1. INTRODUCTION

1.1 Nuclear Energy in The World

During World War II, nuclear technology research focused on producing bombs by splitting atoms of either uranium or plutonium. Since 1950s, attention has turned to peaceful purposes. By the second half of the 20th century, obtaining energy from reliable resources has become the most significant issue of the energy agenda of almost every country in the world. Especially the energy crises of the 1970s accelerated the search for reliable energy resources and highlighted nuclear power plants. Thus, many countries have built nuclear reactors so far. Currently, there are over 440 commercial nuclear power reactors operable in 31 countries, with over 390,000 MWe of total capacity and approximately 60 more reactors are under construction, equivalent to 16 % of existing capacity. These nuclear power stations provide almost 11 % of the world's electricity (Figure 1) as continuous and reliable base-load power, with no carbon dioxide emissions (World Nuclear Association, 2017).

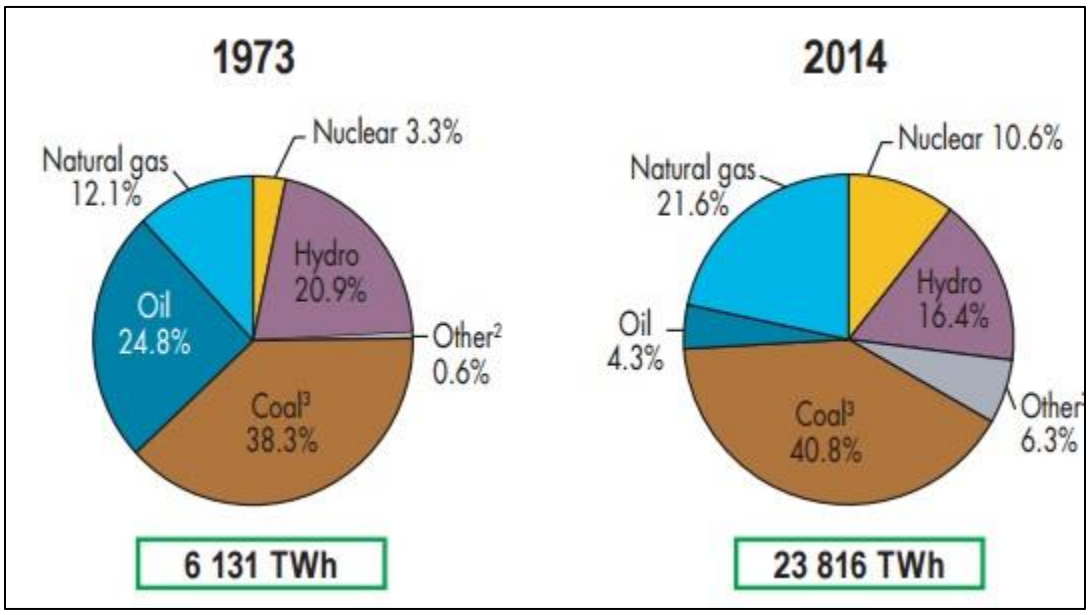

Figure 1. Electricity Generation by Fuel Type in the World (IEA,2016)

Many developing and developed countries in the world are involved in nuclear power development, due to its technical and economic advantages in power generation which can be summarized as follows:

- In Nuclear Power Plants (NPP), fuel is a low proportion of power cost, (5%) compared to Natural Gas Power Plants (40-60 %),
- The fuel (uranium) is on site (not depending on continuous delivery),
- They have relatively quick ramp-up capacity,
- They contribute to clean air and low-CO_2 objectives while producing good voltage support for grid stability.

Today, nuclear power has a portion of over 25% of electricity generation in 16 different nations. Dependence on nuclear power for electricity generation in France is 76.3 %, the highest ratio in the world. In Europe, while Ukraine, Slovakia, and Hungary gets more than half of their electricity from nuclear reactors, Belgium, Czech Republic, Finland, Sweden, Switzerland, and Slovenia get one-third or more of their electricity from nuclear. On the other hand, the U.S.,

UK, Spain, Romania, and Russia almost generate one-fifth of electricity from nuclear power plants (World Nuclear Association, 2017). Table 1. illustrates the reliance on nuclear energy to supply electricity and the number of reactors in operation in some of the abovementioned countries.

Table 1. Reliance on Nuclear Energy to Supply Electricity in Selected Countries. (World Nuclear Association, 2017)

Country	Reliance (%)	Reactors	Country	Reliance (%)	Reactors
France	76.3	58	Finland	33.7	4
Ukraine	56.5	15	Switzerland	33.5	5
Slovakia	55.9	4	Czech Republic	32.5	6
Hungary	52.7	4	South Korea	31.7	25
Slovenia	38	1	Bulgaria	31.3	2
Belgium	37.5	7	U.S.A.	19.5	100
Armenia	34.5	1	U.K.	18.9	15
Sweden	34.3	9	Russia	18.6	35

1.2 Trends in the World

China

China has already built more than 30 new nuclear power reactors and started to operate since 2002, while some other 20 are under construction. Chinese government is also planning to build 30 GWe more nuclear power by 2021 to increase the nuclear generating capacity to 58 GWe. The constructions of many reactors are planned to start within three years. China is commencing export marketing of a largely indigenous reactor design. R&D on nuclear reactor technology in China is superior. (World Nuclear Association, 2017).

U.S.A.

The United States has the largest nuclear power industry in the world, with 100 operating commercial nuclear reactors. The nuclear share of total generation has remained relatively constant over the years despite a decrease in the total number of reactors; this is largely the result of performance improvements (OECD, 2016).

In the USA, the number of reactors under construction is only 4, which are all new designs. One of the reasons for the gap in building new reactors in the USA until recently has been the remarkably successful development in maintenance strategies. Over the last 15 years, modifications have improved the utilization of US nuclear power plants, with an increased output equal to 19 new 1,000 MW plants being built. (World Nuclear Association, 2017).

Europe

Eastern European countries such as Bulgaria, Czech Republic, Hungary, Romania, Slovakia, Slovenia, and Turkey are currently constructing or have sound plans to build new nuclear power plants. Finland and France are both expanding their convoy of nuclear power plants with the 1,650 MWe nuclear reactors, two of which are also being built in China. In 2014, the French Parliament adopted a law to reduce the nuclear share of its total electricity generation from 76% to 50% by 2025. (Energy Information Administration, 2016)

Poland has a nuclear program, with 6,000 MWe planned. Estonia, Latvia, and Lithuania are the parts of a joint nuclear power project. Belarus, on the other hand, has already started construction of its first Russian reactor.

The UK government is planning to have 16 GWe of new nuclear capacity operating by 2030 as well as replacing the country's ageing nuclear reactors with new ones.

Sweden, Slovakia, Hungary, and Spain are all implementing or planning for life extensions on existing plants.

Germany earlier decided to turn off its nuclear plants and then agreed to extend the operating lives of them. After Fukushima accident, the country has again reversed its nuclear policy and decided to shut down the nuclear power plants that were constructed before 1980. Also, it is decided that once the lifetimes of operational NPPs are over, they will be turned off and will not be substituted by new ones. This decision is important as it shows the impact of public opinion on energy policy. Despite ongoing quarrels over its costs, sustainability and effects on German economy, Germany aims to phase out nuclear energy by 2022 (World Nuclear Association, 2017).

Japan

Japan shut down its 50 nuclear power reactors in the aftermath of Fukushima, but the government decided in 2014 to start operating reactors again after a security check. Despite significant public opposition to nuclear power, two nuclear reactors at Sendai were restarted in 2015. (Energy Information Administration, 2015). The Japanese Prime Minister declared that the living standards of the people could not be sustained without nuclear energy (The Independent, 2012).

