Nuclear Energy and International Relations: Outlook and Challenges for Newcomers

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Abstract

Nuclear energy differs from other sources of energy with its military application resting at the core of international relations, that is, nuclear weapons. Under the international nuclear nonproliferation regime, non-nuclear weapon states have the right to use nuclear energy for peaceful purposes under the obligation to apply safeguards, so that the technology is not diverted to military use. This article aims to show that in the new millennium, countries aspiring to generate nuclear energy need to consider their policy from a broader context than energy security. It starts with an overview of nuclear technology and its relationship to proliferation, how its use is regulated, and the expected behavior from states using nuclear energy. It presents the challenges facing nuclear power projects: the Iran nuclear issue; nuclear terrorism becoming a more pressing issue than state-level proliferation; and safety and public acceptance.

Key Words

Nuclear Energy, Nuclear Nonproliferation, Nuclear Security, Public Acceptance of Nuclear Energy.

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Introduction

One of the most pressing issues that the international community is facing in the new millennium is energy security. The demand for fossil fuels is expected to increase because of development projects and the changing socio-economic structures in emerging markets. In addition, long-term energy contracts decrease their availability in the market. The industrialized/developed countries have embarked on projects and energy strategies to decrease the use of fossil fuels and to diversify their providers in order to reduce dependence. Their medium-term strategy is to increase the share of renewables and/or low-carbon energy sources, such as nuclear energy.

Nuclear energy has become popular in the last two decades, which has led to the notion of "nuclear renaissance." Countries at all levels developed a renewed interest in nuclear since it largely addressed political, economic and environmental goals in their energy security policies. Most states

considered nuclear energy as a viable alternative within the debate on climate change, which started a tendency to use low-carbon sources while meeting energy needs.[1] Emerging markets and developing countries leaned on nuclear energy projects (in Asia and the Middle East in particular) to meet their need for development, but at the same time with low energy prices for a competitive edge in international trade. They also tried to reduce energy dependence and to achieve environmental sustainability. Although the 2011 Fukushima accident slowed down some projects, the willingness of the emerging markets has not waned.

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However, nuclear energy is not like other sources of energy. States planning to use nuclear energy are faced with some unique challenges. They need to consider their policy within the broader international relations and international security context. Generating nuclear energy in a power plant is what is called the "peaceful use of nuclear energy" under the international regime on the prevention of the spread of nuclear weapons, and is subject to various rules and regulations different from other sources of energy.

Nuclear technology was used first for military purposes, that is, the atomic bomb. States with nuclear weapons have political and military advantage over their rivals. Some see it also as an instrument of prestige and status, hence power. The nuclear non-proliferation regime distinguishes between those countries with nuclear weapons and those without. The latter group enjoys the right to use nuclear energy for peaceful purposes on the condition that they accept International Atomic Energy Agency (IAEA) safeguards, which serve to detect any diversion or misuse of technology and nuclear material for military purposes.

Currently, three main challenges await states contemplating nuclear energy generation. These operate at the international and domestic policy-making levels. The first is the political question over the use of sensitive technologies by non-nuclear-weapon states, which were worked through during the Iran nuclear issue. The resolution of the issue by diplomatic means strengthened the nonproliferation regime while contributing to regional security. However, the Iran nuclear deal must still be handled with care and the new US administration's view on it is critical

both for the regime and the region.

The second challenge is the changing international security agenda: Concerns about a terrorist attack using nuclear and radiological material occupy the international security agenda more than state-level proliferation of nuclear weapons. International terrorist groups and their intentions pose a direct threat via nuclear and radiological material both in use and in transport. With more nuclear power plants, and nuclear material trade in place, the material and facilities are becoming vulnerable and constitute new targets for terrorist groups. The international response to this threat is "nuclear security," that is, preventing the theft of nuclear material, sabotage or unauthorized access to facilities or transporting vessels. However, the nuclear security culture and the nuclear security norm are yet to develop.

The third challenge is the growing public sensitivity to the risks and dangers of nuclear energy generation. The high perception of risk and social movements against nuclear energy confront policymakers, particularly regarding nuclear safety. At the domestic level, policymakers need to pursue a strategy of informing the public with sound evidence while being open about energy policy in general. The issue is also related with a new socio-economic era that is marked by the adverse effects of industrialization and modernity. To meet the challenge, policymakers need to have a full grasp of the sources of public concern.

To analyze these challenges, the article will introduce a brief overview of the technological aspect of nuclear energy and sensitive technologies for nuclear proliferation. Then, it will provide the main international rules and norms regulating their use, and what behavior is expected from states using- or planning- to use nuclear energy. It also puts forward energy security concerns in the new millennium and shows the rise in demand for nuclear energy. Next, it will look at the previously mentioned three challenges in detail, and will conclude with recommendations for policymakers.

