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POLICY IMPLICATIONS OF IRAN'S NUCLEAR DEAL IN TECHNICAL TERMS FOR THE PLUTONIUM ROUTE, URANIUM ROUTE, COVERT OPTIONS, INSPECTIONS, MONITORING AND VERIFICATIONS.

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ABSTRACT

The present Paper addresses the policy implications of Joint Comprehensive Plan of Action (JCPOA) known as 'Iran Nuclear Deal" implemented on 16th January of 2016 between the Iran and the P5+1 countries (the U.S., U.K. France, Germany, Russia, and China), along with the EU in technical terms to analyze the Plutonium Route, Uranium Route and the Covert options and Inspections, Monitoring and Verifications. A historical review is presented to understand how the Iranian Nuclear Program is formed. Following is shown the current nuclear facilities in Iran and its capacity to process nuclear materials. It is analyzed the impact of JCPOA in Uranium and Plutonium routes. Covert Options always will be an option, so the most sensitive impact is related to the new monitoring and verification policies that must ensure real control of illegal procedures. The main conclusion is that the deal postpones the Iran's nuclear program for more than a decade (15 years), delaying Iran's nuclear bomb time from a few months to at least one year, although there is a current latent capacity to develop a nuclear bomb in Uranium route. It also gives IAEA inspectors capability to monitor nuclear activities and prevent to possible development to a nuclear bomb. To arrive in this conclusion an extensive technical analyze of impact of JCPOA in Iran`s nuclear capabilities was made to discover how effective is the deal to prevent Iran to build, or acquire a nuclear weapon.

1. INTRODUCTION

Iran's nuclear program has always been a source of much controversy in the western world, especially since the 1980s. Since that, decade Iran's non-alignment with the United States of America has led to a climate of mistrust on the part of the western world of Iranian aspirations with regard to the production of nuclear weapons.

In 2003, when the uranium enrichment program through centrifuges was halted, a US-ISRAEL led campaign saw an opportunity to end any nuclear ambition on the part of Iran. After September 11, the western world greatly increased its concerns about nuclear artifacts that could be used by terrorists in an asymmetric war. Due to the historical rivalries between Iran and the US, there is a strong suspicion of Iran's support for anti-American terrorist

groups. In view of the local rivalry between Israel and Iran, the fear of using radiological and nuclear terrorist activities increases.

Iran has always denied having a program for the construction of conventional atomic weapons, that its interest is for peaceful purposes in the generation of electric power. Due to the historical rivalries between Iran and the US and its allies in the Middle East, Israel prominently, the confidence level is very low, which partly explains the sanctions by the US.

After the fall of the Berlin Wall and the end of the Soviet regime in the 1990s, many Soviet scientists migrated to Muslim countries, especially Iran. It is not clear what technical scientific training would be absorbed for the construction of a nuclear weapon. What we can analyze is whether the installed infrastructure, at least the official ones, could lead to the construction of a nuclear weapon.

The last decade, this discussion on the sovereign decision of a state participating in the Nuclear Non-Proliferation Treaty (NPT), in the case Iran, could have the right to have a nuclear program. The beginning of a conciliatory solution is Iran's nuclear deal.

This paper will analyze Policy Implications of Iran Nuclear Deal in technical terms for The Plutonium Route, Uranium Route and the Covert options and Inspections, Monitoring and Verifications. To analyze the effects of Iran's nuclear program on the plutonium and uranium route, the covert options of inspections, monitoring and verifications, the paper does on qualitative analysis, the resources used were speeches, U.N resolutions, reports by the U.S. government and newspaper articles, journals and book articles.

2. HISTORY OF IRAN NUCLEAR PROGRAM

The Iran started its nuclear program in 1957, when a "proposed agreement for cooperation in research in the peaceful uses of atomic energy" was announced under the support of Eisenhower's Atoms for Peace program. The agreement was made public by Shah Mohammed Reza Pahlavi two years later. He structured the establishment of a Nuclear Research Institute in Tehran University. The deal opens the Iran's Civilian Nuclear Industries for U.S. to lease low enriched uranium (LEU) to research purpose. [1]

The Tehran Nuclear Research Center (TNRC) was established in 1967 by the Atomic Energy Organization of Iran (AEOI). The TNRC was equipped with a U.S.-supplied, 5-megawatt nuclear research reactor, which was fueled by highly enriched uranium. In 1968, Iran signed the Nuclear Non-Proliferation Treaty (NPT). It was ratified in 1970, authorizing IAEA does verification in Iran's nuclear program. [1]

According Squassoni (2006), the Shah approved plans to construct up to 23 MW nuclear power station and March 1974, the Shah envisioned a time when the world's oil supply would run out.

In the 1970s several American and European companies were interested in doing business in the nuclear area with Iran, motivated by the statements of the Shah. The first Bushehr plant, was designed to supply energy to the city of Shiraz. During the decade, Siemens, a German company, signed a contract worth US $ 5 billion to build a PWR, a construction that was to

be completed in 1981. According to Squassoni (2006): "Sweden's participation in Eurodif was 10 % For Iran. The French subsidiary Cogéma and the Iranian Government created the company Sofidif (Franco-Iranian Society for uranium enrichment by gas diffusion), with quotas of 60% and 40%, respectively. For its part, Sofidif acquired a 25% stake in Eurodif, which gave Iran its Eurodif share of 10%. Mohammed Reza Shah Pahlavi has lent $ 1 billion (and another $ 180 million in 1977) to build the Eurodif plant, to have the right to buy 10% of the production from the site. "

