

On the Nuclear Option for Sea Water Desalination in the Arab Countries

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Abstract

Water being the most important consumption element in the world. Its world wide availability should be guaranteed to all. The total quantity of water available on earth is about 1000 million km³ and covers nearly 70% of the globe; however 97.5% of the available water is highly saline or brackish.

Arab countries depend in their development, economic and technological programs on fossil fuels as oil and natural gas, which represent 97% of energy consumption in the Arab countries. If we take into account all expectations and indicators concerning the time approach of decay of oil in the Arab region, the situation will be more worth in future, which means the necessity for searching for other energy sources.

Due to the rapid increase in demand for water in Gulf countries; conventional water resources such as fresh surface water and renewable ground water sources are extremely limited. Other alternatives such as waste water reclamation and desalination have been adopted since the 1960.

Desalination of seawater has been commonly used to solve the problems of water supply for municipals and industrial uses. There is increasing government concern about the production cost of desalinated water particularly after the rapid increase of oil prices to about 100\$. There are about 1.483 desalination units operating in the Arabian Gulf countries, which account for 57.9% of the total world wide desalination plant capacity.

In this regard nuclear desalination now appears to be the only technically feasible, economically viable and sustainable solution to meet the future water demands, requiring large scale seawater desalination. Nuclear desalination is economically competitive, as compared to desalination using the fossil energy sources.

The motivation of the present paper was undertaken to show the importance of nuclear power as an important medium to long term alternative option for the Arab countries for both electricity generation and water desalination.

Keywords: Seawater Desalination, Economics of Nuclear Power, Fossil Fuels, Nuclear Energy, Arab Countries.

Introduction

It is well known that 97.5% of the total global stock of water is saline and only 2.5% is fresh water. Approximately 70% of this global freshwater stock is locked up in polar icecaps and a major part of the remaining 30% lies in remote underground aquifers. In effect only a miniscule fraction of freshwater (less than 1% of total freshwater or 0.007% of the total global water stock) that is available in rivers lakes and reservoirs is readily accessible for direct human use. Furthermore the spatial and temporal distribution of the freshwater stocks and flows is hugely uneven hydrologists estimate the average annual flow of all the world's rivers to be about 41.000 km³/y. Less than third of this potential resource can be harnessed for human needs. This is further reduced by pollution such as discharges from industrial process, drainage from mines and leaching of residues of fertilizers and Pesticides used in agriculture. The growing human population crossed the 6 billion mark and is expected to reach 8.3 billion in 2025 and 10-12 billion in 2050.

About 1.1 billion of people living on the global already suffer from a serious lack of freshwater. By 2025 this number will increase to three billion – over 40% of the entire population the crisis will thus occur during 2025 – 2030 about half of world's population will face a serious shortage of water. The global water crisis will hit first Africa, the Middle East South and South East Asia.

It is well known that the Arab world suffers from severe shortage in water resources. The renewable water resources in the Arab region represent less than 1/10 from water sources in the world. The water share for each person in the Arab region doesn't exceed 1744 m³ per year compared with the international share rate of 12900m³ per year for each person.

Status of Water Crisis in Arab Countries

The Arab region is one of the poorest regions in world regarding available water resources. The situation in the countries of the Gulf region is more serious and more complicated, as these countries face a real crisis in their water resources. The total renewable water resources in Gulf countries range between 3-4 Milliar m³ according to statistics in May 2002, and about 10 Milliar m³ annually according to some official estimations. These resources are in the form of rain, floods, underground water and water stored behind dams in south area of Arabic Gulf region. In all cases it doesn't represent more than 3% of total sum of all renewable water resources. The countries of Gulf region depend almost on underground water in frame of its having a strategic reservoir of underground water amounts to 361.5 Milliar m³ annually. This amount represents about 4.6% of total underground water in the Arab countries.

Arab countries are at different stages of development with different resource endowments and income levels. Countries in the Region are Facing Different Challenges:

- Growing energy demand;
- Increasing energy costs;
- Lack of conventional energy resources;
- Increasing dependence on fossil resources;

- Scarcity of water resources;
- Degradation of environmental changes;
- Increasing consumption of fossil resources.

