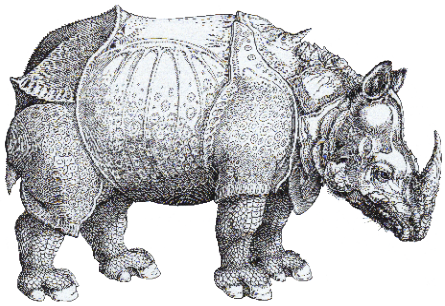


SECURITY INDEX №12 (27) | 2021
OCCASIONAL PAPER SERIES
Global Edition

Inna Rodina

Peaceful Uses of Nuclear Energy in the Middle East

PIRPRESS
MOSCOW, 2021

SECURITY INDEX

Editor-in-Chief: Vladimir Orlov

Editors: Egor Chobanian and Sergey Semenov

Reviewers: George Moore and Mikhail Lysenko

Peaceful Uses of Nuclear Energy in the Middle East / Inna Rodina. M.: PIR Press, 2021. – 36 p. – (*Security Index* Occasional Paper Series).

ISBN 978-5-6047005-3-2

This research paper explores the Middle Eastern energy demand, carefully analyzing the factors that have led the regional countries to a decision to develop the nuclear industry. The paper sheds light on the advantages and disadvantages of various nuclear suppliers, including the Russian Federation. That makes the paper a matter of interest for nuclear energy specialists, policymakers, and a broad audience. It could also be useful research to read amid the upcoming Tenth Nuclear Non-proliferation Treaty (NPT) Review Conference.

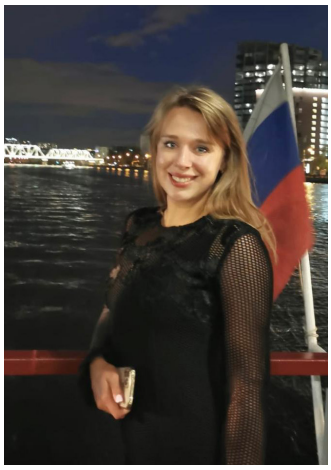
This occasional paper and other materials are available at:
http://www.pircenter.org/en/articles

ISBN 978-5-6047005-3-2

9 785604 700532

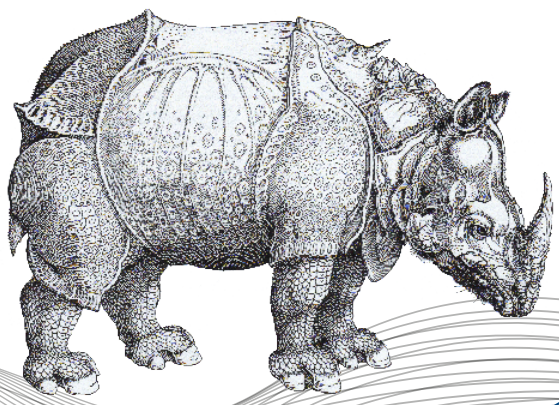
AUTHOR

RODINA Inna



Graduated from the Dual Degree M.A. Program *Global Security, Nuclear Policy and WMD Nonproliferation* developed jointly by MGIMO, Middlebury Institute of International Studies (MIIS, USA) at Monterey and PIR Center. Holds a Bachelor's degree in International Relations from MGIMO with distinction. Participated at PIR Center's internship program in 2019-2021. Member of CTBTO Youth Group and Youth4Disarmament, fellow of the IAEA Marie Sklodowska-Curie Fellowship Programme (MSCFP). Fluent in English, Russian, and Arabic. Research interests: peaceful uses of nuclear energy, nuclear disarmament and nonproliferation in the Middle East, establishment of a WMD-Free Zone in the Middle East, the JCPOA and the US-Russia cooperation.

E-mail: innarodina9551@gmail.com



Contents

Highlights

- There are numerous reasons why the Middle Eastern states are eager to develop nuclear energy, namely economic, political and social ones, significant energy needs, as well as the role of prestige.

- Iran is one of two states in the region that has a NPP (first unit) in operation. It also has ambitious plans for further developing nuclear industry. However, uncertainties regarding the JCPOA could be a stumbling block for its PUNE plans.

- In 2011, Saudi Arabia announced its plans to develop peaceful nuclear energy. However, as of 2021, those plans are still on the paper.

- The UAE nuclear program does not have a long history but it has already proven to be effective. The country established all necessary bodies and adopted a successful legislative system. Moreover, the UAE is very transparent and shows no intention to redirect the nuclear technologies into the military field. As a result, it has the first NPP in the Arab world.

- Jordan has made some attempts to progress in the PUNE field, though the idea to build a NPP in the country seems to be waived indefinitely, and Jordan concentrates on SMR option today.

- Egyptian attempts to implement a nuclear energy program showed what difficulties a country could face in the nuclear field due to developments in the political sphere.

- Further implementation of nuclear projects in the region is dependent on ongoing political tensions, developments in bilateral relations between the regional states and nuclear supplier countries, compliance with nonproliferation norms and changes in the world's nuclear industry.

Peaceful Uses of Nuclear Energy in the Middle East

Inna Rodina

Introduction

There are several reasons why nuclear energy is viewed as a driving factor in the development of sustainable energy sources, namely cost-effectiveness, reliability, and strict regulation of construction procedures. Currently, there are 442 nuclear power reactors in operation and 51 more under construction around the world[1].

Among the nuclear energy "newcomers" are the Middle Eastern states that are making a dynamic progress. In 2011, Iran became the first country in the Middle East to connect the first NPP unit to the national grid. In April 2018, Turkey began construction of Akkuyu NPP. In 2020, the first NPP block started to operate in the UAE. Jordan is also evaluating different options for the PUNE development to cover its energy needs. Saudi Arabia possesses ambitious plans to develop nuclear energy. Although Egypt has faced a coup d'etat which slowed down the development of nuclear energy in the country, it remains committed to progress in it.

The main idea of this paper is to estimate what the prospects for Russian nuclear energy vendor participation in the Middle Eastern projects are. To understand this, the nonproliferation concerns and internationally accepted PUNE norms have to be considered:

1. For the study's purposes, the Middle East is defined as all the Persian Gulf states (Bahrain, Iran, Iraq, Kuwait, Oman, Qatar, Saudi Arabia, and the UAE), as well as Egypt, Israel, Jordan, Lebanon, Palestinian National Authority, Syria, Turkey, and Yemen.
2. To take a closer look at the developing nuclear programs in the Middle East, five case studies were considered, namely Saudi Arabia, Egypt, the UAE, Jordan, and Iran.

Numerous publications touch upon the topic of the development of nuclear energy in the Middle East from various angles. However, there is no complex scientific work that has studied developments in the nuclear energy programs of all major regional countries interested in nuclear energy promotion and shed the light on advantages and disadvantages of various nuclear vendors. The paper contains a comprehensive analysis of numerous aspects, including legal and non-proliferation ones, and recent developments in the PUNE field. It could be a matter of interest for both professional and broad audiences.

[1] Nuclear Power in the World Today (2021, May). World Nuclear Association. - Retrieved from: https://www.world-nuclear.org/information-library/current-and-future-generation/nuclear-power-in-the-world-today.aspx

ANALYSIS OF THE MIDDLE EASTERN ENERGY DEMAND AND ITS DRIVING FACTORS

It is not surprising that the Middle East is the region with the most dynamic rates of nuclear energy development: energy-exporting states intend to redirect oil and gas for export and diversify their economies, while energy-importing countries need to overcome their dependence on oil, gas, and electricity from abroad.

Table 1: Nuclear power plants in the Middle East[2]

Country	Stage
Iran	Bushehr NPP Unit 1: under operation since 2011 (1 GW); Units 2: under construction since 2019 (1 GW).
The UAE	Barakah NPP Unit 1: under operation since August 2020 (1,4 GW); Unit 2 under operation since September 2021 (1,4 GW); Unit 3: under construction since 2014 (1,4 GW); Unit 4: under construction since 2015 (1,4 GW).
Turkey	Akkuyu NPP Unit 1: under construction since 2018 (1,2 GW); Unit 2: under construction since April 2020 (1,2 GW); Unit 3: under construction since March 2021 (1,2 GW).
Jordan	In June 2018, Jordan declared the termination of the agreement with Russia to construct a NPP. Currently, SMR options are under consideration in Jordan.
Saudi Arabia	SMR (SMART and High Temperature Gas Cooled Reactor) is under consideration.
Egypt	El-Dabaa NPP, Four Units (4,8 GW): license for construction of Units 1 and 2 are expected to be received.

In the Middle East, electricity is a very sensitive issue as it grants access not only to light and electrical appliances but also to freshwater. While the Middle Eastern population comprises 4 % of the world's population, it has access only to 1 % of the world's water resources[3]. NPP-desalination plant combination could be a solution to this problem.

With high oil prices, the use of hydrocarbons as an energy source in the domestic market entails lost profits for the countries that

[2] IAEA, PRIS. Country Statistics. - https://pris.iaea.org/PRIS/CountryStatistics/CountryStatisticsLandingPage.aspx

[3] Мировой рынок пресной воды (2009). - Retrieved from: http://www.vigorconsult.ru/resources/mirovoy-ryinok-presnoy-vodyi/

are heavily dependent on oil exports. Also, many oil exporters have little or no domestic refining, and they need to import gasoline and other refined oil products. This problem can be solved through the development of non-hydrocarbon energy.

NPP construction costs are high. So, it could be one of the main obstacles for some Middle Eastern states to develop the nuclear industry. However, it is possible to find a workable solution to handle this problem, such as Build-Own-Operate (BOO) scheme that is being implemented in Turkey. Successful implementation of NPP's projects could encourage external investors to cooperate with the countries of the region. In addition, one of the advantages of nuclear energy is its long-term financial profit. Upon a NPP completion, the revenue from the generated electricity is supposed to significantly exceed the cost of maintaining the station.

ASSESSMENT OF THE MIDDLE EASTERN STATES' CAPACITY TO ABSORB NUCLEAR POWER

The Middle Eastern states have both different backgrounds in the PUNE field and various capacities to absorb nuclear power. Some of the countries have been developing nuclear energy for several decades, while others have adopted their plans just recently. The region is politically unstable, and that is viewed as a real challenge for the PUNE development.

