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THE NUCLEAR DUEL

The path towards nuclear disarmament in the Middle East

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Abstract:

The Nuclear Age started in 1945 when the United States conducted the first nuclear test. By 1996, the so-called nuclear-weapon states had already conducted more than 2,000 nuclear tests. Even though nuclear disarmament speeches and negotiations have taken place, nowadays some states still support nuclear deterrent strategies. This research paper seeks to determine the role played by the nuclear factor in the geopolitics of the Middle East. Firstly, it will examine the basics of the nuclear topic and nuclear disarmament in terms of actors, international nuclear law and theories. Secondly, it will provide an analysis of Israel's and Iran's nuclear programmes and perspectives. Finally, it will propose a hypothetical outcome of the complex relationship between a nuclear Israel and a nuclear Iran, and it will present future recommendations.

Key words: Nuclear proliferation, Nuclear disarmament, Israel, Iran, Nuclear deterrence theory, Game theory.

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List of Acronyms

CNS	Convention on Nuclear Safety
CPPNM	Convention on the Physical Protection of Nuclear Material
CSA	Comprehensive Safeguards Agreement
CTBT	Comprehensive Nuclear-Test-Ban Treaty
IAEA	International Atomic Energy Agency
MAD	Mutual Assured Destruction
MKO	Mojahedin-e Khalq Organization
NPT	Treaty on the Non-Proliferation of Nuclear Weapons
NSG	Nuclear Suppliers Group
START	Strategic Arms Reduction Treaty
TOC	Transnational Organized Crime
UK	United Kingdom
UN	United Nations
UNAEC	United Nations Atomic Energy Commission
UNSC	United Nations Security Council
U.S.	United States
USSR	Union of Soviet Socialist Republics
WA	Wassenaar Arrangement
WMDFZ	Weapons of Mass Destruction Free Zone in the Middle East

Introduction

I. Importance of the nuclear topic

In 2012, more than 95% of the total nuclear weapons in the world were possessed by the United States and Russia. Nuclear weapons have historically caused controversial debates among the international community and international scholars, mainly because they are tools for mass destruction. The Nuclear Age started in 1945 when the United States carried out the first nuclear test. Ever since that moment, states have introduced policies, passed laws and signed international treaties in order to regulate the use of national nuclear energy under the normative umbrella of international nuclear law. Despite international efforts, the ideals of nuclear disarmament and of a nuclear-weapons-free-world has not been possible yet. This section is going to justify the relevance of acknowledging how the Nuclear Age has reshaped the international system.

First, nuclear energy is a key political and geopolitical instrument for any nation state because the possibility of producing an atomic bomb gives it more power and recognition in the international arena. Accordingly, having a national strategy with regard to nuclear weapons is viewed as fundamental for the defence policies of the regions of the Middle East and Asia.

Second, nuclear power has occasioned an international system characterized by interrelated actions of regional powers and superpowers, such as the United States, Russia and China. The Nuclear Age has introduced a new international structure in which traditional actors, such as states and international organizations, have to deal with new actors, such as terrorist groups and transnational organized criminal networks.

Therefore, several Presidents of the United States have addressed the importance of global nuclear disarmament in their speeches, as the ex-President Eisenhower with the “Atoms for Peace” speech (1953), and more recently former President Barack Obama with his speech in Prague (2009). The role that nuclear weapons play nowadays is different from the one they played during the Cold War. This redefinition of nuclear weapons has an important implication on world politics, because they are no longer dependent on a bipolar system made up of two hegemonic blocks: the United States and

the Soviet Union. On the contrary, nowadays world politics are defined by a multipolar system comprised of independent multiplayers that can be either state or non-state entities, which brings more instability and uncertainty into the international sphere.

Finally, deterrence takes place in this uncertain context in which international security has to deal with the challenges of nuclear arms race, nuclear competition, nuclear deterrence, and regional wars and rivalries. Therefore, the international system may not be ready to face the major consequences and challenges that the possession of nuclear weapons by state and non-state actors can have.

II. Objectives and methodology

The aim of the present paper is to answer the following research question: Which role does the nuclear factor play nowadays in the convulsed and complex region of the Middle East?

Therefore, the study is going to examine the nuclear programmes of Israel and Iran in order to offer some hypothetical scenarios in which the use of the nuclear factor would change the balance of power in the Middle East. This investigation pursues some specific objectives, which are:

- To review the history and functioning of nuclear energy;
- To describe interactions between traditional actors and new actors in the geopolitical scenario;
- To provide an international legal framework for the nuclear issue; and
- To explain the logics of the nuclear deterrence theory and the game theory, all this applied specifically to the particular context of the Middle East.

The research methodology preferred to achieve the objectives aforementioned is the qualitative research method. The qualitative methodology has been conducted through participant and non-participant observation.

Participant observation has consisted in thinking critically about personal experiences acquired on personal trips to Middle Eastern countries, such as Israel, Turkey, Jordan, Saudi Arabia, Oman and the United Arab Emirates.

Non-participant observation has implied bibliographic, legal and news research. Firstly, bibliographic research has involved primary and secondary sources. Primary sources used in the elaboration of this paper are legal documents and an interview. Secondary sources used to provide the State of the Art and framework of this investigation are books, scholar articles, journal articles and international journals. Secondly, legal research is done through the study of international legally binding resolutions, treaties and conventions passed by international organizations and agencies. Thirdly, news research is accomplished through the review of newspapers and opinion articles to take into account different perspectives of the nuclear issue.

The method selected to analyse the information presented in the literature review and in the normative and theoretical framework is the case study. The internal actors that comprise the case study are specifically Israel and Iran. The external actors that affect this study are displayed as actors that influence the tension between both states during the 1970s, including the nuclear capacity of each state, the intervention of the United States, and the use that these actors give to the nuclear deterrence theory and the game theory. This case study will conclude with the proposal of three theoretical scenarios for a nuclear Israel and Iran taking into account the ideas presented in the theories studied.

Regarding the structure of the present research study, it is composed of three main chapters. The first chapter is the *State of the Art*, which addresses the basics of the nuclear field and the core features of nuclear disarmament, distinguishing between traditional actors and new actors. The second chapter is the *Normative framework*, which introduces general remarks of the international nuclear law, and the *Theoretical framework*, which is focused on the nuclear deterrence theory and game theory. The third chapter is the *Analysis*, which examines nuclear power configuration in core states and proposes conjectural results of the actions that a nuclear Israel and a nuclear Iran could have. Finally, some *Conclusions* will be drawn from each section and will provide key answers to the role that the nuclear factor plays in the Middle East.

State of the Art

I. Basics of the nuclear field

In 1991, the Cold War suddenly ended with the dissolution of the Union of Soviet Socialist Republics (USSR). After the terrorist attacks of 9/11, the United States (U.S.) and other allies declared the so-called “global war on terror”. In 2018, 17 years after that first declaration, it can be said that a new age characterized by the development of nuclear technology has begun, which is already known as the Nuclear Age. The Nuclear Age is defined by the increasing and strong reliance of states on nuclear weapons that threaten to be in the hands of non-state actors capable of using them against humanity (Falk & Kreiger, 2012).

The advancements in technology have allowed humans to develop such powerful arms capable of destroying themselves and the world. This is the era known as the Nuclear Age, which can be said that started with the first nuclear weapon test in 1945. That was the year when both Hiroshima and Nagasaki were devastated by the bombing conducted by the United States. This first nuclear demonstration of power has led to the arms races that are occurring nowadays. This is the moment when people stand up for the cease of nuclear weapons. The Hiroshima and Nagasaki survivors, which are named as *hibakusha* in Japanese, have fought for decades for the elimination of nuclear weapons.

However, there are both supporters and detractors of the Nuclear Age. The first ones argue that nuclear weapons are a tool of preventing war, whereas the second ones consider nuclear weapons as the way to destroy humanity. It is undeniable that nuclear weapons pose a threat to humanity, especially if misused. Not only can states possess nuclear weapons, but also non-state actors as terrorist groups can have access to some part of them too. For example, among Americans’ greatest concerns there is the threat of nuclear weapons in hands of terrorist organizations. In the Nuclear Age, being a state free of nuclear weapons does not imply being free of a nuclear attack. Consequently, all states are potential objectives of nuclear destruction.

The Nuclear Age started in July 1945, with the United States of America carrying out the first nuclear test by the detonation of an atomic bomb known as “Trinity” in the desert of New Mexico (“Nuclear testing”, n.d.). This first nuclear test was useful to

determine the massive consequences for both the population and the planet that dropping an atomic bomb could have. Nevertheless, it is important to mention the Manhattan Project, which started in 1938 when Otto Hahn and Fritz Strassmann, two German scientists, discovered nuclear fission. In 1939, Albert Einstein and Leo Szilard decided to send a letter to the U.S. President Franklin D. Roosevelt with the objective of notifying him that Germany could have been trying to develop an atomic bomb. Therefore, Roosevelt created the Uranium Committee, which was a group comprised of the best experts in military and scientific fields to ascertain whether Germany could be capable of developing an atomic bomb.

In 1941, the MAUD Committee (which was a British group of experts) concluded that the atomic bomb was possible and that a cooperation between the United States and the United Kingdom (UK) was urgent (The Atomic Heritage Foundation, 2017). However, the United States decided to drop two atomic bombs in Japan as an attempt to end World War II. In August 6, 1945, Hiroshima had to suffer the drop of “an untested gun-type fission bomb called Little Boy” (“Nuclear testing”, n.d.). Two days later, in August 9, 1945, Nagasaki was chosen as the place where an “implosion-type bomb tested at Alamogordo for the first time a month earlier and called Fat Man” would be dropped (“Nuclear testing”, n.d.). Both bombs killed approximately 200,000 Japanese citizens.

Despite the significant aftermaths of these events, the development of nuclear tests in the U.S. was soon followed by the other nuclear-weapon States: “the Soviet Union in 1949, the United Kingdom in 1952, France in 1960, and China in 1964” (“General overview of the effects of nuclear testing”, n.d.) (see Appendix 1). In August 1963, the United States concluded with the bomb tests in the Pacific (Wiesner, 1964: 27). This atmosphere of threat that motivated the launching of nuclear tests during the 1960s and the 1970s is represented in the film *Dr. Strangelove* (Bracken, 2012: 34). The Director Stanley Kubrick managed to reflect the challenges to the global security of the time through a comic version of the disputes between the United States and the Soviet Union during the Cold War. The atomic bomb was portrayed as a comic tool that backed up the theory of nuclear deterrence and the theory of Mutual Assured Destruction (MAD), both of which defend that each party is motivated to be deterred because a nuclear war would end up with destructive and catastrophic global consequences.

All the nuclear-weapon states had already conducted more than 2,000 tests by 1996 (Cook, 2013: 37), which has had tremendous consequences on the atmosphere due to the large amounts of radioactivity released. Not only have nuclear-weapon States conducted nuclear tests, but officially non-nuclear weapon States such as India, Pakistan and the Democratic People's Republic of Korea have also carried them out.

