusively for the defense of the continental United States. These radars are located at Thule, Greenland; Cape Cod, Massachusetts; and Grand Forks, North Dakota.

4.4 The UHF and X-band radars are mutually complementary, distinctly different, and independently critical to the performance of the defense system. The UHF radars have the ability to search for and acquire warheads at long range, but they have no ability to determine the differences between warheads and decoys. The X-band radars have almost no ability to acquire warheads at long range, but when they are pointed to radar targets by the UHF radars, they can collect higher-resolution data on each target. Thus each of these radars performs a critical function for the defense system as a whole and for the other radars; if either the UHF or the X-band radars failed to perform their function, the whole system would collapse.

4.5 The UHF early warning radars involved in the defense of the United States (those at Fylingdales, England; Thule, Greenland; and Cape Cod, Massachusetts) can easily track warheads at ranges of over 3,000 km. These radars have been upgraded but still have severe limitations, notably a range resolution of only 15 m, which is so poor that they cannot tell the difference between a 2 to 3 m long warhead and a 30 cm length of wire.

4.6 By contrast, the X-band EMR can observe warheads and decoys with a range resolution of roughly 15 cm. Such high-resolution data does not guarantee the ability to conclude whether an object is a warhead, decoy, piece of wire, or yet another object, but without this radar the system would have no chance of discerning possible differences in the signals from the many objects that could accompany warheads during an attack. The EMR is intended to perform the critical function of tracking enemy targets for the defense not only of Europe, but also of the United States.

The challenges of ballistic missile defense

4.7 Effective missile defense has proved an elusive goal since the development of ballistic missiles. Nuclear warheads make the requirements for defense especially stringent because a defense that is even ninety percent effective could hardly be judged satisfactory by the defending country, even though the attacker might well consider this to be a serious threat to his offensive capabilities. Missile defense is by its nature a competition between the offense and the defense, and to date the advantage has lain with the offense. Because it is a competition, the offense can be expected to take measures to destroy, overcome, or outwit the defense. One of the obvious ways to do that is to find alternative means of delivery for nuclear warheads: aircraft, cruise missiles, or less conventional means such as freighters entering a port. Here we consider some of the specific challenges facing the proposed European missile defense system.

Countermeasures

4.8 A particularly important group of countermeasures exploits the fact that strategic ballistic missile defense is designed to intercept warheads when they are at high altitudes in the near vacuum of space, where light and heavy objects fly along together because there is no aerodynamic resistance to cause light objects to slow up relative to heavy objects. These conditions, which are intrinsic to all long-range ballistic missile defenses that are designed to operate at high altitude (such as the missile defense elements proposed for Europe), make it possible to build simple countermeasures that can overwhelm the defense.

4.9 Among the measures the attacker can take to confuse the defense and render it ineffective are reduction or elimination of the radar reflections from the warhead by covering the warhead nose with a pointy metallic sleeve and by covering other parts of the warhead with radar absorbent material. Moreover, by scarring the surface of the warhead with wires, it would be possible to create additional reflections in order to confuse the radars. Decoys could also be deployed that would appear to the kill vehicle's infrared homing sensor as credible targets, thereby making the task of target discrimination extremely difficult. Balloons or mock warheads could serve as decoys. (See the full discussion in the Technical Addendum.) Countermeasures of this kind will be readily available to any adversary capable of building, deploying, and operating an IRBM or ICBM.

Attacks with more than one or two missiles

4.10 To be effective against even a relatively unsophisticated enemy, U.S. missile defenses in Europe must be able to withstand attacks involving more than one or two missiles. This is because it is relatively inexpensive for an adversary to build more offensive missiles once it has developed and produced the first one. If Iran were determined to acquire the capability to attack Europe, it would be likely to do whatever it took to overwhelm the missile defenses not only by using decoys to fool the defenses and by deploying stealthy warheads, but also by acquiring a force of more than one or two missiles.

4.11 The U.S. Missile Defense Agency acknowledges that the proposed system could not handle an attack of that kind. The military recognizes that the first interceptor might miss its target and therefore plans to shoot as many as five interceptors at each incoming missile, in order to reduce the probability that the defenses might be penetrated.[16] The idea is that if the first interceptor misses, the second might not, and so on. If Iran were to attack Europe with two missiles, and the defense were to fire five interceptors at each one, the ten interceptors that are planned for deployment in Poland would be quickly used up. If Iran were to launch more than two missiles at Europe, there might be no interceptors left to repel further attacks.