Background

The first use of nuclear fission technology was for military purposes, that is, nuclear weapons. Its application in agriculture, industry, medicine, research and most notably in the generation of electricity followed later. The peaceful use of nuclear technology was made conditional upon its being subject to safeguard inspections of an international atomic energy agency to ensure that no diversion or misuse

takes place. International regulations for peaceful use are covered under the broader concept and the regime of nuclear nonproliferation, that is, the efforts to prevent the spread of nuclear weapons.

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This section will introduce the significance of nuclear weapons in international relations by looking at the theory of Realism, basic concepts and phases of war, and why and how nuclear weapons rest at the core of state power. It will also provide the basics of nuclear fission and its dual-sided nature. Next, it will provide a brief history of the nuclear nonproliferation regime and the development of the regulations for peaceful use of nuclear energy as an important principle of the regime.

The main problematique of the discipline of International Relations is "how to survive in anarchy." The Realist theory of International Relations assumes that the international system is anarchical, that is, there is no higher authority over states, which are the main actors. The theory assumes that states are rational and unitary, and humans are essentially selfish. Just as they pursue their interests, in an anarchical system, states pursue national interests, the primary of which is to survive. In the face of scarce resources, war and conflict are inevitable between states. They rely on their own power, and to prevail in war, states accumulate power, which is military power.[2]

In a Realist environment, war is one of the instruments which states use to reach their political ends. By waging war, states seek a decisive victory that would substantially decrease or eliminate the negotiating power of the adversary, which in turn, would provide a fast and smooth process of political settlement.[3] For such a victory, it is logical that one would pursue a weapon that would render the adversary without enough power to retaliate. In other words, states seek strategic military capabilities as instruments to reach their political goals. The advent of nuclear weapons, with their enormous destructive capacity, have in the contemporary era provided states with such a strategic military capability. It should be noted that when referring to states, Realists are of course implying the great powers. What makes them 'great' is the quality and quantity of their military capabilities.[4] It is no coincidence that

the permanent members of the UN Security Council are granted the status of Nuclear Weapon States (NWS) under the Nuclear Nonproliferation Treaty (NPT). Corroborating Realist theory, nuclear weapons conferred status to their possessors and helped to form the two-tier structure of the international community via international organizations and international treaties.

Nuclear Technology and Peaceful Use

To understand the military and civilian uses of nuclear technology, it is necessary to explain nuclear fission. Fission means the splitting of an atom. When a fissile isotope absorbs a neutron, it splits into two and yields at least two neutrons. This makes it possible to have a fission chain reaction and releases an enormous amount of energy. The first application of this technology was the nuclear weapon, which was developed by the United States during World War II and was used against Japan in 1945, ending the war.

Apart from military uses, nuclear technology can be used for civilian purposes. A basic knowledge of the nuclear fuel cycle, nuclear reactor types, and critical technologies would help to understand the issues surrounding nuclear energy in the context of international relations. Uranium and plutonium are fissile material. The uranium metal found in nature is composed of mainly Uranium-238 (U238) and Uranium-235 (U235) isotopes. The fissile isotope is U235. Plutonium is not found in nature, but is obtained from Uranium. Its fissile isotopes are Pu-239 and Pu-241.[5] When they absorb a neutron, they undergo a fission chain reaction.

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The ratio of U235 isotope in natural uranium is only 0.72%. In order to be used in electricity generation, the ratio of U235 is increased to sustain a chain reaction, which is a process known as "enrichment." The widely used nuclear reactors in the world are light-water reactors, which use 3-5% enriched uranium as fuel. Various enrichment techniques are employed, such as gas centrifuge or gaseous diffusion.

Some research reactors require 20% enrichment level. If U235 is enriched above 90%, it becomes weapon-grade, that is, it can be used to make a nuclear weapon,[6] which is why the technology of uranium enrichment is proliferation-sensitive. Technically, it takes much more effort to obtain 20% enriched uranium from 0.72% than to reach 90% enriched uranium from 20%.[7] Accordingly, the IAEA determines 20% enrichment level as the threshold;[8] that is, in no circumstances can a non-nuclear-weapon state enrich uranium over 20%.

After the fuel is used in a nuclear reactor, it is called "spent fuel" or "used fuel." This product contains U235 and Pu239 and waste elements. The U235 and Pu239 can be recycled and used to make new fuel. Plutonium is not found in nature. It is obtained when U238 absorbs a neutron. Heavy water reactors (using heavy water as neutron moderator) use natural uranium as fuel, and its spent fuel contains weapon-grade Pu-239 (because of low burn-up, Pu239 in the spent fuel of heavy-water reactors is more suitable for a nuclear weapon compared to Pu239 in the spent fuel of a light-water reactor, which has high fuel burn-up). Plutonium in this spent fuel can be recovered in a plutonium reprocessing facility and can be re-used to make a mixed-oxide fuel (MOX) to be used in a light-water reactor. Uncontrolled (without safeguards) and with political will, it can be used to make a nuclear weapon, making it the second sensitive technology for nuclear proliferation. Thus, uranium enrichment technology, enrichment at 20%, heavy-water reactors, and plutonium reprocessing facilities would raise suspicions if safeguards are not applied or are insufficient.

