The Civil Nuclear Power Revival and Nuclear Proliferation

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Introduction

The history of the International Atomic Energy Agency (IAEA) and the Nuclear Non-Proliferation Treaty (NPT) demonstrate that peaceful nuclear energy is a myth. As our January 2007 Briefing, "Civil Nuclear Power and Nuclear Weapons Proliferation", explains promoting 'peaceful' nuclear power has accelerated nuclear weapons proliferation. Nuclear reactors in India, Pakistan, Israel, and North Korea (DPRK) have produced nuclear materials, which have been used to make nuclear weapons. Now civil nuclear reactors look likely to spread even further around the globe risking the possibility of multiple mini-cold wars. [1]

Restricting the spread of nuclear material whilst at the same time promoting nuclear power does not work. And the idea that conventional nuclear reactors are somehow proliferation resistant is based on a fundamental misconception. Separating plutonium from spent nuclear waste fuel does not require a large industrial-scale reprocessing facility. A quick and simply designed plutonium separation facility could be in operation four to six months after the start of construction. [2] A global expansion of nuclear power will require a proportional expansion of uranium enrichment capacity, and probably lead to an expansion of reprocessing too. The diffusion of knowledge and the increase in global trade of the specialized materials and equipment needed to build and operate uranium enrichment facilities and reprocessing plants would make it more difficult to detect clandestine weapons programmes. [3]

Spread of civilian technology

At least 40 developing countries from the Persian Gulf region to Latin America have recently approached the International Atomic Energy Agency (IAEA) to signal interest in starting nuclear power programmes. Proliferation experts have questioned the peaceful intention of some of these countries and say new reactors could provide the building blocks for nuclear arsenals. At least half a dozen countries have also said in the past four years that they are specifically planning to conduct enrichment or reprocessing of nuclear fuel, a prospect that could dramatically expand the global supply of weapons-useable plutonium and enriched uranium. [4]

Thirteen of the 40 countries are in the greater Middle East, according to the International Institute for Strategic Studies (IISS). While this surge of interest is consistent with a worldwide trend, some countries appear to be moving down the nuclear path in reaction to the Iranians and concern about their determined pursuit of technologies that appear designed to provide a nuclear weapons capability. [5]

States with ready access to huge stocks of oil or natural gas, such as Kuwait, Bahrain, Saudi Arabia and the United Arab Emirates, arouse particular suspicions. The Saudis, with their vast oil reserves, have little use for nuclear energy. Yet, as the IISS report makes clear, they regard the possibility of an Iranian nuclear weapon as a "dire and direct threat" to their own existence, and have now revived a nuclear programme that would give them the ability to develop their own nuclear arsenal. [6]

Nor is it just those countries that are in close geographical proximity to Iran that have suddenly rediscovered an interest in matters nuclear. Algeria, which is hardly in Tehran's direct line of fire, has taken advantage of the staggering $81 billion increase in this year's oil revenues, to open negotiations with China on a nuclear pact. But Egypt is the country whose revived interest in nuclear energy is causing the most concern and which could cause a radical shift in the regional balance of power. Washington's failure to curb Iran's nuclear programme has prompted Egypt to take the decidedly risky step of negotiating a deal with Russia to build a number of nuclear power stations. Egypt's ambassador to the United States, Nabil Fahmy recently warned that a nuclear arms race in the region might be inevitable. Another of Iran's big rivals in the region, Turkey, is also moving forward with an ambitious nuclear project.