Figure 2 illustrates the current nuclear energy consumption by region in the world. World nuclear power generation grew by 1.3% in 2015, while the 10-year average is -0.7%. The Asia Pacific region is responsible for all of the net increase, driven by growth in China (+28.9%), which overtook South Korea to become the world's fourth-largest producer of nuclear power. (BP,2016)

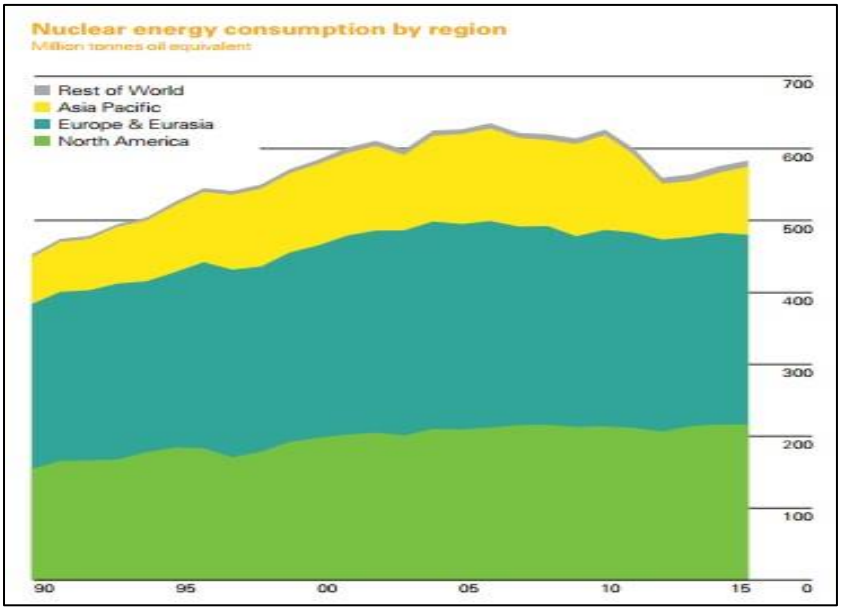

Figure 2. Nuclear Energy Consumption by Region in the World

1.3 Current Energy Outlook in Turkey

As a developing country, Turkey has a rapidly growing economy and energy demand. It has a population of nearly 80 million (TUIK,2017), with an average GDP per capita growth rate of almost 5 % between 2002 and 2015, which in turn has been the principal driver of energy demand and investment in the Turkish energy market. (World Bank,2017). Over the past decade, gross electricity demand has almost doubled to reach 265 TWh, (TEIAS,2017) while natural gas demand increased even faster and climbed up to 49 billion cubic meters (bcm) in 2015 from 22 bcm in 2004. However, Turkey is incapable of meeting overall energy consumption by its domestic resources. The country is highly dependent especially on oil and natural gas imports. Only 25 % of the total energy supply is met by indigenous resources. Although the energy bill is relatively lowered due to recent decline in global oil prices, in 2014 this amounted to nearly $55 billion, 23 % of country's total import. (AA,2015)

As seen in Figure 3, natural gas accounted for 37,8 % of total electricity generation in 2015, although Turkey imports virtually all its natural gas supply. The share of other energy sources used for power generation in 2015 was coal (28,4 %), hydro (25,8 %), wind (4,4 %) geothermal (1,3 %), fuel oil, diesel, and naphtha (1,6 %), and biogas (0,6 %) (MFA,2017).

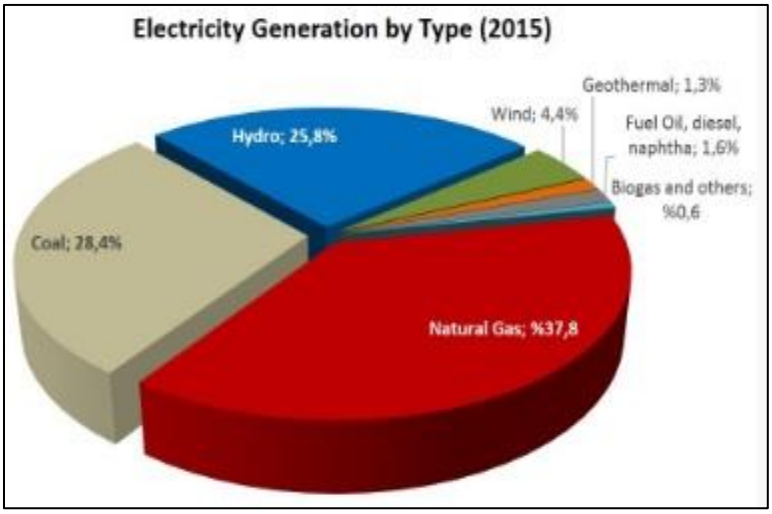

Figure 3. Electricity Generation by Fuel Type in Turkey (MFA,2017)

Turkey imports nearly 99 % of the natural gas it consumes. Over the last decade, Turkey has been the second country, after China, in terms of natural gas demand growth. In 2015, Turkey imported nearly 48,4 bcm of gas. Russia is the biggest supplier of natural gas to Turkey with a share of 55,3 %. It is followed by Iran (16,2 %), Azerbaijan (12,7 %), Algeria (8,1 %) and Nigeria (2,6%). (MFA,2017).

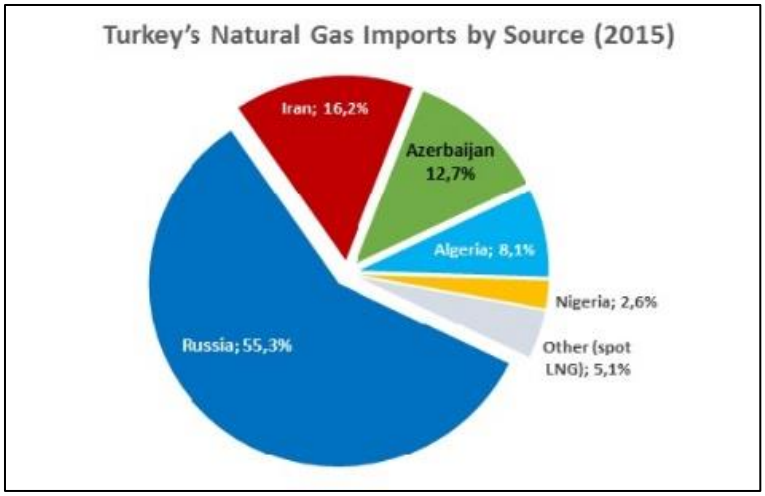

Figure 4. Natural Gas Imports by Source in Turkey (MFA,2017)

Regarding oil, Turkey imports approximately 90 % of its oil supplies. In 2015, Turkey imported 25 million tons of crude oil mainly from Iraq (45,6 %), Iran (22,4 %), Russia (12,4 %) Saudi Arabia (9,6 %), Colombia (3,5 %), Kazakhstan (2,6 %) and Nigeria (2,1 %).

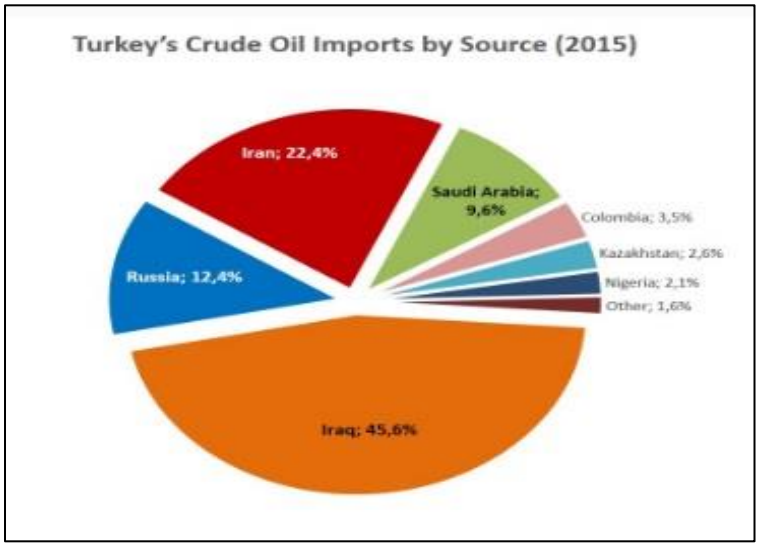

Figure 5. Crude Oil Imports by Source in Turkey (MFA,2017)

1.4 Drivers for Nuclear Power Generation

The drivers for nuclear power generation in its inception was slightly different than the current motivation. The first generation NPPs were mainly justified by the need to mitigate heavy urban smog caused by coal power plants. The other reason to begin utilizing this power was that it was an economic source of continuous reliable source of supply which reduces dependence on imports of fossil fuels, especially after 1970s global oil crises.

In the 21st century, energy generation plans considering climate change and sustainable development come into prominence. In this regard, besides nuclear energy, renewable energy resources became an important part of energy

policies and efficient energy generation facilities have been built from such sources. However, due to the intermittent nature of renewable resources, together with the absence of efficient power storage systems, it is too expensive to generate sufficient energy to meet the growing demand. This irregular nature of renewable energy not only complicates the things for system operators but also increases the uncertainty of future electricity prices. Nuclear energy, on the other hand, is an important sustainable resource which generates electricity for 24/7 with no GHG emissions. Thus, increasing energy demand, climate change, security of supply, increasing fossil fuel price volatility and grid stability can be considered as today's drivers for nuclear build.

Considering Turkey, in addition to the abovementioned drivers some other reasons put nuclear energy up on the top of the government's energy agenda. Ministry of Energy and Natural Resources estimated that the country will have nearly 130 GW installed capacity and 500 billion kWh energy consumption in 2023. More importantly, beside the rapidly growing electricity demand, it is also forecasted that even if renewable resources such as wind, solar and geothermal capacity is fully utilized in addition to hydroelectric power, only the half of the projected electricity demand can be supplied in the year 2023 (MENR, 2015).