Experts usually say that nuclear energy can have a “dual use”. Helen Cook, who is a lawyer in the International Nuclear Energy Group¹, defends that “dual use” can be referred to as “the ability to use nuclear energy for both peaceful and non-peaceful purposes” (Cook, 2013: 27). Dwight Eisenhower, President of the United States from 1953 to 1961, claimed in his 1953 speech to the General Assembly of the United Nations that nuclear energy had to be used peacefully. This mention represented a shift in the history of nuclear energy and his speech became known as “Atoms for Peace”.

I. Basic notions of the nuclear structure

Nuclear energy can be explained as “relating to a nucleus; relating to or using energy released in nuclear fission or fusion” (Cook, 2013: 5). Regarding the procedures for producing nuclear energy, fission and fusion are the two main methods, although fission is the most used one. Fission is the process in which atoms are separated and an amount of heat and neutrons are released, which will repeat this process. The reiteration of this process is known as a “chain reaction”. It is also important to briefly explain the parts of a nuclear reactor, which are principally four: “the uranium fuel assemblies, the control rods, the coolant/moderator and the pressure vessel” (Cook, 2013: 6). The first three parts compose the reactor core, which is enclosed by the pressure vessel. “The fuel rods are loaded into a reactor core” where they produce heat that will be “used to generate electricity” (Cook, 2013: 6). In some cases, the chain reactor can be self-sustaining, which means that a first fission will lead into a second one and it will eventually reach an equilibrium described as “criticality” (*Idem*). Generally, there are three main categories of nuclear materials:

1. “Source material: refers to materials containing the element uranium or thorium in its natural, unenriched state;

¹ Helen Cook is a lawyer in the International Nuclear Energy Group at Pillsbury Winthrop Shaw Pittman LLP focused on international nuclear projects.

2. Special nuclear material: refers to plutonium, uranium-233, or uranium enriched in the isotopes uranium-233 or uranium-235. It is this special nuclear material that serves as the fuel for a nuclear reactor; and
3. By-product material: refers to any radioactive material yielded in, or made radioactive by exposure to the radiation incident to, the process of producing or using special nuclear material. By-product material also includes the tailings or wastes produced by the extraction or concentration of uranium or thorium from any ore processed primarily for its source material content” (Cook, 2013: 6).

Not only does a nuclear power plant consist of a nuclear reactor, but it also needs a turbo-mechanical equipment. Some nuclear reactors use Uranium 235 (U-235) enriched to 2% or 3%, but that can be increased up to 80% or 90% when producing a bomb. “There are currently some 1,475 metric tons of highly enriched uranium in the world, enough for some 60,000 nuclear weapons” (Falk & Kreiger, 2012: 104). In the process of fission of uranium, plutonium arises as a by-product. Nuclear power plants can create Plutonium 239 (Pu-239), which is a very dangerous material used for making nuclear weapons. “There are approximately 485 metric tons of weapons-grade plutonium in the world. Since the amount of plutonium required to make a nuclear weapon is about one-third the amount of enriched uranium, there is enough plutonium in current stocks to make some 60,000 nuclear weapons” (Falk & Kreiger, 2012: 104).

Therefore, nuclear power plants control very dangerous radioactive materials such as uranium and plutonium. The enrichment of uranium and the reprocessing of plutonium give as a result very high radioactive uranium and plutonium, hence the consequences for the atmosphere and the society are tremendous. In 1982, Paul Crutzen and John Birks² conducted a study to reveal the short-term and long-term consequences of a nuclear war. They concluded that the most damaged component would be the atmosphere, specifically the troposphere because of the large amount of fires that would start burning in urban and industrial zones (Crutzen & Birks, 1982). These fires would cause a scenario of darkness because the sunlight would not be able to penetrate through the atmosphere. This darkness period would cause a marine crisis because animals

² Paul Crutzen is a Dutch atmospheric scientist who received the 1995 Nobel Prize for Chemistry. Dr. John W. Birks was Professor Emeritus of Chemistry and Biochemistry at the University of Colorado at Boulder, and he is the current President at 2B Technologies, which is aimed at developing instruments for atmospheric and environmental analysis.

would not be able to feed themselves, hence there would be a global food crisis. Therefore, the short-term aftermath of a nuclear war is really concerning. Moreover, Owen B. Toon, Alan Robock and Richard P. Turco³ have also defended the theory of nuclear winter. Nuclear winter would involve “worldwide climatic cooling from stratospheric smoke” and it “would cause agricultural collapse that threatened the majority of the human population with starvation” (Toon & Turco, 2008: 37).

In the Global Fissile Material Report of 2009, it can be found the statement that

“A civilian nuclear power program provides a state a foundation to produce fissile materials for nuclear weapons. It allows a country to train scientists and engineers, to build research facilities, to construct and operate nuclear reactors, and possibly also to learn techniques of reprocessing and enrichment that could later be turned to producing weapons materials” (Global Fissile Material Report, 2009: 103).

As stated by Steven Starr, an Associate member of the Nuclear Age Peace Foundation, “each of the 440 commercial nuclear reactors in the world contains at least 100 times more long-lived radioactivity than was produced by the bombs which destroyed Hiroshima and Nagasaki” (Falk & Kreiger, 2012: 184). He even defends that “a catastrophic accident at just one of these reactors has the potential to release as much radioactive fallout as would a nuclear war fought with 100 atomic bombs”. Alan Robock and Brian Toon, experts on the aftermath of a nuclear war, have signalled that a regional nuclear war between India and Pakistan could cause “a global famine that could kill one billion people” (Starr, 2010). Therefore, consequences for the world do not only entail human lives but also atmospheric disasters.

The states that currently are formally in possession of nuclear weapons are nine: the United States, Russia, the United Kingdom, France, China, Israel, India, Pakistan and North Korea. In 2009, as it is further explained in Appendix 2, it was estimated that Russia was possessing 10,000 nuclear warheads, which made it the country with the highest number of warheads followed by the United States with 9,400 of which 4,200

³ “Brian Toon is Chair of the Department of Atmospheric and Oceanic Sciences and a member of the Laboratory for Atmospheric and Space Physics at the University of Colorado at Boulder. Alan Robock is a Professor of Atmospheric Science at Rutgers University in New Brunswick, New Jersey. Rich Turco is a Professor of Atmospheric Science at the University of California, Los Angeles” (Toon & Turco, 2008: 37).

were awaiting dismantlement (Global Fissile Material Report, 2009: 9). Moreover, Russia is also the country with more warhead storage sites, which amounted to 48 in 2009 in comparison with the 21 warhead storage sites that the U.S. had domestically and internationally. It was estimated that there were approximately 111 nuclear warhead storage sites worldwide (see Appendix 3), 105 of which were in territory of nuclear weapon states (Global Fissile Material Report, 2009: 11).

Nowadays, five are the nuclear weapons free zones which include the countries that have agreed to one or more of the following treaties: Treaty of Tlatelolco, Treaty of Bangkok, Treaty of Rarotonga, Treaty of Pelindaba and Treaty of Semipalatinsk (Global Fissile Material Report, 2009: 12). These five treaties were covering a total of 110 countries in 2009 (see Appendix 4). Finally, these figures prove the undeniable relevance of achieving a world free of nuclear weapons because a misuse of these could derive in a world crisis with innumerable consequences. The nuclear weapon states need to be together in the defence and proclamation of nuclear disarmament, and together with the non-nuclear weapon states will have to delimitate the path towards a nuclear-weapon-free-world.

II. Nuclear disarmament: core features

The concept of security is difficult to define because scholars differ in providing an established definition for it. Arnold Wolfers states that security can be defined as “a value of which a nation can have more or less and which it can aspire to have in greater or lesser measure” (Baldwin, 1997). Moreover, neorealists argue that security is the most important objective of any state, hence security relies on national objectives and interests. The concept of security is a multidimensional term because it implies several dimensions such as the economic, political, military, social and environmental ones. International security can be defined as the international protection given to the security of all states as a whole. International security is facing an important challenge because technology has allowed the creation and development of nuclear weapons that are more dangerous than those of the past. Furthermore, the international community is concerned about the threat that international criminal and terrorist groups with nuclear weapons could pose. This concern has been debated by recognized and influential politicians such as Mikhail Gorbachev. Gorbachev was elected General Secretary and Head of the Soviet Union in 1985. He was a firm defendant of nuclear disarmament

because he considered that the amounts of money allocated to the military budget were disproportionate because they were only aimed at remaining the enemy of the U.S. As an advocate for nuclear disarmament, in 2007 Gorbachev said that “nuclear weapons are no longer a means of achieving security; in fact, with every passing year they make our security more precarious” (Shultz, 2008: 77-78).

Additionally, in 2007 the Secretary of State for Foreign and Commonwealth Affairs of the United Kingdom, Margaret Beckett, defended that “What we need is both a vision—a scenario for a world free of nuclear weapons—and action—progressive steps to reduce warhead numbers and to limit the role of nuclear weapons in security policy” (Shultz, 2008: 78). The path towards nuclear disarmament should be run by the states with more nuclear capacities, which are the United States and Russia (see Appendix 5), because it would be a reason for the rest of nuclear and non-nuclear states to abandon their nuclear programmes. This section seeks to analyse the most relevant actors involved in non-proliferation processes, which are classified into traditional and non-traditional actors.

I. Traditional actors: main states and international organizations

The most relevant aspect when talking about non-proliferation and nuclear disarmament is the possibility of tension and conflict giving rise to a nuclear dispute. However, there have been more processes of nuclear cooperation than conflict ones. Since the discovery of nuclear weapons, the main actors of the nuclear dispute have been states (Marrero, 2012: 78). During the Cold War, the international system was bipolar, hence the main efforts regarding nuclear cooperation were addressed at minimizing the chances of a nuclear outcome for both the United States and the Soviet Union. These superpowers were responsible for reaching the equilibrium in the international system through mutual nuclear deterrence (Barbe, 1993: 51).

Their military and nuclear capacities defined the level of power and influence they had over the rest of states that comprised the bipolar system. Once the Cold War ended, the international system turned into a multipolar system characterized by the emergence and influence of many state actors. Therefore, the vertical nuclear proliferation that had characterized the age prior to the end of Cold War led to a horizontal nuclear proliferation due to the will of states to be able to defend themselves when facing an

attack in their territories. On the one hand, *vertical* nuclear proliferation can be referred to as the one of nuclear-weapon States that are acquiring and developing new nuclear weapons, and increasing their stockpiles. On the other hand, *horizontal* nuclear proliferation is also known as simply proliferation, and it is that of non-nuclear weapon States that are not permitted to possess nuclear weapons, but that are acquiring them or improving their capabilities in order to be able to produce them (Sidel, 2007). Horizontal proliferation consists as well in the expansion of nuclear weapons from one state to another, and it is usually associated with state and non-state actors.

