Dirassat & Abhath
The Arabic Journal of Human and Social Sciences

مجلة دراسات وأبحاث
المجلة العربية في العلوم الإنسانية والاجتماعية

EISSN: 2253-0363
ISSN : 1112-9751

THE FUTURE OF NUCLEAR DEVELOPMENT IN ALGERIA

مستقبل التنمية النووية في الجزائر

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تاريخ الاستلام : 2020-07-01 **تاريخ القبول :** 2020-09-25

Abstract :

Algeria has future programs of cooperation with the International Atomic Energy Agency, its classic and new partners. Programs rely on nuclear energy for sustainable development programs in Algeria. What prompted Algeria to adopt nuclear development programs are not only modern trends of clean energy, but fear of oil and gas depletion. For this reason, a number of efforts have been made at the field and legal level to achieve sustainable nuclear development. However, there are many difficulties, the most important of which is that Algeria does not have a nuclear plant. It will also face the problem of distributing nuclear electricity from reactors to recover high production costs.

Keywords: development programs, nuclear development, future programs, the International Atomic Energy Agency, nuclear energy.

ملخص :

تمتلك الجزائر برامج مستقبلية للتعاون مع الوكالة الدولية للطاقة الذرية وشركائها الكلاسيكيين والجدد. حيث إن ما دفعها إلى تبني برامج التطوير النووي ليس فقط اتجاهات حديثة للطاقة النظيفة ، بل الخوف من نفاد النفط والغاز. لهذا السبب ، تم بذل عدد من الجهود على المستوى الميداني والقانوني لتحقيق التنمية النووية المستدامة. و لكن هناك صعوبات كثيرة ، أهمها أن الجزائر لا تملك محطة نووية. كما ستواجه تحديات توزيع الكهرباء النووية من المفاعلات لاسترداد تكاليف الإنتاج الباهظة.

الكلمات المفتاحية : برامج التنمية ، التنمية النووية ، البرامج المستقبلية ، الوكالة الدولية للطاقة الذرية ، الطاقة النووية.

1. INTRODUCTION

Proposals for sustainable development in Algeria include economic growth, the legal dimension, environmental protection and access to clean energy. Not surprisingly, nuclear energy, which does not produce greenhouse gases, presented as the main solution to sustainable development.

However, this simplified vision of physical, legal, environmental and economic reality, it is indeed necessary to debate carefully to address the question of the compatibility of current and future nuclear energy with sustainable development in Algeria, by enabling the modern nuclear sector to benefit from the security that these energies provide at the development level.

The problem of the generalized use of nuclear energy during the coming period requires an in-depth and instrumental discussion on the current and future compatibility of this energy, the availability of legal texts and general technologies with sustainable development.

This is what we will try to show by answering the following question:

What is the future for nuclear development in Algeria?

The discussion in our study focuses on the following points of controversy:

- The reasons for Algeria's orientation towards nuclear development, knowing that the potential contribution to the development of developing countries in the nuclear sector is currently characterized by production tools , legal need and technical investments.

- Problems and difficulties that may arise from the use of nuclear energy, such as the risks associated with materials and waste from the nuclear cycle, in particular the fate of highly active long-lived waste.

2. The reasons for Algerian moving to nuclear development.

Industrial and technological development led to fears of depletion of non-renewable fossil energies, such as oil and gas. Put renewable energies as a final solution to energy problem. Nuclear energy is the most important renewable and clean energy, which made countries adopt it as an alternative to other energies because of its various advantages. Like most states, Algeria aim to use nuclear energy in various fields of development. This is what we will try to explain in this part of the article.

2.1. International obligations

Algeria is among the countries that have demonstrated their commitment to pursuing the goals of the International Atomic Energy Agency. In many of the situations the international community has gone through, it has enshrined the principles of nuclear peace and security. Algeria has endeavored to strive to develop its nuclear and energy development technologies[i].

Like other countries, Algeria is required a strictly comply with its international obligations and commitments, the objectives of nuclear non-proliferation and to apply criteria in terms of physical protection and control of imports and exports of materials, nuclear equipment and technologies, and developmental commitments. These commitments are reflected in its adherence to the main international legal instruments - binding and non-binding - in particular those of which the IAEA is the depositary[ii].

