RETHINKING THE OFFER:
THE IMPACT ON NUCLEAR NON-PROLIFERATION OF PROVIDING NORTH KOREA AND IRAN WITH LIGHT WATER REACTORS

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Introduction

Since the discovery of nuclear weapons-related technology in the late 1930s, the United States as well as the international community has put substantial efforts towards controlling the spread of nuclear technology, given the potential dangers it represents. President Dwight D. Eisenhower’s Atoms for Peace speech in the United Nations General Assembly in 1953 led to the establishment of the International Atomic Energy Agency (IAEA), which supervises member states’ peaceful uses of nuclear energy through international safeguards and monitoring. The international community eventually witnessed the successful creation of a nonproliferation regime based on a legally binding treaty, the Treaty on the Non-Proliferation of Nuclear Weapons (NPT; Nuclear Nonproliferation Treaty) in 1968. Based on a clear distinction between nuclear weapon states and non-nuclear weapon states, the treaty has served as the centerpiece of non-proliferation efforts by legally prohibiting the emergence of new nuclear-armed states.¹

Nevertheless, nuclear proliferation has not come to an end. Rather, the risk it poses has significantly increased given the growing availability of related technology and the expansion of non-state actors’ activities.² These changes in global environment have

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¹ The NPT recognizes the countries which have manufactured and exploded a nuclear weapon or other nuclear explosive device prior to January 1, 1967 as nuclear weapon states. The de jure nuclear weapon states include the US, Russia (FSU), the UK, France and China. The rest of the member states are non-nuclear weapon states.

² President Barack Obama pointed out the threat of the spread of nuclear technology in his remarks in Prague, Czech Republic on April 5, 2009. He said, “Today, the Cold War has disappeared but thousands of those weapons have not. In a strange turn of history, the threat of global nuclear war has gone down, but the risk of a nuclear attack has gone up. More nations have acquired these weapons. ... The technology to build a bomb has spread. Terrorists are determined to buy, build or steal one. Our efforts to contain these dangers are centered in a global nonproliferation regime, but as more people and nations break the rules, we could reach the point when the center cannot hold.”

significantly impeded effective control over the spread of nuclear technology and materials. More importantly, certain countries, largely hostile to the US, have explicitly or implicitly expressed their reluctance to abide by internationally imposed restrictions on freedom of action, and have instead attempted to develop their own nuclear arsenals. Failure to curb their ambitions will undermine international peace and security by raising the possibility that such countries will intentionally or unintentionally assist non-state actors such as terrorists in their acquisition of nuclear weapons or nuclear weapon-related materials.

The Democratic People’s Republic of Korea (DPRK; North Korea) and the Islamic Republic of Iran (Iran) are widely perceived as imminent or latent threats to international security from the non-proliferation standpoint. By identifying the two countries as potential proliferators, the international community has attempted to dissuade them from following their nuclear ambitions with a variety of means. China, Japan, Russia, South Korea and the United States have collectively set up a process to engage North Korea in a set of negotiations aimed at leading it to relinquish its nuclear weapons program and related activities. This process, called the Six-Party Talks has examined using a wide range of incentives such as lifting economic sanctions, providing energy assistance and removing the country from the list of state sponsors of terrorism, to convince Pyongyang to abandon its nuclear arsenal. In the case of Iran, the P5+1 (also known as the EU-3+3 countries; France, Germany, the UK + China, Russia and the US) have designed a comprehensive package for Iran including the normalization of trade and economic relations and promotion of political cooperation. In particular, light water
reactors (LWRs) were proposed as one of the incentives to be provided to both Pyongyang and Tehran.

This paper will examine the impact on nuclear non-proliferation efforts of providing the DPRK and/or Iran with LWRs. I hypothesize that LWRs in the hands of the DPRK or Iran will substantially increase proliferation risks in that the two countries have intentions to engage in proliferation activities and LWRs will assist them in realizing their intentions. By proving the hypothesis, I attempt to question previous policy decisions to include the provision of LWRs in incentive packages to the DPRK and Iran.

I will start by looking into the nature and types of nuclear proliferation before turning to a section addressing the proliferation risks of LWRs. By reviewing arguments over proliferation risks of this type of reactor, I intend to explain the condition under which the provision of LWRs would pose nuclear proliferation risks - if countries intend to proliferate nuclear weapons or nuclear explosive materials, the provision of LWRs will involve considerable proliferation risks. Thus, as a next step, I analyze the intentions of the DPRK and Iran. By demonstrating that the DPRK and Iran have intentions – either

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3 Light water reactors (LWRs) use ordinary water (H\textsubscript{2}O) as a material for slowing down movements of neutrons, technically referred to as “moderator.” For this reason, light water reactors are sometimes called as light water-moderated reactors. A more detailed explanation is given in the section IV.

4 In this paper, nuclear explosive materials refer to primarily highly enriched uranium (HEU) and plutonium. HEU and plutonium are primary fissile materials most suitable for producing nuclear weapons. Plutonium is produced from the uranium in nuclear reactor fuel as a result of reactor operation and can be separated from the uranium chemically after the fuel has been removed from the reactor. The separating technology is called reprocessing. Uranium suitable for making nuclear bombs requires approximately ninety percent or more of U-235 concentration. Given that natural uranium contains only 0.7 percent of U-235, natural uranium should be enriched to higher concentration of U-235 to achieve weapons-grade uranium. The technology employed in the process is called uranium enrichment technology. In terms of distinction between fissile material and nuclear explosive material, fissile materials refer to those that can sustain a chain reaction under certain circumstance. Therefore, all fissile materials are nuclear explosives, but not all nuclear explosive materials are fissile. In this paper, both terms are used to refer to HEU and plutonium. See National Academy of Sciences, Monitoring Nuclear Weapons and Nuclear Explosive Materials (Washington, D.C.: National Academies Press, 2001) pp. 109-113.
explicit or implicit - to engage in proliferation activities, I argue that providing the two countries with LWRs will bring about unintended consequences, precipitating the realization of their ambitious goals instead of discouraging them.

**Methodology**

In analyzing the intentions of Pyongyang and Tehran in terms of nuclear proliferation activities, there are four questions to be addressed: Does the DPRK intend to expand its nuclear arsenal? Does the DPRK intend to transfer its nuclear weapons or nuclear explosive materials to any other actors? Does Iran intend to pursue nuclear weapons? And does Iran intend to transfer nuclear weapons or nuclear explosive materials to any other actors when or if it obtains sufficient stockpiles?

As a first step, the paper will examine the motives of Pyongyang and Tehran with respect to acquiring nuclear explosive materials and eventually nuclear weapons as well as exporting or transferring them to other actors. This will serve as a basis for the following analysis in the sense that motivation provides states with willingness to take reasonable risks based on their own cost-benefit calculations. For example, if a state concludes that the benefits from acquiring nuclear weapons or weapons-related materials exceed the costs which it would have to pay to acquire such items, it is likely to pursue nuclear weapon capabilities. It is worth acknowledging up front that understanding the cost-benefit matrices of the DPRK and Iran is difficult given the characteristics of their regimes and the paucity of reliable knowledge about their internal decision-making processes that exists in the open source literature – as such, much of the following section is necessarily indicative rather than conclusive.
The analysis of the motives of Pyongyang and Tehran is followed by the observation of their stated motives for nuclear program. Identifying the gap between the driving factors forcing the countries to pursue nuclear capability and their official stance is useful to predict the country’s potential path in terms of nuclear capability. Despite the usefulness of the evidence, heavy reliance on official statements of the two countries could blur the observer’s perspective if one is not cautious about the possibility of deception. Thus, it should be noted that evaluating the sincerity of the statements is another challenging task.

The first criterion in examining the DPRK and Iran’s intentions to engage in proliferation activities is as to whether or not the two countries have complied with the obligations set under the international arrangements to which they were or are parties. The NPT and the International Atomic Energy Agency (IAEA) are the major international regimes setting legally binding obligations to ensure that there are no illicit proliferation activities, mainly verifying the absence of diversion of nuclear energy from peaceful uses to military applications. Compliance or noncompliance with the obligations under the NPT and the IAEA could be found in official statements of the UN and the IAEA. In particular, the UN Security Council resolutions are a major punitive measure against countries violating these obligations. Other than these universal obligations, the two countries also assume responsibilities in multilateral arena, the Six-Party Talks for the DPRK and the EU-3+3 negotiations for Iran. Thus, the official statements of participants provide a useful complementary tool in verifying noncompliance by Pyongyang and Tehran.
However, the presence of continuous noncompliance with their nonproliferation-related obligations does not necessarily mean that the countries have made a determination to engage in proliferation activities. They might consider the constraint posed by the international regime unacceptable for internal political reasons or they might perceive their continuous defiance as bargaining chip, a tool to achieve their political goals. Nevertheless, taking into account cumulative damages caused by punitive actions, continuous violations could be interpreted to be more than just defiance of the existing international order. In this sense, although the evidence of noncompliance should not be directly interpreted as the country’s firm stance to proliferate, continuous noncompliance indicates that those countries are more likely than not to proliferate, either in the near term or in the longer term.

