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FUTURE DEMAND FOR NUCLEAR ENERGY IN TURKEY

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Abstract

In recent years, as a result of growing technological developments (in health care, military, etc.) conventional energy sources are draining therefore the demand for new energy sources raises day by day. Particularly, countries those have limited conventional energy sources have started using nuclear energy to prevent future energy problems. Turkey is a foreign dependent country because of insufficient energy production. Especially in recent years, the need for renewable energy sources has been increasing day by day. In this respect, the importance of nuclear energy and the establishment of nuclear power plants for its production will greatly reduce the foreign dependency. Establishment of nuclear power plants will affect many sectors like electricity, health, agriculture, military, etc., directly and indirectly. As a result, a greater contribution will occur in economy and jobs in Turkey. In this study, a literature research is performed about the necessity of nuclear energy and the establishment of nuclear power plants in Turkey. Also, it is aimed to light the way to other researchers who will work on this subject.

Key words: *Nuclear energy, Renewable energy, Nuclear power plant*

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1. Introduction

Present, energy requirements are growing because of developing technology and growth in world population. On the other hand, reserves of world's conventional energy resources decrease which will be unable to supply the demand for energy in the future. There are two alternative solutions to this problem: the first is to use existing energy sources more efficiently; the second is to found new energy sources and make them ready to use [1].

Turkey does not have rich energy sources which is the greatest indicator that shows economic growth [2]. Primary energy sources (fossil fuels, biomass, solar energy, etc.) that Turkey have are insufficient to supply existing demand for energy. Due to the limited amount of domestic reserves and their low production capacities, a large amount of energy is supplied through imports. For this reason, Turkey is paying a high price for energy imports, and the number of payments is increasing day by day in parallel to its demand. In addition to not having nuclear energy in Turkey's energy resources, the share of renewable energy sources is also very low. This situation, which leads to an inadequacy of resource variety, necessitates energy importation and makes Turkey a foreign-dependent country [3, 4].

In order to achieve the goal of bringing the economy to the level of developed countries with sustainable development, Turkey should get energy cheaply and as local as possible. Nuclear power is very important to realize this primary objective [2].

For this reason, it would be a good alternative solution for Turkey having nuclear power plants for energy production [2]. Nuclear power is used in many areas like agriculture, boating, military, and medicine.

Most of the previous studies are related to nuclear energy and environmental problems. This article is about the implementation of nuclear power plants and the advantages of using nuclear energy in Turkey. In this study; considering Turkey's current energy production, a literature review was conducted about the necessity of nuclear energy and establishment of nuclear power plants in Turkey.

2. Current Energy Status of Turkey

When total energy production and consumption is considered, Turkey is a foreign-dependent country [4]. Renewable energy sources (the wind, biomass energy, etc.) don't have sufficient productivity. In Table 1, sources and amounts of total energy consumption are shown between 1980 and 2015.

Table 1. Sources and amounts of total energy consumption between 1980 and 2015 (Thousand TOE) and their ratios (%) [5].

Year	Coal	Crude oil	Natural gas	Hydroelectricity	Renewable energy	Other
1980	6794 (20.6%)	16074 (48.8%)	21 (0.1%)	976 (3%)	60 (0.2%)	9024 (27.4%)
1990	15915 (30.2%)	23901 (45.4%)	2804 (5.3%)	1991 (3.8%)	398 (0.8%)	7672 (14.6%)
2000	22452 (28.4%)	32297 (40.8%)	12378 (15.6%)	2656 (3.4%)	1266 (1.6%)	8101 (10.2%)
2005	21840 (24.6%)	32192 (36.3%)	22294 (25.2%)	3402 (3.8%)	1297 (1.5%)	7617 (8.6%)
2010	30864 (29.2%)	29221 (27.6%)	31474 (29.7%)	4454 (4.2%)	2582 (2.4%)	7232 (6.8%)
2015	33942 (26.3%)	39238 (30.4%)	39651 (30.7%)	5775 (4.5%)	6974 (5.4%)	3687 (2.9%)