Due to the scarcity of domestic fossil resources, the country has been closing the gap between the energy demand and domestic supply by importing huge amounts of fossil fuels, mainly oil and natural gas, which causes significant risks in financial, political, social, and environmental frameworks. The solution lies in the diversification of energy sources to mitigate such risks.

Regarding the effects on the budget, Turkey had a current account deficit of 64.9 Billion dollars in 2013 and had total energy imports of 55.9 billion dollars, which accounts for 22.2 % of all country's imports (Namli, 2014). Thus, it is obvious that unless Turkey implements nuclear power program soon as an alternative primary source of energy, she will be more obliged to lean on imported fossil fuels and will be more dependent on its top suppliers, Russia and Iran. The reliability of these suppliers is always subject to debate in terms of energy diplomacy. Probable disagreements with these countries puts Turkey into tremendous risk in terms of energy supply.

Countries able to obtain cheap, high-quality, sustainable energy, are among the most successful ones in global trade and development contest. Turkey has set an ambitious target to become one of the ten largest economies in the world by 2023, the centenary of the foundation of the Turkish Republic. Therefore, Turkey, which has a rapidly increasing energy demand as well as having no other sufficient indigenous energy resources to meet the growing demand, it is almost inevitable to utilize nuclear power in near future. Turkey should add nuclear reactors to its energy portfolio to diversify the energy resources as well as to reduce the high-energy import cost to ensure sustainable economic growth and to achieve similar ambitious targets.

The main reason Turkey considers to include nuclear power within its energy policy agenda is that the country has insufficient domestic energy resources to meet the rapidly increasing energy demand, especially the base-load demand. Nuclear energy seems to be an ideal alternative since it provides an economically viable option to secure energy supply to achieve sustainable development goals as well as reducing GHG emissions. Not only to meet the projected electricity demand to reach the country's aim for economic growth, but also to cut back its vulnerable reliance on Russian and Iranian gas for electricity, it seems essential to have nuclear power generation facilities within the country. The sooner the country has nuclear power the better. At this point, the question is "How"?

In this study, the next section covers the "past and current nuclear energy context and plans in Turkey". Section 3 discusses the "challenges to achieve sufficient nuclear energy capacity". Section 4 describes the "current legal framework on nuclear energy in Turkey" while the last chapter is about the "assessment and recommendations for the implementation of the current nuclear energy policy in Turkey".

2. PAST AND CURRENT ENERGY CONTEXT

2.1 Past Efforts to Build Nuclear Power Plants in Turkey

Although Turkey has no nuclear power generation facility in its territory yet, the county has made many efforts to build nuclear power plants since 1960s. Due to scarcity of fossil resources, the Turkish state has always had a strong motivation for nuclear power. Accordingly, Turkey has made a total of six attempts to build a nuclear power plant for the past five decades.

The first attempt is made by the Turkish Atomic Energy Commission (TAEC), established in 1956. A feasibility study for the first NPP was initiated in 1967, planning to start operation in 1977. However, this attempt failed due to several reasons such as problems related to site selection. Also, the political instability and the country's poor economic conditions played a great role to abandon this first effort.

The second attempt started in 1972 after the site selection of Akkuyu and Sinop sites. In 1976, a license to build a nuclear power plant is issued and negotiations to start the construction and financing is launched with foreign firms. However, this attempt was interrupted by a military coup in 1980.

After 1983 liberalization gained momentum in Turkish economy and energy markets. Following the reorganization of Turkish Atomic Energy Authority (TAEK) and the popularity of build-own-transfer approach, vendors like Canadian, East-German, and American firms were selected to construct three NPPs. However, due to many different and concurrent reasons such as, fears in Western countries about non-peaceful usage of nuclear technology in Turkey, diplomatic problems between West and East Germany and high public opposition due to the Chernobyl disaster happened in 1986, this attempt was cancelled.

Between the years 1993-2000, Turkish government initiated an international tender for a turnkey project and received three different bids from three different countries, but the proliferation concerns as well as no purchase guarantee were the main reasons for the failure of this effort.

The fifth attempt was differently fueled by the growing concerns over Turkey's increasing dependence on Russian gas imports. In 2007, Law on Construction and Operation of Nuclear Power Plants and Energy Sale (No. 5710) was ratified and entered into force on 21 November 2007. While six vendors planned to participate in the process, the state received only one bid from Russian state-owned Rosatom company and it is deemed to be too expensive (Jewell,2015).

The sixth attempt is still in progress. Since 2009, decisive steps have been taken to proceed towards the building of two NPPs using intergovernmental agreements (IGAs) with Russia and Japan, on the sites of Akkuyu and Sinop, respectively.

At the Akkuyu site (four VVER-1200 megawatts electrical [MWe] units) preparations are most advanced and plans to connect the first reactor to the grid by 2023. To achieve this, the construction should start in 2017. The project is relying on a build-own-operate (BOO) model. On the other hand, feasibility studies are in progress at Mitsubishi

Heavy Industries and Itochu for the construction of the Sinop NPP (4480 MWe with four Generation-III pressurized water reactors [PWR] of type Atmea I).

Table 2. summarizes the attempts to introduce NPPs in Turkey up to date.

Table 2. Attempts to Introduce NPPs in Turkey

Attempt No.	Years	Model and Actions	Status/ Causes for Failure
1	1953-1971	*Conventional Purchase *TAEC established (1956) *First research reactor (1961) *Plan to build first NPP in 1977	Failed due to political and economic instability
2	1972-1980	*Conventional Purchase *Feasibility studies in Akkuyu and Sinop *License issued, negotiations for financing and construction with vendors (1976)	Failed due to military coup in 1980.
3	1982-1988	*Build-Operate-Transfer *Bids invited from seven major suppliers *Letters of intent issued to three firms	Proliferation Concerns in West, Chernobyl Disaster.
4	1993-2000	*Build-Operate-Transfer *International tender issued for a turnkey project *Bids received but tender cancelled	Negotiations failed due to proliferation concerns and no purchase guarantee.
5	2002-2009	*Build-Own-Transfer *Plan to build first NPP in 2015 *Sinop is selected	Too expensive bid from Rosatom
6	2010-present	*Intergovernmental Agreement (IGA) *Signed with Russia for the construction of a Build-Own-Operate NPP in Akkuyu (2010) *Another IGA signed with Japan to build the second NPP in Sinop (2013)	In Progress

2.2 The Akkuyu NPP Project

After a total of five failed attempt, Turkey has changed its strategy to build nuclear power plants. For the sixth (last) attempt, rather than issuing tenders for bids from international co-operations, Turkey has signed an intergovernmental agreement (IGA) with Russia. "Agreement between the Governments of the Republic of Turkey and of the Russian Federation for Cooperation on the Establishment and Operation of a Nuclear Power Plant at Akkuyu in the Republic of Turkey" was signed between Ankara and Moscow on 12 May 2010, to build four 1200 MWe AES-2006 units as a US$ 20 billion project, which later announced to be more than US$ 25 billion (WNA, 2017). The IGA was ratified by both Parliaments in the same year, providing the legal framework for the project. The Akkuyu NPP project will be the first project in the world to be built using a Built-Own-Operate (BOO) model (IAE,2016).

In this model, the plant will be owned and operated by the Akkuyu NPP's Joint Stock Company (JSC) which was founded in December 2013 under Turkish law. The JSC will also be the investor. Rosatom, Russia's state-owned nuclear company, together with some of its affiliates, is currently holding the 100 percent of the shares of the JSC and financing the project, but up to 49% may be sold to other investors at a later stage. The Turkish state electric generation company, EUAS, is expected to take a stake in the power plant in the future.

This BOO model is a "full-service" model under which Rosatom will provide engineering, filing of the permits, construction, supply of equipment, commissioning, operation, maintenance, waste management and decommissioning services for the NPP in exchange for a guaranteed electricity price. It also includes training 600 Turkish students in Russian universities to supply the required domestic expertise in the field of nuclear energy. After graduation, the students will be working in Akkuyu NPP.

The Turkish side allocates the site, issues licenses, provides the grid connection, and guarantees the purchase of electricity as per the agreement. Turkish Electricity Trade & Contract Corporation (TETAS) will buy a fixed proportion of the power at a fixed price of 12.35 cents/kWh for 15 years. The proportion will be 70% of the output of the first two units and 30% of that from units 3&4 over 15 years from commercial operation of each. The remainder of the power will be sold by the project company on the Turkish electricity market. After 15 years, when the plant is expected to be profitable, JSC will pay 20% of the profits to the Turkish government (WNA,2017).