After the use of the atomic bomb in 1945, international efforts to prevent the proliferation of such weapons started in 1946. In the United Nations, both the United States and the Soviet Union proposed plans to curb each other from gaining military-strategic advantage. Yet, after four years, the Soviet Union acquired its first nuclear weapon, and in 1952, the United Kingdom followed. In 1960, France and in 1964, China got their nuclear weapons. In 1953, the US President D. Eisenhower carried out the "Atoms for Peace" speech in which he called for using nuclear technology for peaceful uses, which would be put under the safeguards of an international atomic energy agency.[9] As a result, in 1957, the IAEA was established.[10] This principle of peaceful use along with IAEA safeguards became one of the main principles of the Nuclear Nonproliferation Treaty (NPT). The Cuban missile crisis of 1962 resulted in international efforts for a treaty to stop

nuclear weapons proliferation. The text of the NPT was opened for signature in 1968 and the Treaty entered into force in 1970.

The NPT sets two categories for parties to the treaty, and rests on three main principles. It distinguishes between nuclear-weapon states (NWS) and non-nuclear-weapon states (NNWS). In the first group, are states which had detonated a nuclear device prior to January 1, 1967: China, France, the Soviet Union, the United Kingdom and the United States. The rest of the signatories are NNWS, and pledge not to seek nuclear weapons. The first principle of the NPT is nuclear nonproliferation, and accordingly, NWS agree not to transfer nuclear weapons or related material to NNWS, and the latter agree not to receive them (Articles I and II). The second principle is nuclear disarmament, as enshrined in Article VI. According to the third principle of peaceful use of nuclear energy, NNWS have the right to use nuclear energy for peaceful purposes (Article IV) with the obligation that they put their nuclear facilities and activities under IAEA safeguards (Article III).[11]

The safeguard system of the IAEA has rested on the principle of "verification of the compliance" of NNWS with their Treaty obligations.[12] However, the safeguards system later evolved, mainly after the revelation that Iraq was able to develop a clandestine nuclear weapons program even while it was a party to the NPT and had safeguards agreement with the IAEA. With the introduction of the Additional Protocol to the comprehensive safeguards agreements, the new system enhanced safeguards to detect undeclared nuclear material and activities.[13] Adherence to the Additional Protocol is not a legal but a political necessity: It was introduced out of necessity to fulfill the aim of IAEA safeguards. While the text of the Treaty does not mention it, it is the spirit of the NPT and the norm of nuclear nonproliferation that make Additional Protocol the symbol of a NNWS' transparency of its nuclear activities and its commitment to the nuclear nonproliferation regime.

An international regime is a set "… of implicit or explicit principles, norms, rules, and decision-making procedures around which actors' expectations converge in a given area of international relations."[14] It means that states cooperate and form international institutions focusing on an issue that is of common concern, and continue to work for or adopt new rules, build norms and form new institutions which structure their behavior and make it predictable. The issue of nuclear proliferation and the dangers associated with it led states

to work towards and establish its parts of global governance, that is, treaties, international organizations, agreements and most notably, norms.

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The cornerstone of the nuclear nonproliferation regime is the NPT, setting the rules, and specifying states' expected form of behavior. The main principles of the NPT are mutually reinforcing, therefore, the peaceful use of nuclear energy and safeguards are contemplated in the broader framework of nuclear nonproliferation. This renders nuclear energy a special status: It is regulated internationally under the nuclear nonproliferation regime, and all parties are expected to obey its rules and norms on nuclear nonproliferation. In this context, NNWS must not pursue nuclear weapons and must implement IAEA safeguards.

Basics of Nuclear Safeguards

The role of the IAEA is verification, that is, to ensure that nuclear material and facilities are used only for peaceful purposes. According to Article IV of the NPT, NNWS are obliged to place their nuclear facilities under IAEA safeguards, which help in early detection of any misuse of nuclear material or technology, thereby deterring the spread of nuclear weapons.[15]

> IAEA safeguards are a set of technical measures that allow the IAEA to independently verify a state's legal commitment not to divert nuclear material from peaceful nuclear activities to nuclear weapons or other nuclear explosive devices.[16]

Diversion refers to the moving of nuclear material from civilian to military use. The IAEA determines two kinds of diversion: abrupt (involving a large amount of nuclear material); and protracted (nuclear material collected over a period of time).[17] Misuse means the use of nuclear technology, facilities or material originally acquired for civilian purposes, in order to acquire nuclear weapons.[18]

Article III.A.5 of the IAEA Statute grants the IAEA the authority for safeguards, through which it can conclude agreements with states or regional safeguards authorities.[19] Comprehensive safeguards agreements (CSAs), item-specific safeguards agreements and voluntary offer

agreements are the types of these agreements.[20] Accordingly, non-nuclear-weapon states conclude CSAs and accept IAEA safeguards.

