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Nuclear energy and opportunities to benefit from it in Libya

Abdalfettah Aljedk1*

[1] Electrical and Electronics Engineering, Faculty of Engineering / Bani waleed University, Libya

*Crosspnding author: Abdalfettahaljedk@bwu.edu.ly

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Abstract: The exponential growth in population requires a parallel increase in the total electrical energy to feed all loads with electrical energy. Diversity, independency of resources and global warming call for installing renewable and nuclear energy plants.. Where there are many renewable energy sources that can be used in Libya, including nuclear energy; Yet nuclear power with its many attractive features is not used at all. This study presents the energy resources available in Libya and reviews the main challenges and opportunities in the field of nuclear energy. At the end of this paper some conclusions are mentioned.

Keywords: (electrical energy, renewable energy, nuclear power plants, nuclear energy).

Introduction

Nowdays, The population of Libya 8,732,299 million people in 2023, has been as a small country in the world than have population. [Head of the Civil Registry Authority in Libya] Despite the remarkable growth in energy consumption in the last five years due to the large population base, the rate of domestic energy generation still lags behind that of other neighboring countries. Thus, Libya depends mainly on non-renewable energy sources (fuel energy). Because energy is one of the most important strategic requirements for developing countries . Libya's primary energy resources include hard coal, oil and natural gas.

Libya is also witnessing a rapid growth in the demand for electricity and potable water at a low cost, and according to the recent studies. the demand for electricity in Libya will exceed 10,000 MW by the year 2030, unless alternative energy is produced and systems are applied to conserve energy sources.

In order to build or establish a program that provides a huge amount of increasing demand and the development of technical knowledge, skills and experience, Libya needs a balanced and feasible mixture between renewable energies , nuclear energy and fossil fuels so that it is effective, practical, economically serious and sustainable in order to produce energy, which in turn will allow the preservation of energy resources Libya of oil and gas for the future of future generations.

The future of nuclear energy in the world

Nuclear energy supplies the countries of the world with more than 16% of the electrical energy; It supplies 35% of the needs of the European Union. Japan obtains 30% of its electricity needs from nuclear energy, while Belgium, Bulgaria, Hungary, Slovakia, South Korea, Sweden, Switzerland, Slovenia and Ukraine depend on nuclear energy to supply a third of its energy needs. Because the amount of nuclear fuel required to generate a large amount of electrical energy is much less than the amount of coal or oil needed to generate the same amount[1]. One ton of uranium generates energy Electricity greater than millions of barrels of oil or millions of tons of coal. Solar energy cost is much

greater than the costs of nuclear power. It does not release harmful gases into the air, such as carbon dioxide, nitrogen oxide or sulfur dioxide, which cause global warming, acid rain and smog. The source of nuclear fuel (uranium) is readily available and easy to obtain and transport, while the sources of coal and oil are limited [2]. Nuclear power generation plants occupy small areas of land compared to power plants that depend on solar energy or wind energy. However, the use of nuclear energy causes the production of harmful radiation and reduces The degree of its radioactivity After that, it can be recycled and reprocessed to recover the uranium and plutonium that have not yet fissioned, and use them again. For thousands of years, there is no safe system for the disposal of this waste, but nuclear research centers around the world are working on finding modern technology to solve this issue.

Nuclear energy and its future in Libya

The State of Libya does not need nuclear energy for the current generation because it does not have a problem in providing energy due to the presence of oil and gas, but how will future generations Will you manage? Oil is an important thing for human life, not only for engines or power generation, but even in the clothing industries, for example, which oil is threatened with depletion. As for solar energy, it is clean and excellent, but what do we do when evening comes and the sun sets? So we have to develop it in order to store it, but also that is not easy, so it is difficult to be a major source of energy. It is also financially expensive, and it is true that solar energy is widely available in Libya. But if we want to establish a solar power station, the price will be very expensive, reaching five or ten times the construction of a nuclear power station. The problem is that climate change is one of the challenges of energy use, which will require us to use oil reasonably, a country that has abundant financial resources, which makes it have the ability to build nuclear plants for the benefit of future generations, as it will use oil to export and obtain revenues and use nuclear energy to generate electricity, which is strategic good. And if we calculate this, then one gram of uranium produces as much energy as it produces about 1800 liter of oil and three tons of coal [3].