The IISS report says none of the new nuclear aspirants in the Middle East has been known to talk even privately about seeking nuclear weapons. "*What they want is the human and technical infrastructure associated with nuclear-energy programmes in order to provide a counterbalance to Iran, both laying the*

ground for a possible future security hedge, and bestowing national prestige in the context of historic rivalries." [7]

Global Nuclear Energy Partnership

In 2006, the Bush administration launched the Global Nuclear Energy Partnership (GNEP) with the aim of expanding the international nuclear industry and forging partnerships with other countries to address fuel supply, spent nuclear fuel and proliferation of nuclear weapons. According to the administration, under GNEP, the U.S. and other leading nuclear countries would provide an assured supply of reactor fuel and take back spent fuel from other countries that were willing to forego development of their own uranium enrichment and reprocessing programmes. [8]

GNEP will involve the construction of a substantial number of fuel cycle facilities including a reprocessing plant to separate plutonium from spent nuclear waste fuel, (reversing the US practice of not reprocessing spent nuclear waste fuel), a fast reactor, or Advanced Burner Reactor (ABR), fuelled with plutonium, and a fast reactor reprocessing plant.

What GNEP is proposing is supposed to be a proliferation resistant fuel cycle. It proposes the development of more advanced reprocessing that separates plutonium plus neptunium instead of pure plutonium. The proposed ABR reactor would be fuelled with plutonium and higher actinides. [9] This plan is dangerously misguided and in all likelihood with increase nuclear proliferation. The flows and stockpiles of radioactive wastes, and potential nuclear bomb making materials, would actually increase significantly under GNEP. A myriad of transport routes will create additional access points at which these materials could be intercepted and diverted. And under GNEP, the United States would become a final dumping ground for the spent fuel wastes from other countries.

In a report for Friends of the Earth USA, and others, the authors (which included former Clinton Advisor Robert Alvarez) called GNEP “ill-conceived [which] would increase the danger of nuclear proliferation and the potential for weapons grade materials falling into the hands of hostile or unstable nations and terrorist groups”. Another report, by a mixed group of stakeholders from industry and environment groups, brought together by the Keystone Center, concluded that GNEP cannot be seen as a programme to reduce proliferation problems, and may indeed increase them. The study participants agreed that a primary proliferation concern is the diversion of material from bulk handling facilities such as reprocessing plants, uranium enrichment facilities, or MOX fuel fabrication facilities. Growing stocks of separated plutonium represent a significant proliferation risk.

The UK Role

The UK Government has joined the U.S.-sponsored GNEP. [10] Yet at home it likes to give the impression that reprocessing is being phased out.

Sellafield in Cumbria is home to the UK’s two operating reprocessing plants which separate plutonium from spent nuclear waste fuel, and the main storage site for the UK’s embarrassing stockpile of weapons useable plutonium. The older of the two reprocessing plants – the Magnox reprocessing plant – had been expected to close at the end of 2012. But in its Business Plan for the three years 2008 to 2011, Sellafield’s owner, the Nuclear Decommissioning Authority (NDA), says, because of poor plant performance, closure is now unlikely before 2016. [11] THORP, the newer of the two reprocessing plants has only just re-opened after a leak which kept it closed for almost three years. THORP was penciled in for closure around 2010, but is now unlikely to close before 2015. [12]

Although it is clearly disappointing that separation of weapons-useable plutonium will not end as soon as promised, the 2008 Energy White Paper at least says new nuclear power stations should proceed on the basis that spent fuel will not be reprocessed, giving the impression the impression the death knell for reprocessing in the UK had been sounded. [13]

Future reprocessing not ruled out

But NDA officials have not ruled out future reprocessing saying only that operators of potential new reactors should make their calculations on the premise that reprocessing is not an option, because the government "can't guarantee" that reprocessing facilities will be available. When a Government official was asked in 2007 why the government was ruling out future reprocessing when the US "is starting to take steps toward recycling." He said "ruling out" was probably "too strong" an expression. If at some stage in the future, nuclear operators come forward with reprocessing proposals things may change. [14]

Sellafield trade unions have already started campaigning for a new reprocessing plant to be built at Sellafield so that spent nuclear fuel from the proposed new reactors can be reprocessed, and for the possibility of securing reprocessing contracts from abroad to be kept open; and for existing stocks of UK plutonium at Sellafield to be converted into MoX fuel for use in new reactors. [15]

A new reprocessing plant seems like pie-in-the-sky in 2008, but that is what most commentators said about new nuclear reactors less than a decade ago.