The IAEA safeguards system serves as not only a confidence-building measure, but also an early warning mechanism and trigger for international response.[21] The safeguards system evolved as a result of technological change and developments that required its effectiveness. Key events that carried the safeguards to their current level are the incorporation of CSAs as part of the NPT and the Treaty of Tlatelolco, and the experience with Iraq and North Korea. Iraq's exploitation of the loopholes in the system was the main reason behind strengthening IAEA safeguards.[22]

The basis of safeguards is to determine whether a state's declared nuclear material and nuclear-related activities are correct and complete. These aims are achieved through verification measures such as on-site inspections, visits, monitoring and evaluation. There are two categories of measures. The first set of measures involves the verification of declared nuclear material and activities authorized under the CSAs.[23] However, when it was seen that Iraq could pursue a covert nuclear weapons program despite being party to the NPT and subject to safeguards, the focus of the safeguards system shifted to undeclared material and activities. The Additional Protocol was introduced in 1997 to strengthen the Agency's inspection capabilities, and thus to complement the CSAs. Thereby, the IAEA is enabled to verify the non-diversion of declared nuclear material, and to ensure the absence of undeclared nuclear material and activities.

Current Challenges to the Peaceful Use of Nuclear Energy

Energy Security and Nuclear Energy Demand

According to the International Energy Agency (IEA) and the US Energy Information Administration (EIA) estimates for 2040, energy demand will be on rise in upcoming years.[24] States determine their energy policies and energy security views according to their natural resources, needs, geographical location, development level and political criteria, such as keeping dependence on foreign suppliers at a minimum and relying on indigenous resources. In this sense, interest in nuclear energy has continued to grow. In addition to the 450 nuclear reactors in operation worldwide, there are planned nuclear

units and those currently under construction. The latter are mainly in Asia and the Middle East, including China, India, Iran, Japan, Pakistan, Russia, the United States, the UAE and Vietnam.[25] The highest number of reactors under construction is in China and Russia.

A prevalent definition of energy security is based on three criteria: reliability, affordability, and environment-friendliness.[26] The link between energy and state power has been established since the Industrial Revolution, and securing the energy supply became a critical issue with the 1973 oil crisis, as the interruption in the flow of oil and subsequent price fluctuations dramatically affected state security at various levels, including, military, economic and societal. After the end of the Cold War, the adverse impacts of industrialization were felt globally, and the environmental criterion was added.

Energy policies and energy security views differ according to countries' endowments, security cultures, and the level of development.

The energy security definitions of the developed/industrialized countries, such as, the United States, the EU, Canada, South Korea and Japan overlap with the above-mentioned definition of energy security, with an emphasis on reducing dependence, preparing for supply shortages, and focusing on alternatives that are environment-friendly. In their energy policies and strategies, the aim is to lower the share of fossil fuels in order to decrease dependence and CO2 emissions, while increasing the share of low-carbon sources, such as nuclear energy and renewables.[27] The United States, Canada, Japan and South Korea are not only benefitting from nuclear energy, but also providing equipment for nuclear power plants. Despite Fukushima, Japan still relies on a considerable share of nuclear in generating electricity.[28] The EU's dependence on Russian natural gas has resulted in a new approach to increase investment on renewables, diversification of natural gas suppliers and decreasing the share of gas in the energy basket. Brussels also values nuclear energy as an important base-load supply with a caution on nuclear fuel supplied by Russia.[29]

Energy policies and energy security views differ according to countries' endowments, security cultures, and the level of development. In this sense, Russia, China and India deserve attention. Russia's energy security

perspective has been shaped primarily by its vast hydrocarbon reserves, the quest to restore its political and economic power, and its security culture.[30] Russia ranks first in the production of crude oil and second in that of natural gas. Its energy revenues constitute almost half of the country's budget.[31] Russia's energy security view has been shaped in large part by President Vladimir Putin's view of Russia's security, economy and its international position. He saw energy as the instrument for Russia's economic development and to make it a leading power.[32] Accordingly, the extraction, processing and export of the hydrocarbon resources had to be under the control of the state. The industry should be delivered to an equal status with that of the West.[33] Russia pursued a foreign policy under which energy agreements and pipelines forged dependence, which could be utilized as an instrument to wield power. Regarding nuclear energy, Moscow approved plans for several new reactors in 2010. In addition, Russia aspires to become a major exporter of nuclear commodities.[34]