Iran

Iran's interest in nuclear energy development dates back to more than sixty years ago. In the 1950s, Iranian Shah Mohammad Reza Pahlavi initiated a nuclear program with the U.S. assistance as a part of the "Atom for Peace" program[4]. The Shah had ambitious plans to construct 20 nuclear power reactors, a uranium enrichment facility, and a reprocessing plant for spent fuel[5]. At that time, the University of Tehran purchased the equipment for nuclear research and educational activities, established the Nuclear Centre of the University, and started the operation of the Tehran research reactor. At the beginning of the 1970s, Iran established the Atomic Energy Organization of Iran (AEOI) and concluded several nuclear technology contracts with different foreign suppliers. Iran paid $1 billion for a 10% stake in Eurodif's Tricastin uranium enrichment plant (France), and a 15% stake in the RTZ uranium mine in Rossing (Namibia)[6]. Moreover, in 1976, Iran signed a $700 million contract to purchase uranium yellowcake from South Africa[7]. Thus, by 1978-1979, Iran had developed an impressive baseline capability in nuclear technologies. The construction of the NPP at Bushehr was started in 1974 by German Siemens. However, the Iranian Revolution of 1979 changed the plans to develop nuclear energy. Ayatollah Khomeini deemed the nuclear program "un-Islamic" and ordered it terminated. But in 1984, Ayatollah Khomeini reversed course on nuclear power and sought international partners to continue building the construction of the Bushehr reactors[8]. After the Iran-Iraq war of 1980-1988, Iran signed nuclear cooperation agreements with Pakistan and China[9]. However, in the 1980s, due to the U.S. pressure on possible nuclear suppliers, Iran failed to find a vendor to finalize the works on the NPP.

Currently, the nuclear energy organizational structure consists of the Iran Nuclear Regulatory Authority (INRA), the Nuclear Power Plants Division (NPPD), and the Bushehr Nuclear Power Plant (BNPP)

Since the 1980s, due to economic development and population growth, the demand for primary energy resources in the Middle East has increased more than five times

[4] Rowberry, A. (2013, December 18). Sixty Years of "Atoms for Peace" and Iran's Nuclear Program. Brookings. - Retrieved from: https://www.brookings.edu/blog/up-front/2013/12/18/sixty-years-of-atoms-for-peace-and-irans-nuclear-program/
[5] Iran Overview (2015, June). NTI. Retrieved from: https://www.nti.org/learn/countries/iran/
[6] Oliver, M. (2006). Iran and Foreign Enrichment: A Troubled Model. The Arms Control Association. - Retrieved from: https://www.armscontrol.org/act/2006-01/iran-nuclear-briefs/iran-foreign-enrichment-troubled-model
[7] Chaudhry, A. (2004, June 9). Iran's Nuclear Shadow. Iran Watch. - Retrieved from: https://www.iranwatch.org/library/cdi-irans-nuclear-shadow-6-9-04
[8] Iran. ISIS. - Retrieved from: https://isis-online.org/country-pages/iran
[9] Burke, A. (2020, June 15). China in the Gulf: A New Partnership with Iran? CSIS. - Retrieved from: https://www.csis.org/analysis/china-gulf-new-partnership-iran

Operating Company. The INRA is a national nuclear regulatory body established in 1975. It regulates the safety of nuclear installations and radiation activities, as well as issues permits and licenses, regulations, and guides, and provides authorization or supervision of activities. INRA's management system has been established based on the IAEA Safety Standards Series. In 2004, the NPPD holding company was established with the main mission to develop NPPs in all stages. The BNPP Operating Company, which started functioning in 2007, is responsible for executing any activities with the purpose to generate electricity, maintain and repair, and supply fuel for the BNPP. Moreover, several Iranian institutions and universities are conducting nuclear research. The Nuclear Science and Technology Research Institute is considered the key research and development organization in Iran. It is officially affiliated with the AEOI, and it cooperates with international scientific communities, especially, with the IAEA[10].

The Bushehr Nuclear Power Plant

Source: rt.com

Iran became an NPT State party in 1970 and concluded its safeguards agreement with the IAEA in 1974. In 2003, Iran has signed the IAEA Additional Protocol (AP) to its safeguards agreement but still has not ratified it. Currently, there are numerous challenges in the IAEA-Iran cooperation because of the general JCPOA developments. However, IAEA Director General (DG) Grossi works hard to maintain an appropriate level of the Agency's cooperation with Iran.

Thus, Iran's nuclear energy program has witnessed ups and downs over the history of its development. Currently, Iran is one of two Middle Eastern states that have a NPP in operation. Also, Iran has ambitious plans for the further developing nuclear industry. However, difficulties in bringing the JCPOA back to force could be a stumbling block for the PUNE development in Iran.

Saudi Arabia

Saudi interest to develop nuclear energy dates back to the 1960s. In 1977, the Kingdom established King Abdulaziz City for Science and Technology. A decade later, in 1988, it created the Atomic Energy Research Institute to do research on industrial applications of radiation, radioactive isotopes, nuclear power, reactors, nuclear materials, and radiation protection. Since the late 1970s, Saudi scientists have conducted several studies on the feasibility of NPP development for power generation and water desalination.

In 2006, the Gulf Cooperation Council (GCC) summit decided to conduct a study on the feasibility of developing nuclear energy in the region. After the summit, Saudi Arabia renewed its interest in nuclear energy development. In April 2010, King Abdullah issued a decree on the establishment of a new agency - King Abdullah City for Atomic and Renewable Energy (K. A. CARE) that was created as "the driving force for making atomic and renewable energy an integral part of a national sustainable energy mix, creating and leveraging the competitive advantages of relevant technologies for the

[10] Country Nuclear Power Profile. Egypt (2020). IAEA. - Retrieved from: https://cnpp.iaea.org/countryprofiles/IranIslamicRepublicof/IranIslamicRepublicof.htm

social and economic development of the Kingdom of Saudi Arabia"[11].

According to the K. A. CARE Charter, it aims to develop nuclear and renewable energy to meet the needs of the growing population for freshwater, electricity, and the preservation of oil resources for future generations; to ensure uninterrupted power supply to the population; to diversify sources of export income[12]. Among the K. A. CARE's main functions, there is a supervision of the Kingdom's nuclear energy activities.

In April 2016, Saudi Arabia has announced its national program known as Saudi Vision 2030, which aims at transforming the Kingdom by reducing its reliance on oil, diversifying its economy, and developing public service sectors such as health, education, infrastructure, recreation, and tourism[13]. In light of Saudi Vision 2030, K.A. CARE proposed a plan to create an energy mix in which atomic energy plays a major role[14]. Also, the need to develop the PUNE is reflected in other Saudi official documents[15, 16].

In 2011, K. A. CARE coordinator Abdul Ghani Malibari claimed that "Saudi Arabia's objective is to build 16 civilian reactors by 2030 at a total cost of $80 billion"[17]. In more recent statements, the timeline was adjusted for 2032, and expected spending increased to $112 billion[18]. However, the "great expectations" of the 2010s still remain just plans, and as of November 2021, no power reactor is under construction.

In 1988, Saudi Arabia adopted the NPT. In 1962, it became an IAEA member. In 2005, Saudi Arabia signed the CSA, which entered into force in 2009. This agreement was qualified as a Small Quantities Protocol (SQP). However, in 2021, the most straightforward approach for Saudi Arabia to meet its future NPT safeguards obligations would be to rescind its SQP and negotiate subsidiary arrangements with the IAEA to permit the Agency to safeguard the new reactor and its fuel. The best-case scenario would be incorporating an IAEA AP. VCDNP senior research associate Anthony Stott noted that before they bring nuclear fuel, the Saudis need to rescind the SQP. "But there is a lot of work to be done before bringing nuclear fuel – so, for now, it is not a high priority. At the same time, if Saudi Arabia becomes more transparent, it might reach more progress in

[11] Abuaish R. Saudi National Atomic Energy Project. IAEA. - Retrieved from: https://gnssn.iaea.org/NSNI/SMRP/Shared%20Documents/Workshop%2012-15%20December%202017/Saudi%20National%20Atomic%20Energy%20Project.pdf

[12] Royal Decree establishing King Abdullah City for Atomic and Renewable Energy. - Retrieved from: https://www.energy.gov.sa/en/about/Documents/KACARE_Royal_Decree_english.pdf

[13] Abuaish R. Saudi National Atomic Energy Project. IAEA. - Retrieved from: https://gnssn.iaea.org/NSNI/SMRP/Shared%20Documents/Workshop%2012-15%20December%202017/Saudi%20National%20Atomic%20Energy%20Project.pdf

[14] مدينة الملك عبدالله للطاقة الذرية و المتجددة (2020). - Retrieved from: https://www.energy.gov.sa/en/projects/Pages/atomic.aspx

[15] Abuaish R. Saudi National Atomic Energy Project. IAEA. - Retrieved from: https://gnssn.iaea.org/NSNI/SMRP/Shared%20Documents/Workshop%2012-15%20December%202017/Saudi%20National%20Atomic%20Energy%20Project.pdf

[16] National Industrial Development&Logistics Program. Delivery Plan 2018-2020. - Retrieved from: https://vision2030.gov.sa/sites/default/files/attachments/NIDLP%20Delivery%20Plan%20-%20English%20Jan%202019.pdf

[17] Ponani, A. (2011, November 17). Saudi, South Korea ink nuclear cooperation deal. - Retrieved from: https://timesofindia.indiatimes.com/nri/citizen-journalists/citizen-journalists-reports/akbar-ponani/Saudi-South-Korea-ink-nuclear-cooperation-deal/articleshow/10761058.cms

[18] Nuclear Power in Saudi Arabia (2021, January). World Nuclear. - Retrieved from: https://www.world-nuclear.org/information-library/country-profiles/countries-o-s/saudi-arabia.aspx

the field - the results of the UAE's transparency are visible now"[19].

Although Saudi interest in developing nuclear energy dates back to the 1960s and boosted by ambitious plans of the 2010s, Saudi Arabia has not achieved visible progress in the development of nuclear energy.

United Arab Emirates

Unlike Iran and Saudi Arabia, the UAE is a "newcomer" in the nuclear field. The country started to pursue a PUNE program only in the 21st century. The UAE designated Abu Dhabi Executive Affairs Authority as the Nuclear Energy Program Implementation Organization which in 2009 set up the Emirates Nuclear Energy Corporation (ENEC). Currently, the key entities implementing the UAE nuclear energy program are the following: Federal Authority for Nuclear Regulation (FANR), ENEC, Korea Electric Power Corporation, Nawah Energy Company, Barakah One Company[20].

In 2009, the UAE signed a deal worth $20.4 billion with KEPCO to construct four APR-1400 reactors, and in August 2020, Barakah unit 1 became operational; in September 2021, the second unit was connected to the grid[21]. "Once fully operational, Barakah four-unit plant will provide up to 25% of the UAE's electricity needs and will help prevent the release of 21 million tons of carbon emissions, equivalent to removing 3.2 million cars off the road annually"[22].

Director of the Middle East Nonproliferation Program at CNS Dr. Chen Zak Kane believes that from a financial perspective, the UAE has capabilities to develop the PUNE in the country further. But she stressed that it is important that the UAE does not put an emphasis on localization as human resources building capacity is a long-term process. "Efficiency and proficiency are crucial. The UAE pays international experts to develop its nuclear industry. They have resources unless they do not rely on localization. Also, the UAE has tried to address the issue of illicit trafficking through its territory, which it witnessed in the past, as much as it could. In general, the UAE is doing a great job"[23].