Nuclear energy and how to succeed in Libya

Libya is one of the countries that showed good interest in this type of energy, and actively sought to establish a nuclear plant at the end of the eighties and the beginning of the nineties of the last century, and an agreement was reached with a Russian company in this regard to establish a nuclear plant with a capacity of MW 1000 south of the city of Sirt. However, the political circumstances and the country's foreign relations prevented the implementation of the project. Nuclear reactor projects are scientific and technical projects that will not be successful without the following considerations:[4].

1- Spreading scientific awareness among intellectuals and the general public of the importance of using and exploiting nuclear energy in generating electricity, and introducing them to the positive returns from that.

2- Supporting scientists and intellectuals towards directing the government and the state to the scientific policy that results in supporting and establishing scientific projects. 3- Benefiting from the experience of modern countries that use nuclear reactors to generate electric power.[5]

4- Negotiating well with private companies to build nuclear reactors and obtaining adequate international guarantees.

Comparison between nuclear energy and other energies

Nuclear energy is the best means today to provide the world with electric energy, and it is efficient compared to all other energy sources, and its production cost is the lowest compared to other energies. As the importance of relying on nuclear energy has increased in light of the relative consideration of its costs, and its facilities can be established next to the consumption sites easily without the need for

complex transportation and supply arrangements. In addition, nuclear energy is not linked to specific climatic conditions, as is the case with solar energy, wind energy, and water energy. Nuclear energy is clean energy that does not contribute to global warming. In this regard, the former inspector of the International Atomic Energy Agency (IAEA), Hans Becks, stated, That "the danger of global warming is greater than the threat of weapons of mass destruction to the environment," and he also stressed the need to reduce gas emissions and rely on peaceful nuclear energy to obtain electric power without polluting the atmosphere with gases [6][7].

Advantages of using nuclear energy

1 - Diversity and Security First and foremost, installing nuclear power plants on a system improves the security and diversity of that system. In the event of unexpected accidents or disasters, a system fed from several types of resources can be more stable and secure. Moreover, diversity provides more alternatives to unit commitment and spinning tanks, resulting in better economic operation of the power system for both producing companies and consumers[8].

2 – table[1] of shows carbon dioxide emission rates from coal, oil, gas, solar energy, wind energy and nuclear energy. Renewable resources and nuclear energy represent a friendly alternative solution to global warming. In fact, a very attractive feature of nuclear power plants is that about 10-30 grams of carbon dioxide is emitted per kilowatt-hour of energy through the entire energy chain. This is the same rate of emission as in wind power and much lower than coal, oil and natural gas [9], [10]. Accordingly, a large part of the global energy consumption is increased from renewable and nuclear resources, as it will be the least contribution to global warming.

Table 1: CO2 EMISSION RATES

Energy Resource	CO2 Emission Normalized Rate to nuclear (min-max) (gram/kWh)
Coal	900-1200	30-120
Oil	700-900	23-90
Gas	350-900	12-90
Solar	100-200	3-20
Wind	10-75	1-7
Nuclear	10-30	1

3- The Cost : The cost of nuclear energy is cheaper than other alternatives. This has been confirmed by independent studies by the Ontario Energy Authority (OPA) and the Organization for Economic Co-operation and Development[19]. Recent global trends toward higher fossil fuel prices combined with lower interest rates, lower inflation, and the increasing importance of carbon emissions as a direct cost of power generation have improved the relative economics of nuclear power [11].

although gas, coal and nuclear are the lowest cost options according to global surveys, the discount rate plays a significant role in determining overall cost effectiveness. With the large initial capital costs of developing nuclear generation and the relatively low cost of fuel on a per kilowatt-hour basis, the

discount rate plays an important role in determining the relative costs across these options. At a discount rate of 5%, the stable cost of nuclear power is $29/MWh compared to $47 for natural gas. But at a 10% discount rate, nuclear generation costs $43/MWh compared to $51 for natural gas"[12].

4- Other advantage of using nuclear energy which involve it's strong performance record over decades of experience and continuous improvements in its reliability, safety and lower operating costs. Moreover, stability of supply and KWh price is ensured and this can help in hydrogen economy. In addition to the fact that nuclear plants have minimal environmental impacts, since waste volumes are small and manageable, spent fuel storage is no longer a technical issue but rather a political decision [13].