For China and India, the criteria of reduced dependence and long-term availability of supply are the defining features of their energy security understanding. After the end of the Cold War, these two giant economies started growing rapidly, resulting in a rise in energy demand. Their energy security strategy foresees long-term investments with developing countries, rich in energy sources and receptive to foreign investment.[35] China has about 20 nuclear reactors under construction and plans to build more as part of Beijing's plans to increase the share of nuclear energy in order to address air-pollution problems stemming from coal-fired power plants.[36] India is also expanding its nuclear power generation capacity, particularly to use indigenous thorium resources.[37] It aims at supplying a quarter of its electricity generation out of nuclear by 2050.[38]

In addition to rising economies, several countries in the developing world, or which are emerging markets, have opted for nuclear energy, including Bangladesh, Belarus, Egypt, Indonesia, Jordan, Kazakhstan, Thailand, Turkey, Vietnam,[39] and the UAE.[40] Most of them seek to reconcile their need for a sufficient energy supply for development, and at the same time to observe environmental protection and to reduce CO2 emissions. The majority of them are dependent on fossil fuels, and chose diversification in their energy basket by pursuing alternative sources of energy. As Rajiv Nayan observes, "having an energy *mix* has become an international norm."[41] Also, economic development follows as a result of the development in nuclear-

related industries.[42] In countries using hydrocarbons to generate electricity, the cost of production has risen, particularly in the first decade of the 2000s.[43] In the arid Middle East, desalination and air conditioning are essential for urban life. As population rises, so follows the demand for energy.[44] Furthermore, investing in nuclear energy and technology procurement has a political aspect: Nuclear energy generation is seen as a symbol of prestige and status.[45]

The Limits to Peaceful Use: The Iran Nuclear Issue

Under the NPT, non-nuclear-weapon states enjoy the right to use nuclear energy in return for accepting IAEA safeguards. They are required not only to allow IAEA inspections in existing facilities, but also to report their planned nuclear activities. Iran's failure on its reporting requirements to the IAEA in the early 2000s resulted in concerns about Tehran's intentions with its nuclear program. Coupled with the post-9/11 threat assessments and unsupportive political environment in key capitals, a comprehensive agreement on its nuclear program could not take shape until 2015. The bone of contention was Iran's uranium enrichment activities along with other proliferation-sensitive facilities. Negotiations ended with an agreement (the Joint Comprehensive Plans of Action-JCPOA) after political concerns were alleviated with technical measures to prevent proliferation while at the same time allowing Iran to continue enrichment.

The negotiations between Iran and the EU3+3 (or P-5+1, referring to the permanent five members of the United Nations Security Council and Germany) were critical for several reasons: First, in case diplomacy failed, a military option was on the table during the George W. Bush administration.[46] That, and the "Axis of Evil" speech, led the Iranian public to perceive the nuclear program as a symbol of pride and protection against the West, hence making it harder for Tehran to give concessions. The public also assessed that while it is Iran's right to possess civilian nuclear technology, the nuclear program made Iran a target.[47] Second, if the issue was left unresolved, the risk was a NNWS choosing to withdraw from the NPT to go down the path to acquire nuclear weapons. That would send a dangerous signal to other non-nuclear-weapon states, especially those in the region, and also would undermine the norm of the nuclear nonproliferation regime. It was thought that Iran's regional rivals were embarking on nuclear energy projects to keep their nuclear option should Iran go nuclear.[48] Third, how

the international community handled the issue was critical, because the main problem was political: It was distrust mainly between the United States and Iran. It could be ameliorated thanks to the existence of Iranian and American officials with technical expertise and common academic backgrounds favorable for a diplomatic solution resting on technical measures. The JCPOA is the result of hard work for more than a decade, and it hinges on a delicate balance supported with careful rhetoric particularly in Tehran and Washington, D.C.

Article IV of the NPT acknowledges the right of non-nuclear-weapon states to the use of nuclear energy for peaceful purposes, but it does not specify nor does it limit the use of sensitive technologies by non-nuclear-weapon states.[49] However, the nuclear issue with Iran was rather a political problem combined with regional dynamics and United States-Iran-Israel relations and threat perceptions, considering that Iran enriched uranium close to 20%, expanded its enrichment capacity, and did not implement the Additional Protocol. The most important conclusion of the Iran experience was limiting enrichment at 5% (which is the level for making fuel in power generation reactors), hence acknowledging the right for enrichment to Iran, and other NNWS that use nuclear energy. In other words, it allowed indigenous production up to reactor level and under enhanced safeguards. Also, during the talks, G.W. Bush and Mohamed ElBaradei, former Director General of the IAEA, made proposals to deny sensitive technologies to newcomers,[50] which would create a new dichotomy of haves vs. have-nots. For the newcomers, it would also mean that fuel dependence will continue albeit less risky than that on natural gas.

