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The Nonproliferation Review
Publication details, including instructions for authors and subscription information:
http://www.tandfonline.com/loi/rnpr20

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Version of record first published: 05 Nov 2012.

To cite this article: Ephraim Asculai (2012): NUCLEAR POWER IN THE MIDDLE EAST:, The Nonproliferation Review, 19:3, 391-400

To link to this article: http://dx.doi.org/10.1080/10736700.2012.734187

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NUCLEAR POWER IN THE MIDDLE EAST: Risks and Opportunities for Regional Security

Ephraim Asculai

With the exception of Iran, no Middle Eastern state has an operating nuclear power reactor. Several states, including the United Arab Emirates, Saudi Arabia, Qatar, Kuwait, Israel, Syria, Jordan, Turkey, and Egypt are considering constructing such reactors; some have even taken steps towards commencing nuclear power projects. There exist, however, considerable economic, technical, safety, and security challenges to achieving these goals, many of which are acute in the Middle East region. Regional and international cooperation on nuclear technology could not only help regional states meet their energy objectives, but it could also help to build trust among states as a basic step towards a future Middle East Weapons of Mass Destruction-Free Zone.

KEYWORDS: Middle East; nuclear energy; reprocessing; enrichment

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As of August 2012, there were 433 power reactors operating worldwide. Sixty-five reactors were under construction and an additional 158 were firmly planned.[1] A September 2011 report by the International Atomic Energy Agency (IAEA) found some forty-five countries that do not currently have nuclear power are seriously considering developing it.[2] The Middle East is a latecomer to this technology. Apart from Iran, none of the states of the region have operating nuclear power reactors. However, several states, including the United Arab Emirates (UAE), Saudi Arabia, Qatar, Kuwait, Israel, Syria, Jordan, Turkey, and Egypt are considering constructing nuclear power reactors. Some have already taken steps toward accomplishing this aim. Of these, Turkey and the UAE have signed contracts (with Russia and a consortium led by Korea Electric Power Corporation, respectively) for the construction of nuclear power reactors, the first of which is expected to come online in the UAE in 2017.

Three reasons for this trend can be assumed: a real need for additional energy sources; the wish to gain prestige by employing advanced technologies; and the need to present the appearance of a response to Iran's nuclear program, which many fear is geared toward establishing an Iranian regional hegemony through the development of nuclear weapons. These reasons are not mutually exclusive.

With the exception of Egypt, Israel, and Turkey, most of the Middle East states with nuclear power ambitions do not yet have the necessary national infrastructure for accommodating such a huge technical effort. Nuclear power production projects take a long time to set up, and in countries with little or almost no infrastructure, the necessary time from initiation to the first reactor start-up is even longer. This paper will discuss both

Nonproliferation Review, Vol. 19, No. 3, November 2012
ISSN 1073-6700 print/ISSN 1746-1766 online/12/030391-10
© 2012 Monterey Institute of International Studies, James Martin Center for Nonproliferation Studies
http://dx.doi.org/10.1080/10736700.2012.734187

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the generic difficulties in launching a national nuclear power program and the problems that are specific to the Middle East region.

The Pros and Cons of Nuclear Power

Many good reasons serve the proponents of nuclear energy when they present their case to the national decision makers: the increasing costs and foreseeable decreasing stocks of carbon-based fuels; global warming due to the emission of greenhouse gases released from these fuels; carbon taxes imposed in several states; the presently high costs of utilizing renewable energy sources and the scarcity of them in many parts of the globe.

Opponents of nuclear energy have many good reasons at their disposal: the history of severe nuclear accidents affecting the environment; the high investment costs; the dependency on foreign suppliers for the fuel and, in some cases, some aspects of the operation and maintenance of the nuclear power stations. The issue of proliferation does not usually concern the national decision makers, but has a large bearing on the supplier countries' attitude that could hinder the whole project. In some states, the security issue would be a cause for concern. Assuring a high degree of security has a cost, since vulnerability carries its own risk.

Global and Middle East-Specific Issues

The issue of safety is a multifaceted one. Safety is omnipresent in all phases of nuclear power production. Even the simplest way to utilize nuclear energy for electric power production is not simple. Imagine a hypothetical situation where a vendor mounts a nuclear power reactor on a huge barge, tows it to a customer, anchors it, connects the reactor to the national power grid and starts selling electricity. Besides the obvious issue of public acceptance, there would be the issues of regulation, safety assessment and licensing, emergency planning and preparedness, adaptation of the local and national grid, scheduling the reactor's downtime for refueling and routine maintenance, et cetera. Having safety standards dictated by outside authorities, even if they strictly adhere to IAEA safety standards, could be dangerous. These standards must be checked and, if necessary, modified to conform to updated data and criteria, to lessons learned from recent accidents and lesser safety-related incidents, to local conditions, mentality, and even social values. These standards also dictate many of the design features of the reactors and auxiliary systems. Vendors will sometimes try to simplify things to reduce costs, while local authorities will at times try to impose stronger safety margins and thus come into conflict with the vendors. In today's world, the issue of safety will probably ultimately decide the fate of nuclear energy production worldwide.