To supplement this drawback, the paper looks into the scope and area of noncompliance, combined with the countries’ negotiating tactics at the negotiating table. If a country consistently refuses to comply with its obligations in a certain area or continues to demand a certain incentive unconditionally, the behavior could indicate the threshold which the country ought to retain in any circumstances. Pointing to this pattern serves as a useful tool in analyzing what their intentions might be.

The last criterion of the analysis is past proliferation activities. Actual engagement in proliferation activities in the past, combined with their motivations for horizontal proliferation, are useful to consider in examining the prospects of future proliferation. By closely observing the past activities, the paper attempts to predict the probability of their future engagement in proliferation. Although the criterion seems to provide one of the
most powerful yardsticks to judge their intentions, it should be noted that past behaviors
do not necessarily offer the complete explanation about future behaviors. In addition,
given that motivations and constraints are the product of interactions between a state and
the rest of the world, there are significant chances for the state’s behavior to change over
time.

In considering these data points, the paper seeks to answer the questions posed at
the beginning of this section. If I find the following evidences, it is likely that the country
has intention to engage in proliferation activities: the country has a national security or
regime survival-related motivation for nuclear weapon capabilities \(^5\); its official
statements clearly demonstrate its intention to engage in proliferation activities; the
country has continuously defied the international community over its obligations under
the NPT, the IAEA, or multilateral negotiating frameworks; it consistently insists on
pursuing what is widely perceived by the international community to be a latent nuclear
weapons capability; it has engaged in horizontal proliferation activities, such as
transferring sensitive technologies or nuclear explosive materials to other states or non-
state actors, in the past.

**Nuclear Proliferation**

1. **What is Nuclear Proliferation?**

   In narrow terms, nuclear proliferation is defined as the spread of nuclear weapons.
   In broader terms, the definition could include the spread of nuclear explosive materials or

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\(^5\) This argument is based on that national security-related motivation is first and foremost in the sense that it
is related the raison d’etat of the state. Therefore, I assume that national security-related motivation is
strong while other motivations – economic and social - are relatively weak.
essential technology related to manufacturing nuclear weapons. Although the spread of nuclear weapons constitutes as grave a threat to international security as the spread of fissile materials and technologies, it is important to put more efforts into preventing the latter type of proliferation for a number of practical reasons. First, the most challenging task in acquiring nuclear weapons lies in obtaining fissile materials – either plutonium or highly enriched uranium - whereas the design and fabrication of weapons is perceived as less demanding.\(^6\) Thus once countries or non-state actors obtain access to the materials or nuclear technologies for weapons production, the threshold to develop nuclear weapons is relatively low. In addition, with export control and border inspection in place around the world, the transfer of objects as large as nuclear weapons involves substantial risk of detection. For these reasons, the US as well as the international community has continuously pursued ways to effectively stop the transfer of these materials or technologies while focusing on the spread of nuclear weapons per se.\(^7\)

\section*{2. Two Types of Nuclear Proliferation: Horizontal and Vertical}

Nuclear proliferation consists of two types of activities: horizontal and vertical proliferation activities. Horizontal proliferation is the spread of nuclear weapons, nuclear explosive materials or nuclear weapons-related technologies to states or non-state actors that do not already possess such materials or technologies. Under the non-proliferation regime, the possession of nuclear weapons or fissile materials by states other than those

\footnotesize{\begin{itemize}
\item \(^6\) Victor Gilinsky, Marvin Miller, and Harmon Hubbard, \textit{A Fresh Examination of the Proliferation Dangers of Light Water Reactors} (Washington, D.C.: Nonproliferation Education Center, 2004) p. 16.
\item \(^7\) The voluntarily created export control regime, the Nuclear Suppliers Group, has served this purpose by setting the guideline identifying uranium enrichment and reprocessing technology as sensitive technologies and putting stringent restrictions on export of these technologies and nuclear materials.
\end{itemize}}
identified as nuclear weapon states by the NPT constitutes horizontal proliferation. Vertical proliferation occurs when nuclear weapon states expand their own nuclear arsenals in quantity or improve the quality of their existing arsenals. For example, the US development of more sophisticated nuclear warheads through the Reliable Replacement Warhead (RRW) program constitutes vertical proliferation.

Horizontal proliferation has generally been seen as more dynamic and therefore more threatening to international security. The NPT has failed to embrace all the states in pursuit of nuclear weapons. As a consequence, the international community has witnessed several countries remaining outside of the regime while explicitly or implicitly developing and successfully acquiring these weapons. De facto nuclear weapon states include India, Israel, and Pakistan. Furthermore, an unexpected event in the international political setting, the dissolution of the Soviet Union in 1991, brought about the birth of potential nuclear weapon states – Ukraine, Belarus, and Kazakhstan. Nuclear weapons deployed in their soil could have brought about unintended consequences regarding nuclear proliferation. However, painstaking diplomatic efforts and financial inducements successfully convinced these three countries to join the NPT as non-nuclear weapons states. In Latin America, regional rivals Argentina and Brazil pursued nuclear weapons for decades in an attempt to gain regional prestige. However, with the creation of the Argentina-Brazilian Accounting and Control Commission (ABACC) as a confidence-building measure, the two countries have ended their nuclear competition. South Africa

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presents an exceptionally desirable case in nuclear non-proliferation efforts. Nuclear weapons developed under the apartheid regime were destroyed voluntarily, with Pretoria successfully transitioning to become a responsible participant in the nuclear non-proliferation regime. The desire for nuclear weapons on the parts of Libya and Iraq were thwarted, but by different means. Libya reversed its decision to pursue nuclear weapons program in return for political as well as economic and financial inducements from the US and the UK. The major way to roll back Iraq’s desire for nuclear weapons was the use of force, the 1991 Gulf War and subsequent U.N. disarmament efforts through the U.N. Special Commission on Iraq (UNSCOM) and the U.N. Monitoring, Verification, and Inspection Commission (UNMOVIC).

Apart from the countries mentioned above – some accepted as *de jure* nuclear weapon states, some recognized as *de facto* nuclear weapon states, some effectively prevented from going nuclear by various means – the two other states generally perceived to pose dire threats to international security at this moment are the DPRK and Iran. The DPRK acknowledged its possession of nuclear weapons in 2005. Ignited by Pyongyang’s missile and nuclear tests in 2006, the regional regime established to achieve the denuclearization of the Korean Peninsula has sought to address the issue vigorously. Despite some achievements such as the September 2005 Joint Statement and subsequent Action Plans, the DPRK has allegedly continued to engage in clandestine uranium enrichment activities and is suspected of trying to help Syria build a nuclear program. The discord between Iran and the IAEA regarding compliance issue, especially its consistent uranium enrichment-related activities, has raised suspicions about Tehran’s
intentions with respect to its nuclear program. In addition, the EU-3+3 countries’ diplomatic efforts to persuade the country to suspend its uranium enrichment-related activities have made little progress in this context.

3. Threats of Horizontal Proliferation

Kenneth N. Waltz has made a strong and provocative argument in favor of horizontal nuclear proliferation, arguing that “more may be better.” He claims that the gradual spread of nuclear weapons is better than either no spread or rapid spread on the grounds that the further spread of nuclear weapons may be a stabilizing factor in international relations given its deterrence effects. However, his assumptions about rationality have been criticized.

What kinds of threats does horizontal nuclear proliferation pose? There are two categories of threats: nuclear terrorism and regional instability.

Nuclear Terrorism

The acquisition and use of nuclear weapons or fissile materials by terrorist groups is one of the major concerns for the US as well as the international community. Whereas the fear of retaliation could deter states from using nuclear weapons, non-state actors do not have this fear, making deterrence less applicable and effective. Thus, precluding their access to fissile materials and nuclear weapons-related technology is essential in non-proliferation efforts.

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11 Ibid. pp.3-45.
There are two main paths to terrorists’ acquisition of nuclear weapons or nuclear explosive materials: deliberate transfer by a government in possession of such items or theft. Some may argue that although the intentional transfer by a government seems the most reliable way for terrorists to safely acquire nuclear weapons-related capabilities, no state is likely to deliberately engage in horizontal proliferation activities owing to the fear of being detected and suffering subsequent retribution from the states under actual or potential attack.\textsuperscript{13} Nevertheless, provided that the country is convinced that retaliation is not likely to occur or it does not have direct and overt relations with terrorist groups, it might consider offering intact nuclear weapons or fissile materials to terrorist organization in the hope of the weapons’ being used against the country hostile to it.\textsuperscript{14} In addition, an extremely desperate country suffering from internal economic difficulties might consider selling the items for financial reasons. Deliberate transfer of nuclear weapons or fissile materials to terrorist groups could also occur in situations where a central government exerts relatively low influence in the business. For example, it is possible that military or scientific elites who take control over the weapons and related materials might engage in proliferation activities for ideological or financial reasons.\textsuperscript{15} Countries that have close ties with terrorists based on ideological or religious causes


might consider supporting terrorist groups’ activities by providing nuclear weapons as an attempt to make use of the attack to serve their own goals.\textsuperscript{16}

Stealing nuclear explosive materials from a state in possession of them is another way for terrorist groups to acquire the materials necessary for manufacturing nuclear weapons. Given that Russia and other states in the former Soviet Union hold thousands of nuclear weapons and hundreds of tons of inappropriately secured fissile materials, there is a significant risk of terrorist theft from the existing nuclear stockpiles around the world.\textsuperscript{17} In addition to loose control over existing nuclear stockpiles, political turmoil under unstable regimes creates a set of conditions highly favorable for terrorists in pursuit of nuclear weapons by enabling the leakage of the core materials for nuclear weapons.\textsuperscript{18}

Given the vulnerability of Pakistan’s government and the strength of radical Islamic groups in that country, Pakistani nuclear weapons would appear to be a particularly vulnerable target for terrorists.\textsuperscript{19} The possibility that terrorists might take advantage of the potential political disintegration of the DPRK should not be ruled out. Therefore, preventing the spread of nuclear weapons or fissile materials to states which are likely to provide these paths is essential in securing nuclear nonproliferation.