Per IGA between Russian Federation and Republic of Turkey, after taking all necessary permits and licenses operation of Akkuyu NPP will start in 7 years (Akkuyu, 2017). However, this could be delayed due to prolonged approval process. Turkish Ministry of Environment and Urbanization approved the revised environmental impact assessment report of the project, volume of 5,500 page, on 1 December 2014 (CSB,2017). Following this, The Energy Market Regulatory Authority issued a 36-month pre-license for the project in 25 June 2015, allowing some preparatory activities and permits pending the generation license (EPDK,2017). The company plans to start construction in mid-2017 (IAE,2016). In February 2017, Turkish Minister of Energy and Natural Resources said the first reactor is planned to be online by 2023 (Hurriyet,2017). Table 3 illustrates the timeline of the Akkuyu NPP.

Table 3. Timeline of the Akkuyu NPP Project

05/2010	IGA signed
2010	Ratification by both Parliaments
12/2010	Akkuyu JSC founded.
2011	Application for EIA and Pre-License
12/2014	EIA Decision by MEU
2015	Decision on Electricity Generation Pre-License
05/2016	Application for the Construction License
12/2017	Approval of the construction license (Expected)
2023	Start of operation of Unit 1 (Expected)

The Akkuyu NPP will have a total installed capacity of 4.8 GWe comprised of four VVER 1200 units. It is a GEN-III design with passive and active safety systems fulfilling advanced safety requirements. The service life of Akkuyu NPP is 60 years. (Akkuyu,2017)

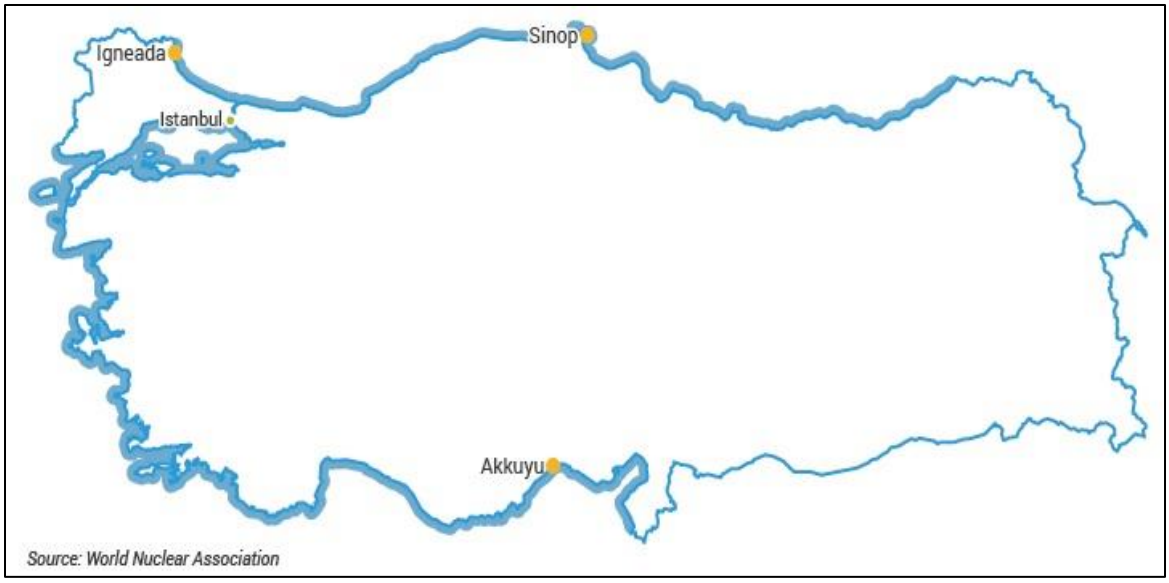

Figure 6. Planned Nuclear Power Plants in Turkey

2.3 The Sinop Project

Turkey is planning the construction of a second nuclear power plant located at Sinop, in northern Turkey, by the Black Sea. To realize this goal, after negotiations with Japanese government, Turkey also signed an IGA with Japan on 3 May 2013 on the "Cooperation for the Development of Nuclear Power Plants and the Nuclear Power Industry in the Republic of Turkey". The agreement includes cooperation on several subjects like training, capacity development, radioactive waste management, nuclear security, and fuel. (TBMM,2013). According to IGA, Sinop NPP will be constructed and operated by Japanese consortium and Turkish Electricity Generation Company (EUAS) (IAEA,2015). Unlike the IGA on Akkuyu NPP, per this agreement, the share of EUAS will be up to 49% in the Sinop Project Company, with the other 51% owned by Mitsubishi, Itochu, and GDF Suez. The other main difference from the Akkuyu agreement is that in the Sinop project the public-private partnership model will be utilized. Negotiations of implementing agreements are ongoing, and the IGA and HGA (host government agreement) was ratified by the Turkish Parliament in April 2015 (IAE,2016). The Sinop project would have a total capacity of 4,480 MW, consist of four Generation III[1] type ATMEA-1 nuclear reactors, each with 1,120 MWe installed capacity. The estimated total cost of the project is US$ 22 billion. Per the IGA, TETAŞ would buy 100% of the generated electricity for a period of 20 years, with a guaranteed electricity rate of 11.80cents/kWh. The first reactor is expected to be operating by 2023. (IAE,2016)

2.4 The Igneada Project

In Turkey, there are further plans to increase the planned nuclear capacity. TAEK has identified Igneada on the Black Sea, 12 km from the Bulgarian border, and this was confirmed by the Turkish Minister of Energy and Natural Resources in October 2015. (Hurriyet, 2015). Since November 2014, Turkey has been in exclusive negotiations with the State Nuclear Power Technology Corporation of China to develop and construct its third four-unit nuclear power plant

[1] Generation III and III+ reactors have significant improvements over Generation II designs in areas such as, fuel technology, thermal efficiency, modular construction, safety systems, and standardized design. They are designed for 60+ year operational life spans. (New Nuclear Energy, 2017)

using reactors of U.S. firm Westinghouse. EUAS signed a memorandum of understanding with these Chinese and American Co-operations in November 2014. The agreement covers reactor technology, and all lifecycle activities including operations, nuclear fuel, maintenance, engineering, plant services and decommissioning. The review and assessment of the report provided by the delivery team of Westinghouse and SNPTC, is in progress. (IAE,2016) (WNA,2017)

Agreement signed on April 2012 between the Government of the People's Republic of China and the Government of the Republic of Turkey for Cooperation in the Peaceful Uses of Nuclear Energy was ratified in Turkish parliament on September, 2016. (TAEK, 2017) This progress and recent visits of Turkish ministers to China perceived as indications of possible future agreement on the construction of third NPP with China, especially in Turkish media. Table 4 summarizes the details of the first two NPP planned projects in Turkey.

Table 4. Details of the Akkuyu and Sinop Nuclear Power Plants

	AKKUYU NPP	SINOP NPP
Type of Reactor	VVER-1200(AES-2006)	ATMEA-1
Number of Units	4 Unit (1200 x 4)	4 Unit (1120 x 4)
Installed Capacity	4800 MW	4480 MW
Approximate Cost	$ 25 Billion	$ 22 Billion
Service Life	60 Years	60 Years

3. CHALLENGES TO ACHIEVE SUFFICIENT NUCLEAR CAPACITY

Commencing on a nuclear power program is a serious undertaking that requires significant political willingness, financial resources, as well as the responsibility to ensure that the essential infrastructure is ready.

In Turkey, nuclear energy policy is surrounded by a variety of risks and challenges although the county has sufficient capacity and willingness to initiate nuclear power, considering the size of its economy (GDP over $717 billion in 2015) (World Bank, 2017), the power infrastructure and growing demand.

These challenges can be categorized as;

- Political
- Institutional / Human Resource Capacity
- Financial
- Public Perception and Safety

3.1 Political Challenges

One of the most significant abovementioned risks is the political one. After several failed efforts to organize bidding processes, Turkey found it useful to conduct direct negotiations via Intergovernmental Agreements (IGAs) and to use a Build-Own-Operate model for the Akkuyu NPP, both to construct the project without going through prolonged bidding process and to guarantee financing. However, while shortening the duration and securing the finance, this method is highly dependent on sound international relationship, which can also be quite risky since the loose international diplomacy can deteriorate at the very least expected moment. As an example, the conflict between Turkey

and Russia following the Russian jet shut down after it violated the airspace slowed down the progress of the Akkuyu NPP in 2015 and negatively affected the timeline of the project.