The March 2011 Fukushima nuclear power plant accident in Japan increased worldwide concerns about the safety of nuclear power. The issue of safety has long been a sore point with many developed countries. One has to examine the global uneasiness about nuclear power and the emotional, political, and practical reactions to Fukushima in order to assess its effects. In Europe, there is a strong division on this issue. Germany, for

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example, is phasing out its nuclear reactors while France continues its heavy reliance on nuclear energy. In many countries both in and outside of Europe, plans are proceeding for the construction of new reactors, although Fukushima has led to reconsideration of certain safety issues in planned projects, and for modifications, where necessary, to existing plants.

The alternative of renewable energy sources will not be able to replace, globally, the existing nuclear electrical supplies, at least not economically, in the near future. These technologies are very geography-dependent, not suitable for all countries, and most methods of production are still costlier than the production of nuclear electricity.[3] Future economic growth, the growing electrical power demands that accompany it, and the need to reduce drastically greenhouse gas emissions will drive future electrical supply trends.

The Middle East region features many problems that do not exist, or are relatively minor, in other regions. In this region, nuclear safety concerns are not the only factor that could halt—or at least postpone the decision to launch—nuclear power programs. Political instability in several states could, in some cases, affect their ability to launch a project that would considerably tax their national resources, and would place in doubt the ability of some states to repay very large debts. Political instability could also affect the will of vendors to sell reactors to unstable regimes. A case in point is Iran, when foreign firms abandoned the Bushehr reactor's construction site after the Iranian Revolution in 1979. Another factor is the danger of extremist groups getting hold of sensitive technologies or materials and utilizing them as tools of terrorism. These are but a few of the problems, and are mentioned as an illustration of the multitude of potential tribulations facing Middle East states launching a nuclear project from scratch.

There is one consideration, though, that could outweigh all others, and that is national prestige. When the will is strong enough, almost any country with a reasonable economic ability could successfully launch a nuclear power program, or, for that matter, a nuclear weapons production program. The motivations may vary, but the end result, given international help, is achievable.

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Economic Considerations

This is not the place for a detailed treatise on the economics of nuclear power production.[4] Mention must be made, however, of several factors that bear on the decision to launch a nuclear power production project in specific states in the region.

For example, what was the justification behind Iran's Shah Mohammad Reza Pahlavi's decision to launch a very large nuclear project consisting of several nuclear power plants? Iran is an energy-rich country, with huge oil and gas reserves, and the local low cost of these resources would make nuclear power production distinctly uneconomical, even today. The reasoning at that time—and today—was to withhold oil reserves for the future, when prices would be higher, and to use some of these carbon-based fuels for the production of more sophisticated (and profitable) products. Where carbon-based fuel is more costly and a carbon tax has to be considered, nuclear energy will be economical, if the reactor is of standardized design, if the construction time is minimal,

and if the nuclear fuel is externally supplied.[5] If the financial outlay is burdensome, and if foreign investments or loans are needed, the cost could tilt the economic balance one way or the other.

Notable Technical Issues

The wider range of technical problems affecting Middle East nuclear projects include the paucity of national infrastructure; safety and security issues; and the potential for the proliferation of nuclear weapons. Each of these will be discussed below.

Infrastructure

Infrastructure encompasses a wide range of issues. Human infrastructure includes trained personnel in most of the technical subjects and at all levels. It necessarily includes: regulators with training in all technical areas and in legal matters; inspectors and quality-assurance experts in engineering and safety areas; as health and public health professionals; knowledgeable local officials, and so on. Relying on outside experts would be counterproductive. Such experts would be beneficial in an advisory capacity, but the application of their advice would depend on local personnel, knowledgeable in local laws and customs. The indigenous engineering workforce in many Middle East states is weak.[6] In 1997, for example, UAE universities produced only half the number of scientists and engineers that the country needed.[7]