The statements of US President Donald Trump and of his team on the Iran deal,[51] throughout the Presidency campaign and since his election do not bode well for the nonproliferation regime: President Trump's dissatisfaction and decertification of the JCPOA) carry the risk to reverse the achievements, which would severely damage regional balances and may trigger proliferation trends. In this case, the nuclear energy projects in the region may be delayed due to political "risks."

Nuclear Terrorism and Nuclear Security

International terrorism ranks first on the security agenda since the September 11, 2001 attacks in the United States. Post-9/11 threat assessments were shaped by increasing concerns on non-

state actors seeking CBRN capabilities to carry out attacks resulting in mass casualties.[52] The threat perception during the G.W. Bush administration was that states that are against the United States might support these terrorist groups by providing them with such materials and agents.[53] As a matter of fact, the UN Security Council Resolution (UNSCR) 1540 (2004) contains provisions to discourage such support and to take measures for their implementation.[54] During the Obama administration, the threat assessment was rather focused on the intention of non-state actors to carry out an attack with nuclear or radiological material. President Obama's Prague speech in 2009 was an important call for efforts to prevent nuclear terrorism.[55]

Nuclear terrorism refers to terrorist activity to inflict damage with the use of nuclear or radiological material. It includes theft, sabotage or unauthorized access to these materials when they are in use in a facility or while they are transported.[56] Terrorists may try to either steal them to make an improvised nuclear or radiological device (dirty bomb), or may treat the facility or the transportation vehicle as a potential weapon to cause radioactive dispersal. In either case, the consequences would be lethal and enormous.

Traditionally, the measures to secure these materials were referred to as "physical protection." After 9/11, the Convention on the Physical Protection of Nuclear Material (CPPNM) was amended to strengthen its provisions. The 2005 Amendment added the phrase "and Nuclear Facilities" to the title of the Convention. Thus, the Convention would apply not only to nuclear material in domestic use, storage and transport but also to nuclear facilities used for peaceful purposes. The preamble of the Amendment underlined the threat of international terrorism and organized crime, and added emphasis on updated physical protection measures.[57] The IAEA defines nuclear security as "[t]he prevention and detection of and response to, theft, sabotage, unauthorized access, illegal transfer or other malicious acts involving nuclear material, other radioactive substances or their associated facilities."[58] The IAEA Glossary adds that the meaning of nuclear security "…includes 'physical protection', as that term is understood from consideration of the Physical Protection Objectives and Fundamental Principles, the CPPNM and the Amendment to the CPPNM."[59]

The concept is rather new for both the newcomers and some old users. An international regime on nuclear security is still developing and drawing substantial organizational governance

support from the existing nuclear nonproliferation regime. The legal basis of nuclear security rests on UN Security Council Resolutions 1373 (2001) and 1540 (2004), the International Convention on the Suppression of Acts of Nuclear Terrorism (ICSANT) and the Convention on the Physical Protection of Nuclear Material (CPPNM) and its 2005 Amendment. Supplementary legal instruments are the Convention on Early Notification of a Nuclear Accident; the Convention on Assistance in the Case of a Nuclear Accident or Radiological Emergency; and the Code of Conduct on the Safety and Security of Radioactive Sources and the Supplementary Guidance on the Import and Export of Radioactive Sources.[60] Other elements include the Global Initiative to Combat Nuclear Terrorism (GICNT), Nuclear Security Summits, and the IAEA, which pioneered a network for education activities (the International Nuclear Security Education Network-INSEN) and coordinates the link between INSEN and the national nuclear security support centers (NSSC). One of the aims of nuclear security efforts is to produce a national culture on physical protection, material accounting, and to develop the norm of nuclear security. It includes a new set of tasks that require national level regulations, including legal and technical frameworks, education and training activities.

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For the newcomers, nuclear security seems rather an unfamiliar concept regarding the definition and perception of threat, terrorist attack scenarios, response measures and even terminology. This translates itself to a lack or insufficiency of national regulations to cope with the threat in facilities, transportation, borders and international cooperation to prevent the threat.

For an effective nuclear security policy, this article recommends that both newcomers and traditional users engage in cooperation and coordination efforts with relevant departments in public administration as well as those in industry and academia to work on a comprehensive plan of action. These departments include ministries of foreign affairs and energy, atomic energy authorities, civil defense agencies, CBRN departments in the military and civilian authorities, and the intelligence community. The academic community can contribute

through research in international relations, nuclear and physics engineering, psychology, sociology and communication, particularly to make simulation exercises to understand public reactions and for developing crisis scenarios. For effective communication and raising awareness, media and scriptwriters could play an important role to develop thrillers and movies regarding the threat and the response. The industry can engage in manufacturing relevant material for physical protection and civil defense. Last but not least, companies giving training to special security forces can provide special training programs on the security of nuclear power plants.