By the year 2018, Algeria has signed a set of additional agreements and protocols that would facilitate the conclusion of safeguards agreements and additional protocols for amending or canceling protocols for small quantities and safeguards agreements. Four contracts signed for agreements and research in the nuclear energy field and sustainable nuclear development. The IAEA and Algeria still maintain the content of the research

agreements as of future and strategic importance[iii].

2.2. Energetic needs

In spite of the great achievements that Algeria has made in the field of hydrocarbons, the Algerian Company for Electricity and Gas "SONELGAZ "will not be able to provide the required quantity of energy in the future. Even if Algeria possesses oil and gas in large quantities, but this does not negate its great need for employment the nuclear energy[iv].

Nuclear energy, due to its many advantages, which imply that the amount of fuel required generating a large amount of electrical energy, is much less than the amount of coal or oil needed to generate the same amount[v]. One acre of uranium generates more energy than those who generate barrels of oil[vi]. And their preparation for the post-oil mercy, which is currently blindly dependent on the production of electricity and the protection of water, which led to the necessity of planning to ensure their availability by not relying on a resource that is lost. According to consuming more than half of its reserves, Algeria will have to import oil from 2037, after registering a decline in production, starting from 2007.Algeria's stock of gas must be protected from running out because of the frequent use in the production of energy causes additional trouble and financial costs to Algeria. And it has contributed to the depletion of 48% of the gas reserve[vii].

Algeria has resorted to the production of electric energy through the use of nuclear power plants that produce the least amount of waste compared to other traditional methods of generating energy that harm harmful gases in the atmosphere as dioxide, carbon, nitrogen oxide, or sulfur dioxide as a result of burning fossil fuels, which causes global warming, acid rain and smog[viii].

Using nuclear energy instead of non-renewable energies creates additional costs. The costs of manufacturing and operating nuclear reactors can be recovered as soon as they are used as alternative energy[ix].

2.3. Climate and environmental protection

In 2014, the Fifth Assessment Report of the Intergovernmental Panel on Climate Change (IPCC) Working Group III[x], confirmed the significant potential of nuclear power in decarburizing the global economy and, in particular, the power sector. In scenarios consistent with the objectives of the Paris Agreement[xi], nuclear generation capacity is projected to increase more than twofold (from 383 GW in 2015 to 930 GW in 2050)[xii].

In addition to the stringency of climate policy, the mitigation potential of nuclear power will be influenced by the growth in energy demand and the share of that demand met by electricity. Furthermore, the market share of nuclear power will also depend on the technological development of other cost effective low carbon energy sources (such as wind, solar and geothermal) and, in particular, of CO2 based technologies for which current costs and performances remain uncertain. The most favorable conditions for nuclear power expansion combine high levels of energy demand driven by economic growth and a rapid

transition away from fossil fuel based technologies without CO2. However, the degree of nuclear power expansion in future electricity mixes could be moderated by the faster adoption of energy savings measures whose potential for climate change mitigation is considerable[xiii].

The deployment of nuclear power can also decrease the aggregate global economic costs of reaching stringent mitigation targets[xiv]. It is predicted that the total discounted policy costs would increase by 18% to 23% in the stringent mitigation 2°C scenarios when global nuclear capacity is aggressively phased out relative to cases where nuclear power remains in the fuel mix[xv].

In addition, more economic benefits of nuclear energy could be realized if non-power applications of nuclear energy (e.g. for hydrogen production, nuclear desalination and district heating) were also considered[xvi]. For example, the extent of decarburization of the power sector via the deployment of nuclear and renewable energy will play a key role in determining the mitigation contribution of many options[xvii].

The environmental considerations demonstrate that nuclear choice in the power sector has important implications for the types and magnitudes of environmental impacts incurred when producing electricity.[xviii]. The scale of natural resource use and the release of emissions, effluent and solid waste to the natural environment also means that policy and strategy in the power sector have ramifications well beyond the sector itself. This opens up the possibility for detrimental impacts in other sectors and the likelihood that policies and strategies promoting sustainable development in the power sector can compromise progress towards policy goals in other areas[xix].