4.12 If Iran believed that U.S. missile defenses were effective and was reckless enough to want to attack Europe or the United States, it could simply build more missiles to overwhelm those defenses. If Iran were to attack Europe with more than one or two missiles, the European missile defense system as proposed could not defend Europe.

16 This was explained to the House Armed Services Committee by the Undersecretary of Defense for Acquisition, Technology and Logistics in testimony in 2003 and by the Director of the Missile Defense Agency in April 2008. See Hearing, March 18, 2003, House Committee on Armed Services, the Honorable Edward "Pete" Aldridge, Undersecretary of Defense for Acquisition, Technology and Logistics, and Hearing, House Committee on Oversight and Government Reform, Subcommittee on National Security and Foreign Affairs, April 30, 2008, Lt. Gen. Henry A. Obering, III, Director, Missile Defense Agency.

Defending both Europe and the United States

4.13 If, as proposed, the U.S. missile defense system for Europe is to defend both Europe and the United States, the system in Europe will need to be able to handle *both* IRBMs aimed at Europe *and* ICBMs aimed at the United States. That means that the proposed system in Europe must operate as both a mid-course system and a post-boost, ascent-phase system. That is something the ground-based interceptor missiles in Alaska and California cannot do. It has never been demonstrated that ground-based interceptor missiles in any location could do it.

4.14 To be effective in this dual mission the proposed system must be able to demonstrate a capability that the prototype system in Alaska and California has never demonstrated and cannot do from those locations. The interceptors proposed for Poland would be much closer to Iran than the interceptors in Alaska and California are to North Korea. This means that the time available for response and engagement would be much shorter than the time available to intercept missiles from North Korea. Such short timelines have never been attempted with the missile defense system in a flight intercept test.

4.15 These shorter timelines would be stressing enough if the radar proposed for the Czech Republic had adequate range to detect an Iranian missile launch as soon as it cleared the horizon. However, technical analysis shows that the proposed radar's range is too short to discriminate, or to provide prompt track data about, warheads delivered by long-range missiles launched from the Middle East toward the United States. (See the Technical Addendum.)

4.16 Iran could perhaps field IRBMs more easily than ICBMs, and so to be effective the proposed European system might have to deal with several intermediate-range missiles fired at Europe, requiring multiple, simultaneous engagements by the proposed interceptors in Poland. This capability has never been demonstrated through flight intercept tests with the missile defense system.

Target discrimination

4.17 Target discrimination is one of the fundamental challenges of missile defense. Apart from the generic difficulties listed above, there are specific reasons to doubt that the missile defenses proposed for Europe can deal with this challenge. (See the Technical Addendum for details.)

4.18 The first reason concerns the missile defense interceptors. Before they can be launched, the interceptor missiles must have precise information from the radars about the expected location of a complex mix of targets and decoys. Interception requires that the homing interceptor (kill vehicle) destroy its target by impact, using infrared sensors to home in close enough to hit the target. The kill vehicle must be able to discriminate between warheads and decoys using only its infrared sensor. This is because if the decoys are clustered within a kilometer or less of the warhead, the X-band radar will not be able to measure the angular position of the different objects accurately enough for the kill vehicle to select the warhead using data from the radar. Exceptions to this situation can occur, but for all practical purposes these exceptions have no meaning for missile defense systems. The kill vehicle will not have sufficiently accurate information about the actual location of each object in the field of view of its infrared sensor to associate, on a one-to-one basis, each object seen by the radar with each object seen by the kill vehicle.

4.19 The second reason has to do with the limitations of the EMR against warheads on trajectories from Iran. The relatively low-frequency UHF radar at Fylingdales can see warheads at all ranges needed by the defense, subject only to limitations imposed by the curvature of the earth. This is not the case with the X-band EMR, which is intended to perform the function of discriminating warheads from the decoys, wires, and other debris that could be traveling along with them.

4.20 A cone-shaped warhead pointed directly at the X-band radar (a nose-on view, which is the same as looking at it from a 0° orientation) might have a radar cross-section of about 0.03 m^2. It is the nose radius of the warhead that determines the radar cross-section. Simply covering the nose with a pointy cone-shaped thin metal sleeve would eliminate the rounded nose's contribution to the radar cross-section. Changing the orientation of the warhead to a few degrees from nose on would result in its radar cross-section dropping to thousandths of a square meter. In all orientations where the radar cross-section is below 0.01 m✲, the EMR's detection range will be well below 600 km.