Nuclear Safety and Public Acceptance of Nuclear Energy

The concepts of nuclear safety and nuclear security usually cause confusion. Particularly, if they do not have a clear line between them in a specific language, it poses a problem in terminology. To make the concepts clearer, one can determine the referent in each term. Nuclear safety means protection of the workers, public and the environment from the risks of radiation by ensuring proper operating conditions, preventing accidents and mitigation of the consequences of accidents.[61] The relevant authorities take precautions to ensure safety, but there still may remain a risk. Nuclear security, on the other hand, involves the element of threat. It is a threat emanating from malicious intent to get hold of nuclear material, or to sabotage the facility or carrier of such material to inflict damage. In this case, the referent is the nuclear material itself.

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Public concerns and debates have usually revolved around the issue of nuclear safety. There have been three major reactor accidents that sustained high public perception of risk from nuclear energy and "anti-nuclearism" as a social movement: Three Mile Island (1979), Chernobyl (1986), and Fukushima (2011). The flip side of coin is that social movements like environmentalism and anti-nuclearism may also be exploited as tools to spread information in order to put pressure on national governments towards a certain "policy choice," particularly in

matters of energy. A sociological and psychological analysis would reveal why the public reactions to nuclear power plants/nuclear energy are usually negative.

At the sociological level, Ulrich Beck, a critical sociologist, explains that societies have reached the era in which they experience the adverse effects of development, industrialization and modernity. In the simple modernity era, they enjoyed its benefits. Right now, they are in what Beck calls the "reflexive modernity" period, meaning that modernity has become a problem in itself: Societies are faced with more pollution and environmental disasters as they grow and develop.[62] They also believe that policymakers are not capable of controlling ecological risks.[63] Thus, Beck introduces the concept of "risk society" based on the concern that dangers and hazards may become predictable but unpreventable, especially within the ecological context. This is applicable to nuclear technologies drawing from Beck's argument that "the injured of Chernobyl… are not born yet."[64] In this period, establishment of big-size projects, including energy projects, are no longer creating excitement, but rather anxiousness and fear. Thus, societies tend to prioritize the environment and to demand local and smaller projects, as part of a new life-style in harmony with the environment.[65]

At the psychological level, audiences are prone to listen and hear messages of "fear" as it is an extension of our drive to survive. They would be ready to receive negative scenarios on nuclear energy because of the impact of nuclear accidents which had massive impacts on their perception of risk. A nuclear power plant failure like the one in Chernobyl is not a possibility in today's world, but nuclear power plant projects can easily trigger its trauma. The failure in Fukushima was not due to an accident, but due its design. In several countries, it resulted in calls to reduce reliance on nuclear energy.[66] After Fukushima, Pew Research Center surveys found that the Japanese public opinion towards reducing the use of nuclear power rose from 44% in 2011 to 70% in 2012.[67] Still, the Japanese government decided in 2014 that nuclear energy would continue to be a key source for energy, and Japan's energy security as a stable and affordable supply and a means to combat global warming.[68] On the other hand, domestic politics, economics and safety culture have determined the German nuclear energy policy and that of nuclear phase-out.[69] Also, Switzerland has decided for nuclear phase-out as it could turn to renewables as alternative energy sources.[70]

A study on the public perception of nuclear energy in the EU countries found that the perception is mainly

determined by fear that is related to safety, terrorism, misuse of radioactive materials, and the eventual disposal of nuclear waste. It underlines that the precondition to gaining public acceptance is to ensure nuclear safety.[71] According to the Eurobarometer 2010 survey on the public perception of safety, more than half of Europeans think that nuclear energy is risky.[72] It also found that although it had been decades since the Chernobyl accident, Europeans expressed resistance and distrust to and perceived threat from nuclear energy, which reflected itself in their perceptions of risk. Also a considerable percentage thinks that the risk is underestimated.[73]

According to the Eurobarometer 2008 survey, 93% of Europeans demand an urgent solution to radioactive waste disposal.[74] The survey also measures the accuracy of Europeans' knowledge about nuclear waste, and finds that most of them know about other sources producing radioactive waste than nuclear power plants, such as research centers and hospitals. However, while 13% of the respondents know that nuclear waste is not always very dangerous, 78% believe that all radioactive waste is very dangerous.[75]

Europeans do not think they are well-informed about safety issues regarding NPPs.[76] EU citizens report receiving information on nuclear energy mainly through the media, but they did not think it was enough to form their opinion on nuclear issues.[77] Instead, they trust scientists the most for information on nuclear energy. This is followed by national nuclear authorities and then the IAEA.[78] The Eurobarometer survey also finds that the nuclear industry is not seen as a reliable source of information regarding issues of nuclear energy.[79]

The Globescan poll conducted in June and September 2011, interviewed people from 23 countries- those which have nuclear power plants in operation, which plan to have NPPs, and those without them. Examples of countries surveyed were Brazil, Indonesia, Japan, Mexico, Russia, Peru and Turkey. The results of the poll, based on an average of 12 countries surveyed, reveal that 30% of the respondents think that nuclear energy is dangerous and that all operating NPPs should be closed down as soon as possible. In countries planning to have NPPs, around 40% of respondents in Chile, Egypt and Turkey gave the same answer, surpassing the supporting view of nuclear energy.[80]