Furthermore, the unending war in Syria has a great potential to cause further conflicts in between two countries. Exacerbating this, unfortunately, Turkey still ranks in the top 25 most unstable countries in the world according to a study conducted by World Bank in 2014 (Global Economy, 2016). In fact, since the foundation of the modern Turkish Republic in 1923, 65 governments have been established so far, i.e., on average, each government served for only 17 months (PM,2017). No doubt the recent increased number of mortal terrorist attacks by PKK and ISIS in Turkey and a failed military coup attempt organized by FETO in July, 2016 worsen the country's national security and political stability index. These events not only undermine investor's trust in government's nuclear energy plan but poses a remarkable risk on the successful completion of the current projects.

3.2 Institution and Human Resource Capacity Challenge

The second challenge Turkey faces is achieving sufficient human resource capacity, i.e., expertise in nuclear energy. Clearly, this is a common problem in many newcomer countries to the nuclear power. The long-term and robust solution lies in the adoption of a human resource development policy in nuclear field. TAEK trains personnel in the nuclear field at the affiliated research and training centers, also arranges co-operation with universities and related organizations on this matter. IAEA is one of the main supporting organizations for developing national manpower through training and fellowship programs. Although Turkey has a research reactor program for more than 50 years, a nuclear power plant requires far more technical and managerial expertise.

There is only one university, Hacettepe University, in Turkey offering undergraduate nuclear engineering program and a few other universities have graduate programs related to nuclear energy. Though a few in numbers, these universities and TAEK can provide sufficient theory to the students and related personnel, but the application in the field of NPP is lacking. To solve this issue, at least for the short term, Turkish students are being sent to Russia for nuclear engineering education and practice. The students, who have successfully completed their program, will receive applied training at the Training Centers of Rosatom (Russian Atomic Energy Authority) and will be subject to the internship program for 1 or 3 years according to the duty to be selected at the Nuclear Power Plants in Russia (MENR,2014). In total, 600 Turkish students are supposed to be sent to Russia and they will be working in the operation staff of the Akkuyu plant after graduation. 190 Turkish students went to Russia between the years of 2011 and 2013 (IAEA,2015).

On the other hand, Turkey needs not only nuclear power plant operators and engineers, but also regulators to govern the market and ensure safe operation of prospective NPPs. The nuclear infrastructure of the country needs to develop at least at the pace of the nuclear power project schedule. However, Turkey has no independent regulatory authority yet. Turkish Atomic Energy Authority (TAEK) has a complex and faulty organizational structure, being the operator of research reactors and nuclear regulator of the country at the same time. Today, the Department of Nuclear Safety (DNS) of TAEK has nearly 80 staff members. There is a plan to further increase the number of staff up to 140. MENR has formed a special working group and started a study to produce a human resources development plan to determine the required number of staff in state organizations in near future. Although, DNS has experience with regulating research reactors, it relies heavily on the support from IAEA and contracts with foreign capable Technical Safety Organizations (TSOs) in the field of regulating nuclear power plants (IAE,2016).

3.3 Financial Challenges

As mentioned earlier, after several failed bidding attempts, Turkey changed its approach to construct nuclear power plants within the country. The financing models offered for the first two NPPs (Akkuyu and Sinop), lean on power purchase agreements. The government of Turkey is enthusiastic to avoid taking major financial risks in these projects, which cost around $ 50 billion together. Thus, per IGA signed for the construction of the Akkuyu NPP, the main financial risk is on the shoulders of the Akkuyu Joint Stock Company, and therefore indirectly of Russia. The provisions of the agreement tie financial risks with political ones since the Russian state-owned company Rosatom, with its affiliates, is currently holding the 100 percent of the shares of the Akkuyu JSC (IEA, 2016). Some financial risks are also born by TETAS as power purchaser, and thus by the Turkish government, at a fixed price for 15 years.[2]

On the other hand, the recent depreciation of the Turkish Lira (TL), and the volatility of the exchange rate has a great potential to change the financial picture of the two main NPP projects in Turkey. Since the power purchase prices are fixed and set in US Dollars, and the wholesale electricity prices in Turkish Electricity Market were around 9 cents/kWh when the agreement was signed in 2010, (1 $ = 1.5 TL) but today it is around 5 cents/kWh, (1 $ = 3.6 TL) which makes the agreed rate for Akkuyu NPP (12.35 cents/kWh) quite high.

3.4 Public Perception and Safety

For the success of a nuclear energy program, not only political commitment, institutional and financial capacity are required, but also creation of positive public perception is essential. Unfortunately, in the history of nuclear energy, there had been three major accidents, namely; Three Mile Island (1979), Chernobyl (1986) and Fukushima (2011) that drastically changed public opinion on nuclear power plants.

In 1979, at Three Mile Island nuclear power plant in USA, a cooling malfunction caused part of the core to melt in one of the reactors. The reactor was destroyed. Some radioactive gas was released a couple of days after the accident, but not enough to cause any significant levels to residents. There were no injuries or adverse health effects reported due to the Three Mile Island accident. It was the first recognized and remarkable accident in nuclear history. Following this accident, the number of reactors under construction in the U.S. rapidly declined. Deficient control room instrumentation and inadequate emergency response training proved to be root causes of the accident (WNA,2012).

The Chernobyl Disaster was a catastrophic accident occurred on 26 April 1986 at the Chernobyl Nuclear Power Plant in Soviet Union. Uncontrolled reaction conditions due to poor operation management led to destructive explosion and fire causing most disastrous nuclear power plant accident in history with huge radioactive spill onto much of the surface of the western USSR and Europe. Due to the accident, in total 31 firemen and employees died in the days-to-months afterward from acute radiation syndrome, with the potential for long-term cancers still being investigated (Britishfreepress,2016). Chernobyl disaster was a turning point for the entire World. The perception that nuclear power was safe reversed.

In Japan, following a major earthquake of magnitude 9.0, a 15-metre tsunami disabled the power supply and cooling of three Fukushima Daiichi reactors, causing a nuclear accident on 11 March 2011. To ensure no death or events

[2] 70% of the electricity generated by the first two units and 30% of the last two units, at an average constant price of USD cents 12.35/kWh over the 15 years. Per IGA, the price can be adjusted annually with an upper limit of USD cents 15.33/kWh.

of radiation sickness, over 100,000 people were removed from their homes. The main cause of this accident in the nuclear power plant was poor design of the height of the walls to counter tsunami waves. The tsunami precautions taken when Fukushima Daiichi was designed in the 1960s were considered acceptable regarding the scientific knowledge then, with low recorded tsunami heights for that region. But in 1990s, new scientific knowledge about the likelihood of a major tsunami of some 15.7 meters at the Daiichi site had come out. However, this discovery had not led to any action by either the plant operator, Tepco, or government regulators, notably the Nuclear & Industrial Safety Agency (NISA). Discussion was ongoing, but no action at all (WNA,2017). After the Fukushima accident, a reassessment of the safety of nuclear power is underway in many countries that had opted for nuclear power. It is announced that all 143 nuclear power plants in the EU will be re-assessed (subject to stress test) using EU wide criteria (EC,2011).

Two important characteristics, technological advance and public perception will determine the future of the nuclear energy. In fact, old technology, poor management and design are the main causes of aforementioned nuclear accidents. As mentioned earlier, Generation III and III+ reactors have significant improvements over Generation II designs in areas such as, fuel technology, thermal efficiency, modular construction, safety systems, and standardized design. With the introduction of Generation III and Generation III + nuclear power plants, although the safety and radioactive waste management issues are solved to a certain extent, creation of positive public perception remains inadequate due to recent nuclear accidents in Generation II or earlier type of reactors. There is no doubt that nuclear accidents can cause a rapid drop in public support and only recovers slowly. For example, after 2011 Fukushima disaster, in a 2012 study about "citizens' preferences on nuclear or renewable energy sources", based on data from a face-to-face survey of 2,422 residents from Turkey, findings indicate that opposition to nuclear power in Turkey is strong (Akyazi, 2012). In fact, except for dramatic nuclear accident times, public opinion on nuclear energy seems to change slowly. On the other hand, in developing countries like Turkey, nuclear energy does not feature amongst most people's highest concerns. The highest energy related concerns are those of price and security of energy supply.

The factors that further reduce public support for nuclear energy are concerns with respect to terrorism, radioactive waste disposal and the misuse of nuclear materials. Turkey is a country fighting with terrorist groups for more than 30 years, especially with PKK, so that it is not easy to ensure the public about the safety of prospective nuclear power plants.

In many countries, like in many other subjects, the public gains most of the information on energy and nuclear power from the media, but does not trust it. Scientists and environmental protection or consumer organizations are the most trusted groups rather than government officials. This is also the case in Turkey. This presents a clear problem to the government who wish to influence the public. Thus, an ongoing relationship between policy makers, the nuclear industry, scientists, environmentalists, media, and society that develops knowledge building and public involvement is getting increasingly important. This communication must be transparent, honest and balanced to ensure positive public perception which in turn helps to build long-term successful nuclear energy policy within the country (OECD,2010).