According to statistical data of 2010 which is obtained from the Ministry of Energy and Natural Resources, while total domestic energy production is 32,493 thousand toe (tons of oil equivalent), 87,409 thousand toe of energy is imported. Hereunder, this shows 80% of foreign dependency in terms of energy production. Currently, 75% of electric generation is supplied using foreign dependent sources like natural gas, coal, crude oil. In 2023, it is foreseen that consumption of electricity will be 500 billion kWh in total and 6000 kWh per capita. In addition to hydraulic energy potential, even if all of its

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renewable energy potentials such as the wind, the sun, geothermal, biomass are used, Turkey cannot supply half of the 500 billion kWh energy consumption which will be achieved by 2023. Therefore, it is obliged to find new ways to produce and use energy more efficiently [5].
One of the most important types of energy that will supply the demand is to move to nuclear energy for energy generation.
Electricity generation provided by the establishment of nuclear power plants will reduce imports of fossil fuels used in thermal power plants or at least prevent increasing of fossil fuel consumption. Low and stable production costs of nuclear power plants will provide Turkey's energy market a competitive structure which is desired to be provided. Also, intended nuclear power plants will provide external benefits in many ways such as: not releasing greenhouse gases, providing heat that can be used in industry and accommodation, job creation, and enabling hydrogen production [3].
Turkey's goal is to supply 5% of its energy needs using nuclear energy by 2020 [2].

3. Necessity of Nuclear Energy Production and Nuclear Power Plants in Turkey

Exhaustive investigation and planning studies considering Turkey's known primary resource reserves and potentials, growth in energy technology and the expected developments show that nuclear energy should be utilized to supply the large electrical power demand that will occur by 2020. It has become mandatory to construct a nuclear power plant in order to own nuclear technology.
Turkey is a country with limited available energy sources and high demand for energy import. Since foreign dependence is increasing for energy, diversification of imported energy types is necessary. Because it does not have rich fossil energy sources and imports 71.8% of required energy from foreign countries. If new investments have not be made on renewable and domestic energy sources, the foreign dependency rate on energy will increase every year. This dependency could lead to huge problems, both economically and in terms of Turkey's security of supply because the fossil fuel prices are rising every year [6].
Nuclear power plants do not pollute the environment like coal, petroleum and natural gas based thermal power plants which emit CO2, NOx and SO2 gases and like coal-based power plants which cause acid rain and produce radioactive ashes. For this reason, nuclear energy which is a clean, safe, economical and suitable way for continuous production, has become a mandatory solution for Turkey's energy production.
When the world's nuclear power plants are observed, 3 of the most developed countries have half of the world's nuclear power plants: the US with 104, France with 58, Japan with 51 (213 in total). France supplies 74.1% of its electricity from nuclear power plants. Also, there are 32 nuclear power plants in Russia, 18 in the UK, 21 in South Korea and 15 in Ukraine. Turkey's neighbors are currently running nuclear power plants: 1 in Armenia, 2 in Bulgaria, 1 in Iran, 3 in Pakistan and 2 in Romania.
By the agreement signed between Turkey and Russia in 2010, construction of the Akkuyu Nuclear Power Plant was started in Gülnar district of Mersin which will provide 4800 MW correspond to 6% of Turkey's electricity production. Likewise, another agreement is signed with Japan to construct Sinop Nuclear Power Plant which has similar technical specifications with Akkuyu Nuclear Power Plant [4].
By this way, Turkey plans to fulfill at least 10% of the installed capacity of electrical power and 17% of the electricity consumption through nuclear power plants by 2023. After establishing Akkuyu and Sinop nuclear power plants, domestic and renewable energy sources will continue to be used with maximum capacity but 7.2 billion dollars will be saved from natural gas imports [7].

