Multilateral nuclear fuel cycle proposals

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A range of initiatives are being discussed to limit the spread of 'sensitive' nuclear technologies through multilateral or international arrangements; however previous proposals have foundered for a range of political or commercial reasons.

Plans to use Australia for an international high-level nuclear waste dump have been revived.

Introduction

A number of proposals have been advanced since the 1970s to develop multilateral or international nuclear facilities.[1] Previous proposals have been abandoned in the face of political and commercial opposition and complexities, and current proposals are also contentious and may well be abandoned.

Developments in recent years include:

- The US proposal for a Global Nuclear Energy Partnership (discussed below).[2]
- In a February 2004 speech, US President George W. Bush said: "The 40 nations of the Nuclear Suppliers Group should refuse to sell enrichment and reprocessing equipment and technologies to any state that does not already possess full-scale, functioning enrichment and reprocessing plants".[3]
- In 2005, the US government announced it would supply 17 tons of highly-enriched uranium to be down-blended for an international fuel 'bank' to supply countries willing to forego enrichment and reprocessing <www.iaea.org/Publications/Documents/Infcircs/2005/infcirc659.pdf> However, that amount would suffice only to keep a single large reactor operating for 15-20 years according to Oelrich.[4]
- In September 2006, the non-governmental Nuclear Threat Initiative announced it would contribute US$50 million towards the creation of a nuclear fuel bank on the condition that within two years the IAEA approves establishment of the bank and that one or more member NPT states contribute an additional US$100 million in funding or an equivalent value of uranium to the bank.[5]
- At the International Atomic Energy Agency (IAEA) General Conference in September 2003, IAEA Director-General Mohamed El Baradei urged consideration of the "merits of multinational approaches to the management and disposal of spent fuel and radioactive waste".[6]
- The 2004 Report of the UN Secretary-General's High-Level Panel on Threats, Challenges and Change argued that "... the proliferation risks from the enrichment of uranium and from the reprocessing of spent fuel are great and increasing" and it recommended the establishment of a system whereby the IAEA would act as a guarantor for the supply of nuclear fuel.[7]
- In June 2004, El Baradei appointed the International Expert Group on Multilateral Approaches to the Nuclear Fuel Cycle, with members from 26 countries. The expert group submitted its report to the IAEA in February 2005. The report presents five multilateral national approaches: reinforcing existing commercial market mechanisms on a case-by-case basis; using the IAEA as a guarantor of international fuel supply; promoting voluntary conversion of existing facilities to multilateral nuclear approaches; creating multinational and regional multilateral nuclear approaches for new facilities; and developing new nuclear fuel cycles under multilateral control, by region or continent.[8]
- The IAEA Expert Group's report was presented to the NPT Review Conference in May 2005 for consideration but the Conference ended without progress being made in this area. Some NPT member states expressed support for multilateral arrangements, but others, including Argentina, Brazil, Egypt, France, Iran and the Non-Aligned Movement (which includes most NPT member states), voiced their opposition to proposals for a moratorium on enrichment and reprocessing, arguing that it would deepen the divide between the nuclear 'haves' and 'have-nots' of the NPT regime.[9]
- In early 2006, the Russian Federation proposed a system of international centres under IAEA control providing nuclear fuel cycle services on a non-discriminatory basis, and volunteered to host such a facility on its territory.[10]
- In June 2006, France, Germany, the Netherlands, Russia, the UK and the US circulated a proposal entitled: "Concept for a Multilateral Mechanism for Reliable Access to Nuclear Fuel".[11]
- In September 2006, the IAEA hosted a "Special Event on Assurances of Nuclear Supply and Non-Proliferation". Proposals including an IAEA fuel bank were discussed.[12]
- ARIUS — the Association for Regional and International Underground Storage — continues to promote the idea of deep geological repositories operated on a regional basis.[13]

The Global Nuclear Energy Partnership (GNEP) would involve, among other things, a small number of 'supplier' nations providing fuel services — fresh fuel and recovery of spent nuclear fuel for treatment and disposal — to 'user' nations. User nations would effectively 'lease' nuclear fuel — they would operate power reactors but would agree not to build enrichment or reprocessing plants. The US envisages a partnership between the five declared nuclear weapons states — the US, UK, China, France and Russia — and Japan. However, other countries could be involved as supplier nations, and of course the whole concept relies on the willingness of other nations to agree to be 'user' nations. The DOE envisages that participating nations would develop international agreements "in cooperation" with the IAEA. The Nuclear Suppliers Group might also be involved.