Experts indicate also that consumption rate of oil increases by the rate of 2% each year, in the same time its depression rate by 3%, which means that the oil will decrease by 50 Milliar barrel daily by year 2020 which is six times more than Saudi Arabia production. In 2004 annual consumption of oil was 29 Milliar barrel and it will be 42 Milliar barrel by 2020 and if oil consumption continues without any increase, it will finished in 40 years. In other words the time left from now to the end of oil age may be 25 years or little more.

Strategic studies indicate that Saudi Arabia will consume by 2010 about 175 Milliar barrel of oil, 77 million barrel diesel, 96 million barrel fuel oil for electricity and desalination plants. If we suppose that the price for oil barrel at this time is 70 \$, diesel (13\$) and fuel oil (50\$). The Saudi Arabia will spend to generate energy 27 Milliar \$ in one year in order to generate energy .

Except, the natural gas which used also in energy generation, and which expected that (88) million barrel are going to be burned in year 2010. So the cost of natural gas could be in range between 3 and 5 Milliar \$. So the total coast for all fossil fuel burned to generate energy in Saudi Arabia about 30 Milliar \$ on the minimum in year 2010 as a fuel. In comparison the nuclear power plants are able to generate electricity with cost 64.9 cents/kwh. This energy value is more beneficial than that produced by fossil fuel. This value for energy could be in a competition with natural gas even if its price go down to (4.7)\$ for each million thermal unit, and in competition also with oil if its price go down to 40\$.

Regarding the rapid increase in oil prices and the delay to find an alternative to fusion energy, so the nuclear option for energy crisis will be definite. In a report for IAEA about the future of energy in the world, IAEA warned about the decrease of oil supply in the international markets which will led to increase in gas barrel price sharply and large depression in rate of economy growth Expectations indicate that request for oil will increase by 95.8 million barrel daily at year 2010 in comparison with 6.81 million barrel this year. Moreover depression in production of OPEC by the rate of 2 million barrel daily in year 2009, decrease in production rate of countries outside OPEC by 800.000 barrel daily.

In spite that countries of the Gulf region are producers of natural gas and their export we could neglect their rights to use the nuclear energy in the frame of their strategy after depletion of fossil fuel. According expectations the continuous rapid increase in population and economy by high rates which could led to continuity of growing consumption of electricity and natural gas, petrochemical and potable water by high rates which means more electric power plants and more units for desalination with rapid growing in consumption of fossil fuels as a fuel for this plants.

Desalination has already made a major contribution to quality of life in the most arid regions of the world, particularly the Arab region and North Africa. Without desalination many of these regions would have remained uninhabited.

Desalination technology is providing safe drinking water even to some water rich nations where pollution reduced the quality of natural waters.

The Arab world stretches a cross well over 12.9 Million square kilometers of area including North Africa and part of western Asia known as Arab region.

In order to meet the rising water demand required by an expanding population and developing economy and to fill the gap between supply and demand, the growing technology of desalination is currently providing enormous quantities of water to meet the escalating needs for domestic and industrial sector in many water scarce Arab countries.

Sea water desalination represents now one of the most options to solve water crisis in the Arab countries Internationally the Gulf countries hold the first position in production of desalinated water from sea with production rate attains to $11.99 \cdot 10^6 \text{m}^3$ daily. There are about 60% from desalination projects all over the world in the Gulf countries, Saudi Arabia is the largest producer for desalinated water in the world with sharing approaching one third of the total world production. At present time it is estimated to be about $217 \cdot 10^6 \text{m}^3$ daily compared with $827 \cdot 10^3 \text{m}^3$ in 2001, which provides more than 70% from drinking water needs through 27 plant for sea water desalination of barakish water. The Saudi Arabia government is planning to establish 22 projects for sea water desalination, 16 projects on red sea bank, 6 projects on Arab Gulf bank, beside study and construction of 13 projects to transport the desalinated water. Emirates came in the second stage for desalination of sea water in the world. Its production reach about $446 \cdot 10^6 \text{m}^3$ annually; sharing with 80% of their water needs.