3. Algeria's efforts to work on the effectiveness of nuclear development

Algeria is working on energy and technological developments, especially nuclear development, which would consolidate the state's right to the peaceful use of nuclear energy, enjoined to intensify its efforts in the international nuclear cooperation with the International Atomic Energy Agency, and states.

3.1. International cooperation:

The IAEA supports Algeria in a wide range of areas including human health, food and agriculture, management of water resources, nuclear energy and nuclear technology, and helps Algeria to use nuclear techniques to combat the degradation of farm land and make soil more productive. It also helps with the development of irrigation technologies for high-value crops, increasing the incomes of farmers, and makes nuclear techniques available for the development of crop varieties that are more resistant to excessive heat and water shortages[xx].

Mr. Amano commended Algeria for sharing its expertise in the use of nuclear techniques in health care with countries in the region. Saying that: “Algeria has played an important role in several regional IAEA research projects, in particular in the field of nuclear cardiology, and helps to train professionals from other countries in Africa in nuclear medicine, very much appreciate

this valuable contribution to improving medical care for millions of people throughout Africa… Algeria is one of more than 30 countries preparing or considering the introduction of nuclear power, The IAEA will provide technical support to Algerian experts who are conducting an energy planning study on sustainable energy development and preparation for nuclear power" [xxi].

-Algeria and Argentina: signed cooperation agreements in the peaceful nuclear field in 1985 and 2008, which includes ratification of the cooperation agreement for the development and toxic use of nuclear energy and nuclear reactors, "Nur and Salem", pending the construction of a third nuclear reactor[xxii].

-Algeria and China: in 1983 granted Algeria a "peace" nuclear reactor within the framework of an agreement concluded between them, which is in turn subject to the supervision of the International Atomic Energy Commission[xxiii], a second cooperation agreement on March 24, 2008 embodied. These agreements concluded between the two parties are willing to expand and further develop economic, technical and scientific relations[xxiv].

-Russia as an important and traditional partner to Algeria[xxv]. Close cooperation was extended to include cooperation within the framework of employment peaceful nuclear energy after Algeria announced its intention to build a nuclear plant to cover the growing demand for energy and electricity currently produced by conventional methods[xxvi]. Algeria's endeavors did not stop there, but were also able to sign other cooperation agreements.

3.2. Legislation

Although there are many laws and decrees that talk about the rules for the use of nuclear energy and the disposal of radioactive waste ... etc. However, there is one text of law dealing with the peaceful application and uses of nuclear energy. Law n ° 19-05 relating to Nuclear Activities, this law is to regulated the peaceful use of nuclear energy in Algeria, and it means achieving sustainable development, and define the legislative and regulatory framework for activities involving nuclear materials and radioactive sources[xxvii].

Algeria is also trying to catch up with the international system in the use of nuclear energy for sustainable development. For this; The National People's Congress (APN) will continue its work in plenary session devoted to the presentation and debate of the bill relating to nuclear activities. It fixes the basic principles governing nuclear installations as well as the peaceful use of nuclear energy, radiation protection, and the application of nuclear non-proliferation guarantees covering all the obligations contained in the agreement signed with the IAEA[xxviii].

This text of law intervened following an assessment of the national situation of the civil nuclear field which identified the limits of the step, in particular "the absence of legislation governing the nuclear activities in Algeria", according to the explanatory memorandum bill[xxix].

3.3. Nuclear facilities and centers

Algeria has set up many bodies and nuclear energy centers as:

3.3.1. Atomic Energy Governorate

The Presidential Decree on the Establishment of the Atomic Energy Governorate was issued on the occasion of the approval of the Algerian Republic and the International Atomic Energy Agency to implement safeguards related to nuclear non-proliferation. The Atomic Energy Governorate has the administrative control powers to implement the national policy for the promotion and development of nuclear energy and technologies, to inform the national authorities of the latest developments in the fields of peaceful nuclear industry[xxx].