4.21 It has been reported that the antenna on the EMR has been designed to hold up to 80,000 X-band transmit/receive modules, which would increase its minimum range from below 600 km against a 0.01 m✲

radar cross-section target to about 1,300 km. That is still substantially short of the more than 2,000 km minimum range required to support the system.

4.22 In the case of an attack from Iran on Washington, DC, warheads could easily be pointed towards, or nearly towards, the EMR. This could be done by rotating the upper rocket stage towards the EMR, spinning the warhead around its axis of symmetry so that it maintains a stable orientation in space, and then pushing the warhead off the upper rocket stage. A CIA report published in September 1999 concluded that any country capable of building an ICBM would be capable of such operations.[17] Analysis of the detection range contours for the EMR and FBX X-band radars against warheads with a radar cross-section of 0.01 m✤ makes it clear that those radars will not have sufficient range even to detect warheads, let alone to gather the high-resolution radar data that is essential for telling the difference between warheads and decoys.

4.23 If this analysis is correct, the proposed EMR will not be able to perform its discrimination function against warheads launched from Iran against either Europe or the United States.

Russian Concerns about the European Missile Defense System

4.24 U.S. critics of the proposed missile defenses in Europe point to the weaknesses discussed above. Russian critics, on the other hand, point to the threat that those missile defenses pose to Russia's national security interests. The main Russian concern is the EMR. The Czech Republic is a convenient place from which to gain a better view of Russian ICBMs and to defend the east coast of the United States. The Russians see enormous potential for upgrading the power of the EMR, giving the U.S. global missile defense system a broad capability to track ICBMs launched from the European part of Russia, providing information not only for the missile interceptors based in Poland but for those based in Alaska too. Deployment of the EMR will, in the Russian view, create over the territory of the United States a "missile defense umbrella" against a potential Russian ICBM attack. The resulting integrated defense, which would include missile defense radars in California and Alaska, would provide comprehensive missile defense coverage of the entire United States against all of Russia's strategic missile forces. Russian military leaders and experts regard the proposed EMR in the Czech Republic as a key element in the creation of the information infrastructure for building up and strengthening the global U.S. missile defense system.

4.25 The United States has argued that since the launch site in Poland will have only ten interceptors it can pose no substantial threat to the large numbers of ICBMs currently possessed by Russia. Russia has countered that the number of interceptors could be increased very quickly. It would not be difficult from either a technical or an economic point of view to increase the number of interceptors: silo-based and mobile interceptors could be deployed for millions of dollars compared to one billion dollars for the EMR. Such interceptors could be deployed in Europe instead of the currently proposed interceptors. The ten interceptors planned for deployment in Poland will be able to intercept Russian ICBMs launched from the European part of Russia. Ten interceptors do not represent a big threat to the Russian strategic missile forces. But Russia is concerned that an increase in the number of interceptors in Poland or in other places in Europe, as well as the interceptors' advancing capabilities, will seriously undermine the Russian retaliatory potential.

4.26 ICBMs launched from Iran on trajectories toward the United States, and IRBMs on trajectories towards Western Europe, would almost certainly deploy warheads that are oriented towards the European midcourse radar, close enough to a nose-on orientation to have very small radar cross-sections. For ICBMs launched from Russia toward the United States, however, the radar viewing angles for the different ICBM stages will produce radar cross-sections hundreds of times larger than the radar cross-sections of warheads launched from Iran. These very large radar cross-sections would make it possible for the EMR — especially if it is upgraded — to track the upper rocket stages of Russian ICBMs with high precision. The radar could observe subtle changes in the motion of the upper rocket stages as the upper stage deploys warheads. The radar might or might not be able to observe the warheads, depending on engineering details and on whether they can be viewed from the back end, but it might be possible to infer the trajectories of the warheads, providing enough information to launch interceptor missiles toward intercept points where they would then home in on the infrared signals from the warheads — and on the decoys that would almost certainly accompany the warheads.

17 Statement for the record to the Senate Foreign Relations Committee on Foreign Missile Developments and the Ballistic Missile Threat to the United States through 2015 by Robert D. Walpole, National Intelligence Officer for Strategic and Nuclear Programs, September 16, 1999, https://www.cia.gov/news-information/speeches-testimony/1999/walpole.htm.