\textit{Regional Instability}\textsuperscript{20}

Proliferation in one country can lead to proliferation in another. Nuclear chain reactions triggered by the appearance of a new nuclear state constitute another threat

\begin{tabular}{l}
\textsuperscript{16} Charles D. Ferguson and William C. Potter, p.57.  \\
\textsuperscript{17} Joseph Cirincione, p.16.  \\
\textsuperscript{18} Charles D. Ferguson and William C. Potter, pp. 59-61.  \\
\textsuperscript{19} Ibid., Joseph Cirincione, pp. 15-18.  \\
\textsuperscript{20} Joseph Cirincione, pp.16-17.  \\
\end{tabular}
resulting from horizontal proliferation. It is neither plausible nor possible that the DPRK or Iran will use nuclear weapons as operationally tactical means to attack the United States or other states hostile to them. The greater danger posed by their acquisition of nuclear weapons lies in the reactions of other states in the region. The emergence of a new nuclear weapon state could trigger a regional adversary to undertake its own security-reinforcing measure in response. This measure is likely to be an attempt to acquire nuclear weapons capabilities given the weapon’s incomparably destructive power. One example of such a dynamic is the case of Pakistan-India in 1998.

In Northeast Asia, the DPRK’s continuous expansion of its nuclear arsenal could undermine the national security of Japan and South Korea, leading these US allies to call for legitimate rights to secure their own security by obtaining nuclear weapons capabilities. In the Middle East, Iran’s nuclear weapons, together with Israel’s conventional and unconventional military superiority, would aggravate the instability of the already volatile region. If Iran’s nuclear weapons capabilities come to a reality, Egypt, Saudi Arabia and other Gulf Cooperation Council (GCC) states would likely attempt to acquire their own nuclear weapons capability.

**Proliferation Risks of Light Water Reactors**

1. **What is a Light Water Reactor?**

Nuclear reactors used for generating electricity have two major types based on what is used as moderator: light water reactors and heavy water reactors. In operating

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nuclear reactors, it is essential that the neutrons emitted in fission be slowed down (a process referred to as having been “moderated”) to maintain a chain reaction with U-235. Materials serving this purpose are called “moderators.” LWRs employ, as a moderator, ordinary water (H\(_2\)O), whereas heavy water reactors use heavy water, made of deuterium and oxygen, D\(_2\)O rather than H\(_2\)O.

The difference in this main feature – the type of moderator - contributes to the differences in required degree of U-235 concentration in fuel. Given the fact that deuterium does not readily absorb neutrons whereas hydrogen can easily do so, many of neutrons are lost during the operation of LWRs, so relatively fewer neutrons are available for maintaining the chain reaction process. This results in the need for LWRs to be fed with fuel of U-235 larger than 0.7% concentration present in natural uranium. Generally 3-4% concentration is required for reactors for electricity production whereas weapons-grade material requires 90% concentration of U-235. In contrast, heavy water reactors employ natural uranium, which certain countries lacking uranium enrichment technology and facilities have viewed as a much easier system to operate given their capacity.

A third type of reactor is called a graphite-moderated reactor; as the name suggests, this type of reactor uses graphite as a moderator. This type of reactor shares

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22 Ibid., p. 22. Nuclear reactors generate heat through nuclear fission, the splitting of a heavy nucleus into two lighter ones. The fission heat is used to boil water or to produce steam for the turbines that drive electric generators.
23 Ibid., p. 26. U-235 is fissile element which fissions after capturing a neutron of almost any energy. To increase the probability of U-235 to fission with neutrons up to the level allowing keeping chain reaction, neutrons should be slowed down.
24 Robert F. Mozley, pp. 77-125. Gas centrifuge technology is one of the most efficient enrichment technologies. This method increases the concentration of the U-235 isotope by spinning uranium hexafluoride gas at high speeds. Such centrifuges can produce both low-enriched uranium (LEU), which can be used in nuclear power reactors, and highly enriched uranium (HEU), which is one of the two types of fissile material used in nuclear weapons.
most of features with heavy water reactors. Technical hazard resulting from operating these reactors has impeded their widespread use.

Although these different types of reactors have distinctive features in technical terms, they share important characteristics from the proliferation perspective, making fine distinctions in terms of their role in nuclear proliferation less meaningful. First of all, all types of reactors produce plutonium, a primary material for nuclear weapons, as a result of their operations. The only distinction lies in how suitable the plutonium contained in the spent fuel is for weapons production based on isotopic composition. Another point is that the distinction between reactors for civilian nuclear energy generation and those for military purposes is not clear.²⁵ The development and application of nuclear technology for civilian uses has long relied on the technology obtained in the production of nuclear weapons as well as on materials essential to the manufacture of nuclear weapons.²⁶ Due to the possibility of applying the same technology and materials for military purposes, measuring the intentions of states in pursuit of nuclear capabilities involves an ambiguity to some extent. All types of reactors therefore involve proliferation risks, but to a different degree according to the types.

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²⁵ Richard L. Garwin and Georges Charpak, pp. 31-32.
²⁶ Ibid.
2. Proliferation Risks of Light Water Reactors

LWRs are generally believed to be proliferation-resistant. It is argued that the need to use slightly enriched uranium as fuel makes LWRs more proliferation resistant by enabling control over fuel supplies. The argument is based on the premise that only a limited number of countries have access to uranium enrichment technology and enriched uranium, and that these countries exert stringent control over uranium enrichment technology such that countries outside of the circle can only import the fuel they need to operate their light water reactors from this limited and known group of suppliers. If combined with conditions set by the suppliers such as putting the fuel under the IAEA monitoring and surveillance, the operation of LWRs substantially reduces the risks of diversion of low enriched uranium or spent fuel. In contrast to heavy water reactors using natural uranium as a feeding material, this feature serves as a substantial barrier for potential proliferators because natural uranium is more readily accessible and the supply is therefore much more difficult to control than enriched uranium. The relatively easy detectability of LWRs is another critical piece of the argument that they are proliferation resistant. Fuel removal from the core of LWRs can be easily detected because the process involves shutting-down and opening up the reactor since it requires time to

27 “Proliferation resistance refers to the adoption of reactor and fuel cycle concepts that would make more difficult, time-consuming, and transparent the diversion by states or sub-national groups of civilian nuclear fuel cycles to weapons purposes.” Harold Feiveson, "The Search for Proliferation-Resistant Nuclear Power," FAS Public Interest Report, September/October 2001, available at www.fas.org/faspir/2001/v54n5/nuclear.htm
In terms of LWR’s proliferation risks, see Robert E. Mozley, pp. 43-76.
28 Robert F. Mozley, p. 64.
29 Ibid.
replace spent fuel with fresh fuel in large bundles. In addition, heavy water reactors are much more efficient in producing plutonium suitable for weapons production than light water reactors, which suggests that LWRs are more proliferation resistant than other forms of nuclear technology.

Scholars who emphasize the potential proliferation risks of LWRs tend to note that while they might be more proliferation resistant than any other forms of reactors, such reactors are not proliferation proof and therefore still pose proliferation dangers. In particular they focus on the possibility that LWRs could be used as facilitators to realize potential proliferators’ intention to build their own nuclear weapons or nuclear weapons-related materials. That is, LWRs might be a useful political tool to encourage responsible nations who have abided by established nonproliferation-related laws and norms to promote peaceful uses of nuclear energy and simultaneously keep their behavior in check. However, potential proliferators are not responsible actors in the international community.

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30 In contrast, heavy water reactors are refueled on-load, that is, fresh fuel is introduced into and spent fuel is removed from reactor while in operation in smaller bundles, making detection much more difficult. David. Fischer and Paul Szasz, Safeguarding the Atom: A Critical Appraisal (London and Philadelphia: Taylor & Francis, 1985) p. 47.

31 In terms of the isotopic composition of plutonium, spent fuel from LWRs contains a substantial amount of reactor-grade plutonium, which is considered unsuitable for weapons production, whereas spent fuel from heavy water reactors contains a considerable amount of weapons-grade plutonium, which is considered suitable for weapons production. The suitability of plutonium for nuclear weapons is determined by the proportion of Pu-240, the most improper isotope for military application because of its numerous spontaneous fissions and heat emission. Based on this criterion, weapons-grade plutonium is defined as plutonium with less than 7% of Pu-240, fuel-grade with less than 18% and more than 7%, and reactor grade with less than 30% and more than 18% of the isotope. In addition, the plutonium from LWR fuel is generally more difficult to extract because the fuel is irradiated for a longer period time and is therefore more radioactive, requiring more shielding. See Bruno Pellaud, “Proliferation Aspects of Plutonium Recycling,” Journal of Nuclear Materials Management Fall 2002, p. 1069; Robert F. Mozley.