4. CURRENT LEGAL FRAMEWORK ON NUCLEAR ENERGY IN TURKEY

4.1 Regulatory Authority

The Law on Turkish Atomic Energy Authority, Law No.2690 approves TAEK as the "regulatory body" for all nuclear and radiation activities and facilities in Turkey and gives responsibility for ensuring the nuclear safety by

licensing and inspecting such activities and facilities. It was established in 1956 as the Atomic Energy Commission and was restructured in 1982 by Law No.2690. The aim of the law was to render the peaceful use of atomic energy in Turkey for the benefits of state in accordance with the national development plans. Today, TAEK is mixing regulatory functions with operational activities and supporting R&D in the field of nuclear energy and is not an independent regulatory authority but under the supervision of Ministry of Energy and Natural Resources. TAEK's main organization consists of four technical and one administrative department, namely:

- Department of Nuclear Safety,
- Department of Radiological Health and Safety,
- Department of Technology,
- Department of Research, Development, and Coordination, and
- Department of Administrative and Financial Affairs (IAEA,2015).

Separation of regulatory functions and other activities of TAEK such as promoting and operating research centers, is expected to be adjusted in the draft nuclear law. It is crucial to ensure not only the structural changes of TAEK, but the appropriate means and resources of the safety authority to execute effective regulatory functions independently.

When it comes to nuclear energy, the top priority becomes the safety and security aspects. Therefore, some comprehensive and supplementary specific legal and regulatory frameworks are required. The Turkish Atomic Energy Authority Law No. 2690 is 35 years old and needs to be updated as soon as possible. A new draft law which will cover and update many issues is still in progress. This New Nuclear Law is expected to cover;

- nuclear safety principles
- establishment of the Regulatory Authority
- responsibilities of the main institutions and licensing process
- detailed enforcement rules
- radioactive waste management policy and its fund
- decommissioning of the NPPs.

It is vital to complete and ratify this New Nuclear Law promptly, since the construction of Akkuyu NPP is expected to start later in 2017.

The new draft law is also expected to establish a new directorate under the Ministry of Energy called the Nuclear Energy General Directorate. This new directorate is supposed to work in order to ensure the sustainable development of the domestic capacity and infrastructure in the field of nuclear energy in terms of technology and human resources, leading to building and operating Turkey's own nuclear power plant (Karaduman, 2015).

4.2 Licensing

To ensure nuclear safety, security and radiation protection, nuclear installations are licensed in Turkey. Site License, Construction License and Operating License are the three main steps in the process of NPP licensing. However, issues related to decommissioning is not mentioned in any regulations in Turkey yet. This is expected to be covered in draft Nuclear Energy Law and other related secondary regulations.

Directive on Determination of Licensing Basis Regulations, Guides and Standards and Reference Plant for Nuclear Power Plants, 2012" describes the licensing method of TAEK by setting the rules for establishing a licensing

basis for NPPs. Department of Nuclear Safety (DNS) is the responsible unit for the licensing of nuclear installations in TAEK. Also, for NPP projects, a positive decision on environmental impact assessment given by Ministry of Environment and Urbanization based on the "Regulation on Environmental Impact Assessment" is a requirement for both the site license and the power production license given by the Energy Market Regulatory Authority (IAEA, 2015).

4.3 National Laws and Regulations on Nuclear Power and Nuclear Safety

The current legal framework of Turkey is consistent with international agreements and treaties, and IAEA safety requirements in most of the aspects of nuclear safety and security. Per the decision on the Adoption of the EU Legal Acquis Implementation, Coordination, and Monitoring, given by the Council of Ministers' decision in 2008, it is specified that prospective nuclear law shall be in conformity with EU standards and offer a high level of nuclear safety.

The main Turkish legal framework regulating nuclear installations are the Law No. 2690, which covers nuclear safety, security, and radiation protection; the "Environmental Law" which regulates environmental impact of these facilities; and the "Electricity Market Law" which mandates electricity production licenses. There are many other institutions involved in the process such as Ministry of Environment and Urbanization, Ministry of Transportation, Energy Market Regulatory Authority etc., which indirectly regulates NPPs in regard of other issues.

The Law on Turkish Atomic Energy Authority, the Decree on Licensing of Nuclear Installations, the Directive on Determination of Licensing Basis Regulations, Guides and Standards and Reference Plant for Nuclear Power Plants and the other related regulations constitute the basis of the legal framework of nuclear safety of nuclear installations in Turkey.

There are also several regulations related to nuclear safety in Turkey. Appropriateness of NPP sites is addressed in the "Regulation on Nuclear Power Plant Sites". Basic requirements on design, construction, commissioning, and operation of an NPP are mandated in the "Regulation on Design Principles for Safety of Nuclear Power Plants" and in the "Regulation on Specific Principles for Safety of Nuclear Power Plants". Requirements on physical protection of nuclear facilities are described in "Regulation on Physical Protection of Nuclear Materials and Nuclear Facilities" while nuclear and radiological emergencies are covered in the "National Regulation on Nuclear and Radiological Emergencies". "Regulation on Nuclear Material Accounting and Control" is an important regulation which describes the requirements on accounting and control of nuclear materials. The newly issued regulations "Regulation on Radioactive Waste Management" and "Regulation on Clearance in Nuclear Facilities and Release of Site from Regulatory Control" addresses radioactive waste management issues in nuclear facilities (IAEA, 2015). Also, Law No. 5710 gives responsibility to MENR and the Under-Secretariat of Treasury to form a National Radioactive Waste Fund. Details regarding the establishment, financing and management of this fund shall be prepared by MENR and the Under-Secretariat of Treasury (IEA, 2016).

In parallel with the aim of the economic liberalization program, The Law No. 5710 and the related regulations aimed to make the investment and operation by the private sector possible. The Law enabled the state to participate in nuclear power projects by means of public-private partnerships. Up to date, TAEK issued several criteria that set up general principles that should be met by investors (IEA, 2016).

As mentioned earlier, to finance capital-intensive NPP projects, different mechanisms have been utilized in Turkey so far. For the construction of the Akkuyu NPP and for the other prospective projects, the IGAs, once ratified by

Parliament, establish the legal basis for the given project. PPAs, on the other hand, set the tariffs. For the Akkuyu NPP, the roles and errands of the different parties are explained in the IGA. The major shortness in the IGA signed to construct the Akkuyu NPP is the responsibility of insuring the risks. The details have not been specified in the IGA and need to be negotiated.

4.4 International Conventions and Agreements

Regarding international treaties, Turkey is party of a full range of International Instruments related to nuclear safety and security. Turkey adheres to the following major international conventions: the Paris Convention on Third Party Liability in the Field of Nuclear Energy; the Treaty on the Non-Proliferation of Nuclear Weapons (NPT); the Convention on the Physical Protection of Nuclear Material (but not the Amendment to the Convention of 8 July 2005); the Convention on Early Notification of a Nuclear Accident; the Convention on Assistance in the Case of a Nuclear Accident or Radiological Emergency; the Joint Protocol Relating to the Application of the Vienna Convention and the Paris Convention and the International Convention for the Suppression of Acts of Nuclear Terrorism.[3]

Bilateral co-operation agreements about peaceful use of nuclear energy are in force with several countries, including the USA, Russia and Germany. Turkey has been a dynamic member of the International Atomic Energy Agency (IAEA) since 1957 and of the Organization for Economic Co-operation and Development (OECD)'s Nuclear Energy Agency (NEA) since 1958. It is also a Contracting Party of the 1960 Paris Convention[4]. Amending Protocols of 1964 and 1982 are also signed and ratified in the parliament. Yet, the Paris Convention does not offer comprehensive requirements in every feature of civil liability in the situation of nuclear accidents. Thus, many countries signed the Paris Convention have also ratified detailed national laws on civil liability issues (Karaduman, 2015). Turkey needs to enact a similar law as well and a draft Law on Third Party Liability is still in progress.

As a party to the NPT, Turkey has established a system of accountancy for and control of nuclear materials based on an agreement between Turkey and the IAEA. Turkey is also party to the Convention on the Physical Protection of Nuclear Material (CPPNM) and fully implements its provisions.