In its nuclear energy policy, the country made its peaceful objectives unambiguous. Anthony Stott underlined the high level of transparency that the Emirati nuclear program bears. So, for example, "Policy of the UAE on the Evaluation and Potential Development of Peaceful Nuclear Energy" of April 2008 - "White Paper" - highlights a series of strategies and commitments, including complete

[19] Interview with Anthony Stott.
[20] Country Nuclear Power Profile. United Arab Emirates (2020). IAEA. - Retrieved from: https://cnpp.iaea.org/countryprofiles/UnitedArabEmirates/UnitedArabEmirates.htm
[21] Yurman, D. (2009, December 28). South Korea wins UAE $20.4 billion nuclear contract. Energy Central. - Retrieved from: https://energycentral.com/c/ec/south-korea-wins-uae-204-billion-nuclear-contract
[22] Barakah: UAE starts up Arab world's first nuclear plant (2020, August 2). BBC. - Retrieved from: https://www.bbc.com/news/world-middle-east-53619916
[23] Interview with Dr. Chen Zak Kane.

operational transparency, highest non-proliferation, and safety and security. It stresses the UAE's commitment to develop and control the nuclear field for peaceful purposes only and in accordance with the policy and international treaties and agreements. Under the law, the UAE permanently foregoes the acquisition of uranium enrichment and plutonium reprocessing capabilities.

The UAE is a good-standing member of all relevant non-proliferation treaties, organizations, and regimes, and it is not known to possess programs for the development of nuclear weapons or their delivery systems. In 1995, the UAE became an NNWS to the NPT. In 2003, it concluded a safeguards agreement with the IAEA and in 2010, it acceded to the IAEA AP.

Thus, while the UAE nuclear program does not have a long history, it proved to be effective. Once the UAE government decided to develop the PUNE, it established all necessary bodies and adopted a legislative system to implement a nuclear energy program. Moreover, the UAE is very transparent: the country made clear that it needs to develop the PUNE without any intention to redirect the nuclear technologies into the military field. As a result, the UAE has the first NPP in the Arab world.

The Barakah Nuclear Energy Plant (Barakah NPP)

Source: www. constructionreviewonline.com

Jordan

Jordan, like the UAE, does not have a long nuclear history: the country's plans to develop the nuclear industry date back to the mid-2000s.

In 2007, Jordan established the Jordan Atomic Energy Commission (JAEC) and the Jordan Nuclear Regulatory Commission (JNRC)[24]. The JAEC is in charge of safety and security, nuclear science and technology, as well as safeguards and verification. The agency is responsible for developing a national strategy to introduce civilian nuclear power into the energy mix[25]. In 2008, the JAEC was empowered to lead Jordan's effort to implement its nuclear strategy and to manage its nuclear program.[26] There are two JAEC promising achievements, namely, the Jordan Research and Training Reactor (JRTR) and the Jordan Subcritical Assembly (JSA)[27]. The JRTR plays a key role in educating and training future generations of nuclear engineers and scientists, as well as supplies radioisotopes for medicine, industry, and agriculture[28,29]. The JSA is the first nuclear facility constructed in Jordan for education, training, and experimental research purposes[30]. Furthermore, in 2017, Jordan commissioned a new Synchrotron-light for Experimental Science

[24] In April 2014 JNRC was merged into the Energy and Minerals Regulatory Commission (EMRC).
[25] Nuclear Power in Jordan (March 2021). World Nuclear. Retrieved from: https://www.world-nuclear.org/information-library/country-profiles/countries-g-n/jordan.aspx
[26] Country Nuclear Power Profile. Jordan (2016). IAEA. - Retrieved from: https://www.pub.iaea.org/MTCD/publications/PDF/cnpp2016/countryprofiles/Jordan/Jordan.htm
[27] Ibid.
[28] JRTR official website, http://jrtr.gov.jo/?AspxAutoDetectCookieSupport=1
[29] Jordan research reactor complete (2016, December 12). World Nuclear News. - Retrieved from: https://www.world-nuclear-news.org/Articles/Jordan-research-reactor-complete
[30] Country Nuclear Power Profile. Jordan (2016). IAEA. - Retrieved from: https://www-pub.iaea.org/MTCD/publications/PDF/cnpp2016/countryprofiles/Jordan/Jordan.htm

and Applications in the Middle East (SESAME), which is the first synchrotron in the region. The EMRC, among others, regulates nuclear materials and activities to ensure the reliability of the safety and security conditions and to account for nuclear materials in Jordan under the IAEA safeguards.

Jordan is a participant in all relevant nonproliferation treaties and agreements. In 1970, it became an NPT State party the treaty, and in 1998, it was the first Middle Eastern state to adopt the IAEA AP. To this date, Jordan has not provoked any proliferation-related concerns.

There are significant obstacles in Jordan to build a NPP. The country is earthquake-prone and water-poor that poses major environmental challenges to developing a large-scale nuclear energy program. The JAEC expected to start building one 750-1200 MWe nuclear power unit for operation by 2020 and a second one for operation by 2025. However, after the termination of the agreements with Rosatom State Atomic Energy Corporation (Rosatom), the JAEC claimed that it would explore using Small Modular Reactors (SMRs). Officially, there was given a financial reason for the termination. At that time, he said, it would be possible to negotiate better terms. "So, I think financing is not the main reason. The real reason is political. The pressure was put on the Kingdom from the U.S. and European sides"[31].

In November 2018, JAEC Chairman Khaled Toukan stated that while Jordan was working on two parallel projects of a single nuclear reactor in the 1000 MWe range and an SMR plant, a SMR project "seems to be the more appropriate in bridging the gap in the Jordanian electricity generation mix"[32]. Currently, there are 6 SMRs under consideration in Jordan[33]. Indeed, an SMR seems to be more suitable for Jordan from a technical perspective. As for price, according to Professor Kamal J. Araj, it is not expected to be high either: "We are talking about a 3-4 GW SMR that has cost 1.5-2 million dollars. So, that's higher than natural gas but still, that's a reasonable investment. Moreover, the mentioned price is the price for the first SMR generation. So, eventually, it'll go down"[34].

Thus, Jordan is viewed as one of the examples of "nuclear newcomers". The country has been actively evaluating available ways to develop nuclear energy. First, it preferred to focus on NPP constructing. However, today, Jordan seems to concentrate on a SMR as this option corresponds more with the Jordanian financial capabilities.

[31] Interview with Professor Kamal J. Araj.
[32] Nuclear Power in Jordan (March 2021). World Nuclear. Retrieved from: https://www.world-nuclear.org/information-library/country-profiles/countries-g-n/jordan.aspx
[33] Hajarat S. (2019, July 4). Overview of Jordan's Nuclear Energy Program. INPRO, Ulsan, South Korea. - Retrieved from: https://nucleus.iaea.org/sites/INPRO/df17/VI.9-Jordan_Sinamees%20Hajarat.pdf
[34] Interview with Professor Kamal J. Araj.

Egypt

Egypt started to develop the nuclear industry under President Gamal Abdel Nasser in the 1950s. However, there were numerous concerns that the nuclear program under President Nasser was aimed at the acquisition of nuclear weapons. At the same time, some nuclear bodies established by President Gamal Abdel Nasser government are still in operation. In the 1980s, under President Mubarak, American and French companies competed over a NPP project in Egypt. However, the project was dropped from the agenda due to two reasons: negative public opinion in Egypt after the Chernobyl disaster of 1986, and the discovery of gas deposits in the 1990s[35].

Consideration of nuclear energy as an option for electricity generation was revived in 2006. During the National Democratic Party conference of 2006, Egyptian politician Gamal Mubarak called on the country to pursue nuclear energy[36]. In October 2007, President Mubarak announced the decision to start the construction of four NPPs under the IAEA supervision[37, 38]. Egypt's interest to develop civil nuclear energy was reflected in the Nuclear Law on Regulation of Nuclear and Radiation Activities (Law №7) issued in 2010. The law established the Egyptian Nuclear and Radiological Regulatory Authority that is an independent nuclear regulatory body, as well as a framework of nuclear regulation in Egypt that includes areas of nuclear safety, nuclear security, and non-proliferation[39, 40, 41]. The law contains provisions that govern all the elements of national nuclear legislation in accordance with many of the IAEA documents. Today the legislation regulating Egypt's nuclear activity is as follows: Law №7 and its amendment; Presidential Decree establishing the Atomic Energy Authority (1955); Law organizing the use of ionizing radiation and protection against it (1991); Law on environmental protection and its executive regulations (1994)[42, 43, 44].

In 1981, Egypt ratified the NPT and then, its nuclear facilities

[35] Ofek, R. (2018, January 8). Egypt's Nuclear Deal with Russia. BESA. Retrieved from: https://www.jstor.org/stable/pdf/resrep16859.pdf?refreqid=excelsior%3Aca9391b25721708f-9ceb6941a85e0922

[36] Slackman, M. and El-Naggar M. (2006, September 19). Mubarak's Son Proposes Developing Nuclear Energy. The NY Times. - Retrieved from: https://www.nytimes.com/2006/09/20/world/africa/20egypt.html

[37] Shay S. (2015). The Egypt-Russia Nuclear Deal. IPS. - Retrieved from: https://www.idc.ac.il/he/research/ips/documents/publication/2/egypt_nuclear_plant2015b.pdf

[38] El-Wakeel, A. (2019, April). Current Status of Nuclear Power Project in Egypt Human Resources Development and Lessons Learned. NPPA. - Retrieved from: http://2021.atom-expo.ru/uploads/pages/112/files/3)%20Prof.%20Dr.%20Amged%20El-Wakeel,%20Board%20Chairman,%20Nuclear%20Power%20Plants%20Author.pdf

[39] Auf, G. Current Status of Nuclear Power Project in Egypt. NPPA. - Retrieved from: https://nucleus.iaea.org/sites/connect/SFMpublic/TM%20Transport%20of%20MOX%20and%20HBU%202019/10_1_Status_NPP_Egypt.pdf

[40] Ali, A. (2012). Legal Elements for Nuclear Security: Egyptian Nuclear Law as A Case Study. IAEA. - Retrieved from: https://inis.iaea.org/collection/NCLCollectionStore/_Public/45/099/45099916.pdf

[41] Nuclear Law Bulletin (2010). OECD. - Retrieved from: https://www.oecd-nea.org/upload/docs/application/pdf/2020-11/nlb85.pdf

[42] Hussein, M. Ibrahim. Current Status of the NCNSRC. IAEA. - Retrieved from: https://www-pub.iaea.org/MTCD/Meetings/PDFplus/2009/37574/3%20Nov%20-%20afternoon%5CEGYPT%20M.Abd%20El%20Moteleb%20-%206b_Egypt_NCNSRC_Moteleb.pdf

[43] Country Nuclear Power Profile. Egypt (2015). IAEA. - Retrieved from: https://cnpp.iaea.org/countryprofiles/Egypt/Egypt.htm

[44] Egypt: Environmental and Climate Change Laws and Regulations. (2021, March 25). ICLG. - Retrieved from: https://iclg.com/practice-areas/environment-and-climate-change-laws-and-regulations/egypt

became subject to the IAEA CSA. However, its position towards the nonproliferation regime is considered to be two-fold. Since the 1995 NPT Review and Extension Conference, Egypt has supported the idea to establish a WMDFZ in the Middle East. At the same time, Egypt criticizes nonproliferation initiatives for the lack of universality and absence of progress in nuclear disarmament: it did not sign the IAEA AP and did not ratify either the Comprehensive Nuclear-Test-Ban Treaty (CTBT) or the Pelindaba Treaty.