There are few reactor vendors in the world. Most countries sign contracts with these vendors and do not attempt to construct reactors on their own. No country in the Middle East can construct a nuclear power plant on its own, or even contribute to this construction in a major way, apart from the supply of labor for the construction of some of the civil engineering aspects. Thus, the design, construction and testing of the reactor proper, and most of the electrical generator systems would have to be done by outside contractors. If the future operation of the nuclear power plants were entrusted to local personnel, these employees would have to be trained, certified according to international standards, and overseen, for at least an initial period, by competent outside authorities, if operational safety is to be assured.[8]

Two major practical problems face some Middle East states when considering the establishment of a nuclear power program: the electrical grid economy and the capability of the country's technical personnel to sustain and operate a full-sized nuclear plant. In order to be economical, a reactor employing current technology would have to produce at least 1,000 megawatts of electricity. It is not considered good practice to have a single power source supply more than ten percent of the national electricity demand. Exceeding this level would put consumers in jeopardy if the station went offline unexpectedly in the event of a malfunction—not necessarily of the reactor—and if the other energy sources cannot compensate for the sudden surge of demand. While most of the Gulf states are electrically interconnected, or are expected to be in the foreseeable future, some, like Jordan and Syria, have mostly independent electricity production and distribution

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systems, with relatively low national demands, and therefore will have difficulties in sustaining a major electrical supplier on their own.

With the exception of Israel and Turkey and possibly Egypt and Syria, Middle Eastern states do not have the necessary human infrastructure to sustain a nuclear power project. While it will probably be possible to obtain, construct, and operate nuclear power plants by an outside party, some internal human infrastructure will always be essential for regulatory work and supervisory activities, and for interfacing with the national grid and services suppliers. Any emergency planning must depend on indigenous capabilities. It is not in the interest of any state to have all of its nuclear power production work done by others. In addition to prestige value, it carries with it the appearance of loss of independence, which is anathema to most, if not all, states.

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Safety

The issue of the safety of nuclear energy has become more prominent since the Fukushima accident.[9] However, this has been, along with the economic issue, a basic consideration ever since the Three Mile Island accident in 1979. Safety considerations must be a part of every stage of the construction, operation, and decommissioning of a nuclear power plant. The construction of the first reactor is the crucial step in employing this form of energy production, and will set the stage for all possible future projects.

The five major steps in the construction and operation of nuclear power production are: regulatory foundation; design; construction; operation; and decommissioning.

The first step sets the safety, construction, and operational standards. It also determines the human and other operational infrastructure requirements, in training and qualifying personnel. The regulatory process includes, inter alia, guidance on nuclear safety, radiation protection (including emergency planning and preparedness), radioactive waste management, the transport of radioactive materials, the safety of nuclear fuel cycle facilities, and quality assurance.

The design stage can be divided into two parts: site dependent design and plant design. While the site dependent design should have local input, the plant design will only have to conform to national regulations and very general safety standards, since there are few of the necessary experts in Middle East states available to actively participate in the design process. Local authorities will also be aware that if any design standards exceeding those of the vendor's are imposed, this will always incur additional costs. On the other hand, the procurers must employ outside expertise to assure that internationally accepted safety standards are upheld in these particular cases. Utilizing standardized reactor designs (modified as necessary for individual plants) can reduce the time required for authorities to approve each new reactor and simplify maintenance and training. Standardized designs can also increase safety and efficiency, which in turn drives down costs. If a decision can be taken to employ a standardized design, this would be a concentrated effort for the first reactor, followed by necessary modifications for ensuing ones, but not a separate effort for each additional reactor.

Security

Another aspect of safety is the security of the nuclear power plants. Although a prominent concern in many parts of the world, this becomes a much larger issue in the Middle East. Because of their vulnerability and the great damage that a serious nuclear reactor accident could cause, both environmentally and economically, these reactors constitute a desirable target both for terrorists and state-initiated attacks. States would have to decide whether to fortify reactors against such attacks, or to depend on deterrence and active protection, rather than bury the reactors or protect them with very heavy, bomb-proof containments. The design option could be very costly and would add to the economic burden of the project. There is also another aspect of security, against which there is almost no protection—the fate of the facility and all related matters, including the irradiated fuel, if a change of the regime occurs, and the new regime annuls the reactor-related agreements and international commitments (such as the insistence on peaceful use embodied in the Treaty on the Non-Proliferation of Nuclear Weapons, or NPT). A ''rogue'' regime could then utilize any available resources in order to attempt to produce nuclear weapons, though not without serious political and economic consequences.