Conclusion

4.27 This analysis points to the following conclusions:

- **a.** The proposed addition of European-based components to the U.S. national missile defense cannot provide a dependable defense for Europe or the United States.
- **b.** Any country capable of building, deploying, and operating IRBMs or ICBMs will be able to develop the countermeasures needed to render the missile defense ineffective. The EMR will face great difficulties in discriminating warheads launched from Iran against Europe or the United States from the decoys that might accompany them.
- **c.** If Iran were to produce a missile that could carry a nuclear warhead to a range of 2,000 km, the European-based components of the U.S. missile defense could not engage that missile. The appropriate missile defense would be shorter-range missile defenses such as Terminal High Altitude Area Defense (THAAD). These missile defenses too would have to be able to cope with the potential countermeasures that could defeat the longer-range exoatmospheric defense system.
- **d.** Russia has made it clear that it regards the proposed European missile defense system as a threat to its national security interests. It places particular emphasis on the capacity of the system for expansion and modernization. Under these circumstances, Russia is unlikely to be willing to agree to deep reductions in strategic nuclear forces.
- **e.** These conclusions suggest that, before taking a decision to deploy the proposed missile defenses in Europe, the Obama administration should conduct a serious technical review of the capabilities claimed for the proposed European missile defense system. In particular it should ask: does the EMR have the range against warheads to support its intended discrimination function? Can the system overcome simple countermeasures? Has the system "demonstrated through successful, operationally realistic flight-testing, a high probability of working in an operationally effective manner," as required by the FY-2008 Defense Authorization Act.

5. Conclusions and Recommendations

The Iranian Programs

5.1 Four questions were posed in paragraph 1.1. On the basis of the analysis in this report, they can be answered as follows, subject to the caveats that have been registered.

5.2 What nuclear capability does Iran have today and what might it have in the future? Iran has been engaged in a serious nuclear program and has made steady progress. By February 2009 it had produced 1,010 kg of low-enriched uranium hexafluoride. That would be enough for one bomb if it were converted to HEU. If Iran were to decide now to make use of this LEU to produce weapon-grade uranium, it would have to remove IAEA control and monitoring of the low-enriched uranium, and of the enrichment process, at the FEP. It would then be a matter of time — in the range of one to three years, according to the estimate given in chapter 2 — before a nuclear explosive device could be produced. It might take another five years to produce a nuclear warhead that could be delivered by existing and future Iranian ballistic missiles.

5.3 What ballistic missile capability does Iran have today and what might it have in the future?

- **a.** Iran has tested at least four liquid-propellant missiles. The Shahab-3 could deliver a payload of 1,000 kg to a distance of 1,100 km. In February 2009 Iran used the Safir-2 SLV to launch a satellite into earth orbit. That launch did not mark a fundamental technological breakthrough since the Safir first stage is based on the Shahab-3 missile. It did, however, demonstrate that Iran was making advances in the development of rocket technology.
- **b.** Iran could develop in perhaps six to eight years a ballistic missile capable of delivering a 1,000 kg nuclear warhead to a range of 2,000 km. The nuclear-missile threat that the European-based components of the U.S. missile defense system are designed to defend against (IRBMs and ICBMs) will not materialize for some years, and probably not in the next decade, unless Iran receives substantial help from outside.
- **c.** In April 2009 North Korea launched the Unha-2 three-stage missile with the ostensible aim of putting a satellite into earth orbit. In that respect the test was a failure, but the first and second

stages appear to have worked successfully, marking a significant advance in North Korea's mastery of rocket technology. If North Korea were to transfer this technology to Iran, it could help Iran, especially by increasing its potential to build missiles with a much greater lift capability than the Shahab-3.

5.4 If Europe had a missile defense system, could that system protect Europe? The analysis given here shows that the missile defense system proposed for deployment in Europe has serious weaknesses and would not be able to provide a dependable defense against IRBMs and ICBMs launched from Iran, if such a threat were to emerge.

