Trends in development planning for the establishment of nuclear plants in Egypt

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Introduction

Securing the demand for energy for future generations constitutes one of the most challenging aspects to face any sustainable development plans, and given the increasing demand for electric energy in Egypt, and as a country with limited resources from fossil fuels, it must diversify its energy portfolio and use its renewable resources. Under the existing plans, Egypt hopes to produce 20% of electricity from renewable energy by 2020, with the development of the nuclear energy industry, especially in a country whose gas resources are limited; Through the application of these programs, it can build its engineering and industrial base and become a competitive player and regional leader in the global economy.

We note that the existing nuclear energy has a very large positive impact on the environment; Nuclear power plants operating in 29 countries produce 15% of the world's electricity and avoid the emission of more than 2 billion tons of carbon dioxide each year. This saving is equivalent to more than 20% of global carbon dioxide emissions from electric power generation. In light of this, it is considered the appropriate option for Egypt; Because it is a technology that has been proven to be safe, clean
and commercially viable, and capable of generating large percentages of the minimum permanent electrical load; In addition, the nuclear program is in fact the main engine for modernizing the education, production, and industrial systems in Egypt, and in itself it constitutes the building of a comprehensive strategy that ensures the commitment of the Egyptian governments to diversify the national economy.

In this research, the following points will be presented:

**The first axis:** economic indicators to assess the feasibility of different technologies in Egypt

**The second axis:** Efforts to achieve environmental sustainability in Egypt

The first axis: economic indicators to assess the feasibility of different technologies in Egypt

**First: Indicators of the costs of nuclear projects in Egypt**

1- Investment cost in Egypt (capital cost): nuclear units and coal-fired units are characterized by high investment costs and low operating costs, while gas generation is characterized by low capital costs and high operating costs, and photovoltaic and solar thermal energy still suffer from very high investment costs Limit its spread even though it consumes free energy resources. The figure shows that solar energy is still the most expensive technology, gas is the cheapest power plant, and the average investment costs in wind power plants are cheaper than the cost of coal in Egypt.
2- Operation and maintenance costs: It is important to note that these values are subject to change over time due to technological development and the continuous search for cost reduction while improving efficiency; Adequate awareness of the full potential of new technologies and with advanced reactor designs will improve efficiency and reduce costs, and the figure shows that the value of operation and maintenance costs is expected to decrease by about 50% for nuclear energy in 2050, and become the lowest value through different technologies, and this gives a future opportunity Positive for nuclear technologies to invade the Egyptian market, which gave the region an opportunity to integrate it as a basic alternative in the energy mix, and then governments that are considering the development of nuclear energy have to budget for the high initial investment costs and potential delays.
Second: Analyzing the impact of the introduction of nuclear power stations and the extent of their environmental repercussions in Egypt

The impact of integrating a nuclear power plant into the Egyptian electrical grid on prices, carbon dioxide emissions, water consumption and fossil fuel consumption is analyzed.

A-Land requirements for nuclear power plants

When the impacts of power plants on land use are measured by the surface area they occupy during their life cycle, it appears that some renewable energy technologies have heavy land-use requirements; A 1,000 megawatt wind farm would need about 85,240 acres of land (about 133 square miles). To calculate a range of capacity factors (32-47 percent), between 1,900 MW and 2,800 MW of wind energy would be required to produce the same amount of electricity as a nuclear power plant of 1,000 MW per year.
Table No. 9 The approximate area required for wind and solar energy compared to the electricity produced annually by a nuclear power plant of 1,000 megawatts

<table>
<thead>
<tr>
<th>Technology</th>
<th>power index%</th>
<th>Square miles needed for 1000 MW</th>
</tr>
</thead>
<tbody>
<tr>
<td>wind</td>
<td>47-32</td>
<td>360-260</td>
</tr>
<tr>
<td>solar</td>
<td>28-17</td>
<td>75-45</td>
</tr>
<tr>
<td>nuclear</td>
<td>90</td>
<td>1.3</td>
</tr>
</tbody>
</table>

As shown in the previous table, the amount of land needed by solar energy to generate the same amount of nuclear energy is between 45 and 75 km. The table shows the approximate land area needed for wind and solar energy to match it with the electricity produced annually by a nuclear power plant of 1,000 megawatts per year; nuclear plants use less land compared to other energy sources.
B- Land use for nuclear power plants in Egypt

For comparison purposes, as in the figure, the land area required to produce 1,000 megawatts of nuclear power is about 1.3 square miles, and this estimate is based on the average of the 59 nuclear power sites in the United States.

Figure No. 29 Comparison between the production of 1000 megawatts of nuclear plants with wind and solar power plants that produce the same capacity annually

Source: Alghory, S. and Aly, A. LM. (2017), a proposal for national efficient land use planning for power plants in Egypt, an integrated nuclear renewable hybrid energy system, pp 7.

The figure shows that the environmental impacts of nuclear energy projects are economically feasible, as nuclear power plants occupy relatively small areas of land compared to power plants that rely on solar and wind energy; Where it requires the establishment of a solar field area of 45-75 square meters compared to 1 square meter to generate energy equivalent to the generation of a nuclear plant with a capacity of 1000 megawatts.

C - water resources to generate electricity

A large nuclear power plant (one-time cooling system) can draw 800 million to one billion gallons of water per day, and these plants are usually built next to rivers, lakes or oceans, and water consumption factors for electricity generation technologies vary greatly within technology categories, and the lowest factors Operational water consumption is generated by wind power, solar photovoltaic, concentrated solar power, and natural gas cycle facilities that use dry cooling technologies.
D- Pillars of human capital development for nuclear facilities in Egypt

Egypt will have the necessary competencies to manage the nuclear energy program, participate in the implementation of nuclear power plants and operate them safely and efficiently, and based on that vision there is a need for a workforce to develop the pillars of research, safety and industry; Therefore, the government will have to focus on a regular education plan for a competent workforce for the national nuclear program, in accordance with national and international nuclear standards, taking into account the following considerations:

1- Quality control initiatives should include recruitment based on merit and international standards.

2- The way towards a nationalized nuclear program lies in involving the local industry in the national action plans.

3- New nuclear energy states that adopt new reactor technologies must allocate additional time for human resources.

4- National quota policies should be flexible to the needs of new nuclear programs.

Reference:


Mustafa Ansari and Ghassan Alakwaa, (August 2018), MENA nuclear plans stalled as challenges begin to surface, Arab Petroleum Investments Corporation pp1-4.


Case study on the feasibility of small and medium nuclear power plants in Egypt, international atomic energy agency, April 1994, pp 58:66.