According the CIA (Central Intelligence Agency) [3] there was concern about the Iranian nuclear program because of the events triggered by the Islamic revolution signifying a loss of technical support from the West . In August 1974, declared that while "Iran's much publicized nuclear power intentions are entirely in the planning stage" [3]

After the Islamic revolution, technical cooperation in the nuclear field was over. Work on the Bushehr nuclear reactor was halted in 1979 with 50%, the company responsible for the project completely abandoned the project in the mid-'79. “The company said they based their action on Iran's non-payment of $450 million in overdue payments, while other sources claim the construction was halted under pressure from the United States”. [4]

Among the most significant international measures against Iran’s Nuclear program, the termination of the HEU fuel supply for Tehran Nuclear Research Center by USA which forced the reactor shutdown for several years, and the end of the supply of enriched uranium by Eurodiff. These measures have made the Iranian discourse aimed at nationalizing the nuclear supply chain because of international boycotts, in consequence made the nuclear program gain a high strategic importance for Iran’s Government. In 1981, Iranian governmental officials concluded that the country's nuclear development should continue.

During the 80’s a series of suspicious activities and U.S. act of barrier were publish to world and led Iran to looking for alternatives to continue its nuclear program. In 1983 Iran asked IAEA officials to help in nuclear problems involved fuel fabrication. The U.S intervened and IAEA did not provide the assistance. Iran tried a bilateral cooperation on fuel cycle with China. China declined due US pressure. In 1984, West German Intelligence reported a suspicious of nuclear bomb construction in two years in Iran with Uranium from Pakistan. After this report a lot of manifestations and studies argue that in few years Iran might have a nuclear weapon. It was the start of “Iran’s Nuclear Bomb fear”. During Iran-Iraq war the reactors in Bushehr were bombed, and the Iran’s nuclear program stopped. In 1985, Iran complained with France asking for reimbursement from the Eurodif’s investment and the enriched uranium delivered. In 1986 the Eurodif manager George Besse was assassinate. After investigations, it was concluded that it was a terrorist action supported by Iran. In 1988, France and Iran signed a accord that Frace accepted Iran as member of Eurodif and deliver it enriched uranium "without restrictions". [4] In end of 87’ Iran and Argentina signed a technical cooperation agreement which Argentina to assist in converting HEU Arak’s reactor in a LEU reactor, and supply the fuel to Iran. Again, under US pressure, Argentina terminated its nuclear cooperation confirmed in justice reported in 2006. Argentina delivered uranium in 1993 and there are suspicious that the bomb attack on Israeli embassy in Buenos Aires in 1992 was made by Iran to pressure Argentina honoring the agreement. [4]

The 1990s, post-Iran-Iraq War period, we will see a clear alignment of Iran with Russia through a research organization called Persepolis, further distancing itself from the Western

axis mainly from the United States. In 1991 France returned $ 1.6 billion to Iran due non deliveries from Eurodif contract. In 1992, Iran invited IAEA's inspectors to visit all the facilities and it was concluded no signs of making nuclear weapons. In the same year, Argentine authorities confirmed U.S. pressure not to supply civilian nuclear equipment. In 1995, Iran signed a contract with Russia to install a VVER-1000 PWR. Under US pressure, China did not go ahead with a contract to build a uranium conversion plant but warned the IAEA that it had provided enough information so that the Iranians could proceed with the project. In the same year inspectors of the IAEA visited the construction site.

The last decade (2000), after 2001 September 11, Iran started a campaign in international community argues its nuclear program has peaceful intentions and intends to provide medical isotopes and scientific research. In contrast, in 2003, the IAEA first reported that Iran had not declared sensitive enrichment and reprocessing activities. Throughout the last decade IRAN and United Nations (UN) have engaged in epic diplomatic battles. In 2003, the IAEA concluded that Iran had failed to fulfill its safeguard obligations according NPT. The Security Council has imposed sanctions, the most severe being the disruption of the enrichment program, even the IAEA finding no evidence of nuclear weapons. Iran did not accept the imposition and offered a long-standing agreement that would allow Iran based on mutual respect and international trust that its program has peaceful purposes. With the intention of improving the image of its enrichment program, that could be used for non-peaceful purposes, to the international community, Iran signed in 2003 the Additional Protocols allowing the IAEA to carry out more stringent inspections by agreeing to send necessary reports and allowing access for IAEA inspectors to nuclear installations. Iran, even though it had not ratified, allowed it full access to its facilities. This attitude had a very strong political weight, because legally the argument of secret nuclear facilities of the US criticism was placed below. Iran has played a good game of diplomacy since it knew of the need for imports nuclear equipments to continue its nuclear program, and that international restrictions do not help the continuity of the program.

In 2004, Iran began construction of the IR-40 reactor, a 40MW heavy water reactor. In the same year under the terms of Paris Agreement, signed in November, the Iranian representative announced voluntary suspension of enrichment program and the voluntary application of additional protocols. It is worth pointing out that uranium enrichment does not disagree the NTP, and this agreement was made under pressure from the European community in this context known as EU-3 (Kingdom, France, and Germany). The following year, Germany refused to export nuclear equipment acquired in the 1980s and to refund the payments. In August 2005, a report by Pakistani and American experts concluded that traces of bomb-grids found in Iran were not evidence of nuclear weapons coming from contaminated equipment from Pakistan. This report was made public by IAEA Director General Mohammad El Baradei, validating Iranian claims that these traces came from contamination and not from a weapons program. In September, in a speech to the United Nations, Iranian President Mahmoud Ahmadinejad suggested that the uranium enrichment program could be administered by an international consortium that was rejected by the US and the EU.