5.5 Does Europe face a military threat from Iran, and if so what is the nature of that threat? This report has focused on the technical rather than the political aspects of a possible threat. It has not assumed that Iran is planning to attack (or to acquire the capability to attack) Europe with nuclear-armed ballistic missiles; it is indeed difficult to imagine the circumstances in which Iran would do so. Iran does not at present possess that capability, nor is there specific evidence that it is seeking to acquire it. The nuclear missile threat from Iran to Europe is thus not imminent. At some point in the future Iran could acquire the capability to attack Europe with nuclear-armed IRBMs. It is not clear, however that the deployment of IRBMs would enhance Iran's security. Large, visible, ground-launched missiles would be both provocative and vulnerable; mobile or silo-launched missiles would be more secure but would take much longer to develop, and their use would elicit a massive response.

5.6 The estimates of the likely timescales for Iranian programs could be upset if Iran were to receive substantial help from outside for its nuclear and missile programs. Close cooperation between the United States and Russia — and with other countries — would be one of the most effective ways of mitigating this danger.

U.S.-Russian relations

5.7 U.S.-Russian relations are no longer the axis on which world politics turns, as they were during the Cold War, but they are still of great importance. These are the two states with the largest number of nuclear weapons and they therefore play a key role in maintaining strategic stability and also exercise significant influence on regional stability. After the collapse of the Soviet Union, Russia and the United States began to construct their relations on a new basis, free from the ideological confrontation of the Cold War. Leaders on both sides spoke of their desire to develop friendly and mutually advantageous relations in a spirit of partnership. The two countries have been cooperating in the fight against international terrorism and against the proliferation of weapons of mass destruction. Both are taking part in the Six-Party Talks on the North Korean nuclear program, and they are working together in the effort to resolve regional conflicts in the Middle East and Afghanistan.

5.8 In recent years, however, relations between the two countries have taken a turn for the worse, casting doubt on the prospects for future cooperation. They reached a low point in August 2008 when the war in Georgia led to sharp rhetoric and a reassessment of relations on both sides. The contentious nature of the missile defense issue both reflects the mistrust that has entered the relationship and in turn exacerbates that mistrust.

5.9 There is now the possibility of an improvement in U.S.-Russian relations, of a move away from the mutual disillusionment and recrimination of recent years. On April 1, 2009, President Medvedev and President Obama signed a joint statement in which they resolved "to work together to strengthen strategic stability, international security, and jointly meet contemporary global challenges, while also addressing disagreements openly and honestly in a spirit of mutual respect and acknowledgement of each other's perspective."

Recommendations

5.10 This report has concluded that there is at present no IRBM/ICBM threat from Iran and that such a threat, even if it were to emerge, is not imminent. Moreover, if such a threat were forthcoming, the proposed European missile defenses would not provide a dependable defense against it. It does not make sense, therefore, to proceed with deployment of the European missile defense system in Poland and the Czech Republic.

5.11 The more immediate danger comes from the military and political consequences that would follow if Iran were to acquire nuclear weapons and the capacity to deliver them against targets in the Middle East. The urgent task, therefore, is for Russia and the United States (and other states) to work closely together to seek, by diplomatic and political means, a resolution of the crisis surrounding the Iranian nuclear program. Such cooperation could be helped if the issue of European missile defense were set aside.

5.12 If deployment of the European missile defense system were suspended, the United States and Russia could explore in a serious fashion the possibility of cooperation in ballistic missile defense, an issue also mentioned in the joint statement of the two presidents. A wide range of options could be explored, including the possibility of boost-phase missile defense. (See the Technical Addendum for a detailed discussion.)

5.13 There is scope for U.S.-Russian cooperation in the following areas:

- **a.** Ensuring that the sanctions the Security Council has imposed on Iran are implemented strictly;
- **b.** Strengthening the nuclear nonproliferation regime, and in particular the IAEA's capacity to implement safeguards and enhance its verification procedures;
- **c.** Strengthening the MTCR in order to restrict further the export of sensitive missile technologies;
- **d.** Persuading Iran, by diplomatic means, to adopt measures that will reassure its neighbors (and the international community more generally) that its nuclear program is directed solely toward peaceful purposes.
- **e.** Exploring the responses the two countries could take if Iran should expel the IAEA inspectors; and studying other paths by which Iran might seek to "break out" as a nuclear power and devising appropriate responses.
- **f.** Investigating seriously the possibility of cooperation in missile defense.

5.14 The issues dealt with in this report — the potential nuclear-missile challenge from Iran and the role of missile defense in meeting that challenge — have in the past served to worsen U.S.-Russian relations. The analysis given in this paper points to a different possibility: that cooperation between the two countries could help to resolve these important and urgent issues and could play a role in changing the U.S.-Russian relationship for the better.

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