In August 2010, President Mubarak announced that the IAEA had approved the El-Dabaa site as an acceptable site for Egypt to build its first NPP[45, 46]. However, the site development was halted due to disputes with the Bedouin tribes, who accused the authorities of confiscating their land without proper compensation. In February 2012, amid the chaos following the 2011 Revolution, thousands of Bedouin attacked the El-Dabaa site[47]. Thus, some disparate parts of the Egyptians have been opposing building a NPP at El-Dabaa. Besides the Bedouin tribes, businesspeople are not fond of having a NPP at El-Dabaa as they want to develop tourism in that area. Moreover, some people are concerned about environmental damage.

However, the objective needs to use alternative energy sources led to the completion of preparatory work and the launching of the El-Dabaa NPP project in 2014. According to the 2019 IAEA INIR conclusions, "Egypt has conducted extensive work to develop its infrastructure for the construction phase of its nuclear power program that has strong governmental support and a clear commitment to safety, security and non-proliferation"[48]. According to advisor to Rosatom DG Vladimir V. Artisyuk, the Jordanian scenario with the termination of its NPP project will not be repeated in Egypt, as it is already another stage of the project's implementation. "Egypt's ambition is an NPP with 4 blocks, while the Al-Dabaa site is for 8 blocks. In case of the project's successful implementation, Egypt will become an energy hub for the Mediterranean countries, Sudan, Jordan, and Libya. Egypt as a very ambitious country does not want to lose such an opportunity. That said, chances for Al-Dabaa NPP construction are high"[49].

Thus, Egypt's attempts to implement a nuclear energy program demonstrate the difficulties that a country could face due to developments in the political sphere. While in the 1950-1960ss, President Nasser's ambitious plans to acquire nuclear weapons through peaceful atom hampered the progress in the PUNE, in the 2010s, the political instability also slowed down the development of the nuclear industry in Egypt. Today, the country has a necessary legislative framework as well as detailed agreements with the Russians to succeed in its plans in the nuclear energy field.

[45] Egypt says to press ahead with nuclear tender (2011, March 11). Reuters. - Retrieved from: https://www.reuters.com/article/nuclear-egypt-idUSLDE7282HM20110309
[46] Egypt unveils nuclear power plan (2006, September 25). BBC News. - Retrieved from: http://news.bbc.co.uk/2/hi/middle_east/5376860.stm
[47] Ofek, R. (2018, January 8). Egypt's Nuclear Deal with Russia. BESA. Retrieved from: https://www.jstor.org/stable/pdf/resrep16859.pdf?refreqid=excelsior%3Aca9391b25721708f9ce-b6941a85e0922
[48] IAEA Mission Report on the INIR – Phase2 (2019). IAEA. - Retrieved from: https://www.iaea.org/sites/default/files/documents/review-missions/inir2-egypt.pdf
[49] Interview with Vladimir V. Artisyuk.

NUCLEAR ENERGY SUPPLIERS IN THE MIDDLE EAST AND LEGISLATIVE FRAMEWORK

Elaborating ambitious plans to develop the PUNE, the majority of the Middle Eastern countries have neither their own nuclear technology nor experience in the field. So, to implement their plans, they need to cooperate with nuclear energy suppliers.

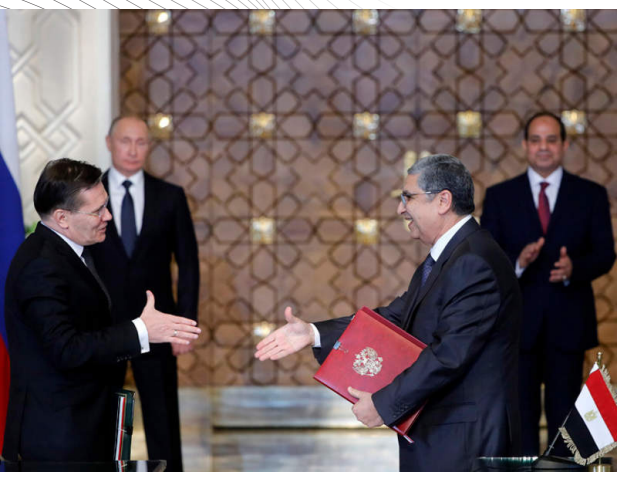
There are various vendors that are interested in cooperating with the Middle East in the PUNE field, including Rosatom (Russia), Westinghouse (the United States), One KEPCO Team (the Republic of Korea), CNNC и CGN (China), и Framatome (France).

Table 2: Current reactor designs that are currently available for the export market

Country	Vendor	Reactor	Capacity (GW)
Russia	Rosatom	VVER (AES-92)	1
		VVER (AES-2006)	1,2
The Republic of Korea	KEPCO-KHNP	APR 1400	1,4
China	China National Nuclear Corporation	CNP-300	0,9
The United States/Japan	Westinghouse	AP-1000	1,1
	GE-Hitachi	ABWR	1,38
France/Japan	Électricité de France - Mitsubishi	ATMEA1	1,1
France	Électricité de France	EPR	1,65

Russia is one of the key nuclear energy suppliers. The Russian NPPs are owned and run by the nuclear utility Rosenergoatom. The utility is 100% owned by the State Atomic Energy Corporation Rosatom that is a global technological leader. Rosatom possesses the largest foreign project portfolio with 35 power units at different stages of implementation in 12 countries. It is a unique company that provides its international customers with an integrated offer that includes not only the construction of Russian-designed NPPs and Centers of Nuclear Science and Technologies, but also the development of nuclear infrastructure, local workforce training, and professional development, localization of production in the customer countries, guarantees fuel supplies for the entire NPP and CNST's life cycle, maintenance and service, spent nuclear fuel (SNF) reprocessing and management, and available Build–Own–Operate (BOO) and Build–Own–Operate–Transfer (BOOT) schemes. Furthermore, Tenex and the International Uranium Enrichment Center (IUEC) can provide assured access to uranium enrichment to interested parties without transferring the sensitive technology or restricting the development of national nuclear fuel cycle programs. That would eliminate concerns related to the sensitive nuclear technologies' proliferation. Also, Russia has SMR options available, which,

given the latest developments in the nuclear energy market, makes Russia a competitive player. Russia's SMR RITM-200 design is the result of 400 reactor-years' worth of combined experience operating small reactors on ships in Russia's fleet of nuclear-powered icebreakers. Soon, Russia will launch BREST-OD-300, which is a part of the Russian state nuclear corporation Rosatom's Proryv, or Breakthrough, project to enable a closed nuclear fuel cycle. BREST-OD-300 is one of the world's major projects in the nuclear industry.



Russia and Egypt signing an agreement on El Dabaa NPP in Cairo, December 11, 2017

Source: www.rosatom.ru

Russia has a well-elaborated basis for cooperation in the nuclear energy field, and its membership in all relevant international treaties and regimes ensures the peaceful nature of such cooperation. Usually, Russia applies the following pattern to advance collaboration on nuclear energy: MoU for cooperation in the PUNE field; "Framework" intergovernmental agreement; Intergovernmental agreement on the construction of a NPP (or a nuclear science center); Intergovernmental agreement on cooperation in ensuring nuclear safety; Intergovernmental agreement on the exchange of information in the event of nuclear accidents; Intergovernmental agreement on the terms of financing (through the Ministry of Finance); Interdepartmental agreements on personnel training. All intergovernmental agreements between Russia and another part include articles concerning the SNF return, the IAEA safeguards, strict export control rules, and restrictions on the use of materials and technologies received from Russia for purposes not provided for by the agreement or without the Russian consent.

The Russian nuclear industry has been present in the Middle East for a long time. The first Russian research reactors in the Middle East date back to the 1960s. First, Russia built a research reactor in Egypt in 1961, then in Iraq in 1967, and finally in Libya in 1981. Nowadays, Rosatom is actively involved in cooperation with the Middle East. Its nuclear energy projects in the region are as follows: Bushehr NPP (Iran), Akkuyu NPP (Turkey), El-Dabaa NPP (Egypt).

The United States has an excellent record of activities in the nuclear industry. The county is the leader in terms of the amount of nuclear reactors on its soil: as of 2021, there are 93 units under operation in the U.S. The American Westinghouse AP1000 is the flagship Generation III+ reactor. In 2005, the reactor received certification from the US Nuclear Regulatory Commission (NRC). The reactor is a two-loop PWR generating 1,1 GW. The AP1000 design increases reliance on passive features that depend on physical phenomena. The reactor can withstand extreme accidents without any release of radioactivity into the environment. Emergency water tanks provide enough water, without any human intervention, to last up to seven days during a severe accident[50]. The Americans can also offer the NuScale SMR. In September 2020, the Nuclear Regulatory Commission (NRC) issued a final safety evaluation report for this reactor, which NuScale Chairman and CEO John Hopkins characterized as "a significant milestone not only for NuScale but also for the entire U.S. nuclear sector and the other advanced nuclear technologies that will follow this establishes the leadership of NuScale and the

[50] Nuclear Energy for the Middle East: Technology Choices and Considerations (2018). - Retrieved from: https://www.researchgate.net/publication/330304292_Nuclear_Energy_for_the_Middle_East_Technology_Choices_and_Considerations

United States in the race to bring SMRs to market"[51].

Many find the U.S. legislation to cooperate in the nuclear energy field the most severe one, though it has no much differencies with the Russian one. Section 123 of the 1954 U.S. Atomic Energy Act is considered to be a gold standard for cooperation. It sets the terms of reference and authorizes nuclear cooperation between the United States and another side. Under a 123 Agreement, the U.S. companies cannot export nuclear technology, materials, and equipment to another country until a bilateral intergovernmental agreement on cooperation in the PUNE is signed[52, 53]. A 123 Agreement requires that any agreement for nuclear cooperation meets nine non-proliferation criteria, including that nuclear material and equipment transferred to the country must remain under safeguards in perpetuity; NNWS partners must have full-scope IAEA safeguards; a guarantee that transferred nuclear material, equipment, and technology will not have any military purpose; U.S. consent is required for any re-transfer of material or classified data[54]. In the Middle East, the United States signed such agreements with Egypt, Turkey, and the UAE.

French nuclear companies have a traditionally strong position in the Middle East. **France** has the largest NPPs network in Europe and its Framatome is the most prominent corporation involved in the NPPs' construction[55]. However, Framatome has significant difficulties in implementing a new type of reactor, namely the European Pressurized Reactor (EPR), which opted to increase redundancy by having four independent safety trains that provide emergency cooling and a double containment building. A core catcher allows the EPR to withstand meltdown scenarios. It generates a massive 1,630 MWe. The reactor is capable of load following and of employing a variety of fuels in the core. Two units were built in China, and three more are under construction in Finland and the United Kingdom but they have been bogged down by cost overruns and technical issues[56].