Nevertheless, states are the main actors concerning non-proliferation issues and nuclear disarmament because of two main reasons. In the first place, the theories of International Relations, such as the realist and neorealist theory consider the state as the main actor in the international arena. In the second place, the state is the main subject of international law and possesses both rights and obligations, hence it is responsible for non-proliferation and nuclear disarmament matters (Marrero, 2012: 79). Moreover, the members of the “Nuclear Club” were originally the five permanent members of the UN Security Council and nuclear-weapon States: the United States, the Soviet Union, China, France and the United Kingdom. As it has been mentioned, the United States and the Soviet Union were considered as superpowers because of the amount of power they had over the international arena. The other three states were considered as states with a higher relevance for the international system than the rest of states. In the mid-70s, other regional powers became members of the Nuclear Club, such as Israel, India and Pakistan (Marrero, 2012: 81). The inclusion of states with weak institutions has risen the concern regarding the security and control of nuclear weapons, because they have put an end to the exclusive nuclear management that the nuclear-weapon States had.

The existence of multiple states with nuclear aspirations made the control of nuclear issues necessary. This is the reason why international organizations took a step in assessing nuclear safety and controlling states that were willing to develop a nuclear programme. Aspects such as the size and the wealth of the state are not important anymore, because international organizations are composed of states with an important influence on them. International organizations are key entities in cooperation processes of non-proliferation issues. Since the United Nations (UN) was created in 1945, once the Second World War was over, the matter of nuclear energy and its use has always

been part of the UN agenda. Furthermore, the General Assembly of the UN has delivered resolutions with the purpose of promoting nuclear disarmament.

Moreover, the International Atomic Energy Agency (IAEA) is a specialized agency of the United Nations that provides assistance to the non-nuclear-weapon states member of the NPT that use nuclear energy in a peaceful way (Marrero, 2012: 85). The Board of Governors of the IAEA is the body responsible for examining whether a non-nuclear weapons state that has agreed not to develop a military nuclear plan can pose a threat to the international peace and security. Based on IAEA recommendations, the UN Security Council can impose sanctions to these non-nuclear weapon states, such as the ones imposed to North Korea and Iran⁴ (Marrero, 2012: 86). Therefore, the possibility of recognized international organizations like the United Nations to impose sanctions gives legitimacy to international organizations aimed at regulating nuclear issues, such as the IAEA. However, the treatment to the non-nuclear weapon states depends on the interests on the state developing a nuclear programme. For example, Israel has developed a nuclear weapon outside of the NPT, and so have India and Pakistan. In contrast to Israel, India and Pakistan were considered a threat for global security when conducted 11 nuclear tests and were condemned to international sanctions (Marrero, 2012: 88). Therefore, since international organizations are composed of states and these are the ones with the real power to decide, international organizations can become subordinate to states and a tool of their foreign policy.

Due to the increasing exchange of nuclear technology and information, it was necessary to create cooperation forums in which there would be a flux of information of the nuclear material transferred and a list of states which would not be ideal to receive nuclear materials because of the potential risk of being used by terrorist groups. Examples of these cooperation forums are the Wassenaar Arrangement (WA) and the Nuclear Suppliers Group (NSG). The latter acts accordingly to the “Non-Proliferation Principle” of 1994:

⁴ Resolutions of the UN Security Council on the nuclear programme of North Korea: S/RES/825 (1993), S/RES/1540 (2004), S/RES/1695 (2006), S/RES/1718 (2006), S/RES/1874 (2009), S/RES/1887 (2009), S/RES/1928 (2010), S/RES/2276 (2016) and S/RES/2397 (2017).

Resolutions of the UN Security Council on the nuclear programme of Iran: S/RES/1696 (2006), S/RES/1737 (2006), S/RES/1747 (2007), S/RES/1835 (2008), S/RES/1887 (2009), S/RES/1929 (2010), S/RES/2105 (2013) and S/RES/2159 (2014).

“whereby a supplier, notwithstanding other provisions in the NSG Guidelines, authorises a transfer only when satisfied that the transfer would not contribute to the proliferation of nuclear weapons.” (“About the NSF”, n.d.).

Some states prefer to address nuclear issues in international cooperation forums rather than in international organizations because the former guarantee the continuity of the nuclear industry and the revenues from it, and they do not limit the sovereignty of states because they can leave the forum whenever. However, nuclear cooperation forums have turned out unsuccessful in several occasions as with North Korea and Iran, so states consider international organizations as the frame where to discuss non-proliferation and nuclear disarmament matters. Nonetheless, international organizations should have enough autonomy to be independent when deciding on any aspect, including nuclear ones, in order to gain recognition and trust from the general public. International organizations are also aware of the shift in nuclear actors that have allowed terrorist and criminal organizations to have access to nuclear energy. Consequently, international organizations are crucial institutions in order to promote international cooperation aimed at encouraging states to abandon the nuclear arms race and become a nuclear disarmed state.

II. New actors in the geopolitical scenario

The traditional actors that have been just studied, states and international organizations, have been obliged to adapt their goals and strategies to those of the emergent actors, such as terrorist groups and international criminal organizations. Traditional actors and transnational entities firmly reject the possession and access of these new actors to nuclear materials due to the lack of transparency, the inability to have mechanisms of control on them and the major consequences of a terrorist nuclear attack.

The end of the Cold War had a tremendous impact on the configuration of the international system because it led to the emergence of new actors that were getting involved in non-proliferation processes and nuclear disarmament. During the Cold War, many nuclear reactors and materials were distributed along the Soviet territory. Once the Soviet Union was dissolved, new Soviet Republics emerged, which meant that there was no longer a centralized control concerning nuclear technology and materials. Consequently, criminal organizations took advantage of this situation and started to

commercialize these products. Moreover, the end of a bipolar system, in which the Soviet Union was an important shield of protection for many states, gave rise to the nuclear arms race because the states that could no longer rely on the protection of the USSR started to acquire nuclear materials with the objective of preparing themselves to defend their state. For these new nuclear states, the way of getting nuclear material would be through criminal organizations, because they offered less costs, time and risks of being exposed. Lastly, the breakdown of the Soviet Union permitted international terrorist groups to gain international presence and conduct their activities in those territories that were left without a strong institutional branch and power. According to John Negroponte, Director of National Intelligence of the United States in 2006, “nearly 40 terrorist organizations, insurgencies, or cults have used, possessed, or expressed an interest in chemical, biological, radiological, or nuclear agents or weapons.” (Negroponte, 2006).

The main actors considered as new are mainly distributed into two classes: transnational organized crime (TOC), and international terrorist groups. The former is aimed at getting an economic benefit from activities such as drug trafficking, human trafficking and even nuclear material trafficking. The latter has the objective of destroying the ideals on which states are founded by the imposition of an opposite conception of how states should actually be. Transnational crime pursues an economic objective because its activities are aimed at getting money, whereas international terror makes every effort to change the course of international relations. International terrorism has scaled up the concerns of the international community on the possibilities of using mass destruction nuclear weapons.

The chance that international terrorist groups have to influence the international system is huge. For example, the terrorist attacks of September 11, 2001 carried out by the terrorist group Al-Qaeda led to a new phase in the international relations known as the “War on Terror”. This ability to make an impact gives them the consideration as actors of the international relations, regardless the refusal from some states to accept them as actors (Marrero, 2012: 95). Despite the differences among both groups, they have already converged because some TOC groups and terrorist groups have in common specific tactics and operations that they put into practice. This connection between transnational crime and international terror combined with high corruption in many states with weak institutions pose an important threat to global security (PfPC

Combating Terrorism Working Group, 2014), because transnational crime organizations can assist terrorist groups in the process of getting nuclear material.

Finally, the inclusion of new actors in the international nuclear spectrum has forced traditional actors to come up with new forms of regulating the development and use of nuclear energy and materials. Transnational organized crime and international terror have taken control over nuclear issues that were previously matter of states and international organizations. The dilemma of nuclear disarmament will continue prevailing because the nuclear-weapon states are no longer supportive to reach nuclear disarmament if the threat of new actors with nuclear weapons persists. Simultaneously, the formally so-called “non-nuclear weapon” states (Israel, India, Pakistan and North Korea) reject any possibility of nuclear disarmament if the nuclear-weapon states remain nuclearly armed. Despite the chances of having a fully nuclear disarmed world have been reduced by the irruption of new actors, the debates and forums regarding nuclear cooperation have increased due to the fears from a nuclear terrorist disaster.

Normative and Theoretical Framework

I. International nuclear law: general remarks

Radioactivity was discovered in 1896 by Henri Becquerel (Myers, 1976: 579), a French physicist that won the Nobel Prize in Physics in 1903 together with Marie Skłodowska-Curie and Pierre Curie for the discovery of radioactivity. However, it was not until the Second World War (1939-1945) when atoms were used in the military field, which completely changed the perception of nuclear risks and the dynamics of war.

In 1942, the Government of the United States of America produced a nuclear weapon that was used three years later. In 1945, two atomic bombs were dropped on Japan: one on the city of Hiroshima, and another one on the city of Nagasaki. These episodes had a tremendous impact in the history of nuclear energy, because uncertainty and fear arose in the international arena. When the Second World War ended, in 1945, the United States was the only state with nuclear capacity. Nevertheless, both the United Kingdom and Canada had helped the U.S. to develop the atomic bomb, so they could potentially be able to develop atomic weapons by themselves. In October 3, 1945, the President of the United States, Harry S. Truman, gave a speech to the Congress and recognized that the control of atomic energy was the most important challenge in the world (Gormly, 1984).

In November 15, 1945, the President of the United States of America, the Prime Minister of the United Kingdom of Great Britain and Northern Ireland, and the Prime Minister of Canada released an “Agreed Declaration on Atomic Energy”⁵. This Agreed Declaration defended the inevitable peaceful use of nuclear discoveries and the appropriate sharing of nuclear information between states. In 1946, the United Nations adopted the “Resolution on the Problem of the Discovery of Atomic Energy” that led to the establishment of the United Nations Atomic Energy Commission (UNAEC), which was suspended in 1949⁶. In the first meeting of the UNAEC, the U.S. Representative Bernard Baruch defended the need of creating an “International Atomic Development

⁵ Agreed Declaration by the President of the United States of America, the Prime Minister of the United Kingdom of Great Britain and Northern Ireland, and the Prime Minister of Canada relating to Atomic Energy, signed at Washington on November 15, 1945.

⁶ General Assembly Resolution on the Establishment of a Commission to Deal with the Problems Raised by the Discovery of Atomic Energy, January 24, 1946.

Authority”⁷ and his proposal became known as “The Baruch Plan”. Regardless of the ambitiousness of the Baruch Plan, it was never implemented. However, it contained two important elements to remark: first, it argued that there had to be punishments for the illegal possession or use of atomic bombs; and second, the five permanent members of the United Nations Security Council (UNSC) would not be allowed to execute their veto power to avoid these penalties (Cook, 2013: 29).

In 1953, the United States President Dwight D. Eisenhower addressed the General Assembly of the United Nations with the “Atoms for Peace Plan” (Atomic Energy, n.d.), which defended the founding of an international atomic energy agency that was created in 1954 by the General Assembly of the UN. In 1955, the first International Conference on the Peaceful Uses of Atomic Energy was held in Geneva, Switzerland. In 1956, the Conference on the Statute of the International Atomic Energy Agency approved the Statute of the International Atomic Energy Agency (IAEA), which became effective on July 29, 1957. As stated in the Article II of the Statute of the IAEA, its main mission is:

“(…) to accelerate and enlarge the contribution of atomic energy to peace, health and prosperity throughout the world. It shall ensure, so far as it is able, that assistance provided by it or at its request or under its supervision or control is not used in such a way as to further any military purpose.”