3.3.2. **Nuclear Security Committee**

Presidential Decree No. 14-159, stipulates that nuclear security measures applied to the physical protection of nuclear installations and nuclear materials, and the security of radioactive sources, then to determine in its article 39 the establishment of a nuclear security committee. This is a translation of the Algerian international efforts and its benign endeavor to ensure Safety of nuclear security and ensuring that the Algerian citizen enjoys his right to sustainable development using clean energies[xxxi].

3.3.3. The Nuclear Safety and Security Authority

The prerogatives and attributions of regulatory control of nuclear activities continue to be exercised by COMENA pending the establishment of the Nuclear Safety and Security Authority with the necessary prerogatives and the independence required[xxxii].

3.3.4. COMENA organization

The Atomic Energy Commission was created by Decree No. 96-436 of December 1, 1996, amended and supplemented. COMENA was placed with the Minister of Energy in May 2006[xxxiii]. COMENA's mission is to develop the skills, knowledge and specialized infrastructure required for nuclear energy mastery and development.

The COMENA program is implemented by its operational study and research and training entities:

-The Algerian Nuclear Engineering Training Institute (IAGN), Algiers.

-The Nuclear Security Training and Support Center (CSN), Algiers.

-The Nuclear Engineering Research and Development Unit (URDIN), Algiers.

And the four nuclear research centers According to Presidential Decree 99-86[xxxiv]:

- The Nuclear Research Center in Algeria

- Drariya Nuclear Research Center

- Birin Nuclear Research Center

-The Nuclear Research Center in Tamanghasset

4. Difficulties of nuclear development in Algeria

Many difficulties face Algeria in the nuclear energy field, specifically the nuclear development. Algeria, like other developing countries in the world, did not look to use nuclear energy until late time. While, nuclear states changing their interest from nuclear armament to nuclear peaceful use.

4.1. There is no nuclear plant and industry in Algeria

Of the 434 nuclear power plants (NPPs); currently operating around the world, only two are on the African continent - Koeberg-1 and Koeberg-2 in South Africa. The nuclear industry also has a history of cost overruns and construction delays. Consequently, a country may face a situation in which it needs debt service that is higher than expected while it cannot recover money from nuclear electricity sales[xxxv].

The interests of Algeria in nuclear energy and its peaceful applications go back to the early seventies when a consistent program for training engineers and scientists in nuclear engineering was set up. Opportunity and feasibility studies for the construction of a nuclear power plant were conducted between 1975 and 1984 with the collaboration of IAEA (Austria), Lahmeyer-International (Germany), Sofratome (France) and Nucleotec (Canada). In parallel extensive efforts were made in the field of Uranium exploration and prospection. In 1982 the 'Commission of New Energies' was created and undertook major actions that led to the implementation of basic nuclear infrastructures (nuclear research centers, research reactors, etc)[xxxvi].

Algeria operates the following main nuclear installations, The Nur Reactor, Es-Salem Reactor and the Nuclear Fuel Fabrication Pilot Plant[xxxvii].

The recovery of the economy and the strong increase in energy demand for the production of electricity and sea water desalination gave renew of interest in the nuclear option and prompted the creation of the 'Commission of Atomic Energy' in 1996 and its subsequent merging into the Ministry of Energy and Mines in the year 2006[xxxviii].

4.2. The slow evolution of the contribution of Nuclear power in the production of electricity

Although Algeria is an oil and gas exporting country, acute problems raised by climate changes and the rapid depletion of fossil resources together with the quick rate of increase observed in domestic demand for electrical energy have prompted the government to pay high attention to the issue of energy security of the country. But several strategic decisions were taken to make an improvement[xxxix]:

• The opening of the electric energy market to the private sector (national and international).

• The introduction of specific taxes on environment polluting fuels (such as gas oil …)

• The encouragement of extensive developments of renewable energy alternatives (essentially solar and wind),

• The implementation of the nuclear power alternative in the energy mix of the country (both for electricity production and seawater desalination).

With respect to this last point, it expected that the base load in the national electric generating capacity, for the period 2030 – 2050, will rely on nuclear. Recent studies indicated the need to put in operation a first nuclear power plant (capacity ≈ 1200 MWe) by the year 2020.In order to support

the program several actions are actually in progress:

• The promulgation of the 'National Nuclear Law'

• The creation of the 'Nuclear Regulatory Agency',

• The finalization of the ratification and implementation of all pertinent international and regional conventions and treaties,

• The creation of the 'Algerian Institute of Nuclear Engineering[xl].