Plutonium stockpiles

Britain has a stockpile of around 100 tonnes of weapons-useable plutonium, which, according to the Royal Society, are kept in "unacceptable" conditions and pose a severe safety and security risk. The Society says ministers must urgently review the way the plutonium is stored. The Government has ignored previous warnings but now the rise of international terrorism means the UK must find a way to use or dispose of the material. The scientists favour using the material as Mixed Oxide (MoX) fuel in new or existing reactors, despite the dangers of transporting the weapons useable material around the country. [16]

In July 2007 the NDA published a summary of the "Uranium and Plutonium: Macro-Economic Study", [17] which provides a wide-ranging analysis of options for the UK's embarrassing stocks of uranium and weapons-useable plutonium, and sets out the financial, socio-economic and environmental impacts of each option. The authors say the UK has enough uranium and plutonium stockpiles to fuel three 1000 MWe reactors for their entire 60-year lives or 12GWe of fast reactors for 700 years. [18] Other options include treating the materials as waste and storing them for possible future use.

So, even without a revival of reprocessing, we could see plutonium fuel transports on UK roads. In May 2008, Sellafield shipped a cargo of highly dangerous plutonium dioxide powder under armed escort to France, simply because the NDA wanted to replace plutonium used in orders for mixed oxide (MOX) fuel that had to be produced in European facilities when Sellafield was forced to sub-contract the orders from the Sellafield MOX Plant (SMP) because of the plant's failure to produce the goods on time. This may be the first of many plutonium-swap shipments as a number of SMP orders have had to be sub-contracted to France and Belgium. [19]

The SMP opened in 2002 and was designed to produce 120 tonnes of MOX fuel per year for THORP's overseas customers. None was produced in the first 2 years of operation and to date – after 6 years - a total of just over 5 tonnes of fuel have been produced. But if the plant continues to operate, MoX fuel shipments to overseas clients in Europe could become a regular occurrence.

Weapons-useable plutonium

To make an efficient and predictable nuclear weapon you would want to maximise the proportion of plutonium-239 (Pu-239) used. Pu-239 is produced when uranium-238, absorbs a neutron. But if fuel remains in the reactor, it is exposed to longer and longer periods of neutron irradiation, so higher isotopes of plutonium are created as the plutonium absorbs additional neutrons -plutonium-240, plutonium-241. But reactor-grade plutonium, with a higher proportion of Pu-240 and Pu-241 can still be used to make nuclear weapons, as was noted in a US Department of Energy study: [20]

"*Virtually any combination of plutonium isotopes ... can be used to make a nuclear weapon. In short, reactor-grade plutonium is weapons-usable, whether by unsophisticated proliferators or by advanced*

nuclear weapon states. Theft of separated plutonium, whether weapons-grade or reactor-grade, would pose a grave security risk."

The use of MOX fuel, therefore, has serious implications for nuclear-weapons proliferation because the plutonium dioxide in it can easily be separated by straightforward chemistry from the uranium dioxide and used to fabricate nuclear weapons. A number of ways of doing this are described in detail in the open literature. [21]

Fast Reactors

Reprocessing, or plutonium separation, originally started to fuel nuclear weapons programmes. But, in the early days of civil nuclear power, it was generally assumed that uranium was a limited natural resource, and that in order to fuel the rapid expansion of nuclear power it would be necessary to make use of plutonium as an energy source. A major focus of nuclear research and development was placed on the development of so-called fast-breeder reactors. These reactors would make use of the relatively abundant quantities of non-fissile uranium-238 (U-238), which was useless for fuelling ordinary reactors. Fast reactors were to be fuelled with a core of plutonium which was surrounded in a 'blanket' of U-238. As the reactor 'burnt' the plutonium the uranium blanket would be converted into yet more plutonium. This fuel cycle would thus provide a nearly inexhaustible supply of fuel.