Traditionally, France has been using its nuclear technology in order to increase its geopolitical influence in various regions of the world. France has signed numerous nuclear cooperation agreements with the Middle Eastern states, including Saudi Arabia, the UAE, Libya, and Qatar. These agreements form the legal framework necessary for a long-term partnership and they are aimed at enabling the development of cooperation under safety, security, and non-proliferation conditions. France goes for a wide-range civil nuclear cooperation only with the countries that have in force the IAEA CSA. Also, France encourages its partners to sign and ratify the IAEA AP if they have not done so. All agreements, which France

Egypt has necessary legislative framework and well-elaborated agreements with Rosatom to succeed in its plans in the nuclear energy field

[51] NuScale SMR receives US design certification approval (2020, September 1). World Nuclear News - Retrieved from: https://world-nuclear-news.org/Articles/NuScale-SMR-receives-US-design-certification-appro
[52] Kimball, D. (2019). The U.S. Atomic Energy Act Section 123 At a Glance. Arms Control. - Retrieved from: https://www.armscontrol.org/factsheets/AEASection123
[53] Nuclear Cooperation with Other Countries: A Primer (2020). Congressional Research Service. - Retrieved from: https://fas.org/sgp/crs/nuke/RS22937.pdf
[54] Kimball, D. (2019). The U.S. Atomic Energy Act Section 123 At a Glance. Arms Control. - Retrieved from: https://www.armscontrol.org/factsheets/AEASection123
[55] Mallet B. (2016). France's EDF throws Areva a lifeline with reactor deal. Reuters. - Retrieved from: https://www.reuters.com/article/us-france-edf-areva-idUSKBN13B0TG
[56] Advanced Power Reactors (2016, May). World Nuclear Association. - Retrieved from: http://www.world-nuclear.org/information-library/nuclear-fuel-cycle/nuclear-power-reactors/advanced-nuclear-power-reactors.aspx

The Republic of Korea is viewed as a serious competitor for traditional nuclear suppliers, including France, Russia, and the United States

signs to cooperate in the nuclear energy field, are subject to approval from the European Commission, under the EURATOM Treaty terms. Furthermore, France has set up the Agence France Nucléaire International, to assist states to access nuclear energy with the implementation of the infrastructures required for the safe development of civil nuclear energy[57].

China has ambitious plans to infiltrate the Middle Eastern nuclear market. To date, it has signed agreements to cooperate in the PUNE filed with two states of the region, namely Iran and Saudi Arabia. However, to construct NPP in the Middle East, China has to gain credibility by successfully launching new reactors in its homeland. Meanwhile, in the Middle East, the status of a "newcomer" does not allow China to implement its ambitious plans. A possible solution for China is to conduct joint projects with the world's major nuclear companies. China puts an emphasis on the development of advanced nuclear power technology, including SMRs, high-temperature fused salt reactors, floating nuclear power reactors, space nuclear power reactors, traveling wave reactors, and nuclear fusion reactors. In 2016, the Chinese SMR ACP100 passed the IAEA general reactor design review[58]. However, sometimes, the absence of Chinese strict rules to cooperate on civil nuclear energy provokes suspicions regarding the proliferation consequences of such a cooperation[59].

The Republic of Korea actively cooperates both on multilateral and bilateral levels to develop nuclear energy. To date, the Republic of Korea has signed nuclear cooperation agreements with 29 countries, and it holds joint standing committees with the United States, France, Russia, China, India, and Saudi Arabia.

Korea Electric Power Corporation (KEPCO) as a state monopoly fully supported by the South Korean authorities is deeply involved in the Middle Eastern nuclear energy market. The Korean APR1400 is the only design currently being built in the Middle East (in the UAE). The modular construction of the reactor allows for a shorter and more reliable build schedule of roughly 48 months, a feat in the industry. The APR1400 received certification from the U.S. Nuclear Regulatory Commission - for the first time for a non-U.S. NPP acquisition - and from the European Utility Requirements that increased the Korean NPPs brand.

In the Republic of Korea, different reactors are under development, notably the APR-1000 that is targeting the Middle East. Following the UAE sale, KEPCO was marketing to such Middle Eastern countries as Turkey and Jordan, and now it is also focused on Egypt and Saudi Arabia. In January 2015, the Republic of Korea launched the System-integrated Modular Advanced Reactor (SMART) Power Company as the sole entity responsible for the export and construction of the small reactor technology. The SMART is a 330 MW pressurized water reactor with integral steam generators and advanced safety features. The unit is designed for electricity generation and thermal applications, such as seawater desalination, with a 60-year design

[57] The responsible development of nuclear energy: France's actions (2010). France TNP 2010. - Retrieved from: https://www.francetnp.gouv.fr/IMG/pdf/eng-nuc_civil_plaquette2010.pdf

[58] Country Nuclear Power Profile. China (2020). IAEA. - 2020. - Retrieved from: https://cnpp.iaea.org/countryprofiles/China/China.htm

[59] See below in the section "China-Saudi Arabia bilateral cooperation."

life and a three-year refueling cycle[60, 61].

Although the Republic of Korea has a mixed nonproliferation record, today it is considered as a good-standing NPT, NSG, and Zangger Committee member. In 2015, it managed to conclude a new 123 Agreement with the United States. Despite the fact that the Republic of Korea does not have a legislative act similar to the U.S. 123 Agreement, it will not go for the cooperation that breaks the U.S. nonproliferation standards as the two countries are close allies. Moreover, the U.S. NRC will not certify a nuclear reactors' supply to a country with an ambiguous nuclear policy.

All in all, nowadays the Republic of Korea is viewed as a serious competitor for long dominated nuclear suppliers - Canada, France, Japan, Russia, and the United States. It has already started an active penetrating into the Middle East nuclear energy market, and it has all chances to gain even more popularity in the region and be involved in the realization of new civil nuclear projects.

[60] Korea, Saudi Arabia to cooperate on SMART deployment (2019, September). World Nuclear News. - Retrieved from: https://www.world-nuclear-news.org/Articles/Korea,-Saudi-Arabia-to-cooperate-on-SMART-deployme

[61] Nuclear Power in South Korea (2020, November). World Nuclear. - Retrieved from: https://www.world-nuclear.org/information-library/country-profiles/countries-o-s/south-korea.aspx

COOPERATION AGREEMENTS BETWEEN NUCLEAR ENERGY SUPPLIER COUNTRIES AND THE MIDDLE EAST: CASE STUDIES

Iran

Iran's cooperation in the civil nuclear energy field on a bilateral basis has been complicated for the last several decades because of its ambiguous nuclear weapons policy. However, today Iran actively cooperates with **Russia** that is considered the main Iranian partner to develop the PUNE. The start of the Iranian-Russian active cooperation in developing civil nuclear energy in Iran dates back to the 1990s. In 1992, Russia signed with Iran an Agreement on Cooperation in the PUNE field and an MoU regarding the expansion of cooperation in the uses of nuclear energy for peaceful purposes. Under those documents, the parties agreed to act in conformity with their respective international obligations and national legislations[62, 63]. Then in 1995, the two states concluded an $800 million contract with the aim to complete the first unit of the unfinished NPP at Bushehr by installing a 1 GW VVER-1000 light-water reactor[64]. The two countries stressed that the future Bushehr NPP would be under the IAEA safeguards. In August 1995, Russia and Iran also concluded a ten-year contract, under which Russia agreed to supply nuclear fuel for Bushehr NPP[65].

Bushehr-1 reactor unit obtained an operational license after the construction of the facility in 2010. It was connected to the grid in September 2011, while commercial operation started in September 2013. The NPP is equipped with a VVER V-446 pressurized water reactor of 1GW gross electrical capacity and 3GW of thermal capacity[66]. Bushehr NPP is unique in design as Russia agreed to incorporate its VVER technology into the original German-built infrastructure[67].

Moreover, the two countries signed an agreement to build two new nuclear power reactors in Iran, with a possibility of six more after that. The two new reactors will be built next to Bushehr NPP. Bushehr-2 and Bushehr-3 will use V-528 VVER-1000 Generation III+ Russian pressurized water reactor design. Bushehr-2 and Bushehr-3 are scheduled for commissioning in 2025 and in 2027, respectively. Each reactor will have an operating life of approximately 60

[62] Memorandum of Understanding between the State Atomic Energy Corporation «Rosatom" and the Atomic Energy Organization of Iran on the Expansion of Cooperation in the Use of Nuclear Energy for Peaceful Purposes. Rosatom. - Retrieved from: https://www.rosatom.ru/upload/iblock/304/30489e17581ebfe81c33951bcebf6be5.pdf

[63] Protocol between the Government of the Russian Federation and the Government of the Islamic Republic of Iran on Cooperation in the Construction of a Nuclear Power Plant in the Territory of Iran of August 25, 1992. Rosatom. - Retrieved from: https://www.rosatom.ru/upload/iblock/c1e/c1e92b5b91ae301fbeb5934e271e68f1.pdf

[64] Iran, Russia agree on $800 million nuclear plant deal. The Washington Post. - Retrieved from: https://www.washingtonpost.com/archive/politics/1995/01/09/iran-russia-agree-on-800-million-nuclear-plant-deal/065791d2-8b4e-448c-ad1f-6254ed4354d2/

[65] Dr. Wehling, F. (1999). Russian nuclear and missile exports to Iran. CNS. - Retrieved from: https://www.nonproliferation.org/wp-content/uploads/npr/wehl62.pdf

[66] Bushehr Nuclear Power Plant. NS Energy. - Retrieved from: https://www.nsenergy-business.com/projects/bushehr-nuclear-power-plant/

[67] Bushehr enclosure leak-tested (2010, February 16). World Nuclear News. - Retrieved from: https://www.world-nuclear-news.org/NN-Bushehr_enclosure_leak-tested-1602107.html

years[68, 69].

Russia has backed Iran in the nuclear dispute since the President Trump administration took the decision to withdraw the United States from the JCPOA in May 2018. Then, the U.S. attempts to garner international support for an extension of the arms embargo against Iran were rebuffed by Russian diplomats[70]. At the same time, the Russian government has always been consistent saying that while Iran has the right to use nuclear energy, the IAEA has to ensure the peaceful nature of the Iranian program. So, for example, in 2003, Russia repeatedly encouraged Iran to sign the IAEA AP, and then two years later, criticized Iran when it suspended voluntary implementation of the AP. In 2006, Russia supported the IAEA Board of Governors' decision to report Iran's nuclear file to the UN Security Council. Senior non-resident scholar with CNS Dr. Hanna Notte believes that it is difficult to answer with precision what extent of Iranian escalation in the nuclear field would lead Russia to push back to the extent that it would freeze economic cooperation, for instance on Bushehr. "Russia definitely does have red lines when it comes to Iran – Iran's leaving the NPT would be such a step. And past patterns suggest that security concerns do outweigh economic interests for Russia, once the two appear to conflict. For instance, in 2010, after Russia supported UN Security Council Resolution 1929 on Iran, President Medvedev banned the delivery of the S-300 to Iran. It was economically detrimental, but it helped to decrease the escalation level in the region. But we should also remember that it was the time of the reset in Russian relations with Washington. This also played into the S-300 decision. So, today – amid serious friction in American-Russian relations, and as Moscow's relations with Tehran have undergone a qualitative change - this kind of decision would be less likely than it was ten years ago. Iran would have to really escalate the situation for Russia to take steps like those taken in 2010"[71].