The threat of terrorism and nuclear security became an issue following 9/11 and further influenced public opinion. Europeans consider lack of security in NPPs against terrorist attacks, the

misuse of radioactive materials and the disposal of radioactive waste as the highest risks to nuclear safety. More than half of them think that NPPs are not sufficiently secured against terrorist attacks and 45% disagree with the statement that "nuclear materials are sufficiently protected against malevolent use."[81] An earlier Globescan poll was conducted for the IAEA in May and August 2005 in 18 countries: Argentina, Australia, Cameroon, Canada, France, Germany, Great Britain, Hungary, India, Indonesia, Japan, Jordan, Mexico, Morocco, Russia, Saudi Arabia, South Korea, and the United States. Views on nuclear security in these countries reflect the perception of the high risk of terrorist acts involving nuclear facilities and radioactive materials due to insufficient protection.[82] The plurality of the respondents thinks that there is a high risk of nuclear terrorist acts.[83]

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The Nuclear Energy Agency (NEA)'s Forum on Stakeholder Confidence (FSC) focusing on radioactive waste management, recommends some confidence factors to develop and enhance feelings of familiarity and control. These are openness, transparency, technical competence and procedural equality.[84] As a result of the FSC meetings in Finland, Canada, Belgium, Germany, Spain and Hungary, the OECD/NEA has found that the involvement of stakeholders in the management of radioactive waste has served to incorporate public values into decisions, build trust in institutions and educate and inform the public in these countries.[85] If the public will participate in nuclear decision-making, it needs to be equipped with knowledge on the issue. Therefore, to improve understanding of the benefits of nuclear energy, education and communication are crucial.[86]

In domestic policy-making, communication is underutilized. The public is generally receptive to messages involving fear, anxiety or panic, exposing them to manipulation in terms of the perception of risk. In nuclear energy debates, knowledge is often "constructed" rather than fact-based. The majority of civil society organizations participating in nuclear energy debates originate from the environmentalist tradition. From a broader perspective, the conflict between environmentalist

and anti-nuclear movements with the proponents of nuclear energy belong to two rival discourses of mainstream and critical worldviews. Put differently, while the mainstream worldview focuses on "solving the problem of energy" in the framework of meeting the rising demand, the critical view favors a new life-style that focuses on reducing energy demand for the sake of protecting the environment.[87] The latter view is expressed by campaigns, protests, demonstrations and concerts which appeal to the youth and sustain public perceptions of risk. Policymakers should consider domestic concerns, the role of civil society, and information politics in their endeavor.

Conclusion

This article provided an outlook of the relationship between nuclear energy and international relations. The peaceful use of nuclear energy is one of the three main principles of the nuclear nonproliferation regime, and states embarking on nuclear power generation are subject to far more extensive rules and regulations compared to other sources of energy. The demand for nuclear energy is rising following the increase in overall demand for energy, and state concerns to limit dependence on fossil fuels and CO2 emissions. However, states are also faced with new challenges in terms of nuclear energy. First, there will be constraints on the nuclear fuel cycle as the settlement on the Iran nuclear issue has limited indigenous production of nuclear fuel and the access of NNWS to sensitive technologies. Second, states are expected to take measures to prevent nuclear terrorism, requiring additional expenditures for security, training and bureaucratic adjustment. Third, they will have to cope with rising concerns on nuclear safety and anti-nuclear movements at the domestic level.

The article has made some recommendations for policymakers on the planning, decision-making and implementation phases of the pursuit of nuclear energy in line with the requirements at the international and domestic levels. First of all, NNWS under the NPT have the right to use nuclear energy for peaceful purposes, and according to the updated norm of safeguards, they are expected to accept and implement the Additional Protocol as a demonstration of transparency. Second, although the estimates of domestic energy need and the number of planned nuclear reactors may make the acquisition of a full nuclear fuel cycle feasible, newcomers should be ready for a denial of sensitive technologies and to depend on fuel suppliers. Third, all states using or planning to use nuclear energy for peaceful purposes are under

the obligation to provide for protection of nuclear materials in order to prevent them from terrorist access. Particularly, in the developing countries, which are new to nuclear energy, training and education programs for nuclear safety and security are essential. These programs should go beyond the narrow energy bureaucracy and cover relevant government agencies, universities and industry. They must also be multidisciplinary to have an accurate understanding of the threat and to be able to formulate an effective response. Fourth, public acceptance of nuclear energy is low almost worldwide. The energy and security bureaucracy could reach out to social communication experts and the movie industry for effective communication tools to spread accurate information on nuclear safety and nuclear terrorism without creating panic.

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