In February 2006, by 27-3 with 5 abstentions, the IAEA governors voted to report Iran to the UN Security Council. This was the beginning of a series of resolutions in the next four years by the Security Council resulting in a series of embargoes and restrictions on Iran's nuclear program. This was part of the policy against terror imposed by the American President Bush,

as a result Iran suspended voluntary cooperation on additional protocols with the IAEA. IAEA President Mohammad El-Baradei proposed a timely solution in which Iran would give up the enrichment process on an industrial scale and would limit its program to a pilot scale by importing all its fuel from Russia. Iran signaled that this proposal could go ahead, but in March 2006, the Bush administration announced that it would not accept any kind of enrichment in Iran. Between 2006-2010 a six of UN resolutions, against Iran's Nuclear program, passed in security council:

1. Resolution 1696 (31 July 2006): Determine that Iran stop its uranium enrichment activities,
2. Resolution 1737 (23 December 2006): Require Iran to collaborate with IAEA, applying sanctions after Iran refused to suspend its uranium enrichment program,
3. Resolution 1747 (24 March 2007): Added more sanctions,
4. Resolution 1803 (3 March 2008): Added more sanctions,
5. Resolution 1835 (27 September 2008): Compilation of previous resolutions,
6. Resolution 1929 (9 June 2010): Imposed the follow actions against Iran: Prohibited the sale of certain weapons to the country, such as tanks, helicopters and rocket systems. It has also imposed restrictions on the operation abroad of Iranian companies suspected of linking to nuclear program. Cargoes to Iran should be inspected by UN Member States whenever there is suspicion that they could contribute to the strengthening of Iran's nuclear program.

In 2009, Iran did not accept the offer by Russia, the United States and the United Kingdom to send its enriched uranium to 3.5% and to enrich it 20% later. Under the proposal, Iran would send 1200 Kg of uranium to France and Russia, where it would be converted, to be later assigned to a research reactor in Tehran. Iran said at the time that it would only exchange its material for uranium at higher levels of enrichment and, above all, that it would only accept the exchange on its own territory, which the other parties considered unacceptable. In June 2009, after Iranian presidential election, Iran initially agreed to a deal to relinquish its stockpile of low-enriched uranium in return for fuel for a medical research reactor, but then backed out of the deal.

On May 7, 2010, Iranian ambassador to Brasilia (Brazilian Capital), Mohsen Shaterzadeh, declared that Iran was flexible to the proposal to carry out the exchange of nuclear fuel for its reactor in Tehran, provided that it was carried out simultaneously. Iranian Foreign Minister Manouchehr Mottaki, in a meeting with Security Council diplomats, reiterated the possibility of uranium exchange. He has accepted the possibility of further discussions with Western countries on the nuclear program. Brazil and Turkey, both non-permanent members of the UN Security Council, have offered themselves as mediators. [5] The proposal of the mediating countries, Turkey and Brazil, was for Iran to accept the International Atomic Energy Agency's plan to enrich Iranian uranium (less than 20%) in another country in order to eliminate international mistrust that Iran could use the material for military purposes. Brazil also proposed that the exchange be made on Turkish territory. On May 16, 2010, Turkish Foreign Minister Ahmet Davutoğlu announced after nearly 18 hours of talks in Tehran that Iran, Turkey and Brazil had reached an agreement on the exchange of nuclear fuels, the official announcement was scheduled for the following day after the review of Brazilian presidents Luiz Inacio Lula da Silva and Iranian Mahmoud Ahmadinejad and the Turkish prime minister, Recep Tayyip Erdoğan. President Lula was expected to announce the results of his talks with the president of Iran on the nuclear issue during the opening session

of the 14th G15 Summit, a group of non-aligned countries. The terms of the new agreement were based on the IAEA's proposal to Iran in October 2009 that Iran would send 1200 Kg of its enriched uranium to 3.5 percent while receiving 120 Kg of enriched uranium in Russia Or in France, to 20% - a very low percentage compared to the 90% needed to produce an atomic bomb. Iran could enrich uranium for peaceful purposes, and the Iranian authorities declare that the nuclear program would continue to be implemented. The agreement should in any case be submitted to the IAEA.

Although Brazilian President Lula considered the agreement as a victory for Brazilian diplomacy, the document was viewed with skepticism by some members of the Israel and E.U., while the U.K., France and the European Union announced that Suspicions about the goals of the Iranian nuclear program remained. So the campaign for new sanctions against Iran has continued. The agreement did not produce results, basically because the U.S.continued to distrust the peaceful intentions of the Iranian nuclear program. In addition, the agreement provided for the transfer to Russia or France of only 1,200 kilos of uranium (the same amount provided for in the failed agreement of October 2009 in Geneva). At that time, 1,200 kilos accounted for about 2/3 of Iran's nuclear fuel stockpile, which was enough to ensure the country would not have the material to make a bomb.

On September 27, 2013, after nearly thirty-five years without official contact, US “President Barack Obama and Iranian President Hassan Rouhani spoke by telephone” [6] on the issues surrounding relations between the two countries. A few days earlier, on the 24th, Rouhani, in his speech at the UN General Assembly in New York, surprised the audience by naming President Obama, saying he hoped the American president would not give in to pressure to re-establish dialogue between Countries. Later, in an interview with CNN, Rouhani, addressing the people of the United States, said he would bring a proposal of peace and friendship between Iranians and Americans.