The IAEA has defined “nuclear law” as:

“The body of special legal norms created to regulate the conduct of legal or natural persons engaged in activities related to fissionable materials, ionizing radiation and exposure to natural sources of radiation” (Cook, 2013: 7).

It has also described the main objective of nuclear law as:

“To provide a legal framework for conducting activities related to nuclear energy and ionizing radiation in a manner which adequately protects individuals, property and the environment” (Cook, 2013: 7).

⁷ Text available at: <http://www.atomicarchive.com/Docs/Deterrence/BaruchPlan.shtml> [Accessed March 3, 2018].

International law provides regulation to diverse fields such as “human rights, security, war and defence, crime, environment, trade and commerce” (Cook, 2013: 21). International law can be divided into public international law and private international law. Firstly, public international law consists in the regulation of “the conduct of, and relationships between, sovereign states, including their international rights and obligations” (Cook, 2013: 21). Furthermore, inter-governmental organisations, non-governmental organisations and individuals are also subjects of public international law. Secondly, private international law is aimed at regulating “cross-border rights and relationships between private entities, including individuals and juristic/corporate entities” (Cook, 2013: 21). The use of nuclear energy cannot be reduced to national borders because the consequences of either a peaceful or non-peaceful use of it entail the rest of the world. Therefore, international law has the capacity to regulate the use of nuclear energy with accordance to international treaties, conventions and agreements (Cook, 2013: 21). As stated in the Article 2 of the Vienna Convention on the Law of Treaties of 1969, the concept of “treaty” can be understood as:

“an international agreement concluded between states in written form and governed by international law, whether embodied in a single instrument or in two or more related instruments”.

International law is comprised of international legal instruments with the objective of providing a framework to the five key areas involving nuclear issues, which are “nuclear non-proliferation and de-nuclearization, nuclear security, emergency preparedness and response, nuclear safety and liability for nuclear damage” (Cook, 2013: 26). The following international legal instruments were adopted under IAEA protection (Milestones, 2015: 26):

- “Convention on Early Notification of a Nuclear Accident (INFCIRC/335);
- Convention on Assistance in the Case of a Nuclear Accident or Radiological Emergency (INFCIRC/336);
- Convention on Nuclear Safety (INFCIRC/449);
- Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management (INFCIRC/546);
- Convention on the Physical Protection of Nuclear Material (INFCIRC/274) and Amendment thereto (GOV/INF/2005/10-GC(49)/INF/6);

- Vienna Convention on Civil Liability for Nuclear Damage (INFCIRC/500);
- Protocol to Amend the Vienna Convention on Civil Liability for Nuclear Damage (INFCIRC/566);
- Convention on the Supplementary Compensation for Nuclear Damage (INFCIRC/567);
- Joint Protocol Relating to the Application of the Vienna Convention and the Paris Convention (INFCIRC/402)^a;
- Comprehensive safeguards agreement – based on The Structure and Content of Agreements Between the Agency and States Required in Connection with the Treaty on the Non-Proliferation of Nuclear Weapons (INFCIRC/153 (Corrected));
- Additional Protocol – following the provisions of Model Protocol Additional to the Agreement(s) Between States(s) and the International Atomic Energy Agency for the Application of Safeguards (INFCIRC/540 (Corrected)); and
- Revised Supplementary Agreement Concerning the Provision of Technical Assistance by the IAEA.”

The Article III of the Statute describes the functions of the IAEA and contains explicit references to the safeguards provisions of the agency. Safeguards are meant to guarantee a peaceful use of the nuclear material in the creation of nuclear weapons. As a nuclear consultant, Carlton Stoiber⁸ defends that the three main functions of IAEA safeguards are accountancy, containment and surveillance, and inspection (Stoiber et al., 2003). Accountancy implies the report by states on the actual possession of fissionable material and its forms. The IEAE applies measures of containment and surveillance by using

“seals on nuclear material containers and filmed or televised recording of key areas at nuclear facilities to determine whether unauthorized movements of material have occurred” (Stoiber et al., 2003).

Inspectors of the IAEA carry out inspections in order to confirm that the quantity of fissionable material declared is the actual one. These safeguards of the IAEA are

⁸ Carlton Stoiber is currently a consultant for IAEA and OECD/NEA in international nuclear law and policy, and lecturer on nuclear law and member of Supervisory Board at International School of Nuclear Law at University of Montpellier. Retrieved from <https://international.anl.gov/training/docs/vitas/AF/Stoiber.pdf>

regulated under the “Structure and Content of Agreements Between the Agency and States Required in Connection with the Treaty on the Non-Proliferation of Nuclear Weapons”, which is also referred to as Comprehensive Safeguards Agreement (CSA). The system of safeguards of the IAEA is prior to that of the Treaty on the Non-Proliferation of Nuclear Weapons (NPT), but the NPT obliges “states to accept IAEA safeguards on certain nuclear materials and activities” (Cook, 2013: 30). The NPT entered into force in 1970 mainly

“To prevent the spread of nuclear weapons and weapons technology, to promote cooperation in the peaceful uses of nuclear energy and to further the goal of achieving nuclear disarmament and general and complete disarmament” (NPT, n.d.).

The NPT classifies states according to two key groups: nuclear-weapons States and non-nuclear-weapons States, but it is mandatory for any kind of state. According to the Article IX of the NPT, a “nuclear-weapon State is one which has manufactured and exploded a nuclear weapon or other explosive device prior to 1 January 1967”. Therefore, the United States (1945), the extinct Union of Soviet Socialist Republics (1949), the United Kingdom (1952), France (1960) and China (1964) can be named as nuclear-weapon states – considering at least in formal terms any other state as a non-nuclear-weapon state (Cook, 2013: 31).

The ratification given by a state to a certain treaty is a sign of submission in terms of national sovereignty to the international common good. The development and proclamation of public and private international laws has usually been the result of international fears from a nuclear disaster. For example, in the 1960s states started to be concerned with the rising number of states getting nuclear energy. Consequently, states decided to declare the Treaty on the Non-Proliferation of Nuclear Weapons of 1968. International treaties are a tool for cooperation among international actors. Nowadays, a nuclear power programme requires a legal body composed of international law, national law and national regulation. (Cook, 2013: 16).

Nuclear security is mainly regulated by the Convention on the Physical Protection of Nuclear Material (the CPPNM), which is the only international legally binding instrument adopted in 1979 in Vienna, but it entered into force in 1987. According to the Article 2 paragraph 1 of the text of the CPPNM (IAEA, 2014), the field of the

CPPNM is the nuclear material used for peaceful purposes while in international nuclear transport. International nuclear transport is understood as:

“the carriage of a consignment of nuclear material by any means of transportation intended to go beyond the territory of the State where the shipment originates beginning with the departure from a facility of the shipper in that State and ending with the arrival at a facility of the receiver within the State of ultimate destination” (CPPNM, Art.1(c),1979).

In 1996, the General Assembly of the UN commanded the International Convention for the Suppression of Terrorist Bombings, and the International Convention for the Suppression of Acts of Nuclear Terrorism (the Nuclear Terrorism Convention). Both of them were created as a response to the transportation of nuclear material between states, because it could end up in terrorist groups hands. The Nuclear Terrorism Convention was designed to prevent, repress and eliminate terrorism, because the United Nations decided that the existing multilateral treaties, such as the Convention on the Physical Protection of Nuclear Material, were not effectively approaching the topic of nuclear terrorism. The Preamble of the International Convention for the Suppression of Acts of Nuclear Terrorism remarks that there is an

“urgent need to enhance international cooperation between States in devising and adopting effective and practical measures for the prevention of such acts of terrorism and for the prosecution and punishment of their perpetrators”.

On March 28, 1979, there was the most important nuclear accident in a nuclear plant that has ever happened in the history of the United States. The Three Mile Island Unit 2 reactor partially melted down and, despite the minimum health aftermath, it raised the international community concern on the procedure to follow when assisting a nuclear emergency. In 1986, the accident of Chernobyl took place and there was not a binding international treaty regarding the provision of assistance for a nuclear accident. Therefore, in 1986 the IAEA General Conference adopted the Convention on Early Notification of a Nuclear Accident (the Notification Convention), and the Convention on Assistance in the Case of a Nuclear Accident or Radiological Emergency (the Assistance Convention), which became effective in 1987. On the one hand, the Article 2 of the Notification Convention expresses that the state responsible for a nuclear accident has the obligation to notify the rest of states, despite the potential or actual threat it

poses for the rest of the world; and to provide information about it (IAEA, 1986). The declared nuclear-weapon States have agreed to report any accident involving nuclear weapons and military nuclear facilities. On the other hand, the Article 1 of the Assistance Convention obliges states to cooperate and provide assistance in the event of a nuclear or radiological accident. Lastly, the Convention on Nuclear Safety (CNS) was signed in 1994 and became effective in 1996. It was created because the international community expressed its will of creating international standards that could regulate the levels of nuclear safety in the States Parties of this Convention.

II. Nuclear Deterrence Theory and Game Theory

The theory of nuclear deterrence aims to defend the need for nuclear weapons. It consists in the assumption of “that the threat of nuclear retaliation by country x will prevent the use of nuclear weapons and other proscribed behaviour against country x ” (Falk & Kreiger, 2012: 134). Nuclear deterrence has also given reasons to states for possessing nuclear weapons, usually arguing that nuclear weapons help to the prevention of war. Therefore, supporters of nuclear deterrence do not share the same eagerness to abolish nuclear weapons as the international law and the international community suggest. Some pro-nuclear deterrence analysts have defended that possessing nuclear weapons could have a positive impact on reaching peace. This can give the general public the wrong idea of nuclear weapons as good tools for increasing the security of the state, because it makes the neighbouring country afraid of threatening your own. However, this creates a false sense of security and portrays a situation of moral failure, which represents a great example of the Prisoner’s Dilemma. This false sense of security may lead people to think that nuclear weapons are good in the sense that are a tool to protect themselves from foreign potential threats, and that for that reason states should not be nuclear disarmed. The only possible alternative to nuclear deterrence can be nuclear weapons eradication.

Nuclear deterrence is based on the security dilemma, by which a state tries to arm up in order to be able to defend itself in the uncertain scenario of a nuclear attack. Therefore, deterrence is understood in the sense of holding back a nuclear attack. Deterrence as “discouraging a potential enemy from launching an attack or doing something perceived to be a fundamental threat to the security of the state” (Falk & Kreiger, 2012: 28). Some governments are convinced that being prepared to offer an aggressive response could

protect them from an attack. The solution to nuclear deterrence would be the eradication of nuclear weapons, which has more to do with Western values and ideas defended by Western governments. As it has been studied, international law aims to protect national security of the parties agreeing to international treaties. However, in some cases concerning nuclear issues, national security cannot be fully guaranteed by international law, and that is when the dilemma of nuclear disarmament arises. “Albert Einstein, Bertrand Russell, and many of the original atomic scientists recognized that nuclear weapons undermined national and global security” (Falk & Kreiger, 2012: 27).