5. ASSESSMENT AND RECOMMENDATIONS FOR THE IMPLEMENTATION OF CURRENT POLICY

5.1. Assessments

In the light of the given information in the previous sections, the following assessments on Turkey's current Nuclear Policy and Strategy can be made;

- First, the major drawback is that Turkey has no comprehensive and official Nuclear Policy, yet. The government should prepare a detailed official document explaining how and why nuclear energy is essential for the country. Not only the power demand analysis and the benefits of the NPPs, but also

[3] A list of international multilateral agreements/ conventions, bilateral co-operation agreements and agreements on early notification of nuclear accidents signed between Turkey and other countries is provided in Appendix 1.
[4] The drafters of the Paris Convention set out to provide adequate compensation to the public for damage resulting from a nuclear accident and to ensure that the growth of the nuclear industry would not be hindered by bearing an intolerable burden of liability (NEA, 2017).

how the technology transfer in this field will bring further benefits to other sectors and the society overall must be analyzed.

- The second significant deficiency is that New Nuclear Law, which is expected to be the framework national law, has not been ratified yet. As the construction of the first NPP of the country, Akkuyu NPP, is about to start in 2017, enacting an updated and comprehensive Nuclear Law, together with related regulations addressing the major specific lacking points such as decommissioning, radioactive waste management and, third party liability as soon as possible is crucial.
- Third, Turkey does not have a sufficiently developed, independent and organized regulator to ensure the safety of nuclear power plants. TAEK must be reorganized not only to ensure its financial and political independence, but accountability and transparency in its decision-making process.
- When assessed based on the financial risks, although Akkuyu and Sinop NPP appear to be advantageous projects for Turkey, the inadequacy of the oversight capacity poses extreme safety and security risks.
- Finally, Turkey has no long-term and comprehensive Human Resource Development Program in the field of Nuclear Energy.

In November 2013, the IAEA conducted an Integrated Nuclear Infrastructure Review in Turkey to assess the country's progress in preparing for the new nuclear power program. It reported positively but recommended "completing a national policy on nuclear energy", "strengthening the regulatory body", and "developing a national plan for human resource development". After four years of the mentioned review, though there seems some progress, main problems remain almost the same for Turkey in this field.

5.2. Recommendations for the Implementation

The following recommendations can be made for the implementation of the current Nuclear Energy Strategy/Policy;

- Complete a comprehensive national Nuclear Energy Policy.
- Proceed urgently for the adoption of the new Nuclear Law.
- Ensure the independence and competence of the nuclear regulatory body by providing necessary resources.
- Consider wide support from international organizations such as IAEA since it is not realistic to expect the country to develop necessary human resources to effectively oversee the process in the short-term.
- Develop long-term Human Resource Plan by collaborating with universities and other competent international organizations to provide necessary workforce in prospective NPPs and in TAEK.
- Turkey should be more proactive to negotiate bilateral agreements to exchange experts and training students in nuclear energy to be able to construct its own nuclear power plant in the future. Per IGA signed with Russia for the construction of the Akkuyu NPP, it is unclear what role the Turkish students will have in the NPP and whether they will be able to access to the design information of the reactor technology.

- Avoid political appointments for the regulatory body. Competency and expertise must be ensured.
- Try to use the same nuclear technology (Pressurized Water Reactor) at least for the first couple of NPPs to avoid increased knowledge challenge.
- The current models used for the IGAs is including power purchase for a fixed price. This mechanism is encouraging cost saving for the company to gain more profit, and since the costliest part of NPPs is related to safety and security, regulatory authority must be fully competent to be able to inspect the NPPs to ensure sufficient safety as soon as possible.
- Power purchasing rates should be renegotiated considering current and future market rates and can be flexible rather than being fixed. Not only Turkish Electricity Market rates but also European Electricity Market rates can be considered since there are plans to integrate the markets in the future. Also, the exchange rate should be taken into account, it is beneficial for the country if the rate is not in US $ but in Turkish Liras or in the currency of the contractor company, since current situation makes the NPPs more expensive for Turkey when US Dollars gets stronger and it usually gets stronger in the long term against developing countries' currencies.
- Strong national nuclear policy requires strong public support. Turkey should ensure public participation in developing its national nuclear policy and try to create positive public perception by not only explaining the benefits of NPPs but also focusing on the adopted high level safety and security measures. This would be helpful to defuse the concerns on the safety and security of the planned NPPs among the public.

6. CONCLUSION

Turkey is incapable of meeting overall energy consumption by its domestic resources. Beside the rapidly growing electricity demand, Turkish Ministry of Energy and Natural Resources forecasted that even if renewable resources such as wind, solar and geothermal capacity is fully utilized in addition to hydroelectric power, only the half of the projected electricity demand can be supplied in the year 2023. Due to the scarcity of domestic fossil resources, the country has been closing the gap between the energy demand and domestic supply by importing huge amounts of fossil fuels, mainly oil and natural gas, which causes significant risks in financial, political, social, and environmental frameworks. The solution lies in the diversification of energy sources to mitigate such risks. Hence, nuclear energy seems to be an ideal alternative since it provides an economically viable option to secure energy supply to achieve sustainable development goals as well as reducing GHG emissions. Not only to meet the projected electricity demand to reach the country's aim for economic growth, but also to cut back its vulnerable reliance on Russian and Iranian gas for electricity, Turkey opted to build nuclear power plants with in the country by utilizing IGAs.

When it comes to nuclear energy, the top priority becomes the safety and security aspects. Therefore, some comprehensive and supplementary specific legal and regulatory frameworks are required. In fact, Turkey is party of a full range of international conventions related to nuclear safety and security. The current legal framework of Turkey, is consistent with IAEA safety requirements, international agreements, in not every but most of the aspects of nuclear safety and security. However, in Turkey, nuclear energy policy faces a variety of risks and challenges.

Although the county has sufficient capacity and willingness to initiate nuclear power, considering the size of its economy (GDP over $717 billion in 2015), the power infrastructure and growing demand, Turkey needs to fulfill several requirements in the following years to achieve successful and sustainable integration of nuclear power into its energy mix.

First, Turkey must develop a comprehensive and official nuclear policy. The government should prepare a detailed official document explaining how and why nuclear energy is necessary for the country.

Strong national nuclear policy requires strong public support. Thus, Turkey should ensure public participation in developing its national nuclear policy and try to create positive public perception by not only explaining the benefits of NPPs, but also focusing on the adopted high level safety and security measures, considering country's recent situation.

Second, Turkey should ratify New Nuclear Law as the framework national law as soon as possible together with related regulations addressing the major specific lacking areas such as decommissioning, radioactive waste management and, third party liability.

Third, Turkey should establish an independent, well-equipped, and well-organized regulator to ensure the safety of current and prospective nuclear power plants. As the construction of the first NPP, Akkuyu NPP, is expected to start in 2017, enacting the national framework law and establishing an adequate oversight capacity promptly is crucial.

On the other hand, using IGAs and BOOs as a model to build the nuclear power plants shortens the duration and secures the finance, but this method depends highly on sound international relationship, which can also be quite risky since the loose international diplomacy can deteriorate at the very least expected moment. As seen in the conflict between Turkey and Russia, following the Russian jet shut down after it violated the airspace, it slowed down the progress of the Akkuyu NPP in 2015. Moreover, the unending war in Syria has a great potential to cause further conflicts in between two countries. Ranking in the top 25 most unstable countries in the world and exposed to increased number of recent mortal terrorist attacks by PKK and ISIS as well as escaping from a failed military coup attempt organized by FETO in July, 2016, the country's national security and political stability index deteriorates. These events not only undermine investor's trust in government's nuclear energy plan but poses a remarkable risk on the successful completion of the current projects.

Finally, Turkey must develop a long-term and comprehensive Human Resource Development Program in the field of Nuclear Energy by collaborating with universities and other competent national and international organizations, to ensure having sufficient nuclear plant operators, engineers, scientists as well as regulators for the next decades as nuclear power is a long-term commitment affecting not only the current but subsequent generations.