On 2 April 2015, in Lausanne, Switzerland, after a week of meetings and two days after the deadline, negotiations between P5 + 1 and Iran reached a preliminary agreement providing for a considerable reduction of uranium enrichment Iranian sanctions. The agreement was expected to be definitively concluded on 30 June 2015. President Obama declared that it was a historic agreement, which should decisively affect relations between Iran and USA.

On 14 July of 2015, the Iranian government and the P5 + 1 nations announced the conclusion of negotiations on the agreement on the country's nuclear program. Under the terms of the document, the economic sanctions imposed on the country will be gradually withdrawn.

3. NUCLEAR FACILITIES AND TECHNOLOGICAL LEVEL OF IRAN’S NUCLEAR PROGRAM

The purpose of this chapter is to provide a description of the nuclear facilities in Iran to serve as a basis for the analysis of routes and possibilities for the use of its nuclear facilities for building nuclear weapons.(fig.1)

Arak is an Industrial complex where IR-40 Reactor is under construction. In the same site there is a heavy water production plant. This site was not inspected by IAEA because is not under operation. According Iran authorities, the Reactor will replace 1967- Tehran Reactor

for research purpose. Based in JCPOA, Iran will redesign the reactor to block the Plutonium Route and prevent any weapons-grade plutonium. All spent fuel will be shipped out of the country. [8]

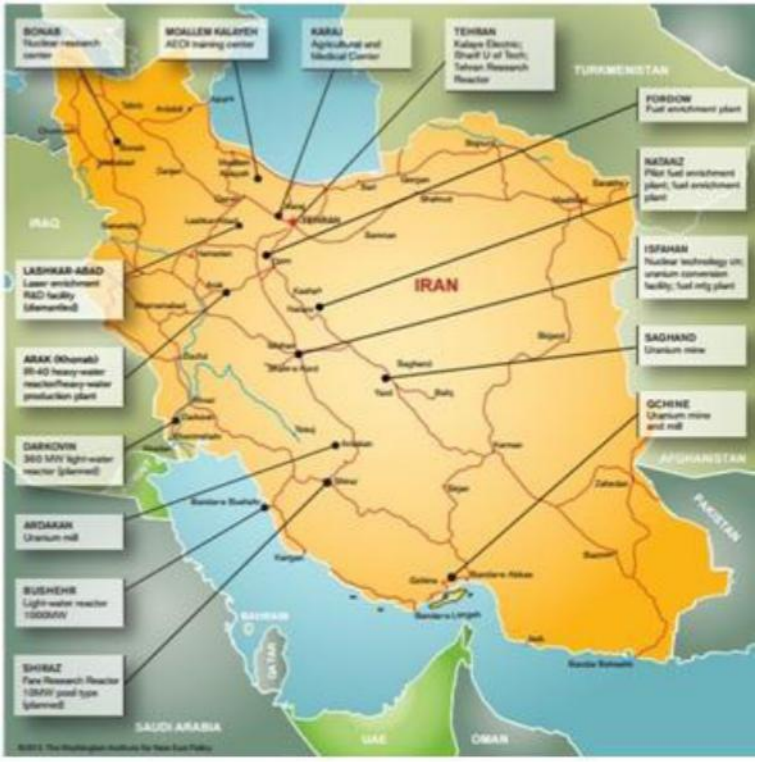

Figure 1 Primary Iranian Nuclear Facilities
Source: **http://www.belfercenter.org/sites/default/files/legacy/files/Nuclear%20Iran-A%20Glossary_March15.pdf** access 28jan17

Bonad is the atomic Research Center applying nuclear technology in agriculture. The Bonad Energy Research Center was established in 1995 to conducts nuclear applied research in agriculture. The facility is under direction of AEOI and persist the suspicious to conduct secret research in nuclear field.

Fardow is a facility near the city of Qom. This facility was discovered in 2009, and it was designed to enrich uranium up to 5% of U-235. Iran said the facility was being built to contain 16 cascades with approximately 3,000 centrifuges. According to IAEA standards, the obligation to declare new facilities must only occur 180 days before the receipt of nuclear material. Under this standard Iran claims that it was within the legality. The JCPOA states that the Fardow enrichment will be paralyzed for 15 years. The installation in this period will have a new purpose being converted into a nuclear, physical and technological center. The 1044 centrifuges that can be installed on site will produce radioisotopes for medical purposes and scientific research. [1]

Isfahan is a nuclear research complex that has 4 small nuclear reactors, a uranium conversion facility and a zirconium production plant. This complex is strategic for the Iranian fuel cycle because it produces key products to supply the country's reactors. All reactors were designed and built with Chinese assistance. Below is a more detailed description of some facilities: [9]

- The 30-kilowatt Miniature Neutron Source Reactor: Used to produce short lived radioisotopes and neutron activation analysis. Your fuel has 1 Kg of HEU. [9]
- Light Water Sub-Critical Reactor (LWSCR): Used for training purpose. Built in 1988 and commissioned in 1992. [9]
- Heavy Water Zero Power Reactor (HWZPR): Used for heavy water research. Built in 1991 and commissioned in 1995. [9]
- Fuel Fabrication Laboratory (FFL): Commissioned in 1988; it is used to research and small scale fuel pellet production. [9]
- Uranium Chemistry Laboratory (UCL): Declared closed by Iran in 1998. [9]
- Graphite Sub-Critical Reactor (GSCR): Used for training purpose. Built in 1991 and commissioned in 1995. [9]

Natanz is a large 8m underground area, intended for uranium enrichment activity. It is a military bunker designed against aerial attacks protected by a concrete wall 2.5 meters thick, itself protected by another concrete wall. The complex has two 25,000 square meter halls and some administrative building. It is estimated that there are 14,000 centrifuges producing LEU after signing the JCPOA. [9]

Parchin is a military complex that manufactures military devices. In 2005 IAEA Inspectors did not find presence of nuclear materials. It is possible that implosion test were done but not credible official source confirmed information.

