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Squaring increasing demand for nuclear energy with disarmament and non-proliferation objectives

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Interest in atomic energy is experiencing a global surge. In addition to the 27 new reactors under construction, over 200 others are planned or proposed worldwide, both to replace older plants and to install additional capacity. By 2030, installed nuclear power capacity worldwide is projected to grow by a minimum of 77 gigawatts and possibly up to 309 gigawatts. As a rough rule of thumb, one gigawatt of energy equals the output of an average sized nuclear power plant. It may be an exaggeration to call this expansion a nuclear renaissance, because even the high-end projection represents less than a doubling of the current capacity. But growth in nuclear energy is a reality. We need to address and prepare for its consequences.

Nuclear energy is particularly attractive for its role in retarding global warming and to meet growing electricity needs in the developing world, including its potential use to power seawater desalination to address growing water shortages in many areas. The rising price of hydrocarbons makes countries with limited oil and gas reserves all the more eager to conserve those supplies for export earnings. Participation in the advanced technology sector of nuclear energy is also seen as a way to keep up with the developed world and with neighbours who are pursuing nuclear programmes. Political factors are particularly important in the Middle East, where concerns about Iran's nuclear aspirations may be giving others in the region an incentive to investigate nuclear energy as a security hedge. This motivation partly explains why at least thirteen countries in the greater Middle East region have talked about pursuing civilian nuclear energy. The sudden peak of interest in nuclear energy in the region leads many analysts to conclude that Iran's neighbours are seeking their own nuclear capabilities as a strategic response. If Iran's nuclear programme is unchecked, there is a reason for concern that it could prompt a cascade of proliferation in a volatile region.

The proliferation concerns do not mean that there should be curbs on nuclear energy. To the contrary, pursued wisely and for exclusively peaceful purposes, nuclear power can be entirely consistent with non-proliferation and disarmament objectives. The key is two-fold: 1) Keeping to nuclear technologies that cannot be used for atomic weapons; and 2) transparency practices that provide convincing proof that this is the case. There are many other questions about nuclear power that have to be considered, of course, including safety issues, environmental concerns and the economic justification in light of other energy alternatives. This paper considers only the proliferation angle.

Controlling sensitive fuel cycle technologies

The defining character of the nuclear age is that the atom can be harnessed for both peaceful and destructive purposes. Nuclear powers plants alone pose little proliferation threat. They can contribute to proliferation risks by providing cover for clandestine activities and an industrial and personnel infrastructure that could be useful to a weapons programme. This danger is real, but the proliferation risk is controllable. The low enriched uranium fuel used by most power reactors cannot be diverted for nuclear weapons use unless it is reconverted to gaseous form then further enriched to weapons grade. The plutonium produced when the fuel rods are irradiated in reactors cannot be extracted for weapons use without chemical reprocessing of the spent fuel. It is these sensitive areas of the fuel cycle – primarily uranium enrichment and plutonium reprocessing – that pose the problem.

There is no legal prohibition on these technologies and several states contend that Article IV of the NPT, in affirming the inalienable right to nuclear energy for peaceful purposes, includes the right to enrichment and reprocessing. Nevertheless, a consensus is gradually emerging that these technologies need somehow to be controlled so as to plug what IAEA Director General Mohamed ElBaradei calls the ‘Achilles heel’ of the NPT. There are differing interpretations of what Article IV permits, but taken to its extreme, the loophole that many say exists in the language of the article would allow states to produce and stockpile highly enriched uranium and separated plutonium right up until the point before they are fashioned into weapons.

In drawing attention to the problem, Dr. ElBaradei's seminal October 2003 *Economist* article encouraged a flurry of proposals aimed at a solution. However, his suggestion that all enrichment and reprocessing activity be put under multilateral control met firm resistance from the existing technology holders. That they should give up national control of such a strategic technology is a politically challenging idea, to say the least. But it is not totally far-fetched. The five NPT-acknowledged nuclear weapons states have already stopped producing fissile material for weapons purposes, and all the major players have signalled support for a treaty mandating such a cut-off, if only the right formula could be found to bridge differences on modalities and conditions. That leaves civil production of enriched uranium fuel and civil reprocessing of plutonium for recycling. Three of the less than one dozen countries that enrich uranium commercially – Germany, the Netherlands and the United Kingdom -- already do so in the Urenco multilateral joint venture. French enrichment is also carried out by a multinational firm, Eurodif. The United States has proposed a multilateral context for future reprocessing of spent fuel in a proliferation-risk free way under its Global Nuclear Energy Partnership, if the envisioned technologies can in fact be developed.

If the international community is ever to meet the NPT goal of nuclear disarmament, the dual-use technologies will have to be regulated. The production of highly enriched uranium should be banned for both military and civilian purposes and phased out or halted for a long period of time for naval propulsion. The production of separated plutonium, which is used to fuel some reactors, should also be halted for several decades until stocks are drawn down. This still leaves a break-out potential for states that produce low enriched uranium. Unless multinational ownership or international controls of some sort are adopted that would preclude potential break-out scenarios, the latent weapons capability conferred by these technologies could be destabilizing in a nuclear weapons-free world. It would be useful to begin now to take up Dr. ElBaradei's challenge.