4.3. The high cost of developmental nuclear industries:

Algeria -collaborating with the IAEA- is working to overcome the economic challenges by modernizing plant systems to reduce operation and maintenance costs, while improving performance. In addition to its materials research that supports the long-term operation of the nation's of reactors, the nuclear programs are also looking to diversify plant products through non-electric applications such as water desalination and hydrogen production[xli].

As the projected Nuclear Power Plant Construction Costs Are Soaring Companies that are planning new nuclear units are currently indicating that the total costs (including escalation and financing costs) will be in the range of $5,500/kW to $8,100/kW or between $6 billion and $9 billion for each 1,100 MW plant. Algeria needs a strong economy, and to recover costs by selling graduated electricity to neighboring African countries[xlii].

On the other hand, the operating cost of a natural gas plant is higher. Fuel amounts to 50- 65% of the cost of electricity from a gas plant compared to about 15% of the cost of nuclear electricity. As for hydroelectric projects, they require a large outlay for construction but operating costs are relatively small. Comparisons of the economics of various types of power plants having differences in upfront costs, construction times, fuel costs, and other determinants of economic performance are possible with levelized cost methodology[xliii].

5. RESULTS AND DISCUSSION

-Many argue that Algeria's use of nuclear energy is not possible in the long run, that is, the field of development may be delayed until 2025 or 2030 because successful nuclear programs require varied experiences that enable legislative bodies to provide the necessary infrastructure. But this does not mean that Algeria is not able to take initial steps in this. With regard to the possession of about 29 thousand tons of uranium reserves and the optimal exploitation of all its natural and financial resources, it enables it to occupy the second position in Africa in the production of nuclear energy after South Africa, which allows the authority to sweep all Europe.

-Building a nuclear power plant can be a disincentive for stakeholders. Traditional reactor designs are billions of dollars in infrastructure projects. The high costs of capital and approvals for licensing and regulation, along with long periods of time and construction delays, have impeded the public interest.

-Nuclear power generation from uranium not only produces electricity, but also consumes fuel and high-level radioactive waste (HLW) as a by-product. For this HLW it is necessary to find a technical and socially acceptable solution.

-Nuclear energy is not always synonymous with clean energy, as nuclear accidents may happen. Some nuclear accidents caused environmental disasters that affected the principle of sustainable development and the future plans of countries.

-Political turmoil in Algeria has made the use of nuclear energy a deferred program. Most of the policies aimed to promote sustainable development and the use of renewable energies, but nuclear energy was not the first choice.

-Despite the material qualifications of uranium found in Algeria. The use of nuclear energy to develop nuclear development requires scientific, legal, and economic efficiencies.

6. CONCLUSION

Algeria has a firm conviction that international cooperation in the peaceful use of nuclear energy is the key to the successful implementation of a national nuclear energy program. In this context, Algeria has ratified or signed seven conventions related to non-proliferation, safeguards, nuclear safety and nuclear security. Algeria has an excellent program of cooperation with the International Atomic Energy Agency. The programs depend on introducing nuclear energy into sustainable development programs in Algeria. IAEA technical assistance is being carried out in various fields of importance for the introduction of nuclear energy to produce electricity and desalinate sea water. In addition, cooperating agreements with its classic and new partners. That is why Algeria has made efforts to achieve the goal of development using nuclear energy. What motivated Algeria to adopt nuclear development programs not only the recent trends of clean energies, but the fear of oil and gas depletion. That is why it has made a number of efforts at the field and legal levels to achieve sustainable nuclear development. However, there are many difficulties, the most important of which is that Algeria does not have a nuclear plant. It also faces the problem of distributing nuclear electricity from the reactors, to recover the high production costs. Some countries have been able to recover the cost of building nuclear plants and reactors, but the foundations of the African market may not be in the interest of the Algerian nuclear industry. The future and the reality will reveal to us Algeria's readiness to truly implement the nuclear development plans.

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