While the GNEP envisages fuel leasing, with spent fuel sent to a small number of GNEP supplier nations for treatment and disposal, this is just one possible permutation. Another possibility would involve limiting the spread of enrichment and reprocessing nations but continuing the current practice whereby spent fuel is sent to commercial

reprocessing plants (mainly those in France and the UK) with high-level nuclear waste returned to the nations from which the spent fuel came, i.e. those operating power reactors.

Other multilateral approaches more explicitly envisage a central role for the IAEA, such as an IAEA-operated fuel'bank or IAEA control over the operations of enrichment and reprocessing plants.

There are various political and commercial obstacles to developing multilateral nuclear arrangements. Steve Kidd (2006) from the World Nuclear Association states:[14]

> *"One barrier to the creation of multinational fuel cycle facilities, with attendant guarantees of supply in exchange for strict adherence to safeguards, is the view held by some countries that they ought to develop full fuel cycle facilities because of security of supply or import-saving reasons. Transport of nuclear fuels from continent to continent has also become difficult, to add to concerns about the reliability of various suppliers, so there is some argument for developing facilities 'at home'.*
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> *For example, countries possessing significant uranium resources are inclined to develop them and then think about developing other areas of the fuel cycle too. Hence Brazil's involvement in uranium and enrichment, to fuel its own reactors and, less obviously, the views now regularly expressed in Australia that it should "add value" to its uranium sales by converting and enriching too. ...*
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> *An alternative view of GNEP may see it as somewhat discriminatory and potentially anti-competitive. By restricting parts of the fuel cycle to particular countries, albeit with fair rights of access to nuclear materials, there is a risk of maintaining or even reinforcing the existing NPT arrangements that have always upset certain nations, notably India and Pakistan. Similarly, by maintaining a market stranglehold on, for example, enrichment facilities in the existing countries, it can be argued that the market will be uncompetitive and lead to excessive profits being achieved by those who are so favoured."*

Weapons Proliferation

Proposals for major changes to international fuel cycle arrangements contain with them an implicit acknowledgement of the flaws of current arrangements. According to IAEA Director-General Mohamed El Baradei: "Under the current regime ... there is nothing illicit in a non-nuclear-weapon state having enrichment or reprocessing technology, or possessing weapon-grade nuclear material. And certain types of bomb-making expertise, unfortunately, are readily available in the open literature. Should a state with a fully developed fuel-cycle capability decide, for whatever reason, to break away from its non-proliferation commitments, most experts believe it could produce a nuclear weapon within a matter of months. In 1970, it was assumed that relatively few countries knew how to acquire nuclear weapons. Now, with 35-40 countries in the know by some estimates, the margin of security under the current non-proliferation regime is becoming too slim for comfort. We need a new approach".[15]

In relation to multilateral approaches along the lines of the GNEP, there is the obvious problem that those countries most likely to forego enrichment and reprocessing are those with the least interest in weapons production, and vice versa.

The fundamental premise of the GNEP is that it involves an expansion of nuclear power in the US and other countries including a growing number of 'developing' countries. This creates an increased proliferation risk with more countries in possession of nuclear facilities, materials and expertise.

The GNEP envisages the spread of nuclear power reactors, which can be used to produce plutonium-239 or uranium-233 for use as the fissile material in weapons, and to produce other nuclides for use in weapons such as tritium which is used to boost the yield of nuclear weapons. (A power reactor is used to produce tritium for weapons in the US.) Extracting fissile material from spent fuel or irradiated targets requires a reprocessing capability, but that is not difficult to achieve on a small scale, e.g. hot cells operated in connection with research reactors.

It may be possible to limit the spread of enrichment and reprocessing, but this may just displace the proliferation problem in some cases; for example research reactors might be used in conjunction with small reprocessing facilities (hot cells) if the enrichment or (large-scale) reprocessing routes to fissile material are not available. Indeed there is a long history of research reactors being used in weapons programs, with the research reactors producing plutonium for weapons in Israel and India being the best known examples.

It is no small contradiction that the GNEP aims to limit the spread of enrichment and reprocessing, yet two proposals to have emerged are for the recommencement of commercial reprocessing in the US and the introduction of enrichment to Australia. The recommencement of reprocessing in the US — until recently it had been US government policy to set an example by not reprocessing — is a proliferation concern which may or may not be offset by other aspects of the GNEP scheme.