32 Victor Gilinsky, Marvin Miller, and Harmon Hubbard, A Fresh Examination of the Proliferation Dangers of Light Water Reactors (Washington, D.C.: Nonproliferation Education Center, 2004). The report argues that light water reactors no longer should be given to any nation that might divert the reactor’s fresh lightly enriched fuel or the plutonium-laden spent fuel to make nuclear weapons or nuclear explosive devices.
They have resisted following generally accepted international customs or binding arrangements. Their goal is to successfully circumvent those rules by reducing chances of detection and subsequent punishment of their behavior.

LWRs could accelerate potential proliferators’ illicit nuclear weapons program. First of all, the control over uranium enrichment technology and components required to build uranium enrichment facilities is extremely difficult to achieve, if not impossible. The key reason for this phenomenon is the growing availability of advanced centrifuge enrichment technology and related components. The dual-use nature of the technology has discouraged countries from preparing effective legislations and exerting complete law enforcement power with respect to control. Combined with clandestine efforts by individuals to create illicit proliferation network such as A. Q. Khan, complete control over relevant technology and component have been significantly unachievable. In the presence of uranium enrichment facilities, the provision of LWRs will further contribute to facilitating the states’ clandestine activities to produce highly enriched uranium by allowing them to skip the process of converting natural uranium ore to low enriched uranium if the reactor-providing country guarantees a substantial supply of fresh light water reactor fuel. 33 States with the determination to take advantage of LWRs in proliferation activities will likely engage in clandestine uranium enrichment activities by diverting fuel supplied by the providing country.

Unfortunately, the IAEA’s ability to detect and monitor clandestine uranium enrichment facilities has been demonstrated to suffer from severe limitations in the past,

33 Ibid., p. 3. and p. 14.
raising the probability that countries may be able to undertake undetected uranium enrichment activities if they decide to do so. For example, Iraq’s enrichment program was only discovered after the first war with the US. The DPRK’s suspected uranium enrichment program was not detected by the IAEA monitoring and Iran’s enrichment plant was revealed only after an exile group provided information on its location and operations to the United States. The presence of a suspected research reactor in northern Syria was only discovered by the Israeli strike against the reactor. In light of these past failures, the presence of IAEA safeguards does not necessarily mean that a determined state cannot engage in illicit activities.

3. Potential Proliferators?: The Role of Intentions

Given that determined proliferators can take advantage of LWRs for the purpose of expanding their own nuclear weapons or fissile materials or transferring these items onwards, the critical factor in judging whether LWRs will play a role of promoting the peaceful use of nuclear energy or facilitating an illicit nuclear weapons program may be the intentions of the state operating the LWRs. That is, LWRs will be used to supply civilian nuclear energy if the country operating the reactor so chooses; by contrast, however, LWRs will have adverse effects on nuclear nonproliferation efforts if they fall into the hands of countries intent on illicitly developing, acquiring and/or transferring nuclear weapons or nuclear explosive materials.

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34 Ibid. p.23.
Since a country’s intentions are a key variable in predicting the potential proliferation risks of LWRs, the next section will examine the intentions of the DPRK and Iran.

Analyzing the Intentions of the DPRK and Iran

1. The DPRK

Motivations

Pyongyang’s motivation for developing nuclear weapons is profoundly interrelated with its threat perception and national security considerations.35 The DPRK’s nuclear research program began as early as the 1950s36 following the Korean War, during which the US threatened the communist coalition with the use of nuclear weapons. Since the end of the war, the US has deployed a vast number of troops in South Korea with currently 28,500 troops stationed in and near Seoul. A series of South-North military confrontations over the past demonstrated North Korea’s vulnerability to external threat, primarily South Korea backed by the US.37 North Korean threat perceptions are also reflected in its consistent demand for concluding a Non-Aggression Treaty between Washington and Pyongyang. The shift of US policy from active engagement strategy to

35 Pyongyang’s stated reason for its possession of nuclear weapons supports this argument. For example, the DPRK Foreign Ministry stated on October 3, 2006 that “The DPRK's nuclear weapons will serve as reliable war deterrent for protecting the supreme interests of the state and the security of the Korean nation from the U.S. threat of aggression and averting a new war and firmly safeguarding peace and stability on the Korean peninsula under any circumstances.”

36 Joseph Cirincione, p. 284.

more assertive policy\textsuperscript{38} further isolated North Korea. This might have contributed to Pyongyang’s decision to break out of the agreement negotiated with the previous administration and to seek more extreme means to secure its national security against external threats. The growing external threat, combined with diminished reliability in relations with other communist countries as a result of the dissolution of the Soviet Union and China’s pursuit of market-oriented economy, has further exacerbated its security environment, leading the country to respond to the threat in an extreme way. North Korea’s decision to expand its nuclear arsenal by continuously producing weapons-grade nuclear materials serves the same purpose – reinforcing its deterrent capabilities - given its inferiority in conventional military capabilities compared to those of South Korea backed by the US forces.

Pyongyang’s motivation for exporting nuclear weapons or nuclear explosive materials to other states or non-state actors seems to have little relevance to its other security concerns. Rather, its engagement in horizontal proliferation activity undermines its national security, the very objective which the regime tries to secure through seeking nuclear weapons capability. The driving force, therefore, stems from its financial interests. Despite the regime’s efforts to reform its centralized economy by amending its constitution to attract more foreign direct investment and running the Gaeseong industrial complex, the country is facing serious economic problems along with energy crisis and severe famine, which could eventually undermine the legitimacy of Kim Jong-il regime.

\textsuperscript{38} In contrast to the Clinton administration’s strategy in dealing with North Korea, the Bush administration took several assertive actions toward North Korea. This includes designating the country as one of “Axis of Evil” countries in the State of the Union address in 2002 and overtly discussing the possibility of regime change.
It is plausible that North Korea might be willing to sell nuclear weapons or fissile materials at a high price to remedy the internal problems which would possibly threaten the destiny of regime. Nevertheless, predicting whether the DPRK will actually engage in those activities is a challenging task in that the reaction and following punitive measures by the US as well as the entire international community would be more intense and dramatic than those against the DPRK’s expansion of its own nuclear arsenal.

**Stated Pursuit of Nuclear Weapons**

On February 10, 2005, the DPRK officially acknowledged its possession of nuclear weapons and demonstrated its intention to further expand its nuclear arsenals. In a statement released by the official Korean Central News Agency (KCNA), the North Korean Foreign Ministry said that “We (the DPRK) have manufactured nukes for self-defense to cope with the Bush administration's evermore undisguised policy to isolate and stifle the DPRK. Its nuclear weapons will remain nuclear deterrent for self-defense under any circumstances.” 39 North Korea’s nuclear weapons capability was further demonstrated in a nuclear explosion test on October 9, 2006. 40 In a statement released by the KCNA, the North Korean Foreign Ministry stated that “The U.S. extreme threat of a nuclear war and sanctions and pressure compel the DPRK to conduct a nuclear test, an

The intention to expand its nuclear arsenals is more explicitly expressed in Korean. The English version is rather ambiguous. 미국이 핵물동이를 휘두르면서 우리 제도를 기어이 없애버리겠다는 기도를 명백히 드러낸 이상 우리 인민이 선택한 사상과 제도, 자유와 민주주의를 지키기 위해 핵무기고를 높이기 위한 대책을 취할 것이다. (The U.S. disclosed its attempt to topple the political system in the DPRK at any cost, threatening it with a nuclear stick. This compels us to take a measure to bolster its nuclear weapons arsenal in order to protect the ideology, system, freedom and democracy chosen by its people.)

essential process for bolstering nuclear deterrent, as a corresponding measure for defense.”

The DPRK officially stated that the country would “strictly prohibit nuclear transfer and always sincerely implement its international commitment in the field of nuclear non-proliferation as a responsible nuclear weapons state.” Especially, in the October 2007 statement for the implementation of the 2005 Joint Statement, the DPRK reaffirmed its commitment not to transfer nuclear materials, technology, or know-how. However, in contrast to these pronouncements, several North Korean negotiators implied the possibility of transferring nuclear explosive materials. In April 2003, a North Korean official told his US counterpart that Pyongyang might take physical action in response to US insufficient concessions. Although it is not clear what physical action North Korea would mean, it could include nuclear testing or sales of the materials to others.

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42 “DPRK Foreign Ministry Clarifies Stand on New Measure to Bolster War Deterrent,” October 4, 2006; “DPRK Opposes All Forms of Terrorism and Any Support to It,” June 10, 2008, available at http://www.kcna.co.jp/index-e.htm “It will take active part in the international efforts to prevent substance, equipment and technology to be used for the production of nukes and biochemical and radioactive weapons from finding their ways to the terrorists and the organizations that support them and faithfully fulfill its duty in the field of non-proliferation as it committed itself in the statement of the Ministry of Foreign Affairs on October 3, 2006 and agreements made at the six-party talks.”