Saghand is one of Iran's first uranium mines. It was commissioned in 2005 and is estimated to contain between 3 and 5 ton of uranium oxide at a density of 500 ppm in an area of 100 to 150 km^2. This mine is designed to extract low-grade minerals with conventional underground mining techniques.

According to IAEA reports, Chinese experts estimate that the mine may contain 100 ton of uranium. Making some estimates based on the concentration of 500 ppm it is possible to conclud that the mine is non-economic, but it is of strategic character because Iran can hardly import yellowcake. This may be a reason that Iran has invested so much in the production of centrifugues because the lower uranium content need more centrifuges and yellowcake to be transform in UF_6 to reach LEU levels and even more levels of HEU. [10]

Tehran Nuclear Research Center (TNRC) was established in 1967 under U.S. Atoms for Pearce. Initially, it was designed to operate with 5 MW Nuclear Pool Research Reactor and fuelled by High Enriched Uranium (HEU) fuel. Argentina's National Atomic Energy Commission converted the reactor in a Low Enriched Uraniun (LEU) with 19.75% and supply with LEU in 1993. In 2012, Iran loaded the reactor with first fuel element produced in Iran. [9]

Iran and Russia signed a contract in November 2014 to build two nuclear reactors in Bushehr. The expectation is 10 years of construction. An ongoing negotiation with China to build two more 100 MW nuclear reactors. The aim of these nuclear reactors is produce electricity for domestic consumption. [2]

Fuel Manufacture Plant is located in Isfaran and directed by AEOI. Produces fuel elements to Arak, Bushehr and Darkhovin reactors. Iran's Fuel Plate Fabrication Plant has produced fuel for the Tehran Research Reactor. According David Albright and Christina Walrond in 2013

Iran continues to conduct fuel element activities in violation UN resolutions. “Iran has constructed 37 prototype natural uranium fuel assemblies at the FMP for initial testing and eventual integration into the IR-40 reactor” [11] Iran has two main uranium mines Saghand and Gchine. Gchine is located near Bandar Abbas in souththern Iran. [9] Ardakan Yellowcake Production Plant process uranium ore from Saghand. “Iranian officials acknowledge that the country’s uranium deposits are insufficient for its planned nuclear power program. These reserves are sufficient, however, to produce 250-300 nuclear weapons” [12]. The production of Gchine is estimated in 21 ton of uranium per year. The production can be inadequate to a 1000 MW reactor that need 25 ton of LEU, however can be adequate to HEU in nuclear weapons due its application needs less yellowcake than a commercial reactor, and with a high number of centrifuges even in an non economic process, HEU quantity to a nuclear bomb can be reached. [9]

Iran's entire nuclear infrastructure is based on the fuel cycle and its facilities are designed to meet the needs of its reactors and research centers. Unfortunately, these same facilities can be applied in a nuclear weapons program, the main reason for concern on the part of the United States. Apparently all the technology used in the Iranian nuclear program is imported, initially from Germany and later from Russia. Given the technological developments and installed research centers it is quite possible that the Iranian enrichment process should be at a level where from imported technologies, there are studies applied in the improvement and installation of the enrichment centrifuges.

According Devenport [13]: “Iran has manufactured more than 20.000 centrifuges domestically for Natanz and Fardow facilities, but is unlikely to be able to produce indigenously all of the materials, such as high-quality carbon fiber and maraging steel, necessary to expand its nuclear program”. The enrichment capability is a key point to produce the nuclear weapons. The number of centrifuges gives an idea about the Iran capability to arrive at a HEU grade (weapon grade). This is the main concerning of EU and US, because the enrichment activity is not forbidden in NPT, so Iran works in legality and an argument for halting enrichment activity in Iran has no support in international law.
Undoubtedly, Iran's nuclear facilities have the capacity to produce nuclear material for an atomic bomb. The Installed capacity, such as the number of centrifuges (10.000.) is much higher than the internal needs. Other constraints must be observed, Iranian industry does not have the technological capacity to produce all the inputs for such an arms program, so there is a strong dependence on imported products and technologies that come mainly from Russia and China.

4. JCPOA AND POLICY IMPLICATIONS

The Joint Comprehensive Plan of Action (JCPOA) is an international agreement assigned in Vienna, Austria, on July 14, 2015, between Iran and permanent members of UN security council(U.S., U.K. France, Germany, Russia, and China), and EU. The JCPOA, or Iran’s Nuclear Deal, is a diplomatic attempt to resolve an international stalemate related to the Iran’s Nuclear Program. The great fear of the west countries over the Iranian nuclear program is the production of nuclear weapons. There is a tripod to produce a nuclear weapons program : Nuclear fuel, Nuclear warhead, and Missile technology.

The JCPOA main objective is stopping Iran from a possible development of a Nuclear Weapon. The deal is intended to build constrain to Iran acquire Nuclear Fuel in enrichment

level for a Nuclear Bomb. To assure the objective, the agreement will implement a series of inspections to prevent Iran produces fissile material in declared facilities for a military use. Iran has two main routes to reach a nuclear weapon. These routes are called: the uranium route and the plutonium route.