Proliferation Risks

While the potential benefits of having a nuclear power program are significant, there are some obvious drawbacks, relating to the possible diversion of nuclear materials for the purpose of nuclear weapons production. These concerns go beyond the boundaries of the state and involve the nuclear fuel cycle—the supply of the nuclear fuel and the disposal of the irradiated fuel. Allowing a country to produce its own nuclear fuel and/or letting it retain the irradiated fuel and possibly reprocessing it gives a state the potential to eventually produce nuclear weapons if it so chooses.

There are two major routes to the achievement of a military nuclear capability. One is through the production of highly enriched uranium (HEU), defined as uranium containing more than 20 percent uranium-235 (weapon grade uranium is typically 85 percent or more). The other is the production of plutonium. Both of these materials, in significant quantities, can be used in the cores of nuclear explosive devices. Most nuclear power reactors utilize nuclear fuel composed of low enriched uranium (LEU), which contains less than 20 percent uranium-235. States that have the technology for producing LEU will usually encounter little difficulty in further enriching the uranium to HEU.

Plutonium is created as a byproduct of the operation of nuclear reactors; some of the uranium-238 in the nuclear fuel is transformed during the irradiation process into plutonium. In order to utilize the plutonium, the nuclear fuel has to be reprocessed, and the plutonium separated from the uranium and from the highly radioactive fission products (the nuclear waste). Although the technology to reprocess the fuel is cumbersome and cannot be easily be concealed, it is still the preferred method for nuclear weapons production. Plutonium produced in power reactors will usually be of a low grade, but these reactors, operated in a certain way, could be used to produce considerable amounts of weapon-grade plutonium.

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While the problem of the supply of nuclear fuel could be dealt with by conditioning the sale of a nuclear power plant on the continuing external supply of the necessary nuclear fuel and backed up by the establishment of a multilaterally administered LEU fuel bank, the issue of the disposal of the irradiated fuel is more complicated.

In this respect, note must be taken of the International Framework for Nuclear Energy Cooperation (IFNEC, formerly the Global Nuclear Energy Partnership, or GNEP), established in 2007. ''Broadly, IFNEC's mission is the global expansion of nuclear power in a safe and secure manner. A major rationale is reducing the threat of proliferation of nuclear materials and the spread of sensitive nuclear technology for non-peaceful purposes.''[10] This could mean the ''cradle-to-grave'' fuel management that is central to IFNEC activities, along with assurance of fuel supply. In addition to the creation of IFNEC, the United States is bound by section 123 of the Atomic Energy Act of 1954, which sets the nonproliferation conditions to which a state must conform when signing a nuclear cooperation agreement with the United States.[11] However, the Obama administration, during recent negotiations with Jordan and Vietnam over such agreements, has dropped a demand that requires these states not to produce their own nuclear fuel, retreating from the standard set in a similar agreement in 2009 with the United Arab Emirates.[12]

This change came in the wake of Jordan discovering considerable uranium ore deposits and announcing that it was considering producing its own nuclear fuel. It subsequently signed a contract with the French corporation Areva for the exploration and mining of uranium.[13] The situation, however, remains unclear, and the United States is apparently unhappy with the prospect, not denied by Jordan, that it will eventually seek to enrich its own uranium supply.[14] Jordan is a member of IFNEC, and as such is not bound to give up any rights to peaceful uses of nuclear energy, including uranium enrichment. But, as a state in the Middle East, Jordan's enrichment decisions have possible implications for the region, and raise fears of abuse in the future.

However, if a state constructs and operates a nuclear power station, with the nuclear fuel supplied from external sources, and the spent fuel transported out of the country and the region, the proliferation risks would be significantly mitigated. It would be very expensive for a state to build its own enrichment plant to generate fuel for reactors to produce electricity. Such an approach only makes sense when there is no assurance of fuel supply. Should a state insist on doing this, as in the case of Iran, its motivations would become suspect. On the other hand, one has to consider the issues of independence and prestige, which are a major part of the decision making process in the Middle East. The economics are but a part of the cost-benefit analysis that takes into account all factors. In addition, having the potential for producing military-grade fissile materials, even as a very long-range project, could be another factor in the cost-benefit balance.

The problem is different when considering the ultimate disposal of the spent nuclear fuel. As mentioned, this fuel can be reprocessed, but it can also be stored in a long-term storage site. The transportation of this fuel is costly and cumbersome but necessary in the Middle East. If the spent fuel could be stored for unlimited time in the state where it was irradiated, this would probably be the more economical method of fuel disposal. However, this would also be a cause for concern, because it leaves open the possibility of reprocessing this fuel and producing plutonium, even years later.