Continued Defiance of International Obligations

Announcing its withdrawal from the NPT and noncompliance with IAEA safeguards agreement\(^{46}\)

The DPRK joined the NPT on December 12, 1985 and the IAEA safeguards agreement entered into force on April 10, 1992. After the agency conducted its initial inspections to verify the accuracy of North Korea’s declaration, it found inconsistencies between declared plutonium product and the results of its analysis of samples, suggesting that the country might possess undeclared plutonium.\(^{47}\) Although the agency requested additional access to sites and information to determine the completeness and correctness of the declaration provided by the DPRK, the country refused to comply with the obligation. In response to the agency’s referring its noncompliance to the UN Security Council, on March 12, 1993, the DPRK announced its decision to withdraw from the NPT for supreme national security considerations.\(^{48}\) Pyongyang had suspended the decision in June 1993 after the US diplomatic efforts.

On June 13, 1994, the country took further action by withdrawing from its membership in the IAEA.\(^{49}\) On the grounds that it was no longer obliged to accept the

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\(^{46}\) The NPT requires non-nuclear weapon states to accept full scope-safeguards and conclude a comprehensive safeguards agreement with the IAEA. The IAEA safeguards agreement should be concluded between a state party to the NPT and the IAEA and such agreement shall enter into force not later than eighteen months after the date of initiation of negotiations. However, the DPRK made the withdrawal of US nuclear weapons from South Korea a condition of its conclusion of a safeguards agreement. The North Korea’s IAEA safeguards agreement came after the US withdrew them as part of a global tactical nuclear withdrawal in 1991. See Joseph Cirincione pp. 279-293.

\(^{47}\) “In Focus : IAEA and DPRK” Fact Sheet on DPRK Nuclear Safeguards, available at http://www.iaea.org/NewsCenter/Focus/IaeaDprk/fact_sheet_may2003.shtml

\(^{48}\) Article X of the NPT stipulates that “Each Party shall in exercising its national sovereignty have the right to withdraw from the Treaty if it decides that extraordinary events, related to the subject matter of this Treaty, have jeopardized the supreme interests of its country.”

\(^{49}\) Although it withdrew from the IAEA, the DPRK is required to accept IAEA inspections as part of its NPT obligations. On this ground, the IAEA maintained that North Korea’s safeguards agreement remained in force and so the country should allow the inspectors to conduct inspections in accordance with the safeguards agreement. However, the DPRK took the position that it was in a special position with regard to
IAEA inspections, Pyongyang continuously refused to implement procedures for the IAEA inspections. North Korea’s attempt to break out of the two major international nonproliferation institutions – the NPT and the IAEA - seriously undermined the international community’s efforts to remedy its noncompliance to international obligations.

**Suspected uranium enrichment-related activities and withdrawal from the NPT**

In the 1992 North-South Joint Declaration on the Denuclearization of the Korean Peninsula, both Pyongyang and Seoul committed not to possess uranium enrichment facilities. Additionally, North Korea reaffirmed that it would take steps to implement the Declaration in the 1994 DPRK-US Agreed Framework. Therefore, although uranium enrichment activities exclusively for peaceful purposes are allowed under the NPT, any type of uranium enrichment activities are prohibited by the two legally binding bilateral arrangements.

In 2002, the US voiced its suspicion about Pyongyang’s pursuit of uranium enrichment capabilities. The Bush administration announced that the secret DPRK's program was a violation of the 1994 DPRK-US Agreed Framework, the NPT, the DPRK-IAEA Safeguards Agreement and the 1992 North-South Joint Declaration on the

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50 Selig Harrison, “Did North Korea Cheat?” *Foreign Affairs*, Vol.84 No.1 January/February 2005. Pyongyang’s clandestine activities to construct uranium enrichment facilities were revealed by the US following Assistant Secretary of State James Kelly’s visit to Pyongyang in October 2002. While James Kelly said that North Korean First Deputy Foreign Minister Kang Sok Ju acknowledged the existence of such a program, Kang later denied this and North Korean Foreign Minister Paek Nam Sun said that Kang had told Kelly that North Korea is entitled to have such a program or an even more powerful one to deter a preemptive US attack.
Denuclearization of the Korean Peninsula. Despite the IAEA’s request for additional information to verify the implementation of the IAEA safeguards, Pyongyang provided little cooperation. The US administration responded with the suspension of the heavy oil supply which had been provided pursuant to the 1994 Agreed Framework. North Korea announced its intention to lift the freeze on its nuclear facilities at Yongbyon and removed monitoring devices such as seals and surveillance cameras installed by the IAEA. Additionally it expelled the inspectors and announced its withdrawal from the NPT effective as of January 11, 2003. As a consequence of Pyongyang’s persistent defiance of the international nonproliferation regimes, the IAEA has never been able to get a complete picture regarding the entire scope of North Korea’s nuclear weapons-related activities with remaining outstanding issues unresolved.51

*Defiance of the established nuclear order and UN Security Council resolutions*

In 2005, the DPRK stood against the established international order under the NPT by officially announcing its possession of nuclear weapons. Additionally, Pyongyang demonstrated its nuclear weapons capability by conducting a nuclear explosive test in 2006. The international community expressed profound concern over North Korea’s nuclear capability, which constituted a serious threat to peace and stability.

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51 “Implementation of the Safeguards Agreement Between the Agency and the Democratic People's Republic of Korea Pursuant to the Treaty on the Non-Proliferation of Nuclear Weapons” Report by the Director General GC(49)/13 August 4, 2005. “Since 1993, the Agency has been unable to fully implement the comprehensive safeguards agreement concluded in 1992 with the Democratic People’s Republic of Korea (DPRK) in connection with the Treaty on the Non-Proliferation of Nuclear Weapons (NPT) (INFICIRC/403). The Agency has never been allowed by the DPRK – a party to the NPT since 1985 – to verify the correctness and completeness of the DPRK’s initial declaration of nuclear material subject to safeguards under that agreement. Following agreement between the DPRK and the United States of America on an “Agreed Framework” in October 1994, and pursuant to the request of the United Nations Security Council, from November 1994 to December 2002, the Agency monitored the ‘freeze’ of the DPRK’s graphite moderated reactors and related facilities. … on 31 December 2002 the Agency had to cease its inspection activities in the DPRK in response to the request of the DPRK.”
combined with its delivery vehicle-related capability demonstrated in its ballistic missile tests carried out three months before.

The UN Security Council immediately responded by adopting two resolutions with respect to North Korea’s provocative actions. UN Security Council Resolution (UNSCR) 1695 was in response to Pyongyang’s ballistic missile launches in July 2006, calling for the country to suspend its ballistic missile-related activities.\textsuperscript{52} UNSCR 1718 addressed Pyongyang’s nuclear test in October 2006, urging the country to “abandon all its nuclear weapons in a complete, verifiable and irreversible manner.”\textsuperscript{53} Additionally, both resolutions strongly demanded that the DPRK immediately retract its announcement of withdrawal from the NPT and the IAEA, to return to the treaty and the IAEA safeguards at an early date and continue to comply with its obligations under the NPT and the terms and conditions of its IAEA safeguards agreement.\textsuperscript{54}

Despite the international condemnation and economic and financial sanctions imposed by the international community, Pyongyang continued to defy that it relinquish its nuclear weapons, giving no sign of retracting its withdrawal of the NPT and the IAEA either. Rather, the intensity of its defiance has only increased. The DPRK launched missiles on April 5, 2009 and decided to cease all cooperation with the IAEA by requesting the removal of monitoring equipment and asking the inspectors to leave the country as the earliest possible time.\textsuperscript{55}

\textsuperscript{52} UN Security Council Resolution 1695, S/RES/1695 (2006), July 15, 2006
\textsuperscript{54} UN Security Council Resolution 1695 and UN Security Council Resolution 1718.
From North Korea’s perspective, nuclear weapons increasingly appear to be seen as an indispensable tool to securing regime survival. As a strategy of achieving deterrence against its major threat – the US – Pyongyang has long pursued nuclear weapons capability. Its defiance of the NPT, the IAEA, the UN and the Six-Party Talks are tactics in implementing the strategy. Pyongyang intends to break out of the international or multilateral regimes when the restraint imposed on the country serves as an impediment to acquiring necessary capability in terms of regime survival or the security environment surrounding the country aggravates. Its withdrawal from the IAEA in 1994 occurred when North Korea perceived the IAEA safeguards to be a significant hurdle to reaching its goal. Its withdrawal from the NPT in 2003 came after the country was seriously threatened by the US. North Korea’s demonstration of its nuclear weapons capability in 2005 and 2006 also reflects its perceived vulnerabilities in security environment it faces. Therefore, unless the leadership’s perceptions of existential threats change, the need to retain the capability remains essential to North Korea and so the country is likely to continue to expand its nuclear arsenal as its official statements demonstrate.

**Consistent Demand for LWRs**

A notable negotiating tactics which Pyongyang uses is its consistent demand for LWRs as a replacement for its graphite-moderated reactor at Yongbyon. Since the 1994 Agreed Framework included the provision of LWRs, the DPRK has consistently demonstrated significant interest in the project. For example, on September 20, 2005 North Korea’s Foreign Ministry stated that it was essential for the United State to provide
LWRs to Pyongyang as early as possible, underlining its right for the peaceful use of nuclear energy as an independent right of a sovereign state and adding that “Washington should not even dream that North Korea will dismantle its nuclear deterrent before receiving the reactors.” In 2007, North Korea’s nuclear envoy reiterated its demand for LWRs as a reward for its eventual dismantlement of nuclear weapons program.