In Uranium route, the uranium must be enriched because in nature U-235 is approximately 0.7% and its isotope is fissile and can sustain a fission chain reaction. The problem of this route is the enrichment process is a process used to produce fuel to commercial nuclear power plants. It's a dual technology that can be used for civilian and military purposes. It's necessary between 9 to 25 Kg of uranium (U-235) in HEU to produce one warhead. The key strategy to prevent proliferation in Uranium Route is to limit the number of centrifuges, impose severe restrictions on the export of nuclear technology and fissile materials. [13] [14] [2] [11]
The Plutonium route is more complex to reach a nuclear weapon. [15] Plutonium must be produced because is a element rare. It is necessary a reactor and in "weapon grade:" is necessary a low Pu-240, concentration less than 7%. [15] [16] The amount necessary to produce a warhead is between 2 to 9 Kg less than U-235. The key strategy to prevent proliferation in Plutonium Route is to forbid access to a special reactor to produce plutonium. [13] [16]

According Persbo [14], the uranium route is considerably shorter. The principle of Uranium cycle is converting the yellowcake into a gas compound (UF_6). The next step is the enrichment. Nuclear Weapons need U-235 in HEU (the average of nuclear bomb enrichment is more than 90% of uranium-235.). Iran's enrichment using gas centrifuges.

The centrifuge machines rotates very fast requires very little electricity, and takes up very little floor space. The separation is done by the centrifugal force acting on the particles of UF6, concentrating the U-238 in a region more external than the U-235, because the first one is heavier only about of 1% in relation to the second. Hence the term "ultra" centrifugation (operating at very high tangential velocities), to separate two elements whose masses are very close together. The enrich gas will be converted into a metal and it pass to process to weaporization.

The Enrichment activity is done in Natanz and Fordow. The process in Iran is based in centrifuges. The UF_6 is rotated at extreme speeds. Heavier uranium atoms (U-238) are concentrated at the top of the centrifuge, and the lighter (U-235) atoms are in the center. The gas recovered in the center is sent to a new centrifuge, which repeats the process successively, increasing the degree of uranium concentration. The mills that do this process have thousands of centrifuges.

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scenarios to Iran arrives in 90% of UF6 in a quantity of 1 SQ1 (Table 1). Iran is increasing the production of key raw materials (zirconium, heavy water, high strength aluminum), but depending still on imports (maraging steel, instrumentation). Probably, illicit networks to bypass international sanctions prohibiting the purchase of these materials have been done by Iran's government. This is the most effective strategy to stop or diminish the production of centrifuges in Iran. The number of centrifuges in Iran has steadily increased over the last decade.

Table 1 Iran's Capability to produce 1 SQ

Scenario	Description	Time required for one SQ
1	Use all current centrifuges in Natanz and Fordow with natural uranium	6 mouths
2	Use all current centrifuges in Natanz and Fordow with 3-5 % uranium	2 months
3	Use 6000 IR-1 centrifuges as tandem cascades with 20 % uranium	2 weeks
4	Use 3000 IR-2ms at an unknown location	1-2 weeks

Source: Author from (Heinoken,2013) [18]

Currently, Iran has 209 Kg of UF6 enriched close to 20%. The amount necessary to produce one nuclear bomb is 250 Kg [10]. In conclusion, Iran has technology and capacity to produce HEU and stockpile to reach this objective.

The main points of Iran's nuclear deal regarding Uranium Route are:

1. Uranium Stock: The excess of 300 Kg LEU UF_6 or equivalent form must be down-blend to natural uranium or sell. The UO_2 enrich between 5 to 20% must be fabricate fuel into fuel plates, export or dilute. [20]
2. Enrichment Process: Enrich at limit of 3.67% and below. [20]
3. Centrifuges Control: Remove 1000 IR-2m and advanced centrifuges. It will be allowed limited units to agreed R&D program. Remove 5600 IR-1 centrifuges and remove nuclear material from Natanz and Fordow. AIEA will monitor the storage of centrifuges and supervise the remaining 348 IR-1s that it will produce stable isotopes. [20].

The current stock of enriched nuclear material is 8500 kg of LEU (Table 2). The agreement provides for a reduction to 300 kg, which makes any military (nuclear bomb) aspiration impossible with this amount at 3.5% enrichment. The second point, complementary to the previous, ends with LEU between 5 and 20%, and currently the stock is around 200 kg, abolishing any aspiration for the immediate construction of a nuclear bomb due to the total lack of ready-to-use nuclear material. The most severe restrictions apply to Iran's enrichment

[1] "SQ- The approximate quantity of nuclear material required to manufacture the first nuclear weapon taking into account the manufacturing losses. Production of 1 Significant Quantity (SQ) of weapons grade uranium from natural uranium requires about 5000 Separative Work Unit (SWU) of enrichment effort" [18].

capability. When the JCPOA was concluded, Iran had about 20,000 centrifuges. The points 3 reduces a lot Iran´s capability to enrich uranium and associated to point 1 made it impossible to enrich the amount of uranium needed for a bomb in less than a year.

The main point of JCPOA is undoubtedly the reduction of enrichment capacity in Iran. In Natanz of 6104 IR-1 type centrifuges (first generation) only 5060 may be working in the next 10 years. The rest (including 1000 modern IR-2 centrifuges) will be collected and stored under IAEA monitoring. Iran will be able to continue scientific research over the next 8 years without accumulating enriched uranium. The development process of isotope separation by laser will be paralyzed in the next 10 years.