Need to take into consideration In the cost of using nuclear

There are three main issues need to be taken into account during the use of nuclear energy 1. Nuclear safety and security Like the Chernobyl plant accident in 1986, the ever-desired end to nuclear plants. Indeed, when such a catastrophe strikes, many lives can be lost and thousands suffer health disorders, as well as serious environmental impacts that can add to long-term concerns. In the case of Chernobyl, it was clear that poor management and outdated reactor design were the main culprits. After the accident of 1986 in particular, international agreements and the nuclear safety system were reviewed and some of them were concluded to enhance the safety of nuclear activities [14]. Nuclear security at the same time is another major concern. That is, nuclear facilities must be protected and nuclear materials and radioactive sources must be well monitored.

2. Nuclear materials as a source of radiation All types of nuclear materials involved in the nuclear energy chain may emit beta, gamma, and/or protons, neutrons, alpha particles, and fission fragments. These radiations can pose risks to workers and the environment [15]. Hence, ensuring that nuclear material is well managed and controlled at all stages from production to storage under an authorized regulatory regime is essentially a national task. In addition, international systems may be parallel to national systems to improve global nuclear safety. Considering the disposal of spent fuel, about 10,000 tons of spent fuel annually is a small amount compared to the 28 billion tons of waste carbon dioxide from fossil fuels that are released directly into the atmosphere. However, being a highly hazardous material, radioactive waste is a matter of concern to the public despite experts stressing the safety of geological disposal.

3. Natural disasters: Natural disasters may threaten nuclear plants if they are not well designed to withstand expected natural disasters. For example, the Cooper Nuclear Power Plant experienced flood waters on the Missouri River near Brownville in July 1993 and the operator was forced to shut down the reactor [16]. In addition, hurricanes and tornadoes are another threat to nuclear plants; The Davis Base Nuclear Power Plant near Toledo, Ohio, was hit by a hurricane and winds caused an off-site power loss that automatically shut down the reactor [17]. Moreover, the recent disaster in Japan (the Fukushima nuclear accident in 2011) has resulted in a relapse in the republic's public opinion towards nuclear power.

The economic aspect of using nuclear energy

1-The nuclear reactor construction project has been considered one of the long-term projects from the economic, strategic and national perspectives.

2- Availability of means of protection and safety more than before as a result of avoiding defects and shortcomings in old nuclear reactors, the most famous of which is the Chernobyl reactor accident in the former Soviet Union and the nuclear reactor disaster in Fukushima, Japan, following the earthquake. 3- Increased global demand for electric power. 4- The rapid increase in the cost of electric

power generation generated by fossil fuels, which makes nuclear power generation an attractive economic option.[18]

Nuclear energy and it's development in Libya and the Arab world

Nuclear energy has countless peaceful uses, and all of them achieve great economic benefits for the countries that use them, and Libya and the Arab countries can achieve great economic gains if this energy is used on a large scale and in studied ways, and given the presence of vast areas of desert lands in Libya and the Arab world, storming the desert for the purpose Development is one of the basic purposes that must be taken into account in any direction of economic and social development in Libya and the Arab world, and in this regard nuclear energy can play a very important role in the development of desert areas by addressing the problems of the desert environment, especially energy, agriculture and water[19]. Nuclear energy is used in desert development by providing energy and clean water for the benefit of human, agricultural and industrial development in these arid regions.

Conclusion

Libya is a very large country with a land area of 1,800,000 Km^2 and a small population of 8,732,299 million in 2023. By 2030 the population of Libya will increase to 10 million, this growing population definitely needs an increase in energy supply and it must be in parallel with The same rate of increasing electricity generation in general and installing new types of power stations is required and welcome in any energy supply system. Given the lack of nuclear energy resources in Libya, the installation of nuclear power plant(s) is important for diversity and national independence as well. Having much lower carbon dioxide emission rates than coal and gas plants adds another attractive environmental advantage. Moreover, the stability of energy prices and stability in generation invite investors to invest in nuclear energy. On the other hand, this energy resource involves challenges and issues that must be taken into account. Among these challenges, the establishment of a national regulatory system based on the results of the long experience gained by other countries in the use of nuclear energy and international or regional cooperation is also required to ensure security and safety. In addition, it must be disposed of. radioactive waste very safely. Finally, natural disasters also pose a critical challenge, if the National Nuclear Authority decides to build a nuclear plant(s), the site must be chosen carefully and the construction constructed in such a way as to take into account all natural disasters.

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