Regarding game theory, it is a particular approach framed in the economic field that was used by Thomas C. Schelling to provide understanding to the interrelation of deterrence and the consequences of nuclear weapons. Game theory is often used to explain the logics of international politics and the interrelations between global actors. It is essentially based on two variables, which are rationality and credibility (Malone, 2016). The former refers to the assumption of the rationality of the players involved in the game, which will seek to maximize their gains. The latter relates to assuming that the actions of a player are determined by specific strategies. Game theory leads to the concept of *brinkmanship*, which has been defined as “threats that leave something to chance” (Nalebuff, 1986). Brinkmanship is founded on the hypothesis that a player will push another player towards failure or surrender. Even though the game takes into account the rationality of actors, there are intrinsic risks that cannot be controlled by the players and that can have an unexpected effect on the strategies. Both the nuclear deterrence theory and the game theory are the theories used to explain the analysis part.

Analysis

I. Nuclear power configuration in core state actors

The main reason why states go nuclear have to do with their grand strategy and the national interest they are focused on achieving. For example, Iran has the objective to become a regional power and gain a relevant position in the international arena, India and Pakistan seek to achieve strategic equilibrium, and Israel aims to become a secure state. It has been estimated that approximately 1,700 tons of highly enriched uranium are distributed along 100 locations, being the territories of the nuclear-weapon States the ones in which these quantities are bigger (Marrero, 2012: 98). Nevertheless, the so-called “non-nuclear weapon States” (India, Pakistan, Israel and North Korea) are also in possession of nuclear warheads, and in the case of Israel “other warheads” due to the policy of ambiguity it maintains (see Appendix 1 and 2). The first tool that a state has to address when deciding to develop a nuclear programme is the national policy on nuclear power. It is crucial because states playing in the international arena need to be aware of the reasons why states decide to become nuclear powers. The main elements that a public nuclear national policy may have are the following:

- “Peaceful use commitment: commitment to the peaceful use of nuclear power and to abide by obligations contained in the Treaty on the Non-Proliferation of Nuclear Weapons and all related Safeguards Agreements and controls.
- Participation in the global nuclear community: espousing a commitment to membership of and participation in the global nuclear community (...).
- Primacy of nuclear safety: the prioritisation of nuclear safety and the protection of people, property and the environment from harmful effects of radiation (...).
- Openness and transparency
- Justification: (...) no practice that potentially involves exposure to ionising radiation should be adopted unless the benefits of the practice outweigh the health detriments that it may cause” (Cook, 2013: 14).

International relations are based on interactions between states. How to approach nuclear energy is a challenge for the current international agenda and it remains a controversial matter for the international community. Relations of power highly depend on the national interests of states, which differ from one nation to another. Regarding

nuclear arms in the Middle East, two states are relevant to be analysed: Israel and Iran. These states are not interdependent since their relations of power are asymmetric. It is due to the fact that Israel has a strong secret nuclear programme. Additionally, Iran has rejected to recognize the state of Israel, as in the Oslo Accords (1993).

The game theory is the most appropriate approach to explain this asymmetry of power, because the inexistent interdependence in the Israel-Iran relations have resulted in a zero-sum game (Torres, 2013). A zero-sum game means that the gain or loss that either Israel or Iran lives is going to be balanced by the loss or gain that the other player will experience. Therefore, if results are added the sum will be equal to zero. It is publicly known that Israel relies on a nuclear programme that has not been explained in detail because it maintains a policy of “nuclear opacity”. Even though it has not ratified the NPT, the international community has neither forced nor sanctioned Israel for possessing a nuclear programme that can pose a threat to the international security and survival. On the contrary, the West has always rejected the possibility of a nuclear Iran, and it has held negotiations in order to end with the process of enriching uranium because it could allow Iran to produce an atomic bomb. This section is going to be focused on the analysis of the nuclear programmes of Israel and Iran, specifically on the evolution and size of the programme, and the reasons that justify and motivate each country to not abandon the nuclear path. Finally, the imbalance of power between these two regional powers will be studied in order to find out how the struggle to become the regional hegemon in the Middle East could conclude.

I. Israel's nuclear programme: a general frame

The first nuclear test took place in 1945 and was carried out by the United States. During the 1950s and the 1960s, the nuclear-weapon and the non-nuclear weapon states conducted several nuclear tests and increased their nuclear capabilities. This section is going to study the core aspects of the Israeli nuclear policy based on actual and estimated information.

Israel became a nuclear power in 1966 when it designed two atomic bombs with the purpose of detonating them in Cairo and Damascus in the Six-Day War (June 1967), which was fought by Israel, Egypt, Jordan and Syria. In 1970, the United States, the Soviet Union and the United Kingdom together with a group of non-nuclear weapon states arranged the NPT. The Article VI of the NPT obliges states that have ratified the treaty to cease the nuclear arms race and achieve nuclear disarmament. Israel, India and Pakistan did not agree to the treaty and continued with the development of nuclear weapons (Global Material Fissile Report, 2009: 26). On the one hand, Egypt signed the NPT in 1968, therefore contributing to the nuclear arms race would be considered as a violation of the treaty. On the other hand, in 1969 a secret memo between Henry Kissinger and Richard Nixon was discovered. This memorandum contained information about keeping the Israeli bomb secret. The discovery of this memo did not imply that Israel was infringing the NPT, because it was not a party of it. Israel signed the Comprehensive Nuclear-Test-Ban Treaty (CTBT) in 1996, but it has not ratified the NPT, which makes it the only non-nuclear weapon state that has not signed it. Furthermore, Israel has stood firm against the 1995, 2005 and 2010 NPT Review Conferences that encouraged the Middle region to achieve a Middle East WMD Free Zone ("Nuclear Disarmament Israel", 2017).

The Prime Minister of Israel from 1948 to 1953, and re-elected for the period from 1955 to 1963, Ben Gurion, decided to create a nuclear programme for its country in order to be prepared for the hypothetical case of a second Holocaust. After the victory of Israel in the War of Independence in 1949, Ben Gurion was highly concerned with the security of Israel and the chances of an Arab invasion and hostility. Gurion had a pessimistic view on the security of the Israeli state, which had a major influence on the national strategy of security. Gurion decided to use the advantage that Israel had in technology over the rest of states in order to develop advanced scientific and military

weapons to become stronger than its neighbours and capable of defending itself from any foreign attack. Gurion got more convinced about developing a nuclear programme after the speech from the U.S. President “Atoms for Peace”, in which the U.S. claimed that Israel was ready to receive training and research for a reactor that would be safeguarded by the U.S., and that it would not allow Israel to develop a nuclear weapon. However, it was not until Shimon Peres arrived when an alliance between France and Israel resulted in the Dimona deal (Cohen, 1998). Peres appointed a selected team of notable physicists and counted with the support of the international Jewish community. This nuclear project allowed Israel to have a new strategy on national security that was characterized by the development of a nuclear programme in secret. Israel’s will on nuclear weapons could be seen as that of becoming the only power in the region of the Middle East with nuclear weapons, even though it has defended that “it will not be the first nation to introduce nuclear weapons to the Middle East” (Ami, 2009: 7).

Israel has special considerations when publicly declaring the size of its nuclear arsenal because it has always maintained a position of “nuclear opacity”, which basically consists in neither confirming nor denying the actual possession of nuclear weapons. Therefore, it might only make a statement regarding its stock of fissile material and classify the rest of the material as for “other uses” (Global Fissile Material Report 2009: 39). However, there are actual evidences of the nuclear arsenals that Israel possesses (see Appendix 6). In the Dimona nuclear power plant, the activities were being kept as a secret until 1986. Mordechai Vanunu was a technician that worked in the Dimona facility from 1976 until 1985. He took photos inside the plant and wrote comments about the operations that were being conducted (see Appendix 7). He later shared this information with the Sunday Times and the story was published on 5 October 1986.

This event was relevant because it was the only way of finding out the nuclear capacity of Israel. It revealed that Israel had an advanced stock of nuclear material that had not been declared to any organization, which was not a violation of the international law because, as previously explained, Israel had refused to join the NPT. Vanunu was tried in Israel and found guilty of violating the secrecy oath he signed when he started working for the plant, so he was condemned to 18 years in prison and Israelis considered him as a traitor (Global Material Fissile Report, 2009: 118-119). The policy of nuclear opacity “has left unclear whether it is continuing to produce weapon-grade plutonium at its Dimona nuclear complex, most likely it is, if only as a by-product of its

tritium production” (Global Material Fissile Report, 2009: 87). However, it has been estimated that it has roughly 100kg of highly enriched uranium (HEU) and it may have conducted practices to enrich uranium (Global Material Fissile Report, 2009: 14). If estimations regarding the rate of production of plutonium at the Dimona reactor are right, which are “15-18 kg/yr.” (Global Material Fissile Report, 2009: 16), it could be said that Israel could be in possession of “more than 100 nuclear warheads” (Global Material Fissile Report, 2009: 16).

To conclude, the policy of “nuclear opacity” maintained by Israel is the outcome of a mistrust from the Israeli government on the mechanisms of nuclear disarmament and non-proliferation. Israel justifies its need for a nuclear project on the basis of geography. It is emplaced in the Middle East surrounded by Arab states, which Israel portrays as enemies and threats to its own survival. Israel is in favour of a Weapons of Mass Destruction Free Zone in the Middle East (WMDFZ), which inevitably requires the compromise from the Arab nations to disarm, especially the abandonment of the processes of enriching uranium that Iran carries out nowadays.

II. Iran’s nuclear programme: Evolution

Iran has developed a nuclear programme as a way to counteract the Israeli nuclear threat. The objective of Iran is to become a regional power and gain recognizable international status. The Iranian government has been firm in defending the need of having a nuclear programme (see Appendix 8), since all the attempts made in the past had been frustrated by foreign actions. Consequently, the persistent nuclear dispute on whether Iran is prepared or not to possess a nuclear programme cannot be understood without an explanation of the historical factor. On the one hand, the debate in the West has always been about the costs, risks and threats that an Iranian nuclear programme could have for Western countries. On the other side, Iran has always defended its “inalienable rights” (Dehghani & et al, 2009: 931) to have and develop a nuclear programme. Therefore, the Iranian government considers that a nuclear programme is a sacred value for the nation, and that Iranian people could consider renouncing to the nuclear programme only if material incentives were given, such as money and sacred land (Dehghani & et al, 2009).