4. Structure of Nuclear Energy Power Plants

When the internal structure of the nuclear power plant is observed, it is seen that the energy is generated by the uranium (U-235, U-233, U-238) through a nuclear fission and it heats the steam to extreme temperatures. This high-temperature steam is directed to the turbines which are connected to the electric

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generators. High-energy steam strikes to the turbine blades so the turbine shaft rotates and the generator converts mechanical energy to electrical energy and generates electricity. The electricity generated by the generator is carried using conducting wires and directed to consumers through power lines. The steam which has low pressure and relatively low temperature lefts the turbine and is directed to the condenser where it becomes water after condensation. Emission of fission energy heats the water and it becomes steam again. This way the cycle continues. Figure 1 shows the structure of a nuclear power plant and Figure 2 shows sample photos for nuclear power plants [8].

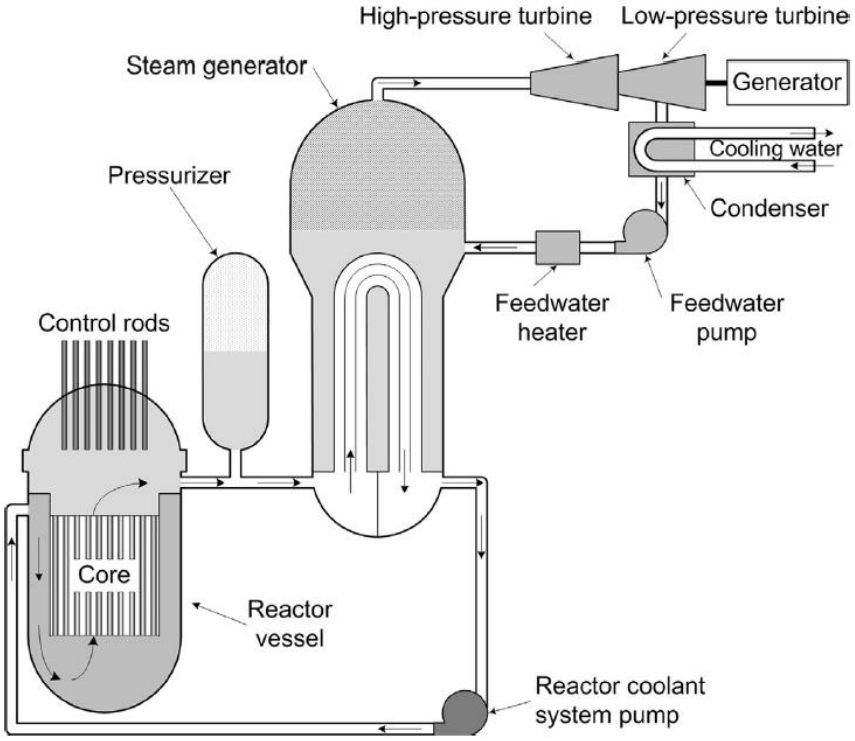

Fig. 1. The structure of nuclear power plant [8].

Fig. 2. Sample photos for nuclear power plants [9, 10].

5. Conclusions

Nuclear energy is not a short-term solution to the energy problem in Turkey's present condition. Hence, it is necessary to follow a conservative nuclear energy policy based on resources, involving nuclear technology development and decreasing foreign dependence [11]. Before deciding on a nuclear power plant, construction method, financial model, technology implementation, and nuclear waste management should be discussed and foreign dependency should be carefully examined [12]. Nuclear

power plants should be designed in accordance with the safety regulations and should be established and run in convenient areas.

In today's competitive world, one of Turkey's goals for year 2023 is to become a country with strong economy. Therefore, foreign dependence should be eliminated and limited sources should be expanded. Limited availability of areas for renewable energy plants and their performance alteration with seasonal change increases the demand for nuclear energy in Turkey. Nuclear power plants seem to be a mandatory solution for Turkey’s energy production to reach the level of developed countries by energy capacity. Except nuclear power plant’s initial investment cost, it does not have a higher cost of production. On the other hand, establishment of nuclear power plants in Turkey will provide employment and help technology development besides electricity production.

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