Pyongyang’s motive in aggressively condemning the termination of the LWR project and in consistently demanding LWRs in exchange for the dismantlement of its reactor at Yongbyon is not entirely clear. Does the regime regard the inducement exclusively as a tool of energy assistance? Does it intend to use the LWR project as a bargaining chip to extract more concessions from other Six-Party Talks countries? Does it view LWRs as an element of assuaging concerns of the international community while secretly retaining its nuclear weapons capability? Or combination of all these reasons? Pyongyang’s tactic should be understood in a broad context, especially given its stated motive for nuclear weapons – regime survival. The country explicitly stated that its

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56 “Spokesman for DPRK Foreign Ministry on Six-Party Talks,” Korean Central News Agency of the DPRK, September 20, 2005, available at http://www.kcna.co.jp/index-e.htm We (the DPRK) made it clear that the basis of finding a solution to the nuclear issue between the DPRK and the U.S. is to wipe out the distrust historically created between the two countries and a physical groundwork for building bilateral confidence is none other than the U.S. provision of LWRs to the DPRK. We strongly demanded that the U.S. remove the very cause that compelled the DPRK to withdraw from the NPT by providing LWRs to it. … As clarified in the joint statement, we will return to the NPT and sign the Safeguards Agreement with the IAEA and comply with it immediately upon the U.S. provision of LWRs, a basis of confidence-building to us. … What is most essential is, therefore, for the U.S. to provide LWRs to the DPRK as early as possible as evidence proving the former's substantial recognition of the latter's nuclear activity for a peaceful purpose.

57 Associated Press, “N. Korea wants light water reactors,” July 21, 2007; The former diplomat, Charles L. Pritchard, who is now head of the Korea Economic Institute and was a North Korea policy coordinator under Presidents Clinton and Bush, said that North Koreans also told him they expected to be provided with light water-reactors for dismantling their nuclear installations, See Helene Cooper, “In Disclosure, North Korea Contradicts U.S. Intelligence on Its Plutonium Program,” The New York Times, May 31, 2008

possession of nuclear weapons are for self-defense from external threats and therefore would not discard a tool of maintaining its nuclear weapons capability without any alternative option. In this respect, it is likely that North Korea views the project as a tool for extracting substantial concessions from other Six-Party Talks countries by complying with part of the obligations and at the same time adequately maintaining its nuclear weapons capabilities at the necessary level.

**Past Horizontal Proliferation Activities**

There has been an allegation that Pyongyang provided assistance to Damascus in Syria’s suspected construction of a nuclear research reactor.59 Despite Pyongyang’s denial, if the DPRK was actually involved in any form of assistance – export of materials or technical assistance through training, the activity not only constitutes a violation of its obligations under UN Security Council Resolution 1718 and the October 2007 Action Plan agreement but also suggests that Pyongyang is willing to undertake an astonishing level of risk of being detected in selling these items. Given the lack of clarity regarding the matter, it is premature to conclude that North Korea has determined interests in exporting its nuclear-related materials or technologies to other countries or possibly non-state actors. Nevertheless, the Syrian case suggests that the possibility of North Korean nuclear proliferation transgressions can not be ruled out.

59 Peter Crail, “NK-Syria Nuclear Connection Questionable,” *Arms Control Today*, October 2007; “The Curious Incident in Northern Syria and Its Potential Proliferation Implications,” Prepared Remarks by Daryl G. Kimball for the Korea Economic Institute Forum, “What If They Did It? North Korea, Syria, and Nuclear Proliferation,” November 1, 2007 available at http://www.armscontrol.org/events/20071101_NK_Syria, The speculation is primarily based on the evidence that satellite imagery suggests the facility could have been a small research reactor similar in design to the 5 megawatt North Korean reactor at Yongbyon and there have been North Koreans in the site.
The DPRK’s history of selling strategic items also suggests that the sale of nuclear weapons or fissile materials is conceivable. Pyongyang exported conventional weapons, missile-related components and counterfeit currency for money in the past. Given the incomparably greater risks of international sanctions and even armed conflict stemming from its nuclear proliferation activities, North Korea would likely attempt to reduce the risks of its being detected and suffering from punishments by seeking a deal which would not jeopardize regime survival and simultaneously ensure substantial revenue from the sale of such technologies. In light of the economic situation in the diplomatically and economically isolated country, financial advantages obtained from selling the materials or expertise might be a highly attractive incentive.

2. Iran

Motivations

Iran’s aspiration for nuclear capabilities including enrichment and reprocessing technologies and eventually for nuclear weapons are likely to be deeply rooted in national security concerns. Geopolitically, Iran is surrounded by countries with which it

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61 Iran acquired its first nuclear research reactor, a small US-supplied 5 MW(t) reactor, during the 1960s under the shah Mohammad Reza Pahlavi’s rule. As part of his ambition to secure Iran’s dominance in the Persian Gulf region, he began an extensive nuclear power program in the mid-1970s, which included plans to build 22 nuclear power reactors and to develop civilian fuel-cycle facilities. However, the 1979 Islamic Revolution halted the plan partly due to the Islamic regime’s opposition to nuclear technology for religious reasons. Under Ayatollah Ruhollah Khomenei, the country began small-scale research on centrifuge enrichment technology that it had secretly acquired from Pakistan during the Iran-Iraq War in the 1980s. The new supreme leader Ayatollah Ali Khamenei and President Ali Akbar Hashemi Rafsanjani expanded the covert enrichment program and purchased design technology for the production of heavy water and heavy-water research reactors from Russia. See Bruce Riedel and Gary Samore, “Managing Nuclear Proliferation in the Middle East,” *Restoring the Balance: A Middle East Strategy For The Next President* (Washington, D.C.: Brookings Institution Press, December 2008) pp. 96-97; Joseph Cirincione, pp. 295-313.
exchanges hostilities. The relation with Iraq is based on mutual distrust from the eight-year Iran-Iraq War. Iraq’s ability to use chemical weapons and the isolation imposed on Iran by the US and its Arab neighbors during the Iran-Iraq War are seen as a primary driving factor in Tehran’s decision to pursue unconventional weapons capability, especially nuclear capability, as a means of self-defense and deterrence in the 1980s.\textsuperscript{62} The current US military presence in Iraq and the possible emergence of a US-influenced Iraqi government hostile to Iran constitute a serious threat to the country. Additionally, Israel, a strong ally of the US and frequent advocate for preemptive attack on Iran’s nuclear program, is already a virtual nuclear power with ballistic missile capability to reach Tehran. In this context, achieving deterrent and retaliatory capabilities against the Israeli threat is indispensable to Iran.

Iran’s motivations for transferring its nuclear weapons or nuclear explosive materials to terrorist organizations is likely to be to use terrorism in pursuit of its goals, the same purpose of its military and financial assistance for a variety of terrorist groups in the Middle East. Iran’s continued denial of Israel’s right to exist and its pursuit of influence in Iraq have led the country to encourage anti-Israeli terrorist attacks and to interfere Iraq’s internal politics by providing a variety means of assistance – financially and operationally. If Iran is determined to achieve aforementioned political goals, it might attempt to offer fissile materials or even nuclear weapons to terrorists.

Nuclear Activities for Peaceful Purposes

Iranian officials have repeatedly claimed that its nuclear program is exclusively for peaceful purposes. Supreme Leader Ayatollah Ali Khamenei has reiterated the stance by underlining that Iran is not pursuing nuclear weapons but peaceful use of nuclear energy and stressing the country’s opposition to the production or possession of these weapons is based on Islamic beliefs. 63 President Mahmoud Ahmadinejad has also asserted that Tehran’s nuclear program is for peaceful use of nuclear energy. 64 Former President Akbar Hashemi Rafsanjani, Hassan Rohani, a central figure in the negotiations with the EU, and other officials also reaffirmed the stance. 65

Along with the assertion that its nuclear program is exclusively for peaceful purposes, the country has firmly expressed its inalienable right to develop full nuclear fuel cycle as an inherent right accorded by the NPT. Supreme Leader Khamenei welcomed the Guardian Council’s passage of a bill approving peaceful nuclear development, and praised the test run of its first nuclear power plant at Bushehr, implying Tehran’s intention to continue pursuing self-sufficiency in a complete nuclear fuel

63 “Iran vows to persevere on peaceful nuclear program,” Xinhua, June 3, 2008, available at http://news.xinhuanet.com/English/2008-06/03/content_8307614.htm
64 In a speech at the United National General Assembly on September 23, 2008, Iranian President Mahmoud Ahmadinejad said that “Iran has an inalienable right in producing nuclear fuel for peaceful purposes like all the nations and Iran has fully cooperated with the inspectors of the IAEA and the Agency has repeatedly confirmed that Iran’s activities are peaceful.”
65 “Former Iranian president reaffirms peaceful use of nuclear program.” Xinhua, April 17, 2006; Iranian Ambassador to the International Atomic Energy Agency (IAEA) Ali Asghar Soltanieh said on the Board of Governors in Vienna that Iran's nuclear programs were for peaceful use. And Soltanieh said Iran would keep cooperating with the IAEA However, he said Iran would not give up its uranium enrichment activity. See “Iran reaffirms peaceful nature of its nuclear program.” Xinhua, June 6, 2008.; Iranian Foreign Ministry spokesperson Hassan Qashqavi state on November 10, 2008 that “pursuance of nuclear weapons has no place in the country’s defense doctrine.” See Paul K. Kerr, “Iran’s Nuclear Program: Status,” CRS Report for Congress, November 20, 2008, p.2.
cycle. President Ahmadinejad is also one of the strongest proponents for the country’s nuclear energy program. In justifying the need to produce electricity from nuclear energy, the Iranian officials have contended that the country plans to expand its reliance on nuclear power as an alternative energy source given growing energy demand.