Transporting spent fuel to treatment or disposal facilities in a small number of countries would potentially reduce the risks of (horizontal) proliferation. Very few countries would be willing to host an international high-level nuclear waste repository. The Russian government has expressed a willingness to do so, but that debate has some way to go and it is very unlikely that Russia would accept most or all high-level nuclear waste — other options would also need to be found.

Another proliferation risk concerns fast neutron reactors (with plutonium as the primary fuel) which are being promoted in the context of the GNEP and some other multilateral proposals. The concentration of plutonium in fast neutron reactor fuel (perhaps 90%) or spent fuel is vastly greater than plutonium in conventional spent fuel (about 1%) so far less would need to be diverted to obtain enough plutonium for a weapon.

Lance Joseph, a member of the IAEA's International Expert Group on Multilateral Approaches to the Nuclear Fuel Cycle, says there were "real reservations" within the Expert Group about any multilateral arrangements entailing the construction of new facilities or the conversion of existing facilities to multilateral control. Joseph provides this discussion on the proliferation issues:[16]

> *"Actually, the case for the multilateral approach is not self-evident. The main perceived benefit is that the number of facilities would be less than if individual states constructed their own, while the attendant problem of safeguarding the facilities is reduced both in scope and expense. Non-proliferation benefits could also be expected to derive from the multinational oversight inherent in a multilateral arrangement, with the presence of multinational staff putting all participants under a greater degree of peer scrutiny, making it more difficult for any individual partner to effect a breakout, and providing less opportunity for diversion, theft or loss. More generally, establishing multilateral facilities could be tantamount to denationalising fuel cycle activities by placing decisions on operation, as well as the distribution of product, in the hands of a collectivity rather than those individual partners.*
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> *Yet downsides, existing and potential, are also evident. In particular, multilateral options could well have the counterproductive effect of stimulating, or increasing, an unnecessary early deployment of high-risk technology, and promoting its unwarranted transfer. And it would contribute little or nothing to non-proliferation were participants free to remove, say, separated plutonium or enriched uranium from the multilateral facility to use unchecked as they see fit. Indeed, to be effective, in non-proliferation terms, any multilateral arrangement would have to ensure not only that the facility and its technology could not be abused, but also that the product would be subject to appropriate international controls over its storage, release, use and ultimate dispostion. But even were such safeguards in place, the multilateral approach probably means wider dissemination of knowledge and broader access to sensitive know-how.*
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> *Of even more concern, given the prevalent view (reflected also in the expert group) that any new arrangements would need to be voluntary, a multilateral arrangement might well have the paradoxical effect of tying down the arrangement-abiding participant while non-participating rogue states could still roam free. True, with the existence of a multilateral alternative, the justification for a national program becomes less persuasive, and the degree of ambiguity surrounding a national decision to proceed less clouded, with the result that the international community becomes more alert to the possible nuclear intentions of the state in question. This may not be unimportant given the contemporary example of Iran, and the large constituency, such as reflected in the recent [NPT] review conference, for giving Iran a free pass. ... The hope would also have to be that a satisfactory experience in a multilateral venture in securing reliable and adequate supplies of fuel and services would lead most states to conclude that this way of meeting their nuclear requirements was preferable to a more independent, but problematic, alternative. However, that is not going to deter the committed proliferator (DPRK or Iran?) or any*

state (Brazil?) determined to acquire the full nuclear cycle for reasons of national independence or prestige. That will be so no matter how compelling any new multilateral arrangement, and whatever additional incentives were built in. One might conclude, therefore, that the multilateral approach could remove a pretext for a country to move ahead independently but not provide a cast iron guarantee that it will not do so.

That's not all. Dig a little deeper into the [Expert Group's] report and one soon finds that a threshold question ... about any new facility, whether it be multilateral or otherwise, is whether such new capacity is actually physically needed. For enrichment, the true answer is probably no, since present capacity comfortably outstrips demand for all projections out to 2020, and probably beyond. ... Much the same considerations apply to reprocessing where, again, the present market situation is pretty comfortable, with existing capacity expected to exceed demand for reprocessing services for at least the next two decades."