The “Atoms for Peace” speech of the U.S. President Eisenhower in 1953 is crucial to understand the interest of Iran in nuclear weapons. This speech affirmed that Israel was ready to receive training and research for a reactor, and it also contributed to provide the Shah of Iran with technical assistance. In 1967, the United States decided to supply Iran with a reactor, which was “a 5MWt pool-type light water research reactor” (“Tehran Research Reactor”, 2013) known as the Tehran Research Reactor (TRR). Because Iran had joined the IAEA in 1959, the IAEA was responsible for supervising this reactor. Iranian Shah Mohammad Reza- Pahlavi (1941-1979) “planned to create a “full-fledged nuclear industry” with a 23,000 megawatts electricity production capacity” (Sabet, 2013: 77). There have been concerns on Iran’s nuclear programme because “in 1976 Iran paid one billion dollars for a ten percent stake” (“Nuclear”, 2017) of a company specialized in uranium enrichment and it sent Iranian technicians overseas with the objective of receiving nuclear thorough training.

Therefore, when the Iranian revolution started in 1979 Iran had enough knowledge to produce an atomic bomb if necessary. Furthermore, during the Iran-Iraq War (1980-1988), the Islamic Republic of Iran decided to arm itself as “a nuclear deterrent against Iraq” (Sabet, 2013: 77). In 2002, the Iranian opposition group Mojahedin-e Khalq Organization (MKO) unveiled the centrifuge facility at Natanz (Global Fissile Material Report, 2009: 120). This revealing information was motivated by a group that was planning to take down the government of that moment, hence Iran experienced a period of high political instability.

In 2003, the IAEA managed to carry out inspections to find out suspicious locations and activities that the Iranian regime was executing (Global Fissile Material Report, 2009: 94). Following this inspection, Iran decided to comply with the Additional Protocol of the NPT voluntarily from 2003 until 2006. This Additional Protocol permitted non-weapon states “to declare to the IAEA all significant nuclear-related activities and allow the IAEA to check those declarations” (Global Fissile Material Report, 2009: 94), hence Iran had to conclude its enrichment activities for that period because if not Iran would have been infringing the international law and more sanctions would have been applied towards the Islamic Republic of Iran. In 2006, the Board of Governors of the IAEA reported the ending of Iran’s compliance with the Additional Protocol to the UNSC, which in July passed Resolution 1696, that “demanded that Iran suspend enrichment activities, banned the international transfer of nuclear and missile technologies to Iran,

and froze the foreign assets of twelve individuals and ten organizations involved with the Iranian nuclear program” (“Nuclear”, 2017). Nonetheless, the Iranian President Mahmud Ahmadinejad (2005-2013) determined that Iran would continue with the process of enrichment and it ignored Resolution 1696 and Resolution 1737 of the UNSC. In 2007, Jacques Chirac, President of France, said that “it would not be very dangerous if Iran obtained nuclear weapons” (Sagan, 2012). Finally, despite there have been several negotiations between the West and Iran to make an agreement to regulate the Iranian nuclear programme, the Joint Comprehensive Plan of Action (JCPOA)⁹ has been the only one that has limited the nuclear capacity of Iran as the way to relieve it from international sanctions. The JCPOA was reached on July 2015 between the P5+1 and Iran. The P5+1 is the name given to the five permanent members of the UNSC (the United States, the United Kingdom, China, Russia and France), plus Germany.

The main concern with the idea of Iran emerging as a nuclear power is that it would have more power to continue with conventional military actions. Moreover, it is also worrying that the Iranian regime maintains close ties with delicate non-state groups, such as Hezbollah and the Islamic Revolutionary Guard Corps. On the one hand, Hezbollah is the Lebanon-based Shi’a militia that has carried out civilian attacks in Israel. On the other hand, “the Islamic Revolutionary Guard Corps is responsible for running Iran’s operations in support of terrorist organizations and controls the nuclear programme” (Sagan, 2012). Even though Iranian leaders have expressed their peaceful means for having a nuclear programme, the information exposed by the MKO showed that Iran was conducting the reprocessing and enrichment procedures in a clandestine way, which gave rise to the mistrust from the international community and the belief of the West that Iran’s actual intention is to produce a nuclear bomb and pose a true threat for the international security, which would give it a recognizable and powerful position in the global panorama.

The possibility of Iran developing a nuclear programme could have an impact on the status quo of the Middle East, because it would increase its nuclear capability and strength, and it would give rise to a phase of nuclear proliferation. The matter of a

⁹ Donald Trump, current President of the United States, has addressed the JCPOA as “the worst deal ever” (DiChristopher, 2018). Trump held a meeting on April 26, 2018 in Washington with the President of France, Emmanuel Macrone, to discuss whether the JCPOA should be preserved or not. After the meeting, the French president declared that in his opinion the U.S. president would “get rid of this deal on his own, for domestic reasons” (Borger, 2018). Therefore, the future of the JCPOA is currently uncertain.

nuclear Iran is one of the most important challenges that international security is facing nowadays. There have been international sanctions on Iran such as economic and financial ones, which have had important remarkable negative effects on the economy, the currency and the population of Iran. Not only did Iranian exports decrease when international sanctions were applied, but the value of the Iranian rial severely decreased together with the standards of living. These sanctions were an indirect message of the West of telling Iran that the development of its nuclear programme would have a tremendous cost for its nation. However, international sanctions have not effectively discouraged Iran from continuing the expansion of its nuclear programme.

The regional rivalry between Israel and Iran brings uncertainty and instability to the region of the Middle East. Besides, both of them are nuclear powers in a greater or lesser measure, which raises the level of threat to the global security. As it is going to be analysed in the next section, Israel and Iran have held the same levels of nuclear tension, but there have been moments in which a nuclear attack was highly estimated to happen. This hypothetical scenario of a nuclear war casts doubts on the effectiveness of the theory of nuclear deterrence.

III. Israel and Iran: hypothetical scenarios

Game theory reveals that countries do not necessarily have to detonate a nuclear weapon in order to use it as to threaten their enemy. The nuclear deterrence theory is based on the subjective perceptions of fear, which means that even though it is not clear how much nuclear power a country has, it remains an important threat for its enemy. In the nuclear game, a state needs to assure how much risk it is disposed to assume. This can be applied to the case this paper is studying, so when Israel makes a nuclear decision it first has to determine what Iran would expect it to do. It also has to consider that addressing a nuclear escalation towards Iran can have indirect consequences, such as retaliation from the rest of regional countries. For example, Egypt can arm itself to revenge Iran and deliver an attack to Israel. Escalation can lead to more escalation, hence the problem with arms races arises. A nuclear arms race between several regions can lead to a proxy war with tremendous consequences for the international arena.

In the 1970s, there was a strong tension between Iran and Israel. Israel planned to conduct a nuclear detonation with the objective of surprising and scaring Tehran at the

same time. Tehran rapidly responded to this threat by showing its military capability that would not doubt to use to destroy any military base. Even though Iran supposedly did not have the same nuclear capability as Israel, it decided to put into practice a strategy based on the nuclear deterrence theory and the game theory. Both Israel and Iran held nuclear deterrent positions and managed to avoid a nuclear war in the region. At that time, the U.S. decided to intervene to calm down the tension by arguing that a nuclear war had to be prevented no matter what. It may be wrongly assumed that nuclear deterrence theory was effective in preventing a nuclear dispute, but the truth is that it did not work because Iran expressed its will to use atomic weapons if necessary.

Therefore, Israel considered this as a threat for the survival of its state and the U.S. had to publicly announce that if Iran happened to use any atomic weapon against Israel that would be its end. These announcements contributed to an increasing escalation that went against the theory of nuclear deterrence. Once again, Tehran tried to follow the nuclear deterrent strategy and decided to force Iranian population to abandon their towns. This was the way Iran decided to tell Israel that it was ready to attack, and that if a counter-attack happened, the consequences on the Iranian population would not be that massive because it had already evacuated its people. Israel did not see this strategy from Iran coming because it was caught in an environment of internal distrust and retaliation, so it did not have a plan for evacuating urgently Israelis. In this moment characterized by high levels of tension, threat and retaliation, Iran announced it would not carry out any further action for the good of world peace.

These events represent the dangerous strategy followed by Iran, that led to a brinkmanship crisis because Tehran almost surpassed the limits of safety before announcing it would stop. It proved that a state with limited nuclear power can threaten international stability, security and survival if it follows a strategy of unstoppable escalation. This dispute makes evident that a weapon can be used in objective and subjective ways. This situation is an example of the game theory, because it revealed the importance of psychology and competition in world politics. As defended by John von Neumann and Oskar Morgenstern in *Theory of Games and Economic Behavior* (1944), the number of parties involved in a conflict has increased, as Israel, Iran and the United States were implicated. When two parties with weapons are involved in a dispute it is considered a “duel”. Martin Shubik, an American economist, introduces a new term for the situations in which three parties with weapons are engaged in the same dispute,

which is going to be known as a “truel”. Despite the fact that this dispute originally started as a duel, once the U.S. came into scene the game turned into a truel. There are remarkable differences between a duel and a truel. On the one hand, a duel is easier to control because each actor expects the other one to attack first, hence actors understand the logics of the nuclear deterrence theory. As an example, both Israel and Iran could be considered in that moment as soft nuclear forces because they were waiting for the other one to attack first. On the other hand, a truel is harder to control because information is limited and there are unequal positions of power. Moreover, it is common that the strongest party wins in a duel, whereas in a truel there are more variables to take into account, such as the psychological ones. Shubik argues that a truel can give the victory to the weakest party, as it happened with Iran. Nevertheless, the dispute cannot be considered as a perfect truel because Israel and the United States would act as the same side, hence it would be an unequal conflict.

After having revised and analysed the tension between Israel and Iran in the 1970s, it is necessary to consider the consequences for each of the possible scenarios of having a nuclear Israel and a nuclear Iran. The outcomes of these scenarios are summed up in the following table:

Table 1: Game theory applied to Israel and Iran.

		Israel	
		Attack	No attack
Iran	Attack	War, War	Win, Lose
	No attack	Lose, Win	Tie, Tie

Source: Self-made table

The first scenario is the most relevant one because it implies that both Israel and Iran would attack each other and it would result in a war. It has to do with Mutual Assured Destruction: once a country has attacked first, the latter will respond by counterattacking the former, which will lead to the destruction of both of them. As it has been studied, both states are nuclear powers and capable of producing a nuclear

weapon. A regional war between two nuclear powers could have catastrophic global consequences.

In the second scenario, one player would attack the other one, and this would result in a win-lose situation based on the zero-sum game, because the benefit of the winner would be what the loser is deprived of. This scenario can happen either with Israel being the first one to attack, or Iran being the first one to launch an attack towards Israel.

In the former case, Israel would attack the Iranian nuclear arsenal and centres in order to destroy any chance of developing an atomic bomb that could be directed towards the Israeli state. If so, Iran would be too weak to attack back, but it would raise up uncertainty and instability to the region of the Middle East, hence Israel would win other regional enemies willing to revenge Iran. If Iran does not respond to an Israeli attack, it could be considered as a victory for Israel and it could lead Israel to believe that is the way of solving problems with its enemies, which is not. If Iran responds to the attack with its military and nuclear capabilities, and encourages terrorist groups to attack Israel, there would be not only consequences for Israel but for the whole international community, because it would also affect the United States, Iraq and Afghanistan. Therefore, it would have indirect consequences such as escalation and retaliation in the region.