Russian government has always been consistent saying that while Iran has the right to use nuclear energy, the IAEA has to ensure the peaceful nature of the Iranian program

Besides Russia, it is also **China** that cooperates with Iran in the nuclear energy field. The China National Nuclear Corporation (CNNC) signed with Iran the first contract for Arak redesign. Under the contract, the CNNC completed the design concept for the Arak reactor renovation[72].

Saudi Arabia

Saudi Arabia cooperates with a number of countries to develop nuclear energy. The Kingdom has developed strategic partnerships with countries experienced in the use of nuclear power and is extensively using their technical support. Among its partners, the United States, the Republic of Korea, Russia, and China stand out. Saudi Arabia has also signed agreements to cooperate in the PUNE field with France, Argentina, Kazakhstan, Jordan, Finland, and others.

[68] Bushehr Nuclear Power Plant. NS Energy. - Retrieved from: https://www.nsenergy-business.com/projects/bushehr-nuclear-power-plant/
[69] BNPP Overview. NTI. - Retrieved from: https://www.nti.org/learn/facilities/184/
[70] Черненко, Е. (2020, June 10). Сергей Лавров вписался за Иран. Коммерсантъ. - Retrieved from: https://www.kommersant.ru/doc/4373924
[71] Interview with Hanna Notte.
[72] China, Iran sign first contract for Arak redesign (2017, April 24). World Nuclear News. - Retrieved from: https://www.world-nuclear-news.org/Articles/China,-Iran-sign-first-contract-for-Arak-redesign

The United States is viewed as one of the key Saudi partners to develop nuclear energy. However, there is a stumbling block in Saudi-American cooperation, namely Agreement 123.

In 2008, the United States and Saudi Arabia signed an MoU on Civil Nuclear Energy Cooperation. According to the Memorandum, the two countries "establish a comprehensive framework for cooperation in the development of environmentally sustainable, safe, and secure civilian nuclear energy through a series of complementary agreements"[73]. The MoU states that Saudi Arabia will buy nuclear fuel on the international market instead of developing sensitive nuclear technologies. But the MoU is just a statement of intent regarding future cooperation that is not legally binding. The U.S. Presidents, starting with President Obama have been conducting negotiations with the Kingdom to conclude a 123 Agreement but it has not signed so far. The Biden administration's approach towards nuclear cooperation with the Saudis has not been articulated yet. However, it is highly likely that President Biden will adhere to President Obama's hard line in negotiations with Saudi Arabia. Anthony Stott believes that Biden will continue the discussion on a 123 Agreement with Saudi Arabia, but it will be mostly secret discussions. "For the last several years, the United States has been losing ground – Russia, France, China, and others have taken some projects in the nuclear energy field that could be beneficial for the Americans. So, the U.S. Department of Energy is working on changing this situation and on increasing its presence in countries. There is a dilemma in the negotiations with Saudi Arabia: from one side, it is a possible loss from an industry perspective; from the other side, it is a possible loss from a proliferation perspective. They are looking for a way to balance"[74].

China is interested in cooperation with the Saudis. First, China intends to further expand its presence in the global nuclear energy market. Second, such cooperation ensures the stability and security of the Saudi oil supplies to China. And third, China works on ousting its main strategic opponent - the United States - from the Middle East in general and Saudi Arabia in particular[75].

In 2012, Saudi Arabia inked an agreement with China to enhance cooperation between the two countries in the development and use of atomic energy. The agreement sets a legal framework that strengthens scientific, technological, and economic cooperation between the two states[76]. Moreover, in 2016, the CNEC and K.A. CARE signed an MoU on the construction of a high-temperature gas-cooled reactor, and then in 2017, the two countries signed a Cooperation Agreement for a joint study on the feasibility of HTGRs

[73] U.S.-Saudi Arabia Memorandum of Understanding on Nuclear Energy Cooperation (2008). The U.S. Department of State. - Retrieved from: https://2001-2009.state.gov/r/pa/prs/ps/2008/may/104961.htm
[74] Interview with Anthony Stott.
[75] Сажин, Вл. (2020). Ядерная программа Саудовской Аравии: прошлое, настоящее, будущее. - Retrieved from: https://interaffairs.ru/news/show/27228
[76] Summer, S. (2012). Saudi Arabia, China Sign Nuclear Cooperation Pact. WSJ. - Retrieved from: https://www.wsj.com/articles/SB10001424052970204680045771647420 25285500

construction in Saudi Arabia [77,78].

Saudi Arabia has numerous agreements with **the Republic of Korea** to cooperate in the PUNE field. In November 2011, the two countries signed an Agreement for Cooperation in the Peaceful Uses of Nuclear Energy which calls for cooperation in nuclear R&D, including building nuclear power plants and research reactors, training, safety, and waste management[79]. In June 2013, the KEPCO offered support for the localization of nuclear technology, along with joint research and development of nuclear technologies if Saudi Arabia purchases South Korean reactors. In September 2015, Saudi Arabia and the Republic of Korea signed contracts aimed at supporting the Saudi Arabia-South Korean cooperation in developing SMART SMRs[80]. In September 2019, the two counties signed an MoU on comprehensive cooperation in nuclear research and development which implies collaboration on the commercialization of the SMART SMRs. That will give Saudi Arabia not only an SMR but ownership rights as well[81, 82]. So, the SMART makes the Republic of Korea one of the most promising Saudi partners to develop nuclear energy in the Kingdom.

In 2015, **Russia** and Saudi Arabia signed an Agreement on Cooperation in the field of nuclear energy for peaceful purposes, under which the parties shall develop and strengthen cooperation in the PUNE area "in accordance with the needs and priorities of the national nuclear programs of each of the state parties"[83]. The document creates a legal basis for the Russian-Saudi cooperation in the field of nuclear energy[84, 85]. In October 2017, Rosatom and the K.A. CARE signed a "program of cooperation" in the PUNE. Rosatom said that Russia and Saudi Arabia plan to "cooperate in small- and medium-sized reactors; in the training of personnel for Saudi Arabia's national nuclear program; and the development

[77] China, Saudi Arabia agree to build HTR (2016, January). World Nuclear News. - Retrieved from: https://www.world-nuclear-news.org/NN-China-Saudi-Arabia-agree-to-build-HTR-2001164.html

[78] Feasibility study for Saudi Arabian HTGR project (2017, March). World Nuclear News. - Retrieved from: https://www.world-nuclear-news.org/NN-Feasibility-study-for-Saudi-Arabian-HTGR-project-1703174.html

[79] Nuclear Power in Saudi Arabia (2021, January). World Nuclear. - Retrieved from: https://www.world-nuclear.org/information-library/country-profiles/countries-o-s/saudi-arabia.aspx

[80] Saudi Arabia and Korea further SMART cooperation (2015, September). World Nuclear News. - Retrieved from: https://www.world-nuclear-news.org/NN-Saudi-Arabia-and-Korea-further-SMART-cooperation-03091501.html

[81] Korea, Saudi Arabia to cooperate on SMART deployment (2019, September). World Nuclear News. - Retrieved from: https://www.world-nuclear-news.org/Articles/Korea,-Saudi-Arabia-to-cooperate-on-SMART-deployme

[82] Korea, Saudi Arabia progress with SMART collaboration (2020). World Nuclear News. - Retrieved from: https://world-nuclear-news.org/Articles/Korea-Saudi-Arabia-progress-with-SMART-collaborati

[83] Соглашение между Правительством Российской Федерации и Правительством Королевства Саудовская Аравия о сотрудничестве в области использования атомной энергии в мирных целях. - Retrieved from: http://docs.cntd.ru/document/420297801

[84] Russia and Saudi Arabia have initialed an intergovernmental agreement on cooperation in the field of peaceful use of nuclear energy (2015). Rosatom. - Retrieved from: https://rosatom-europe.com/en/press-centre/news/79-russia-and-saudi-arabia-have-initialed-an-intergovernmental-agreement-on-cooperation-in-the-field-of-peaceful-use-of-nuclear-energy/

[85] Новак: Россия заинтересована в строительстве атомных блоков в Саудовской Аравии (2016). Atominfo. - Retrieved from: http://www.atominfo.ru/newsn/u0925.htm

of its nuclear energy infrastructure"[86].

Furthermore, Rosatom has passed two qualifying stages in the tender to build a Saudi NPP and was invited to participate in the third one. However, given the U.S. influence on the Kingdom, it is unlikely that Rosatom will bypass Westinghouse and become the first nuclear vendor to build NPP in Saudi Arabia. The Saudis are more likely to use negotiations with Russia as leverage to promote their interests in the negotiations with the Americans.

Thus, Saudi Arabia has only a rudimentary civilian nuclear infrastructure and does not have the physical and technological resources to create nuclear weapons. The Kingdom develops the nuclear industry but if it intends to progress in it, the SQP's rescission and putting in force a more advanced IAEA verification mechanism would be the most logical solution. Without such changes, it is highly likely that the states that are on the Saudi shortlist as possible partners to develop nuclear energy, namely the United States, France, the Republic of Korea, Russia, China, will not cooperate with the Kingdom in a full extent.

Egypt

To develop nuclear energy, Egypt cooperates with various international vendors. However, the majority of the cooperation agreements were concluded in the 1980s. At that time, Egypt signed a 123 Agreement with the United States. However, in December 2021, the agreement will expire without renewal terms in place[87]. In the new century, Egypt has signed a few agreements to develop nuclear energy, namely with the Republic of Korea, Russia, and China. The Egyptian partner number one in the nuclear industry is Russian Rosatom.