Continuous Noncompliance with International Obligations

Secret nuclear programs and suspicious activities

Tehran has secretly pursued the ability to produce nuclear materials that can be used for manufacturing weapons and hid the activities from the IAEA for about two decades. In August 2002, an Iranian exile group, the National Council of Resistance on Iran (NCRI) revealed that Tehran possessed a more extensive nuclear program than it had previously declared to the IAEA. Given that the undeclared facilities included uranium enrichment-related facilities at Natanz and heavy water reactor at Arak, facilities which can be used to produce nuclear materials for the core of nuclear weapons – highly enriched uranium or plutonium - the international community became suspicious of Tehran’s intentions for its nuclear program. Iran claimed that its centrifuge program at Natanz was exclusively for making fuel for its German-supplied Bushehr LWR.

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66 Iran's Supreme Leader Ayatollah Ali Khamenei vowed Friday that the country's path to nuclear success can not be blocked. The Iranian leader hailed the launching of the country's first home-made satellite and the test run of its first nuclear power plant at Bushehr in the past year as “important achievements.” See “Iran's supreme leader vows nuclear path can't be blocked,” Xinhua, March 20, 2009.
67 At the United National General Assembly on September 23, 2008, President Ahmadinejad strongly expressed his determination for retaining the inalienable right to develop full nuclear fuel cycle while condemning that the nations opposing to Iran’s exerting its own right tend to monopolize technologies and to use those monopolies in order to impose their will on other nations.
69 Joseph Cirincione, p.297.
70 Judith S. Yaphe and Charles D. Lutes, p. 53.
However, Tehran’s justification raised more suspicion because Germany had suspended the construction of the reactor by the time Iran started to engage in uranium enrichment-related activities in 1985 and the construction did not begin again until Russia concluded a contract to complete the reactor in 1995. Furthermore, in January 2004, additional undeclared nuclear activities were revealed including the country’s secret procurement of enrichment technology and nuclear know-how from A. Q. Khan network.71

Given the continuous revelations of secret activities and suspicions over its intentions with respect to acquiring nuclear capabilities, Tehran’s implementation of the Additional Protocol 72 is essential to ensuring the “absence of undeclared nuclear materials or activities.”73 However, Iran has not ratified the Protocol and continues to defy the demands of the IAEA Board of Governors and the UN Security Council regarding the implementation of the Additional Protocol.

*Continued uranium enrichment activities and violation of UN Security Council resolutions*

Since Iran’s declaration to the IAEA in 2003 about the presence of uranium enrichment-related facilities and activities74, the international community has failed to persuade Iran to suspend these activities. Rather the country has continued to expand the number of centrifuges at its commercial-scale enrichment plant and to conduct research

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72 Additional Protocol to IAEA safeguards agreement authorizes the IAEA to have access to undeclared facilities and to request additional information to states-parties, thus increasing the ability of the agency to investigate clandestine facilities or activities.
74 Iran’s work on gas-centrifuge-based uranium enrichment program was greatly accelerated in the 1990s after Iran gained access to centrifuge technology and material through the A. Q. Khan nuclear black market network. The existence of facilities was revealed in 2002 by an Iranian exile group. See Joseph p. 299.
on more advanced centrifuge designs at its pilot-scale enrichment facility at Natanz in
defiance of the UN Security Council resolutions – 1737 in 2006, 1747 in 2007, and 1803 and
1835 in 2008.\textsuperscript{75}

Additionally, despite the EU-3+3 countries’ (China, France, Germany, Russia, the
United Kingdom and the United States) efforts\textsuperscript{76 77} to diplomatically settle down the
disputes surrounding Iran’s uranium-enrichment-related activities, the country has
continuously asserted its right to develop the entire nuclear fuel cycle, arguing the
development of uranium enrichment technology is an essential part of it. In addition,
Tehran claimed that it needs to produce low enriched uranium so as to prevent potential
fuel supply disruptions which would halt the operations of its current and future LWRs.\textsuperscript{78}

\textit{Limited scope of cooperation with the IAEA on outstanding issues}

Iran’s limited cooperation with the IAEA regarding possible military dimensions
to its nuclear program has contributed to the suspicion that the country is pursuing a

\textsuperscript{75}Peter Crail, “Iran Forges Ahead on Enrichment,” \textit{Arm Control Today}, December 2008; Report by the
IAEA Director General, \textit{Implementation of the NPT Safeguards Agreement and relevant provisions of

\textsuperscript{76} The EU-3+3 countries presented a proposal in June 2006 as an attempt to settle down the Iranian nuclear
issue. The proposal requires Iran to commit to addressing all the outstanding concerns of the IAEA through
full cooperation with the IAEA; to suspend all enrichment-related and reprocessing activities to be verified
by the IAEA, as requested by the IAEA Board of Governors and the UN Security Council; to commit to
continue this during these negotiations; and to resume implementation of the Additional Protocol. In
exchange for Iran’s commitment, the EU-3+3 countries will reaffirm Iran’s right to develop nuclear energy
for peaceful purposes in conformity with its NPT obligations, and in this context reaffirm their support for
the development by Iran of a civil nuclear energy programme; commit to actively support the building of
new light water reactors in Iran through international joint projects, in accordance with the IAEA Statute
and the NPT.; and agree to suspend discussion of Iran’s nuclear programme at the Security Council on
resumption of negotiations.

\textsuperscript{77} The countries presented Iran with a revised proposal on June 14, 2008. See Peter Crail, “Iran Presented

\textsuperscript{78} “Soltaniyeh: Iran Has No Alternative But To Enrich Uranium,” \textit{Islamic Republic News Agency}, October
nuclear weapons program. In response to the IAEA’s request that Iran provide access to the relevant personnel, documents and information that would allow the international community to exclude the existence of possible military dimensions to its nuclear program, Iran has offered little cooperation and has not yet provided the requested information, or access to the requested documentation, locations or individuals. In spite of the fact that Tehran has been willing to disclose previously undeclared nuclear activities to the IAEA (which has enabled the IAEA to resolve several outstanding issues since 2003), essential information necessary for ensuring the absence of undeclared nuclear material and activities has remained unsolved.

Although whether or not Iran has a determined intention to acquire nuclear weapons capability at this moment is not clear, the country obviously does not intend to give up its right to develop the full nuclear fuel cycle, especially uranium enrichment capability. It continued to violate its international obligations under the NPT, the IAEA and the UN Security Council in spite of economic sanctions and restrictions on financial transactions. Why does Tehran perceive the abandonment of its right to develop uranium enrichment technology as unacceptable? Iran seems to be reluctant to eradicate the source

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82 This information includes information about a high level meeting in 1984 on reviving Iran’s pre-revolution nuclear program; the scope of a visit by officials associated with Iran’s Atomic Energy Organization to a nuclear installation in Pakistan in 1987; information on 1993 meeting between Iranian officials and member of a clandestine procurement network run by former Pakistani nuclear official A. Q. Khan. See Paul K. Kerr, CRS report, pp. 6-9.
83 Ibid.
of potential fuel which would eventually contribute to arming Iran with the most devastating weapons. Two scenarios are most plausible at this moment. First, Iran has already set a goal of acquiring nuclear weapons capability, but as a long-term goal. Until the country is equipped with full capacity, it will remain a minimally responsible actor in the international community by complying with most of the obligations under the international regimes, which enables it to pursue the necessary capability without irritating neighboring countries so much as to spur them to action. Then it could break out of the international regimes. Second, it is possible that Iran does not have a coordinated domestic position on nuclear weapon issue except that most of the leaders have agreed to retain the potential.

It also should be noted that the scope of Iran’s cooperation with the IAEA suggests that Iran is not willing to act as a responsible actor in the international community. If Tehran has a true willingness to act as a responsible non-nuclear weapon state, it should have fully provided access to information or documentation to resolve its suspected activities as early as possible, especially its previous efforts related to acquire nuclear weaponization designs.