For further discussion on the proliferation issues associated with multilateral approaches, see Burnie and Ansolabehere et al.[17]

Implications For Australia

The pursuit of multilateral fuel cycle arrangements could have various implications for Australia, but it ought to be kept in mind that previous proposals have been abandoned and current proposals face major obstacles.

Possible implications for Australia include:

- increased uranium exports (since most multilateral proposals are premised on an expansion of nuclear power) partly offset by reduced demand to the extent that fast neutron reactors displace conventional reactors;
- the Australian government is clearly interested in developing an enrichment industry in Australia, which would bring its own set of regional implications;
- conversely, options for domestic enrichment or reprocessing may be closed off if Australia agrees to multilateral arrangements;
- there is some interest — in Australia and overseas — in building a high-level nuclear waste repository in Australia, which could be connected to multilateral nuclear fuel cycle arrangements.

A turning point in Australia's nuclear debate came in May 2006, before and during Prime Minister John Howard's visit to the US. There, Howard discussed nuclear issues with US President George W. Bush and government officials. On June 6, the Howard government initiated a broad-ranging inquiry — the Uranium Mining Processing and Nuclear Energy Review (UMPNER) — to investigate potential Australian involvement in all aspects of the (civil) nuclear fuel cycle, from uranium mining, conversion and enrichment, nuclear power, reprocessing and the "business case" for Australia hosting an international nuclear waste repository.[18]

Prime Minister Howard has acknowledged that the decision to establish the UMPNER inquiry was motivated in large part by overseas developments, in particular the GNEP.

There is clearly some concern within the federal government that the GNEP could limit Australia's future options. As Prime Minister Howard said in July, 2006: "I think it [GNEP] further focuses our attention, concentrates our mind. If we were to decide in the not too distant future that it would be a good idea to process uranium or to keep open that possibility, that would obviously have relevance to GNEP. The fact this is being developed is a reason why we should look more closely at whether we should process uranium".[19]

The Prime Minister, Foreign Minister Alexander Downer and others are interested in developing a domestic enrichment industry. An enrichment plant would give Australia the capacity to produce not only low enriched uranium for reactors but also highly-enriched uranium which could (if sufficiently enriched) be used directly in nuclear weapons. Australian opposition to uranium enrichment programs in Iran and North Korea would be undermined. Likewise, Australia could not credibly oppose other countries in the Asia Pacific region wanting to develop the capacity to produce fissile material under the guise of a peaceful program.

Alexander Downer, when asked on ABC radio on August 17, 2006 whether a uranium enrichment industry would bring Australia closer to a nuclear weapons capability, said: "Not at all." However, an Australian Strategic Policy Institute report notes that an enrichment industry would give Australia "a potential 'break-out' capability whether that was our intention or not" and that this point is "unlikely to be missed by other countries, especially those in Australia's region".[20]

An enrichment plant would also produce depleted uranium waste with its attendant environmental risks and proliferation risks (via re-enrichment). The accumulation of depleted uranium would raise further military and security issues since it has been used by the US and NATO in munitions used in Iraq, the Balkans and Afghanistan.

Nuclear Waste Repository

Under the GNEP or other multilateral approaches, there may be growing pressure on Australia, as a major uranium exporter, to accept spent nuclear fuel or high-level waste for treatment, storage and/or disposal.

An international consortium has already attempted to develop an international nuclear waste repository. Australians first learnt of Pangea Resources in December 1998 when the company's corporate promotional video was leaked. The main financial backer of Pangea Resources was British Nuclear Fuels Limited, with support from the Swiss radioactive waste agency Nagra and the Canadian based Golder Associates. By early 2000, Pangea had spent $15 million on its Australian activities but decided to also consider sites in southern Africa and South America.

In 2002, Pangea was closed down but a number of individuals involved in Pangea formed ARIUS — the Association for Regional and International Underground Storage. While ARIUS does not have offices in Australia, its representatives have occasionally promoted the idea of establishing a nuclear dump in Australia.

In September 2005, Bob Hawke, Labor Prime Minister from 1983 to 1991, attracted widespread media coverage by promoting the idea of Australia building a repository to take overseas nuclear waste. While the Liberal/National Coalition government maintains its policy of opposing such proposals, Coalition Senators refused to support a Senate motion opposing an international nuclear dump in May 2006.