In 2008, **Russia** and Egypt signed an Intergovernmental Agreement to cooperate in the PUNE, enabling Moscow to bid for the construction of the first NPP in Egypt. However, under President Hosni Mubarak, the works were halted due to disputes with residents regarding the place of the construction. In April 2013, Egypt approached Russia to renew its nuclear cooperation agreement with the focus on a NPP construction at El-Dabaa and joint development of uranium deposits[88]. And then, in 2015, Russia signed two agreements to finance and build the NPP, one of which is for the constructing and operating of four power units with VVER-1200 type reactors, while the second one is a Russian 35-year loan of $25 billion that covers most of the project's cost[89, 90, 91]. Under the

[86] Russia, Saudi Arabia strengthen ties in nuclear energy (2017, October). World Nuclear News. - Retrieved from: https://www.world-nuclear-news.org/NP-Russia-Saudi-Arabia-strengthen-ties-in-nuclear-energy-06101701.html

[87] Agreement for Cooperation between the United States and Egypt Concerning Peaceful Uses of Nuclear Energy. - Retrieved from: https://media.nti.org/pdfs/StateandEgyptPeaceNuc1981.pdf

[88] Shay, S. (2015). The Egypt-Russia Nuclear Deal. IPS. - Retrieved from: https://www.idc.ac.il/he/research/ips/documents/publication/2/egypt_nuclear_plant2015b.pdf

[89] Russia signs deal to build Egypt's first nuclear plant (2015, November). Alarabiya News. - Retrieved from: https://english.alarabiya.net/business/energy/2015/11/19/Russia-signs-deal-to-build-Egypt-s-first-nuclear-plant-

[90] Ofek, R. (2018, January 8). Egypt's Nuclear Deal with Russia. BESA. Retrieved from: https://www.jstor.org/stable/pdf/resrep16859.pdf?refreqid=excelsior%3Aca9391b25721708f9ceb6941a85e0922

[91] Schepers, N. (2018, April). Russian incentives for nuclear hopefuls in Africa. IISS. Re-

agreements, Rosatom will supply nuclear fuel throughout the entire NPP life cycle (60 years). The design selected for El-Dabaa NPP belongs to the latest Generation 3+ nuclear reactors, which is fully compliant with all post-Fukushima IAEA requirements. The second signed Agreement is a Russian 35-year loan of $25 billion that covers most of the project's cost[92, 93, 94]. The first El-Dabaa NPP test runs are expected to take place in 2022, while its full commissioning is scheduled for 2026. Rosatom estimates that the project will be completed in 2029, and then, Rosatom will train personnel and assist its Egyptian partners in operation and maintenance during the first 10 years of the NPP operation[95, 96].

United Arab Emirates

To develop its nuclear industry, the UAE is actively cooperating with nuclear energy suppliers, among which France, the Republic of Korea, Russia, the United Kingdom, and others. However, in its nuclear activity, the UAE mainly relies on close strategic partnerships with **the United States**[97]. Once the UAE took the decision to build a NPP, it resolved to forgo domestic enrichment and reprocessing, and "to conclude long-term arrangements... for the secure supply of nuclear fuel, as well as the safe and secure transportation and, if available, the disposal of spent fuel via fuel leasing or other emerging fuel supply arrangements". The UAE's high commitments in the nuclear energy field were reflected in the UAE-U.S. 123 Agreement for Peaceful Civilian Nuclear Energy Cooperation that is viewed as the non-proliferation "gold standard." In December 2009, the agreement entered into force and provided the necessary legal basis for future nuclear cooperation between the two countries.

Under the U.S.-UAE Agreement 123, the UAE agreed not to pursue sensitive fuel cycle activities that would produce fissile material useable in nuclear weapons[98]. The agreement allows U.S. intervention in removing special fissionable material from the UAE if its operation of the agreement comes into question. Furthermore, it prohibits transfers of special nuclear material except in small amounts for discrete purposes and establishes the full application of IAEA

trieved from: https://www.iiss.org/blogs/analysis/2018/04/russia-nuclear-africa

[92] Russia signs deal to build Egypt's first nuclear plant (2015, November). Alarabiya News. - Retrieved from: https://english.alarabiya.net/business/energy/2015/11/19/Russia-signs-deal-to-build-Egypt-s-first-nuclear-plant-

[93] Ofek, R. (2018, January 8). Egypt's Nuclear Deal with Russia. BESA. Retrieved from: https://www.jstor.org/stable/pdf/resrep16859.pdf?refreqid=excelsior%3Aca9391b25721708f-9ceb6941a85e0922

[94] Schepers, N. (2018, April). Russian incentives for nuclear hopefuls in Africa. IISS. Retrieved from: https://www.iiss.org/blogs/analysis/2018/04/russia-nuclear-africa

[95] Ofek, R. (2018, January 8). Egypt's Nuclear Deal with Russia. BESA. Retrieved from: https://www.jstor.org/stable/pdf/resrep16859.pdf?refreqid=excelsior%3Aca9391b25721708f-9ceb6941a85e0922

[96] Rosatom Projects. Retrieved from: https://rosatom.ru/en/investors/projects/

[97] Bryan, R. Early (2009, June). Strategies for Acquiring Foreign Nuclear Assistance in the Middle East: Lessons from the United Arab Emirates. Belfer Center for Science and International Affairs at the Harvard Kennedy School. Retrieved from: https://www.belfercenter.org/publication/strategies-acquiring-foreign-nuclear-assistance-middle-east-lessons-united-arab

[98] Hibbs, M. (2010). Saudi Arabia's Nuclear Ambitions. Carnegie Endowment. - Retrieved from: https://carnegieendowment.org/2010/07/20/saudi-arabia-s-nuclear-ambitions-pub-41243

safeguards to the UAE. In case the agreement is terminated, these conditions will be in force[99]. The United States intends to establish the agreement with the UAE as the model for all future 123 Agreements.

From the nine companies that expressed interest to construct the UAE's first NPP, the ENEC comprised a shortlist of three, namely, Areva (now Électricité de France), with Suez and Total, proposing its EPR; GE Hitachi proposing its ABWR; and the Korean consortium proposing the APR1400 PWR technology. The last group was led by the KEPCO and included Samsung, Hyundai, and Doosan, as well as Westinghouse. In December 2009 the KEPCO-led consortium was selected to build four APR1400 reactors at one site. Later, the KEPCO claimed that the reason for their selection in the face of other strong competitors was their highest capacity factor, lowest construction cost, and shortest construction time[100].

KEPCO signed an agreement UAE to provide maintenance at the Barakah NPP for 5 years

Source: www.asianews.it

In June 2009, the UAE signed a nuclear cooperation agreement with **the Republic of Korea** to allow the transfer of technology and equipment[101]. According to the agreement, the KEPCO has built Barakah NPP in the UAE, which started its functioning in August 2020. The construction took longer than it had been planned. Although there is little information in the open-source regarding the reasons behind these delays, it is possible to identify several, including difficulties in the UAE- the Republic of Korea bilateral relations, unsatisfactory human resources development, and cracks in the reactors' containment building have been reported[102]. In 2019 and 2020, the Republic of Korea and the UAE announced that they seek opportunities to cooperate in the nuclear energy field beyond their current collaboration on Barakah NPP[103, 104].

Although the United States and the Republic of Korea are the UAE's main partners to develop civil nuclear energy, the Russian-Emirati well-elaborated basis for cooperation in the nuclear energy field and a general trend in developing the bilateral relations stimulate their cooperation in the nuclear energy field. So, in December 2012, Russia and the UAE signed an agreement to cooperate in the field of peaceful uses of nuclear energy that includes basic and applied research; nuclear fuel cycle services - the supply of nuclear fuel for power and research nuclear reactors, the SNF return; education and training of specialists in the field of nuclear energy and others[105].

[99] The UAE 123 Agreement: A Model for the Region? (2009, October 23). CSIS. - Retrieved from: https://csis-website-prod.s3.amazonaws.com/s3fs-public/legacy_files/files/attachments/091023_Pickering%20Summary.pdf

[100] Nuclear Power in the United Arab Emirates (April 2021). World Nuclear. Retrieved from: https://www.world-nuclear.org/information-library/country-profiles/countries-t-z/united-arab-emirates.aspx

[101] UAE, S.Korea sign nuclear cooperation pact (2009, June 22). Reuters. Retrieved from: https://www.reuters.com/article/emirates-skorea-nuclear-idUSLM53733520090622

[102] Park, J., Rizkallah, P., and Ahmad, A. (2020). Middle East Nuclear Monitor 2019. Issam Fares Institute for Public Policy and International Affairs (IFI) at the American University of Beirut (AUB). Retrieved from: https://www.aub.edu.lb/ifi/Documents/publications/research_reports/2019-2020/20200109_middle_east_nuclear_energy_monitor_2019.pdf

[103] Ibid.

[104] Ambassador expresses hope for further Korea-UAE cooperation (2020, March 20). World Nuclear News. - Retrieved from: https://www.world-nuclear-news.org/Articles/Ambassador-expresses-hope-for-further-Korea-UAE-co

[105] Соглашение между Правительством Российской Федерации и Правительством Объединенных Арабских Эмиратов о сотрудничестве в области использования атомной энергии в мирных целях. - Retrieved from: http://docs.cntd.ru/docu-

Moreover, in 2015, the ENEC reached an agreement with Rosatom's Tenex for the delivery of half of the UAE's required uranium in 2020-2035. In 2019, Rosatom and the ENEC renewed their memorandum of understanding (MoU) on the PUNE cooperation that extends the activities conducted through the 2017 MoU. The 2019 MoU establishes a framework for cooperation between the two parties in numerous fields, such as creating a nuclear science center in the UAE, plant development and investment, nuclear fuel cycle management, training of UAE nationals.[106]

Jordan

As a country new to the nuclear energy field, Jordan largely relies on foreign suppliers in assistance related to the development of its nuclear industry. The country is an International Framework for Nuclear Energy Cooperation member, and the JAEC being Jordan's representative, has been negotiating nuclear cooperation agreements with numerous countries, including Russia, the United States, the United Kingdom, France, the Republic of Korea, and Saudi Arabia.

Russia is "the main partner for Jordan in the PUNE area"[107]. In 2013, the JAEC announced that Rusatom's reactor export subsidiary AtomStroyExport would be the supplier of two AES-92 nuclear units, while Rusatom Overseas would be a strategic partner and a NPP operator through the joint venture. In 2014, Jordan and Russia signed an Intergovernmental Agreement and Intergovernmental Pre-investment Agreement, under which the NPP was supposed to consist of two units with a total capacity of 2 GW. The construction was scheduled to be complete in 2022 and after that would provide about half of Jordan's electricity and enabled its exports[108]. However, in June 2018, Jordan declared the termination of the agreement as "it was deemed too costly because of Rosatom wanting to secure finance through commercial loans"[109, 110].

In May 2018, the JAEC and Rosatom signed an agreement to perform a feasibility study on the SMR deployment. JAEC Chairman Khalid Toukan said: "We have been cooperating with Rosatom for many years, and we plan to develop this cooperation in various areas. At the moment, the SMRs construction seems more relevant, so we decided to focus on this project"[111]. In his turn, Rusatom Overseas President Evgeny Pakermanov stated: "We must meet the current strategic needs and interests of our partners. That is

ment/902395099

[106] Russia, UAE extend MoU on cooperation (2019, October). World Nuclear News. - Retrieved from: https://world-nuclear-news.org/Articles/Russia,-UAE-extend-MoU-on-cooperation

[107] Interview with Professor Kamal J. Araj.