**Proliferation Activities**

The US government has long designated Iran as the world’s most active state sponsor of terrorism. According to the US Department of State, “Iran’s Islamic Revolutionary Guard Corps (IRGC) and Ministry of Intelligence and Security were directly involved in the planning and support of terrorist acts and continued to exhort a

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variety of groups, especially Palestinian groups and Lebanese Hezbollah. In addition, the IRGC was increasingly involved in supplying lethal assistance to Iraqi militant groups."85 Terrorist organizations which Iran has assisted financially and operationally are extensive; Lebanese Hezbollah, HAMAS, Palestinian Islamic Jihad (PIJ), the al-Aqsa Martyrs Brigades, and the Popular Front for the Liberation of Palestine-General Command. The scope of assistance is also extensive; providing funding, training and safe passages, and more importantly a variety of weapons. Given its close ties to a variety of terrorist groups and past transferal of weapons to such groups, the possibility that Iran would consider providing nuclear weapons or fissile materials to terrorists as the most effective tool to achieve its goals should not be ruled out.

Reassessing the Role of Light Water Reactors

1. The DPRK

The 1994 DPRK-US Agreed Framework stipulates that “the US will undertake to make arrangements for the provision to the DPRK of a light water reactor project with a total generating capacity of approximately 2,000 MW(e)” in exchange for Pyongyang’s agreement to freeze and ultimately dismantle its 5 MW(e) graphite-moderated reactor at Yongbyon.86 As the central component of the agreement, the project of constructing two 1000-MW(e) light water reactors in Sinpo had been conducted by the Korean Peninsula Energy Development Organization (KEDO), an international consortium created to implement the denuclearization accord. The $4.6 billion project had been considerably

85 Ibid.
delayed due to splits over cost-sharing issues among Japan, South Korea and the US. Equally if not more importantly, several political crises on the Korean Peninsula – most notably the submarine incident in 1996 and the Taepo-dong missile test in 1998 – delayed the implementation of the project. Under the Bush administration, political conflicts between Washington and Pyongyang overrode the debate over economic incentives to North Korea; the DPRK was designated as one of the “Axis of Evil” countries. After Assistant Secretary of State for East Asia and the Pacific James Kelly’s visit to Pyongyang in 2002, the relations between the US and the DPRK became stalemated over the latter’s suspected uranium enrichment activities. The project was eventually terminated in June 2006.\(^{87}\)

The suspension and eventual termination of the LWR project under the 1994 Agreed Framework was primarily due to political deadlock among major interested parties. Unfortunately the decision doesn’t appear to be a reflection of the serious concerns over proliferation risks posed by transfer of LWRs.\(^{88}\) Although the recent action plan agreements for the implementation of the September 2005 Joint Statement do not


\(^{88}\) Some experts had expressed their concerns over proliferation risks, but most policy makers seem to believe that LWRs are proliferation resistant enough to prevent proliferation risks even if provided to potential proliferators. See “Progress and Challenges in Denuclearizing North Korea,” An Arms Control Association Press Conference, April 10, 2002, available at http://www.armscontrol.org/node/2518

Ambassador Gallucci pointed out the risks as follows; “I think that the light-water reactor project was not the best outcome that could be imagined. I think, at the time, it was the best outcome that could be negotiated. What I’m saying is that it would be better if we weren’t delivering two 1,000-megawatt light-water reactors to North Korea. It would be better if we were delivering something else that didn’t have potential security implications. Suppose we had made a deal in which KEDO delivered a couple of thousand megawatts of conventionally fueled energy. That would be better. It would be better for the North Koreans because they could have gotten it sooner and better for us because there would be no nuclear power and accumulation of plutonium involved. That is not as bad as what the gas-graphite system, which the North Koreans were building, would have produced, but it is still not ideal.”
explicitly include the provision of LWRs to the DPRK as a means of energy assistance,\textsuperscript{89} Pyongyang’s consistent demand for the resumption of the project in return for its disablement and further dismantlement of the graphite-moderated reactors and related facilities in Yongbyon could lead other Six-Party Talks’ participants to politically decide to resume the project.

However, given the aforementioned analysis regarding North Korea’s intentions, the provision of LWRs should not be a part of incentive packages presented to Pyongyang. The country has a determined intention to expand its nuclear arsenal and can regard financial incentives from selling these items as attractive. Combined with its suspected procurement efforts to acquire uranium enrichment technology, the provision of LWRs is likely to facilitate Pyongyang’s intention in proliferation activities. Instead, the Six-Party Talks participants could consider providing conventional fuel such as heavy oil as a means of energy assistance.\textsuperscript{90}

\textbf{2. Iran}

The offer of LWRs was first presented to Iran by EU-3+3 countries in June 2006 in an effort to persuade Tehran to suspend its uranium enrichment activities and its construction of a heavy water reactor at Arak.\textsuperscript{91} Another proposal building on the previous offer and revised in some aspects by adding more incentives was presented in


\textsuperscript{91} “Elements of a revised proposal to Iran made by the E3+3” available at http://www.diplomatie.gouv.fr/en/article-imprim.php3?id_article=5314
June 2008.\textsuperscript{92} This also includes the support for the construction of LWR based on state-of-the-art technology as one of a variety of incentives. However, Iran has rejected these proposals on the grounds that the halting of its uranium enrichment activities is an unacceptable demand.\textsuperscript{93}

Other than a LWR project proposed by EU-3+3 countries, Iran has been constructing a 1,000 MW(e) light water reactor at Bushehr with assistance of Russia, which is scheduled to be loaded with fuel imported from Russia during the second quarter of 2009.\textsuperscript{94} The original German contractor, which began constructing the reactor in 1975, abandoned the project following Iran’s 1979 revolution. Russia agreed in 1995 to complete the reactor, but the project has encountered repeated delays partly because the US raised concerns that the project might be used to facilitate an Iranian nuclear weapons program by providing the country with access to sensitive nuclear technology or expertise.\textsuperscript{95} Partly reflecting this concern, Russia took steps to mitigate the project’s proliferation risks; Moscow and Tehran concluded an agreement in 2005 stating that Iran would return the spent fuel to Russia and the operation of the facility would occur under IAEA safeguards.\textsuperscript{96}

\textsuperscript{92} Proposal to Iran by China, France, Germany, the Russian Federation, the United Kingdom, the United States of America and the European Union Presented to the Iranian authorities on 14 June 2008.


\textsuperscript{95} Then-Deputy Assistant Secretary of Defense Marshall Billingslea testified before the Senate July 29, 2002, that the United States was “concerned that the Bushehr nuclear power project is, in reality, a pretext for the creation of an infrastructure designed to help Tehran acquire atomic weapons.” Paul K. Kerr, CRS report p. 13.

\textsuperscript{96} Paul Kerr, “Iran, Russia Reach Nuclear Agreement,” \textit{Arms Control Today}, April 2005.
The analysis of Iran’s intentions in previous section suggested that although Tehran may not be actively pursuing a nuclear weapons capability at this moment, the country is likely to keep the option as a long-term goal. The country is likely to adhere to its formal obligations under the NPT while developing the capabilities needed for a nuclear weapons program.\(^\text{97}\) And then it could withdraw from the NPT to manufacture nuclear weapons or continue to remain within the NPT while maintaining a latent nuclear weapons capability.\(^\text{98}\) Once Iran achieves the capacity to produce nuclear weapons, the possibility that fissile materials or even nuclear weapons might fall into the hands of terrorists becomes much greater than in the case of North Korea given Tehran’s close ties to a variety of terrorist organizations. In particular, Tehran’s ambition to master uranium enrichment technology, combined with the provision of LWRs, would significantly undermine international non-proliferation efforts and therefore EU-3+3 countries should not include the LWR-related inducement in their proposal. In addition, it seems that Iran does not regard the provision of LWRs as an attractive incentive. Given that Iran’s most important interest lies in securing its right to legitimately develop full nuclear fuel cycle, the EU-3+3 countries should focus on addressing this issue to make a meaningful progress in the negotiations with Iran.

**Conclusion**

Political decisions can bring about unintended consequences. President Dwight D. Eisenhower’s ‘Atoms for Peace’ initiative of 1953 had a significant impact on the way

\(^\text{98}\) Ibid.
the world dealt with nuclear energy. He suggested “making joint contributions from their stockpiles of normal uranium and fissionable materials to an international Atomic Energy Agency.” By putting the hazardous materials under the supervision of the international agency, he dreamed of a world free of secret nuclear activities. This is the origin of the IAEA safeguards. Another notable suggestion was to promote the peaceful uses of nuclear energy by providing related technology to interested countries. President Eisenhower directed the Atomic Energy Commission to provide free world nations with limited amounts of raw and fissionable materials as well as generous assistance for building power reactors. 99 In retrospect, the measure contributed to horizontal proliferation. India, Israel and Pakistan clandestinely diverted the US good-faith assistance for promoting civilian uses of nuclear energy to military uses.

The international community should take into account the impact of the irreversibility in its non-proliferation efforts. Once a country becomes an actual nuclear weapon state, however much the established international regime denies it, the country’s capability is recognized by the globe. Although the international community would be silent about the matter, this alters other countries’ strategic calculation in the relations with the country, eventually bringing about the change in the entire security environment. Israel’s no-denial/no-confirmation strategy with respect to its possession of nuclear weapons and India-Pakistan’s officially demonstrated nuclear weapons capability changed the entire strategic circumstances. Given the nature of irreversibility of nuclear proliferation, policy makers should focus on the prevention of the proliferation. That is,

the international community should prepare for the worst scenario when dealing with countries which easily disregard the established international laws and norms.
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