While working toward future controls on enrichment and reprocessing, it makes sense for the present to limit the expansion of these sensitive technologies so as not to increase the problem set. However, an international consensus approving a mandated limitation is unlikely to emerge. It is far better for states to decide of their own sovereign will not to pursue the full nuclear fuel cycle. Positive incentives can provide encouragement. States that agree voluntarily to purchase fuel cycle services on the international market rather than

develop indigenous facilities will find that the international route considerably eases their path to nuclear power. It will be far less expensive, in terms of both economical and political costs. Taking this route will also be likely to produce quicker agreements.

Limits may also be imposed on the supply end. As a condition of supply of nuclear power plants, some exporting states as a matter of rational policy will require a commitment by the recipient state not to pursue enrichment and reprocessing. How such a commitment is expressed can be politically sensitive, and perhaps left to a confidential side letter to state-to-state agreements. Limitations can also be part of a straight-forward commercial deal, in which the supplier side undertakes to provide all the fuel cycle services associated with power plant operation. Fuel leasing may emerge as the best option. Supplier states would provide the enriched fuel, take back the spent fuel and arrange for final disposition. If plutonium is separated out, the remaining radioactive waste, unusable for weapons purposes, could be vitrified and safely stored in a waste repository. Few countries want to take another's nuclear trash. But it far preferable to leaving plutonium to sit for years in accessible fuel ponds in potentially unstable areas. Spent fuel containing weapons usable plutonium, whether from power reactors or research reactors, should be removed from any region where it could contribute to nuclear proliferation.

In setting conditions of supply, the industrialized states must not allow the legitimate quest for nuclear energy on the part of developing countries to morph into a nationalistic campaign of defiance. Many developing countries are sceptical about Western intentions and claim that any restrictions on enrichment and reprocessing technologies would unfairly negate their rights. By that, they mean it may infringe on their ambitions for energy security, technological development, the status symbol of advanced nuclear facilities, and potential future deterrence. There is thus widespread resistance within the developing world to any new category of nuclear 'haves and have-nots' based on fuel cycle technology.

Concerns about exacerbating such political tensions contributed to the NSG's rejection of President Bush's February 2004 proposal to prohibit the transfer of enrichment and reprocessing technologies to countries that do not already possess operating facilities for these activities. Most NSG members preferred an alternative approach of subjective criteria for regulating the export of sensitive technologies, such as whether the importer's nuclear programme is economically feasible and sensible. Given the ready availability of enriched

uranium fuel in the international market, enrichment does not make economic sense for new entrants to the nuclear energy field.

Providing attractive international fuel cycle services can give recipient states an incentive to forgo their own sensitive technologies. Pursuing this logic and focusing on the most urgent issue of the front end of the fuel cycle, a number of states as well as nongovernmental organizations have tabled at least ten different proposals to assure the supply of enriched uranium fuel. These proposals include a fuel bank under IAEA auspices and a Russian plan to donate a sizeable amount of LEU produced by its international enrichment facility at Angarsk for guaranteed supply to any country meeting criteria determined by the IAEA. This is a tangible offer, making the long-held idea of assured fuel supply a near-term reality. Guaranteed fuel cycle arrangements can be supplemented by policies to facilitate financing for those states seeking nuclear power without indigenous enrichment and reprocessing capabilities.

The key question is whether recipient states will accept guaranteed fuel supply assurances. Despite their voluntary nature, some developing countries see them as a Trojan horse. It is not surprising that almost all of the ideas for guaranteed fuel supply have emerged from the ranks of the existing technology holders. One notable exception was a suggestion made public by the Gulf Cooperative Council in November 2007 for an extra-regional enrichment centre, perhaps in Switzerland, to supply enriched uranium fuel to all the states of the Gulf.

The GCC suggestion is worth serious consideration. It would offer a face-saving way for Iran to forego enrichment as part of a voluntary regional arrangement. By doing so, Iran would at the same time meet its obligation to respect United Nations mandates and provide the best means of assuring the world that its nuclear weapons program is not intended for weapons purposes. The GCC plan also would be a practical step toward a zone in the wider Middle East free of nuclear weapons and other weapons of mass destruction.

Regional agreements

Ideally, the entire Middle East would be a zone free of both enrichment and reprocessing. The WMD Commission headed by former Dr. Hans Blix recommended that all states in the region commit themselves for a prolonged period of time not to have any enrichment,

reprocessing or other sensitive fuel cycle activities on their territories. This would mean that all fuel cycle services to future nuclear power plants in the Middle East would be provided from facilities located outside the region. Such a step would not require Israel to abandon completely its policy of nuclear ambiguity or the deterrence provided by its nuclear program. If estimates are correct that Israel has produced enough fissile material for some 200 weapons, it might be argued that this is sufficient to meet it deterrence needs. Unfortunately, prospects for a regional agreement at the moment are not bright, given the compliance problems with existing non-proliferation norms, the challenges of verification and the need for an accompanying peace process if any country is to unilaterally reduce its security posture. But the growing challenges to the non-proliferation regime require greater creativity and effort in promoting solutions.