In the latter case, Iran would develop an atomic bomb and would attack Israel with the purpose of destroying it. In the hypothetical event that Iran produces an atomic bomb, a strong imbalance of power would be spread through the region of the Middle East, which would represent a turning point for the international system. The possibilities of Iran to develop a nuclear bomb are a clear threat for the hegemony and dominance of Israel in the region. The power that Israel has to negotiate with the United States would also be affected. This is one of the reasons why Israel has defended that a nuclear Middle East cannot be accepted by the West.

In the third scenario, there would be neither an attack from Israel nor Iran. It is not very probable that Iran attacks first because it lacks enough information about the nuclear weapons that Israel actually possesses, and the response could be worse than expected. Therefore, the alternative for Iran would be that of acting as a nuclear deterrent and waiting for Israel to make the first move. Increasing a nuclear deterrent can lead to nuclear escalation, which can end up with a high degree of retaliation from both parties,

hence with a nuclear war. International scholars believe that the reason why a nuclear war has not happened has to do with the nuclear deterrence theory. As aforementioned, states that support the effectiveness of nuclear deterrence theory will not attack until their enemy attacks first, so war is prevented thanks to the threat of war. However, the decision of both players to cooperate towards a non-attack policy is improbable to happen because it implies the renounce from both sides to the possible outcomes they could have unilaterally, and because the existent asymmetry in the information makes them rely heavily on mutual trust. Trust is not a usual value in a nuclear crisis, hence mutual cooperation towards non-attacks is improbable to occur in such extreme cases.

To conclude, none of the options are good in the long-term. It is also important to bear in mind that contemporary states are no longer in a bipolar system, but in a multipolar one with nuclear multiplayers that can pose a threat to national security regardless their size. It cannot be predicted whether Israel or Iran will attack or not, but it can be said that this environment of tension can only derive in nuclear escalation among the rest of states in the region of the Middle East. These scenarios prove that nuclear deterrence theory is not perfect and effective, and that it has gaps that can give rise to a nuclear war. Debates supporting nuclear disarmament and de-nuclearization need to be strengthened and the nuclear-weapon states need to be the ones leading the debates. International Relations are not only about bilateral negotiations and interactions, but about a decentralized world system characterized by great risks that comprise instability and deterrence between state and non-state actors. Finally, nuclear logics in the Nuclear Age work with a multiplayer game theory, which is made up of independent actors. If the Middle East continues to become nuclear, the current balance of power will be changed and nuclear interactions between traditional and new actors will be the future trend.

Conclusions

The general public has assumed that the chances of a nuclear war are very low because the droppings of both nuclear bombs took place in 1945 and nuclear weapons have not been used in another war since that moment. This acknowledgement and complacency diminishes the chances of reaching a global nuclear disarmament. Bringing awareness about the real nuclear threat remains the most important challenge because it is absolutely necessary in order to change the future of international nuclear law. Despite the speech of Barack Obama in Prague on April 5, 2009 in which the former President of the United States expressed his will for a worldwide nuclear disarmament, the former President assured \$200 billion over the decade to modernize the U.S. nuclear weapons and technology (Falk & Kreiger, 2012: 192). Moreover, the White House has asked for the support of other \$85 billion for the development of nuclear weaponry and missile defence (Falk & Kreiger, 2012: 7). The speech was held in Europe, which could have had an influence on the remarkable hope for a nuclear-free world, but at the same time Barack Obama pointed out that the disarmament process would take a long time. Some countries believe that their security rely on the U.S. “nuclear umbrella”, so they fear from de-nuclearization processes that could turn into more exposure to a military attack. The end of vertical nuclear proliferation did not entail the subsequent process of nuclear disarmament, but the beginning of a new era in which states would focus on developing a nuclear strategy that would guarantee their own security (Marrero, 2012: 84). The new nuclear states consider nuclear arms as the main tool for securing their states, hence these new states are against the processes of non-proliferation and nuclear disarmament. Moreover, some current conflicts and tensions could end up with the use of nuclear weapons by any party, such as the Indo-Pakistan conflict and the U.S.-North Korean tension (Falk & Kreiger, 2012). Regional conflicts could eventually be international, which gives rise to uncertainty and unpredictability to the international arena. Additionally, non-state actors such as terrorist organizations and extremists increase the risk of a nuclear war.

The era in which state and non-state actors can be pictured nowadays has been named as the “Nuclear Age”. The Nuclear Age is mainly defined by two elements. The first one is the assumption by both the society and the government that war is permanent, so states have to be armed in order to defend themselves, which derives in a lack of hope in

disarmament. The second one has to do with the issue of arms control, which is often misunderstood with the concept of nuclear disarmament. Arms control involves management rather than disarmament (Falk & Krieger, 2012), whereas nuclear disarmament concerns de-militarization aspects.

However, the general public tend to think that arms control is the path for global disarmament because both concepts have not been clearly differentiated, but it is important to know that arms control is the first step to slowing down nuclear proliferation. Nuclear weapons cannot be treated as simply arms control because this confusion may lead to a world catastrophe. In the Nuclear Age, the concept of security has been redefined in order to include other spheres, such as the human security and the energy security. Human and energy security need to be aligned along with national security, which brings back the importance of disarmament to secure the state. Nuclear weaponry is not only a political priority, but also a moral one. The realization by the general public that they live in the era of the Nuclear Age can give them an idea of the current level of nuclear escalation. This realization is the first step towards nuclear disarmament and demilitarization. The absence of a nuclear war in the past half century does not undermine the possibility of it. Furthermore, the aftermath of a nuclear war is still unknown and so are the dangers of a nuclear arms race.

States have to decide their grand strategy, which is also influenced by both concepts of nuclear deterrence and nuclear disarmament. States should pursue global nuclear cooperation and disarmament rather than relying on the idea of nuclear deterrence. The main debate is about choosing to have either a world free of nuclear weapons where nuclear deterrence makes absolute no sense, or a world composed of several nuclear states regardless their size. Nuclear disarmament is key in the Nuclear age, but the current nine nuclear-weapon states have to be sure that they will need to cooperate with the non-nuclear weapon states to reach a world free of nuclear weapons because it will have to be based on mutual faith. The Strategic Arms Reduction Treaty (START) has already introduced an advance in the field of non-proliferation. Governments will have to make an effort to cooperate in order to control the transport and exchange of nuclear material between countries. A world free of nuclear weapons does not mean that there would be no wars at all, because conventional weapons will remain existent. Despite the fact that a world free of nuclear weapons is a long-term project, it is important to remark that in 1986 there were 70,000 nuclear weapons worldwide, whereas nowadays this

quantity has been reduced to 20,000, of which 6,000 are deployed (Falk & Kreiger, 2012: 187). Another key element for the annihilation of nuclear weapons is the support for this cause from recognized professionals and politicians such as Henry Kissinger, George Schultz and William Perry, who have been supportive of the nuclear abolition project.

Regarding the effectiveness of nuclear deterrence, it is only effective when considering state actors, but it is not applicable for non-state actors because they do not have neither territory nor people to deter. Another key aspect is that nuclear deterrence is based on the rational actions made by actors, but the world is usually led by irrational actions. As in the case studied, Israel has repeatedly threatened Iran with military attacks, yet it has not been intervened by the international community despite it possesses a nuclear arsenal. These threats mean an excuse for Iran to keep developing a nuclear programme and proliferation. Israel would have to start encouraging nuclear disarmament throughout the Middle East and stop launching military threats to neighbouring countries. With respect to Iran, the global community should focus its efforts on creating a system of effective sanctions that discourages it from becoming nuclear. It would have to be a win-win deal in order to make sure that the Iranian government complies with it. Moreover, Iran will have to be sure that nuclear deterrence can neither be the principle that guides the nation nor a sacred value for Iranian people. However, there are still three main challenges for nuclear disarmament and non-proliferation: it is considered as a long-term goal, deterrence is still the driving force in the current international arena, and the de-nuclearization plan has not been specifically detailed.

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Appendices

I. Appendix 1: First nuclear weapons tests by current nuclear weapon states, 1945-2009.

Country	Date of first nuclear test	Date of accession to NPT
United States	July 16, 1945	1970
Russia	August 29, 1949	1970
United Kingdom	October 3, 1952	1970
France	February 13, 1960	1992
China	October 16, 1964	1992
India	May 18, 1974	-
Israel	? ⁹²	-
Pakistan	May 28, 1998	-
North Korea	October 9, 2006	1985 (withdrew 2004)

Source: *Global Fissile Material Report 2009: A Path to Nuclear Disarmament* (p.26),
 Fourth annual report of the International Panel on Fissile Materials, 2009.
 Retrieved from <http://fissilematerials.org/library/gfmr09.pdf>

II. Appendix 2: Estimation of total nuclear-weapon stockpiles in 2009.

Country	Nuclear Warheads
United States	9400, of which 4200 are awaiting dismantlement
Russia	10,000, with a large fraction awaiting dismantlement
France	fewer than 300
United Kingdom	185
China	about 240
Israel	100 - 200
Pakistan	70 - 90
India	60 - 70
North Korea	fewer than 5

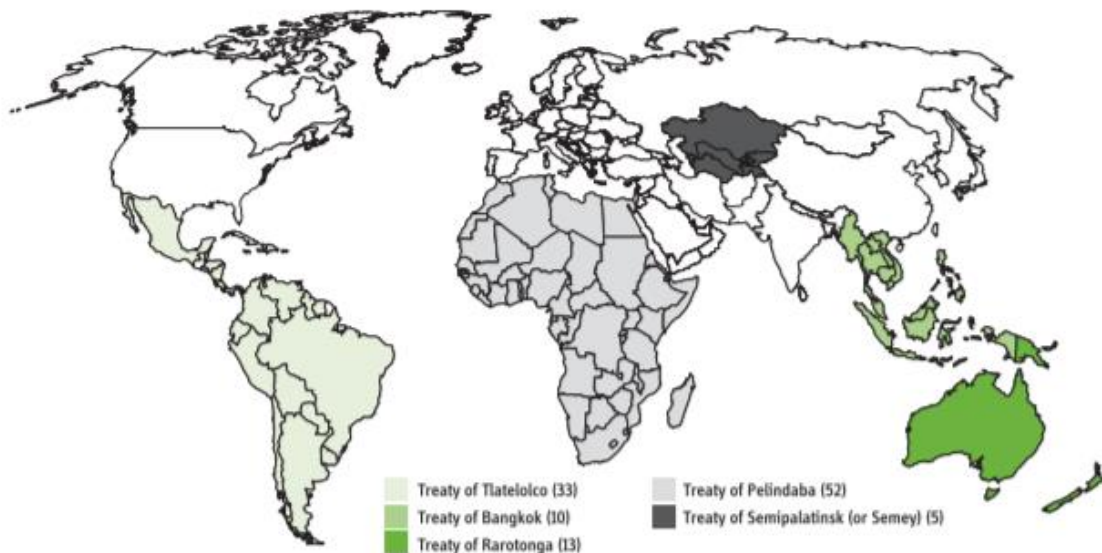
Source: *Global Fissile Material Report 2009: A Path to Nuclear Disarmament* (p.9),
 Fourth annual report of the International Panel on Fissile Materials, 2009.
 Retrieved from <http://fissilematerials.org/library/gfmr09.pdf>