Australia, some argue, has a moral responsibility to accept nuclear waste as a major uranium supplier. However, there is a strong argument that countries using uranium to fuel nuclear power reactors have the greater responsibility. Further, only a tiny minority of Australians are involved in, and benefiting from, the uranium mining industry — ought not the responsibility lie with this minority?

While advocates of a repository in Australia claim it will be a positive non-proliferation initiative, the potential benefits must be weighed against the fact that nuclear utilities are looking to off-load their waste to facilitate further production of nuclear waste (and fissile material) through the operation of reactors.

There are serious environmental and public health risks associated with high-level nuclear waste. As Professor John Veevers from Macquarie University wrote in the Australian Geologist — when Pangea Resources was attempting to foist a nuclear dump on Australia — such a dump would pose serious public health and environmental risks: "[T]onnes of enormously dangerous radioactive waste in the northern hemisphere, 20,000 kms from its destined dump in Australia where it must remain intact for at least 10,000 years. These magnitudes — of tonnage, lethality, distance of transport, and time — entail great inherent risk." [21]

The debate over nuclear waste management options is certain to continue because of the intractable nature of the problem. About 250,000 tonnes of spent nuclear fuel have been generated in power reactors around the world, yet there is not a single permanent repository to dispose of any of this waste.

Nuclear Fuel Leasing Group & Uranium Industry Framework

The Nuclear Fuel Leasing Group's (2006) submission to the UMPNER panel states: "The NFLG has four founding parties who are Dr John White, Mr David Pentz, Mr Daniel Poneman and Mr Michael Simpson. These parties and their associates form an international group from Australia, the US and the UK."[22]

The NFLG submission proposes the establishment of an 'Australian Nuclear Fuel Leasing' (ANFL) company which "contracts for uranium from Australian mines only, buys conversion services, contracts for enrichment services with the technical specifications provided by the NPP fuel designers, contracts for fuel fabrication services to specifications provided by the NPP operator and contracts for all fresh fuel transportation services. After some 3 to 5 years generating electricity in the lessee's NPP reactor, the spent fuel is removed from the reactor and placed in the NPP cooling pond for between 9 to 20 months. ANFL will then contract for spent fuel transportation services and provide final reprocessing or storage and disposal facilities. The leased, Australian owned, spent fuel will be moved from the NPP reactor to the site of cooling spent fuel storage. ANFL will arrange for spent fuel to be stored for approximately 27 to 30 years in Australia and then be transferred to a co-located spent fuel geological disposal facility. This facility would be used solely for Australian origin spent fuel."

The 'disposal facility' would be located in South Australia or Western Australia according to the NFLG.
In relation to transportation options, the NFLG submission says: "The Australian Submarine Corporation (ASC) and the Adelaide-to-Darwin railway line could provide strategic capabilities to the ANFL proposal."

The NFLG claims these arrangements will "significantly enhance the international regime of non-proliferation and safeguards, by creating a system of control not possible with the current commercial market." They would also give Australia a large stockpile of fissile material that it does not currently have, which could excite regional interest just as enrichment proposals have.

The Uranium Industry Framework (UIF) was established by Ian Macfarlane, Minister for Industry, Tourism and Resources in August 2005. It includes representatives of federal, state and territory governments, mining companies, and the Northern Land Council (an Aboriginal organisation based in the Northern Territory).
The objective of the UIF is "to identify opportunities for, and impediments to, the sustainable development of the Australian uranium mining industry".[23] It will present an "Action Plan" to the government in the second half of 2006. The UIF has evidently taken an expansive view of its terms of reference. Media reports based on an as-yet unreleased draft report of the UIF's stewardship working group state that it will recommend a stewardship approach to Australia's involvement in the nuclear fuel cycle including uranium mining and processing, and disposal of high-level nuclear waste in Australia.[24]

The UIF Steering Group presented its report and recommendations to Ian Macfarlane in August 2006. The Steering Group continues working on an 'Implementation Plan' and will take the government's views into account prior to finalising the Implementation Plan in October 2006. One wonders if contentious proposals, such as high-level nuclear waste disposal in Australia, will remain when the Steering Group's report is finally made public.

Further reading:

Nuclear Age Peace Foundation: www.nuclearfiles.org/menu/key-issues/nuclear-weapons/issues/proliferation/fuel-cycle/index.htm

International Atomic Energy: www.iaea.org/NewsCenter/Focus/FuelCycle/index.shtml

US Department of Energy's GNEP website: www.gnep.energy.gov

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