After 10 years, Iran will gradually replace the IR-1 type centrifuges with a later technology. In the next 15 years only the Natanz unit will be allowed to enrich uranium, and this activity will be prohibited elsewhere. Enrichment of uranium above 3.67% is prohibited.

In the next 15 years, Fordow cannot be used for uranium enrichment or for nuclear material storage. The site will be transformed in place with just research purpose into an international cooperation. 1044 of 2700 IR-1 centrifuges will be used to produce radioisotopes (part of Russia cooperation), while the remainder will be storage in separated sites without possibility of being used. [8]

Diplomatic agreements are in essence a game of profit and loss. On the one hand, undoubtedly a severe restriction precludes any short-term nuclear war aspirations, but retains the capacity for R&D of Iranian nuclear technology. In 15 years without the restrictions imposed with the Russian cooperation, it will be possible access to research materials increasing Iranian nuclear technical capacity will be maintained. If there are undeclared facilities, to some extent the acquisition of nuclear material by this route will be even more worrying. This is the main criticism by Israel and the US that fear the Iran will train in the medium term through unconventional means, access to now restricted technologies that could contribute to the future development of a nuclear bomb. What may seem like a victory, the partial submission by Iran to international pressure, can be associated with a clear strategy of acquiring knowledge to achieve a future goal (nuclear bomb).

Important part in the plutonium cycle, for years Iran claimed that the IR-40 reactor in Arak was designed and built to produce medical isotopes. The major international concern is the use of this reactor to produce plutonium. According Asculai [15], there are some proliferation concerns about the reactor's ability to produce plutonium for military applications. “It is expected that IR-40, in full operation, can produce from 8 to 10 kilograms of plutonium per year within its spent nuclear fuel”. [11] IAEA did not report no trace of plutonium in reprocessing activities from the spent fuel. 5 Kg is sufficient to produce one nuclear weapon, and use U-238 fueled heavy-water reactors is a common method to produce plutonium Pu-239.

The main points of Iran’s nuclear deal regarding Plutonium Route are:

1. Take away inoperable existing Reactor core(calandria) for Arak reactor.
2. Modernize of existing Arak Reactor
3. Export all excess of Heavy Water.
4. Modify Arak’s Fuel Production Line.
5. Banning Reprocessing and Separated Plutonium Activities for 15 years

6. Restrictions in R&D activities with Uranium and Plutonium Isotopes

In 2004, Iran revised its declaration to the IAEA and gave up building a reprocessing in Arak. Some specialists Asculai [15] and Persbo [14] have concerning about Iran had carried out reprocessing experiments during 1988-1993 without informing the IAEA. Another possibility is to have clandestine facility to do it.

Probably, Iran may have abandoned the plutonium route because of technical problems. This provides greater international support for the agreement and continues its development process on the uranium route, and a technically more viable route. Another point that is possible to achieve in the clandestine way from Pakistan or North Korea small amounts of plutonium, but sufficient to make some units of nuclear bombs.

Opens source literature indicates that weaponization must be preceded by a series of test and simulations. IAEA did not indicate any nuclear test. Deposit sphere plutonium in a warhead without previous criticality tests can be difficult challenge. As discussed before is more plausible in a clandestine route get nuclear bomb design from North Korea, Pakistan than to design on own. The real fact is that there is no information that can be published about Iran's actual ability to design and build a nuclear bomb. So, The Iran's Nuclear Deal intends to break Uranium and Plutonium routes to arrive in a nuclear bomb.

The covert option will always be an alternative. The thermometer will be the US relationship with the Middle East. This option will not necessarily take place within Iranian territory, but can be carried out with support and assistance abroad. The ethnic problems of the region, aggravated by radical groups like the Islamic State (IS) are source for the continuity of clandestine programs.

There is no doubt that Iran has technical qualifications to produce a nuclear bomb. Secret activities have a high probability of existing, whether in Iranian territory or abroad. While on the one hand the Deal was effective in banning activities that could guide to the construction of a nuclear bomb in Iran's land, it is not effective in developing the future capacity, even indirectly, to obtain and understand means to reach an atomic bomb. There are two important key points, accepted ratify additional protocol and implement modified code 3.1. These two procedures are the most important conquest of Iran's Nuclear Deal in terms of Inspection, Monitoring and Verification, providing more security in terms of non-proliferation of nuclear weapons to the world under the leadership of an agency (IAEA) that truly represents the interests of the international community.

5. CONCLUSIONS

The Iran's Nuclear Deal is undoubtedly a step forward in terms of non-proliferation. Iran signed the NPT and has voluntarily signed additional protocols. The policy of non-alignment with the US and Israel brings with it diplomatic problems that are, in the end, the interests of these agents in the domain of their influence in the region. The rise of extremist groups, as Islamic State, the war in Syria, the case of the Palestinians is fuel for clandestine nuclear activities.

The President Trump, during 2016 election campaign, told that will continue to punish Iran for its human rights abuses and support for terrorism. No aspect of JCPOA prevents the

United States from maintain or implement new sanctions on Iran for its suspicious support terrorism. The UN can continue impose sanction on Iran for other non-nuclear disreputable activities. The agreement treat the available nuclear fuel in both plutonium and uranium routes, and try to break the possibility of Iran get nuclear material to build a nuclear bomb.