III. **Appendix 3: Estimation of the number of nuclear warhead storage sites by country in 2009.**

Country	Warhead storage sites
China	14
France	7
India	5
Israel	4
Pakistan	8
Russia	48
United Kingdom	4
United States (domestic)	15
United States (in five foreign countries)	6
Total	111

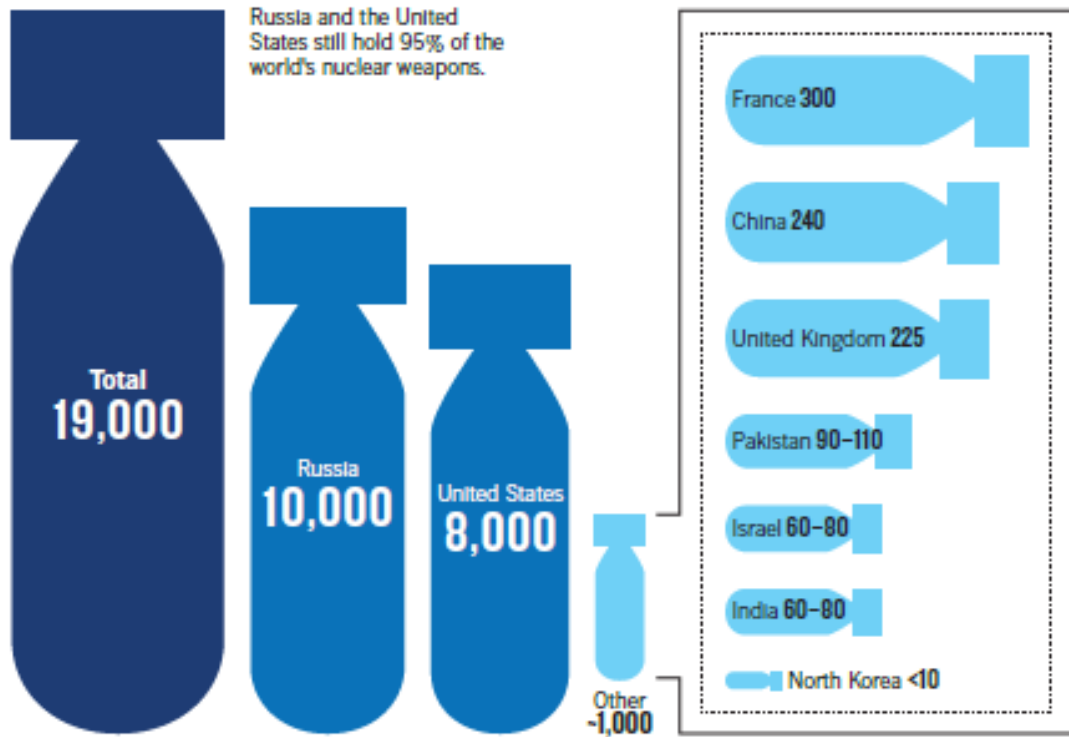
Source: *Global Fissile Material Report 2009: A Path to Nuclear Disarmament* (p.11),
 Fourth annual report of the International Panel on Fissile Materials, 2009.
 Retrieved from <http://fissilematerials.org/library/gfmr09.pdf>

IV. **Appendix 4: Nuclear-Weapon-Free-Zones in 2009.**



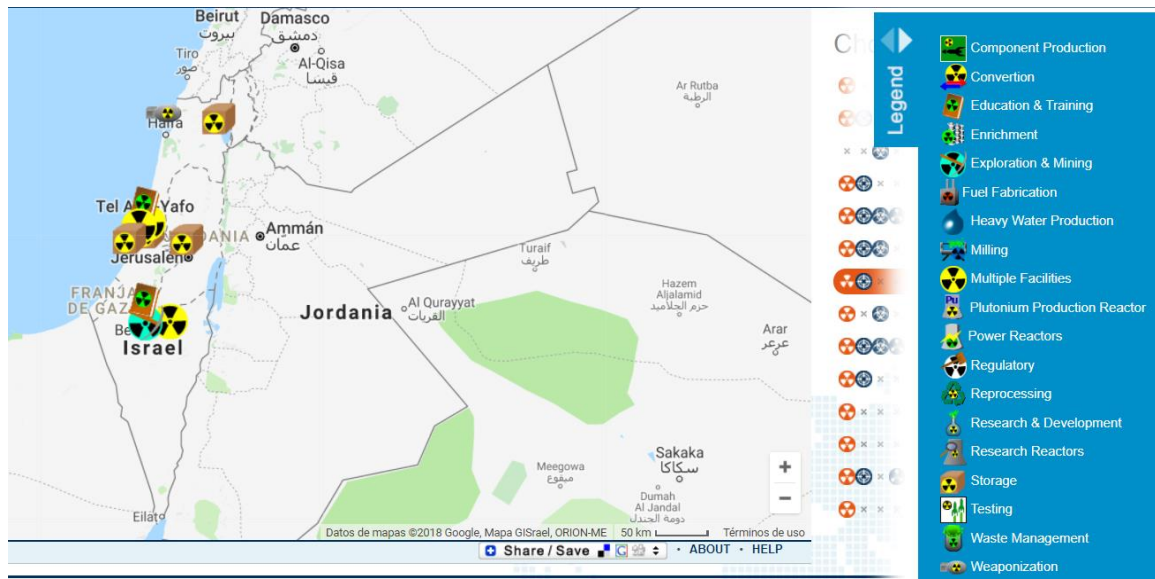
Source: *Global Fissile Material Report 2009: A Path to Nuclear Disarmament* (p.12),
 Fourth annual report of the International Panel on Fissile Materials, 2009.
 Retrieved from <http://fissilematerials.org/library/gfmr09.pdf>

V. Appendix 5: Nuclear weapons of nuclear states.



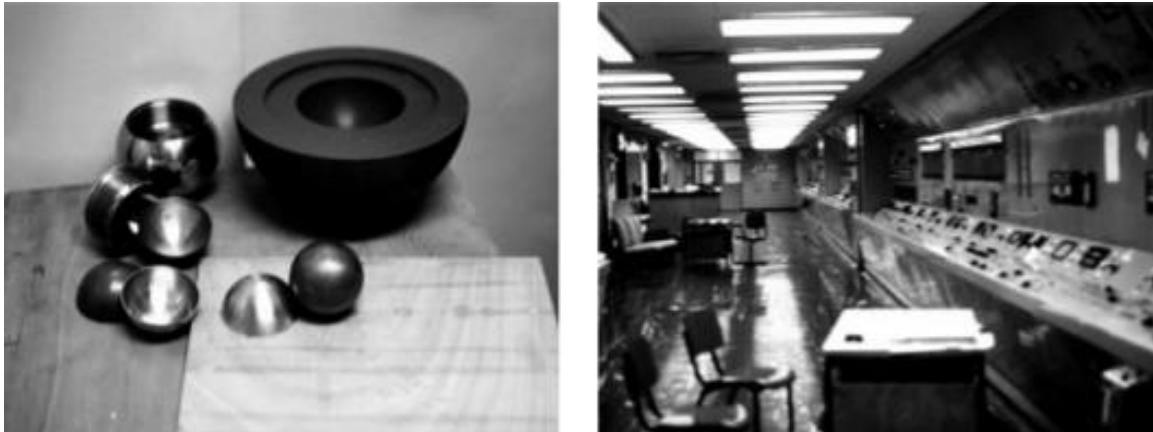
Source: Sagan, S. D. (2012). Policy: a call for global nuclear disarmament. *Nature*, 487(7405), 30-32. doi:10.1038/487030^a

VI. Appendix 6: Nuclear map of Israel.



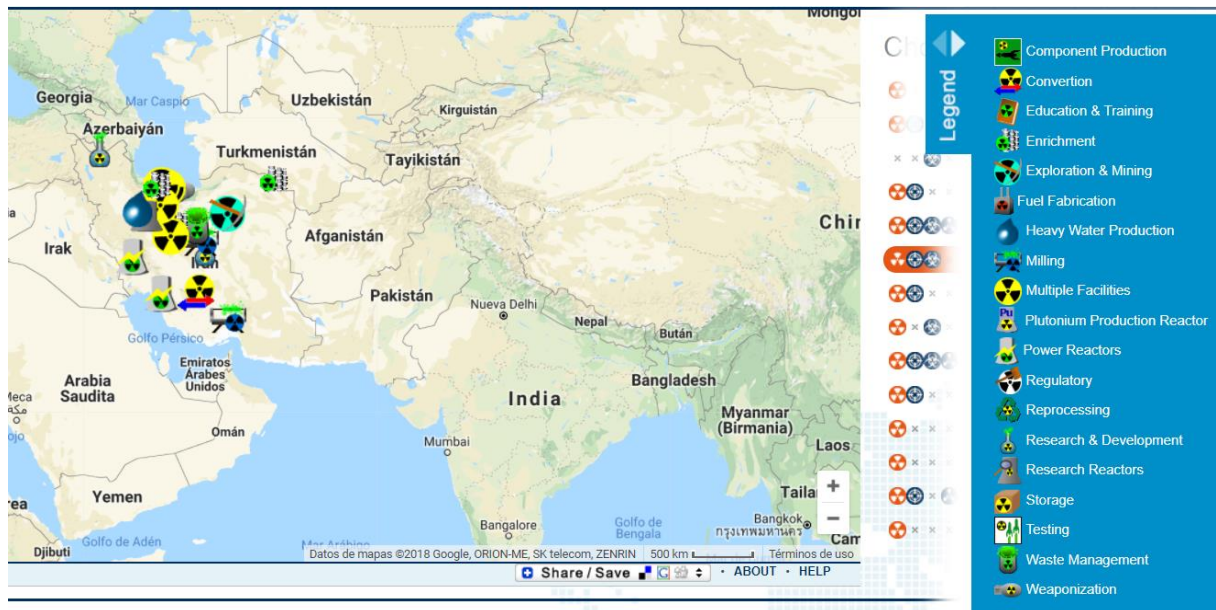
Source: "Nuclear Map" [map]. In: NTI. *Israel facilities: nuclear map*. Retrieved from http://www.nti.org/gmap/nuclear_israel.html . (April 13, 2018).

VII. Appendix 7: Pictures taken by Vanunu inside Dimona.



Source: *Global Fissile Material Report 2009: A Path to Nuclear Disarmament* (pp.118-119), Fourth annual report of the International Panel on Fissile Materials, 2009. Retrieved from <http://fissilematerials.org/library/gfmr09.pdf>

VIII. Appendix 8: Nuclear map of Iran.



Source: “Nuclear Map” [map]. In: NTI. *Iran facilities: nuclear map*. Retrieved from http://www.nti.org/gmap/nuclear_iran.html . (April 13, 2018).