In the meantime, some states are moving ahead on their own to create the right conditions for nuclear energy development. The deal that Abu Dhabi struck with France in January, setting the stage for cooperation on two state-of-the art power reactors sets an important precedent for the region. The United Arab Emirates is reportedly working on a nuclear energy white paper which makes it clear that the state has no interest in technology that can be used for nuclear weapons. Any other nation that seeks foreign technology assistance to develop nuclear power would do well to follow the UAE's example.

Iran should also take note that the easiest way to enjoy the benefits of nuclear power is not to pursue an enrichment technology for which it has no current economic justification and that causes so much international concern. The offer put to Iran in June 2006 by EU Foreign policy chief Javier Solana on behalf of France, Germany, the UK, China, Russia, and the US would provide, among other benefits to Iran, advanced nuclear technology as long a Tehran decided to forego enrichment and reprocessing until there was international confidence in Iran's peaceful intentions. The Iranian people might well ask their leaders why they pursue policies that lead to increasing isolation and economic sanctions while their neighbours can benefit from peaceful nuclear cooperation with the world. It is not because anyone denies Iran nuclear energy. It is because the international community is rightfully concerned about Tehran's pursuit of dual-use technologies.

Transparency measures

States interested in nuclear power should also establish clear non-proliferation credentials by accepting and implementing full transparency measures. IAEA full-scope safeguards are a basic transparency requirement of the NPT. In addition, all states that have what is called a Small Quantities Protocol that holds in abeyance most of the verification tools of the IAEA should accept the modified instrument adopted by the IAEA Board of Governors in September 2005.

The transparency measure of most value is another protocol – the Additional Protocol to the standard safeguards agreement. Every country should have one. In particular, countries that seriously consider adopting national nuclear power programmes should ratify and implement the Additional Protocol as one of their first steps. While not yet a universal legal requirement, it has become the international norm for confirming a state's non-proliferation credentials. The Additional Protocol does not offer fool-proof protection against proliferation. Like other safeguards measures, it cannot prevent the non-peaceful use of nuclear materials. IAEA safeguards are akin to alarms, not locks. They are designed to detect diversion of nuclear material, and thereby deter. The added value of the Additional Protocol is to provide for the access rights and informational basis that allow the IAEA to provide credible assurances regarding the absence of undeclared nuclear material and activity. But even this conclusion, which is not easily drawn, should not foster a false sense of security if other steps are not also taken.

Accepting the Additional Protocol is a voluntary undertaking, which can be influenced by positive incentives. The 45-member Nuclear Suppliers Group (NSG) is close to adding to its conditions for supply of nuclear technology that the recipient country has an Additional Protocol in effect. Only one of the NSG members opposes setting this condition, because it has not yet accepted the Additional Protocol for itself, but overcoming this opposition appears to be only a matter of time. Pending an NSG rule change, the G8 countries could consider collectively declare that concluding the Additional Protocol will be a condition of supply of nuclear technology. The G8 has so far only declared a commitment to working toward establishing the Additional Protocol as a new standard. A decision by the G8 members to make it a prerequisite for supply for their own exports would be an important

step, because they comprise most of the countries in the nuclear power plant exporting business.

The IAEA safeguards system is still a work in progress, and can be improved in many ways, both in terms of technology and legal measures. Employing existing safeguards measures alone, it is particularly difficult, for example, to detect clandestine uranium enrichment facilities. The IAEA Secretariat is developing advanced technologies for the detection of undeclared nuclear activities. Wide-area environmental sampling is one prospective new verification tool, not yet approved by the IAEA Board of Governors. Its cost-effectiveness is questionable, however, unless the IAEA already has a tip-off as to the location of a suspect site. Effective IAEA verification therefore requires the cooperation of states with national intelligence capabilities. For states that are in violation of their safeguards agreement, the IAEA also needs greater inspection authority, at any place, at any time. It is unfortunate that the IAEA special committee on strengthening safeguards last year was unable to reach agreement on any such measures.

Conclusion

The global resurgence in nuclear energy presents serious challenges. Fortunately the proclaimed renaissance will not arrive overnight. Plans for nuclear power take 10 to 15 years to materialize. For new entrants to the market, nuclear energy first requires an extensive set of preparatory arrangements and infrastructure to be put in place, covering physical, regulatory, legal and personnel institution building. The careful feasibility studies that must precede any national decision to embark on nuclear power plant projects may conclude that nuclear energy is not the best energy solution for some of the countries that have announced an interest in this technology. There is time, therefore, to put in place a robust regime of policies and practices that can serve as a bulwark against a proliferation cascade and provide the basis for a stable nuclear-weapons free world.