APPENDIX

1- INTERNATIONAL MULTILATERAL AGREEMENTS/CONVENTIONS

NAME	SIGNATURE DATE	RATIFICATION DATE
Paris Convention on Third Party Liability in the Field of Nuclear Energy	29.07.1960	13.05.1961-10806
Protocol to Amend the Convention on Third Party Liability in the Field of Nuclear Energy of 29 July 1960	28.01.1964	13.06.1967-12620
Treaty on the Non-proliferation of Nuclear Weapons (NPT)	28.01.1969	28.11.1979-16823
Agreement Between the Government of the Republic of Turkey and the IAEA for the Application of Safeguards in Connection with NPT	30.06.1981	20.10.1981-17490
Protocol to Amend the Convention on Third Party Liability in the Field of Nuclear Energy of 29 July 1960, as Amended by the Additional Protocol of 28 January 1964	16.11.1982	23.05.1986-19115
Convention on The Physical Protection of Nuclear Material	23.08.1983	07.08.1986-19188
Convention on Early Notification of a Nuclear Accident	28.09.1986	03.09.1990-20624
Convention on Assistance in the Case of a Nuclear Accident or Radiological Emergency	28.09.1986	03.09.1990-20624
Joint Protocol Relating to the Application of the Vienna Convention and the Paris Convention	21.09.1988	19.11.2006-26351
Convention on Nuclear Safety	24.09.1994	14.01.1995-22171
Comprehensive Nuclear Test Ban Treaty	03.11.1999	26.12.1999-23918
Protocol Additional to the Agreement Between the Government of the Republic of Turkey and the IAEA for the Application of Safeguards in Connection with NPT	06.07.2000	12.07.2001-24460
Protocol to Amend the Convention on Third Party Liability in the Field of Nuclear Energy of 29 July 1960, as Amended by the Additional Protocol of 28 January 1964 and by the Protocol of 16 November 1982	12.02.2004	Awaiting approval
Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management	-	Awaiting approval

2- BILATERAL AGREEMENTS

2-1- Bilateral Cooperation Agreements

NAME	SIGNATURE DATE	RATIFICATION DATE
Agreement Between the Government of Canada and The Government of the Republic of Turkey for Co-operation in the Peaceful Uses of Nuclear Energy	18.06.1985	29.06.1986-19149

Agreement Between the Government of the Republic of Turkey and the Government of the Argentine republic for Co-operation in the Peaceful Uses of Nuclear Energy	03.05.1988	08.02.1992-21136
Agreement Between the Government of the Federal Republic of Germany and the Government of the Republic of Turkey for Cooperation in the Peaceful Uses of Nuclear Energy	14.01.1998	Awaiting approval
Agreement Between the Government of Korea and The Government of the Republic of Turkey for Co-operation in the Peaceful Uses of Nuclear Energy	26.10.1998	12.04.1999-23664
Agreement Between the Government French Republic and The Government of the Republic of Turkey for Co-operation in the Peaceful Uses of Nuclear Energy	21.09.1999	25.02.2011-27857
Agreement Between the United States of America Concerning and The Government of the Republic of Turkey for Co-operation in the Peaceful Uses of Nuclear Energy	26.07.2000	09.07.2006-26223
Memorandum of Understanding for Technical Cooperation and Exchange of Information in Nuclear Regulatory Matters Between the Turkish Atomic Energy Authority and The State Nuclear Regulatory Committee of Ukraine	07.06.2005	22.10.2008-27032
Agreement between the Government of the Republic of Turkey and the Government of the Russian Federation for Cooperation in the Use of Nuclear Energy for Peaceful Purposes	06.08.2009	12.02.2011-27844
Agreement between the Government of the Republic of Turkey and the Government of the Hashemite Kingdom of Jordan for the Cooperation in the use of Nuclear Energy for Peaceful Purposes	17.02.2011	Awaiting approval

2-2- Agreements on Early Notification of Nuclear Accidents

NAME	**SIGNATURE DATE**	**RATIFICATION DATE**
Agreement Between The Government of Turkey and the Republic of Bulgaria on Early Notification of a Nuclear Accident and Exchange of Information on Nuclear Facilities	28.07.1997	11.09.1997-23107
Agreement Between the Government of the Republic of Turkey and the Cabinet of Ministers of Ukraine on Early Notification of a Nuclear Accident and Exchange of Information on Nuclear Facilities	23.11.2000	02.05.2001-24390
Agreement Between The Government Of The Republic Of Turkey And The Government Of Romania On Early Notification Of A Nuclear Accident	03.03.2008	16.05.2008-26878

Agreement between the European Atomic Energy Community (EURATOM) and Non-member States of the European Union on the Participation of the Letter in the Community Arrangements for the Early Exchange of Information in the Event of Radiological Emergency (ECURIE)	26.07.2005	Awaiting approval
Agreement between the Government of the Republic of Turkey and the Government of the Russian Federation on Early Notification of a Nuclear Accident and Exchange of Information on Nuclear Facilities	06.08.2009	12.02.2011-27844

3- AGREEMENTS/PROTOCOLS WITHOUT RATIFICATION

NAME	SIGNATURE DATE
The Cooperation Protocol between Turkish Atomic Energy Authority and Institute of Nuclear Physics of Ozbekistan Academy of Sciences for the Peaceful Uses of Nuclear Energy	06.11.1998
Protocol for Cooperation between Academy of Sciences of Tajikistan and Turkish Atomic Energy Authority for Peaceful Uses of Nuclear Energy	12.11.2002
Agreement between the Turkish Atomic Energy Authority and the Federal Environmental, Industrial and Nuclear Supervision Service for Co-operation in the Field of Nuclear Licensing and Supervision	08.06.2010
Co-operation Program between the Turkish Atomic Energy Authority (TAEK) and the State Nuclear Regulatory Inspection (SNRCU) for 2011-2012	25.01.2011
Arrangement for Cooperation between the Radiation and Nuclear Safety Authority of Finland and the Turkish Atomic Energy Authority	20.09.2011

APPENDIX 2

Laws, Decrees, Regulations, and Guides Concerning the Safety of Nuclear Installations

Laws

1. Law on Turkish Atomic Energy Authority, 1982

Decrees

1. Decree on Licensing of Nuclear Installations, 1983
2. Decree on Radiation Safety, 1985

Regulations

1. Regulation on Working Procedures of Atomic Energy Commission, 1983
2. Regulation on the Establishment and Working Procedures of Advisory Committee on Nuclear Safety, 1997
3. Regulation on Radiation Safety, 2000
4. Regulation on Physical Protection of Nuclear Materials and Nuclear Facilities, 2012
5. Regulation on Nuclear Material Accounting and Control,2012
6. Regulation on Basic Requirements on Quality Management for the Safety of Nuclear Installations, 2007
7. Regulation on Nuclear Safety Inspections and Enforcement, 2007
8. Regulation on Safe Transport of Radioactive Material, 2005
9. Regulation on Nuclear and Radiological National Emergency Preparedness, 2000
10. Regulation on Specific Principles for Safety of Nuclear Power Plants, 2008
11. Regulation on Design Principles for Safety of Nuclear Power Plants, 2008
12. Regulation on Site of a Nuclear Power Plant, 2009
13. Regulation on Issuing Document Base to Export Permission for Nuclear and Nuclear Dual Use Items, 2007
14. Regulation on Protection of Outside Workers in Controlled Areas from the Risks of Ionizing Radiation, 2011
15. Regulation on Radioactive Waste Management, 2013
16. Regulation on Clearance in Nuclear Facilities and Release of Site From Regulatory Control, 2013.

Documents and Guides

1. A Guide on Fire Protection in Nuclear Power Plants
2. A Guide on Documentation Examples, Work Instructions and Procedures for the QA Program for Survey, Assessment and Approval of Nuclear Power Plant Sites
3. A Guide on External Man-Induced Events in Relation to Nuclear Power Plant Design
4. A Guide on Seismic Design and Qualification of Nuclear Installations
5. A Guide on the Earthquake Related Subject Requested in the Issuance of Limited Work Permit and Site License, 1989
6. A Guide on Establishing and Implementing a Quality Assurance Programme for Safety in Nuclear Installations, GK-KYS-01, 2009
7. A Guide on Management of Non-Conformance Control and Corrective Actions for Safety in Nuclear Installations, GK-KYS-02, 2009
8. A Guide on Management of Document Control and Records for Safety in Nuclear Installations, GK-KYS-03, 2009
9. A Guide on Inspection and Testing for Acceptance for Safety in Nuclear Installations, GK-KYS-04, 2009
10. A Guide on Assessment of the Implementation of the Quality Assurance Programme for Safety in Nuclear Installations, GK-KYS-05, 2010
11. A Guide on Quality Assurance in Procurement of Items and Services for Safety in Nuclear Installations, GK-KYS-06, 2010
12. A Guide on Quality Assurance in Manufacturing for Safety in Nuclear Installations, GK-KYS-07, 2011
13. A Guide on Quality Assurance in Research and Development for Safety in Nuclear Installations, GK-KYS-08, 2011
14. A Guide on Establishing and Implementing a Quality Assurance Program in Siting for Safety in Nuclear Installations, GK-KYS-09, 2010
15. A Guide on Quality Assurance in Design for Safety in Nuclear Installations, GK-KYS-10, 2011
16. A Guide on Quality Assurance in Construction for Safety in Nuclear Installations, GK-KYS-11,2011
17. A Guide on Quality Assurance in Commissioning for Safety in Nuclear Installations, GK-KYS-12, 2011
18. A Guide on Quality Assurance in Operation for Safety in Nuclear Installations, GK-KYS-13, 2011
19. A Guide on Quality Assurance in Decommissioning for Safety in Nuclear Installations, GK-KYS-14,2011
20. A Guide on Format and Content of Site Report for Nuclear Power Plants, 2009
21. A Guide on Specific Design Principles, 2012

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