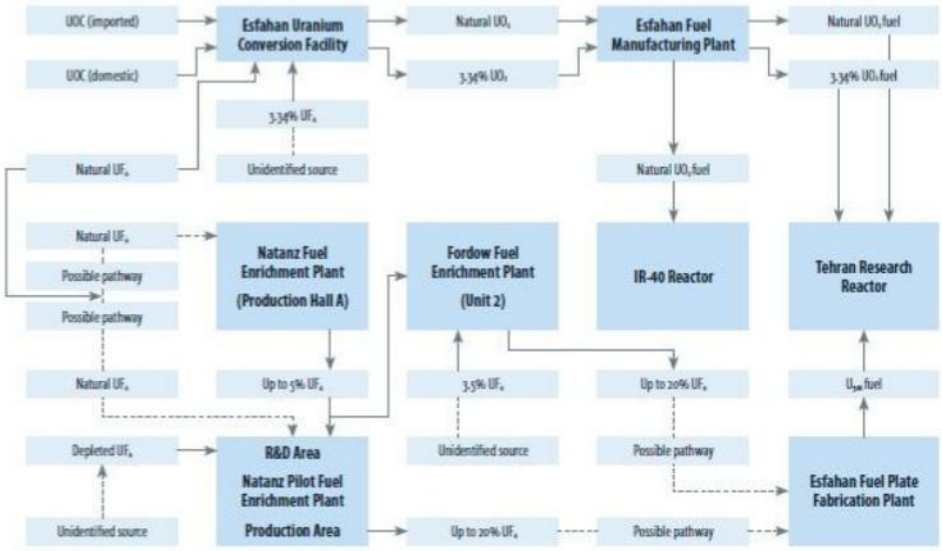

Figure 2 Iran's Routes to Nuclear Bomb
Source: **(David Cliff,2013) [21]**

The Iran cooperation with IAEA means international support even if the US has a counterpart. For much of the world, even among its allies, the US position of guardian of the world, is not well seen by all. The election of President Trump may be an obstacle to the agreement. Approval of the US Congress is required, including funding for the IAEA. According to indications during the campaign there may be retrocession of this process in 2017.

The US position is in a difficult situation because if Congress rejects the agreement it will be necessary to convince the international community of the continuation of the sanctions imposed on Iran. On the other hand, abandoning an agreement with the approval of the UN Security Council will mean another round of negotiations with Iran without support from the EU.

A military action such as occurred in Iraq after 9/11 seems unlikely at this time and the US would do it unilaterally. The arguments of the Invasion of Iraq, mass destruction weapons not found, brought an international questioning about the real American interests in the region. The ravages with its allies and the confrontation with Russia and China can mean serious diplomatic problems.

The main point of Deal is that it is based in verifications. Verifications by the IAEA mean total monitoring of nuclear activities in Iran. This monitoring includes the nuclear supply chain, the control in the research and production of centrifuges, and the operation of the reactors. The agreement will allow the inspection of undeclared facilities and others that did not have prior access. In addition, 66% of the centrifuges will be put out of operation, 98% of the uranium stock will be removed, the plutonium route prevented with the modernization

of the IR-40 before Iran receives any relif from the sanctions imposed. The agreement is undoubtedly a major breakthrough against the proliferation of nuclear weapons in Iran.
All these actions will be verified and monitored by the IAEA and will increase the time in more than a decade of Iran to obtain a nuclear weapon. The time to obtain a nuclear bomb is a very difficult prevision. American Analysts claim 2 a 6 months while Iranian specialists 3 to 8 years. The current deal broke the plutonium route and restricts a lot uranium route. In declared installations will be impossible to produce nuclear bombs. Although the Uranium route is a real possibility to reach a nuclear bomb, the enrichment process is under rigorous supervision.

The agreement has other interesting points, even if Iran looks for clandestine options, what is known about official program will be monitored, verified and inspected. It is a major breakthrough in terms of non-proliferation and information for possible military action.

Iran is not North Korea. Iran is more democratic, and its non US aligned policy do not assume public test of atomic weapons. Past agreement between US and North Korea only addressed the plutonium pathway to a bomb. [16] JCPOA is more complete by restricting plutonium route, uranium route, and covert action. The Iran deal is an international diplomatic instrument constructed with UN supervising involving many counties in the negotiations process.

The great difficulty in understanding the agreement is how much Iran is willing to convince the international community of its peaceful intentions to apply nuclear technology, when its biggest rival and local enemy Israel has such technology in military application. The disproportion of the technological power of war between Israel and the rest of the Arab and Persian community is undoubtedly the motivating factor for all countries to have nuclear weapons.

Suspicion of support terrorist groups by Iran has a negative impact on the stability of the region. Of course, the possession of a nuclear bomb by Iran would be a very strong danger because this technology could be passed to those groups (terrorists) and or countries that are enemies of Israel great partner of the US. This will only be resolved by solving the Palestinian question.

Another criticism of the agreement is the 15-year deadline, meaning after that period Iran could, for example, enrich more than 3.67%. Diplomatic solutions are the manifestation of a collective agreement, what one can with a minimum of acceptance of all the participants. It is now time to bring Iran closer to the international community and not isolate it with a series of sanctions that bring it closer to covert option.

Some aspects of the JCPOA will last 25 years, such as monitoring of uranium mines and supply chain. “Other aspects are permanent as the implementation of robust IAEA safeguards and access to investigate suspicious sites for illicit nuclear activity”. [13] Iran is still prohibited from owning nuclear weapons under NPT. After the agreement any suspicious activity that infringes the JCPOA will require a response from the international community with retaliation based on a well-founded legal theory. Finally, the Iran’s Nuclear deal postpone the Iran’s nuclear program for more than a decade, approaching Iran’s “breakout time” from a few months to at least one year. It also permits IAEA inspectors capability to monitor nuclear activities and prevent to possible development to a nuclear bomb.

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