However, fast reactors have been a disaster world-wide:- economic realities; problems associated with reprocessing; concerns over nuclear proliferation; serious technical problems and the risk of catastrophic accident have all come together to stop the development and construction of commercial scale fast breeder reactors. One major difficulty with fast reactors is that they use liquid metal as a coolant – usually liquid sodium, which explodes on contact with air. Currently, only one FBR of commercial scale in the world is operating--the Beloyarsk BN-600 FBR in Russia. India is only intermittently operating its Fast Breeder Test Reactor (FBTR) at Kalpakkam. The UK has closed down its Prototype Fast Reactor at Dounreay in Scotland. The French closed down their Superphénix Fast Reactor in 1996 after it had achieved an average capacity factor of less than 7% over eleven years' of operation. It had repeated shutdowns, the longest of which lasted four years. Japan's fast reactor has been shut since a leak of liquid sodium coolant in 1995. [22]

Fast Reactor Revival?

Many nuclear supporters accept that if there is to be a big expansion of nuclear power, uranium resources might become a limiting factor, and cite fast reactors as the way forward. According to the International Atomic Energy Agency (IAEA) and the Organization for Economic Co-operation and Development (OECD) the total identified amount of conventional uranium stocks, which can be mined at a reasonable cost, is about 4.7 million tonnes, which is sufficient, at current demand, for 85 years. World uranium sources are probably much larger – up to 35 million tonnes - but the cost of extracting this would be prohibitive and the amount of energy required and the carbon released as a result would make it pointless. So it is likely that, if there is to be a global expansion of nuclear power, the industry will attempt to develop fast reactors, which can be fuelled with weapons-useable plutonium, and create more plutonium in the process. In theory this could lengthen the life of uranium resources to 2,500 years. [23]

This 'plutonium economy' would require more reprocessing and more transports of plutonium and MOX fuel around the globe. This will present a serious threat to efforts to control the spread of nuclear weapons and prevent nuclear terrorism. The United Nations Intergovernmental Panel on Climate Change (IPCC) said the security threat of trying to tackle climate change with a global fast reactor programme "would be colossal" [24]

Generation IV Reactors

An international collaboration, which includes the UK, is working on a research and development project on so-called 'Generation IV' reactors which is investigating several new reactor-types, one of which is an attempt to revive the fast reactor. Although this is not expected to come to commercial fruition until around

2030, far too late to be of any help in tackling climate change, it is keeping alive the idea of a fuel cycle which involves trade in weapons-useable materials. [25]

Britain is investing millions of pounds in this US government project. It joined the US Department of Energy's Generation IV forum in 2000, alongside eight countries, including France, Brazil and Japan. The Generation IV scheme has shortlisted six possible designs, which it claims will be cheaper, cleaner and safer than current reactors. [26]

Dr Frank Barnaby of the Oxford Research Group says a major concern about a nuclear rennaissance is that the nuclear industry will press for a Generation IV reactor type in a few years time because of fears about uranium supplies. A new generation of plutonium powered nuclear reactors will require reprocessing plants to feed them, and will create an international plutonium and MOX economy: a global trade in a substance that can just as easily be fashioned into nuclear weapons made in facilities that cannot be effectively safeguarded.

The risk of plutonium being diverted for a clandestine state programme is extremely serious in itself, but as the plutonium-MOX economy grows, the risk of plutonium finding its way to a terrorist group dramatically increases with it. A new generation of plutonium powered nuclear reactors would increase the number of targets for a nuclear terrorist attack because reprocessing produces high-level radioactive waste and excess plutonium that has to stored, stores that can be targeted. [27]

Conclusion

The nuclear industry's vision is clear – a world fuelled by nuclear energy with most spent fuel being reprocessed to separate plutonium to fuel fast reactors. This scenario will almost certainly never come to fruition because of technical, economic and other obstacles. But, in the meantime, spreading civilian technology around the globe threatens to open a Pandora's Box with multiple mini-Cold Wars springing up in trouble spots around the world. If the unproven technologies are shown to be viable, the spread of nuclear power will inhibit the adoption of more reasonable solutions to global climate change by diverting resources into the prohibitively expensive nuclear option.

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