[108] Russia and Jordan agree $10 billion construction project (2015, March). World Nuclear News. Retrieved from: https://www.world-nuclear-news.org/Articles/Russia-and-Jordan-agree-$10-billion-construction-p

[109] Nuclear Power in Jordan (March 2021). World Nuclear. Retrieved from: https://www.world-nuclear.org/information-library/country-profiles/countries-g-n/jordan.aspx

[110] Jordan scraps $10bn Russian nuclear scheme (2018, June). JCR. Retrieved from: https://www.globalconstructionreview.com/news/jordan-scraps-10bn-russian-nuclear-scheme/

[111] Россия и Иордания развивают сотрудничество в области ядерной энергетики (2018, May 27). Rosatom. Retrieved from: https://rosatom.ru/journalist/news/rossiya-i-iordaniya-razvivayut-sotrudnichestvo-v-oblasti-yadernoy-energetiki/

why we, together with our Jordanian colleagues, decided to focus our efforts on the SMRs development that is based on Rosatom's innovative solutions"[112].

Although Jordan and the **United States** signed an MoU regarding potential nuclear cooperation, the process of negotiating a 123 Agreement has been suspended. The United States started the negotiations with Jordan to conclude the agreement at the time of the President Obama administration. Since then, the negotiations have stalled several times, and to date, the agreement has not been concluded. The potential partnership with Jordan put the United States in a quandary: the United States tries to find a balance between promoting greater civilian use of nuclear energy, without risking an arms race in the Middle East. The United States has been demanding that Jordan not produce its own nuclear fuel – the right that the Kingdom enjoys as an NPT State party. U.S. officials claim if Jordan does not relinquish its right to produce fuel, it raises proliferation risks[113]. Meanwhile, Jordan states that the 123 Agreement's terms would limit Jordan's ambition to become a "regional nuclear fuel supply and export center"[114]. Professor Kamal J. Araj stressed, "If enrichment makes economic sense, we want to have this right…we find the U.S. approach unacceptable. Jordan will never sign a 123 Agreement with such restrictions"[115].

France and Jordan widely cooperate on uranium exploration and mining. An MoU on uranium exploration and mining, which was signed between the two countries in August 2008, provided for establishing a joint venture to explore uranium in Jordan. Then in October 2008, the JAEC and Areva[116] established a joint venture to define uranium resources in central Jordan, and in February 2010, this became the joint venture company Nabatean Energy. Areva secured exclusive uranium mining rights in central Jordan for 25 years with the goal "to create a full partnership with Jordan on training and obtaining nuclear technology"[117, 118].

In December 2008, the JAEC signed with the Korean vendor and KEPCO, **the Republic of Korea**, signed an MoU to conduct site selection and feasibility study on nuclear power and desalination projects. This is related to Doosan Heavy Industries, which is known as the South Korean main nuclear equipment maker conducting desalination-related work in Jordan under a separate recent agreement. Since then, the two countries have actively developed nuclear cooperation[119, 120].

In 2008, Jordan and **China** signed an MoU on cooperation in

[112] Ibid.
[113] Solomon, J. (2010). Jordan's Nuclear Ambitions Pose Quandary for the U.S. WSJ. - Retrieved from: https://www.wsj.com/articles/SB10001424052748704414504575244712375657640
[114] Ibid.
[115] Interview with Professor Kamal J. Araj.
[116] Currently Orano.
[117] Nuclear Power in Jordan (March 2021). World Nuclear. Retrieved from: https://www.world-nuclear.org/information-library/country-profiles/countries-g-n/jordan.aspx
[118] Jordan and Areva sign exploration agreement (2008). World Nuclear News. - Retrieved from: https://www.world-nuclear-news.org/Articles/Jordan-and-Areva-sign-exploration-agreement
[119] Jordan research reactor complete (2016, December 12). World Nuclear News. - Retrieved from: https://www.world-nuclear-news.org/Articles/Jordan-research-reactor-complete
[120] All systems go for Jordan's first nuclear reactor (2010). World Nuclear News. - Retrieved from: https://www.world-nuclear-news.org/Articles/All-systems-go-for-Jordan-s-first-nuclear-reactor

the PUNE field, particularly electricity generation and water desalination[121]. The agreement is aimed to establish a legal and political framework for cooperation between the two states; it is focused on the prospect of cooperation in training as well. In 2015, the JAEC and the CNNC conducted negotiations for the Industrial and Commercial Bank to finance not less than 50% of the NPP construction project, with the use of Russian technology[122]. When in 2018 the JAEC canceled the construction of the two planned Russian VVER units, it started negotiations with the CNNC on building a 220 MWe HTR-PM high-temperature gas-cooled reactor for operation from 2025.

Thus, despite the Middle East is a region with difficult climate conditions to build NPPs, there are numerous countries with ambitious plans to develop the PUNE. The Middle Eastern states possess various potential to overcome challenges posed by different stages on the way to have nuclear power in operation. History of the nuclear industry of some Middle Eastern countries, like Egypt and Iran, dates back to the mid-1950s, while other states, like the UAE and Jordan, launched their PUNE programs in the 2000s. Furthermore, the states of the region have different financial capabilities. A lot depends on a state's flexibility in negotiations with nuclear energy suppliers and the IAEA, as well as on progress in creating conditions for investment flows and general political developments.

[121] Jordan and China sign nuclear agreement (2008). World Nuclear News. - Retrieved from: https://www.world-nuclear-news.org/Articles/Jordan-and-China-sign-nuclear-agreement

[122] Nuclear Power in Jordan (March 2021). World Nuclear. Retrieved from: https://www.world-nuclear.org/information-library/country-profiles/countries-g-n/jordan.aspx

CONCLUSION

The Middle East is combination of commerce and geopolitics. The development of nuclear energy in the region is a promising and important task. There are numerous reasons why the Middle Eastern states have decided to develop nuclear energy, including economic, political, social ones, as well as significant energy needs. There is also the role of prestige: while such Middle Eastern countries as Iran and the UAE already have NPP in operation, Egypt and Saudi Arabia with their ambitions for leadership in the region do not want to lag behind.

At the same time, the capabilities of the Middle Eastern states to absorb nuclear power differ, and the conducted case studies have demonstrated that. While there are rich countries in the region, such as Saudi Arabia and the UAE, for which NPP construction is not a big deal from a financial perspective, Jordan, for example, has faced financial difficulties. Among other factors, technical capacity to build NPP and the factor of transparency stand out. Also, the Middle Eastern countries have different nuclear energy backgrounds: while Egypt and Iran have been developing the PUNE for several decades, the UAE and Jordan have set their nuclear energy priorities only at the end of the 2000s. As for Saudi Arabia, its nuclear program dates back to the 1960s, but only within the last decade, the Kingdom has demonstrated a significant interest in nuclear energy. However, there is no direct connection between the duration of the nuclear energy program and achievements, which a country has reached, – and the UAE case study proved that.

Developing nuclear energy requires the Middle Eastern states to import know-how. There are several main nuclear supplier countries – the United States, the Republic of Korea, France, China, and Russia.

The **US Westinghouse** is one of the regional countries' key partners. However, the stumbling block for full-scale American cooperation with some of the Middle Eastern states, namely, Saudi Arabia and Jordan, is difficulties to agree on a legal framework, in particular to reach an agreement on Section 123 of the U.S. Atomic Energy Act.

The **Korean KEPCO**, which is a state monopoly, holds a prominent position in the Middle Eastern nuclear energy market. The Korean SMART is viewed as the nuclear energy future, and it perfectly suits the Middle East and Africa. Moreover, the Republic of Korea has already built a NPP in the UAE. However, the Korean NPP is dependent on the United States and Russia: its reactors are American intellectual property, and they use Russian fuel.

French Framatome, being a well-known corporation engaged in NPP construction, holds a traditionally strong position in the Middle East.

Chinese CNNC and CGN are gaining momentum: they are losing from a quality perspective, however, the commissioning of new Chinese reactors in connection with its financial assets and possible cooperation with a third country can make China the biggest nuclear energy supplier.

Russia is a competent player in the nuclear energy field. Rosatom has several visible advantages, namely extensive experience in NPP construction, development of SMR, the IUEC and Tenex, SNF return, favorable price conditions, including available BOO and BOOT schemes. The Russian cooperation with the Middle East in

the nuclear industry dates back to the 1960s. Today Russia is actively developing connections in the PUNE area with its Middle Eastern partners. Russia is constructing NPPs in Iran, Turkey and about to start in Egypt and it has concluded numerous framework agreements on peaceful nuclear energy with the states of the region.

Thus, the Middle East is prone to the development of peaceful nuclear energy. However, further successful implementation of nuclear projects in the region is dependent on various factors that are as follows: general developments in the region, ongoing political tensions and confrontations affect the prospects for peaceful nuclear energy; developments in bilateral relations between the Middle Eastern states and nuclear supplier countries; compliance of the regional states with nonproliferation norms; progress in the nuclear industry in the world in general. ■

ACKNOWLEDGEMENTS

The publication is a short version of Inna Rodina's M.A. thesis that was supervised by Dr. Mikhail N. Lysenko (Moscow State Institute of International Relations, MGIMO) and Dr. George Moore (Middlebury Institute of International Studies at Monterey, MIIS). The author also expresses her gratitude to Prof Kamal J. Araj, Dr Vladimir Artisyuk, Dr. Chen Zak Kane, Dr. Hanna Notte, and Mr Anthony Stott for related to the topic conversations, which contributed to the paper.

Security Index Occasional Paper Series
Global Edition

№12 (27), 2021

Inna Rodina

Peaceful Uses of Nuclear Energy
in the Middle East

Editor-in-Chief: Vladimir Orlov

Editors: Egor Chobanian and Sergey Semenov

Reviewers: George Moore and Mikhail Lysenko

Design and DTP: Egor Chobanian

The cover of this report uses elements of
Albrech Dürer's Rhinoceros woodcut

The *Security Index* journal logo:
© Vladimir Orlov

Editorial work on this issue
was completed on November 25, 2021

PIRPRESS

SECURITY INDEX

Security Index Occasional Paper Series Global Edition - reports, analytical articles, comments and interviews that reflect the positions of Russian and foreign experts on the current challenges to global security and Russia's policy in this area. The aim of the series is to provide a clear analysis of international security problems and to offer specific and realistic solutions for them. The series replaced the *Security Index* journal published by PIR Center in 1994-2016. The authors and editors of the series welcome comments, questions and suggestions, which readers can email inform@pircenter.org.

RUSSIA'S ROLE IN THE PROCESS OF ESTABLISHING WMDFZ AND DEVELOPMENT OF PEACEFUL NUCLEAR ENERGY IN THE MIDDLE EAST

This occasional paper was written within the framework of the project Russia's Role in the Process of Establishing WMDFZ and Development of Peaceful Nuclear Energy in the Middle East, which is part of the Nuclear Nonproliferation & Russia Program. Within the project PIR Center tracks the implementation of nuclear energy projects in the region and monitors proliferation-related risks and developments with a particular emphasis on the establishment of WMDFZ in the Middle East.