Moreover in addition to sea water desalination, the treated waste water is considered another important source for water in arid areas in Gulf countries. By using new technologies; it was possible to produce water with relatively high quality which could be used for irrigation and agriculture Qatar was one of the first countries all over the world which have adopted treated sanitary waste in irrigation purposes.

Although of the efforts performed by countries in the Gulf region to control the water crisis. It is needed to have common strategy to behave with the water crisis in the area. This strategy has to contain a number of elements mainly:

- Sharing of the private sector with governments in the Gulf countries in future water projects regarding management, distribution and production of water.
- Enforcement of the role of civilian society association in public water awareness.
- Searching for utilization of new technologies for purification and water desalination, as technologies of membranes and their applications in treatment of waste water and its recycling use together beside solar energy and its application in desalination.

Future of Nuclear Power in Arab Countries

However the future of nuclear power in generation of electricity and seawater desalination may be one of the sources necessary to face the

increasing needs of electricity generation and fresh water production in Arab countries.

According to the international report for energy in year 2006. Although of the high costs in construction of nuclear power plants in comparison with conventional fossil power plants; we found that nuclear power plants produce more energy, reach up to 1000 Megawatt. Some of them their capacity could reach range (600-1800) Megawatt, however the conventional power plants could reach limits between (300-800) Megawatt.

The Economic of Nuclear Power

In many places is nuclear energy, complete with fossil fuel for electricity generation, despite of the relatively high capital costs and the need to internalize all waste disposal and decommissioning costs. If the social health and environmental costs of fossil fuels are also taken into account nuclear is outstanding.

The cost of electricity production for plants that cost 1-5 billion \$ would be 3.3, 3.8 and 4.4 cents/kwh respectively.

There are number of benefits for using nuclear energy as, it offers cheap energy on the long term. Nuclear power helps in reducing costs for energy intensive processes such as, sea water desalination. There is an added value of nuclear desalination in says 10% of power of the currently large available power reactors being dedicated for water production i.e. having dual purpose plant for electricity generation and sea water desalination. On the long term a new generation of innovative small and medium nuclear power plants could also co generate electricity and potable water both safely and at competitive prices in today's market. The nuclear energy is a clean energy as the problem of nuclear waste disposal and which represent the actual problem for reactor in its impact on environment, the real fact that the size of these nuclear waste is much less than waste produced from fossil fuel plants.

Moreover desalination process using fossil plants however are energy intensive and are responsible for a good portion of green house gases emissions in the region. So, in order to produce 1m³ of desalted water from typical cogeneration fossil plant results in 12 kg of Co₂ gas emission (at energy consumption rate of 24 kwh/m³ using thermal processes). The current Co₂ emission due to desalination can therefore be estimated as 720 million ton Co₂ per year. The amount is expected to increase to 1600 million ton by 2050. This is an unacceptable situation and cannot be allowed to continue from both population health view point and from global warming point of view.

Discussion and Conclusion

There is no doubt that nuclear power offers substantial long-term benefits to any government seeking to reduce the risks entailed in purchasing fossil energy from countries or regions that are perceived to be unstable suppliers. Moreover nuclear power could offers alternative option for region for both electricity generation and seawater desalination. Nuclear energy advocates seem to be driven by two very loosely coupled needs – the first for much more

energy to support economic growth world wide, and the second to mitigate global warming driven by the emersion of green house gases from fossil oil.

The nuclear option is not without opposition though. Many are unhappy with idea, as concerns remain about proliferation, climate changes radioactive waste disposal and the risk of accidents. Chernobyl and three Mile Island nuclear accidents are still fresh in the world's collective memory. Nuclear waste is recognized as one of the biggest dilemmas faced by advocates of nuclear energy programs. This waste remains radioactive for thousand of years. The nuclear energy lobby now urgent ally seeking long terms disposal arrangements that are safe environmentally sound and above all are publicly acceptable.

While it is difficult to predict with any confidence what the 21 century holds for nuclear power, the factors that will shape its future are relatively evident to ensure that nuclear energy remains a viable source of safe secure and environmentally benign energy.