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The road to nuclear weapons production based on reprocessing is a tortuous one, especially when enriching uranium for this purpose is much easier, easily concealable, and requires less expertise and infrastructure than the establishment of a nuclear power program.

The Larger Issues Involved in Middle East Nuclear Power Production

If the current plans for constructing nuclear power stations in Middle Eastern states go forward, how might this further the concept of a Middle East Weapons of Mass Destruction-Free Zone (MEWMDFZ)? Finalizing a treaty to such an end and then implementing it does not seem a viable way to proceed at this time. Building trust through cooperation, and especially in the nuclear area, could provide the proper means of realizing the vision of a WMD-free Middle East.

Building trust in today's Middle East is, however, no easy task. With Israel assumed to have nuclear weapons, Syria and Libya having sought nuclear weapons, and Iran presumed to be pursuing them, it is difficult to see the Middle East states sitting down and achieving sufficient trust to start working on the idea of a MEWMDFZ. The problem is compounded by the fact that several states in the region either have or have used chemical weapons. The 2012 conference on this topic, even if it goes forward, will probably achieve very little in this direction. One way of starting to build trust that could lead somewhere is through international cooperation in the application of nuclear technology. The most basic step would be in pursuing joint projects to share nuclear energy, even if the actual operation of the nuclear power station would remain under the control of one state.

Another positive effect of building trust in the Middle East is reducing the security risks to nuclear reactors. This would manifest first in the reduction of state-originated threats. But reducing the risks of terrorism, especially state-sponsored terrorism, is important too. A terrorist attack would not necessarily involve a frontal assault, but might involve sabotage by insiders that could not only cripple the installation but also trigger a safety-related accident.

What Next?

There is no clear and unequivocal answer to this question. Nuclear energy remains one of the safest sources of energy.[15] Some concerns, such as the economics of nuclear power, have little bearing on international security. Safety and security, however, could have transboundary and international implications and warrant further attention. Such issues can be addressed without infringing on national sovereignty. Safety oversight, by the best available professionals not directly involved with the reactor construction project, could go a long way toward providing assurances both to the reactor owners and to the population at large about the safe design and operation of the nuclear power plant.

Alleviating proliferation concerns is another matter. The supply of the nuclear fuel by outside producers should be a condition of supplying the reactor. Permitting a Middle East

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state to produce its own nuclear fuel is fraught with dangers. Utilizing pre-existing suppliers not only eases proliferation concerns, it is also economically sensible. It appears, however, that some countries are not willing to forgo this option, and the United States, which has the potential to persuade these countries to do so and to agree on more strict IAEA verification mechanisms, is willing, albeit reluctantly, to accede to these states' wishes.[16]

Dealing with the disposal of spent nuclear fuel is a different matter. Constructing a reprocessing plant for these fuels in any Middle Eastern country could lead to misuse and eventual "breakout"—producing plutonium for nuclear weapons use. Regional instability precludes having either a long-term storage site or a reprocessing plant in the Middle East. Placing such facilities under IAEA inspections is not a solution either. Inspectors require the cooperation and support of the host country. At most, the IAEA inspectors can report unusual occurrences; they cannot guarantee the security of the fuel.

The best solution would then be the construction of an international depository site, preferably outside the region, operating under international control. This could be in one of the nuclear weapon states, as designated in the NPT. It could also be in a non-nuclear weapon state, but would then have to come under international jurisdiction, perhaps even policed by UN forces. If reprocessed, the plutonium thus produced could then be combined with uranium to produce mixed oxide fuel for use in the power reactors of the originating state. The process of international cooperation needed for this arrangement should be launched as early as possible, to be ready for use as early as 2020, when the first spent fuel from the Middle East could be ready for transfer.

These proliferation-resistant arrangements could be seen as rather harsh by many in the region, especially when compared to other regions, such as South America, where some states have uranium enrichment plants and spent fuel is not transported abroad. The obvious difference between South America and the Middle East is the relative regional peace and the lack of need for nuclear weapons (indeed, the entire continent, as well as all of central America and the Caribbean is covered by the 1967 Treaty of Tlatelolco, which bans the production, acquisition, receipt, storage, and deployment of nuclear weapons). The Middle East is not covered by any such treaty, and the NPT has been abused by several states. This is the outstanding reason why preventive arrangements must be made.

If it is possible to enact regional arrangements for non-discriminatory cooperation in nuclear power production, this would go a long way towards the reduction of regional tensions. In that case, and if there is a significant lessening of regional tensions, the proliferation-resistant measures could perhaps be eased, but not totally disbanded. Unfortunately, this is probably a long way into the future.

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